



ATRA Technical Seminar Manuals 1990-2008





By Year

Please use the bookmarks to navigate through this section





By Transmission

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096/01M

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2ML70

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31TH

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3T40

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4-AT

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40TE

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413

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41TE/A604

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42LE

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42/44/46/47/48RE

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42/46/47RH

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42RLE

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450-43LE

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45RFE

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4EAT

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4F27E

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4L30E

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4L60/700-R4

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4L60E

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4L60E HD

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4L70E

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4L80/85E

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4R44/55E

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4T40/45E

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4T60/440-T4

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4T60/65E

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4T80E

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5L40/50E

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5R44/55E

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62TE

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670

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6L50

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6L80

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6L90

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6F55

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6R60

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6T40/45

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6T70/6T75

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722.0, .1, .2, .3, .4, .5, .6

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727

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81-40LE

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904

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A140E

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A340

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A4AF3

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A4BF2

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A4RA

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A500/A518

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A761

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A4LD

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AF17

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AF21-B

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AF23-5

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AF33-5

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Aisin Warner

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AOD

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AODE/4R70W

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AW50-42LE

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AXOD

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AX4N/4F50N

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AX4S/AXODE

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B4RA

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B6VA

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B7VA

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B7WA

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B7XA/B7TA

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BAXA

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BAYA

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BCFA

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BMXA

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CVT

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CD4E

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E4OD/4R100

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F4A2, 3, 4, 5

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F4AEL

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F4E-III

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F4EAT

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FNR5

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G4AEL/4EAT

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GF4AEL

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Jacto 5 Speed

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JR403E

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KM175

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LCT 1000

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M4RA

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M4VA

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MAXA

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MAYA

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MCLA

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MP6/MP7

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N4A-EL

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RE4F02A

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RE4F03A/V

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RE4F04A/4F20E

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RE4R01A/R4A-EL

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RE5R05A

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RL4F02A

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RL4F03A/V

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R/V4A51

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SZCA

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TAAT

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Torqshift/5R110W

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U140E

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U241E

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ZF

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1990 A.T.R.A. Seminar Manual



For over 35 years the "Good-Guys"

1990 SEMINAR HANDOUT

**Automatic Transmission Rebuilders Association
2472 Eastman Avenue #23
Ventura, California 93003
(805) 654-1700**



ATRA 1990 SEMINAR HANDOUT

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440 - T4 SECTION

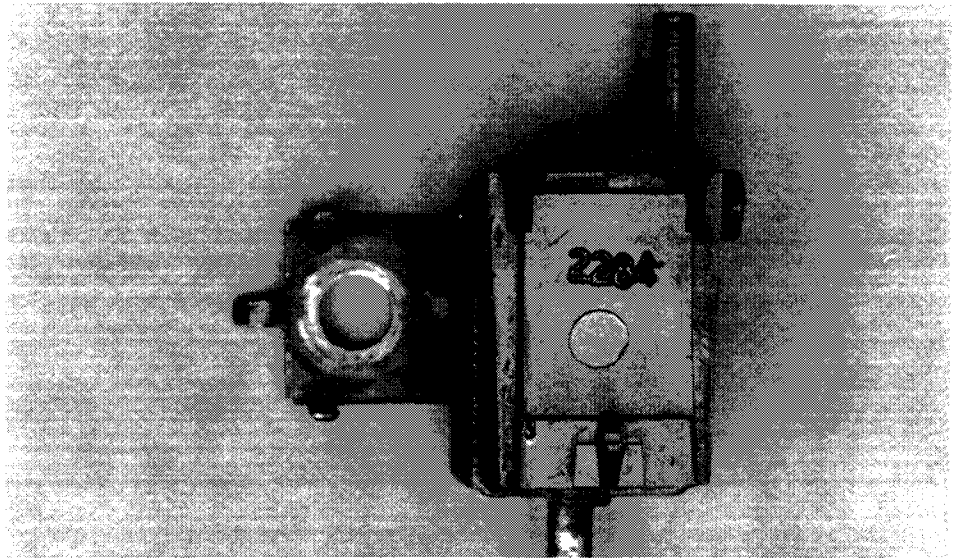
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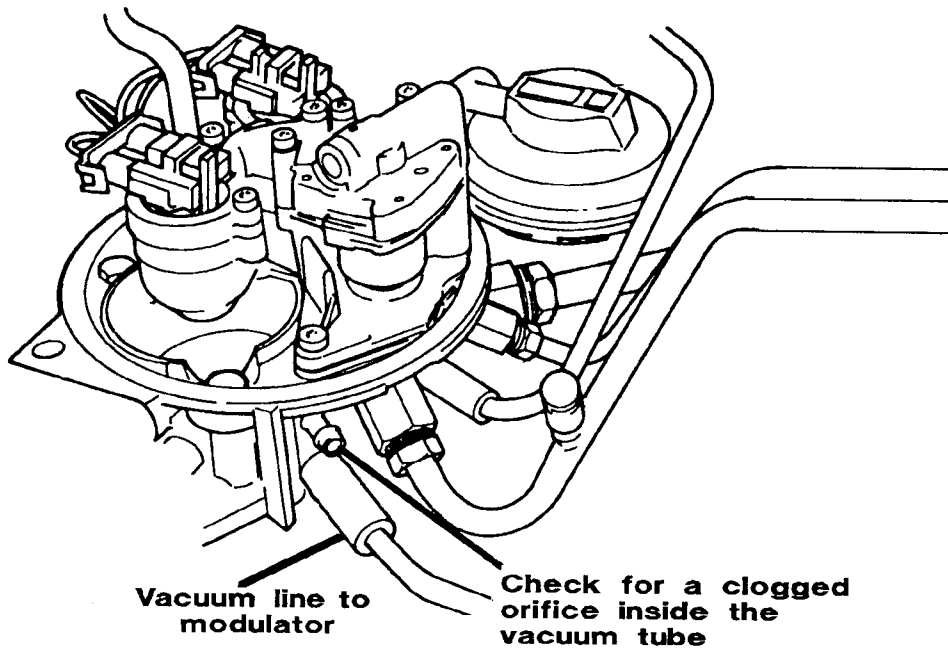
AXOD
A4LD
LOCK UP
700 - R4
AOD
A140E
A604
E4OD

**1-2
SLIP OR CHATTER**

1. If the modulator vacuum circuit has an aspirator in it, replace it with a piece of tubing.



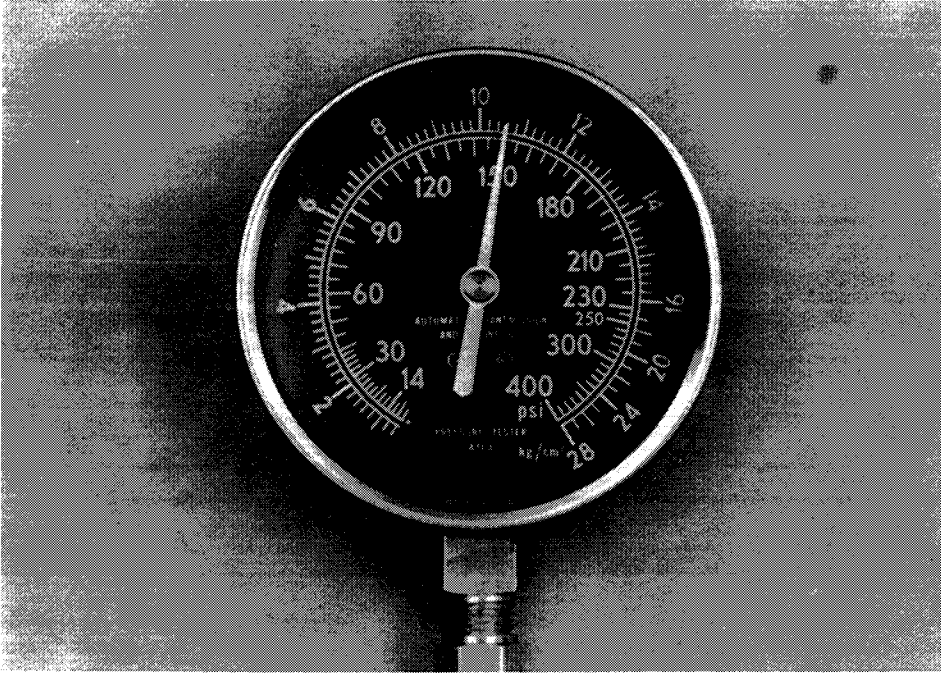
2. Check for a plugged orifice. Check the vacuum fitting at the fuel injection. It has a .030" orifice inside. If the orifice gets clogged with carbon it can trap vacuum. Trapped vacuum can slow down the response of the modulator. This will cause a 1-2 shift under minimum line pressure.



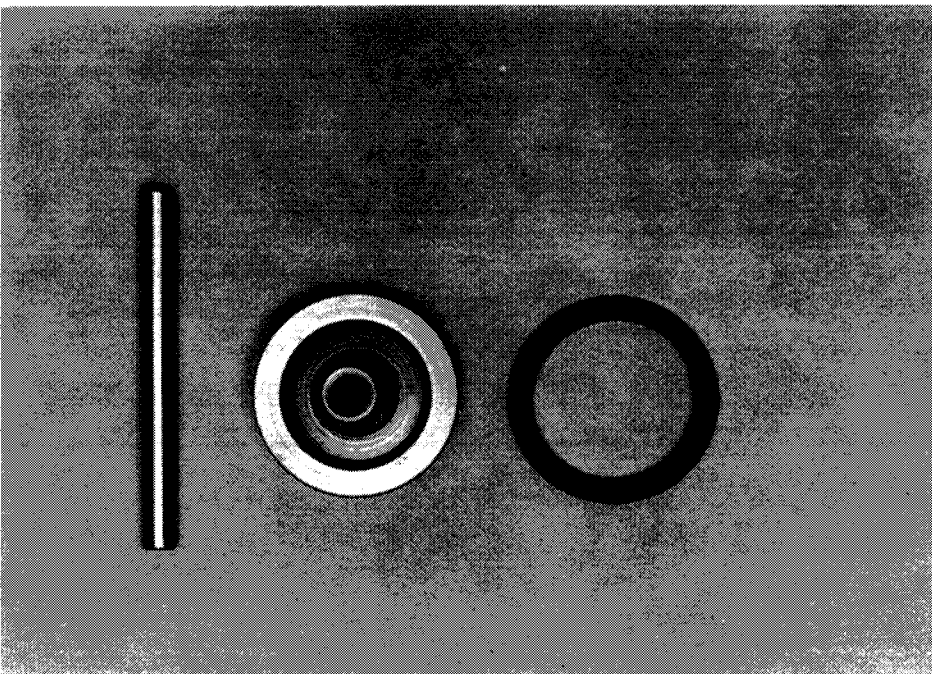
440-T4-2

**1-2 SLIP OR
CHATTER
(CONTINUED)**

3. Check for line pressure at a stall; Min. 150 psi.

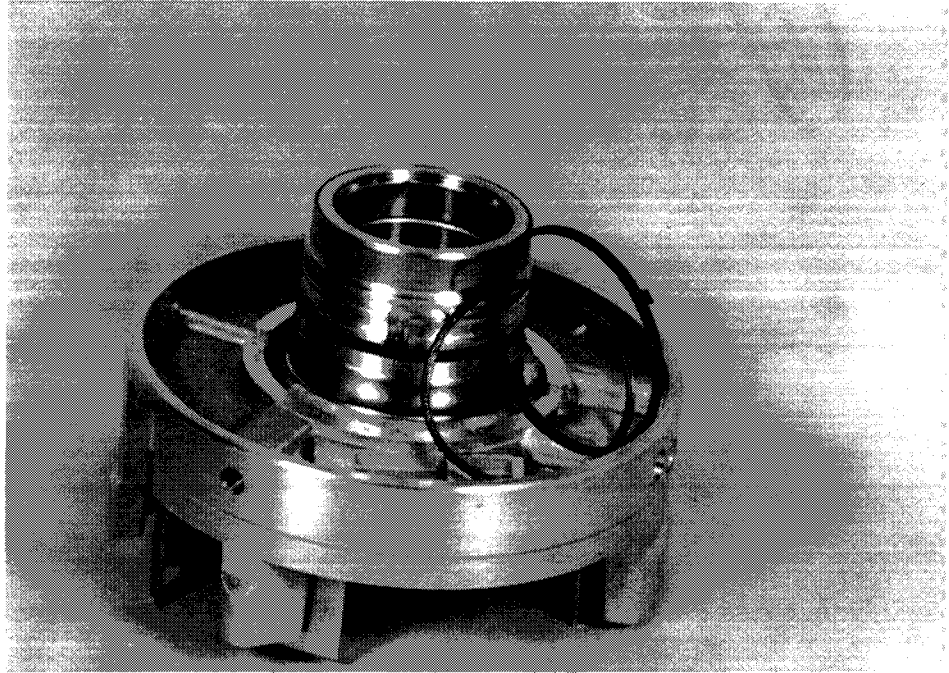


4. Check the 1-2 accumulator for a torn seal and/or a worn piston and shaft.



**1-2 SLIP OR
CHATTER
(CONTINUED)**

5. Leaking 2nd clutch sealing rings - If you need to change the support, use the late style support with the Vespel sealing rings. If the 2nd clutch drum bushings are worn excessively it can cause sealing ring leakage.

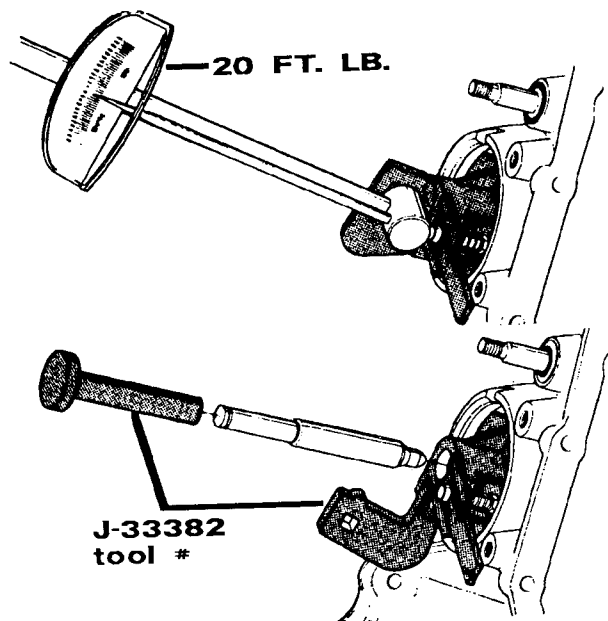


6. Use the improved 2nd clutch frictions with the Koline steels.
Part #8662913 5 clutch pack
Part #8662914 6 clutch pack

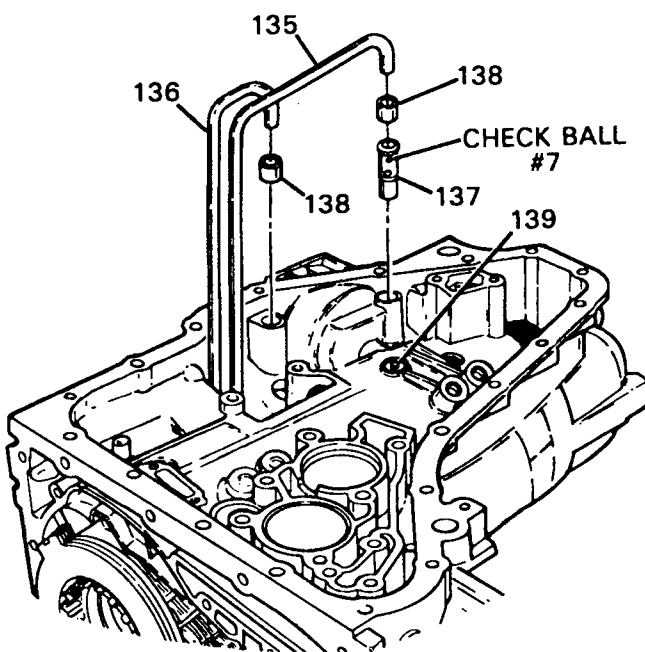
440-T4-4

2-3 SLIPS & FLARE-UPS

1. Make sure the 1-2 servo travel is $\frac{1}{8}$ " - $\frac{1}{4}$ ".



2. Solvent check the third accumulator checkball capsule.

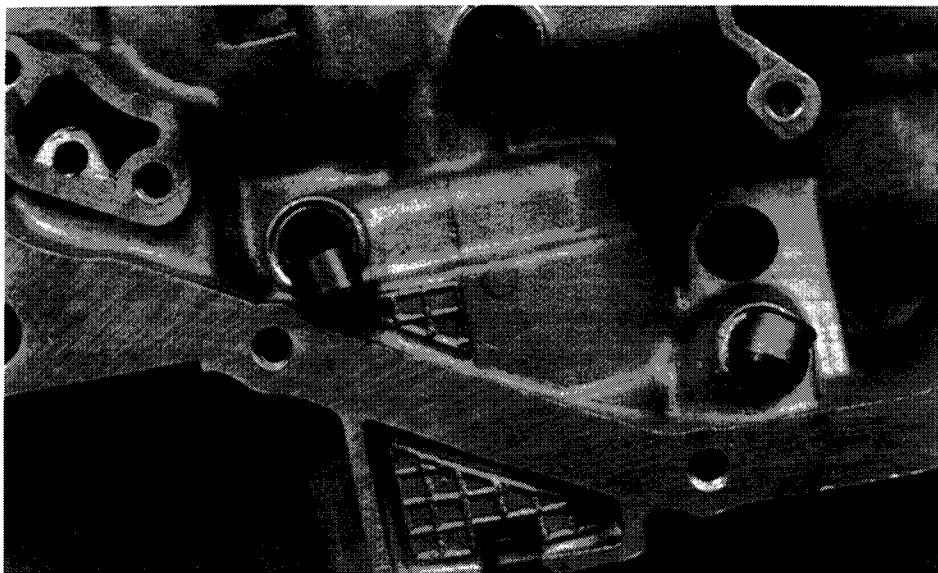


If it leaks replace it with
Part #8646190.

- 135 PIPE, 1-2 SERVO (RELEASE OIL)
- 136 PIPE, 1-2 SERVO APPLY
- 137 CAPSULE ASSEMBLY, BALL CHECK
- 138 SEAL ASSEMBLY, 1-2 SERVO PIPE
- 139 STOP, 1-2 BAND ASSEMBLY

**2-3 SLIPS &
FLARE-UPS
(CONTINUED)**

3. A leak at the servo release seals can cause a 2-3 slip always replace them.



4. Check for a rolled inner lip seal in the 3rd clutch drum.

Note: The late seal will work in the early drum. Be careful when you put the piston in so you don't roll the seal.

5. A bad 3rd roller clutch will cause a neutral shift from 2nd to 3rd. A good way to test the 3rd roller clutch is to shift to low at 20 mph with your foot off the gas. If you get engine braking the 3rd roller clutch is working. Note: Always sand the outer race with 320 grit sand paper before assembling the 3rd roller clutch.

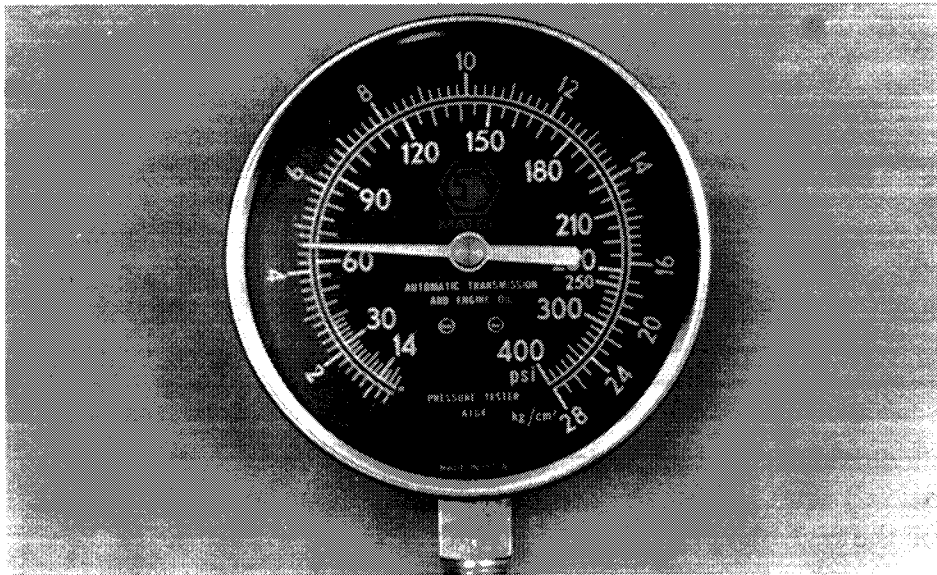


440-T4-6

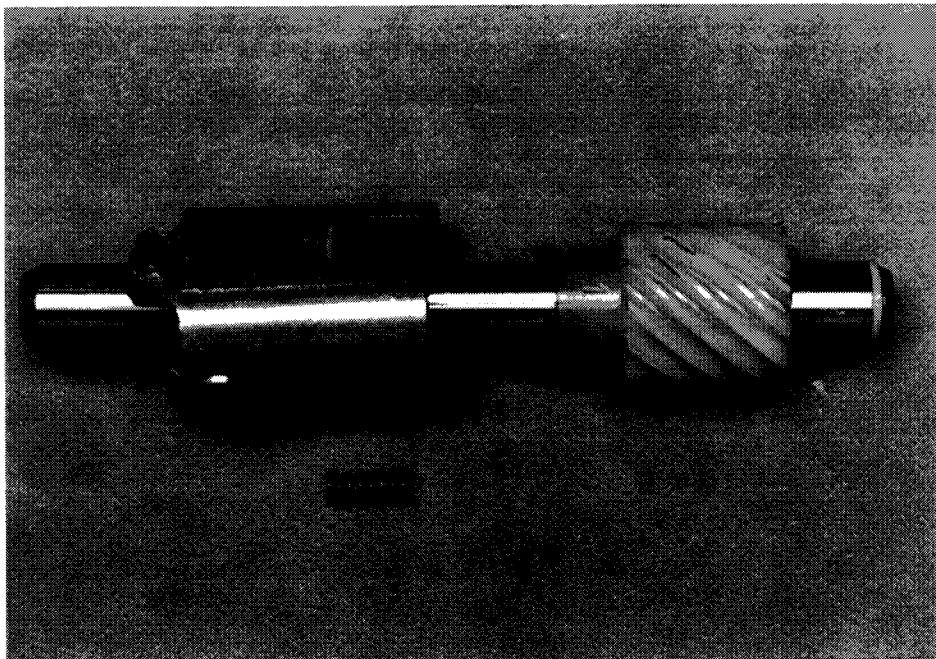
2-1 DOWNSHIFT CLUNK

2-1 Coastdown clunk. (Roadtest after each step.)

1. Make sure the engine idle is not above normal.
2. Verify that line pressure is normal; 60-75 in Drive.
High line pressure will flood the governor circuit.



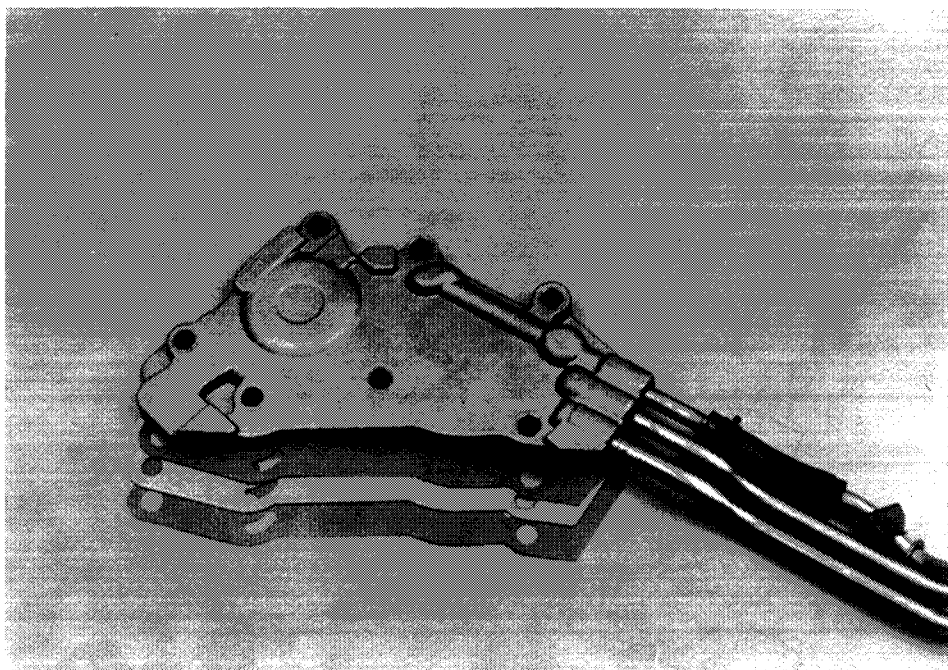
3. Remove the primary weight governor spring. The primary weight is the heavy weight.



440-T4-7

**2-1 DOWNSHIFT
CLUNK
(CONTINUED)**

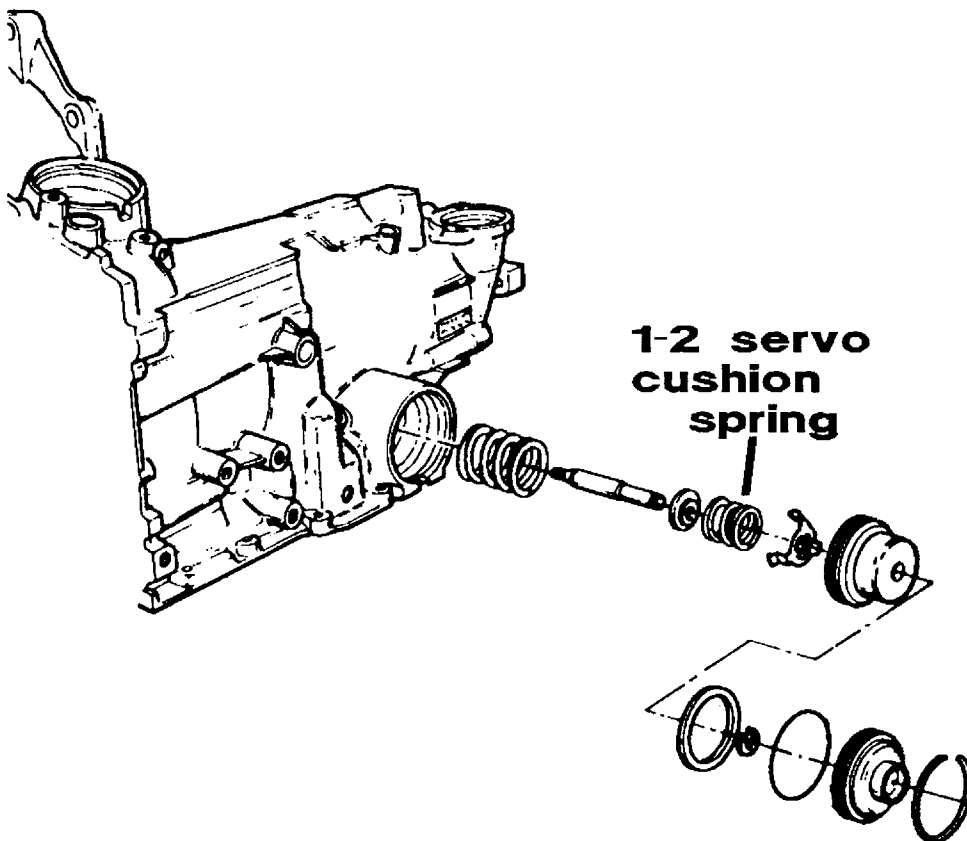
4. Remove the gasket between the accumulator separator plate and the cover.



440-T4-8

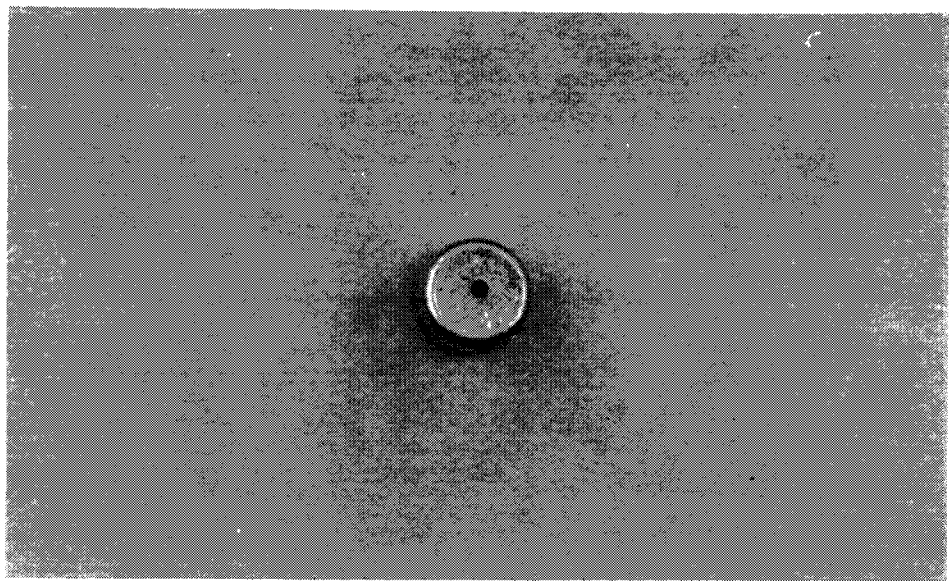
**3-2 COASTDOWN
CLUNK**

1. Check steps 1 thru 4 on page 1 under 2-1 coastdown clunk.
2. Use the updated 1-2 servo cushion spring. GM part #8668123.

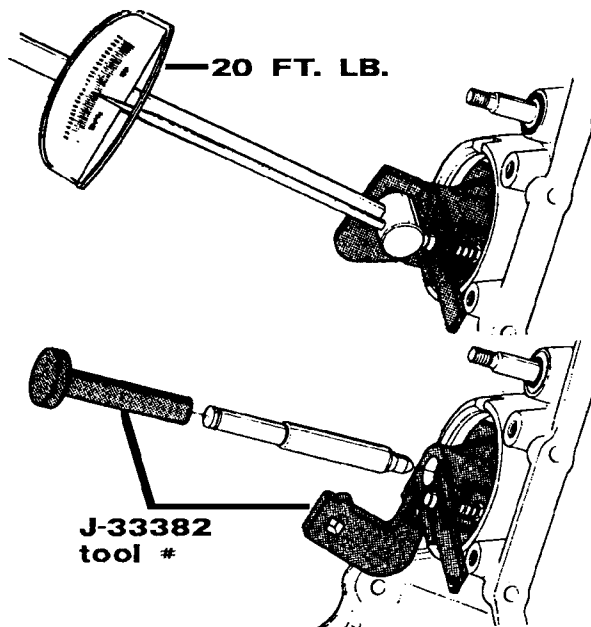


**3-2
KICKDOWN CLUNK****(Road test after each step)**

1. If the vacuum line has an aspirator between the intake manifold & modulator, replace it with a solid tube. (See the section on 1-2 slips and chatters.)
2. Check for a missing orifice in the vacuum circuit to the modulator. If there is no orifice, install one in the end of the vacuum line closest to the manifold. The orifice should be .030" - .040". You can make an orifice out of the metal end of a glass fuse.



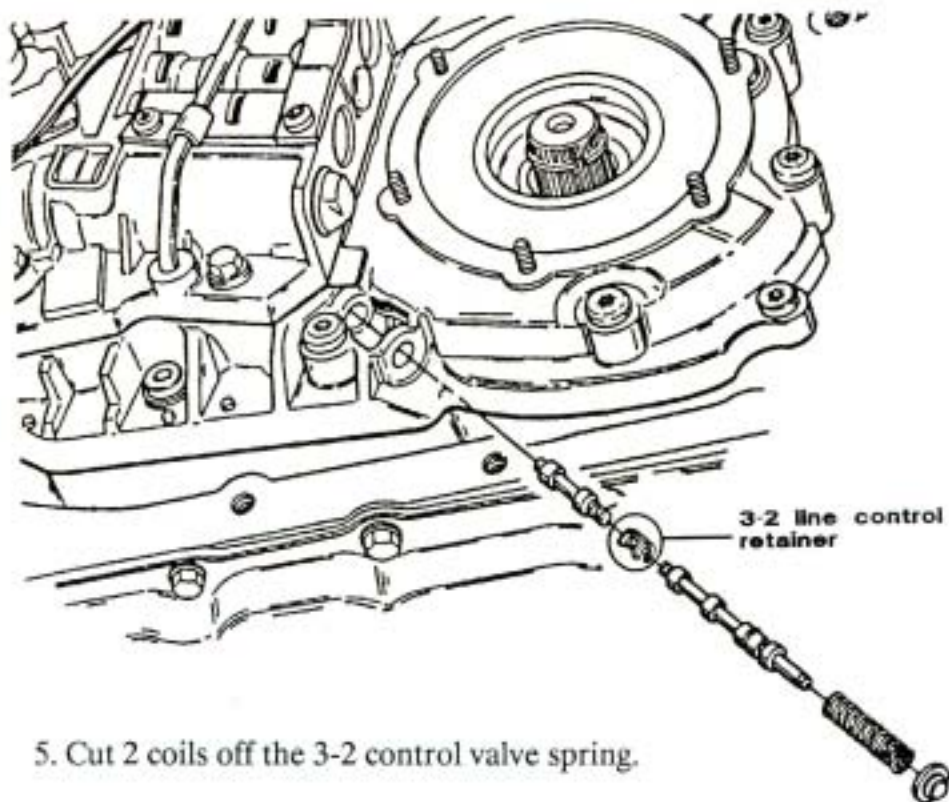
3. Check the 1-2 servo travel; 1/8" - 1/4".



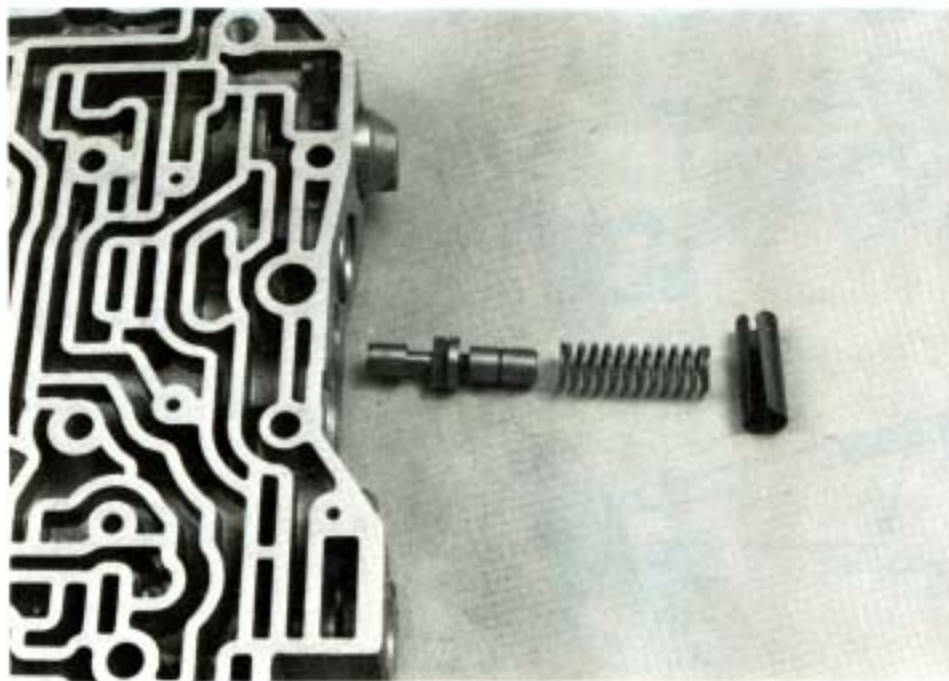
440-T4-10

**3-2
KICKDOWN CLUNK
(CONTINUED)**

4. Check for a broken 3-2 line control valve clip (3.8L engine).

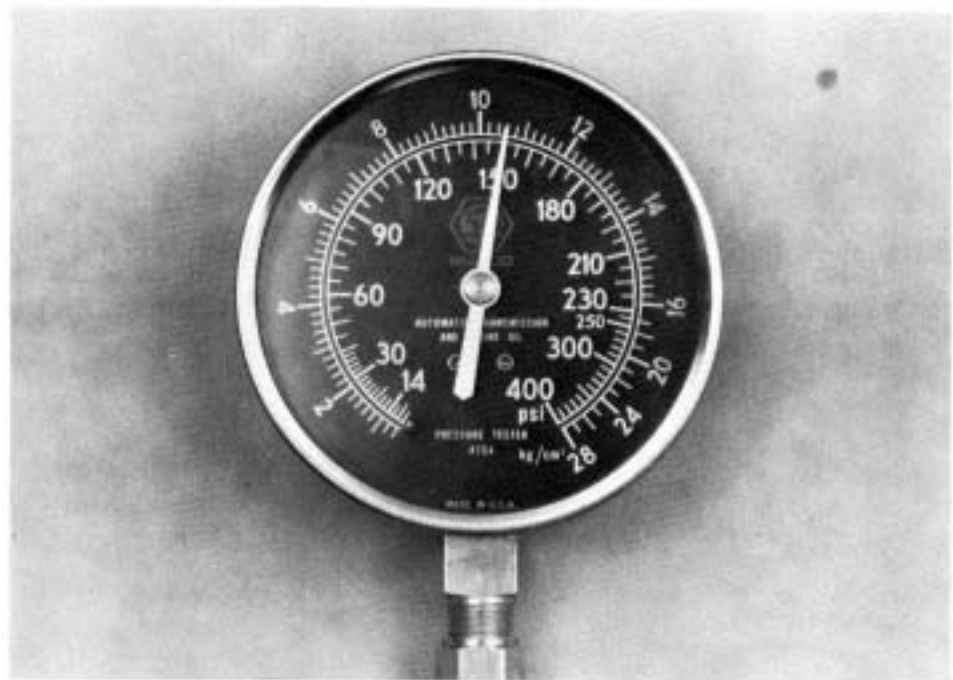


5. Cut 2 coils off the 3-2 control valve spring.



3-2 FLARE UP

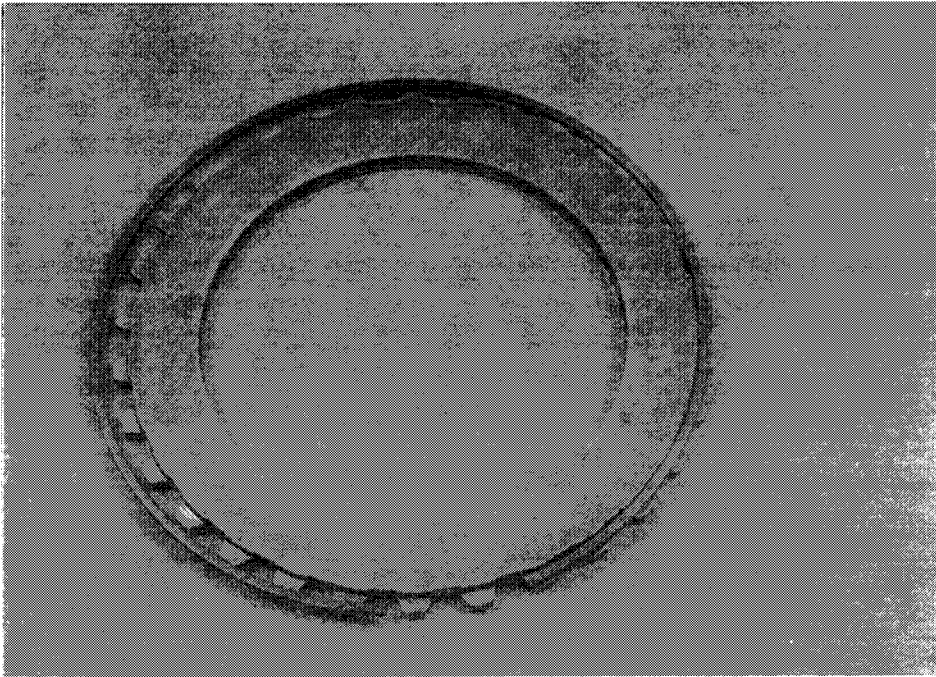
1. Check the 1-2 servo travel; 1/8" - 1/4".
2. Check for a restricted orifice in the vacuum line. If a vacuum aspirator is in the vacuum circuit, replace it with a piece of tubing. (See the section on 1-2 slips and chatters.)
3. Check line pressure in Drive at stall; Min. 150 psi.



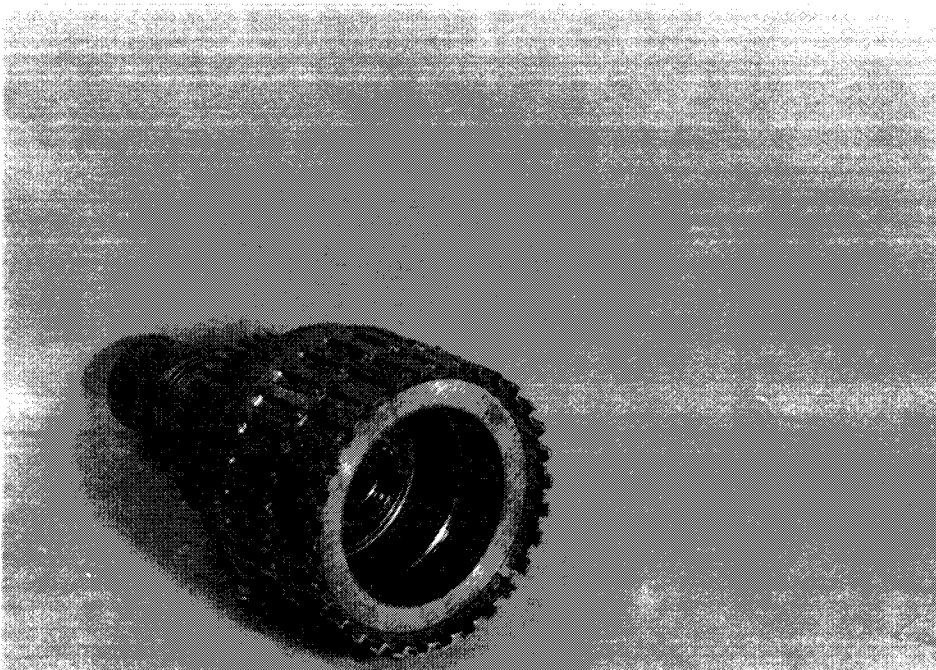
440-T4-12

BIND-UP ON 3-4

1. Input clutch lower backing plate upside down.



Install the input clutch lower backing plate with the groove facing down.

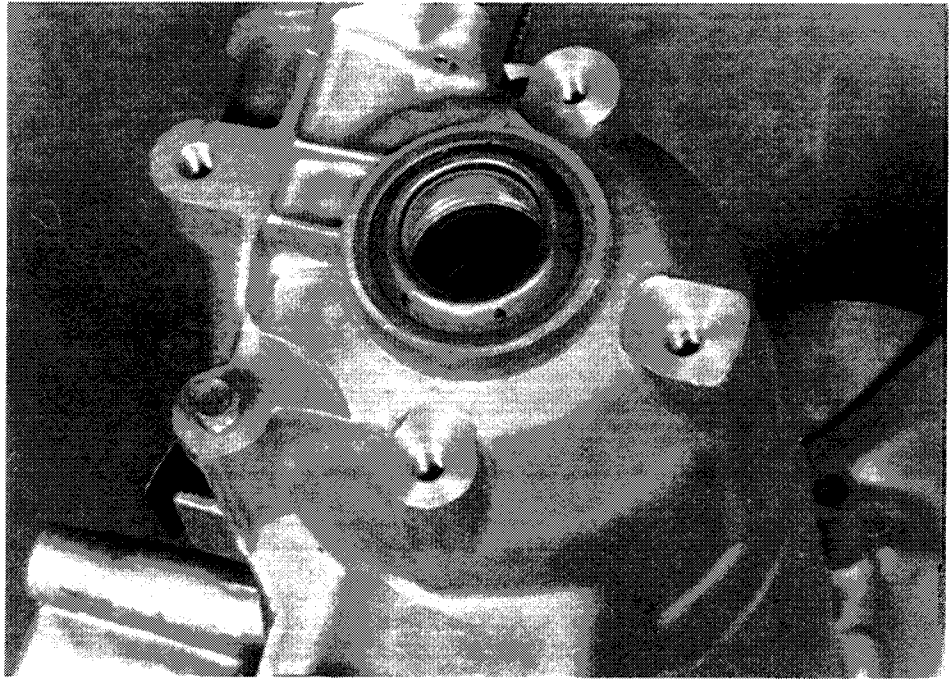


When you air check the 3rd clutch make sure the input clutch is free to turn.

NO UP SHIFTS

1. Check governor pressure.

The governor pressure tap is located next to the passenger side axle.



The pressure gauge should read zero psi and increase with vehicle speed. Consider it a hydraulic speedometer. If the pressure is low or the gauge shows no pressure, remove the governor and air check it. Hold the weights out and blow in the end of it.

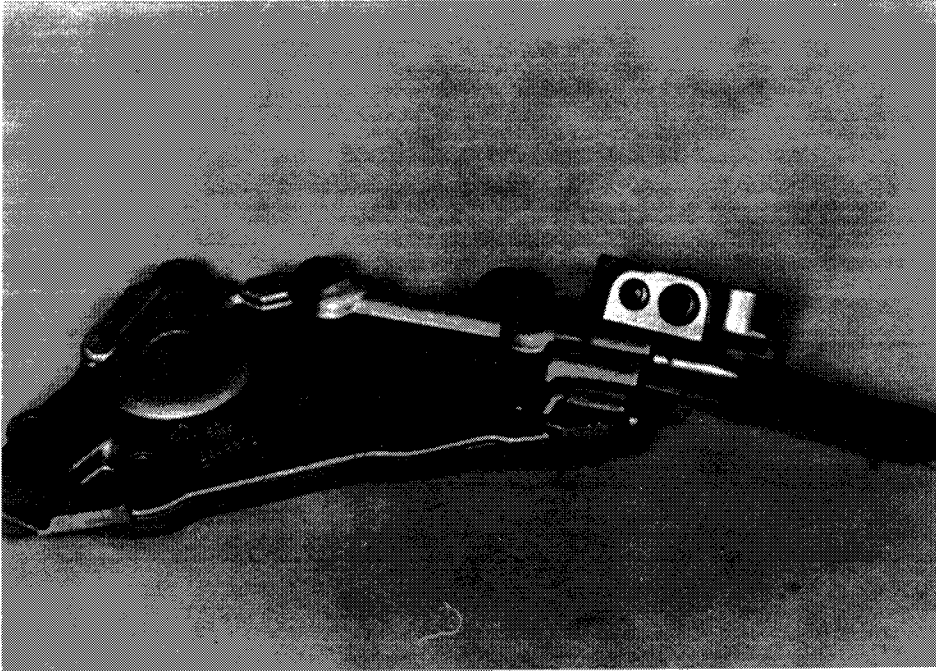


(Use 20 psi regulated air)

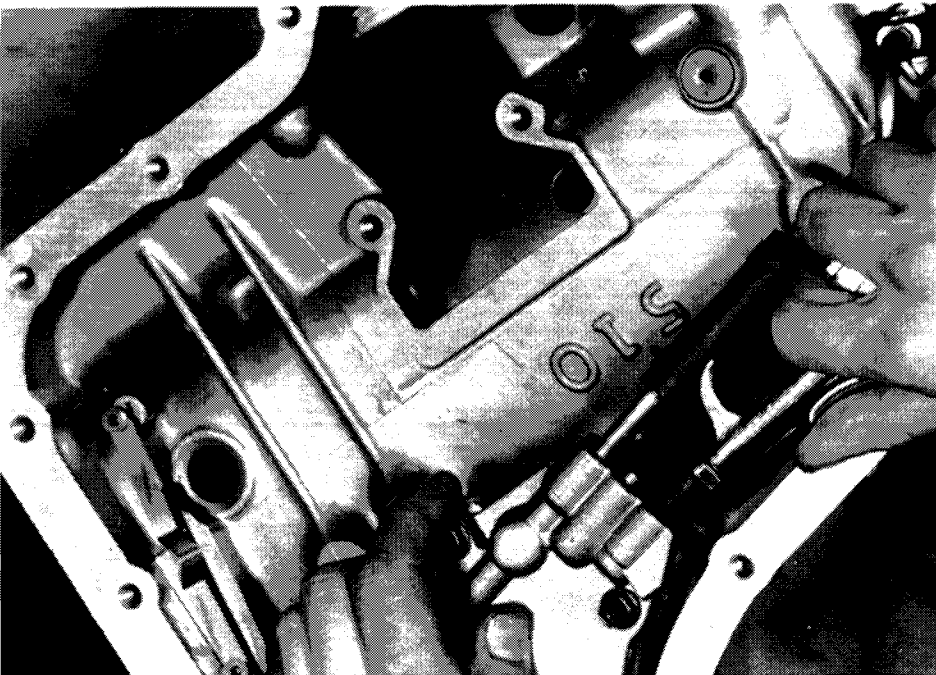
440-T4-14

**NO UP SHIFTS
(CONTINUED)**

If the governor leaks, replace it. If the governor is O.K., check the governor feed tube for a plugged screen and/or orifice.



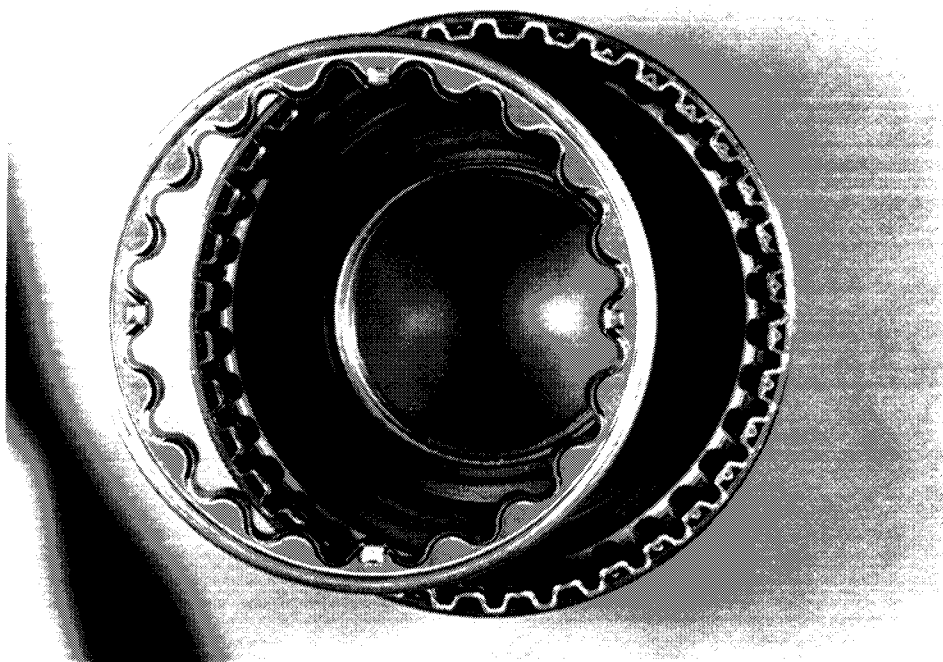
2. Air check the governor circuit remove the governor pressure tube. Blow air into the accumulator cover and listen for the shift valves to move.



The 1-2 shift valve must move to get 2nd, 3rd or 4th.

**NO UP SHIFT
(CONTINUED)**

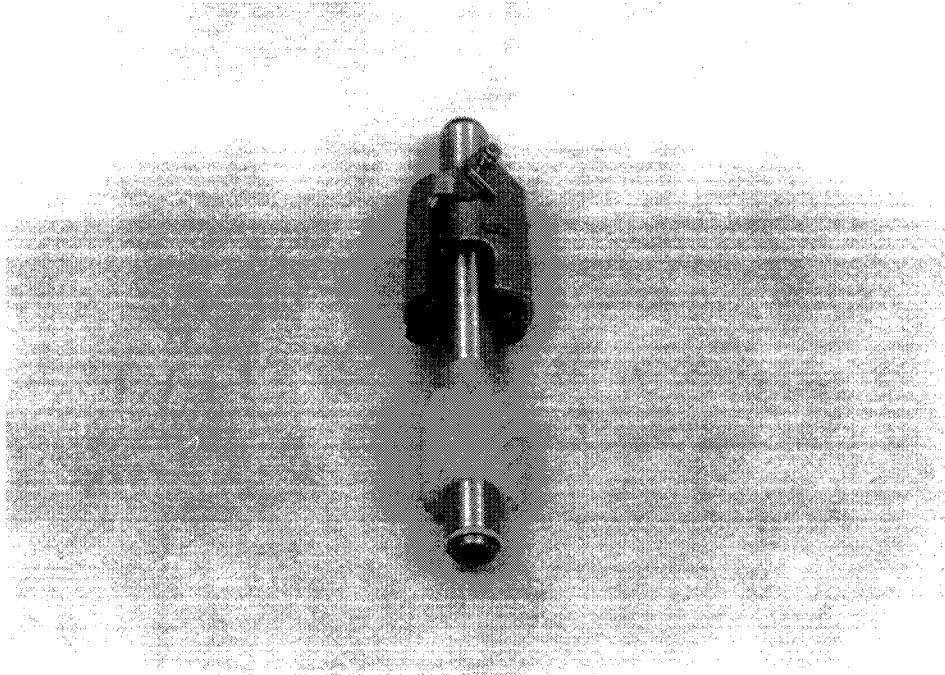
3. Check the 2nd clutch for damage or mis-assembly. The 2nd clutch drum is the main drive member for 2nd, 3rd & 4th. The 2nd clutch must work to get any upshifts. Make sure the piston return spring assembly isn't upside down.



440-T4-16

NO MOVEMENT

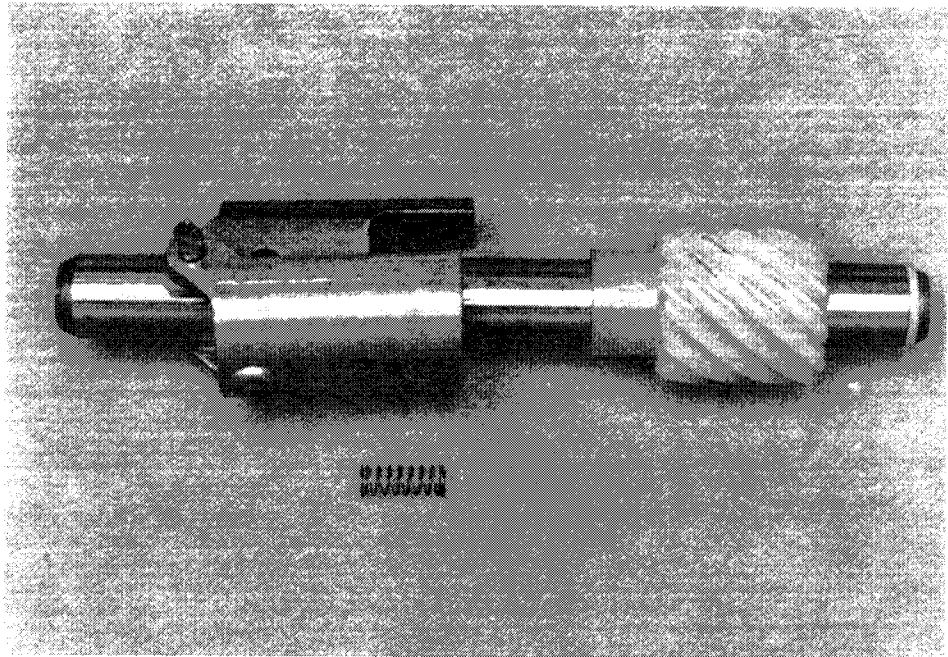
The input clutch & sprag are used in 1st & Reverse. An easy way to check the input clutch & sprag is to remove the governor and bind the two weights out.



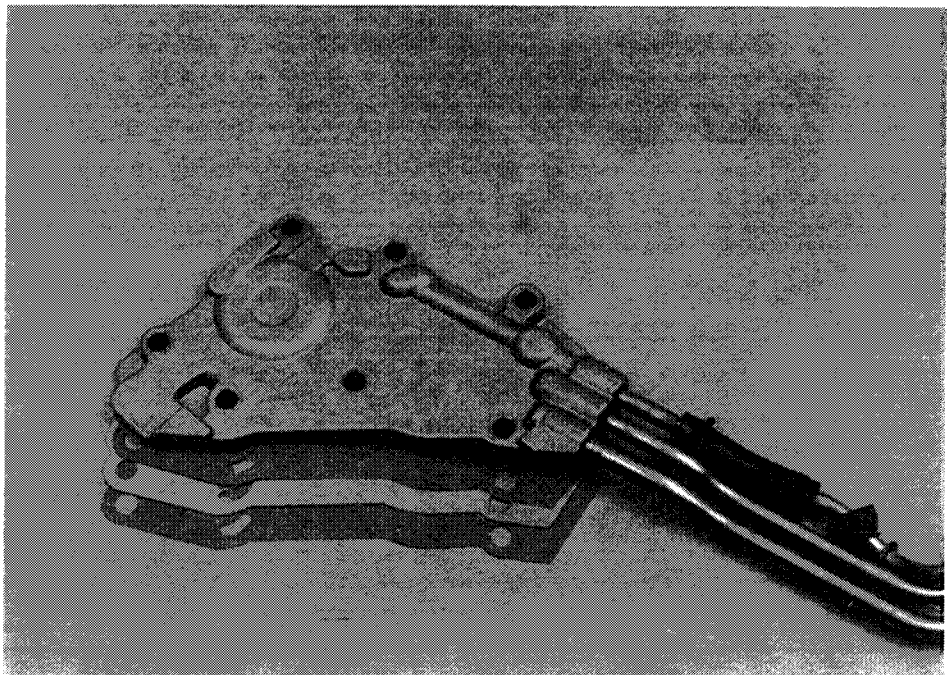
The transaxle should make a high gear start with the governor weights blocked out. If it does, check the input clutch and sprag for damage. If the car doesn't move, check for a no line pressure condition or loose manual control valve link.

**WRONG
GEAR STARTS**

1. Check for high line pressure. Normal line pressure in Drive is 60 - 75 psi.
2. Check the governor pressure (with the drive wheels stopped). If the governor pressure is zero, the wrong gear start condition is from one or more shift valves being stuck. If governor pressure is higher than zero, remove the primary weight spring.



The primary weight is the larger of the two. If the condition still exists, remove the gasket between the accumulator separator plate and the cover.

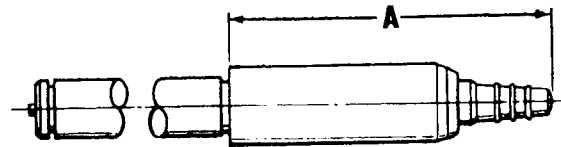
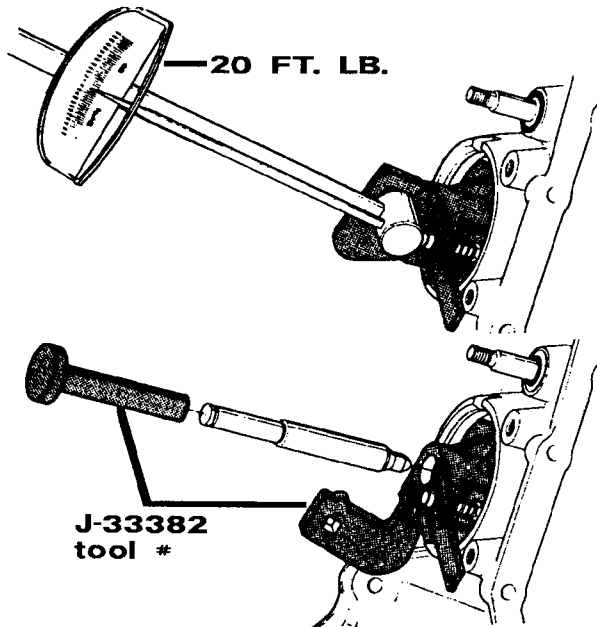


440-T4-18

REVERSE PROBLEMS

DELAYS/CHATTERS

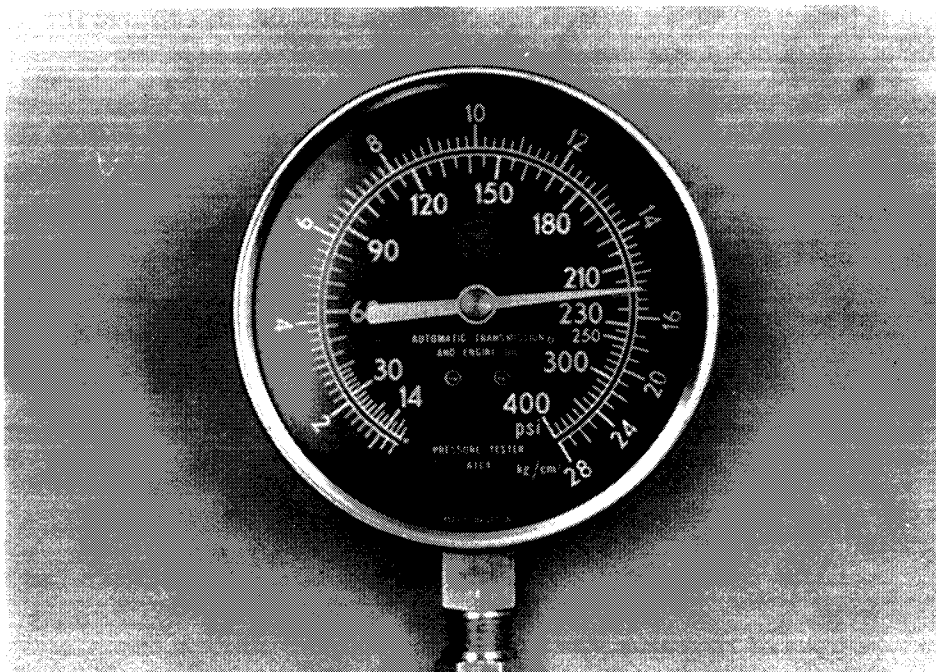
1. Verify that servo travel is correct; 1/8" - 1/4".



REVERSE BAND APPLY PIN

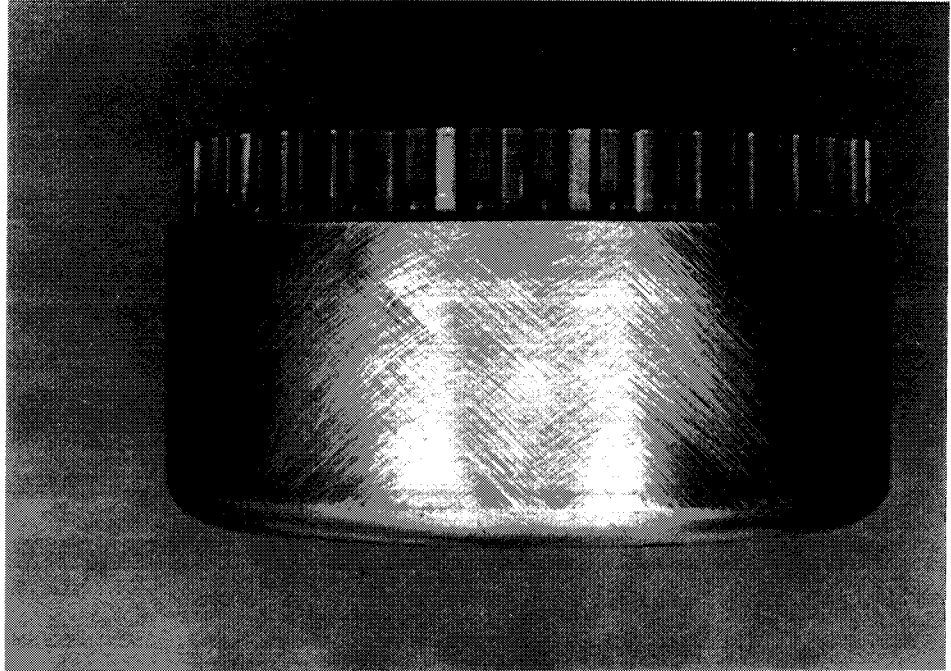
IDENTIFICATION	DIMENSION A
2 GROOVES & WIDE BAND	72.96-73.11mm (2.872"-2.878")
1 GROOVE & WIDE BAND	74.01-74.16mm (2.913"-2.919")
NO GROOVES	75.03-75.18mm (2.953"-2.959")
1 GROOVE	76.08-76.23mm (2.995"-3.001")
2 GROOVES	77.13-77.28mm (3.036"-3.042")
3 GROOVES	78.18-78.33mm (3.077"-3.083")

2. Check line pressure at stall; Min. 220.

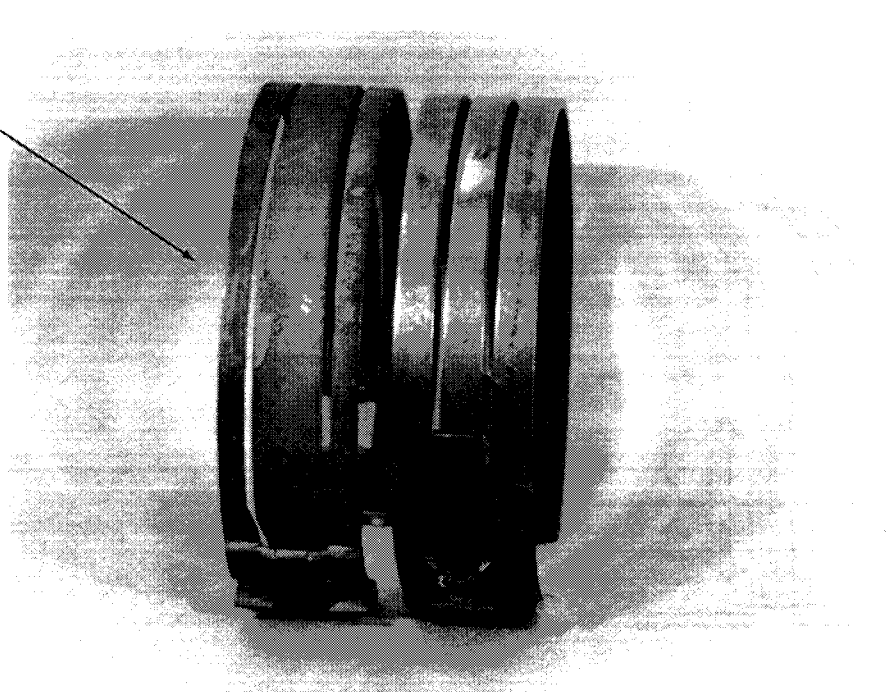


**REVERSE
PROBLEMS
(CONTINUED)**

3. Sand the 2nd clutch drum outer surface with 80 grit sand paper.



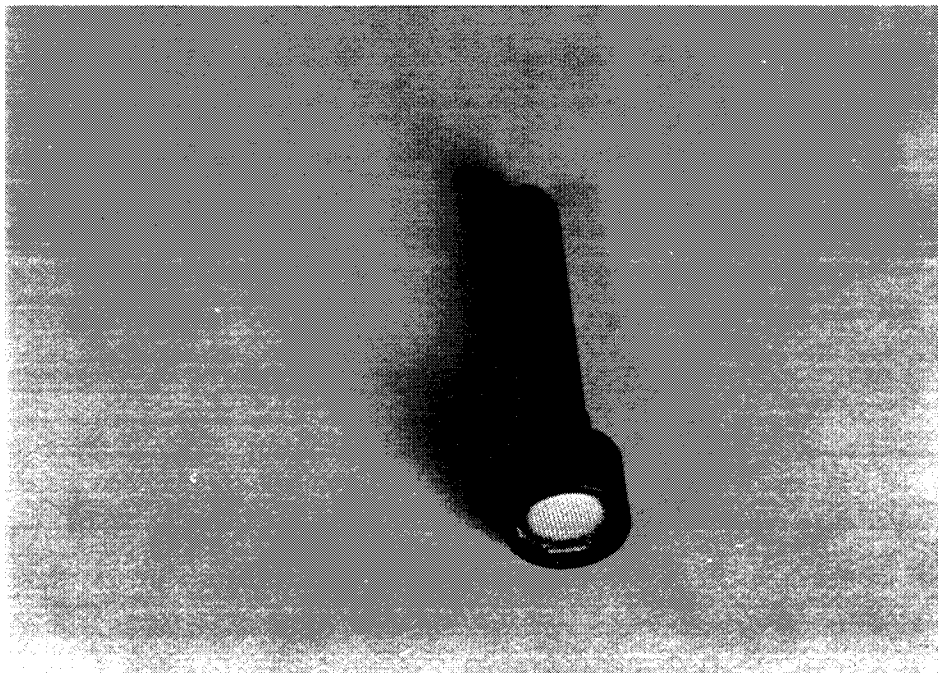
4. Use the late style Reverse band part # 8668012.



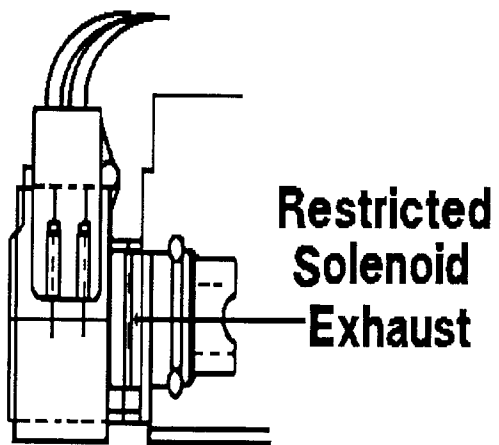
440-T4-20

**T.C.C. LOCK-UP
ON TOP OF 2ND
GEAR**

1. Missing or broken T.C.C. signal oil tube part #8658060.

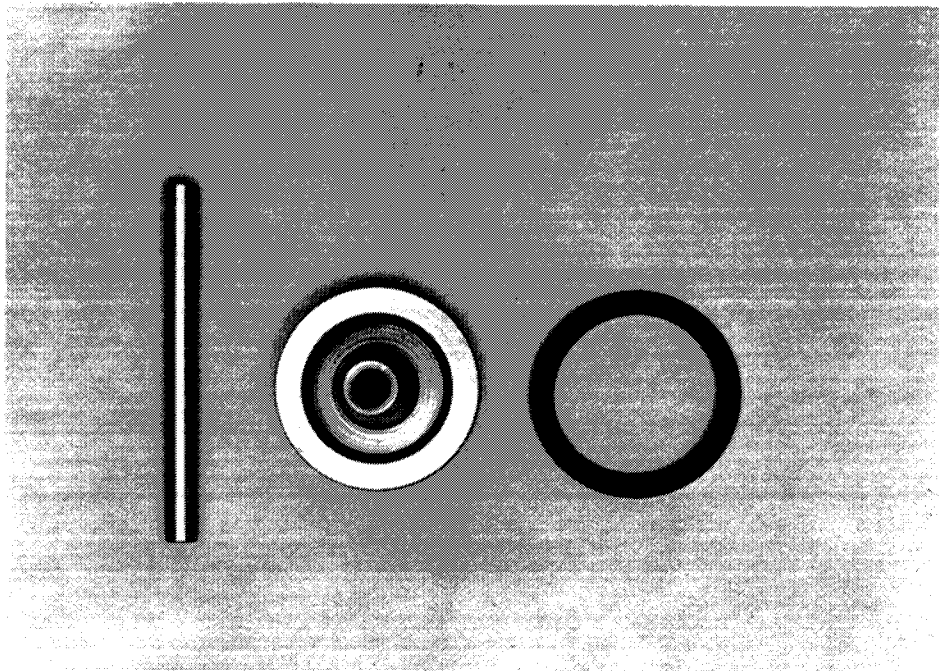


2. Restricted lock-up solenoid.

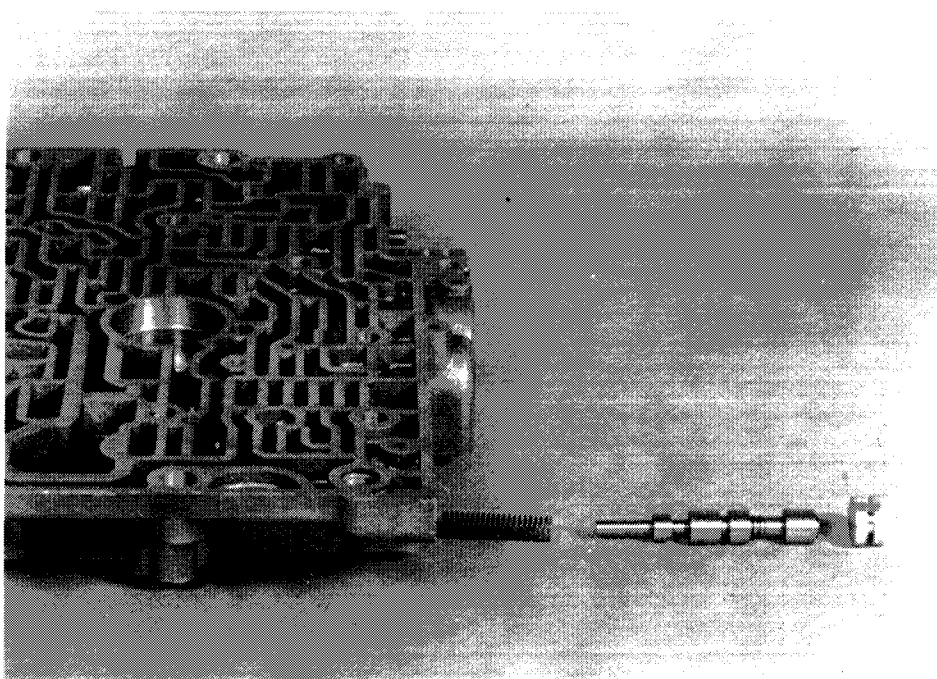


T.C.C. SHUDDER

1. If the T.C.C. accumulator piston and shaft are worn, replace them part #8646926.



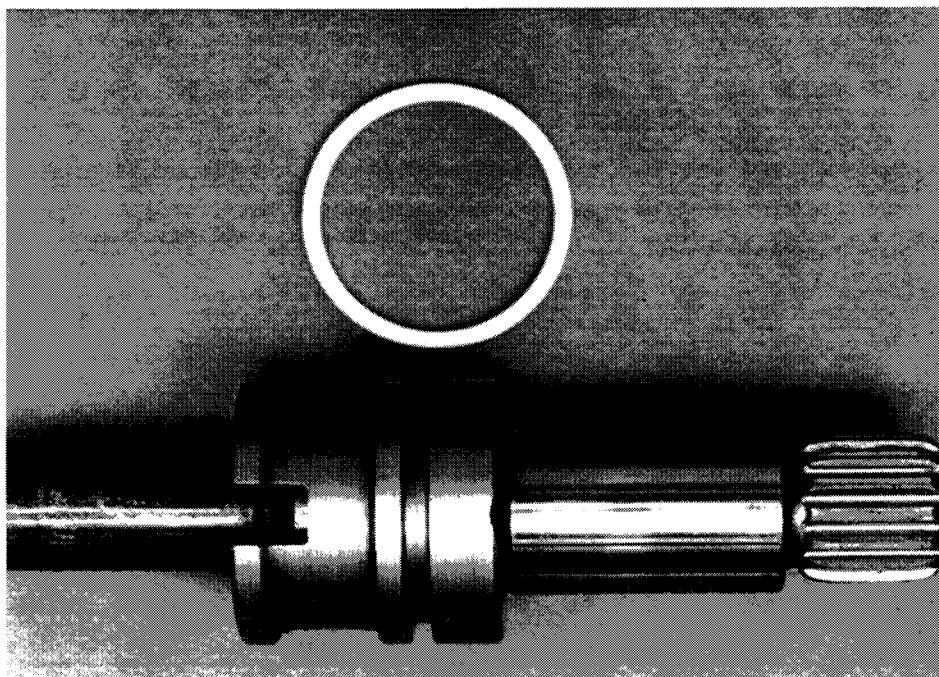
2. Increase the tension of the T.C.C. regulator spring. If there isn't a spring, install a 1 1/2 lb spring. If there is a spring, increase the spring weight 1 lb. Don't exceed 2 1/2 lbs.



440-T4-22

**T.C.C. SHUDDER
(CONTINUED)**

3. Use a solid Teflon sealing ring on the pump drive shaft.
A 700-R4 turbine shaft ring works fine.



PARTS LIST

440-T4 PARTS LIST

TCC SIGNAL OIL TUBE	8658060
TCC SIGNAL TUBE O'RING	8658109
QUAD SEALS	8662329
2ND CLUTCH SEALING RINGS (VESPEL)	8662330
2ND GEAR DRUM	8661912
SPROCKET SUPPORT - LATE	8662523
1-2 SERVO PIPE SEAL (VB)	8656567
1-2 SERVO PIPE SEAL (CASE)	8656568
1-2 SERVO PISTON SEALS	8658160
# 7 CHECK BALL CAPSULE	8646190
VB-CHANNEL GASKET SET 1984 - 1985 1/2	8646907
VB-CHANNEL GASKET SET 1985 1/2 - ON	8646949
MODULATOR-ADJUSTABLE WITHOUT VALVE	3057721
MODULATOR-NON ADJUSTABLE WITH VALVE	8649956
MODULATOR VALVE - WITH STEM	8656074
EARLY IMPROVED INPUT SPRAG	8646986
3RD ROLLER CLUTCH ASSEMBLY	8662676
LATE INPUT SPRAG ASSEMBLY	8662031
PLASTIC LUBE DAM	8658368
ACTUATOR GUIDE	8656689
4TH CLUTCH HUB	8656355
3-4 ACCUMULATOR SPRING	8649092
KOLINE STEELS EARLY .090 THICK	8662309 (5 EACH)
KOLINE STEELS LATE .077 THICK	8662006 (6 EACH)
TCC ACCUMULATOR PISTON & SHAFT	8646926



AXOD SECTION

440 - T4

AXOD

Shift Quality	Page 1, 2, 3, 4, 5
Planetary Gear Train Failure Page	.6, 7, 8
2-1 Downshift Clunks	Page 9, 10
No Movement	Page 11
T.V. Pressure Problems	Page 12

A4LD

LOCK UP

700 - R4

AOD

A140E

A604

E4OD

AXOD-1

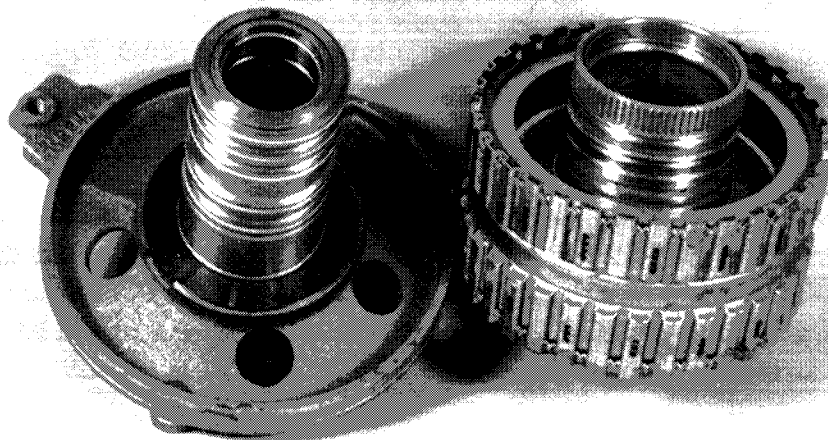
**SHIFT
QUALITY**

1-2 Slips, Slide Bumps & Chatters

Make sure the sealing rings that you use on the Driven sprocket support measure .080" in thickness. They can be identified by their color. They are orange with green speckles. Part #E6DZ-7D019-A



Make sure you check the Direct / Intermediate clutch drum bushing and the Driven sprocket support bushing for wear.

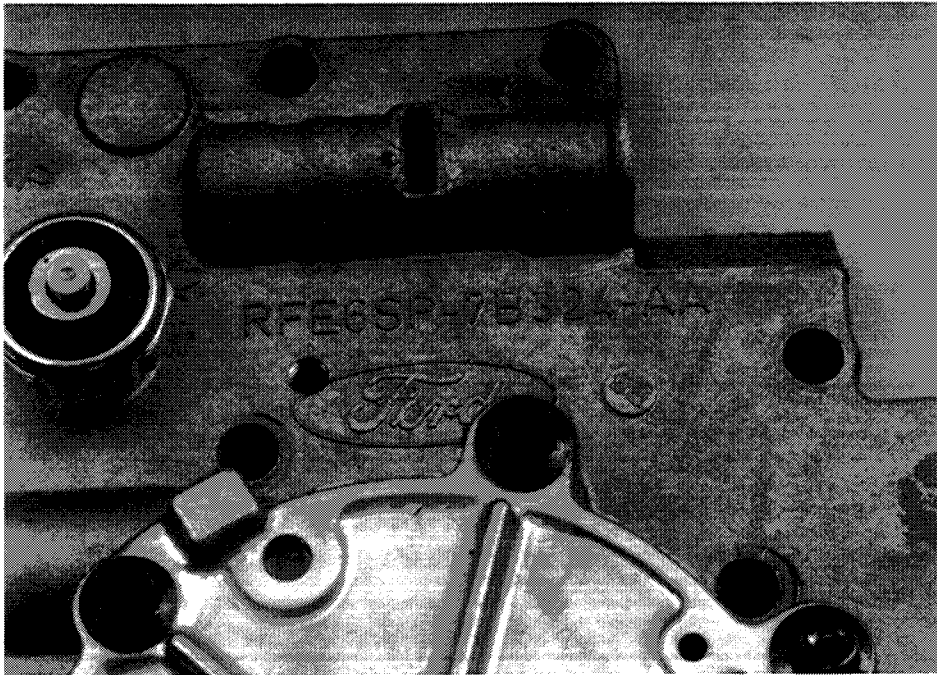


Excessive bushing wear will make it difficult for the Driven sprocket support sealing rings to seal against the Direct/Intermediate clutch drum. The part number for the Driven sprocket support bushing is E6SP-7G170-AA. The part number for the Direct/Intermediate clutch drum bushing is E6SP-7G123-AA.

AXOD-2

SHIFT QUALITY (CONTINUED)

Be aware that the valve-body assemblies, including the pump cover, channel casting and both separator plates, have changed several times over the years. The important thing to remember is that these components must be kept as a matched set and must use the correct valve-body gaskets.



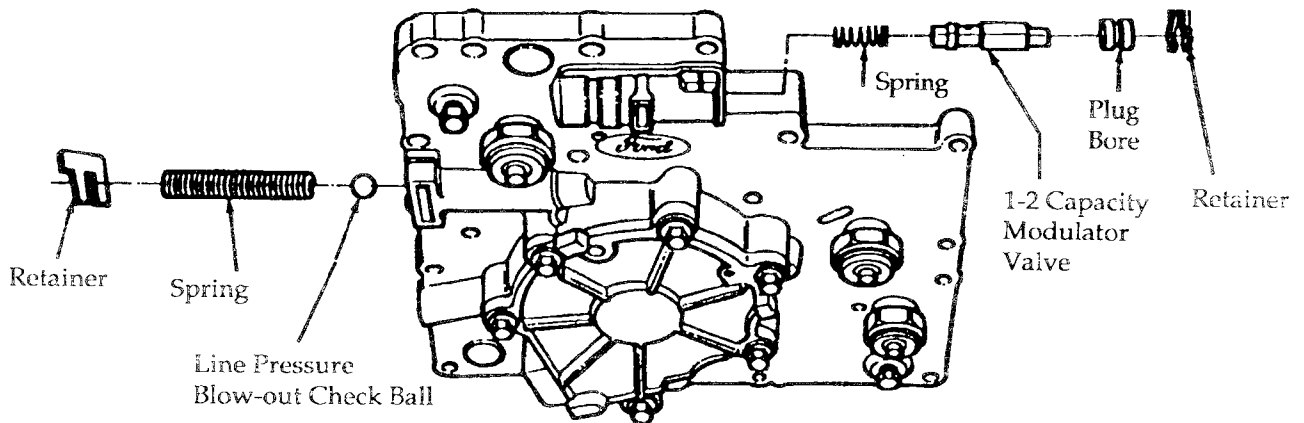
The best way to identify the components is to use the rough forget number cast into each piece. This number always starts with RF-, followed by a letter and a number for that year.

For example, RF-E6 would indicate 1986. The 1986 gaskets have no I.D. marking on them. The 1987 set has a white I.D. stripe on each of the four gaskets. The set for '88-'89 has yellow stripes. For 1990, 3.8L two of the four gaskets will have blue stripes, while the two gaskets closest to the chain cover will still have the '88-'89 yellow stripe. The 2 blue gaskets are #E9OY-7A136-A and E9OY-76331-A.

AXOD-3

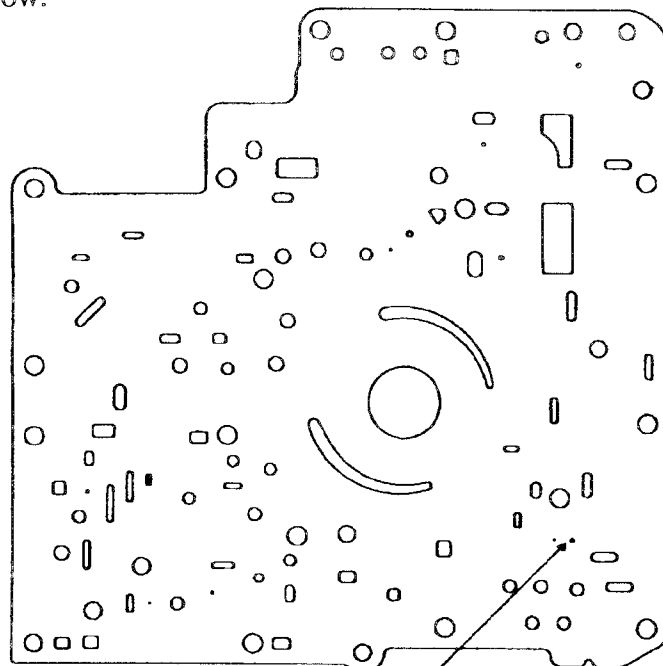
SHIFT QUALITY (CONTINUED)

Cleaning up the 1-2 shift by installing a heavier 1-2 capacity modulator-valve spring.



Find something that weighs approximately 1 1/2 pounds at .415"t. Many GM governor springs are very close, but weigh them to be sure.

The 2-3 shift also needs attention, so we've been enlarging the 2-3 feed hole to .093", as shown below.



**2-3 Feed Hole
Enlarge to .093"**

AXOD-4

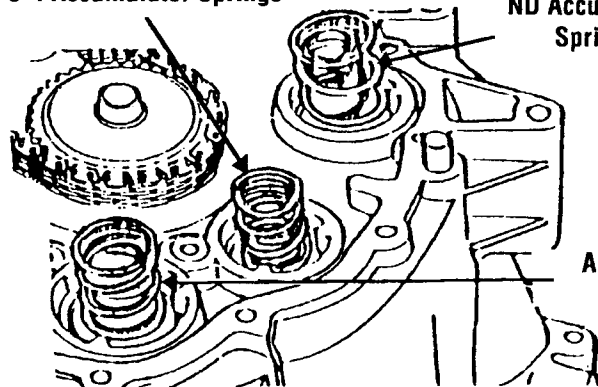
SHIFT QUALITY (CONTINUED)

Accumulator springs are easy to mix up, and it's almost impossible to find the correct replacement in any of the manuals. Refer to the following chart before choosing the correct setup.

3-4 Accumulator Springs	3.0L engine 3.8L engine	2 green springs 2 plain springs
ND Accumulator Springs	all engines	1 blue and 1 orange
1-2 Accumulator	3.0L engine 3.8L engine	2 yellow springs 3 brown springs

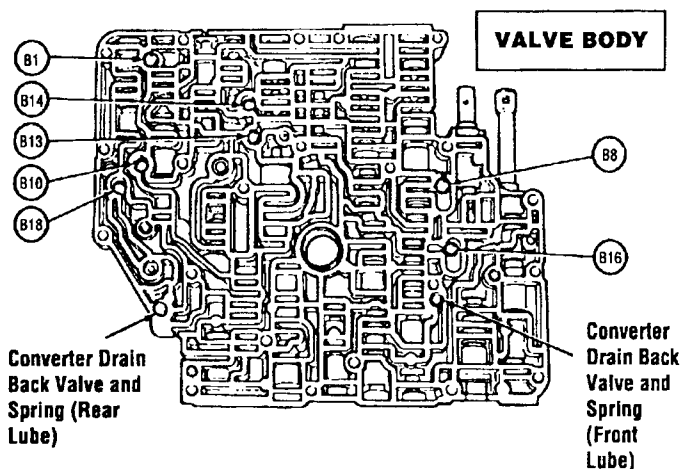
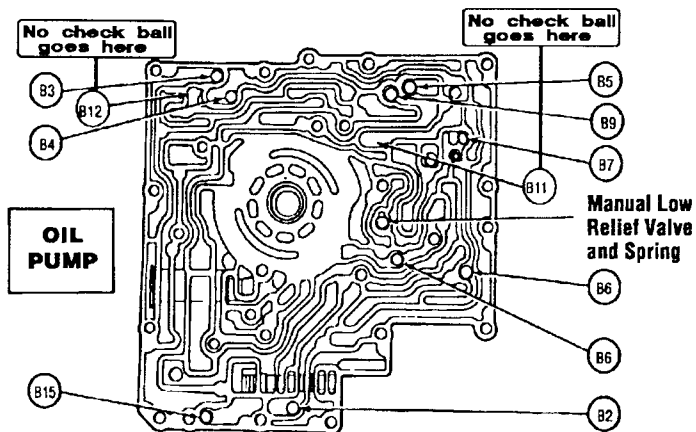
3-4 Accumulator Springs

ND Accumulator Springs



1-2
Accumulator
Springs

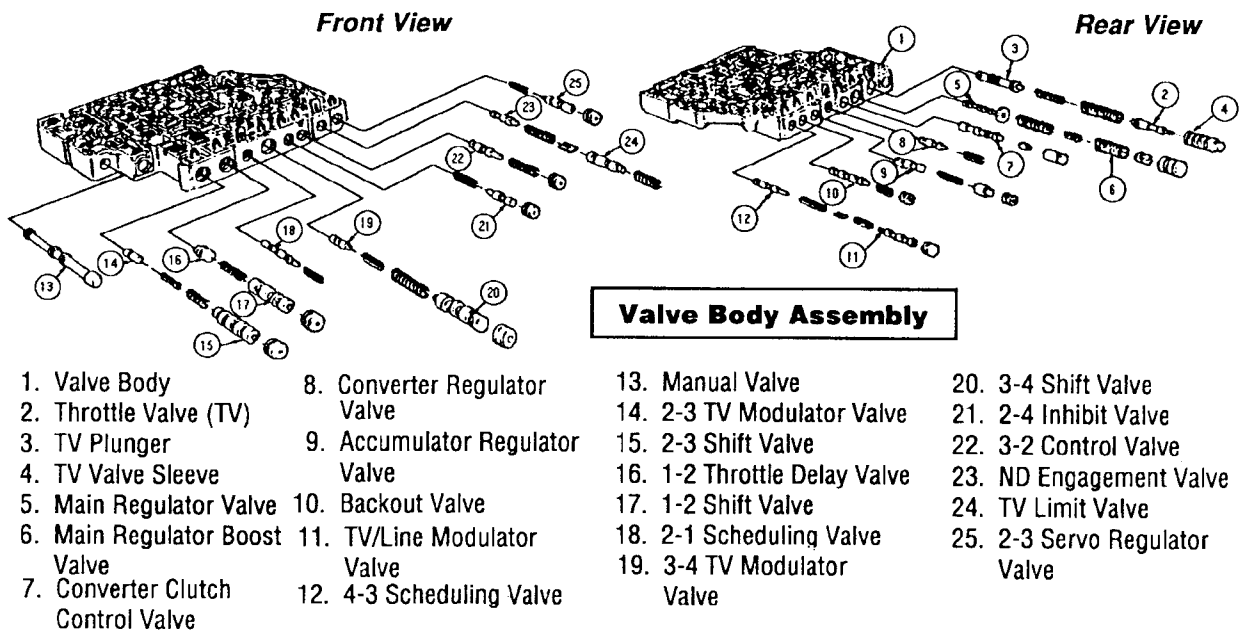
Many manuals show an incorrect checkball placement. Use the following picture and do not put ball #3 into cavity #12, as it will cause a bindup in the 1-2 shift. If you lose a checkball, the correct replacement size is .315".



AXOD-5

SHIFT QUALITY (CONTINUED)

Several manuals also show some valves installed incorrectly. Use the following picture and pay particular attention to the T.V./line modulator valve #11 and the 2-1 scheduling valve #18.



AXOD-6

PLANETARY GEAR TRAIN FAILURE

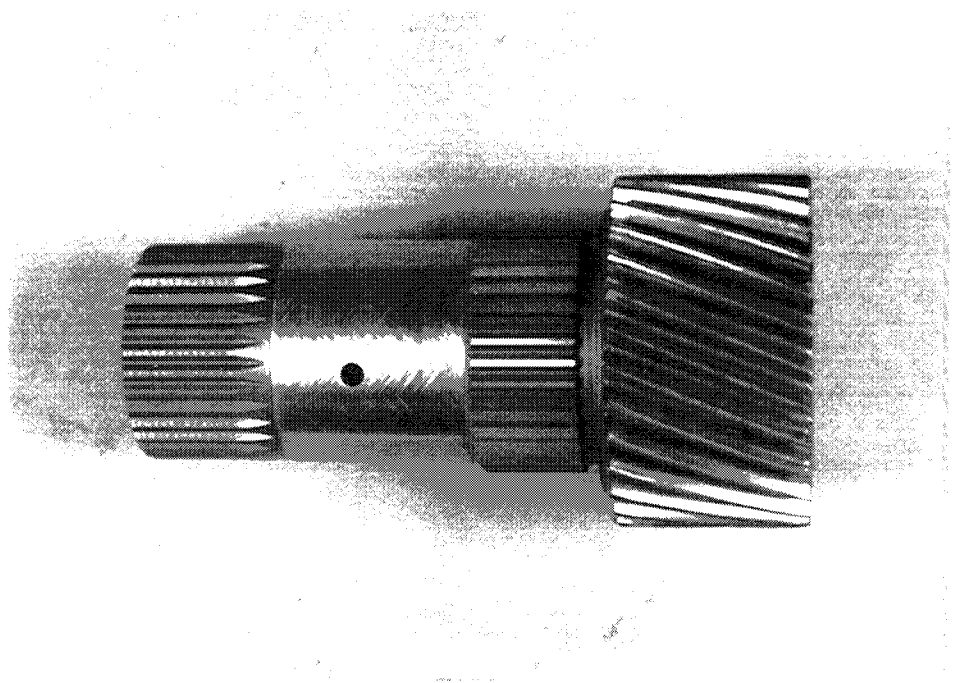
The most costly complaint is planetary-gear-train failure. When you experience this type of failure, or want to prevent it, the first things to check are the two bushings in the rear-planetary support. Sometimes these bushings move out of position and block the lube hole between them.



The 1988 and later rear support has a one-piece bushing with a hole in the center to help correct this potential problem. The late support will fit the earlier models.

**PLANETARY GEAR
TRAIN FAILURE
(CONTINUED)**

The second thing to check is the lube hole in the support and the two lube holes in the sun-gear shaft. Make sure they are drilled through completely; a few from the factory were not.

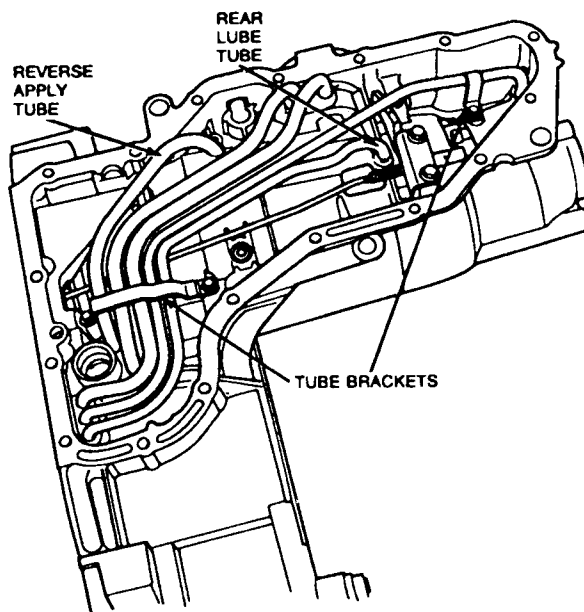


When installing the lube seal in the case, make sure it's inserted far enough to prevent leakage, but not so far as to crush it and block all lube flow. A new Ford tool is available for this purpose.

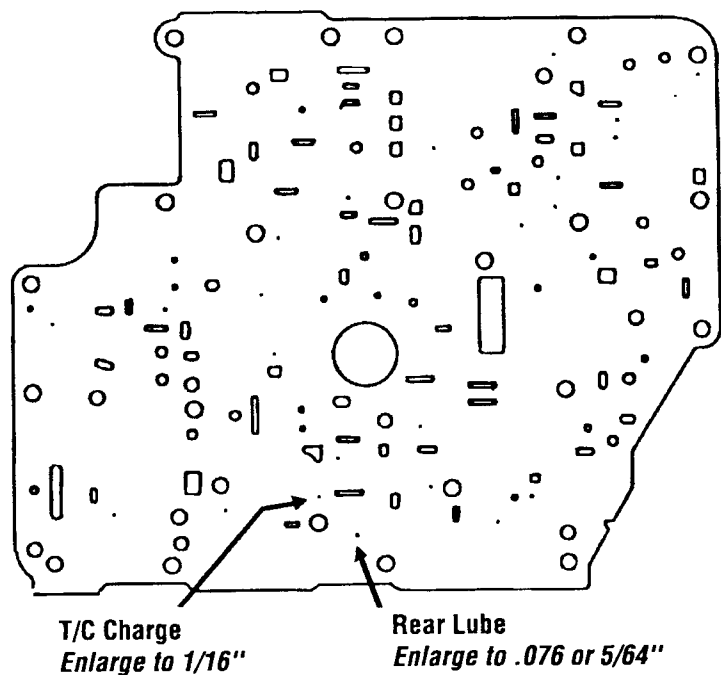
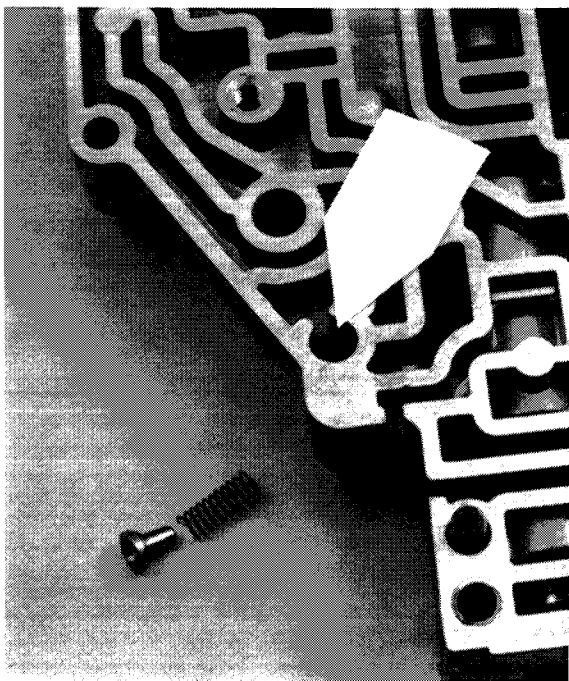
AXOD-8

PLANETARY GEAR TRAIN FAILURE (CONTINUED)

Be certain you remove the old sealant from the rear lube feed tube before reinstalling it with Lock-tite.



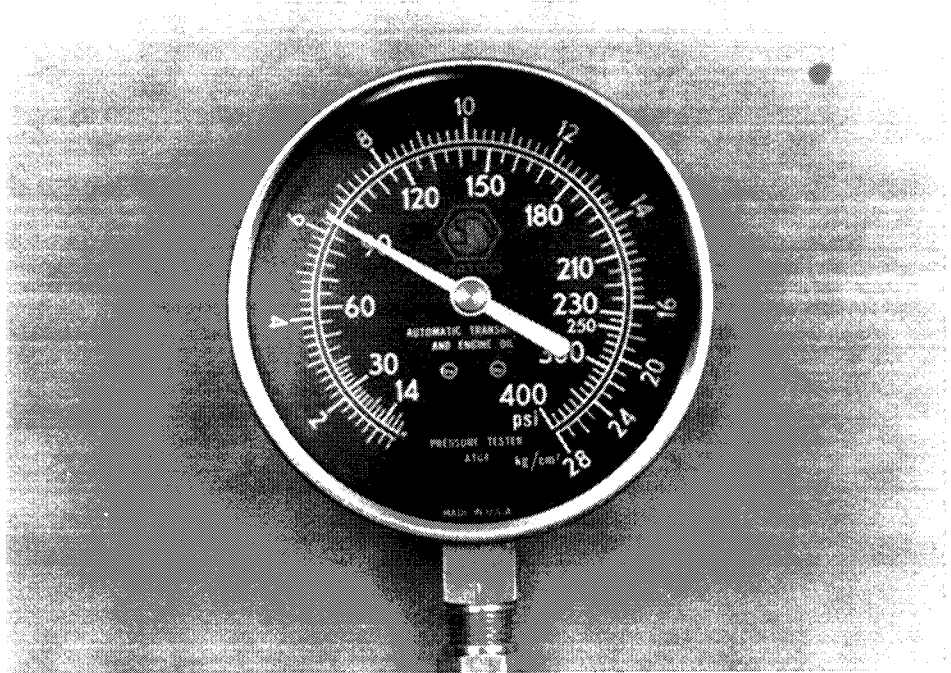
To increase lube flow dramatically, enlarge the two feed holes in the separator plate and trim 3 1/2 coils off the rear lube check-valve spring.



AXOD-9

2-1 DOWNSHIFT CLUNKS

1. Make sure line pressure is normal;



80 - 95 psi in drive at an idle.

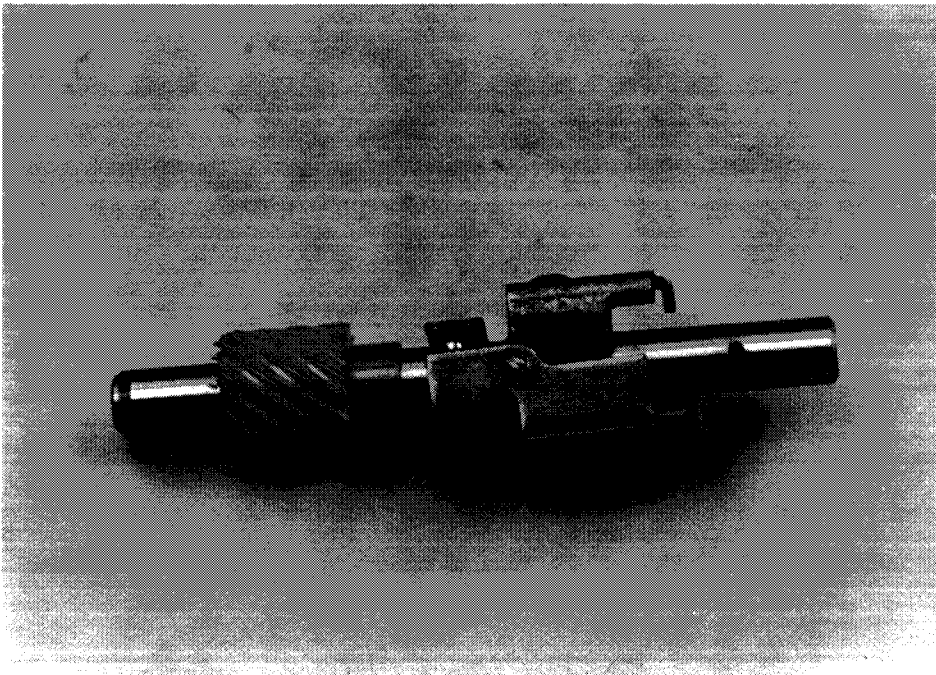
2. Using the wrong valve body gaskets can cause uncontrollable throttle pressure.
(See the page 2)

3. A loose T.V. cable can cause a no shift condition and make the accelerator pedal very hard if not impossible to move. To fix this, turn the engine off and tighten the cable 1/8" at a time until the T.V. cable can be moved with the engine ON.

AXOD-10

2-1 DOWNSHIFT CLUNKS (CONTINUED)

4. If the line pressure is normal, remove the primary governor weight spring.



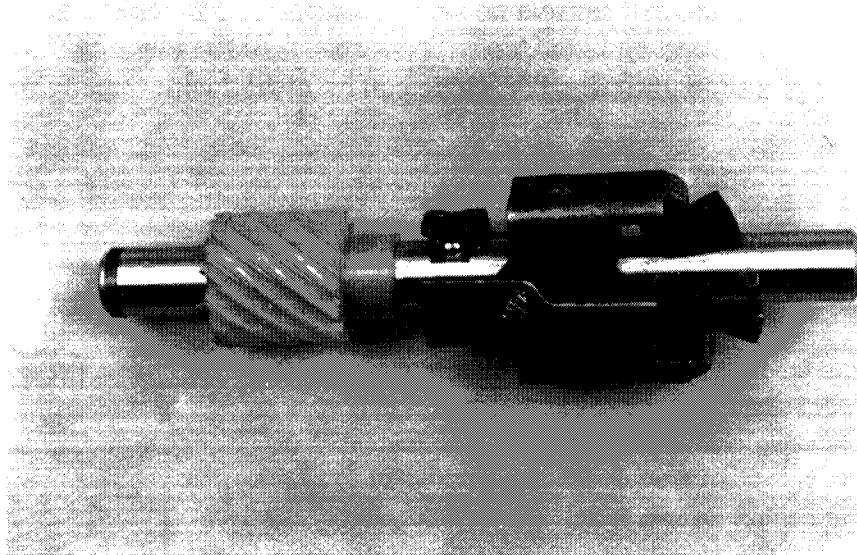
The primary weight is the larger of the two weights. If the governor doesn't have a spring, take the sealing ring off the governor. If the clunk is still there check the valve body for at sticking 1-2 shift valve.

5. A worn forward sprag can also cause a 2-1 clunk. Always replace the forward sprag. Part # E60Z-7A089-A

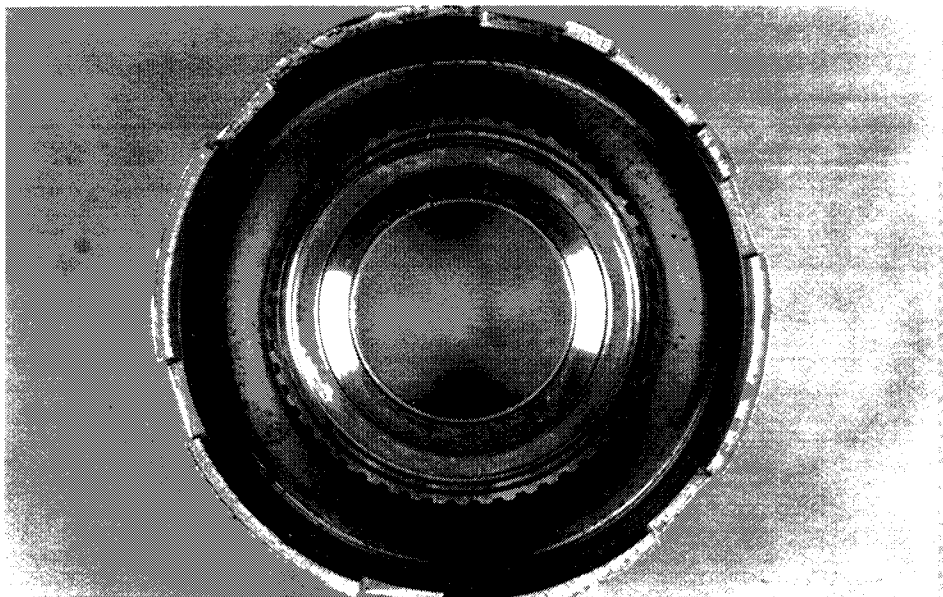
AXOD-11

NO MOVEMENT

A no movement condition can be caused by a forward sprag being installed backwards, a bad forward sprag, or a forward clutch that doesn't work. The easiest way to check this is to bind the governor weights out to give the transaxle a high governor signal.



Reinstall the governor. Start the engine and put the gear selector in Drive. If the car moves the problem is in the forward clutch or forward sprag. Put the gear selector in Manual Low. With the governor weights bound the transaxle will be in 2nd gear. If the transaxle binds up, the forward sprag is in backwards. The forward sprag race should freewheel counter-clockwise and lock clockwise in the overdrive drum when installed correctly.



T.V. PRESSURE PROBLEMS

1. Using the wrong valve body gaskets can cause uncontrollable throttle pressure.
(See page 2)

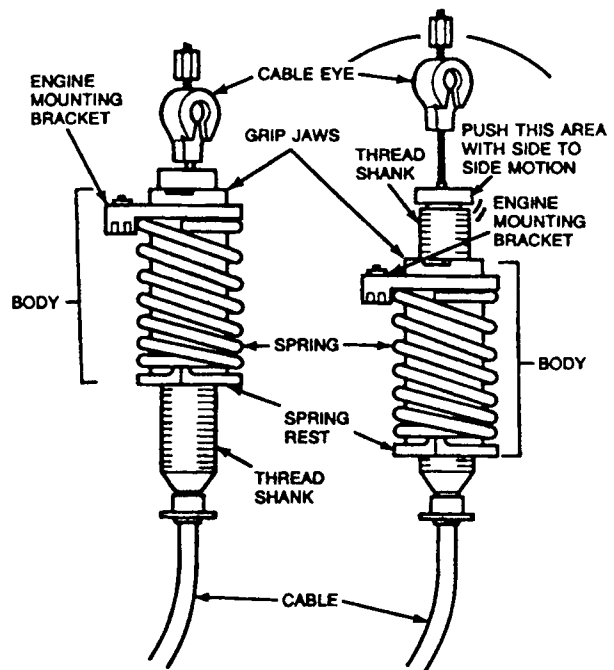
3. A lose T.V. cable can cause a no shift condition and make the accelerator pedal very hard if not impossible to move. To fix this, turn the engine off and tighten the cable 1/8" at a time until the T.V. cable can be moved with the engine ON.

Throttle Valve (TV) Cable

The throttle valve (TV) cable normally does not need adjustment. The cable should be adjusted only if one of the following components is replaced:

- Main control assembly
 - Throttle valve cable
 - Throttle valve cable engine mounting bracket
 - Throttle control lever link or lever assembly
 - Engine throttle body
 - Transaxle assembly
1. Connect TV cable eye to transaxle throttle control lever link and attach cable boot to chain cover.
 2. With TV cable mounted in engine bracket, make sure threaded shank is fully retracted. To retract shank, pull up on spring rest with index fingers, and wiggle top of thread shank while pressing shank through spring with thumbs.
 3. Attach end of TV cable to throttle body.
 4. Rotate throttle lever to WOT position and release.

NOTE: Threaded shank must show movement or "ratchet" out of grip jaws. If no movement is observed, inspect TV cable system for broken or disconnected components and repeat procedure.





A4LD SECTION

440 - T4 AXOD

A4LD

Pressure Testing	Page 1
Direct Clutch Problems	Page 2
Diagnosing No 4th Gear	Page 3
Downshift Problems	Page 4, 5
Shift Quality	Page 6
Servo Assembly Application Charts	Page 7, 8
Shift Timing	Page 9, 10
Engine Stall	Page 11
Front Seal Blowout	Page 12
Vent Leaks	Page 13
Parts Interchange	Page 14

LOCK UP
700 - R4
AOD
A140E
A604
E4OD

A4LD-1

**PRESSURE
TESTING**

	IDLE	10" VAC	WOT
P&N	50-70	-----	-----
R	75-110	155-180	280-320
FORWARD RANGES	50-70	90-115	165-195

**HIGH
ALTITUDE**

	IDLE	10" VAC	WOT
P&N	50-60	-----	-----
R	65-80	120-145	245-285
FORWARD RANGES	50-60	70-95	140-180

GEAR	OVER- DRIVE BAND A	OVER- DRIVE CLUTCH B	OVER- DRIVE ONE WAY CLUTCH C	INTERMEDIATE BAND D	REVERSE AND HIGH CLUTCH E	FORWARD CLUTCH F	LOW AND REVERSE BAND G	ONE WAY CLUTCH H	GEAR RATIO
1 — MANUAL FIRST GEAR (LOW)		APPLIED	HOLDING			APPLIED	APPLIED	HOLDING	2.47:1
2 — MANUAL SECOND GEAR		APPLIED	HOLDING	APPLIED		APPLIED			1.47:1
D — DRIVE AUTO. — 1ST. GEAR		APPLIED	HOLDING			APPLIED		HOLDING	2.47:1
ⓓ — O/D AUTO. — 1ST. GEAR			HOLDING			APPLIED		HOLDING	2.47:1
D — DRIVE AUTO. — 2ND. GEAR		APPLIED	HOLDING	APPLIED		APPLIED			1.47:1
ⓓ — O/D AUTO. — 2ND. GEAR			HOLDING	APPLIED		APPLIED			1.47:1
D — DRIVE AUTO. — 3RD. GEAR		APPLIED	HOLDING		APPLIED	APPLIED			1.0:1
ⓓ — O/D AUTO. — 3RD. GEAR			HOLDING		APPLIED	APPLIED			1.0:1
ⓓ — OVERDRIVE AUTOMATIC FOURTH GEAR	APPLIED				APPLIED	APPLIED			0.75:1
REVERSE		APPLIED	HOLDING		APPLIED		APPLIED		2.1:1

A4LD-2

A4LD DIRECT CLUTCH PROBLEMS

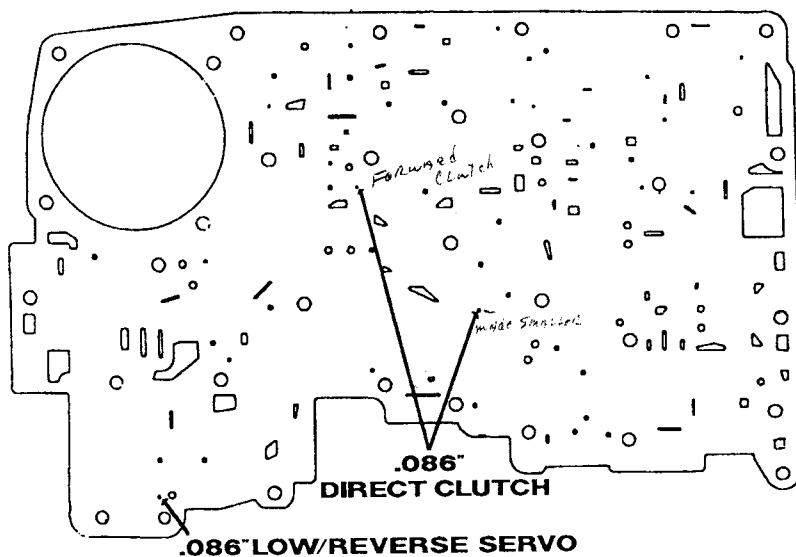
Slips in 3rd or reverse.

2-3 Flare. Delayed reverse.

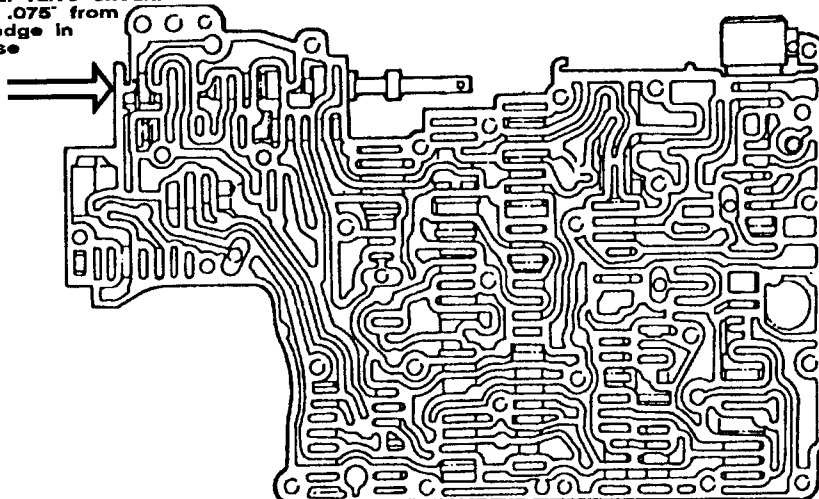
No 3rd or reverse.

Direct clutch burn up.

Always use the viton rubber rings on the center support. Teflon at this location will leak 10 - 20% of the apply oil. Metal rings will leak over 25%. Direct clutch viton rings are Ford #E5TZ-7D429-A. Drill the three holes in the separator plate as shown. Adjust the manual valve as shown, otherwise the direct clutch may be partially applied in 1st and 2nd.



Manual valve should
be in .075" from
this edge in
reverse



**DIAGNOSING
NO 4TH GEAR**

Problem: No 4th gear

Diagnosis:

- Raise the vehicle on the lift.
- Loosen the lock nut for the overdrive band adjustment. Have an assistant accelerate up to about 50 mph and hold at that speed.
- Try to turn the overdrive band adjustment screw "in".
- If the adjustment screw **DOES NOT** turn easily it indicates the overdrive band is applied. This means the valve body and governor made the 3-4 upshift, and there is an internal mechanical problem.
- If the adjustment screw **DOES** turn it means there is a **VALVE BODY OR GOVERNOR** problem.

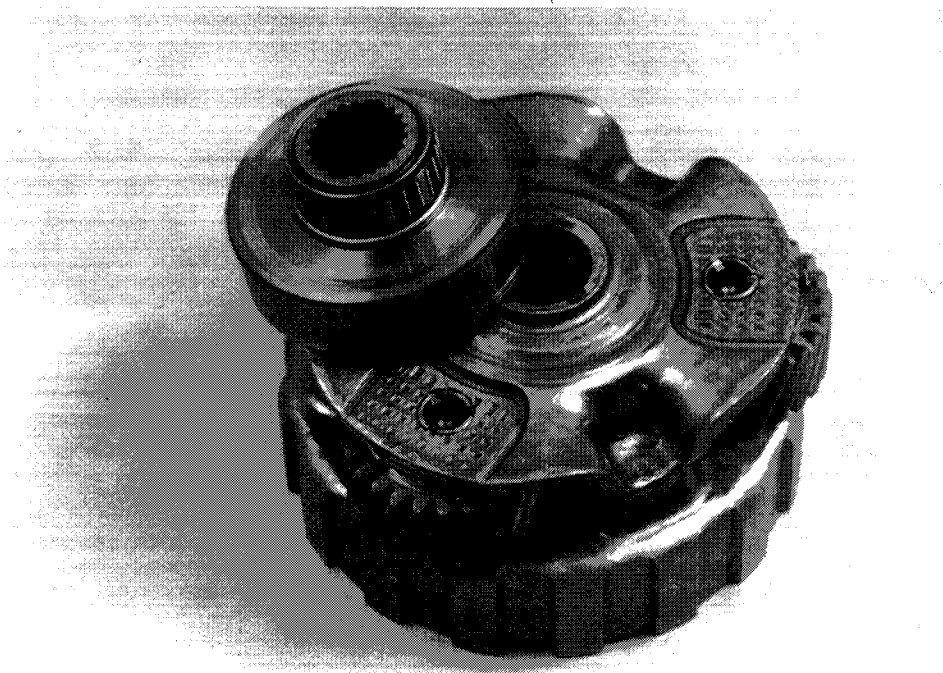
Diagnosis indicates INTERNAL problem.

CAUSE: Inner sprag race broken away from overdrive planet carrier.

NOTE: During a 4-3 kickdown, a weak sprag will slip, then grab. The shock of re-engagement is what usually breaks the planet.

CORRECTION: Replace the planet carrier **AND** the sprag.

Planet carrier #E9TZ-7B446-A, sprag #E5TZ-7A089-A



A4LD-4

A4LD DOWNSHIFT PROBLEMS

Neutrals during passing gear or after coastdown

The overdrive sprag must lock in 1st, 2nd and 3rd gear, and must free-wheel in 4th gear. If the selector is in the D4 position, the sprag will also free-wheel when coasting. Weak sprags will fail to lock under a load after they have been free-wheeling such as passing gear from 4th. This failure to lock will cause a neutral condition.

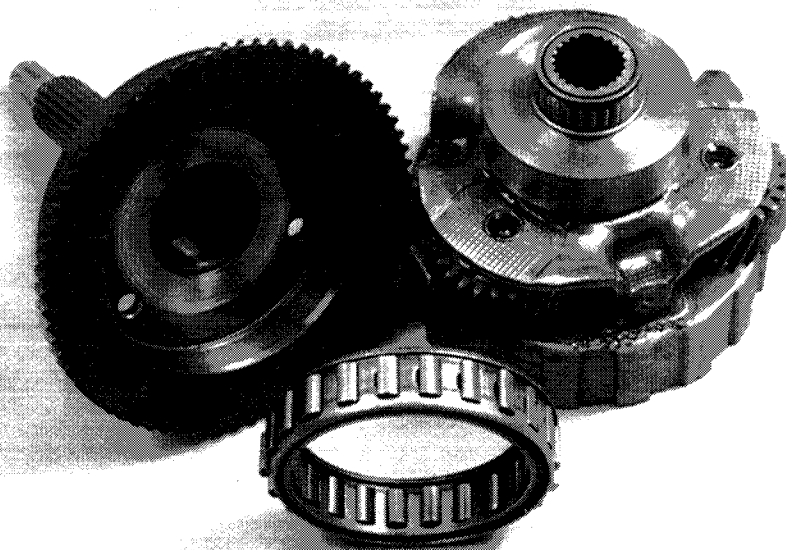
IT IS RECOMMENDED TO REPLACE THE SPRAG DURING REBUILD OR REPAIR ON VEHICLES WITH MORE THAN 40,000 MILES.

Use the updated 24 element sprag #E5TZ-7A089-A, Also, install the late sprag wear plate #E5TZ- 7L339-A. The late wear plate has tabs to keep it from rotating when installed. When the early plate rotates it generates fine metal particles.

If the inner or outer races are worn, they **MUST** be replaced.

Outer race #E5TZ-7A658-A.

Inner race (overdrive carrier) #E9TZ-7B446-A.



A4LD-5

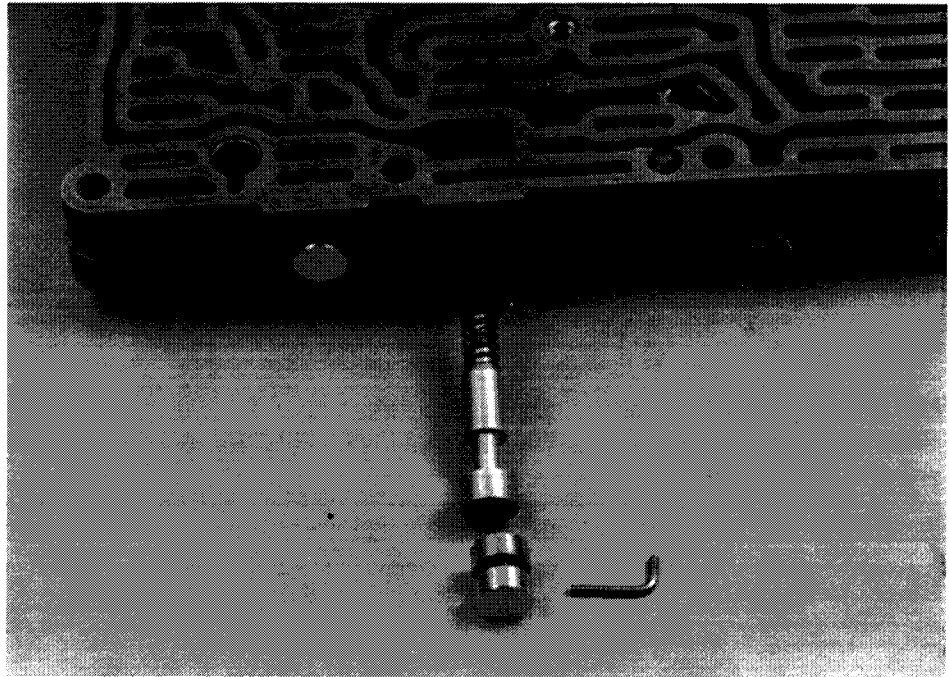
**A4LD DOWNSHIFT
PROBLEMS
(CONTINUED)**

Sensitive 4-3 Kickdown

To eliminate a sensitive 4-3 downshift, install Ford # E5TZ- 7E479-A. If the 4-3 is still too sensitive, increase the tension on the throttle pressure boost spring.

3-2 Downshift Flare

If the sprag is in good condition, remove the intermediate servo return spring.



A4LD-6

SHIFT QUALITY

The following charts will show the proper application of servo components for various vehicles.

You may want to do some customizing to affect shift quality.

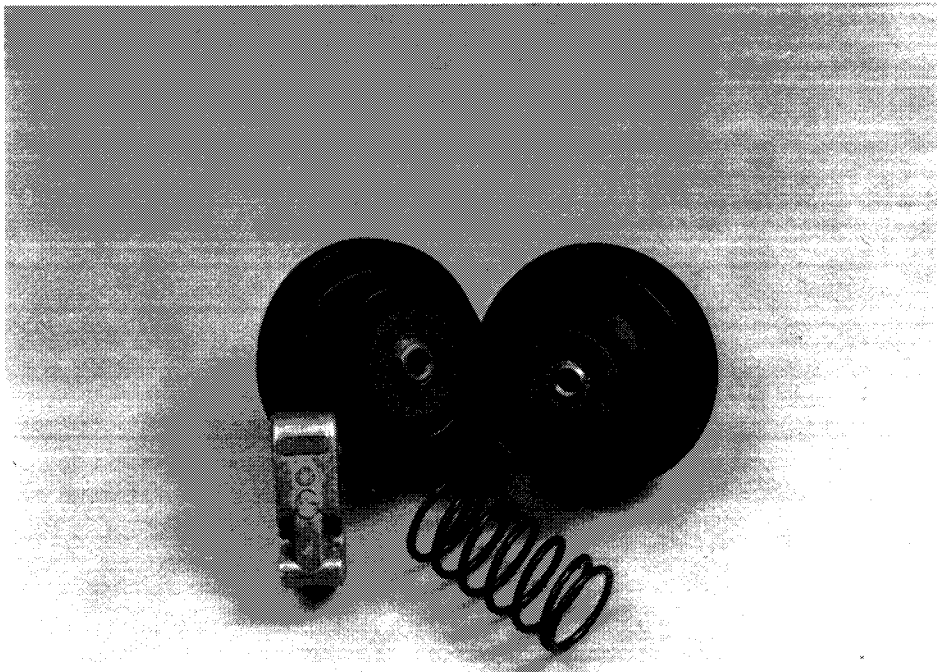
Servo size - a larger intermediate servo will make the 1-2 and 2-3 shift firmer.

Servo spring - a lighter servo spring will make the shift firmer.

Apply lever - G = softest shift
E = medium shift
C = firmest shift

Note on 2-3 shift:

Always drill the separator plate as shown on page 2.



A4LD-7**SERVO ASSEMBLY
APPLICATION
CHARTS****1985 - INTERMEDIATE SERVO**

MODEL	ENGINE	SERVO SIZE (MEASURE ID OF SERVO COVER)	SPRING COLOR	APPLY LEVER CODE
Bronco	6 cylinder	1.820"	Blue	E
Ranger	4 cylinder	1.820"	Blue	G
	6 cylinder	1.820"	Blue	E

1985 - OVERDRIVE SERVO

Bronco	6 cylinder	2.075"	Blue	E
Ranger	4 cylinder	2.075"	Blue	G
	6 cylinder	2.075"	Blue	E

1986 - INTERMEDIATE SERVO

Aerostar	4 cylinder	1.820"	Blue	G
	6 cyl-2.8 liter	1.820"	Green	E
	6 cyl-3.0 liter	1.820"	Orange	E
Bronco	6 cylinder	1.920"	Orange	E
Range	4 cylinder	1.820"	Blue	G
	6 cylinder	1.920"	Orange	E

1986 - OVERDRIVE SERVO

Aerostar	4 cylinder	2.075"	Blue	G
	6 cyl-2.8 liter	2.075"	Blue	E
	6 cyl-3.0 liter	2.075"	Green	E
Bronco	6 cylinder	2.075"	Green	E
Rangerr	4 cylinder	2.075"	Blue	G
	6 cylinder	2.075"	Green	E

1987 - INTERMEDIATE SERVO

Aerostar/ Ranger	4 cylinder	1.820"	Blue	G
	6 cylinder	1.920"	Orange	E
Bronco	6 cylinder	1.920	Orange	E
Mustang	4 cylinder	1.820	Blue	G
	6 cylinder	1.820	Blue	G
T-Bird/ Cougar	4 cylinder	1.920	Blue	E
	6 cylinder	1.920	Blue	E
Mustang	4 cylinder	2.075"	Blue	G
	6 cylinder	2.075"	Blue	G
T-Bird/Cougar	4 cylinder	2.075"	Blue	E
	6 cylinder	2.075"	Blue	E

A4LD-8**SERVO ASSEMBLY
APPLICATION
CHARTS
(CONTINUED)****1988 - INTERMEDIATE SERVO**

MODEL	ENGINE	SERVO SIZE (MEASURE ID OF SERVO COVER)	SPRING COLOR	APPLY LEVER CODE
Aerostar/ Ranger	4 cylinder	1.820"	Blue	G
	6 cylinder	1.920"	Orange	E
Bronco	6 cylinder	1.920"	Orange	E
Mustang	4 cylinder	1.820"	Blue	G
	6 cylinder	1.820"	Blue	G
Scorpio	4 cylinder	1.920"	Blue	E
	6 cylinder	1.920"	Blue	E
T-Bird/Cougar	4 cylinder	1.920"	Blue	E
	6 cylinder	1.920"	Blue	E

1988 - OVERDRIVE SERVO

Aerostar/ Ranger	4 cylinder	2.075"	Blue	G
	6 cylinder	2.075"	Green	C
Bronco	6 cylinder	2.075"	Green	C
Mustang	4 cylinder	2.075"	Blue	G
	6 cylinder	2.075"	Blue	G
Scorpio	4 cylinder	2.075"	Blue	G
	6 cylinder	2.075"	Blue	G
T-Bird/Cougar	4 cylinder	2.075	Blue	E
	6 cylinder	2.075"	Blue	E

A4LD-9

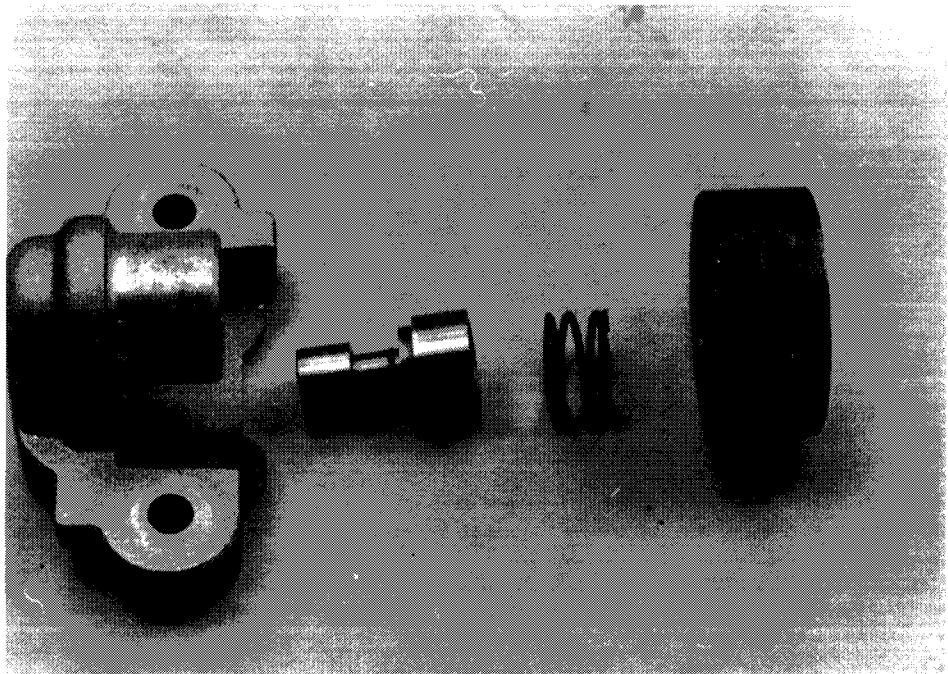
**SHIFT
TIMING**

Late shifts

A late 1-2 shift is often the result of a missing, or wrong governor spring. The correct spring for all vehicles except the Aerostar is #D8BZ-27A302 (color light brown). For the Aerostar use #E69Z-AA302-A (color light green).

If the wide open throttle 1-2 is very late, and the correct spring is installed, Ford has a new governor valve to correct this problem. Ford #E8RY-7C054-B

To correct slightly late shifts, you can install two GM pump bolt washers between the governor valve and the spring.

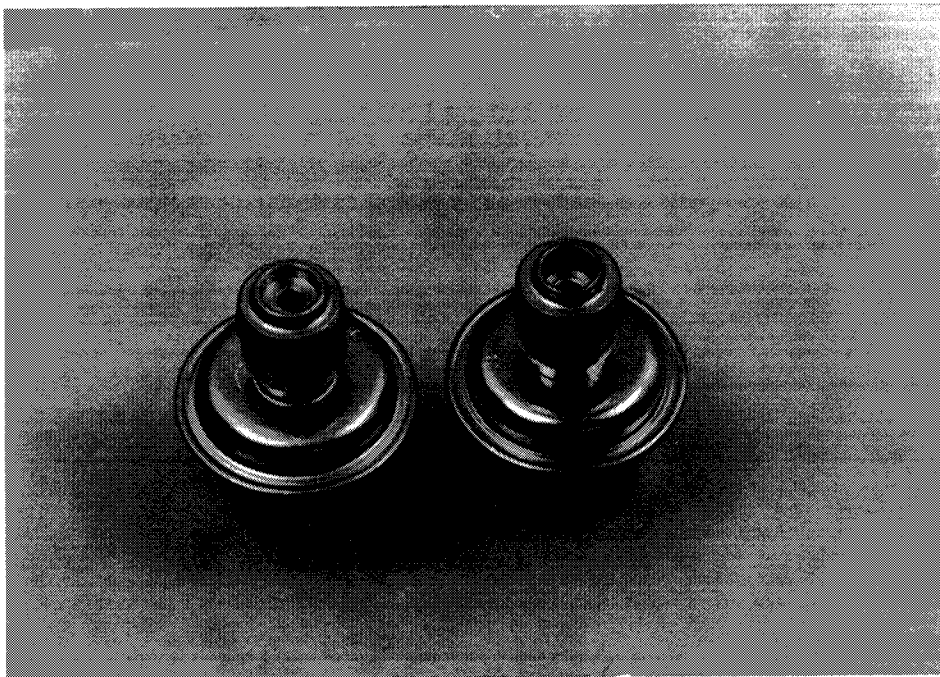


A4LD-10

**SHIFT TIMING
(CONTINUED)**

Very late harsh shifts.

You probably know by now, that a C-3 modulator won't work in a A4LD.



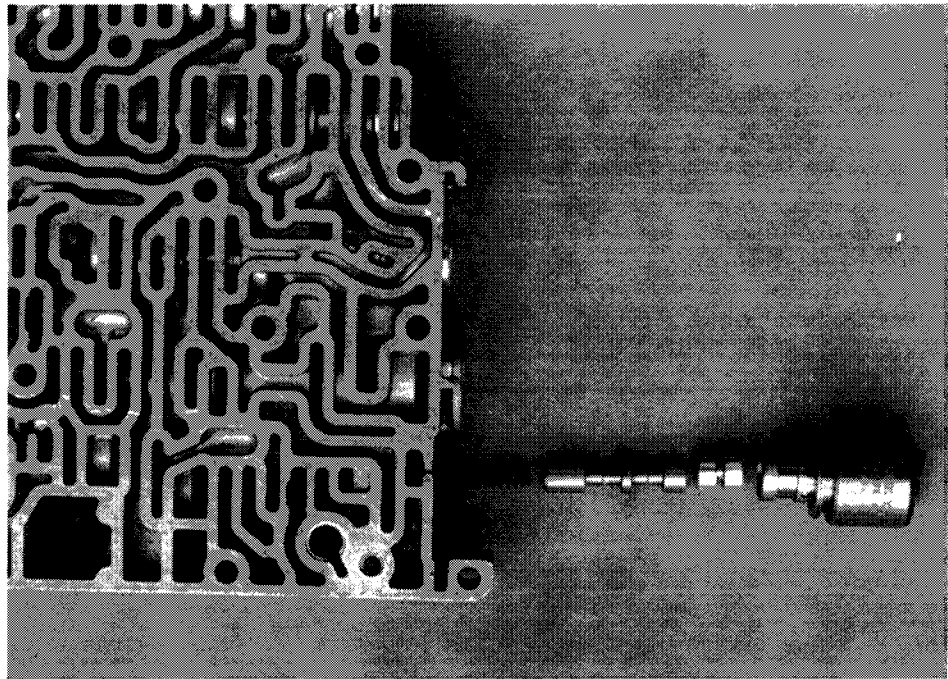
Fine tuning the shift timing

Use the shift timing formula given below to correct early or late shifts, when the governor and modulator are correct. Refer to the 700 section on shift timing for details on this method.

Original spring weight divided by original shift speed = factor.
Factor times desired shift speed = new spring weight.

A4LD-11

**A4LD
ENGINE STALL**



Engine stalls when shifting into forward or reverse.

If it has been determined that engine running condition is not at fault, the problem may be a broken converter clutch shuttle spring. A broken spring may allow the converter clutch shuttle valve to remain toward the bottom of its bore.

If spring is broken, replace it with OEM# E5TZ-7L 490-A Spring, or use the blue or white 1-2 capacity spring from SK® AOD.

A4LD-12

FRONT SEAL BLOWOUT

Problem: Front Seal Blowout

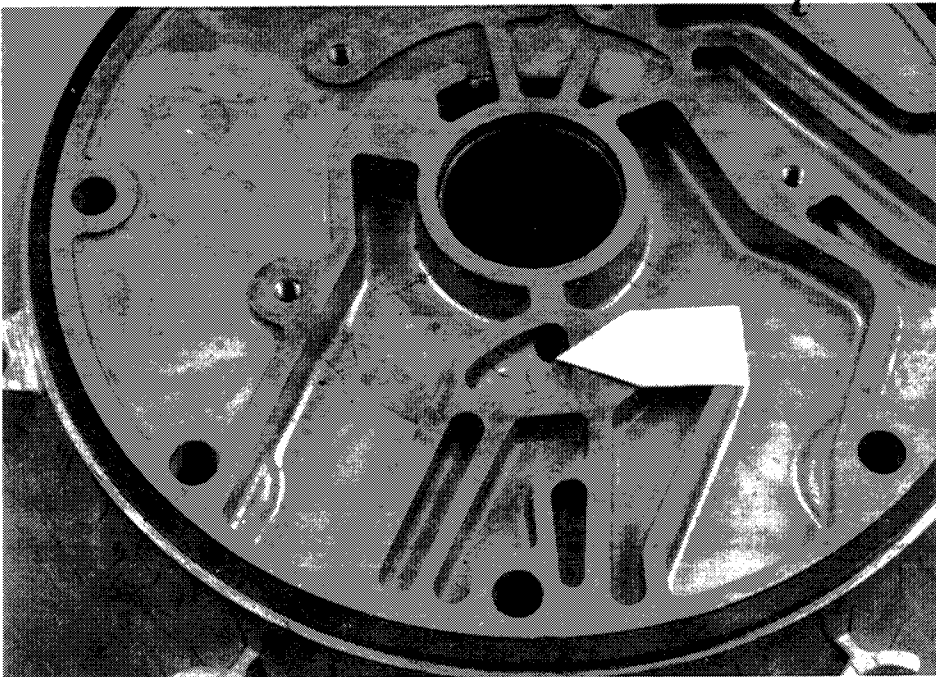
Solution: When servicing the A4LD transmission for front seal blowout, check the following:

1. Pump bushing to converter hub clearance should not exceed .003 inch.
2. Check for restriction in the drain back passage between the front seal and bushing.
3. Always use the proper front seal for the A4LD only - Part #E5TZ-7A248-A.

The front seals are now being staked in by the manufacturer. Do not remove a staked seal and replace it with a new seal, without staking the seal in place.

A special tool is available to stake the seal in place.

Check with your supplier for more information, and the availability of the seal staking tool.

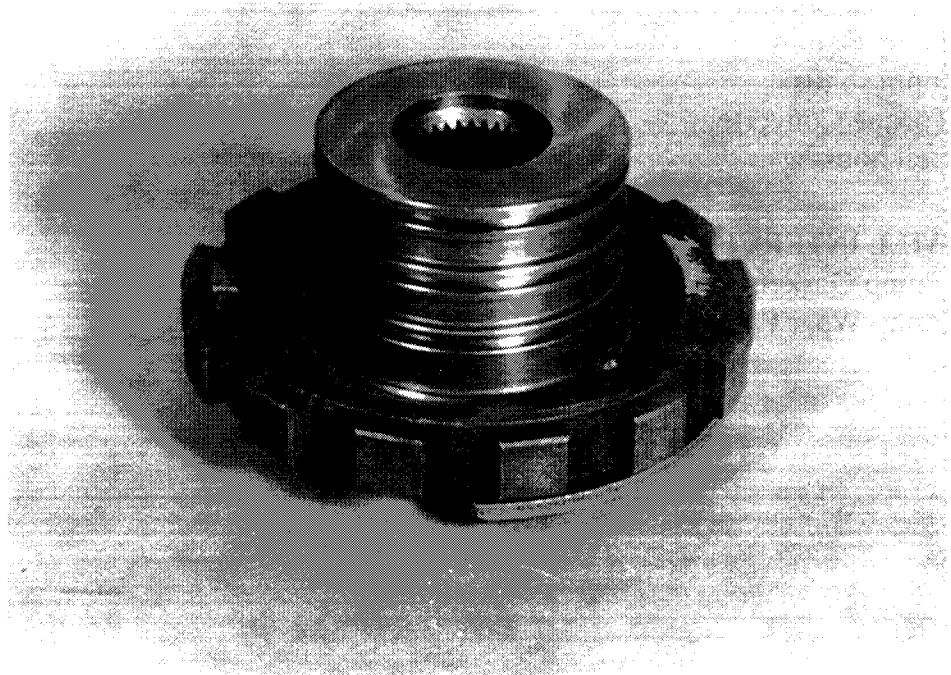


A4LD-13

**VENT
LEAKS**

Do not use Teflon rings on the governor support. If the transmission originally came with cast iron rings, then replace with cast iron rings. If the transmission came with Viton rubber rings OR if you are using a new case, then use rubber rings #E7TZ-70011-A.

If a vent leak still persists, then raise the vent using rubber hose. This will be similar to vents on transfer cases. You may also want to baffle the vent with a little foam or a piece of sponge.



A4LD-14

**C3/A4LD PARTS
INTERCHANGE**

WILL INTERCHANGE:

Gear train components. Be sure to observe early vs late on planet-to-ring-gear match up.

Pump Gears

Thrust washers

Direct Drum

Forward Drum. Must also install C-3 direct drum

Clutches and steels

Governor support and body

Servo's. Be sure to see application charts.

WILL NOT INTERCHANGE:

Modulators and pins

Pump Bodies

Input shafts

Torque Converters

Bell housing

WILL INTERCHANGE IF MODIFIED

Pump Gaskets

Pump Wear Plates



LOCK UP SECTION

**440 - T4
AXOD
A4LD**

Lock Up

No Lock Up	Chart 1
No TCC Release	Chart 2
Check For 12 Volts To Terminal A	Page 1
Check For 12 Volts To Terminal A At Transmission	Page 2
Check For 12 Volts At Both Sides Of The Fuse	Page 3
Check For 12 Volts At Both Sides Of The Brake Switch	Page 4
Adjusting Replacing The Brake Switch	Page 5
Checking Wires For Shorts And Opens	Page 6
Check For Ground At Terminal D At The Transmission (ALDL Quick Method)	Page 7
Check For Ground At Terminal D At The Transmission (Regular Method)	Page 8
Ground The D Wire At The Transmission (ALDL Quick Method)	Page 9
Ground The D Wire At The Transmission (Regular Method)	Page 10
Check Cooler Line Pressure Or Surge	Page 11
Check The Solenoid	Page 12
Check The Electrical Switches On The Valve Body	Page 13
Check The Lock-up Apply Valve	Page 14
Check Signal Oil Circuit	Page 15, 16 17, 18
Checking The Computer System	Page 19, 20
How To Read Trouble Codes	Page 21

**700 - R4
AOD
A140E
A604
E4OD**

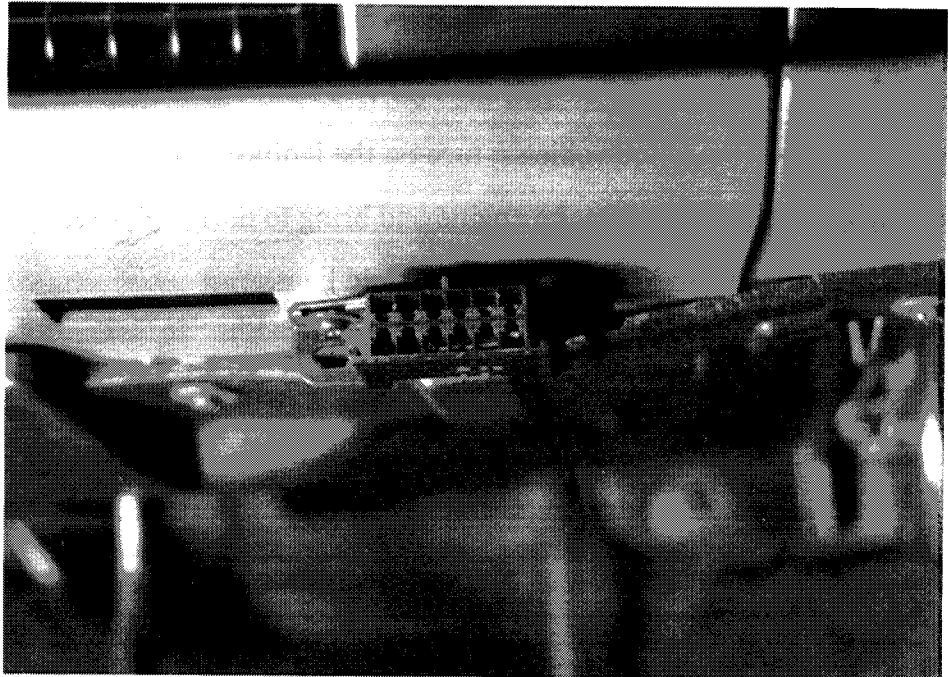
LOCK UP-1

**CHECK FOR 12
VOLTS TO
TERMINAL A**

ALDL QUICK METHOD

Note: ALDL quick methods, when given, are a way to perform many of the tests at the Assembly Line Diagnostic Link (ALDL).

This will allow you to do most of the electrical checks from the driver's seat and save much valuable diagnostic time.



- Connect one end of a test light to terminal A at the ALDL.
- Connect the other end to terminal F at the ALDL.
- Turn on the ignition and the tester should light. (Note: some transmissions, like the 125C must shift to 3rd before the tester will light)
- If the tester lights, you have 12 volts to terminal A at the transmission. Go to page 7.
- If the tester does not light, then check for 12 volts by the regular method.

LOCK UP-2

**CHECK FOR 12
VOLTS TO
TERMINAL A AT
TRANSMISSION**

REGULAR METHOD

- Check for 12 volts to terminal A at the transmission.
- Raise the vehicle on the lift so the driving wheels are off the ground.
- Connect the alligator clip of your test light to ground. Unplug the wires at the case and place the tip of your test light on the terminal marked A.
- Do not depress the brake pedal.
- Computer controlled vehicles: turn on the ignition and the tester should light.
- All other vehicles: start the engine and bring to normal operating temperature.
- Raise RPM to 1500 and the tester should light.



LOCK UP-3

CHECK FOR 12 VOLTS AT BOTH SIDES OF THE FUSE

- Check for 12 volts at both sides of the fuse.
- Locate the fuse box and the fuse marked "gauges" (most models).
- Connect the alligator clip of your test light to ground. Turn the ignition on.
- Place the tip of your test light on one side of the fuse and the tester should light.
- Place the tip of your test light on the other side of the fuse and the tester should again light.



LOCK UP-4

CHECK FOR 12 VOLTS AT BOTH SIDES OF THE BRAKE SWITCH

- Check for 12 volts at both sides of the brake switch. Some GM vehicles have two electric switches at the brake pedal. One switch will have four wires and the other switch will have two wires and a vacuum hose. **Important:** Either of these switches can be used for lock-up. To avoid mis- diagnosis, check them both. If the upper switch with the vacuum hose is used, check the two wires at that switch. On the four wire lower switch, check the two wires farthest from the plunger.
- Connect the alligator clip of your test light to ground.
- Do not depress the brake pedal.
- Turn the ignition "on".
- Push the tip of your tester into one wire and the tester should light.
- Now test the other wire and again the tester should light.
- Depress the brake pedal and re-test. Only one wire should now be hot.



LOCK UP-5

ADJUSTING REPLACING THE BRAKE SWITCH

- Remove the brake switch from its bracket.
- Reconnect the wires to the brake switch.
- Re-test as stated on page 4, but push and release the plunger with your finger or thumb.
- If it now passes the test, the brake switch is good, but needs adjusting.
- If it still doesn't pass, replace the brake switch.



LOCK UP-6

CHECKING WIRES FOR SHORTS AND OPENS

Checking wires for shorts and opens

Important: Make sure the ignition switch is "off" for the following tests.

Shorts:

- Set your ohmmeter to ohms times one (Rx1)
- Connect one lead of your ohmmeter to one end of the suspect wire.
- Connect the other lead of your ohmmeter to a good ground.
- If the meter reads ANYTHING other than infinity, you have a short to ground in that wire.

Opens:

- If a suspect wire has no voltage through it, and its connection at both ends is good, and it's not shorted to ground, the wire has an open in it.
- Replace the wire.



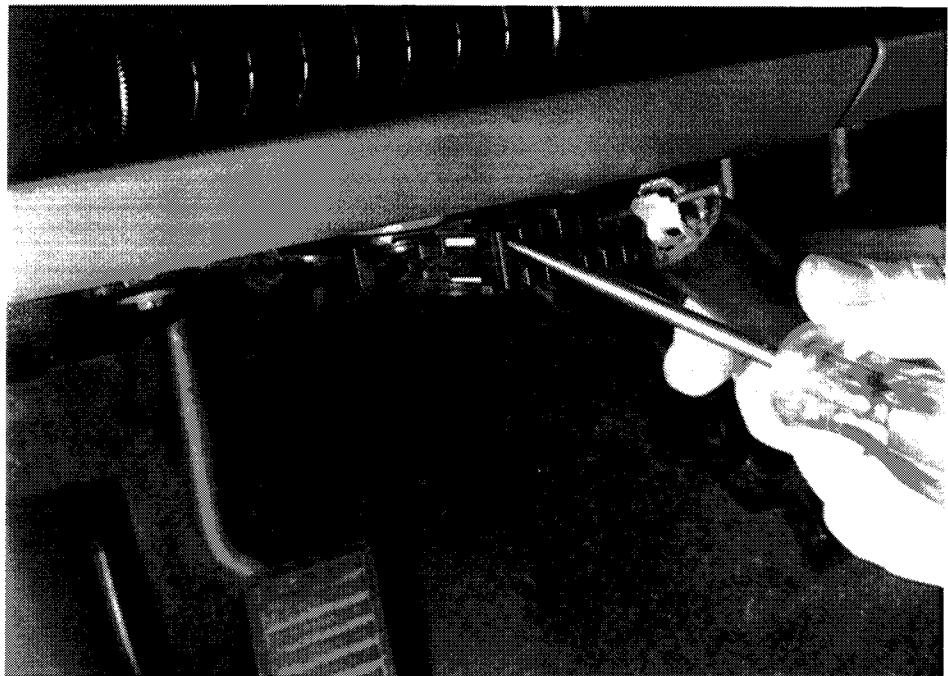
LOCK UP-7

**CHECK FOR
GROUND AT
TERMINAL D AT
THE
TRANSMISSION**

ALDL QUICK METHOD

Note: First you must have **passed** ALDL Quick method on page 1.

- The test light should still be connected between terminal A and F at the ALDL.
- With the engine at normal operating temperature, go for a road test.
- As you start your road test the tester should be lit. (Note: if your foot is on the brake the light will be out)
- Watch the test light to see if it goes out at some point during the road test.
- If the test light goes out, you have ground at terminal D at the transmission.
- If the test light stays on you have a computer system problem. (see page 19) Go to page 9.



LOCK UP-8

CHECK FOR GROUND AT TERMINAL D AT THE TRANSMISSION

REGULAR METHOD

- Check for ground at terminal D at the transmission.
- On Non-computer-controlled vehicles skip this test and go directly to cooler line pressure, or surge test.
- Raise the vehicle on the lift so the driving wheels are off the ground.
- Unplug the wires at the case and connect the alligator clip of your test light to terminal A.
- Place the tip of your test light on terminal D.
- Start the engine and bring to normal operating temperature.
- Place the selector in Drive. (O.D. on four speed units).
- Accelerate slowly to 60 mph and the tester should light.



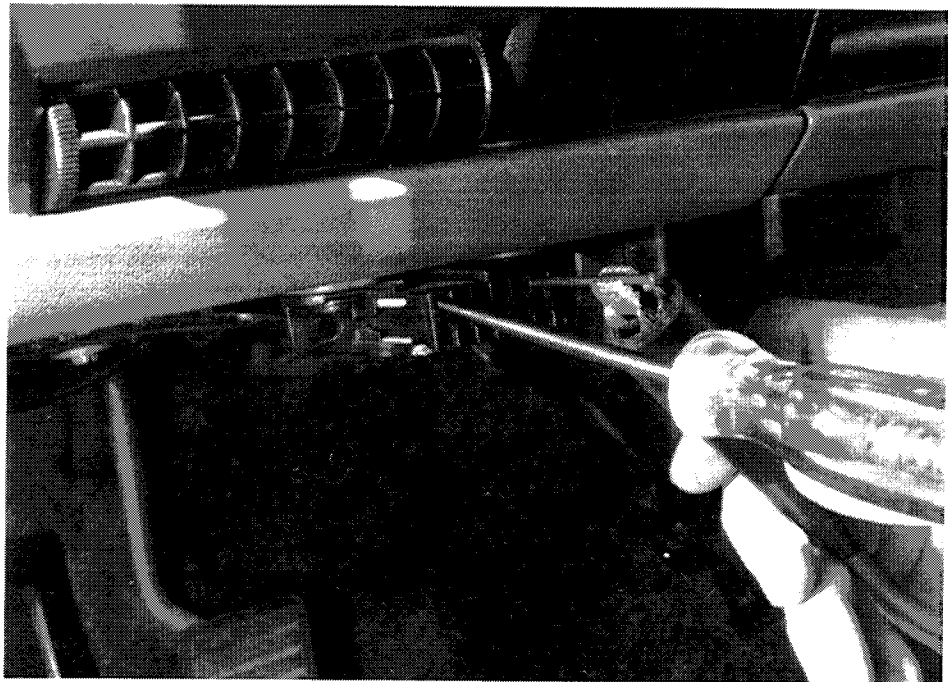
LOCK UP-9

**GROUND THE D
WIRE AT THE
TRANSMISSION**

ALDL QUICK METHOD

Note: You must first have passed ALDL Quick method on page 1.

- Connect one end of a test light or jumper wire to terminal A at the ALDL.
- Go for a road test. (This can also be done on the lift)
- At approximately 35 mph, connect the other end of the test light or jumper wire to terminal F at the ALDL. The torque converter should Lock-up.
- Whether the T/C locks up or not, follow the trouble shooting tree to the next step, usually cooler line surge test.

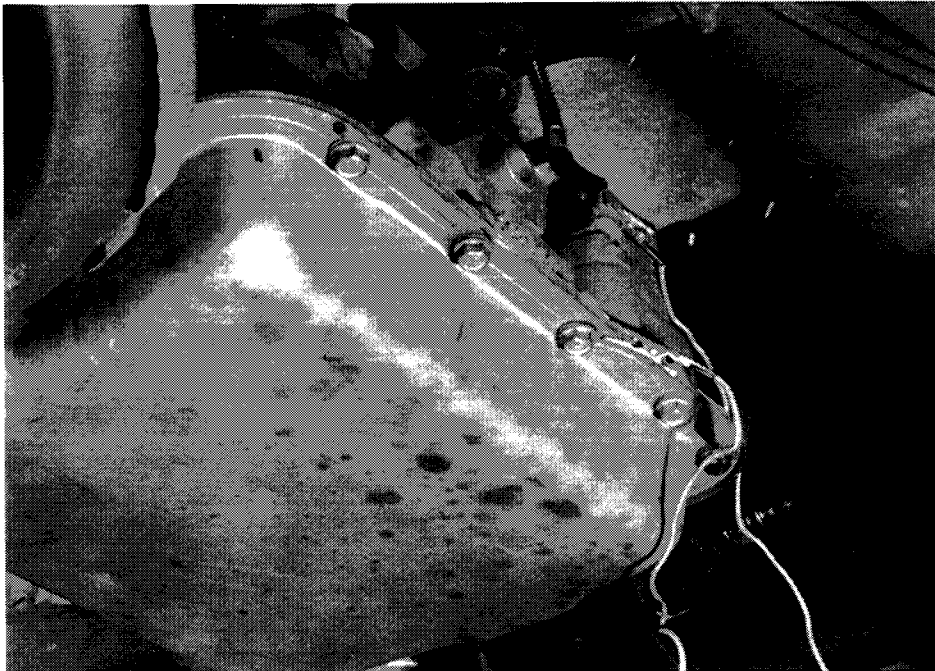


LOCK UP-10

GROUND THE D WIRE AT THE TRANSMISSION

REGULAR METHOD

- Shave a little insulation from the D wire near the transmission connector.
- Connect one end of a jumper wire to the bare wire you just shaved.
- Connect the other end of the jumper wire to ground.
- Road test for lock-up (can be done on lift).
- If you're not sure if lock-up occurred, then hold a steady speed of 60 mph (on the lift) and lightly touch and release the brake. You should feel lock-up disengaged and re-engage.



LOCK UP-11

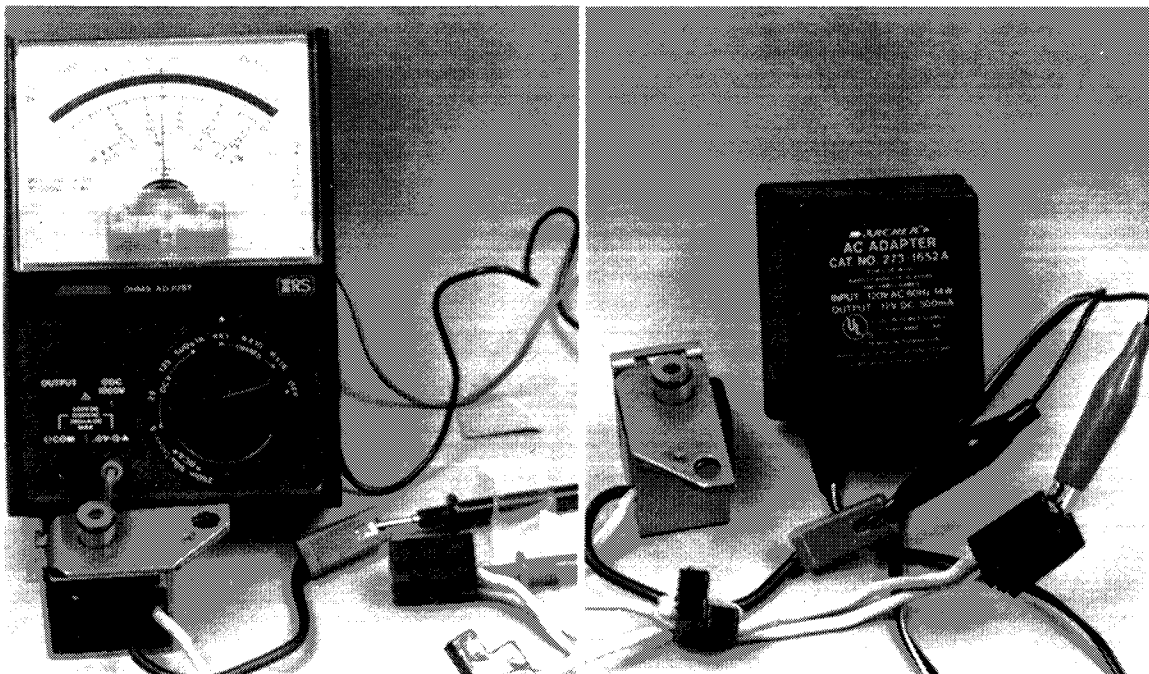
**CHECK COOLER
LINE PRESSURE
OR SURGE**

- Check cooler line pressure or surge.
- Disconnect a cooler line.
- Attach one end of a rubber hose to the disconnected line coming from the radiator.
- Insert the other end of the rubber hose into the fill tube of the transmission.
- With the driving wheels off the ground, start the engine. Hold the rubber hose in your hand. Have an assistant place the selector in Drive and (slowly) accelerate to 60 mph. When the lock-up valve moves, the rubber hose should jump slightly.

LOCK UP-12

CHECK THE SOLENOID

- You will need an ANALOG ohmmeter and a 12 volt source for this test.
- Connect the BLACK lead of your ohmmeter to the RED wire on the solenoid.
- Connect the RED lead of your ohmmeter to the BLACK wire on the solenoid. If you have a one-wire solenoid then connect the RED lead of your ohmmeter to the solenoid body.
- With the ohmmeter set at ohms times one (Rx1), the reading should be no less than 20 ohms, but not infinite.
- Connect the RED lead of your ohmmeter to the RED wire on the solenoid and the BLACK lead to the BLACK wire or body (You're just switching your connections).
- The ohmmeter should read less than the reading in the first test.
- Connect the solenoid to a 12 volt source. BE SURE TO OBSERVE PROPER POLARITY, if using a car battery.
- With lung pressure (or very low pressure) try to blow through the solenoid. It should be sealed.
- Disconnect the 12 volt source and you should now be able to blow through the solenoid.



LOCK UP-13**CHECK THE
ELECTRICAL
SWITCHES ON THE
VALVE BODY**

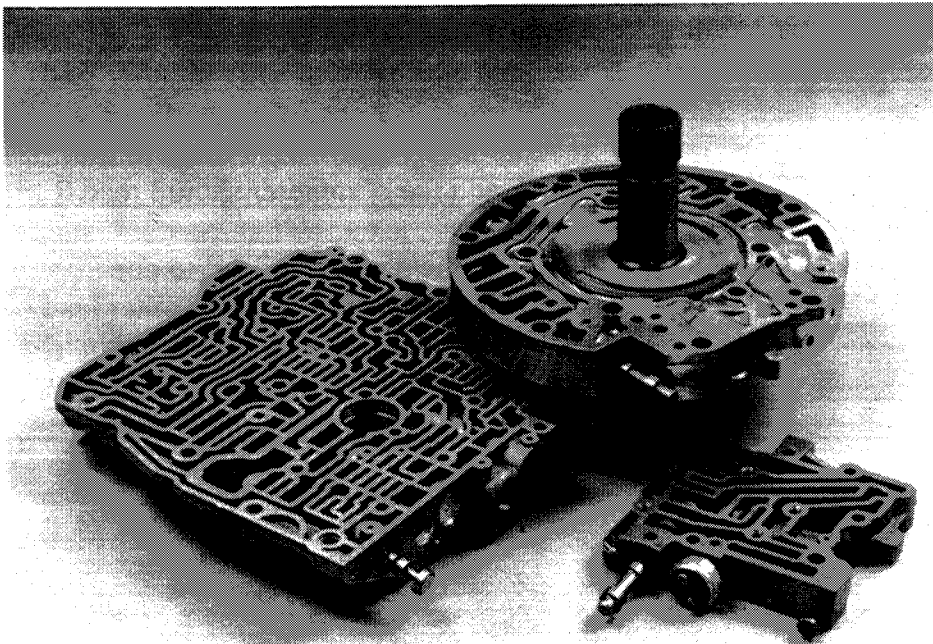
NOTE: If you have passed the ALDL Quick method on page 1, the electrical switches are NOT causing the no lock-up condition.

Switch Type	Part #	Test
Single terminal normally open	8642473	Connect one ohmmeter lead to the terminal of the switch and the other lead to the body of the switch. Ohmmeter should read infinite. Apply 60 psi of air to the switch and the ohmmeter should read 0.
Signal terminal normally closed	8642569 8634475	Connect one ohmmeter lead to the terminal of the switch and the other lead to the body of the switch. Ohmmeter should read 0. Apply 60 psi of air to the switch and the ohmmeter should read infinite.
Two terminal normally open	8643710	Connect one ohmmeter lead to one terminal of the switch and the other lead to the other terminal. Ohmmeter should read infinite. Apply 60 psi of air to the switch and the ohmmeter should read 0.
Two terminal normally closed	8642346	Connect one ohmmeter lead to one terminal of the switch and the other lead to the other terminal. Ohmmeter should read 0. Apply 60 psi of air to the switch and the ohmmeter should read infinite.

LOCK UP-14

CHECK THE LOCK-UP APPLY VALVE

- Check the lock-up apply valve.
- Check the lock-up apply valve to make sure it is not stuck or assembled backwards.
- **125C:** located in auxiliary valve body
- **180C:** located in pump
- **200C:** located in pump. Not accessible with transmission in car
- **250C:** located in auxiliary valve body
- **350C:** located in auxiliary valve body
- **200-4R:** located in pump, above the solenoid
- **700-R4:** located in pump, above the solenoid
- **440-T4:** located in valve body under solenoid



CONVERTER CLUTCH CONTROL VALVE

LINE

EX

CONV FEED

CONV TO COOLER

REG LINE

RELEASE

APPLY

CONVERTER TO COOLER

CONV FEED

CONVERTER CLUTCH REGULATOR VALVE

ORIFICE CUP PLUG

SHIFT TV

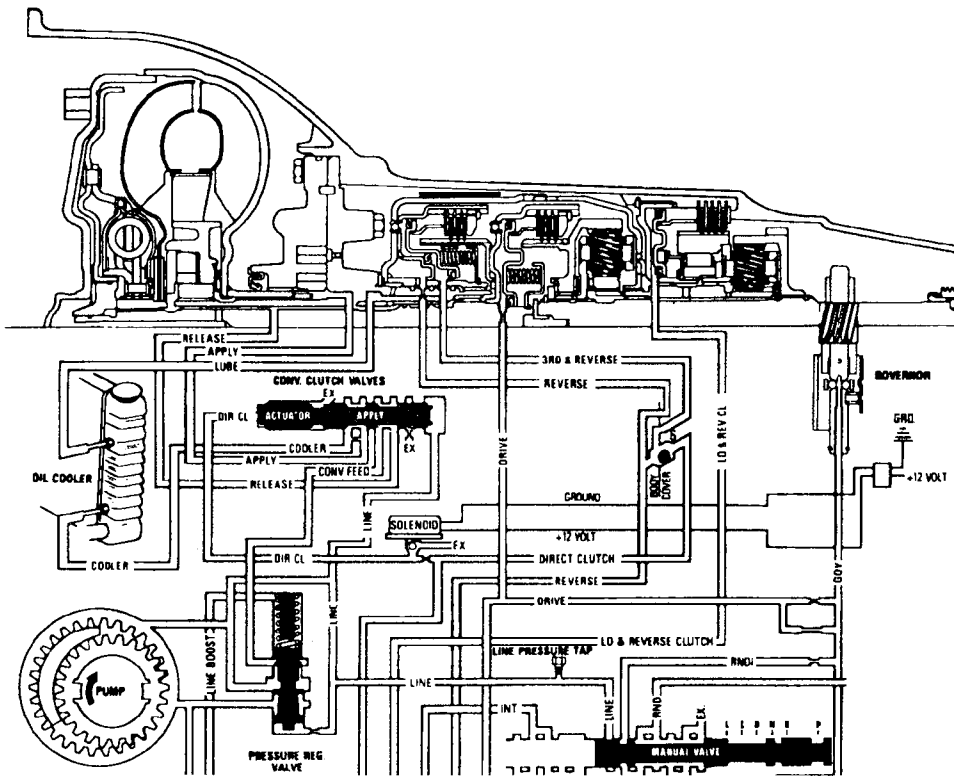
SOLENOID

The diagram is a detailed schematic of the hydraulic system for a 1965-1966 Ford Mustang. It shows the engine at the top, connected to an oil cooler on the left. The oil cooler has a 'CONV. TO COOLER' line and a 'CONV. RELEASE' line. The 'CONV. RELEASE' line goes to the transmission. The 'CONV. APPLY' line goes to the servo release. The servo release is connected to a solenoid valve, which is also connected to a GOV. SWITCH. The solenoid valve is connected to a TEMP. VACUUM SWITCH, which is connected to a BRAKE SWITCH. The BRAKE SWITCH is connected to an ELEC. CONV. line. The ELEC. CONV. line goes to the transmission. The transmission has three clutch lines: 1st CLUTCH, 2nd CLUTCH, and 3rd CLUTCH. The diagram also shows a SOLENOID VALVE and a GOV. SWITCH. The entire system is controlled by a -12V battery and a BRAKE SWITCH.

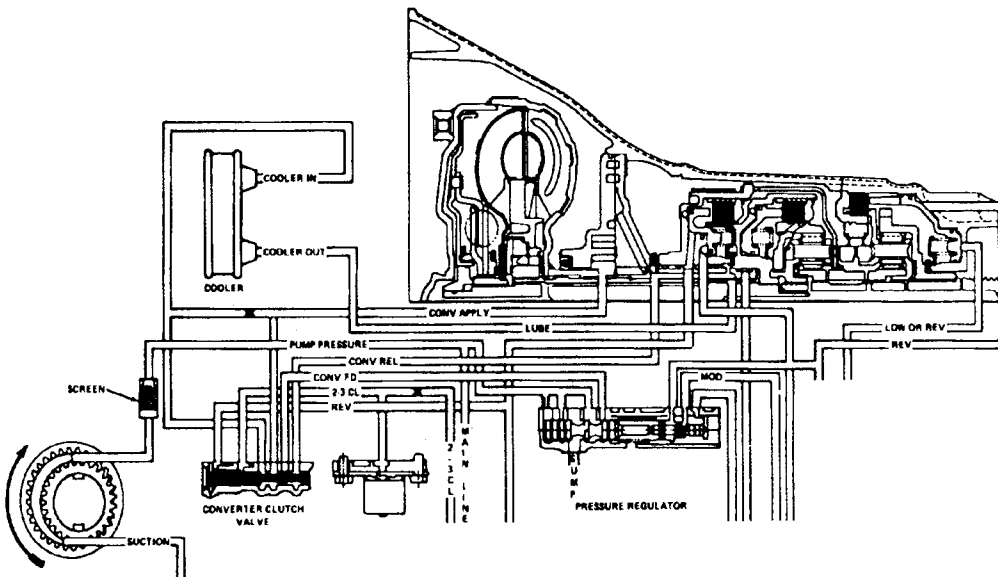
LOCK UP-16

CHECK SIGNAL OIL CIRCUIT (CONTINUED)

200C: Uses third gear oil for signal

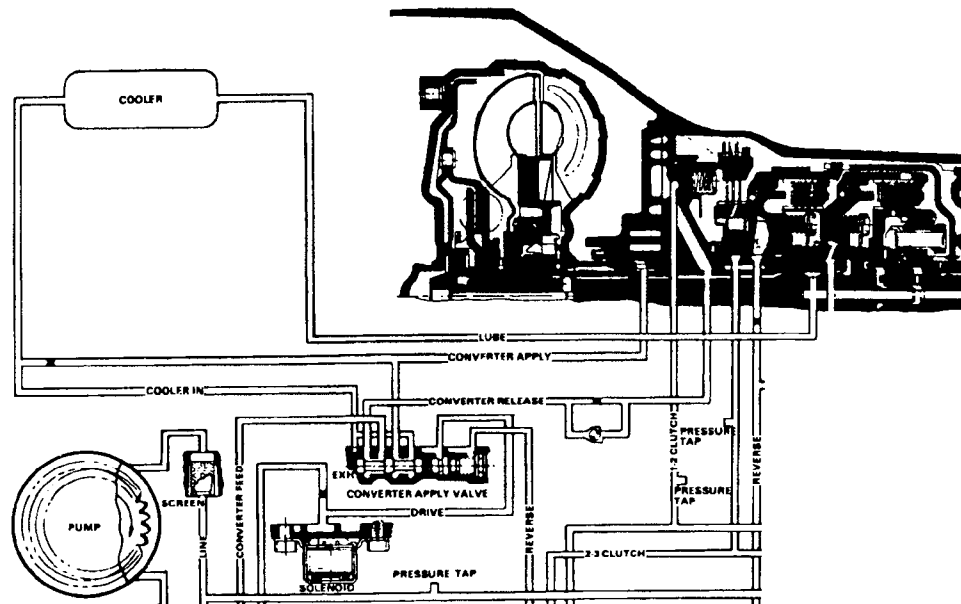


250C/350C Chevrolets: Uses third gear oil for signal

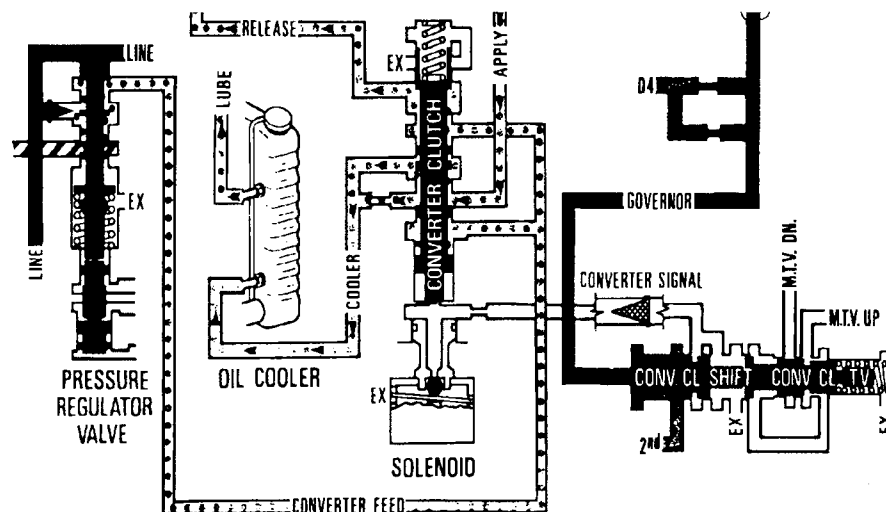


CHECK SIGNAL OIL CIRCUIT (CONTINUED)

250C/350C Buick, Olds, Pontiac, Multi-cases: Uses forward clutch oil as signal



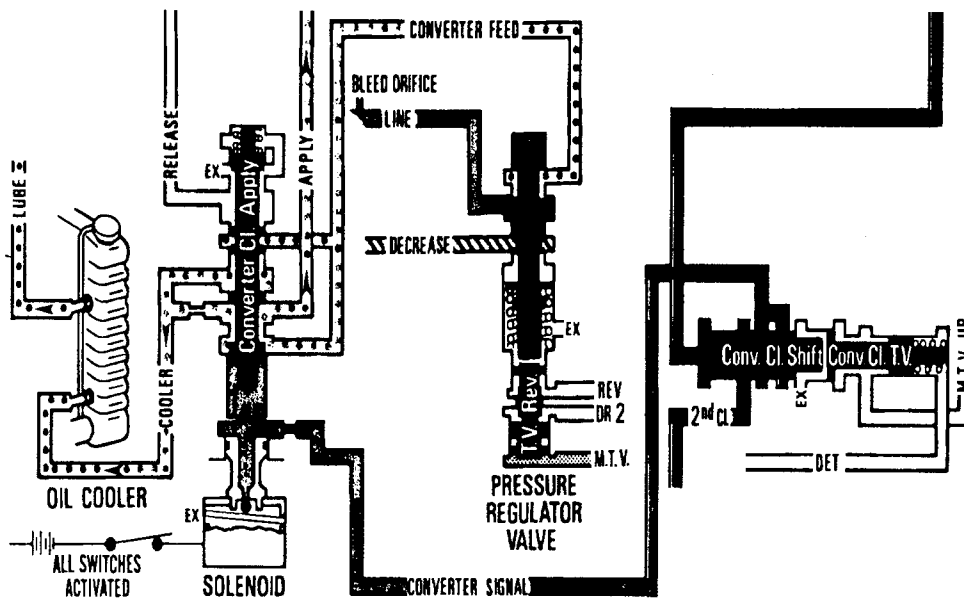
200-4R: Uses second gear oil for signal



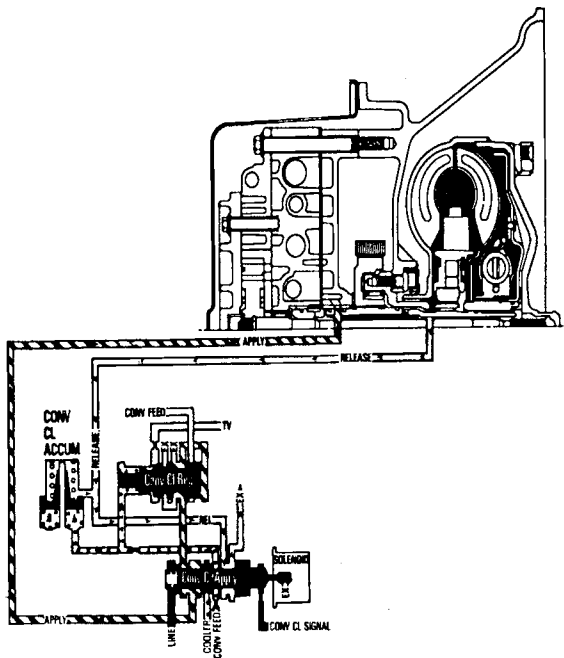
LOCK UP-18

CHECK SIGNAL OIL CIRCUIT (CONTINUED)

700-R4: Uses second gear oil for signal



440-T4: Uses second gear oil for signal



**CHECKING THE
COMPUTER SYSTEM****Checking the Computer System**

The purpose of the following tests is to allow the Professional Transmission Technician to locate the general area of a computer system malfunction. For a more complete test procedure, refer to the appropriate shop manual. The computer system has a self-diagnostic capability. Always begin computer system checks by accessing the computer's diagnostic circuit. All of the sensors which send information to the computer are assigned a two-digit trouble code. If one of these sensors malfunctions, the computer will store the sensor's trouble code in its memory and usually activate the "Check Engine" or "Service Soon" light. When the computer is in the diagnostic state, it will read out the trouble codes stored in its memory. You then have a place to start looking for the malfunction.

Diagnostic Circuit Check

- Turn the ignition "ON" and have the engine "OFF".
- The check engine light should be "ON" steady. (If the check engine light is "OFF", check the bulb.
- If the bulb is good, or the light flashes intermittently, refer to the car's service manual for further checks.)
- Connect a jumper between pins A and B of the 12 pin ALDL. **figure 1**

LOCK UP-20

CHECKING THE COMPUTER SYSTEM (CONTINUED)

- The check engine light should flash a code 12. (If it does not flash a code 12, refer to the car's service manual for further tests)
- If you get a code 12, note and record any additional codes. (See: How to Read Trouble Codes) page 21.
- If a 50 series code is stored, refer to the car's service manual for further tests.
- Clear the computer's long term memory, and go for another road test. (See: Clear Computer)page 21.
- Retest and record codes.
- If no codes were present in EITHER test, the computer doesn't see any malfunctions. (This does not mean that there is no malfunction)
- If codes were only present in the first test, they are intermittent. Make a visual check of the circuit involved.
- If codes were present in BOTH tests, the computer is seeing a current malfunction. The following codes are most likely to affect transmission performance.
- **Code 14** = Shorted Coolant Temperature Circuit
- **Code 15** = Open Coolant Temperature Circuit
- **Code 21** = Throttle Position Sensor Circuit
- **Code 24** = Vehicle Speed Sensor Circuit
- **Code 32** = Barometric Pressure Sensor Circuit
- **Code 34** = MAP or Vacuum Sensor Circuit

LOCK UP-21

HOW TO READ TROUBLE CODES

How To Read Trouble Codes

Trouble code 12 will show as one flash of the check engine light followed by a pause and then two more quick flashes. This will repeat two more times. Code 34 will show as three flashes followed by a pause and then 4 quick flashes. All codes in the computer will flash three times, starting with the lowest code, until all codes have been displayed. The computer will then start the entire sequence again beginning with code 12. If more than one trouble code is present, always start your checks with the lowest number code. **Exception:** A50 series code is always checked first. An example: if a code 21 and a code 32 were present, you would diagnose code 21 first.

Clear Computer.

- Turn the key "off".
- Remove the jumper between A and B at the ALDL.
- Disconnect the pigtail lead on the positive battery cable for 10 seconds.
- Reconnect the pigtail and the codes are erased.
- Drive the car at operating temperature for at least 5 minutes before re-checking for trouble codes.



700 - R4 SECTION

440 - T4
AXOD
A4LD
LOCK UP

700-R4

4th Gear Complaint	Page 1, 2
Setting The T.V. Cable	Page 3
Line Pressure At 1200 RPM	Page 4
Check The Governor	Page 5
Reverse Problems	Page 6
Shift Quality	Page 7, 8, 9
Shift Timing	Page 10, 11, 12
Pump Information	Page 13, 14, 15

AOD
A140E
A604
E4OD

700-R4 4TH GEAR COMPLAINTS

No 4th, Late 4th, Falls Out of 4th

- Reset TV cable: see page 3
- Check manual linkage adjustment.
- Check line pressure @ 1200 RPM: should be 70-80 psi: see page 4
- Check pressure at 4th gear tap
 - If 4th gear pressure is zero go to 1
 - If 4th gear pressure is low go to 2
 - If 4th gear pressure is normal go to 3

1. Is this a truck with oversize tires? (*This will create low governor pressure*)

Check the governor: see page 5

Re-check VB bolts for proper torque, especially the stiffner plate.

Check the Pressure Regulator snap ring to be sure it's in its groove.

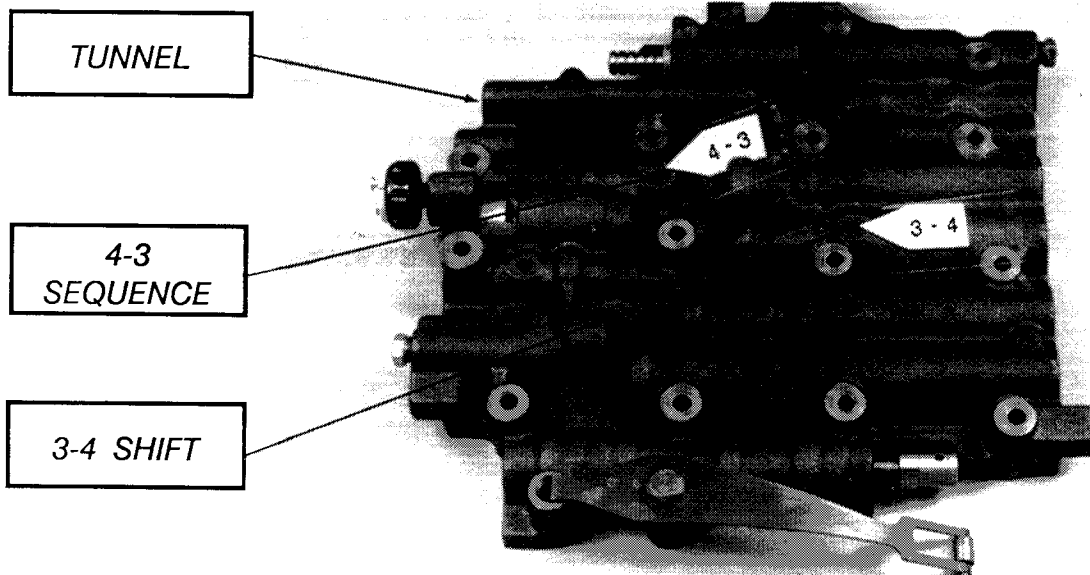
Air check into the exhaust hole at the 4-3 sequence valve (*This will air check the 4th apply circuit of the servo*).

Air check into the exhaust hole at the 3-4 shift valve (*This will check the 4th gear switch, the 4-3 relay and sequence valves for stickiness, and check for a missing plug at the relay valve*).

Air check the governor circuit: (*This will check the governor circuit for leaks and checks for a stuck 3-4 shift valve*).

Check for cup plug in tunnel being missing.

Remove valve body and check for the following: stuck valves, relay valve in backwards, 3-4 valve sleeve rotated, plugs missing from MTV up and down valves, gaskets covering separator plate holes, check ball placement in case and 3-4 spring tension. (*should be 4 1/2 to 5 1/2 @ .675"*)



**700-R4 4TH GEAR
COMPLAINTS
(CONTINUED)**

No 4th, Late 4th, Falls Out Of 4th

2. Remove pan and air check into the exhaust hole at the 4-3 sequence valve. (*This will air check the 4th apply circuit at the servo including VB leaks*)

Remove servo and check seals, clearance, assembly errors, piston (*for cracks*), and pin bore for wear.

Check 3-4 accumulator piston for cracks or damaged seal and missing air bleed cup plug.

3. Remove pan and check servo exhaust hole for blockage by pan gasket or sealant (*RTV*).

Air check into 4th gear pressure tap. Air should come out 4-3 sequence exhaust hole showing a clear circuit.

Block 4-3 sequence exhaust hole and air check again. The servo should apply.

Reinstall the 4th gear pressure tap plug, because it could be the problem, and air check into the 4-3 sequence exhaust hole. The servo should apply.

Remove the servo and check to see if the servo pin is stuck in the second gear piston.

Check for stripped sun gear shell. (*Will also cause no 2nd and no reverse*)

4th Gear Bind-up: The cause is mis-assembly of overrun clutch pack or a cracked forward clutch piston.

**SETTING THE T.V.
CABLE**

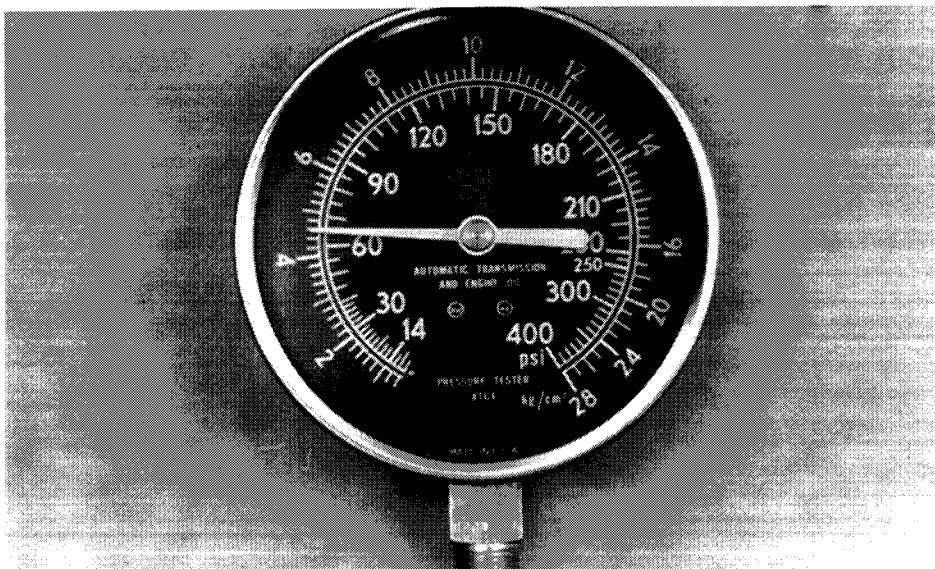
- Release the cable lock and push the cable housing toward the fuel injector at least one inch.
- Have an assistant push the accelerator to the floor while you make sure the fuel injector or carburetor is at wide open throttle. Correct as necessary to get wide open throttle.
- With the accelerator still to the floor, release the cable lock again and pull the cable housing **AWAY** from the fuel injector (or carb) **AS HARD AS YOU CAN**.
- This setting is **MAXIMUM T.V. NEVER** adjust the cable housing any farther away from the fuel injector. You may want to mark the cable at this point for reference.
- Push cable toward fuel injector 1/8 of an inch and road test for proper operation.
- During the road test, two checks **MUST** be performed
 1. Make a light throttle 1-2 upshift then floorboard the accelerator. You must get a 2-1 kickdown.
 2. At 45 mph in 3rd, floorboard the accelerator. You must get a 3-2 kickdown.
- If you fail **EITHER** test, adjust the cable, one click at a time, away from the fuel injector until you get kickdown. This setting is **MINIMUM T.V. NEVER** adjust the cable housing any closer to the fuel injector. You may want to mark the cable at this point for reference.

700-R4-4

**LINE PRESSURE AT
1200 RPM**

The following information is a very important, and a very good check of the overall condition of the hydraulic system.

- With the transmission at normal operating temperature and the TV set correctly, the line pressure at 1200 RPM should be between 70 and 80 psi in Park, Neutral, Overdrive and Drive.
- If pressure is OK in Park and Neutral but low in Over-Drive and / or Drive, you have internal leaks.
- If pressure is low in Park and Neutral, then check pressure again at slow idle. Pressure must be at least 50 psi. If pressure is below 50 psi you have a pump or filter problem. If pressure is above 50 psi, then get a stronger pressure regulator spring.
- If pressure is above 80 psi then remove the pan and remove the T.V. plunger (This can be done without removing valve body). Reinstall pan with just 4-5 bolts and recheck the pressure. If pressure is now normal, you have a valve body problem. If pressure is still high, you have a pump problem.



CHECK THE GOVERNOR

- Hold the governor vertically by the gear. The top land must be open at least .025".
- Push in one weight, the top land must stay open.
- Let the first weight fall back out and press in the other weight, the top land must still be open.
- Press in both weights, the bottom land must open at least .020".
- The governor lands must measure .799" - .800" in diameter with no scoring or scratches. (.798" is not good enough)
- The gear must be tight.
- Governor end clearance .060" maximum. Tap the center of the governor cover with a hammer to reduce clearance.

The 700R4 currently uses, five basic governor designs. You can tell the difference by the inner weights. GM does have more than five governor part numbers, but most of the differences are the spring tensions. Measure the thickness of the inner weight and use the chart below.

Engine

Diesels
V8
Gas Inline 6 cyl and 4.3 V6
Other V6's
4 cyl
Corvette, Trans Am, Z28 w/H.O.

Inner Weight Thickness

.185" (3/16)
.155" (5/32)
.155" (5/32)
.115 (less than 1/8)
.060" (1/16)
Governor weight has tab on top



700-R4-6

REVERSE PROBLEMS

Bind-up in Reverse

- 4-3 Sequence valve stuck inward
- 2-3 Shift valve stuck inward. (Will also cause 3rd gear starts)

Reverse delays, slips, harsh, chatters

82-86 Stack up Pressure plate **Top**

Friction

Flat steel

Friction

Waved steel

Friction

Flat steel

Friction

Waved steel **Bottom**

Set clearance to .060" - .085" by one of the following methods

- Selective pressure plates from 87 and later units
- Thicker snap ring: THM 200 center support or THM 400 intermediate clutch
- Extra steel: Only if clearance is VERY excessive (over .140")
- Two frictions together with the lining taken of one side of both.

87 - on

Clearances and stack up is good as is, but you may want to replace one flat steel with a waved steel to soften the engagement.

IMPORTANT: Plug bleed hole in the aluminum piston and re- drill new hole .062 (1/16) or smaller.

**SHIFT
QUALITY**

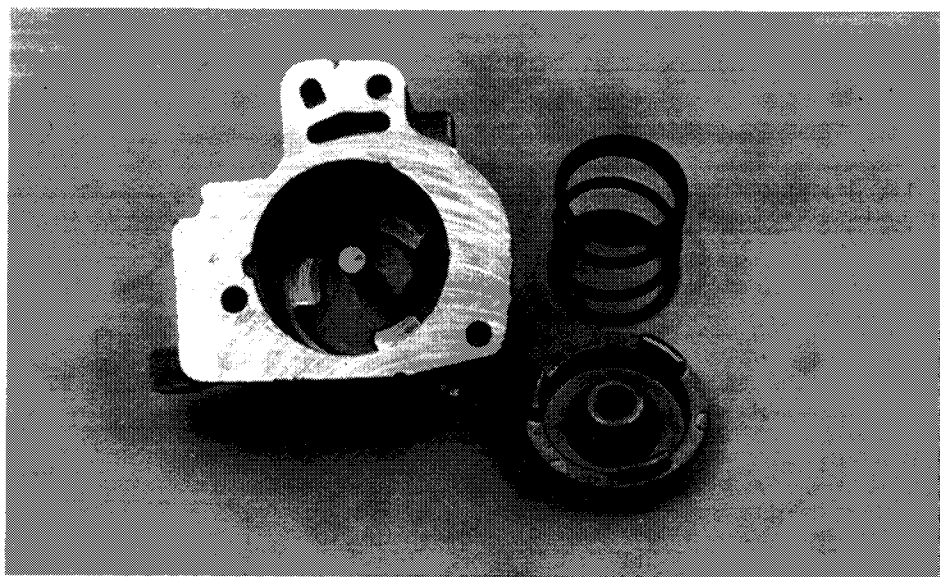
Drilling feed holes in separator plates is **NOT** the way to improve shift quality. It will make medium and heavy throttle shifts firmer, but will also make light throttle shifts bangy and uncomfortable. It can also cause slips or flares on the 2-3 upshift.

Leave the separator plate alone and work with the accumulators and the servo to get high quality shifts. Also remember; clutch clearances, clutch quality, steel plate finish and type of fluid all have a dramatic affect on shift quality.

1-2 slide and slide-bump, or just bump, is the number 1 shift quality complaint. It is caused by an accumulator spring that is way too weak. Remember, the factory calibration works OK when the vehicle is brand new. It doesn't work very well by the time you get the vehicle with a lot of miles on it. The best thing you can do for the 1-2 shift is to go a lot heavier on the accumulator spring. Twice as heavy is a good place to start.

3-4 accumulator: Install spring first, then piston.

BOTH accumulators: Rubber seals work better than Teflon sealing rings.



SHIFT QUALITY (CONTINUED)

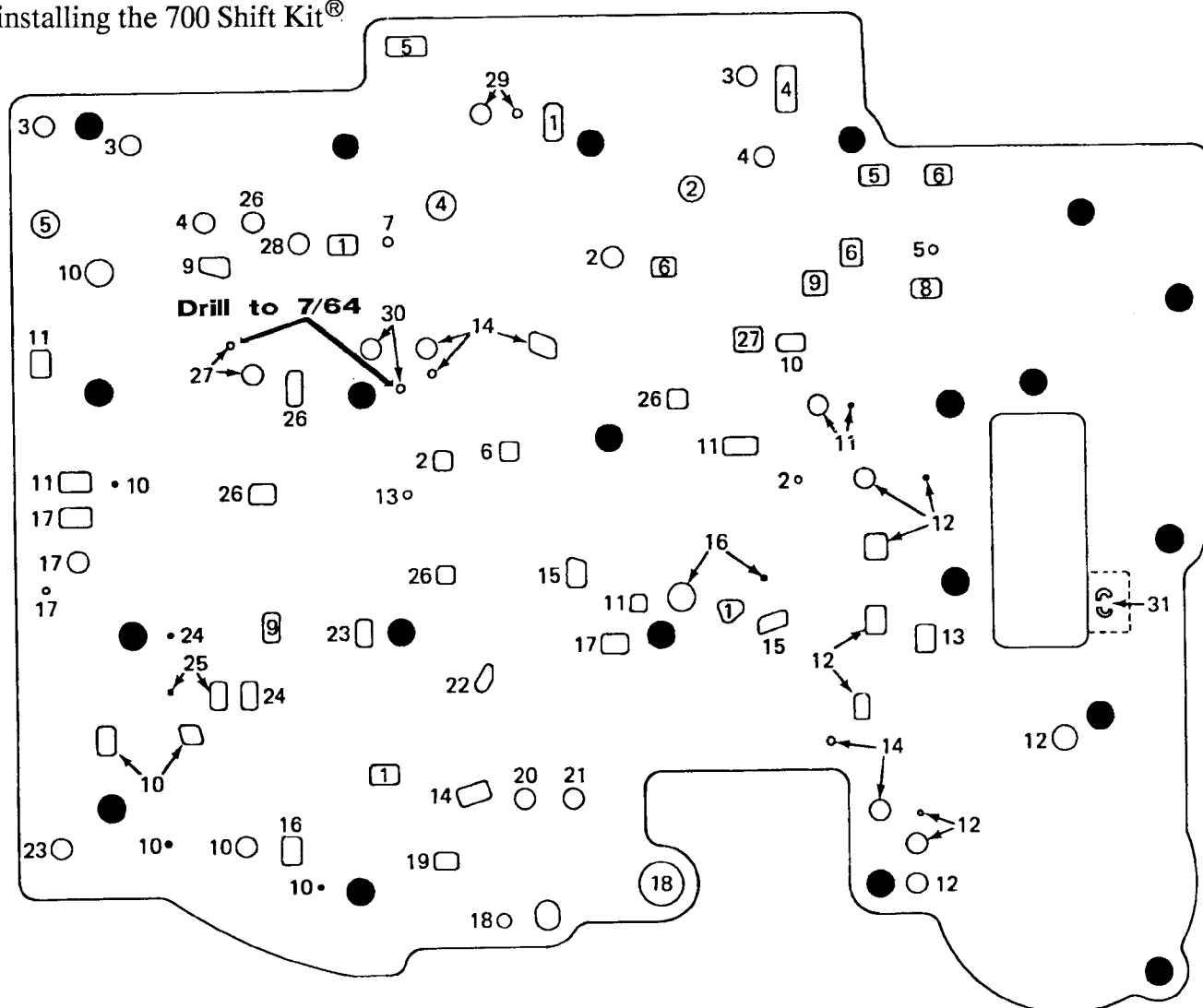
Servo clearance should be between 1/16 and 1/8 to get the best shift quality and avoid 2-3 flares. If you have a short 2-3 flare, try removing the servo return spring to correct the problem. If the flare persists then drill the hole in the separator plate as shown in figure 1. Next try switching to the 093 servo. If these things don't correct the flare, then check the 3-4 clutches for leaks and proper clearance. (.030" - .080")

Clunks on Coastdown

Clunks during the coastdown shift in the "3" position can be reduced by three modifications in the servo.

- Install a heavier servo cushion spring.
- Grind the cushion stop 1/8" shorter.
- Leave out the big snap ring on the retainer plate.

Note: ALL the shift quality information you just read will be taken care of by installing the 700 Shift Kit®



**SHIFT QUALITY
(CONTINUED)****Servo**

There are currently three servo's available for the 700R4. The most common servo has the casting number 8642553. It is the middle size of the three servo's and is used in V6 turbo's, V8's and diesels. The part number for the 553 servo is 8642613. The servo guide is 8642924 or 8642463.

The 8642554

servo has the smallest apply area, which will give the softest 1-2 and 2-3 shifts. It is used in 4 and 6 cylinder vehicles. This servo is not recommended for most applications. Its part number is 8642614 and the guide is 8642957 or 8642462.

The 8642093

servo has the largest apply area. It was only used by GM in the high output applications. Its purpose was to allow a larger 2-3 feed hole in the separator plate without getting a 2-3 cut lose or flare. (Remember: Drilling holes in separator plates can cause a 2-3 flare.) Its part number is 8642079 and the guide is 8642925 or 8642110. It will give the firmest 1-2 and 2-3 shifts and can be used to correct 2-3 flares.



700-R4-10

SHIFT TIMING

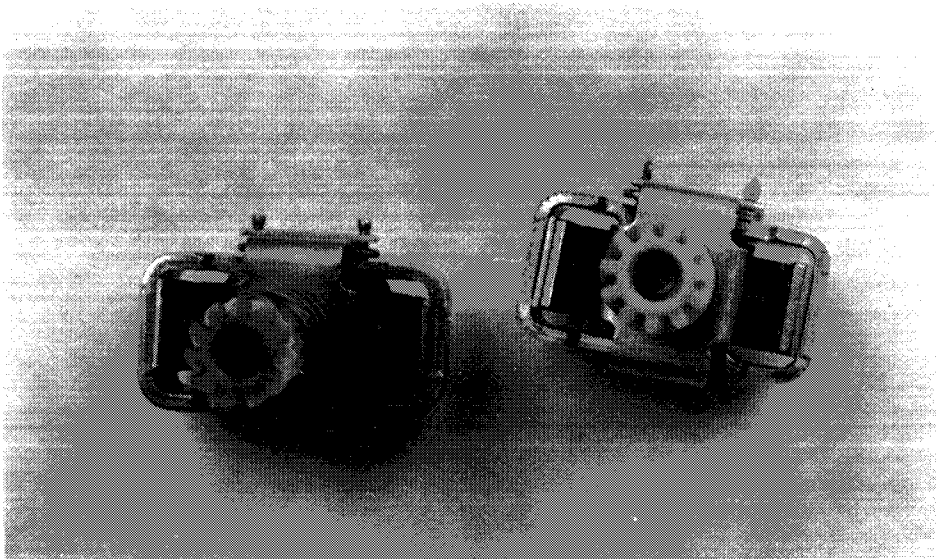
Set the T.V. cable as shown on page 3. If the shift timing is not correct with the T.V. set between minimum and maximum, then its time to look elsewhere. The T.V. cable is **ONLY** for fine tuning the shift timing.

If all the shifts are late or early, then start with the governor. If only one shift is late or early, usually go to the valve body.

Governor weights affect shift timing at higher road speeds. (Above 35-40) Governor springs affect shift timing at lower road speeds. (below 35-40)

Heavier weights and springs make shifts happen earlier. Lighter weight and springs make shifts happen later.

Example: Heavier governor weights will have very little effect on the 1-2 shift, because it happens below 35 mph. They will have more effect on the 2-3 shift and have the most effect on the 3-4 shift. Heavier springs will have the most effect on the 1-2 shift. They will have some effect on the 2-3 and the least effect on the 3-4 shift.



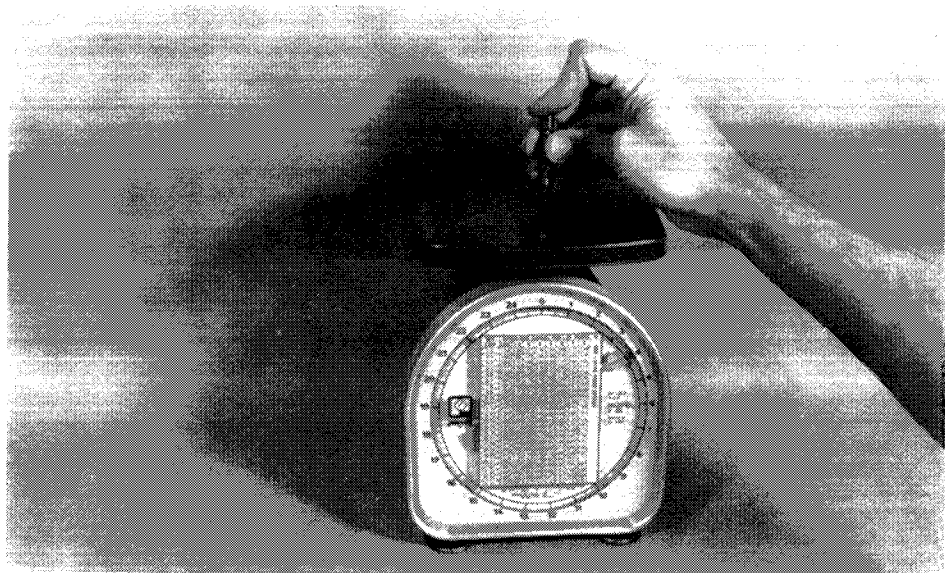
**SHIFT TIMING
(CONTINUED)**

The governor has two springs. When the springs are close to the same tension, they will affect the 1-2 more. When the tensions are quite different they will affect the 2-3 more.

Summing up governor changes

- 1-2 too late: Put in heavier springs. Start by replacing the lighter of the two springs with a heavier one so the tensions are closer to equal.
- 1-2 too early: Put in lighter springs. Start by replacing the heavier spring with a lighter one.
- 2-3 too early or too late: If the 1-2 and the 3-4 are on time, go right to the valve body; governor changes will affect the 1-2 and 3-4.
- 3-4 too late: Put in a governor with heavier weights. see page 5
- 3-4 too early: Put in a governor with lighter weights. see page 5

Once the shift timing is close with governor changes, it's time to go to the valve body. Each shift valve has a stem that the spring slides over. The length of the stem is the working height of the spring. Compress the spring to its working height on a scale and read its tension. Once you know the spring tension, you can dial in shift timing quite easily. Determine where it shifts at **MINIMUM** throttle. Divide the spring weight by the mph it is currently shifting at. Example: 6 pound spring divided by 53 mph 3-4 upshift = .133 factor



SHIFT TIMING (CONTINUED)

Now multiply the factor by the mph you want it to shift at.

Example: .113 factor x 40 mph desired shift = 4.52 spring

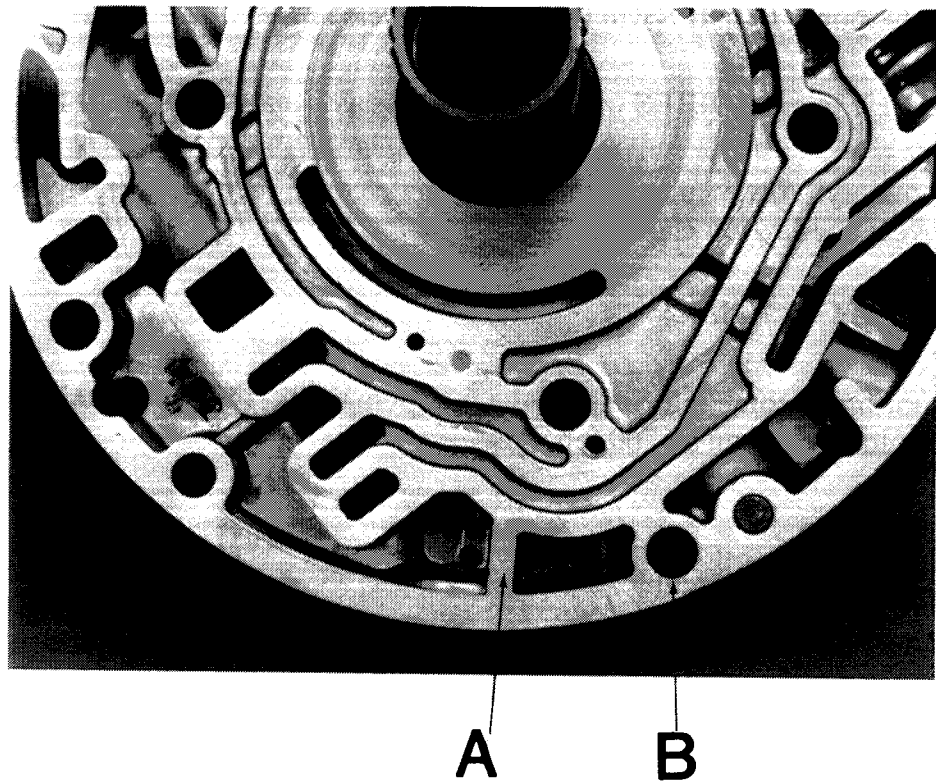
Answer; If a 6 pound spring is creating a 53 mph shift, a 4.5 pound spring will bring it to 40 mph.

Summing up shift timing

- Set the T.V. to the middle of maximum and minimum.
- Make the major changes in shift timing at the governor.
- Finish the shift timing at the valve body.
- Use the T.V. cable for fine tuning.

**700-R4 PUMP
INFORMATION****Pump Interchange**

In 1985 GM added the dam at arrow "A", to prevent oil leakage out of the pump bolt hole, arrow "B". The area between the dam and the bolt hole is now a void. Cross leaks may fill this void with oil so an orificed cup plug was removed to give the void full exhaust.



When an early pump body, no dam, is matched with a late pump cover then line pressure goes past the dam and out the exhaust hole. This causes low line pressure, delayed engagements, and slipping on shifts.

700-R4-14

**700-R4 PUMP
INFORMATION
(CONTINUED)**

Forget the Casting Numbers

LATE pump **COVERS** will fit all pump bodies if you modify them by plugging the exhaust hole. Use the small orificed cup plug available in SK 700 and SK 200-79 Shift Kits.

EARLY pump **COVERS** will fit all pump bodies as is.

LATE pump **BODIES** will fit all pump covers as is.

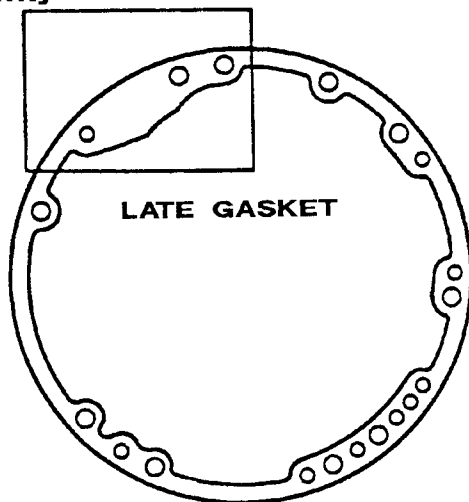
EARLY pump **BODIES** will fit early covers as is and **MODIFIED** late covers.

Summary: Always plug the hole in the late cover, then mix & match bodies and covers anyway you choose.

Pump Gaskets

Contrary to some information, the new pump gasket **WILL FIT ALL** 700 pumps and should be used on all 700 rebuilds.

this section of the gasket prevents
oil from splashing out the breather
cavity



**700-R4 PUMP
INFORMATION
(CONTINUED)**

Pump Modifications

7 vane vs. 10 vane rotors

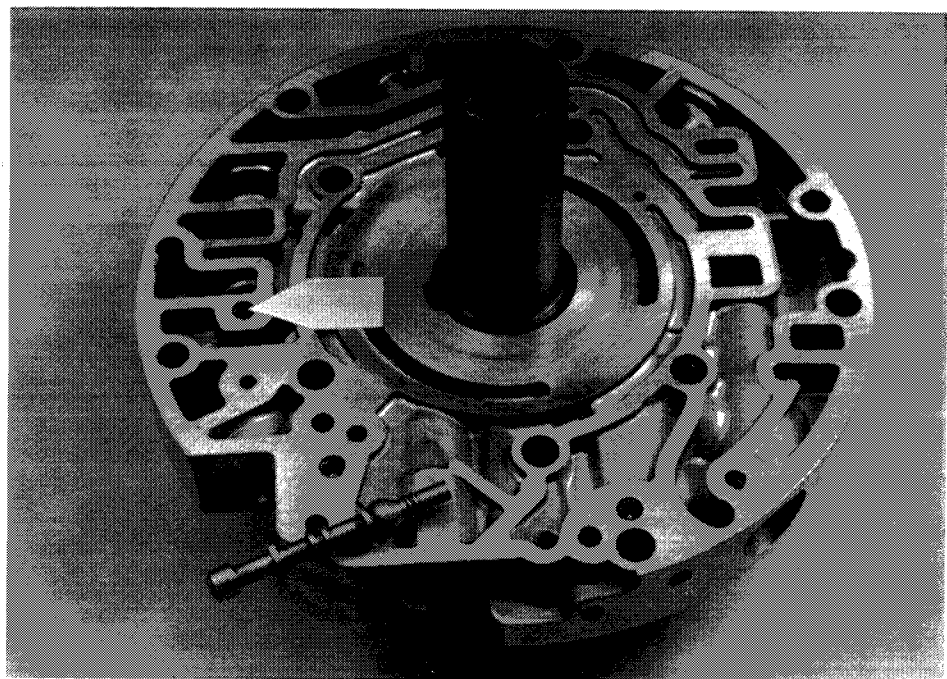
GM went to the 10 vane rotor for noise reduction. The 10 vane rotor DOES NOT have a higher oil volume. Updating to the 10 vane rotor is unnecessary.

Pump Bushing Walkout

Often, the pump bushing will move forward causing a front leak or front seal pop out. Prevent this by staking the bushing in place just like a torque flight. Drill two or three 3/16" staking holes, 1/8" deep, in the pump body. Apply Loctite to the bushing and press it into the pump. Use a punch to push some bushing metal into the staking holes.

Recommended Modifications

1. Grind the second land off the pressure regulator valve.
2. Drill the cooler and lube orifice to .125" (1/8). These two modifications will give more converter, lube, and cooler flow. They will also prevent pressure regulator buzz and pump ring breakage.





AOD SECTION

440 - T4
AXOD
A4LD
LOCK UP
700 - R4

AOD

4th Gear Complaints	Page 1, 2
T.V. Adjustment Related Symptoms	Page 3
Throttle Pressure (T.V.) Adjustment	Page 4, 5, 6
Low Governor Pressure	Page 7, 8, 9, 10
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Shift Timing	Page 16
Downshift Problems	Page 17
Delayed Engagements	Page 18
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A140E
A604
E4OD

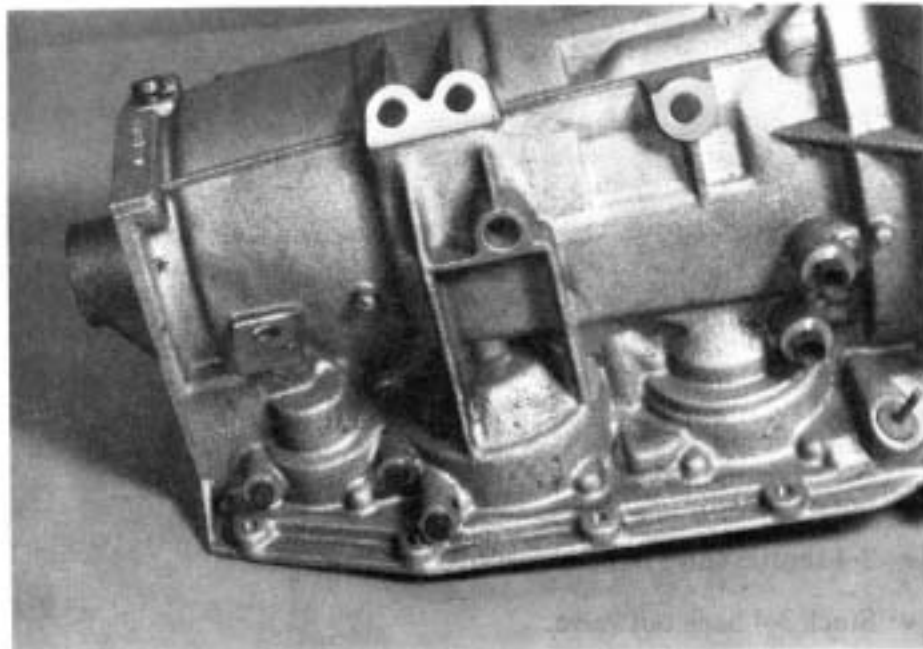
**4TH GEAR
COMPLAINTS**

No 4th, late 4th, falls out of 4th.

1. Check the line pressure at 1200 RPM.
2. Reset the Throttle Valve (T.V.) pressure. See page 3 for carbureted engines and page 5 for fuel injected engines.
3. Check for low governor pressure. Perform two checks while on the road test:
 - *Check for a wide open throttle 1-2 upshift.
 - *Check for a wide open throttle 3-2 downshift from a cruising speed of 35 mph.

If there is no W.O.T. 1-2 upshift and there is a 3-1 downshift in place of a 3-2 downshift, suspect low governor pressure see page 7.

4. Install a gauge on the forward pressure port and one on the direct pressure port. The pressure port locations are on the passenger side of the vehicle.



Accelerate to 55 mph in the "3" position and check the gauge readings. If the forward pressure is 10 psi or more higher than the direct pressure, there is a leak preventing the 3-4 shift. See page 11.

AOD-2

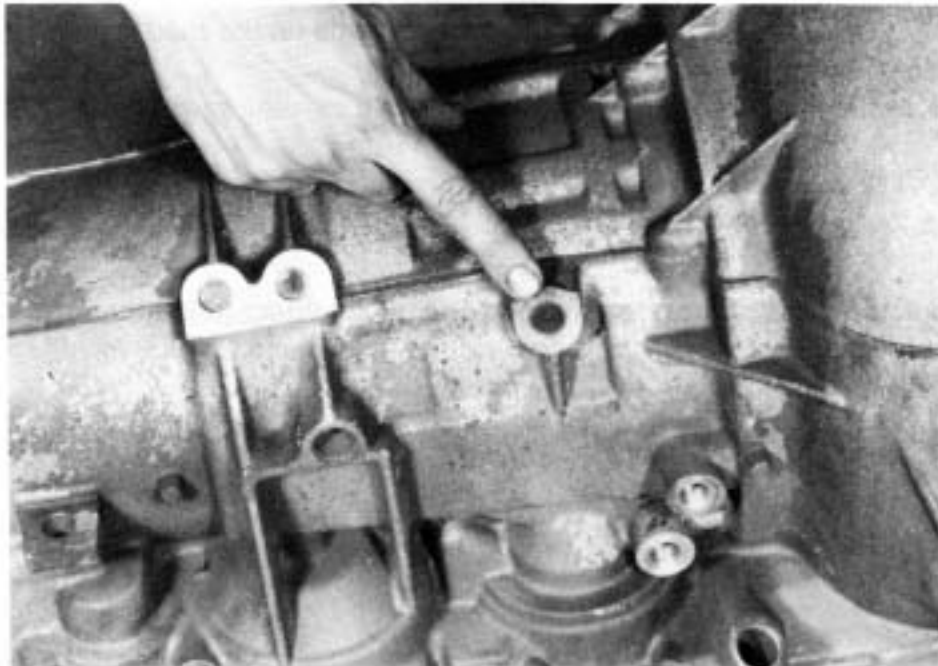
4TH GEAR COMPLAINTS (CONTINUED)

NEUTRALS ON 3-4 SHIFT

Check for engine braking in 2nd when pulling lever from 3 to 1 at 45 mph.

If there is no engine braking:

- Check: O.D. servo pin. Not engaged in band strut.
- Band anchor pin. Backed out of case.



- Broken band.
- Burnt band.
- O.D. servo seals bad.
- Servo feed hole blocked.
- 3-4 shuttle valve in backwards.
- Stuck 3-4 back out valve.
- Still no 4th? call ATRA Helpline.

AOD-3

**T.V. ADJUSTMENT
RELATED
SYMPTOMS**

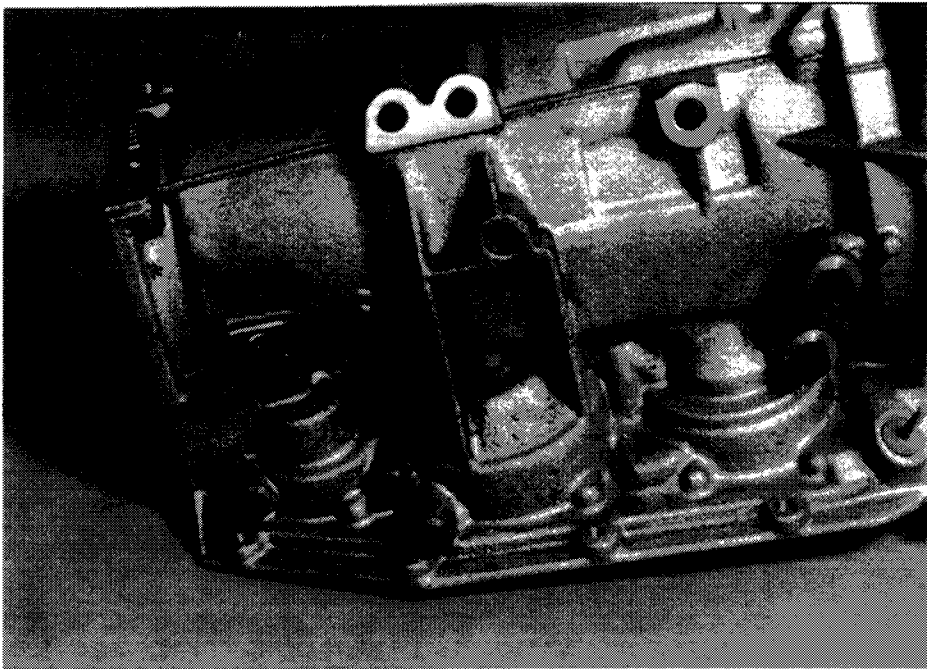
- 1. Slip-bump feel on light throttle shift into and out of O.D..
- 2. No forced down shift (kick down) function at appropriate speeds.
- 3. Shift clunk when throttle is backed off after full or heavy throttle acceleration.
- 4. Extremely delayed and harsh up shifts, especially at light to moderate acceleration.
- 5. Harsh idle engagement.
- 6. Harsh coasting down shifts.
- 7. Harsh 3-4 up shifts when backing off the throttle.

AOD-4

THROTTLE PRESSURE (T.V.) ADJUSTMENT

NOTE: This chart is for transmissions with a T.V. rod. For transmissions with a T.V. cable see page 6.

- 1. Locate the T.V. pressure port on the passenger side, close to the rear of the transmission. In this general location there are three pressure ports near the pan rail. The T.V. pressure is the middle port.
- 2. Attach a 0-100 p.s.i. pressure gauge to the T.V. port.



- 3. With the engine OFF and the air cleaner ON check for binding in the T.V. linkage. T.V. linkage must return to rest on fuel system linkage.

**THROTTLE
PRESSURE (T.V.)
ADJUSTMENT
(CONTINUED)**

- 4. With the engine OFF and the air cleaner OFF, have an assistant press the accelerator pedal down completely.
- 5. Check that the fuel system throttle is open all the way to allow the fuel system linkage to rest on the throttle stop. Correct as necessary.
- 6. Turn OFF the air conditioner.
- 7. If engine is equipped with a vacuum operated throttle modulator, disconnect it and plug the vacuum hose. If equipped with a throttle solenoid positioner or an idle speed control, DO NOT disconnect either of these units.
- 8. Block wheels, set parking brake, select NEUTRAL and start engine. DO NOT check or set T.V. pressure in park.
- 9. Warm up transmission and engine. It MUST be OFF of choke fast idle and transmission fluid warm.
- 10. Adjust engine idle speed to specifications.
- 11. Place Ford tool #D84P-070332-A, T.V. linkage spacer block tool between the carburetor linkage and the transmission T.V. linkage adjusting screw. If Ford tool D84P-70332-A is not available you may use a fabricated block .397" thick or use a 25/64 drill shank. If you're using a drill be sure to measure at the largest diameter.
- 12. With engine idling in NEUTRAL and adjustment block in place, adjust the screw to obtain 33 psi.
- 13. If it is not possible to adjust the pressure within the range of the adjustment screw, loosen the linkage rod bolt at transmission with a 13 mm wrench and slide rod in direction necessary. Readjust screw as necessary.
- 14. Remove the gauge block, T.V. linkage must return to rest on fuel system linkage. Pressure gauge must read under 5 psi, adjust if necessary. After adjustment recheck for 30 - 40 psi with the gauge block.
- 15. Reconnect vacuum operated throttle modulator if the hose was removed.
- 16. Reinstall the air cleaner.
- 17. Road test.

AOD-6

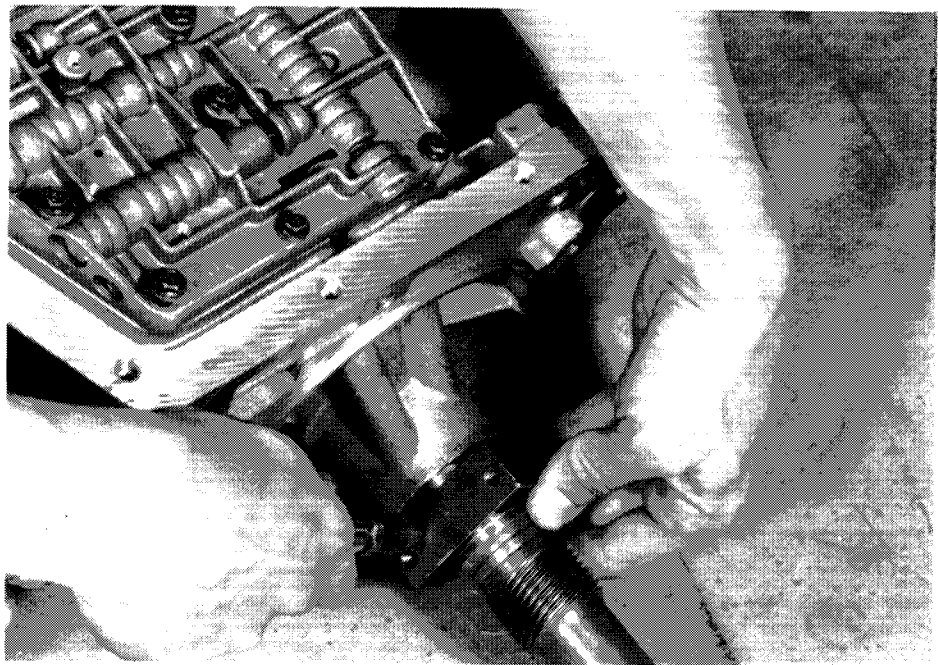
THROTTLE PRESSURE(T.V.) ADJUSTMENT (CONTINUED)

NOTE: This chart is for transmissions with a T.V. cable. For transmissions using a T.V. rod linkage see page 4.

- 1. Locate the T.V. pressure port on the passenger side, close to the rear of the transmission. In this general location there are three pressure ports near the pan rail. The T.V. pressure is the middle port.
- 2. Attach a 0-100 p.s.i. pressure gauge to the T.V. port.
- 3. If necessary remove the air cleaner cover and inlet tube from the throttle body inlet for easier access to throttle lever.
- 4. With engine OFF, have assistant inside the vehicle push accelerator pedal completely to the floor.
- 5. Check to make sure the butterfly throttle shaft bottoms completely on the stop. Correct as necessary.
- 6. Operate the ENGINE and TRANSMISSION until warm.
- 7. Insert tapered end of T.V. gauge tool T86L-70332-A between the crimped slug on the end of the cable.
- 8. Set parking brake and place shift selector in NEUTRAL. With the gauge tool in place and engine idling in NEUTRAL, the T.V. pressure should be 33 psi.
- 9. To increase or decrease pressure, release cable lock and reposition cable.
- 10. Remove the tool and replace the air cleaner cover and inlet tube from the throttle body.

**LOW GOVERNOR
PRESSURE**

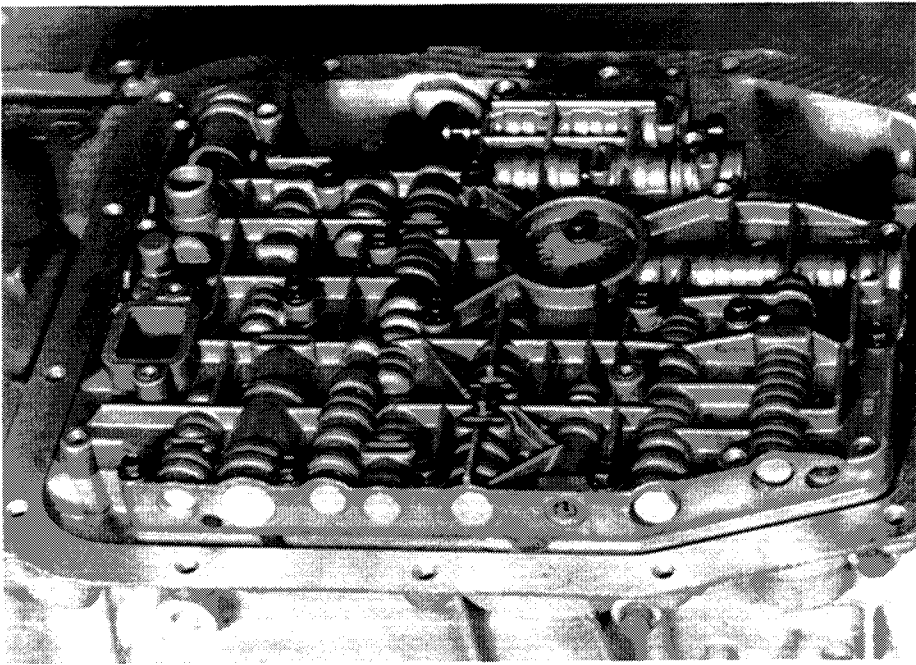
If governor pressure is low, (See the section on 4th gear complaints) check the governor for loose bolts, dirty governor filter, stuck or dragging governor valve, worn governor valve bore, poor mounting surface and broken or incorrect spring (too light). Low governor pressure can be caused by things other than a bad governor. To find possible causes, slowly apply air through the governor to valve body port on the main shaft.



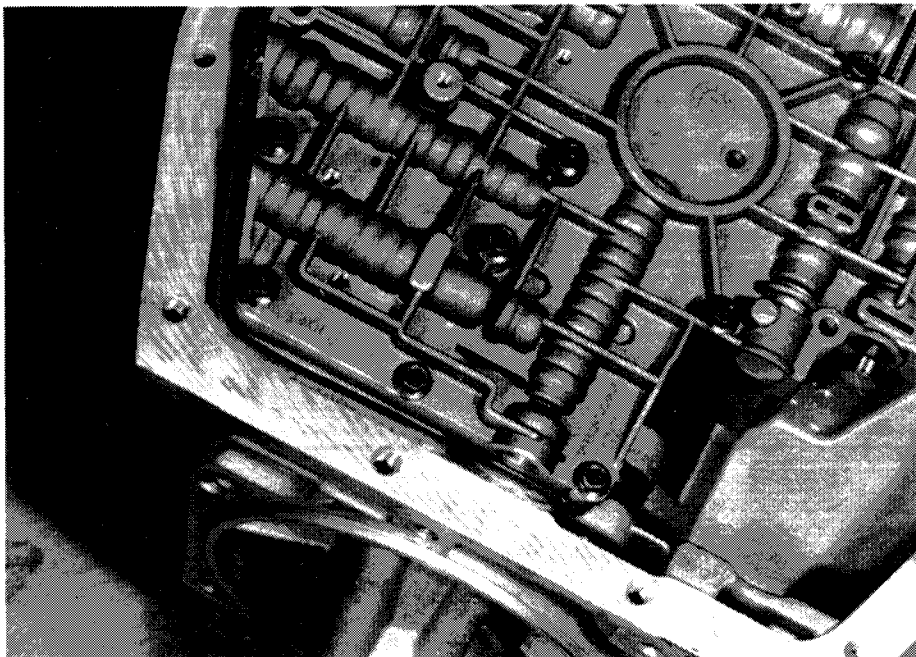
AOD-8

**LOW GOVERNOR
PRESSURE
(CONTINUED)**

With the pan off, look and listen for leaks in the governor circuit. Also check that the 3-4 shift valve moves freely. Common locations for governor leaks are, the aluminum retaining plugs on the sides of the valve body.



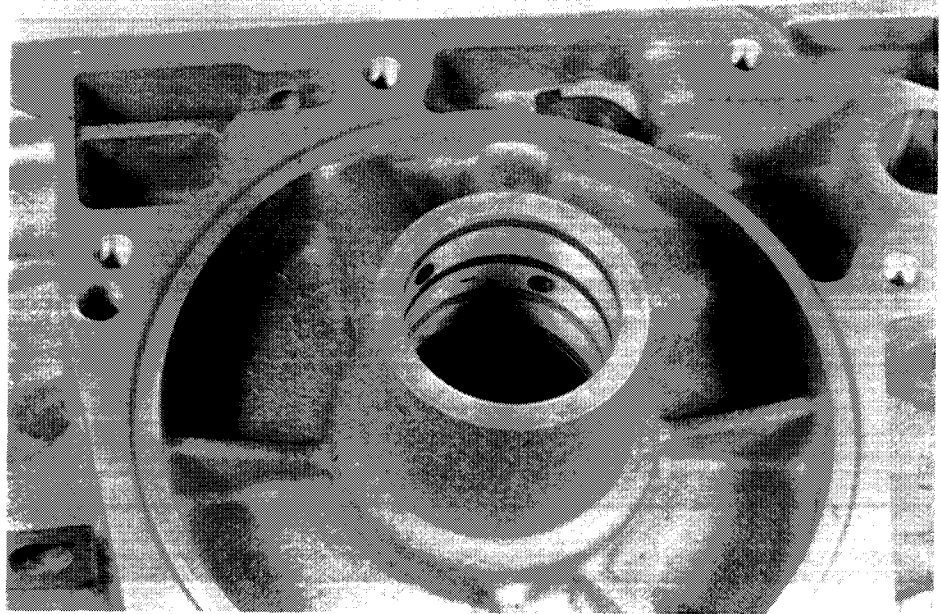
The rear of the valve body gasket area.



AOD-9

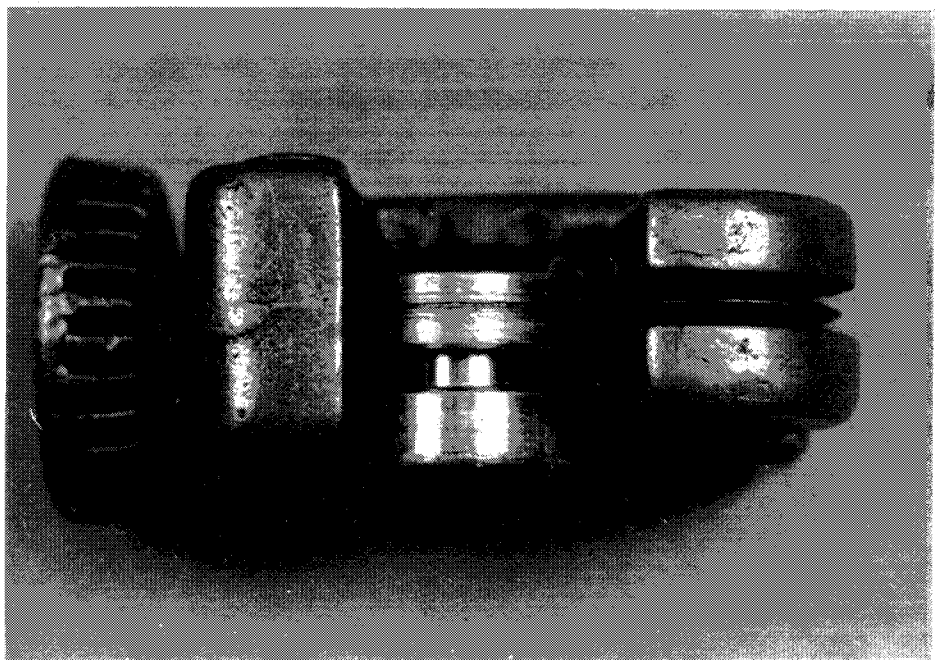
**LOW GOVERNOR
PRESSURE
(CONTINUED)**

The rear of the case ring bore.



The governor counter-weight-to-main-shaft contact area.

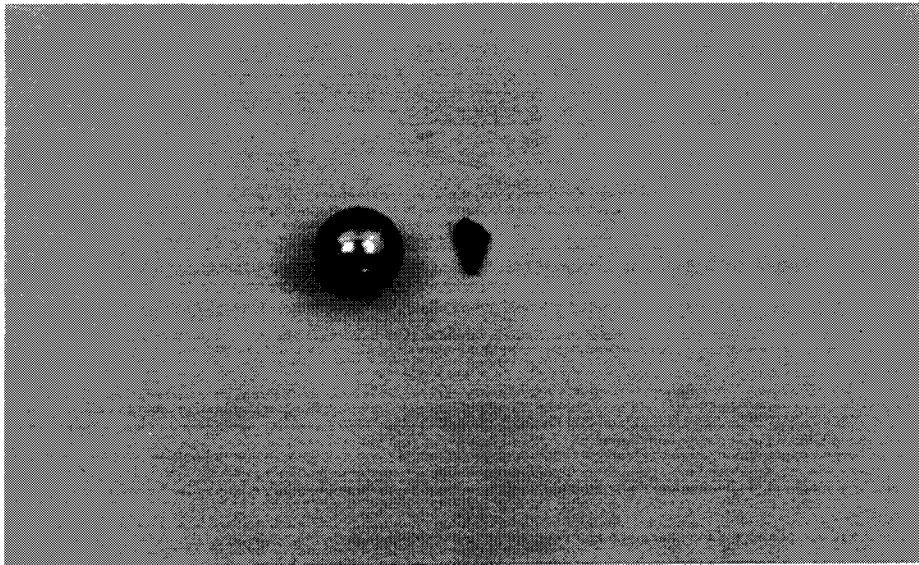
To correct leaks at the aluminum plugs, use a tubing cutter to flare them slightly larger for a better fit.



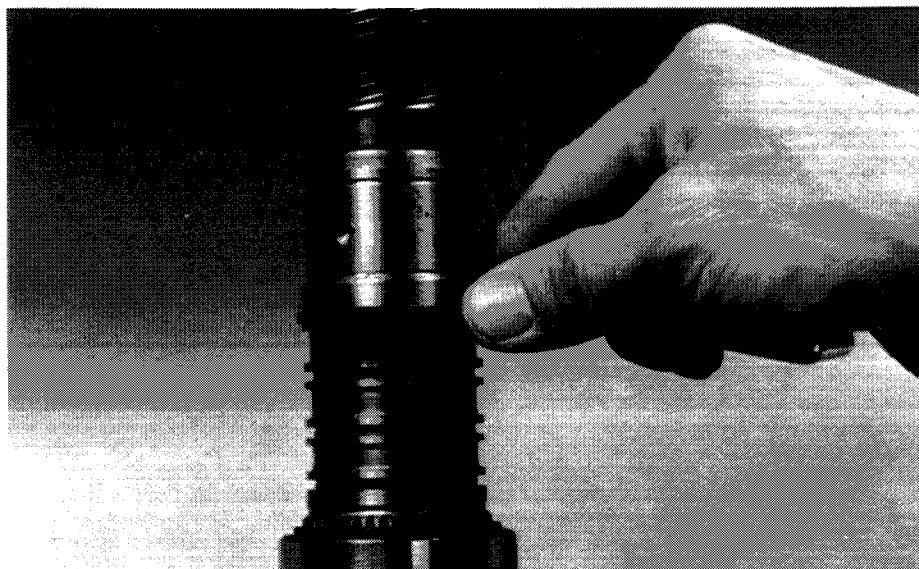
AOD-10

**LOW GOVERNOR
PRESSURE
(CONTINUED)**

To correct leaks at the governor counter weight area using a safety razor blade cut off 1/16 inch of an o-ring cross section and place under the check ball before installing the counter weight.

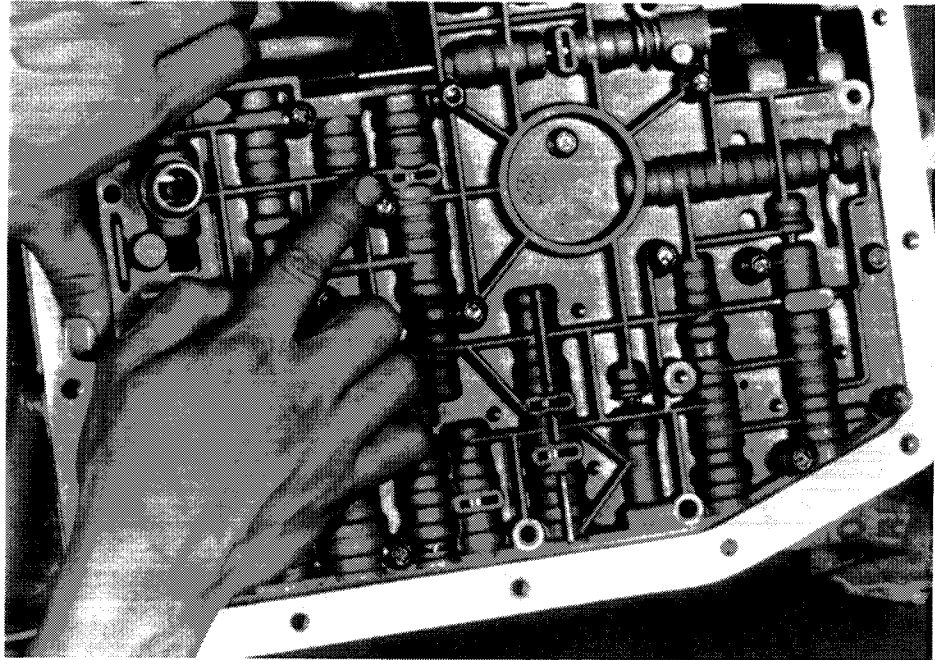


To correct leaks at the valve-body-to case area, flat file the case and use two gaskets between the case and separator plate. Check the case bore where the rings ride. If you can feel your finger nail catch on the grooves the case should be replaced or sleeved. Check all of the oil control rings in the bore before installing. Check the ring grooves on the output shaft for step wear. Use ONLY good quality rings and measure side clearance to be no more than .004" with ring in the groove.



**DIRECT CLUTCH
LEAKS**

Remove the pan. Apply 50 psi air pressure to the direct pressure port on the outside of the case.

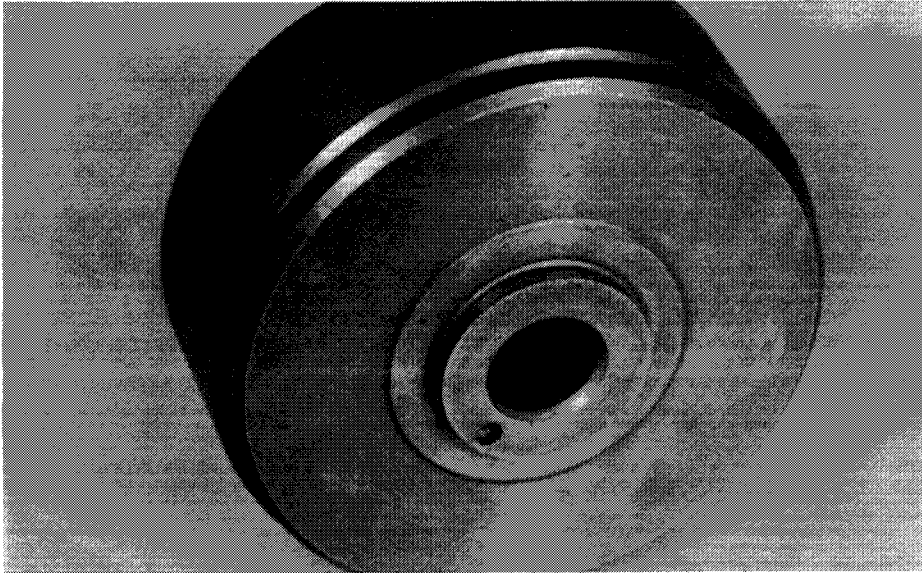


Air will come out the exhaust port at the 2-3 shift valve. Seal the exhaust port with your thumb and air check again. Some locations to inspect for leaks are: Valve body gaskets, aluminum orifice control plug, 2-3 accumulator ring, ring bore in the rear of the case, cup plug in the output shaft, direct clutch cylinder ring sealing area, direct clutch seals and checkball in the direct piston.

To correct a leak at the aluminum orifice control plug; flare the plug using a tubing cutter and replace keeper with flat plate style E5AZ-7E335-A. To correct a leak at the 2-3 accumulator ring: Use a metal or solid Teflon ring from a THM 200 1-2 accumulator piston. To correct leaks at the valve body to case surface; flat file the case and use two valve body gaskets between the case and separator plate. Do not torque valve body to more than 60 in. lbs. To correct a leak at the ring bore in the rear of the case; if your finger nail can hang on the grooves in the bore, replace the case or resleeve it. **THE BORE MUST BE PERFECT.** The output shaft should have **NO** step wear in the ring grooves. Rings **MUST** be high quality and **MUST** be fitted into the bore for sizing before installing on output shaft. After ring is installed on output shaft, a .004 feeler gauge should not fit between ring and shaft. To correct a leak at the plug on the output shaft: Install a new plug with Lock-tite. Make sure it drives in tight. To correct a leak at the drum to output shaft: If your finger nail can hang on the grooves in the bore, replace the drum.

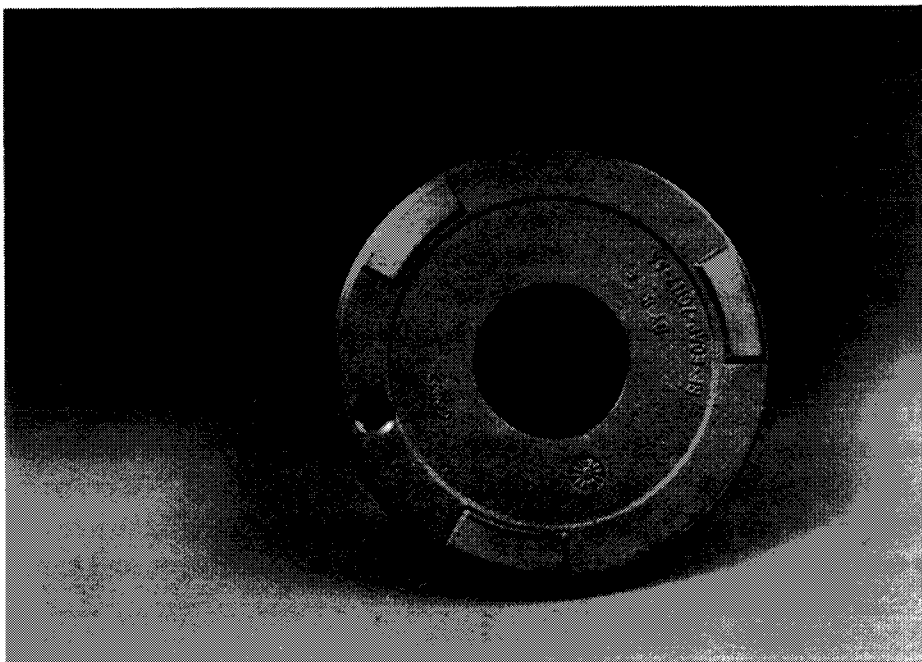
AOD-12

**DIRECT CLUTCH
LEAKS
(CONTINUED)**



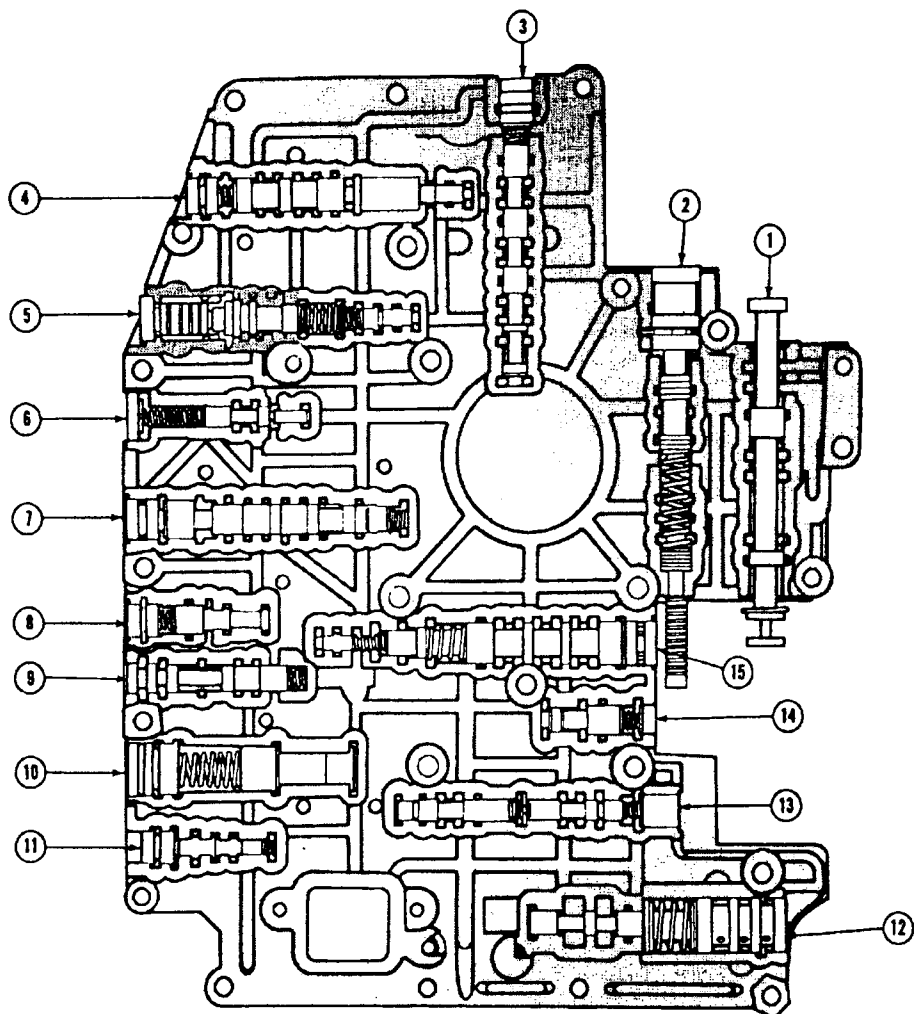
THE BORE MUST BE PERFECT. Do not use metal rings at this location. Only use Teflon rings. Use the originals or custom fit your own.

There should be NO step wear in the output shaft ring grooves. To correct a leak at the direct clutch seals; check the piston and drum for damage. With piston upside down fill checkball capsule with solvent. If it leaks replace piston.



Completely assemble drum with clutches, air test with 50 psi.

SHIFT QUALITY



ITEM DESCRIPTION

1. MANUAL VALVE
2. THROTTLE SYSTEM VALVES
3. 2-3 BACKOUT VALVE
4. ORIFICE CONTROL VALVE/2-3 CAPACITY MODULATOR VALVE (FUNCTIONS ARE SEPARATED BY A SPRING RETAINING PLATE)
5. 3-4 SHIFT AND 3-4 MODULATOR VALVES
6. TV LIMIT VALVE
7. 1-2 SHIFT VALVE
8. OD SERVO REGULATOR VALVE
9. 3-4 SHUTTLE VALVE
10. 1-2 ACCUMULATOR VALVE
11. 1-2 CAPACITY MODULATOR VALVE
12. MAIN REGULATOR AND PRESSURE BOOST VALVES
13. 2-1 SCHEDULING VALVE/LOW SERVO MODULATOR VALVE (FUNCTIONS ARE SEPARATED BY A SPRING RETAINING PLATE)
14. 3-4 BACKOUT VALVE
15. 2-3 SHIFT, 3-2 CONTROL AND 2-3 TV MODULATOR VALVES

**SHIFT QUALITY
(CONTINUED)**

1-2 Shift

Slide or slide-bump @ light throttle.

- Install stronger capacity modulator valve spring.

Slide or slide-bump @ heavy throttle.

- Missing or broken accumulator valve spring.

Slide @ all throttle openings.

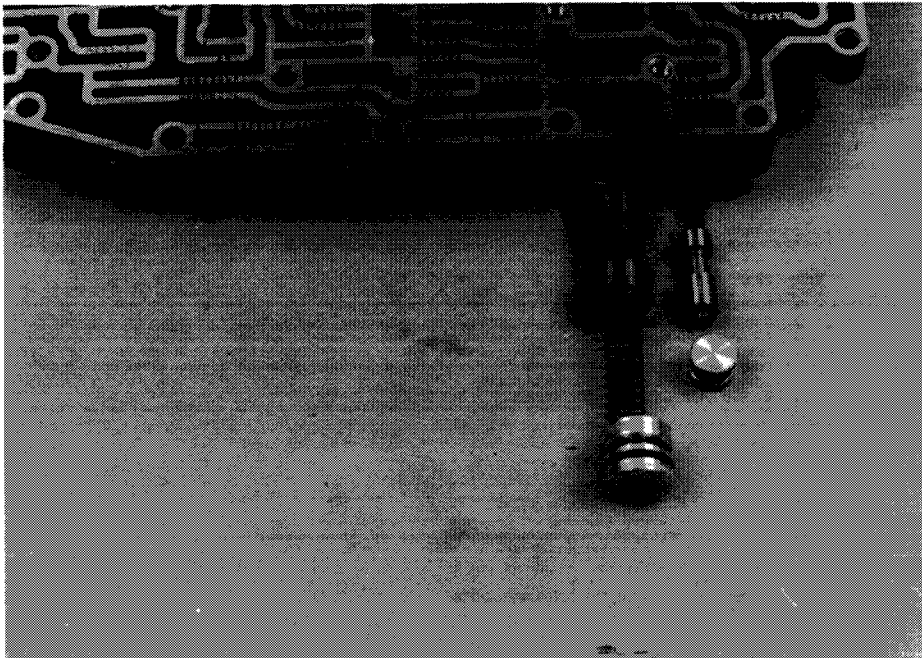
- Damaged or missing o-ring on accumulator valve retainer.

Slide or slide-bump @ heavy throttle.

- If all valve body modifications have not worked, install new factory intermediate frictions.

Harsh at all throttle openings.

- Stuck or misassembled capacity or accumulator valves.



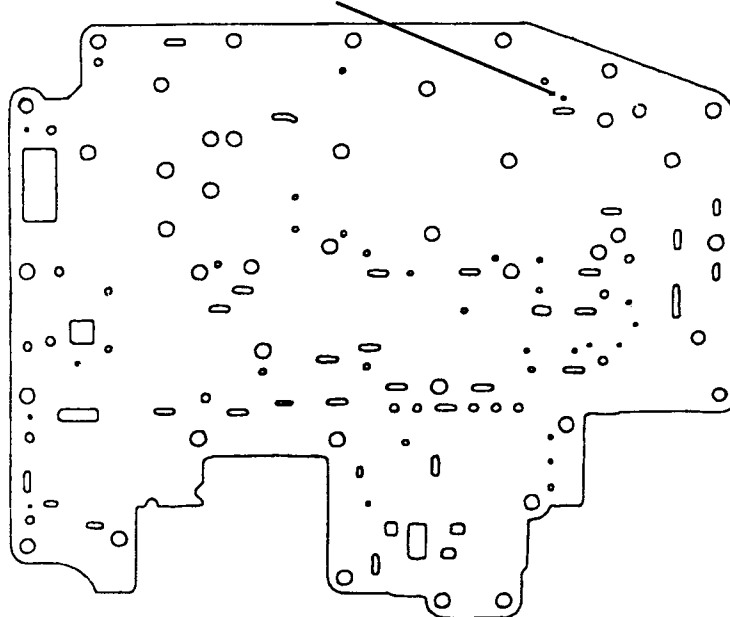
**SHIFT QUALITY
(CONTINUED)****2-3 Shift**

Most 2-3 shift quality complaints are the result of leaks in the direct clutch circuit. During rebuild, follow the steps in "Direct clutch leaks, page 11."

Other complaints are from poor quality direct frictions or poor quality fluid. Use factory friction plates and MERCON fluid.

Ford released some AOD's with stamped steel direct drums. Always replace these with cast 6 plate drums #E8LY-7F283-A.

**1989 HAS A HOLE AT THIS LOCATION
INLARGE TO 3/32 (.093)**



SHIFT TIMING

- * Set T.V. as outlined on page 3
- * Check governor as outlined on page 1
- * Use the following formula to dial in each shift.

Original spring weight divided by original shift speed = factor.

Factor times desired shift speed = new spring weight.

Weigh the springs at the heights listed below.

1-2 spring .585"

2-3 inner spring .580"

2-3 outer spring .375"

3-4 inner spring .560" (early style)

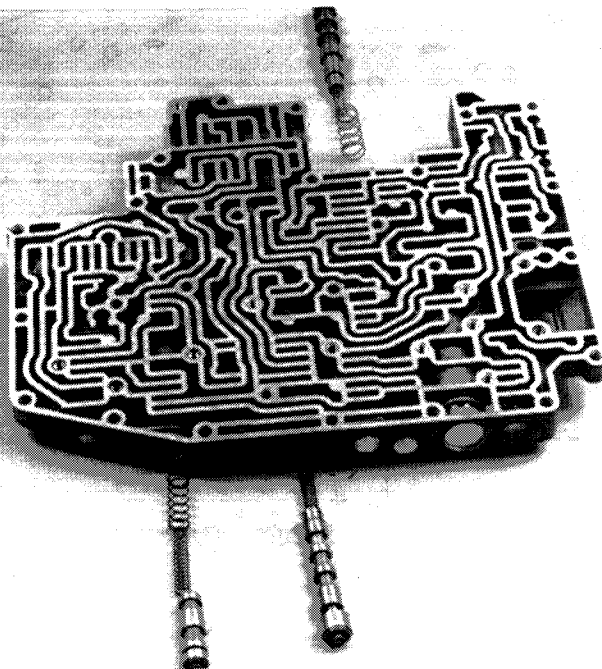
3-4 outer spring .500" (early style)

3-4 inner spring .850" (late style)

3-4 outer spring .620" (late style)

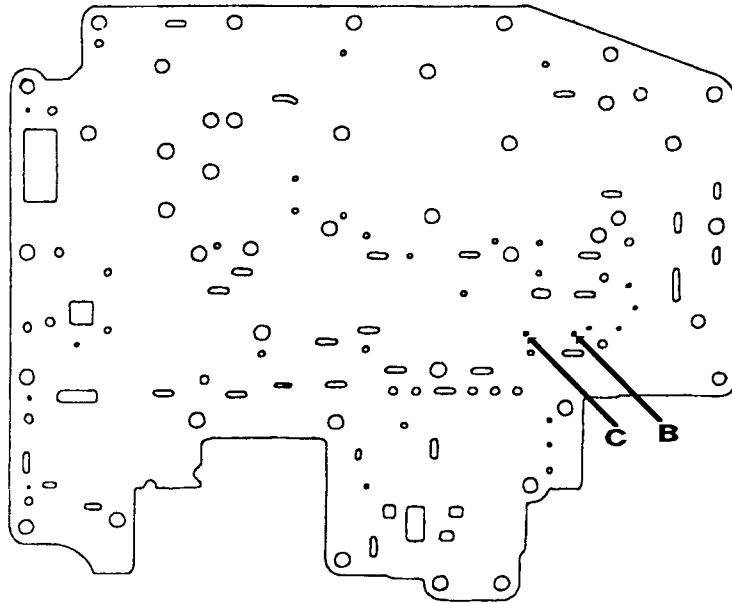
2-3 and 3-4 valves have inner and outer springs.

Weigh each spring at its proper height, then add them together before working the formula. Make any changes to the outer spring only.



**DOWNSHIFT
PROBLEMS****4-3 Kickdown flare.**

- Enlarge orifice "B" to 1/16

**4-3 Coastdown clunk or bang.**

- Be sure the 2-3 backout valve is not stuck.

Flat file and double gasket the valve body.

- Reduce orifice "C" to .040"

3-2 too sensitive

- Add 4 oz. to the 2-3 inner shift spring.

No 3-2 KD.

- Check T.V. pressure at full throttle. Must be 90 psi. Be sure 2-3 T.V. mod valve is not stuck.

3-2 not sensitive enough.

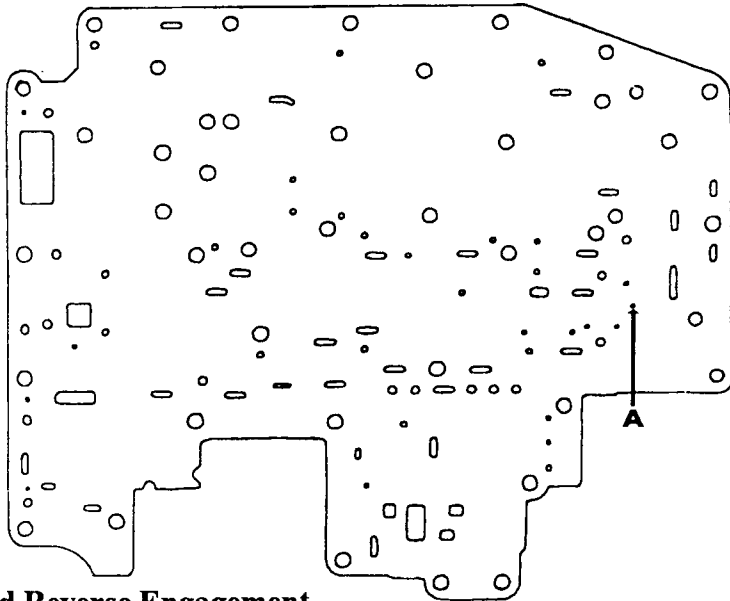
- Remove 4 oz. from the 2-3 inner spring.

AOD-18

DELAYED ENGAGEMENTS

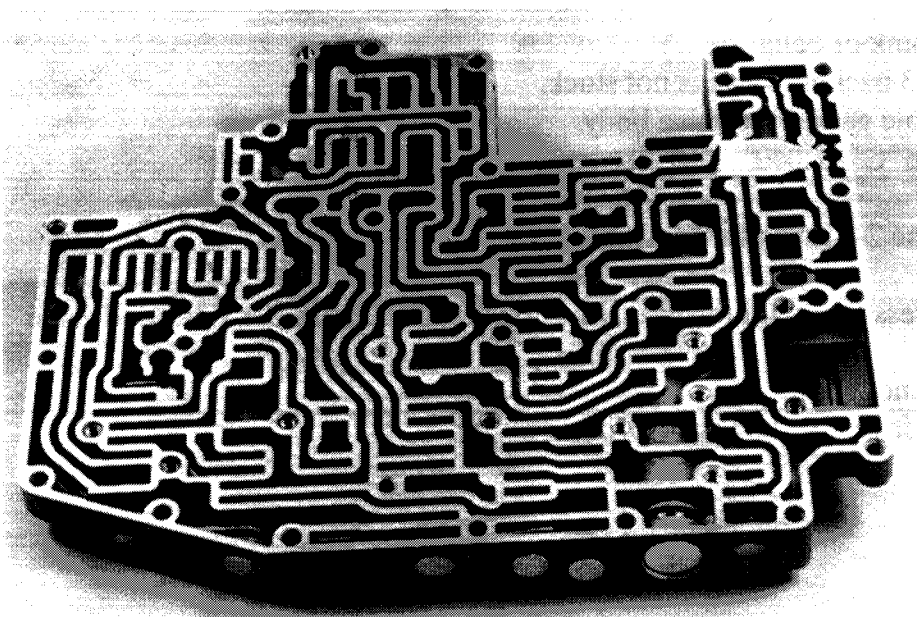
Delayed Forward Engagement

- Drill orifice "A" to .110"
Reseal 2-3 and 3-4 accumulator pistons



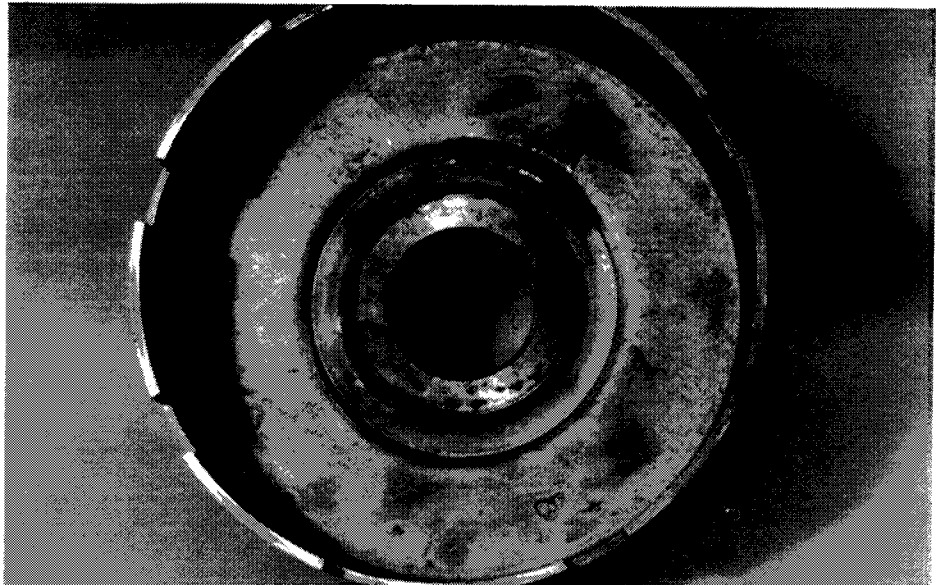
Delayed Reverse Engagement

- Remove #8 check ball
If reverse is now too harsh, replace check ball and drill orifice beside it 1 or 2 drill sizes.



MISSING GEARS**No Second, No Fourth, and No Reverse.**

- This is caused by the Sun gear being broken out of the drive shell. Replacement with a new part is all that is necessary.

**No Third, Neutrals on overdrive shift.**

- Inspect direct drum for stripped splines. Inspect for stripped converter. Clamp locking pliers onto shaft and try to turn. The shaft should rotate only a few degrees. Attempt to compress the damper springs: It should not rotate. If the shaft breaks free and rotates - the torque converter should be replaced.



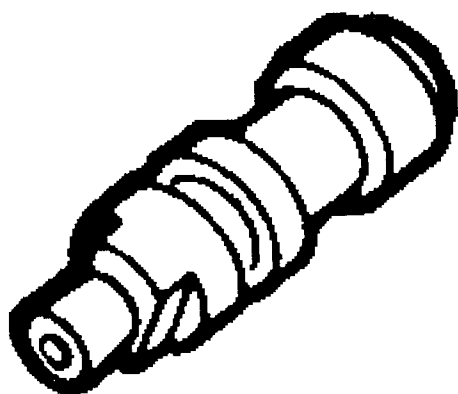
**MISSING GEARS
(CONTINUED)**

No Second, Neutrals on Fourth, Reverse O.K.

- The transmission is shifting 1-3 neutral. Check for a stuck 1-2 shift valve.

No forward, Good Reverse (with 1983-85 valve body)

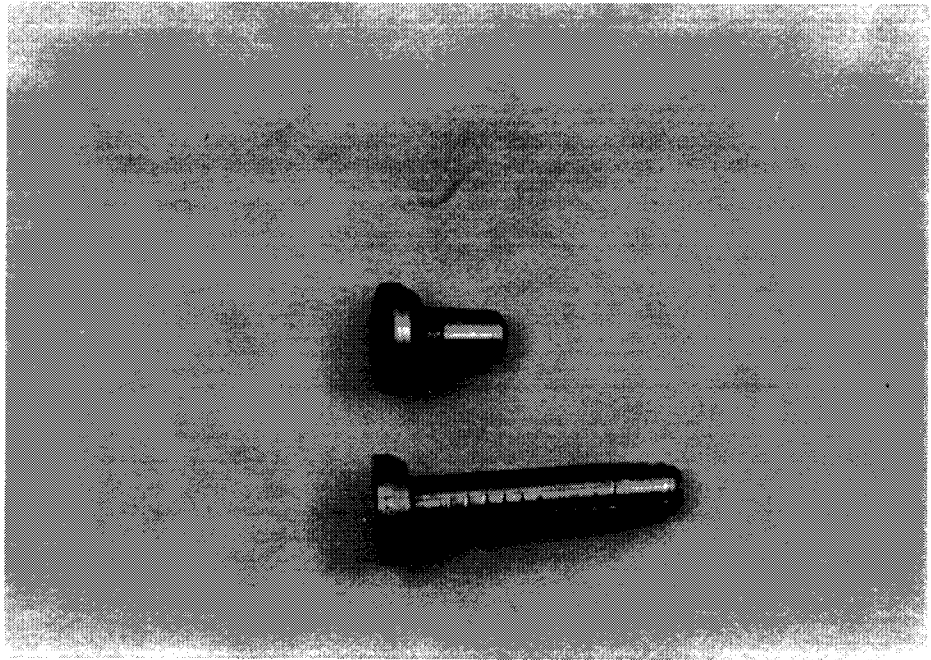
- If this happened after being in overdrive, check for a stuck 3-4 shift valve. An improved 3-4 valve is available to prevent this condition, part # E5AZ-7F259-A. Other causes may be a stuck 2-3 back out valve or a stuck orifice control valve.



NOISES

Clunk or Click on 1-2 shift.

- This can be caused by a missing anti clunk spring.

**A buzzing noise at idle and low speeds.**

- The noise may vary with throttle but is not necessarily consistent with rpm increase. This is found in transmissions produced through 1982. If an early valve body is exchanged to a later vehicle the noise can be pronounced. The correction is to replace the short stemmed converter pressure relief valve with the later long stem type part #E2AZ-7E217A

Clutch squawks on shifts.

- This can be caused by incompatible clutch plates and fluid. To correct, install O.E.M. clutch plates and Mercon fluid.

High pitched noise in all ranges.

- The noise is directly related to engine r.p.m. This is caused by the # 7 & # 8 roller thrust bearings on either side of direct drum. The direct drum is splined to the converter cover which will allow the direct drum to rotate at engine rpm.



A140E SECTION

440 - T4
AXOD
A4LD
LOCK UP
700 - R4
AOD

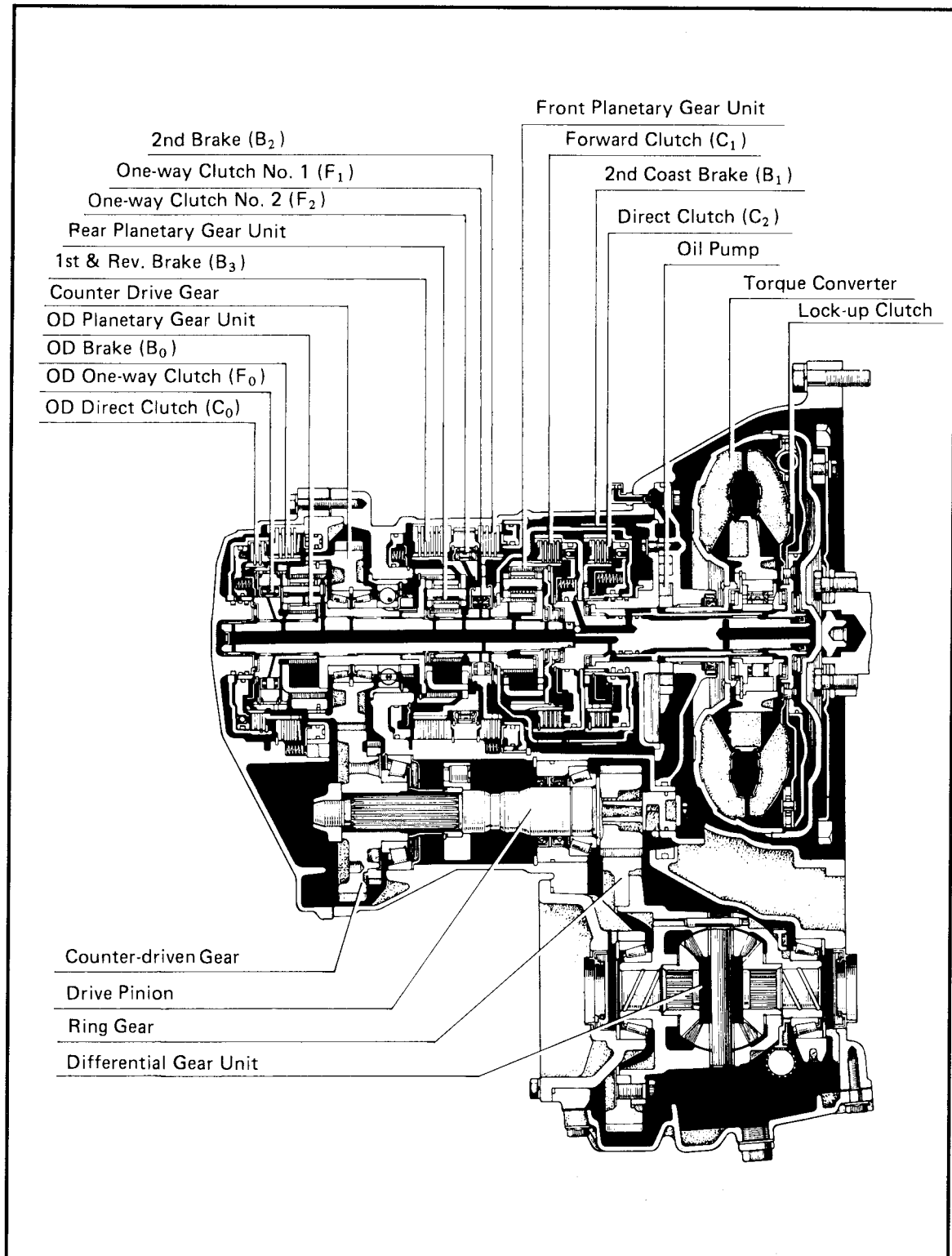
A140E

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Clutch Failure After Rebuild	Page 12, 13
Diagnosing A No Shift Problem	Page 14
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Checking The DG Voltage	Page 18, 19
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A604
E40D

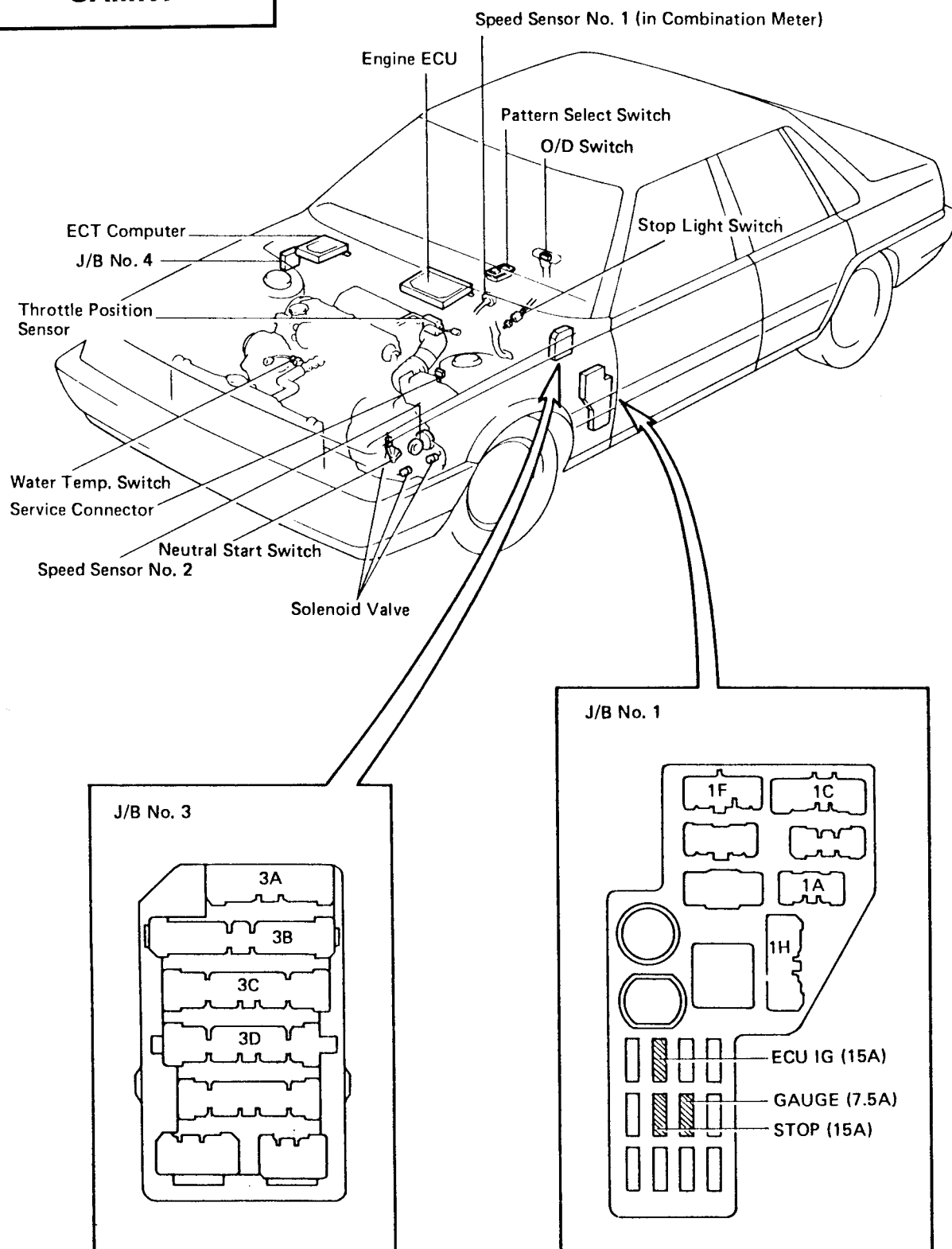
A140E -1

A140E SECTIONAL VIEW



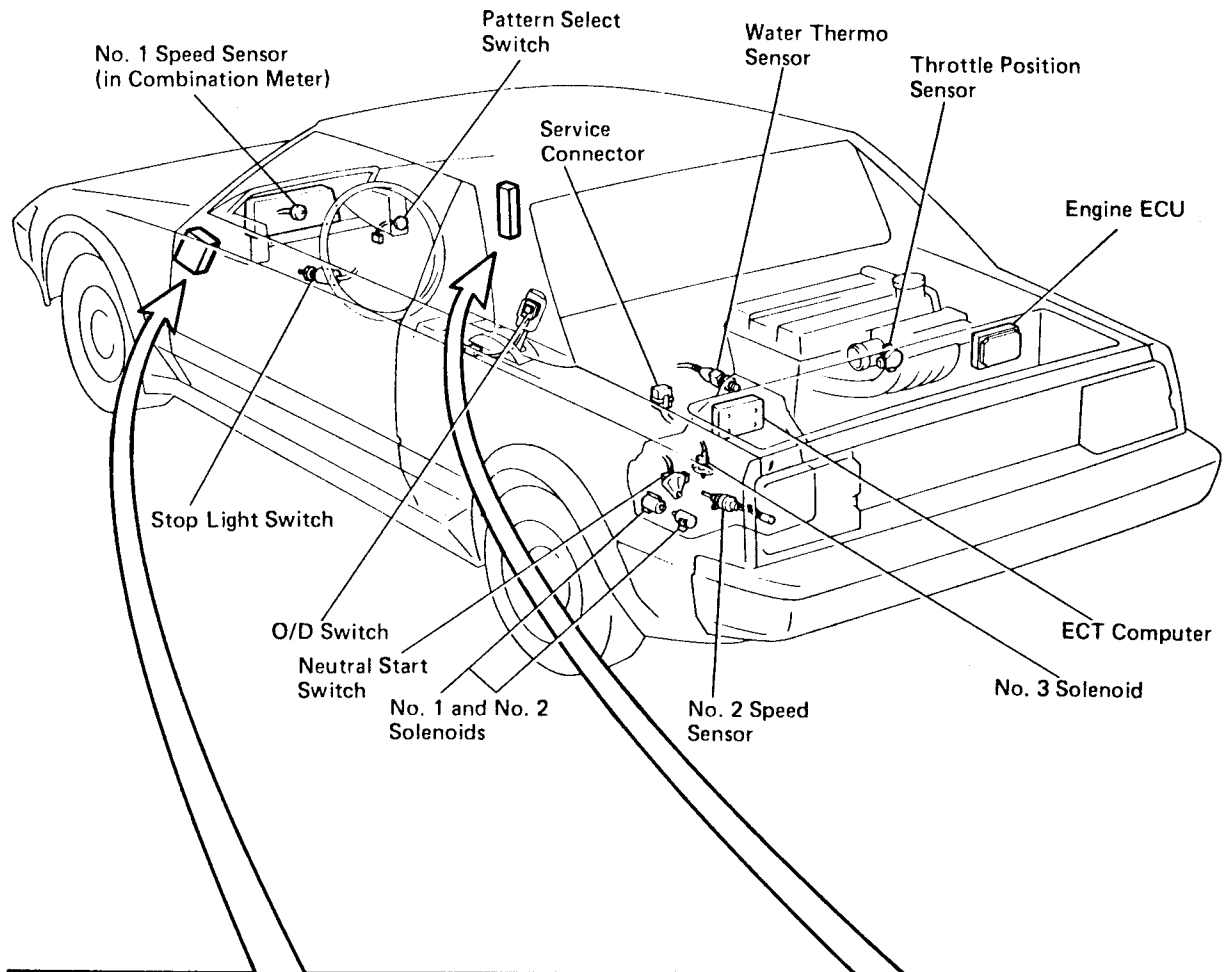
A140E-2

SYSTEM LAYOUT CAMRY

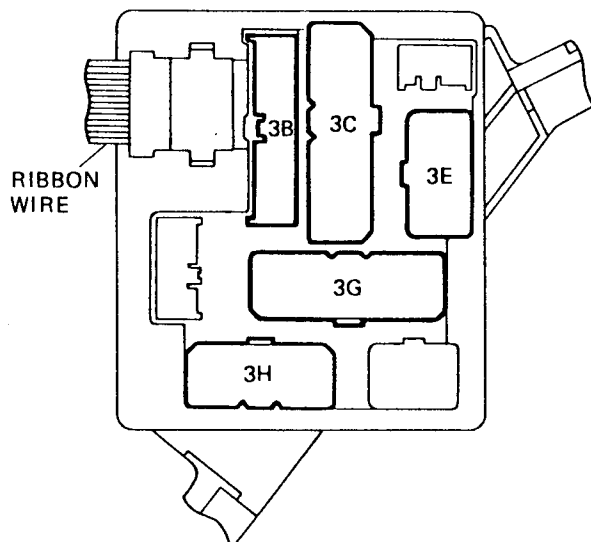


A140E-3

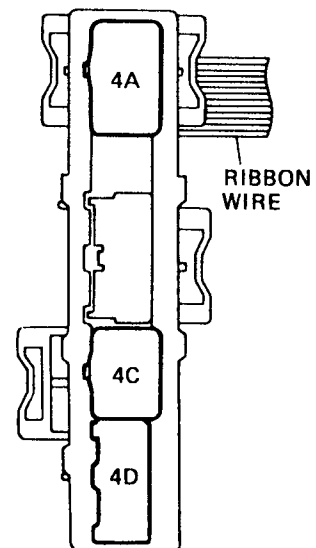
SYSTEM LAYOUT MR2



J/B No. 3

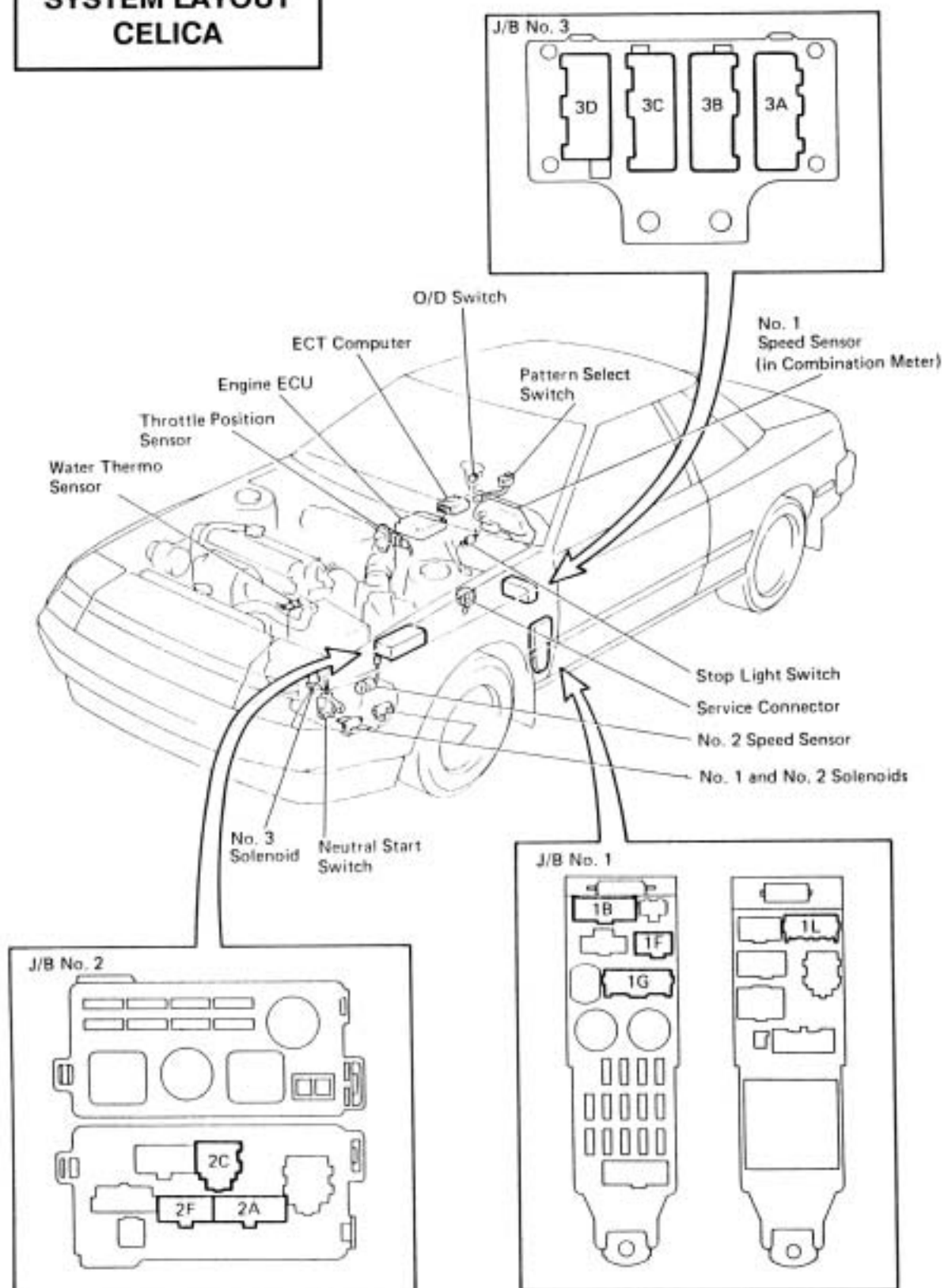


J/B No. 4



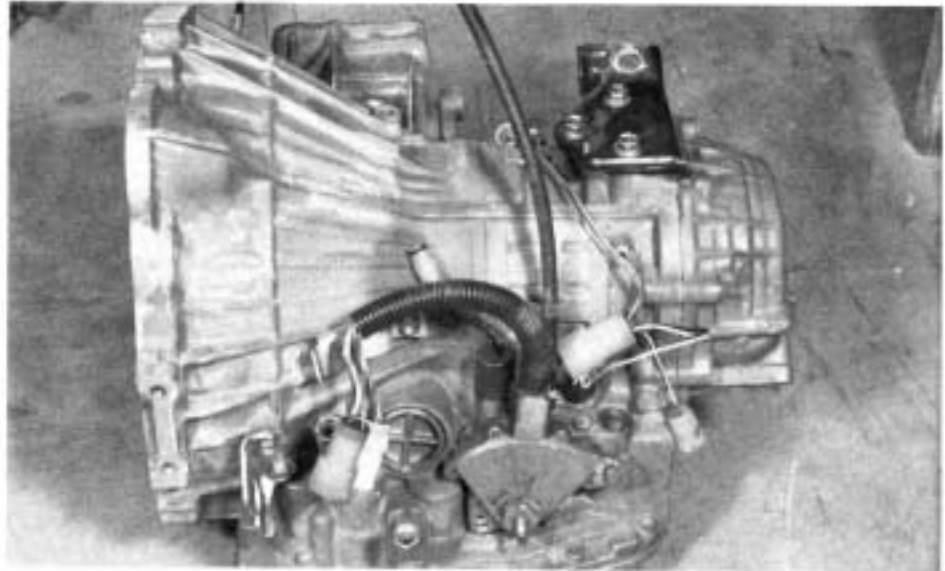
A140E-4

SYSTEM LAYOUT CELICA



A140E-5

PLANET AND DRUM FAILURES



TOYOTA A140

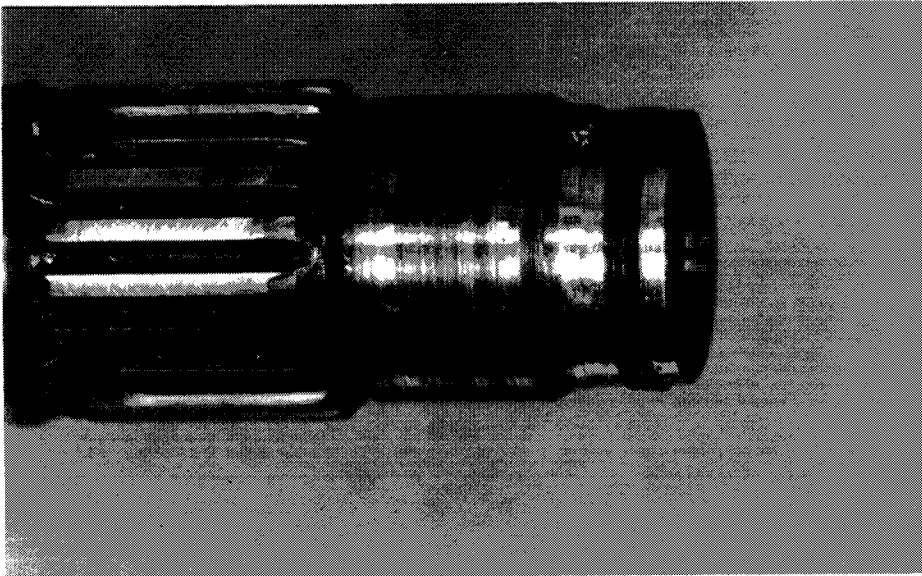
Hard parts failure in a Toyota A-140E is a common problem that starts at the stator support. The failure is a chain reaction that starts with the stator support bushing wearing out. The first design stator supports came with an aluminum bushing which would wear out very easily. The second design came with a bronze bushing that would last longer. ALWAYS use a stator support with a bronze bushing !



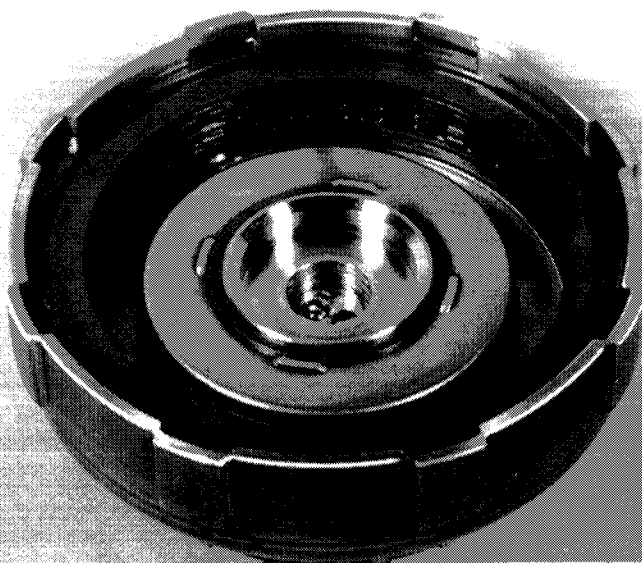
A140E-6

**PLANET AND
DRUM FAILURES
(CONTINUED)**

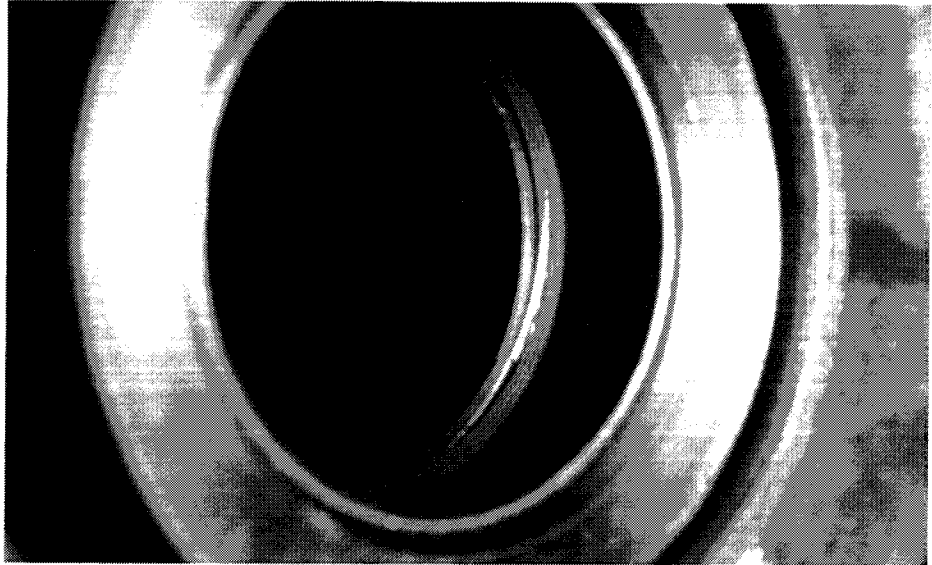
Once the stator support bushing wears out, it no longer supports the forward (C1) clutch drum. Without proper support, the turbine shaft begins to wobble. The forward (C1) clutch drum has a sealing ring surface at the end furthest from the turbine splines for the sealing ring of the overdrive planet shaft.



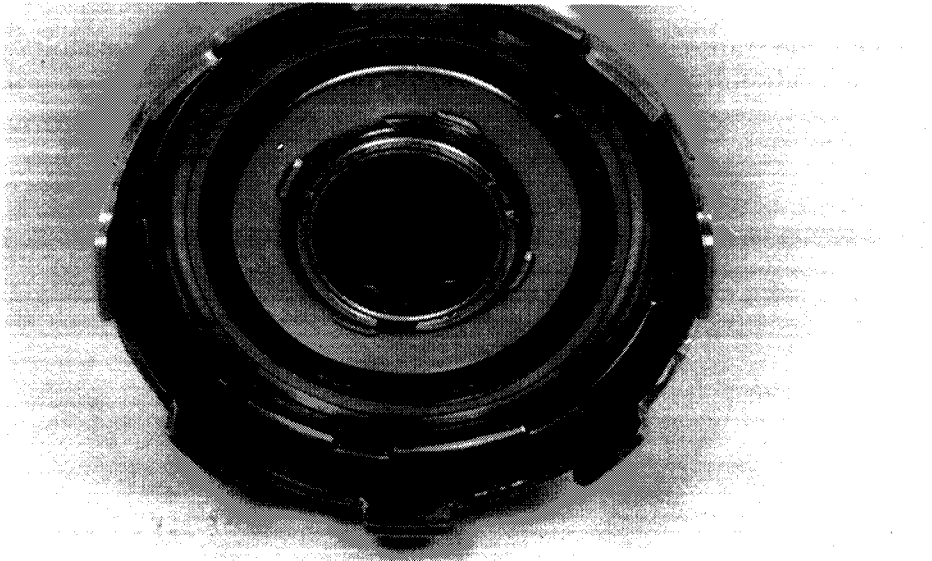
The wobbling forward (C1) clutch drum damages the sealing ring and its groove on the overdrive planet shaft. Usually this damages the sealing ring surface at the rear of the forward (C1) clutch.



Once this damage occurs, lube oil starts leaking, causing the overdrive planet to fail.

**PLANET AND
DRUM FAILURES
(CONTINUED)**

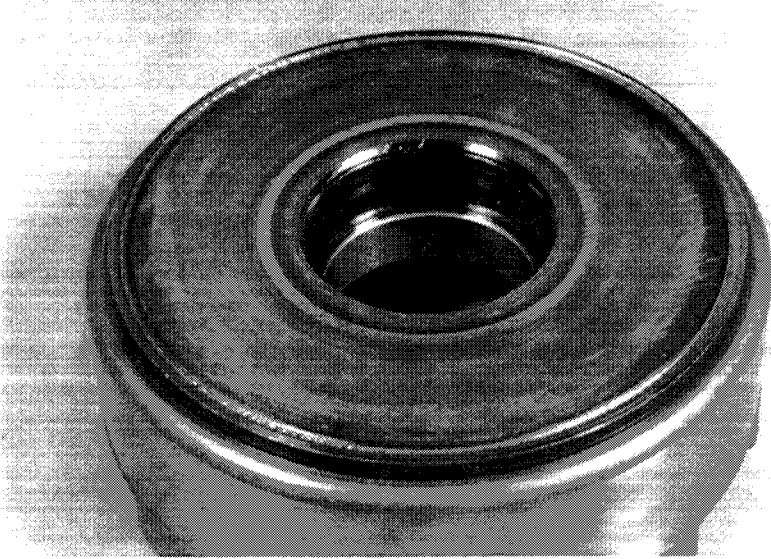
The chain reaction continues. The wobbling forward (C1) clutch drum will eventually contact the stator supports' inner sealing ring surface. This wears out the sealing rings and damages the sealing ring surface causing forward (C1) clutch failure.



The direct clutch (C2), when applied, grabs the hub on the forward clutch. Since the forward clutch is wobbling, the direct clutch wants to wobble also, eventually wearing out the direct clutch support bushing.

A140E-8

**PLANET AND
DRUM FAILURES
(CONTINUED)**



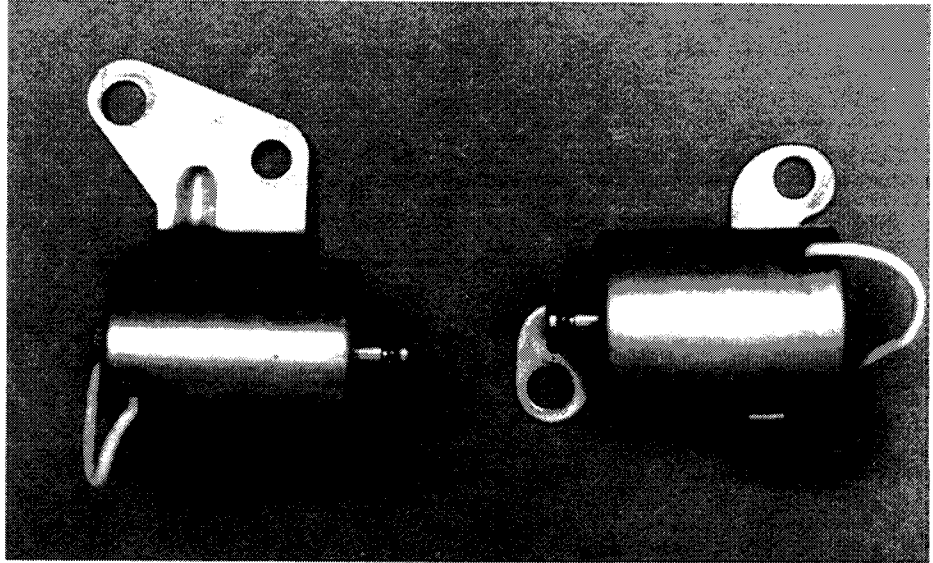
Without proper support, the direct clutch sealing ring surface contacts the stator support. The direct clutch sealing rings become damaged and the direct clutch fails.

Usually the transaxle will fail with all four parts damaged; the stator support, the forward clutch (C1), the direct clutch (C2), and the overdrive section. The overdrive section includes the OD planet, the overrun clutch, and the overdrive ring gear.



**AFTER REBUILD
SHIFTING
PROBLEMS**

The most common complaint, after rebuild, is stacking the shifts at medium and heavy throttle. The cause is restricted shift solenoids. Remember, energized solenoids are electromagnets. Before the transaxle failed, they were drawing metal particles into themselves.

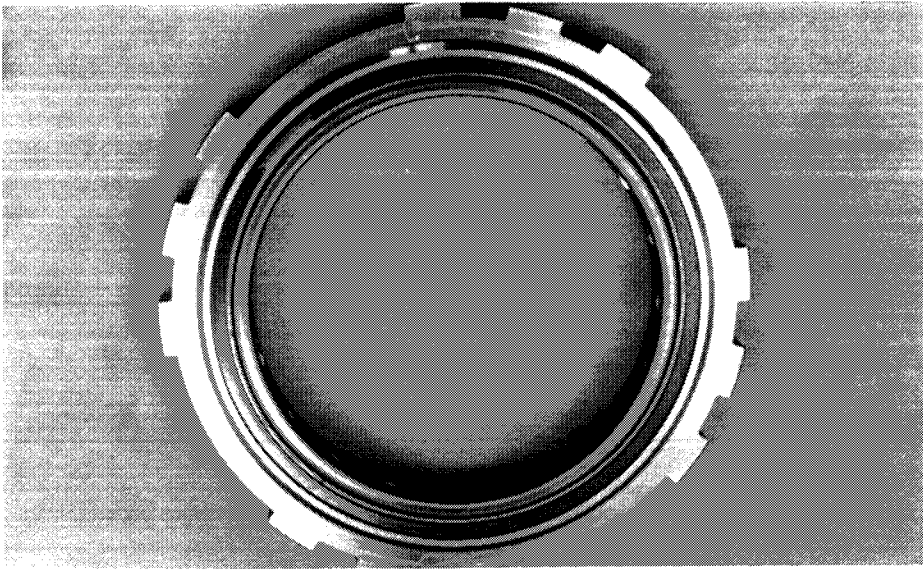


The restricted solenoids can't exhaust all the fluid they get under medium and heavy throttle conditions. This causes the shift valves to move and the transaxle upshifts. See page 27.

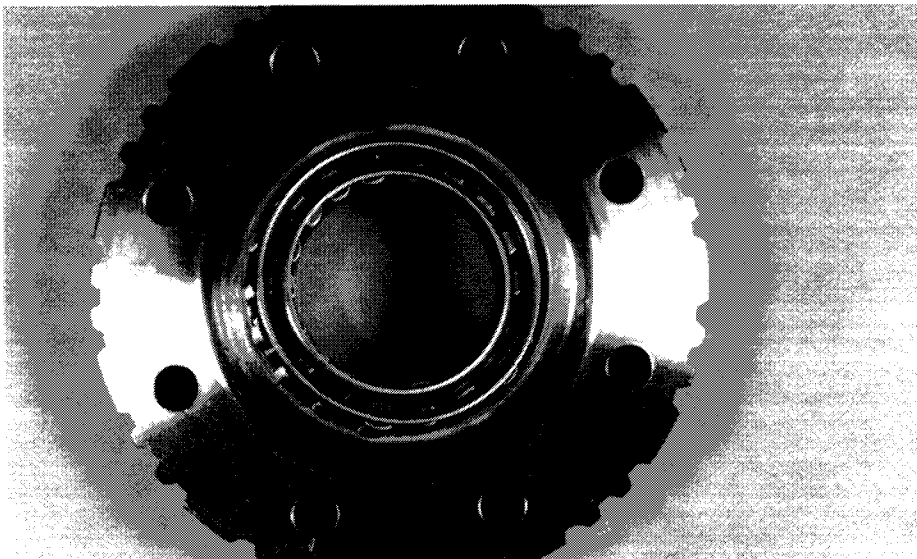
A140E-10

**AFTER REBUILD
SHIFTING
PROBLEMS
(CONTINUED)**

Another problem after rebuild, is a bind-up on the 1-2 shift. With the drive wheels on the ground, the car will only move forward in manual low. The cause is the low (F2) sprag being in backwards. You need to install the sprag housing with the shiny side facing the pump and the dull side facing the rear of the transaxle.



If you install the intermediate (F1) sprag backwards, you will get a bind-up on the shift into third.

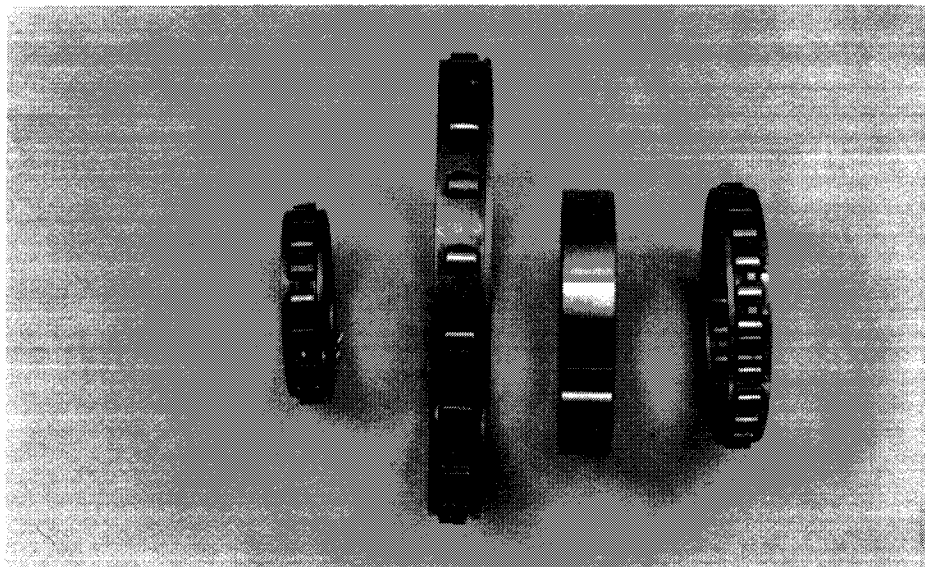


**AFTER REBUILD
SHIFTING
PROBLEMS
(CONTINUED)**

The direct (F0) sprag is in the overdrive planet. If you install it backwards, the transaxle will bind up on the 3-4 shift but will work fine in all other gears.



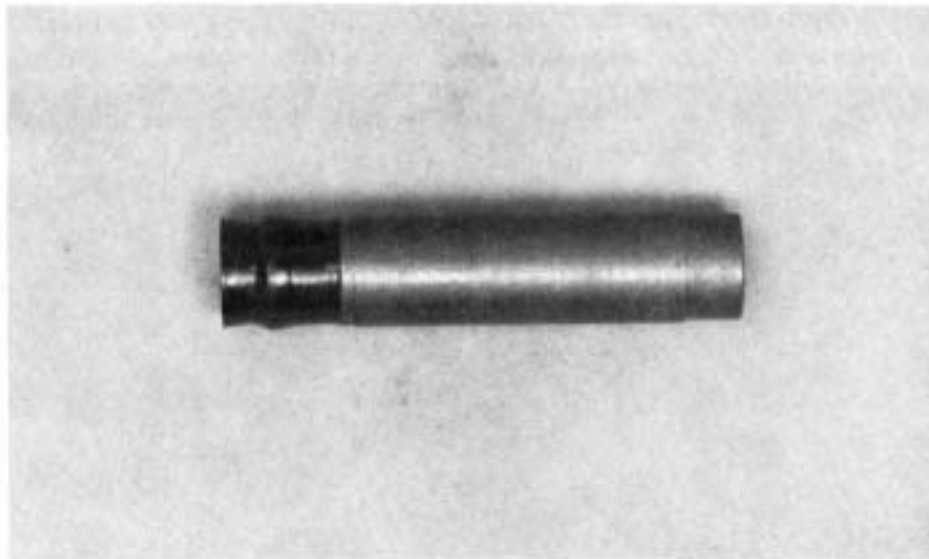
The best way to make sure all the sprags are in correctly, is to have the lip of each sprag face the case bearing! The intermediate and low sprags will face towards the rear. The direct sprag will face towards the front.



A140E-12

**CLUTCH FAILURE
AFTER REBUILD**

A common problem after rebuild is intermediate clutch failure. Usually the cause is using the early type B2 seal. The late design B2 seal has a tube attached to it.

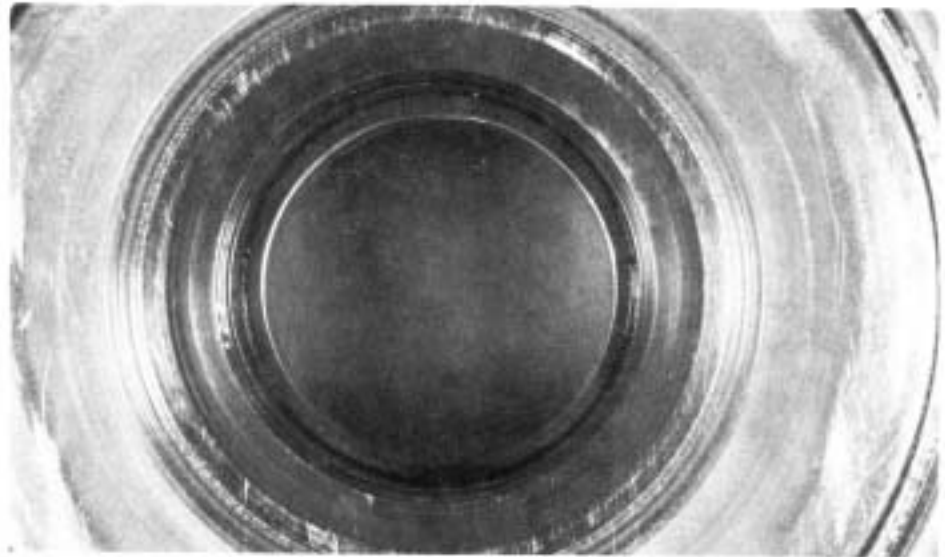


When you bolt on the valve body, it presses on the tube. This keeps the B2 seal in contact with the intermediate clutch housing. The following part numbers are for the late design B2 seal:

A130 AND A140	35150-32011
A240	35159-20010
A340	35159-30010

**CLUTCH FAILURE
AFTER REBUILD
(CONTINUED)**

Another problem after rebuild is leaking oil control rings. This will cause forward clutch, direct clutch, and overdrive planet failure. Always bore fit the oil control rings and be sure the end gap does not exceed .003".



OEM rings are individually machined and may reduce premature clutch failure. The following part numbers are OEM.

Forward clutch (C1)	35712-32010
Direct clutch (C2)	35617-32010
Servo	35815-32010
Overdrive shaft	35748-32018

A1404-14

DIAGNOSING A NO SHIFT PROBLEM

STEP 1

- On 1986 and later USA models check for trouble codes. See page 15.

STEP 2

- Quick check the transaxle. See page 17.

STEP 3

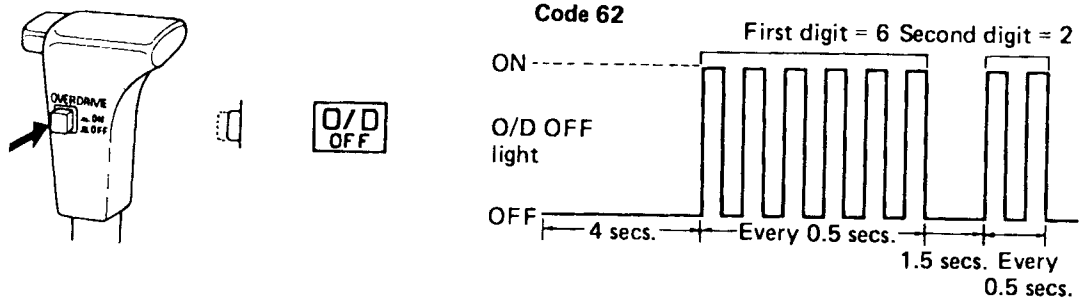
- Check DG voltage. See page 18

STEP 4

- Check the neutral start switch. See page 26.

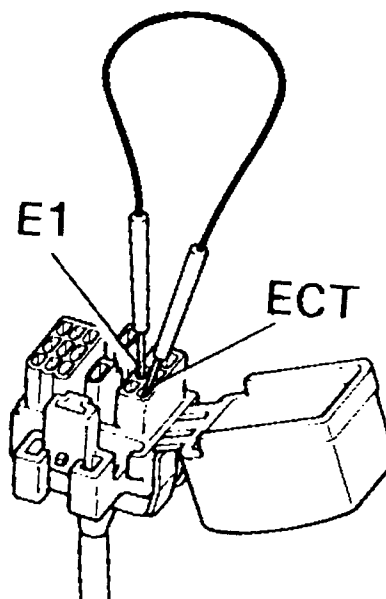
CHECKING FOR TROUBLE CODES (1986-ON)

With the ignition "on" and the OD disable switch "off", check for a flashing "OD off" light.



If the light is off, go to step 2 on page 17.

If the light is flashing, check for trouble codes. Using a jumper lead, connect terminals ECT and E1 at the service connector.



A140E-16

CHECKING FOR TROUBLE CODES (CONTINUED)

Turn the ignition on (don't start the engine). Turn the OD cancel button off. The OD off light on the dash will flash trouble codes just like a GM computer. Use the Chart below to find the problem

A-140E TROUBLE CODES

Code No.	Light Pattern	Diagnosis System
Normal		Normal: this appears when none of the other codes are indicated.
42		Defective No. 1 speed sensor (in combination meter) Severed wire harness or short circuit
61		Defective No. 2 speed sensor (in ATM) Severed wire harness or short circuit
62		Defective No. 1 solenoid or short circuit Severed wire harness or short circuit
63		Defective No. 2 solenoid or short circuit Severed wire harness or short circuit
64		Defective No. 3 solenoid or short circuit Severed wire harness or short circuit
If more than one code is going to be output, the light will pause for 2.5 seconds, then indicate the next code. After all codes have been output, the light will pause for 4 seconds, then repeat the above sequence until memory is cleared		

If the transaxle still won't shift, go to page 17.

QUICK CHECKING THE TRANSAXLE

Disconnect the wiring harness at the transaxle. Using a wishbone lead **Figure 1**, attach the single lead to the positive battery terminal. Use the chart in **Figure 2** to shift through the different ranges by connecting the appropriate wires with the wishboned jumper lead.

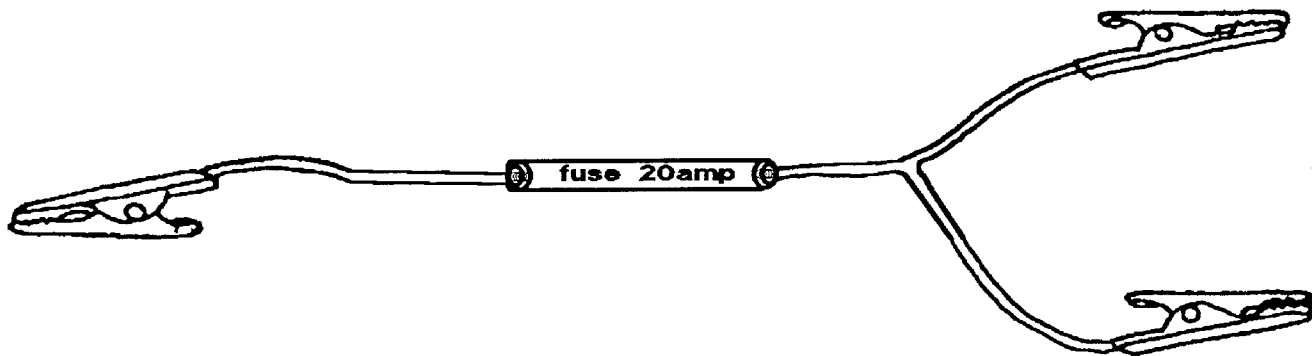


Figure 1

	White Wire	Black Wire
1st	connected	disconnected
2nd	connected	connected
3rd	disconnected	connected
4th	disconnected	disconnected

Figure 2

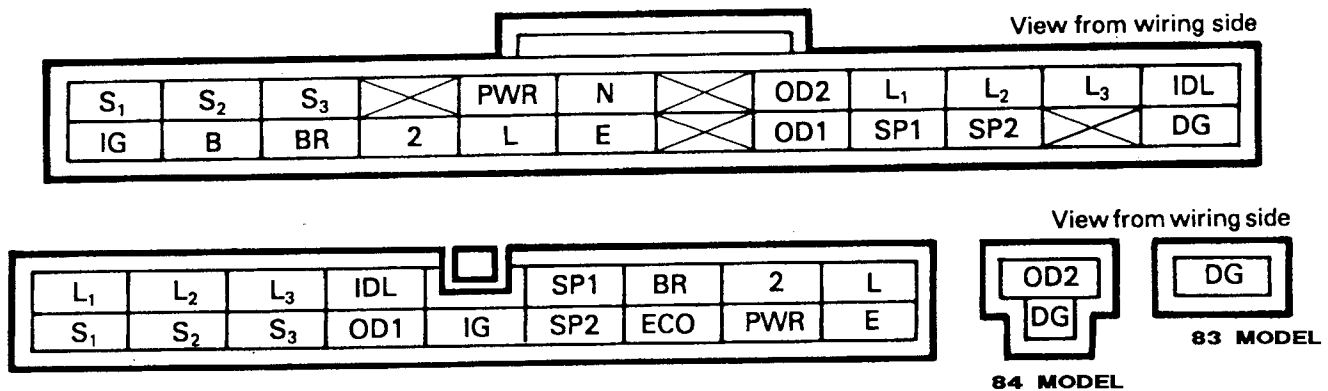
If the transaxle shifts correctly, the no shift condition is external. Go to page 18.

If the transaxle doesn't shift, the problem is the valve body, the solenoids, or internal.

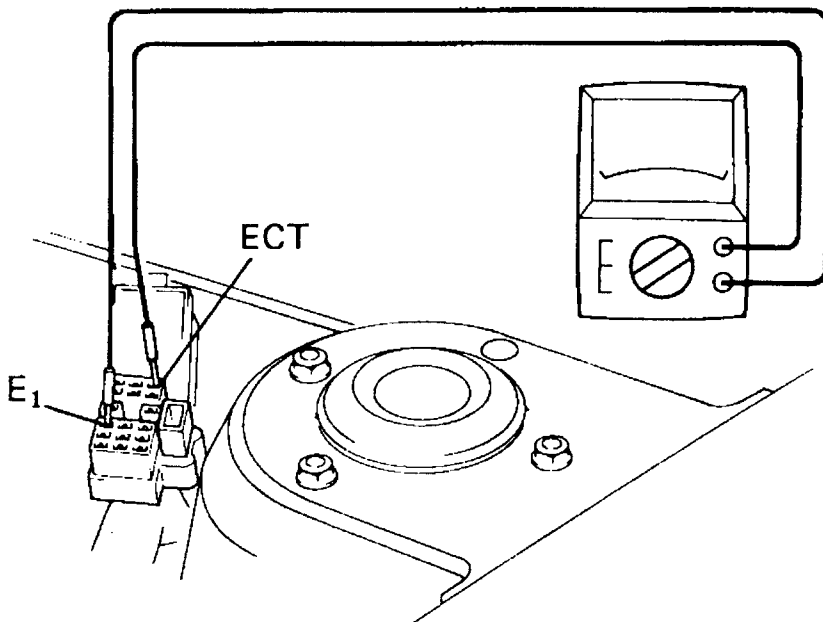
A140E-18

CHECKING THE DG VOLTAGE

Locate the DG terminal on the ECT computer.



(1985 and later models, you can use the ECT terminal at the service connector instead of the DG).



Drive the car on the lift to warm up the engine. The drive wheels must be free to turn.

Stop the drive wheels, put the gear selector in neutral and release the brake. Don't turn the engine off. If voltage at the DG terminal is 0 volts, go to page 14, step 4.

**CHECKING THE DG
VOLTAGE
(CONTINUED)**

On 1983-1985 models and on 1986 Canadian models, a voltage reading of +4v indicates an open vehicle speed sensor. See page 20. A voltage reading of +8v indicates an open circuit to one or more shift solenoids or a shorted brake switch. See page 22. Any other voltage reading indicates a faulty or misadjusted throttle position switch. See page 24.

On 1986 and later USA models, a voltage reading of +8v indicates a shorted brake switch. See page 23. Any other voltage indicates a faulty or misadjusted throttle position switch. See page 24.

TESTING THE V.S.S.

Turn the engine off.

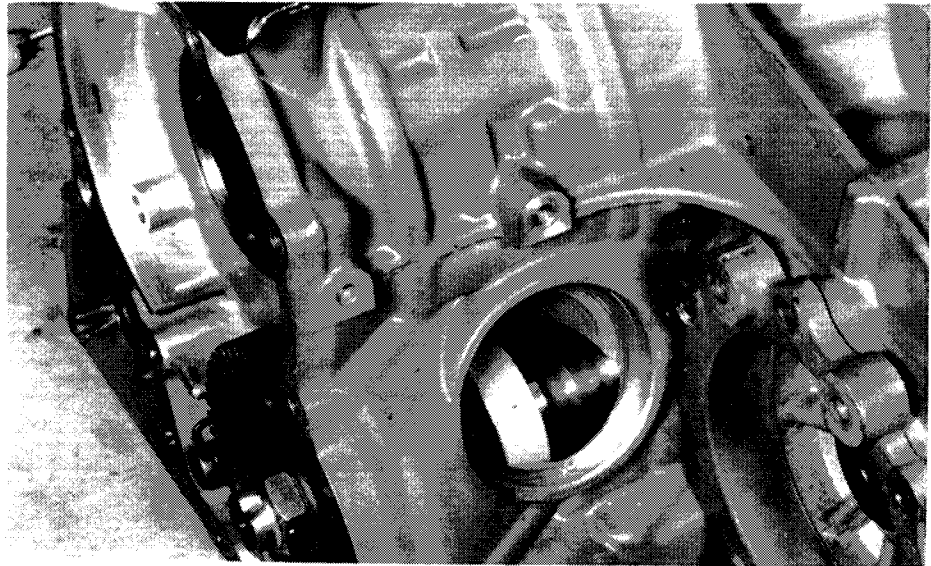
Locate the SP2 terminal on the computer; this is the #1 vehicle speed sensor (the main sensor) lead which goes down to the transaxle. With wire harness to the ECT computer disconnected and an ohm meter connected to the SP2 terminal and ground, turn the drive wheels of the car. The ohm meter should fluctuate between zero ohms and infinite resistance. If ok, go to the throttle position switch test. See page 24.

If the VSS test fails the test, then do the same test with the two leads to the VSS at the transaxle.



**TESTING THE V.S.S.
(CONTINUED)**

If the test still fails, check the rotating magnet on the drive pinion for damage and/or replace the VSS.

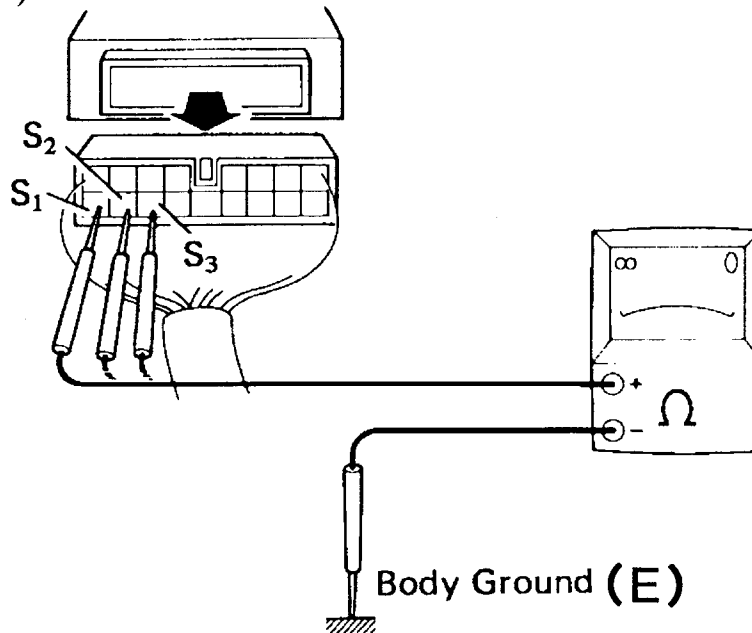


If the test is ok, check for damaged wires leading to the VSS. One wire goes to body ground and the other goes to the SP2 lead to the ECT computer.

A140E-22

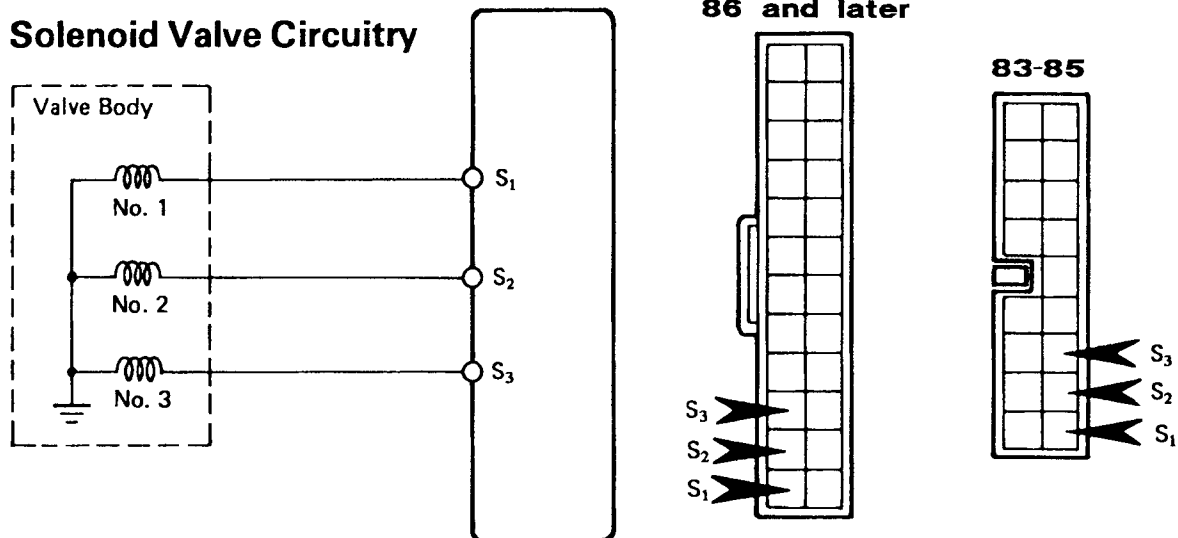
SOLENOID RESISTANCE

Disconnect the wire harness to the ECT computer. Check the resistance between S1 and E (body ground).



The resistance should be 11-15 ohms.

Solenoid Valve Circuitry

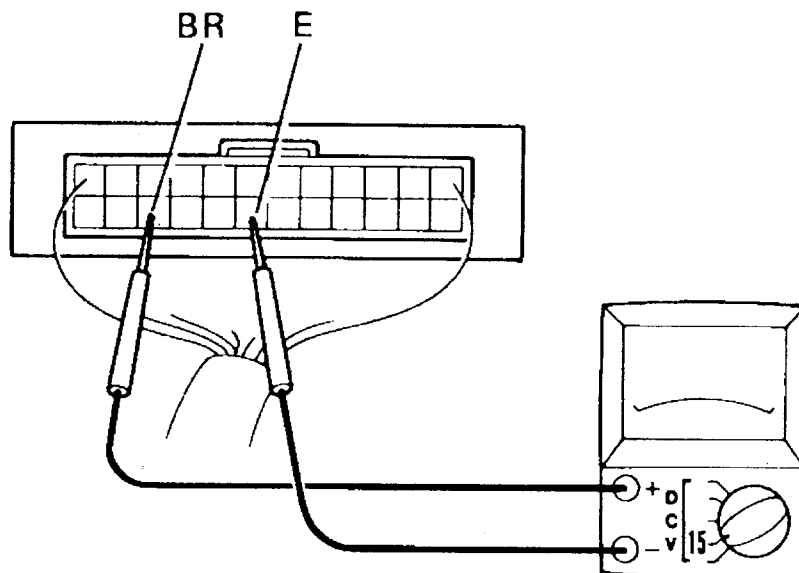


Check the resistance between S2 and E and S3 and E, the same way. S1, S2, and S3 are connected to solenoids #1, #2, and #3 respectively.

A140E-23

**BREAK SWITCH
TEST**

Check the voltage between terminals BR and E (body ground).



With your foot off the brake pedal, there should be zero volts. When you step on the brake pedal, the voltage should change to + 12 volts. If not, check the brake switch adjustment or replace the brake switch.

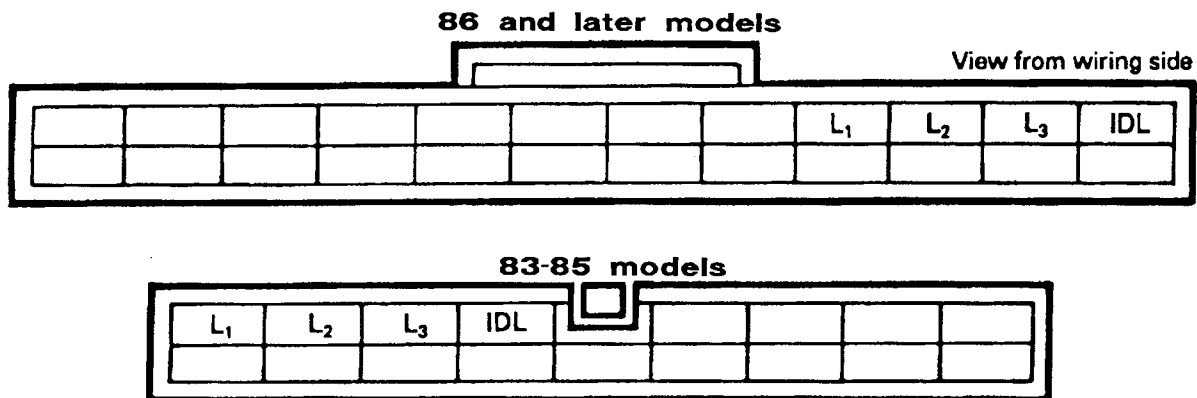
A140E-24

THROTTLE POSITION SWITCH

There are two types of TPS. A direct type, used in the Camrys and an indirect type used in the MR2 and Celica. The direct type is digital and sends a ground signal to the computer at terminals L1, L2, L3, and IDL in different combinations.

There are nine different combinations. Closed throttle, 1/8 throttle, 1/4 throttle, and so on. The indirect type is analog. It is nothing more than a variable resistor with an extra contact for closed throttle. The voltage signal from this type of switch goes to a digital converter (TCCS) that converts the analog signal to a digital signal.

With both types, disconnect terminals L1, L2, L3, and IDL from the computer harness. (Make sure you mark them so they go back in the right slots.)

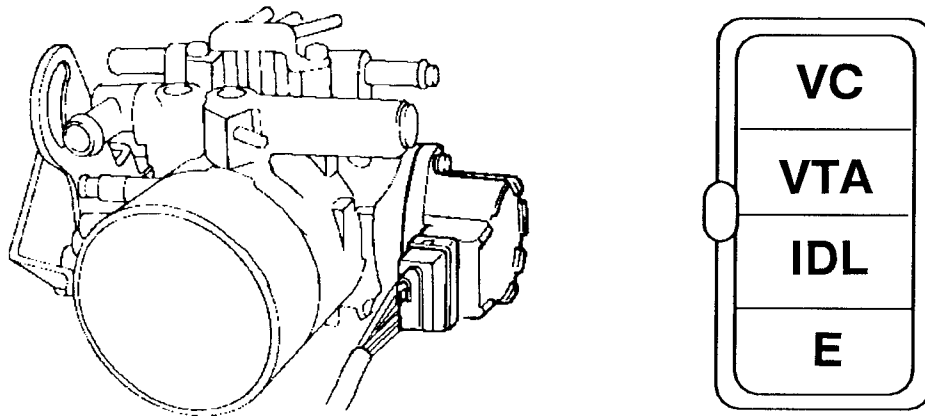


Now connect the computer to the harness. Ground the IDL terminal and turn the ignition on (engine off). The voltage at the DG terminal should be 0v.

**THROTTLE
POSITION SWITCH
(CONTINUED)**

If the voltage is still higher than 0V, replace the ECT computer. If the voltage is at 0V, start the engine and see if the transaxle will shift. If it does, and the car you are working on is a Camry, adjust or replace the TPS. If the car you are working on is an MR2 or Celica, you must check the TCCS also.

To do this, connect the L1, L2, L3, and IDL wires to the ECT computer (make sure the ignition is OFF). Now disconnect the harness at the carburetor that goes to the TPS. Connect the IDL terminal to "E" and "VTA" of the wire harness.



Turn on the ignition and check the DG voltage. It should be 0 volts. If so, adjust or replace the TPS. If not, replace the TCCS.

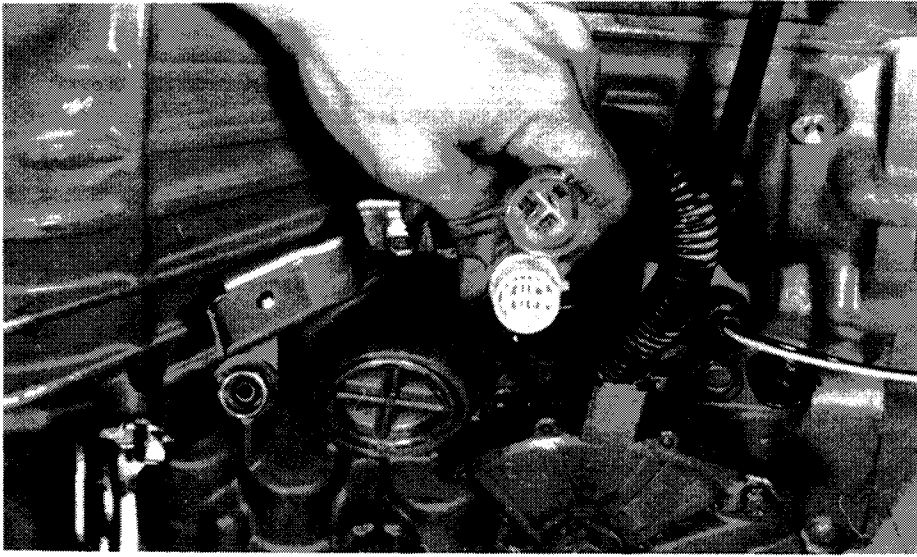
NOTE: with the TPS working normally, you can check throttle position at the DG terminal.

- 1) Turn the ignition ON (engine off)
- 2) Check voltage at DG
- 3) At closed throttle, the voltage should be at 0v and increase + 1v per 1/8 throttle opening. For example, 1/2 throttle = 4 volts, 7/8 throttle = 7 volts.

A140E-26

**CHECKING THE
NEUTRAL START
SWITCH**

The neutral start switch may be causing the "no shift" problem.



Check the neutral start switch by disconnecting the wire harness to it and see if it shifts. If it does, adjust or replace the switch. If it doesn't, check the "L" wire of the ECT computer harness for a short to +12 volts. If the "L" wire is ok, replace the ECT computer.

**A140E STACKED
SHIFTS****SOLENOID TEST**

- 1) Raise the drive wheels
 - 2) Disconnect the harness to the transaxle that goes to the solenoids.
 - 3) Connect a + 12v lead to the white wire and the black wire on the transaxle harness.
- 4) Start the engine and put the gear selector in Drive. (The transaxle should be in 2nd gear.)
- 5) Raise the engine idle to 1200 rpm.
- 6) Pull the t.v. cable all the way to the maximum position
- 7) Does the transaxle make an upshift?
- NO** - stacked shift problem is computer related. Go to step 2 on page 14.
- YES** - If it upshifted, clean or replace the solenoids as needed.

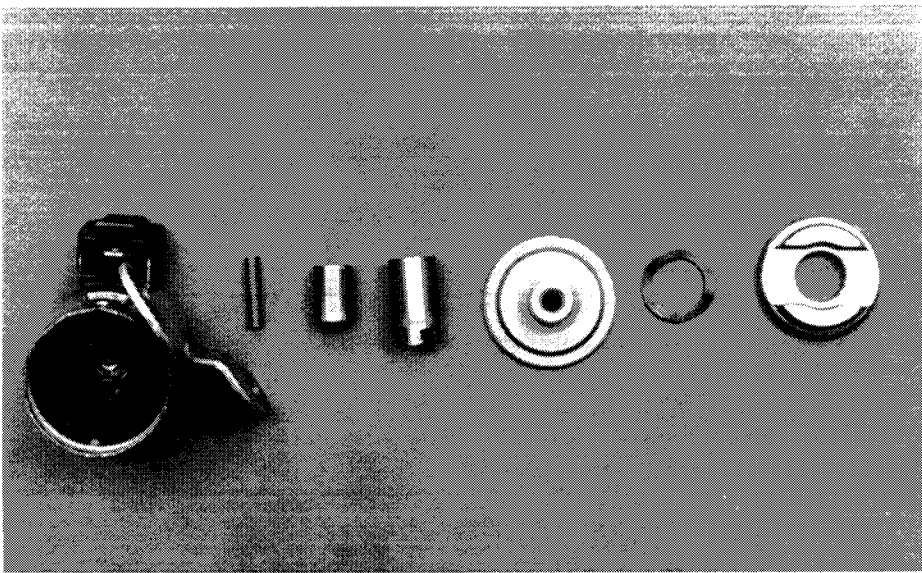
A140E-28

**A140E STACKED
SHIFTS
(CONTINUED)**

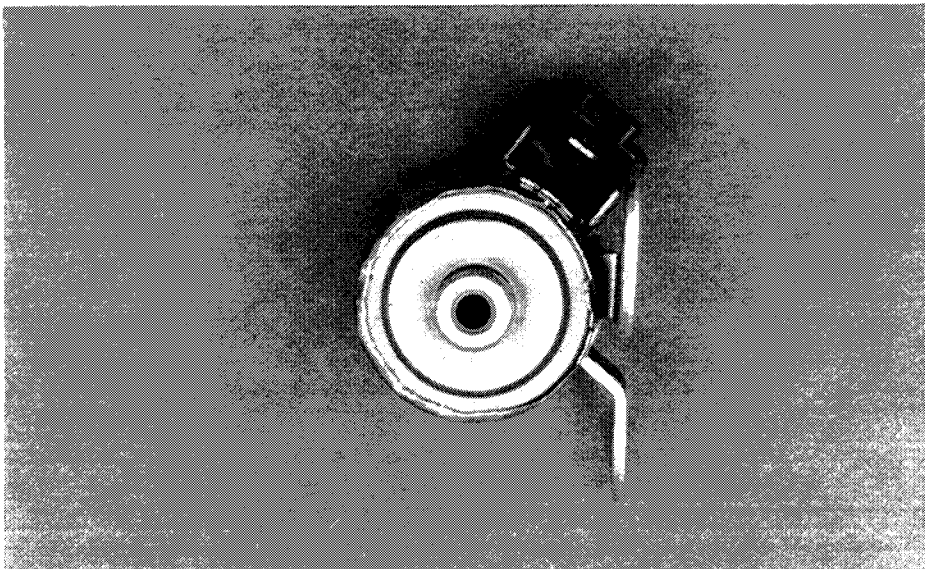
Solenoid Cleaning

The shift solenoids are normally closed solenoids and must be energized in order to clean them. Use a low amperage + 12v dc supply (500 ma). Open the solenoid and flush it with solvent.

If the solenoids are still clogged, you can **carefully** peel the backing off and disassemble them.



Once you clean all the parts, reassemble the solenoid and **carefully** bend the backing in place.

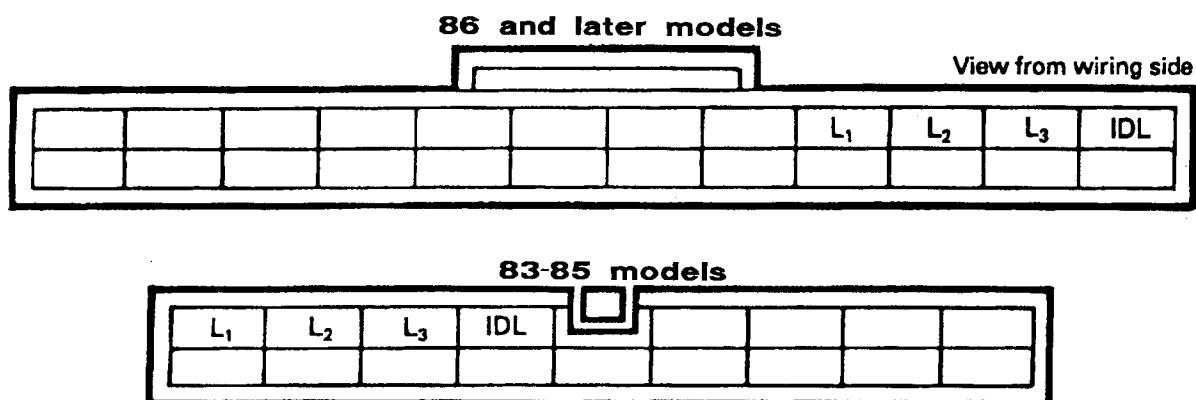


A140E STACKED SHIFTS (CONTINUED)

T.P.S. CHECK

With the ignition on (engine off), and your foot off the brake, check the voltage at the DG terminal at closed throttle. The voltage should be 0 volts and increase +1 volt per 1/8 throttle. Such as, +2 volts at 1/4 throttle, +5 volts at 5/8 throttle, etc.

If the voltage is low, disconnect the wires at the IDL, L1, L2, and L3 terminals of the ECT computer.



Make sure you mark the wires so they go back in the connector correctly. Ground the terminals of the ECT computer according to the chart below and check for the appropriate voltage at the DG terminal.

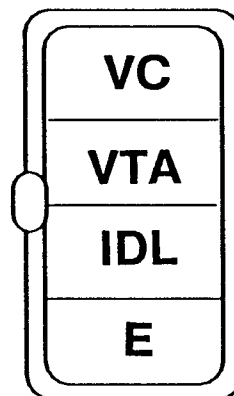
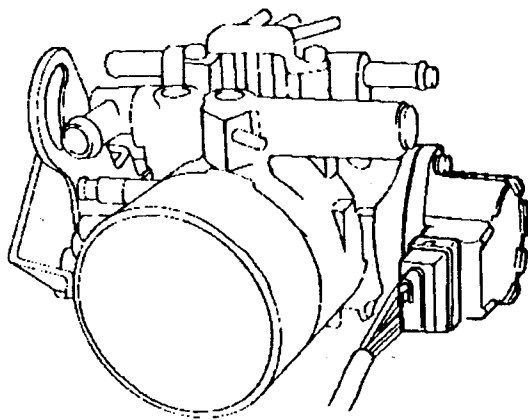
GROUND TERMINAL(S)	VOLTS
IDL	0
0	1
L3	2
L2 & L3	3
L2	4
L1 & L2	5
L1 & L2 & L3	6
L1 & L3	7
L1	8

A140E-30

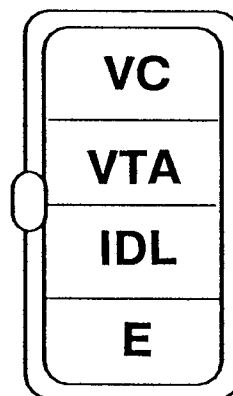
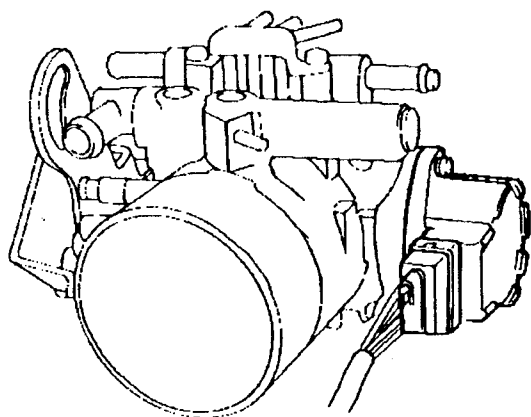
A140E STACKED SHIFTS (CONTINUED)

Note: If you have a voltage reading that is stuck at +8v, check to make sure the brake switch isn't closed and there are no open circuits to the shift solenoids.

- If the voltage works according to the chart, replace the TPS.
- If you're working on an MR2 or Celica, you must check the TCCS ECU before condemning the TPS. The TCCS ECU is a converter that changes the analog signal of the VSS to a digital signal
- To check the TCCS ECU, turn the ignition off. Replace the IDL, L1, L2, and L3 wires at the ECT computer. Now disconnect the harness to the TPS. Connect terminals VTA, E and IDL together.



- Now turn the ignition "on" and check the DG voltage. It should be 0 volts. Turn the ignition "off". Now connect the VC and VTA together.



Turn the ignition "on" and check the DG voltage. It should be +8 volts. If the voltages are correct, TCCS ECU is ok. Replace the TPS.

A140E-31

**140E PART
NUMBERS**

PART NUMBERS

TURBINE SHAFT SEALING RINGS	35712-32010
DIRECT DRUM SEALING RINGS	35617-32010
OVERDRIVE SHAFT SEALING RINGS	35748-32010
SERVO SEALING RINGS	35815-32010
A131L & A140E B2 SEAL	35159-32011
A240E B2 SEAL	35159-20010
A340H B2 SEAL	25159-30010
MANUAL SHAFT PIN RETAINER (COLLAR)	90560-20006
A140E CRUSH SLEEVE	41231-32010
A131L CRUSH SLEEVE	41231-20020
INTERMEDIATE SHAFT NUT A-140E	90179-20004
INTERMEDIATE SHAFT NUT A-131L	90179-18001
GOVERNOR SLEEVE	35145-32011
LUBE PLUGS FOR O/D PLANET	90334-03001

A140E



A604

SECTION

440 - T4
AXOD
A4LD
LOCK UP
700 - R4
AOD
A140E

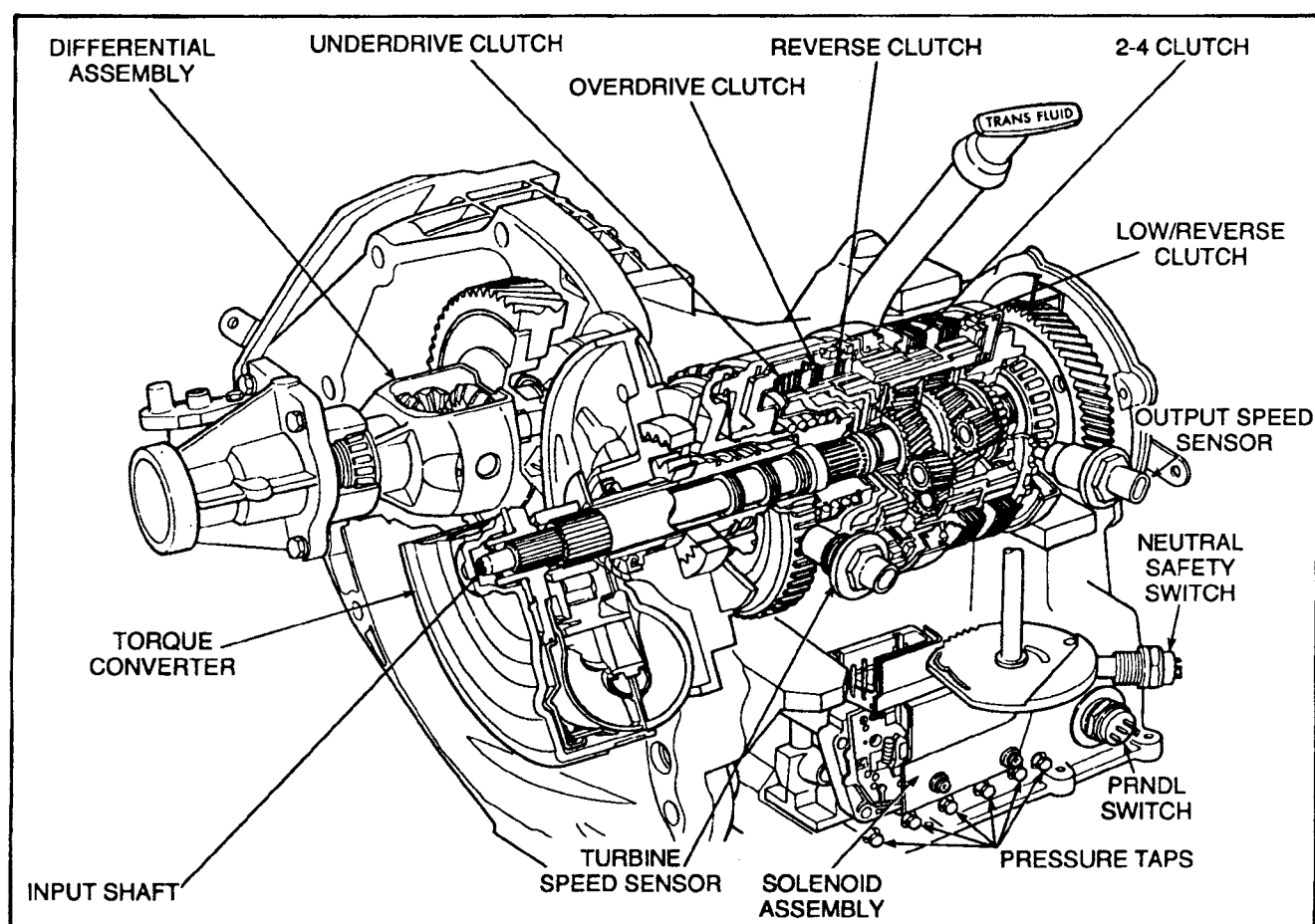
A604

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Testing Solenoids	Page 7

E4OD

INTRODUCTION**Chryslers' A-604 Transaxle**

The Chrysler A-604 is a computer controlled four speed TRANSAXLE. It can be found in 1989 and later Caravans, Voyagers and LaBarons. The computer controls the shift timing and control pressure with a solenoid assembly mounted to the side of the TRANSAXLE. The solenoid assembly also contains three pressure switches that send information back to the computer.



A604-2

SOLENOID ASSEMBLY

CHRYSLER A-604 ELECTRICAL DIAGNOSIS

The solenoid assembly (Fig. 1) for the Chrysler A-604 consists of 4 solenoids, 4 ball valves, 3 pressure switches and 3 resistors. The ball valves are operated by the solenoids and together they shift the transmission through the various gears and control lock up. The 3 pressure switches and resistors are used to signal the computer that a shift has occurred.



Figure 1

During rebuild or repair, the solenoid assembly should be checked for proper operation. This can be done through the 8 pin connector (Fig. 2). Refer to figure 3 for the function of each of the 8 pins.

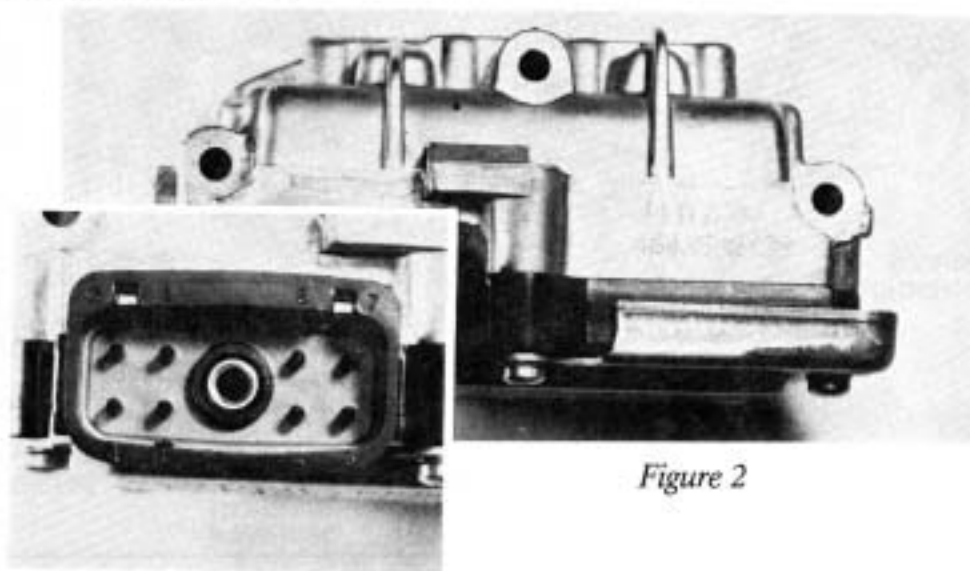


Figure 2

PIN #	FUNCTION
1	2-4 PRESSURE SWITCH
2	LOW-REVERSE PRESSURE SWITCH
3	OVERDRIVE PRESSURE SWITCH
4	12 VOLT INPUT
5	UNDERDRIVE SOLENOID
6	OVERDRIVE SOLENOID
7	LOW-REVERSE/LOCK-UP SOLENOID
8	2-4/LOW-REVERSE SOLENOID

Figure 3

QUICK SHIFTING**Quick Shifting The A-604 Transaxle**

By energizing the solenoids in the proper sequence the TRANSAXLE can be shifted through all four forward gears. Keep in mind the transaxle will shift more firmly since the computer will be unable to oscillate the shift solenoids. The computer oscillates the shift solenoids to control hydraulic apply pressure.

- Raise the drive wheels.
- Disconnect the 8 pin connector at the solenoid control box, You'll find a number stamped in the plastic cover next to each pin.
- Start the engine and place the selector in drive. The transaxle should be in second gear.
- Connect a 12 volt jumper lead to pin #4. Then ground pins 7 & 8 simultaneously. The transaxle should downshift to first gear.
- Remove the ground wires at pins 7 and 8 and the transaxle should upshift into second gear.
- Ground pins 6 and 8 to upshift into third gear. round pins 5 and 6 for fourth gear.
- With the transaxle in 2nd, 3rd, or 4th gear, grounding pin 7 should apply the converter clutch. Use the chart in figure 3 for a quick reference.

RANGE	GROUND THESE PINS
FIRST GEAR	7 AND 8
SECOND GEAR	0
THIRD GEAR	6 AND 8
FORTH GEAR	5 AND 6
LOCK-UP	7

A604-4

CLEANING SOLENOIDS

The solenoid housing can be disassembled and cleaned as follows.

START by removing the six torx bolts that hold the cover on. When you lift the cover off, be careful not to lose the tree springs, (see Fig. 4).

Take the three springs out and carefully lift the plastic housing that holds the four solenoids and three pressure switches (see Fig. 5).

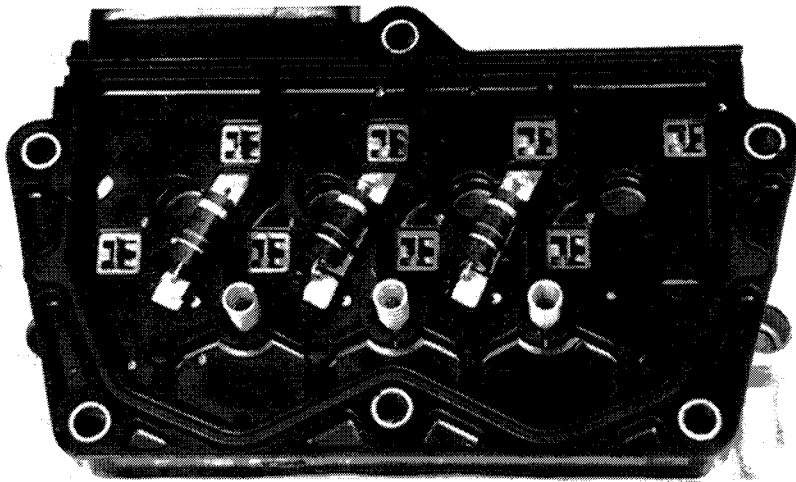


Figure 4

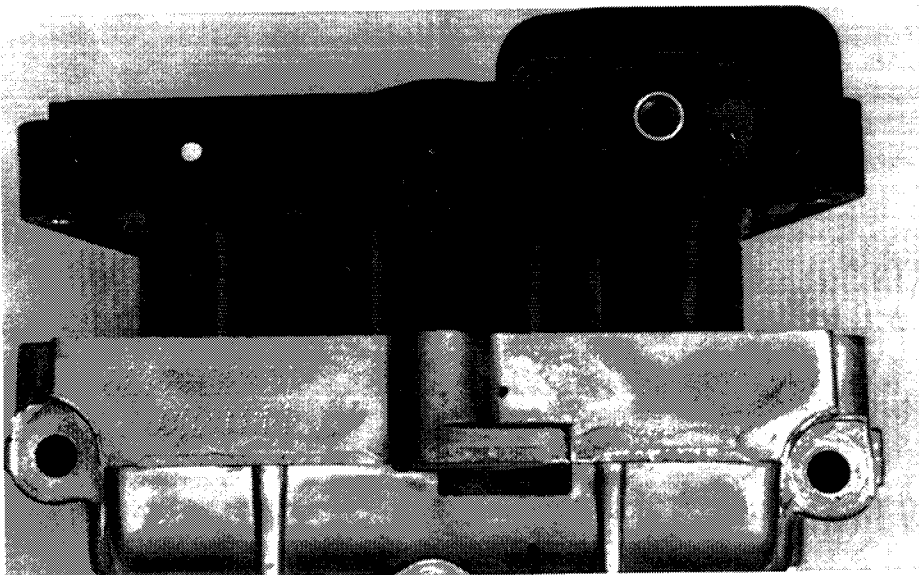


Figure 5

**CLEANING
SOLENOIDS
(CONTINUED)**

Now you can take the switches and solenoids off (see Fig 6). The factory adjusts these levers and they must go back in their original locations.

Now is a good time to check the resistance of the solenoids and resistors. A digital ohmmeter works best. The solenoid resistance should be 1.5 ohms. The resistors should measure 270-330 ohms. You can replace the resistors if they are defective, make sure the replacement resistors have a one amp rating.

Turn the aluminum housing upside down to collect the four washers and valve needles that will fall out (see Fig. 7)

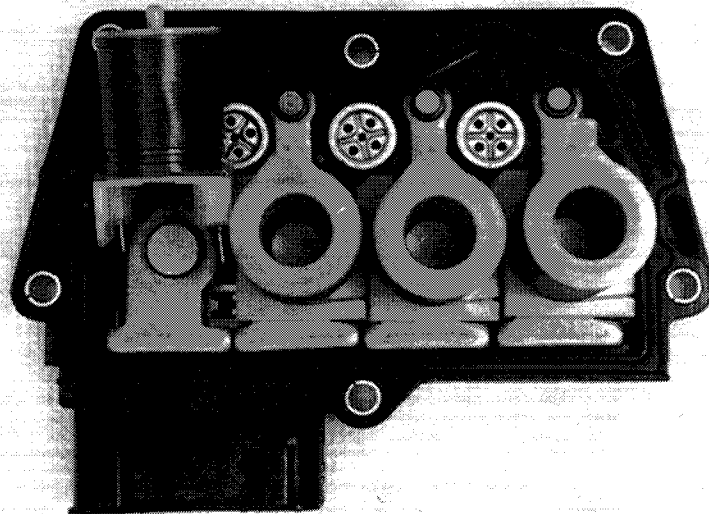


Figure 6

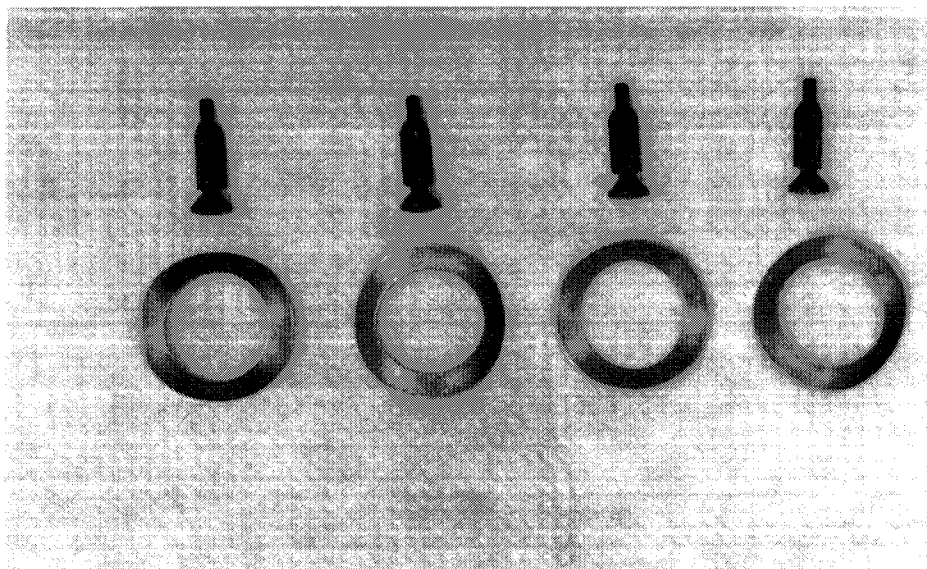


Figure 7

A604-6

**CLEANING
SOLENOIDS
(CONTINUED)**

Take out the two torx bolts that hold the four valves in place (see Fig. 8).

Remove the valves and the check balls under each valve.

Finally, remove and clean the eight screens on the bottom of the casting. Clean all the parts and re-assemble in reverse order.

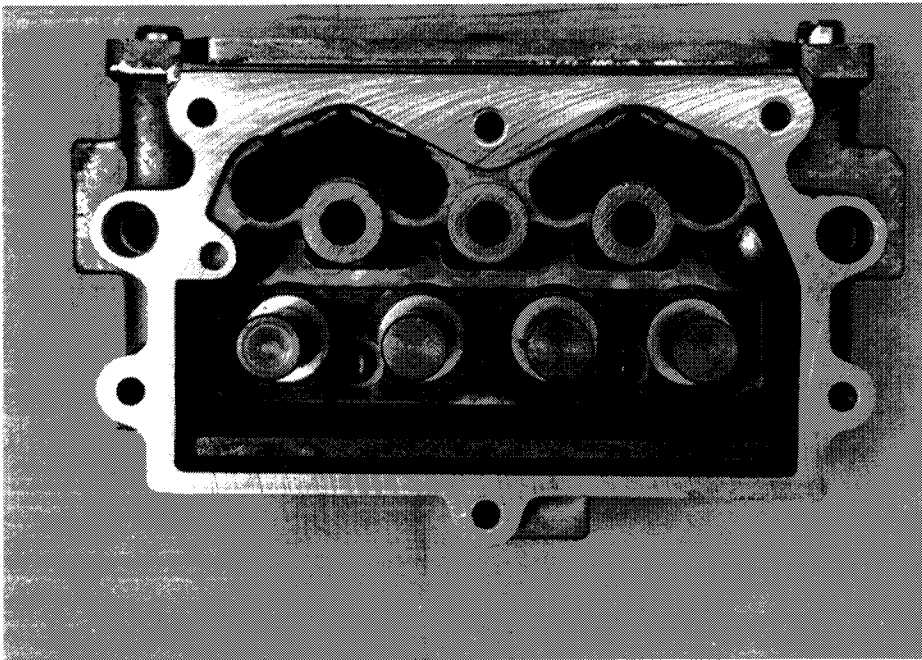


Figure 8

**TESTING
SOLENOIDS**

Once you get the solenoid assembly together, you'll want to bench test it before you put it back on the transaxle.

Set your ohmmeter at ohms times 1 (Rx1). Connect the two leads to pins 1 and 4. The resistance should be 270-330 ohms. Blow compressed air into the 2-4 pressure switch feed (see Fig. 9). The resistance should go to zero. You have just checked the 2-4 pressure switch and its resistor.

Do the same test with the low-reverse pressure switch connecting pins 2 and 4. Connect pins 3 and 4 to check the pressure switch.

Now check the solenoids. Leave the ohmmeter lead on pin 4 and check the resistance on pins 5, 6, 7, and 8 with the other lead. Each should have 1.5 ohms of resistance.

Put the solenoid assembly back on the transaxle and check it for proper operation.

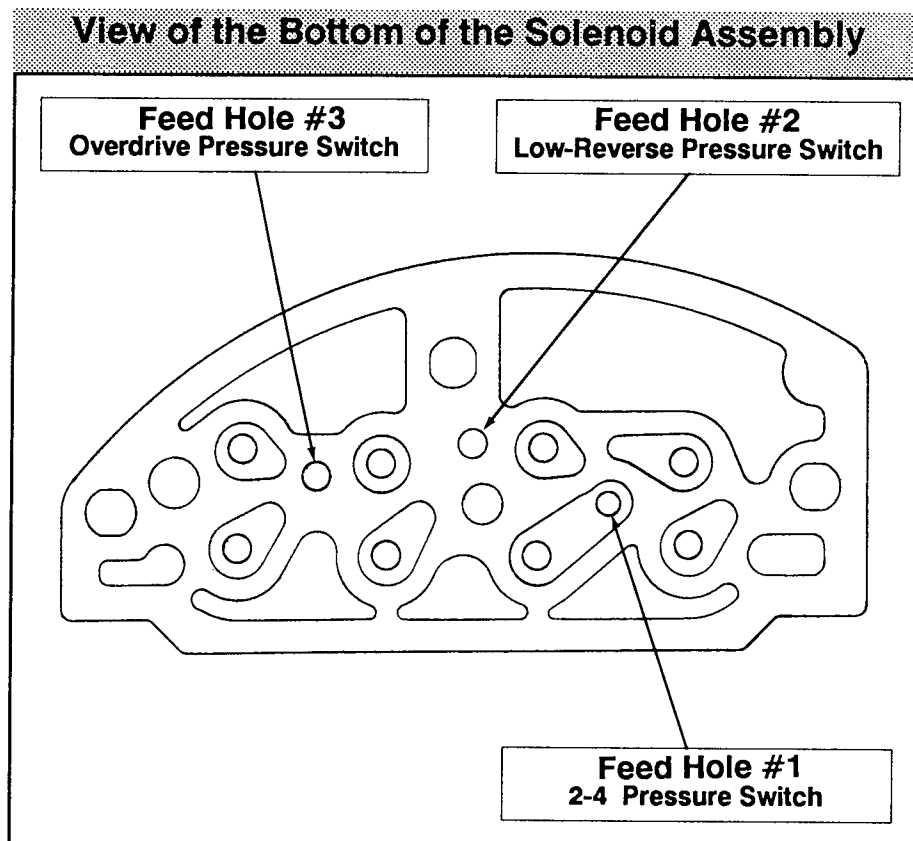
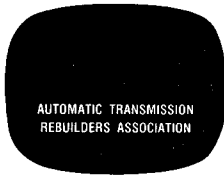


Figure 9



E4OD SECTION

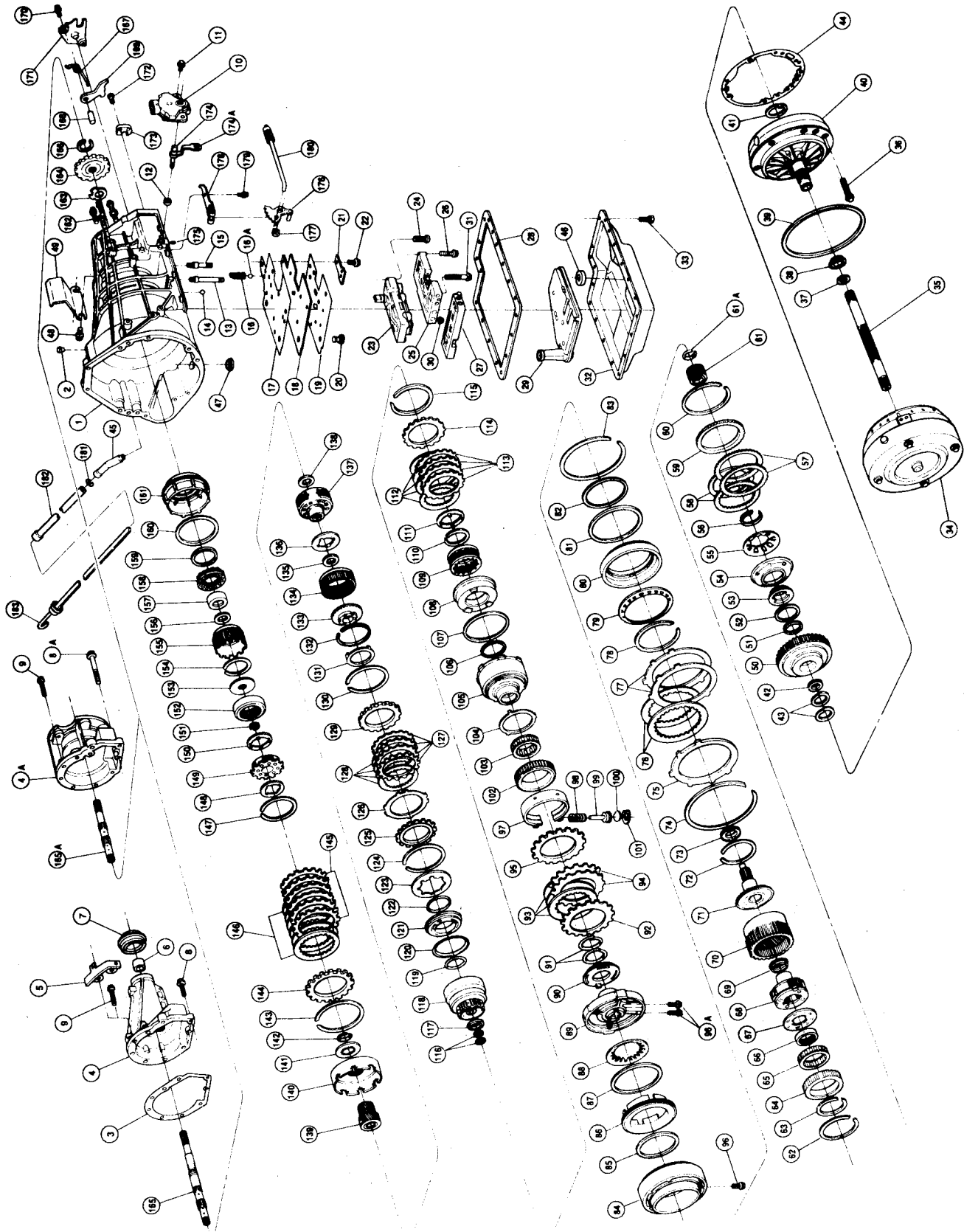
440 - T4
AXOD
A4LD
LOCK UP
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AOD
A140E
A604

E4OD

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E40D-1

EXPLODED VIEW



E40D-2

1.	7005	CASE ASSEMBLY	50.	7G387	COAST CLUTCH CYLINDER ASSEMBLY
2.	7034	VENT ASSEMBLY	51.	7A548-JA	SEAL — INNER
3.	7086	GASKET — EXTENSION HOUSING	52.	7A548-EA	SEAL — OUTER
4.	7A039-CB	EXTENSION ASSEMBLY (4X2)	53.	7G419	PISTON
#	7A041	— EXTENSION & BUSHING ASSY.	54.	7N519	RING — PISTON APPLY
#	7A040	— EXTENSION	55.	7B070-EA	SPRING — PISTON RETURN
4A.	7A039-DA	EXTENSION ASSEMBLY (4X4)	56.	N804949-S	RING — RETAINING
7A039-EA	7A102	EXTENSION ASSEMBLY (SUPERDUTY)	57.	7B442-CA	PLATE — COAST CLUTCH EXTERNAL SPLINE
7H102	7A034	BRACKET — WIRING	58.	7B164-CA	PLATE — COAST CLUTCH INTERNAL SPLINE
#5.	7052	BUSHING — EXTENSION HOUSING (4X2)	59.	7B437-CA	PLATE — COAST CLUTCH PRESSURE
6.	7A034	SEAL — EXTENSION HOUSING (4X2)	60.	N804950-S	RING — RETAINING (SELECTIVE FIT)
7.	7052	BOLT — EXTENSION (4X2 BOTTOM) (2 PCS.) M10X1.5X35MM		N804951-S	RING — RETAINING
8.	N605802-S36	BOLT — EXTENSION (SUPERDUTY & 4X4 BOTTOM) (2 PCS.)		N804952-S	RING — RETAINING
8A.	N605659-S36	M10X1.5X90MM	61.	7670	GEAR — OVERDRIVE SUN
9.	N605803-S36	BOLT — EXTENSION (TOP) (7 PCS.) M10X1.5X40MM		377300-S	RING — RETAINING
10.	7F293	SENSOR — MANUAL LEVER POSITION	62.	377155-S	RING — RETAINING (OUTER RACE TO OVERDRIVE RING GEAR)
11.	N805312-S100	BOLT ASSEMBLY (2 PCS.) M6X1.0X30MM	63.	377135-S	RING — RETAINING (OVERDRIVE OWC TO OUTER RACE)
12.	7B498	SEAL — MANUAL LEVER	*64.	7G389	RACE — OVERDRIVE ONE WAY CLUTCH OUTER
13.	N805331-S	STUD — CASE TO SOLENOID BODY (1 PC.) M6X1.0X79MM	*65.	7G381	CLUTCH ASSEMBLY — OVERDRIVE ONE WAY
14.	7E195	BALL — RUBBER CHECK (10 PCS.) (2 IN MAIN CONTROL)	*66.	7G388	RACE — OVERDRIVE ONE WAY CLUTCH INNER
15.	379581-S	BALL — STEEL CHECK (1 PC.)	67.	7G400	WASHER — THRUST
	N805330-S	STUD — CASE TO CONTROL ASSEMBLY (4 PCS.)	68.	7E031	CARRIER ASSEMBLY — OVERDRIVE PLANETARY
		M6X1.0X61.25MM	#	7L676	— CARRIER
16.	7D017	EPC BLOW-OFF SPRING	#	7D008-CA	— PLANET GEARS (4 PCS.)
16A.	353078-S	EPC BLOW-OFF BALL	#	7A238-CA	— PLANET SHAFTS (4 PCS.)
17.	7D100	GASKET — SEPARATOR	#	7A242-AA	— THRUST WASHERS (8 PCS.)
#18.	7A008	PLATE — SEPARATOR	#	7D037-BA	— NEEDLE BEARINGS (80 PCS.)
19.	7C155	GASKET — SEPARATOR	#	380225-S	— RETAINING PINS (4 PCS.)
20.	7G308	SCREEN — SOLENOID	#	7E486	— NEEDLE BEARING ASSEMBLY
#21.	7F282	PLATE — SEPARATOR PLATE REINFORCING	69.	7G128	NEEDLE BEARING ASSEMBLY
22.	N605772-S	BOLT (3 PCS.) M6X1.0X16MM	70.	7B53	GEAR — OVERDRIVE RING
23.	7G391	SOLENOID BODY ASSEMBLY	71.	7G382	CENTER SHAFT
24.	N805329-S	BOLT — TORX HEAD (9 PCS.) M6X1.0X40MM	72.	7G375	RING — RETAINING (CENTER SHAFT TO OVERDRIVE RING GEAR)
25.	7A100	MAIN CONTROL BODY ASSEMBLY	73.	7G178	NEEDLE BEARING ASSEMBLY
26.	N805326-S	BOLT (18 PCS.) M6X1.0X42.5MM	74.	7B421	RING — OVERDRIVE RETAINING
27.	7G422	ACCUMULATOR BODY ASSEMBLY	75.	7B066-BB	PLATE — OVERDRIVE CLUTCH PRESSURE
28.	7A191	GASKET — OIL PAN	76.	7B164-EA	PLATE — OVERDRIVE CLUTCH INTERNAL SPLINE
29.	7G186-AA	FILTER AND SEAL ASSEMBLY (4X2)	77.	7B442-DA	PLATE — OVERDRIVE CLUTCH EXTERNAL SPLINE
30.	N805328-S	NUT (5 PCS.) M6X1.0	78.	N804948-S	RING — RETURN SPRING RETAINING
31.	N805327-S	BOLT (7 PCS.) M6X1.0X66MM	79.	7B070-CA	SPRING — OVERDRIVE RETURN
32.	7A264-FA	PAN — OIL (4X2)	80.	7G418	PISTON — OVERDRIVE
32A.	7A264-GA	PAN — OIL (4X4)	81.	7A548	SEAL — OVERDRIVE OUTER
33.	N605902-S36	BOLT — OIL PAN (20 PCS.) M8X1.25X12MM	82.	7F225	SEAL — OVERDRIVE INNER (SAME AS INTERMEDIATE INNER)
34.	7902	TORQUE CONVERTER ASSEMBLY	83.	7B421	RING — INT./O.D. CYLINDER RETAINING
35.	87650-S2	— PLUG — CONVERTER DRAIN 1/8 IN-27	84.	7G385	CYLINDER — INTERMEDIATE/OVERDRIVE
36.	N805260-S	SHAFT — INPUT	85.	7F225	SEAL — INTERMEDIATE INNER
		BOLT & WASHER ASSEMBLY — PUMP (9 PCS.)	86.	7E005	PISTON — INTERMEDIATE OUTER
		M8X1.25X65MM	87.	7F224	SEAL — INTERMEDIATE
		— WASHER — REPLACEMENT (9 PCS.)	88.	7B070-DB	SPRING — INTERMEDIATE RETURN
37.	7G379	SEAL RING — TEFLON	89.	7G033	SUPPORT ASSEMBLY — CENTER
38.	7A248	SEAL — CONVERTER HUB	90.	7L326	WASHER — THRUST
39.	7D441	SEAL — SQUARE CUT O.D. PUMP	91.	7D429-A	SEAL — DIRECT CLUTCH CAST IRON (2 PCS.)
40.	7A103	PUMP ASSEMBLY	92.	7B066-CA	PLATE — INTERMEDIATE CLUTCH APPLY
41.	7D014	WASHER — PUMP THRUST	93.	7F219	PLATE — INTERMEDIATE CLUTCH INTERNAL SPLINE
42.	7E486	NEEDLE BEARING ASSEMBLY	94.	7B442	PLATE — INTERMEDIATE CLUTCH PRESSURE
43.	7G402	SEAL RING — TEFLON (2 PCS.)	95.	7B437	PLATE — INTERMEDIATE CLUTCH PRESSURE
44.	7A136	GASKET — PUMP	96.	N805310-S101	BOLT — CYLINDER HYDRAULIC FEED (1 PC.) M10X1.5X24MM
45.	7N463	STUB TUBE	96A.	N805311-S101	BOLT — CENTER SUPPORT HYDRAULIC FEED (2 PCS.) M12X1.75X31MM
46.	7L027	MAGNET — PAN	97.	7D034	BAND ASSEMBLY
47.	7N171	PLUG — CONVERTER ACCESS	98.	7D028	SPRING — SERVO RETURN
48.	N605770-S36	BOLT — HEAT SHIELD (2 PCS.)	99.	7E221	PISTON ASSEMBLY — SERVO
49.	7A434	HEAT SHIELD — SOLENOID BODY CONNECTOR			

*NOT SERVICED IN KITS ONLY

100.	7D027	PLATE — SERVO COVER	142.	377300-S	RING — RETAINING
*101.	N650246-S	RING — SERVO RETAINING	143.	N805207-S	RING — RETAINING
*102.	7G380	RACE — INTERMEDIATE ONE WAY CLUTCH OUTER	144.	7D408	PLATE — REVERSE CLUTCH PRESSURE
*103.	7F271	CLUTCH ASSEMBLY — INTERMEDIATE	145.	7B442-EA	PLATE — REVERSE CLUTCH EXTERNAL SPLINE
		ONE WAY	146.	7E312	PLATE — REVERSE CLUTCH INTERNAL SPLINE
104.	7G401	WASHER — THRUST (LG. DIA.)	147.	377155-S	RING — RETAINING
105.	7D044	DRUM ASSY — INTERMEDIATE BRAKE	148.	7D423	WASHER — THRUST
106.	7A548-GA	SEAL — INNER	149.	7D006	CARRIER ASSEMBLY — REVERSE PLANETARY
107.	7A548-FA	SEAL — OUTER	#	7D007	— CARRIER
108.	7A262	PISTON ASSEMBLY	#	7D008-BB	— PLANET GEARS (4 PCS.)
#	7A258	— PISTON	#	7A238-BA	— PLANET SHAFTS (4 PCS.)
#	375393-S	— CHECK BALL (7/32 INCH DIA.)	#	7A242-BA	— THRUST WASHERS (8 PCS.)
#	7E220	— BALL RETAINER	#	7D037-CA	— NEEDLE BEARINGS (84 PCS.)
109.	7G298	SPRING — PISTON RETURN	#	380225-S	— RETAINING PINS (4 PCS.)
110.	N804817-S	RING — SPRING RETAINING	150.	7D423	WASHER — THRUST
111.	7D428	WASHER — THRUST (SMALL DIA.)	151.	387031-S	RING — RETAINING (FOR OUTPUT SHAFT)
112.	7B164-GA	PLATE — DIRECT CLUTCH INTERNAL SPLINE	152.	7A153	(1-1/2 IN DIA.)
113.	7B442-FA	PLATE — DIRECT CLUTCH EXTERNAL SPLINE	153.	7D164	GEAR — REVERSE RING
114.	7B066-BA	PLATE — DIRECT CLUTCH PRESSURE	154.	377132-S	HUB — OUTPUT SHAFT
115.	377126-S	RING — RETAINING (SELECTIVE FIT)	155.	E7AP-7E193-AA	RING — RETAINING
	377127-S	RING — RETAINING		E7AP-7D390-AA	REVERSE HUB AND CLUTCH ASSY (4X2)
	377128-S	RING — RETAINING		E7TP-7D390-AA	— HUB ASSEMBLY (4X2)
	377437-S	RING — RETAINING		7E392	— HUB ASSEMBLY (4X4)
	377444-S	RING — RETAINING		7E190	— SPRING ASSEMBLY
116.	7D019	SEAL RING — TEFLON (2 PCS.)		377135-S	— ROLLER — OVERRUNNING CLUTCH
117.	7F374	NEEDLE BEARING ASSEMBLY		7E194	— RING — RETAINING (2 PCS.)
118.	7D424	CYLINDER — FORWARD CLUTCH ASSEMBLY	156.	7E413	— BUSHING — OVERRUNNING CLUTCH
119.	7E244	SEAL — INNER	157.	7D171	NEEDLE BEARING ASSEMBLY
120.	7A548	SEAL — OUTER	158.	7F153	RACE — LOW/REVERSE ONE WAY CLUTCH INNER
121.	7A262	PISTON ASSEMBLY	159.	7D404	SPRING — PISTON RETURN
#	7A258	— PISTON	160.	7D403	SEAL — INNER
#	375393-S	— CHECK BALL	161.	7D402	SEAL — OUTER
#	7E220	— BALL RETAINER	162.	7D167	PISTON
122.	7D256	RING — PISTON APPLY	163.	7B388	BOLTS (5 PCS.) 5/16 IN-24 (ONE WAY CLUTCH TO CASE)
123.	7B070-AA	SPRING — PISTON RETURN	164.	7A233	WASHER — THRUST
124.	377127-S	RING — RETAINING (FOR RETURN SPRING)	165.	7060-AA	PARKING GEAR
125.	7B066-AA	PLATE — FORWARD CLUTCH PRESSURE	166.	7060-CA	OUTPUT SHAFT ASSEMBLY (4X2)
126.	7E457	SPRING — CUSHION	167.	387035-S	OUTPUT SHAFT ASSEMBLY (4X4)
127.	7B442-FA	PLATE — FORWARD CLUTCH EXTERNAL SPLINE	168.	7D070	RING — RETAINING (1-9/16 IN DIA.)
128.	7E311-AA	PLATE — FORWARD CLUTCH INTERNAL SPLINE	169.	387640-S	SPRING — PARKING PAWL RETURN
129.	7B066-BA	PLATE — FORWARD CLUTCH PRESSURE	170.	7A441	PIN — PARKING PAWL
130.	377127-S	RING — RETAINING (SELECTIVE FIT)	171.	N805232-S	PARKING PAWL
	377437-S	RING — RETAINING	172.	7D419	BOLT AND WASHER ASSEMBLY (2 PCS.)
	377444-S	RING — RETAINING	173.	N805261-S190	PLATE — PARKING ROD GUIDE
	386841-S	RING — RETAINING	174.	7G101	ABUTMENT — PARKING PAWL ACTUATING
	386842-S	RING — RETAINING	175.	7A286	LEVER ASSEMBLY — MANUAL CONTROL
131.	7D090	WASHER — PLASTIC THRUST	176.	7B210	INSULATOR
132.	377132-S	RING — RETAINING	177.	7A115	PIN — MANUAL LEVER RETAINING
133.	7D393	HUB — FORWARD	178.	N800287-S36	LEVER — INNER DETENT
134.	7D392	GEAR — FORWARD RING	179.	7E332	NUT — INNER DETENT LEVER M14X1.5 HEX
135.	7F078	NEEDLE BEARING ASSEMBLY	180.	N805503-S	SPRING ASSEMBLY — MANUAL VALVE DETENT
136.	7D423	WASHER — THRUST	181.	7D410	BOLT — HEX FLANGE HEAD M6X1.0X16.5MM
137.	7A398	CARRIER ASSEMBLY — FORWARD PLANETARY	182.	87034-94	ROD ASSEMBLY — PARKING PAWL ACTUATING
#	7D055	— CARRIER	183.	7A228	O-RING FILLER TUBE
#	7D008-AB	— PLANET GEARS (4 PCS.)		7A020	INDICATOR ASSY. — OIL LEVEL
#	7A238-AA	— PLANET SHAFTS (4 PCS.)			
#	7A242-AA	— THRUST WASHERS (8 PCS.)			
#	7D037-CA	— NEEDLE BEARINGS (68 PCS.)			
#	380225-S	— RETAINING PINS (4 PCS.)			
138.	7F078	NEEDLE BEARING ASSEMBLY			
139.	7D063	GEAR — FORWARD/REVERSE SUN ASSEMBLY			
140.	7D064	INPUT SHELL			
141.	7D066	WASHER — THRUST			

*NOT SERVICED
*SERVICED IN KITS ONLY

E40D-4

APPLICATION CHART

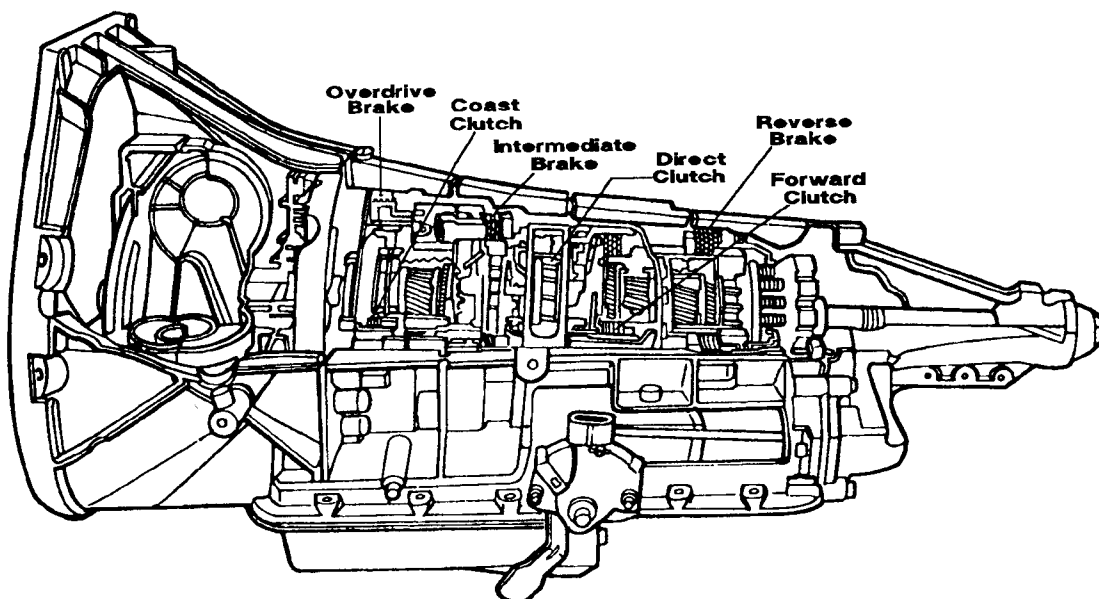
Gear	Friction Elements							One-Way Clutch					
	Coast	Inter- mediate	Direct	Forward	Reverse	Over- Drive	Band	Drive			Coast		
	O/D OWC	Inter- mediate OWC	Low Reverse OWC	O/D OWC	Inter- mediate OWC	Low Reverse OWC							
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑧	⑨	⑩
Ⓓ first	*			apply				hold		hold	o/r*		o/r
Ⓓ second	*	apply		apply				hold	hold	o/r	o/r*	o/r	o/r
Ⓓ third	*	apply	apply	apply				hold	o/r	o/r	o/r*	o/r	o/r
Ⓓ fourth		apply	apply	apply		apply		o/r	o/r	o/r	o/r	o/r	o/r
1	apply			apply	apply								
2	apply	apply		apply			apply			o/r			o/r
Reverse	apply		apply		apply				o/r			o/r	

O/D — Overdrive

OWC — One-Way Clutch

O/R — Overrunning

*In D Range with the Overdrive Cancel Switch pressed, the coast clutch is applied and the O/D one-way clutch is bypassed.



E40D-5

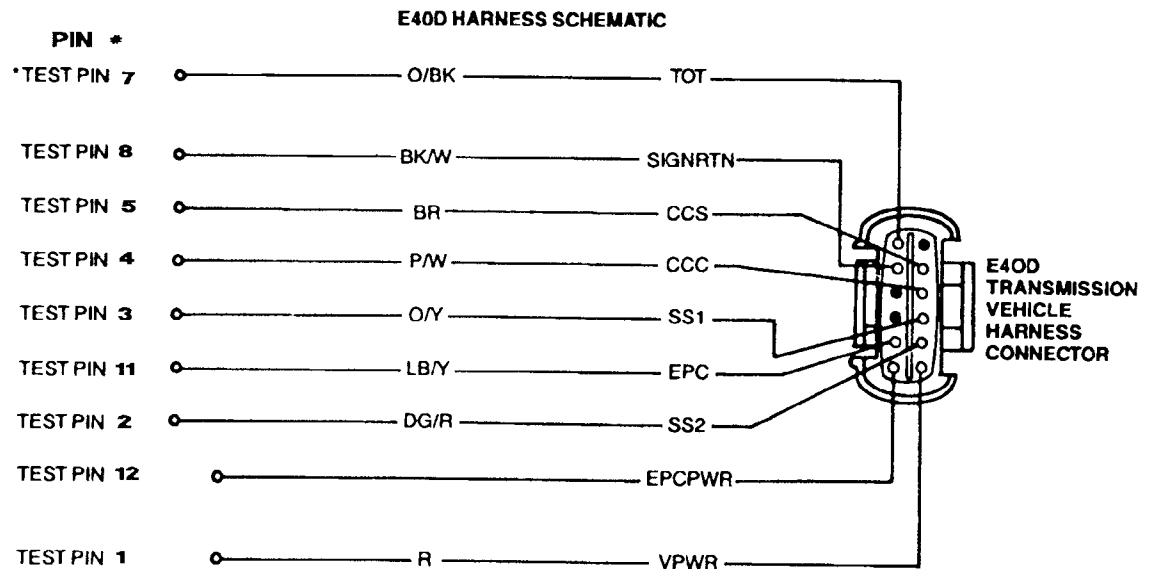
QUICK CHECK THE TRANSMISSION

The E40D can be shifted without the computer by energizing the #1 and #2 shift solenoids in the right sequence.

Connect a 12 volt lead to pin #1.

Connect a ground lead to the pin(s) in the chart below to shift the TRANSMISSION.

	Pin #3	Pin #2
1st Gear	Ground	0
2nd Gear	Ground	Ground
3rd Gear	0	Ground
4th Gear	0	0



*TEST PINS LOCATED ON BREAKOUT BOX.
ALL HARNESS CONNECTORS VIEWED INTO MATING SURFACE.

E40D-6**TESTING
ELECTRICAL
COMPONENTS**

Use the chart below to test the internal electrical components.

Pin #

1 +12 volt common lead (no test for this lead).

2 #2 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 2, it should be 20 - 30 ohm.

3 #1 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 3, it should be 20 - 30 ohm.

4 #3 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 4, it should be 20 - 30 ohms.

5 #4 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 5, it should be 20 - 30 ohms.

6 Void

7 TOT - Check the resistance between pins 7 & 8 use the temperature chart fig for the resistance.

8 TOT - Check the resistance between pins 7 & 8 use the temperature chart fig for the resistance

9 VOID

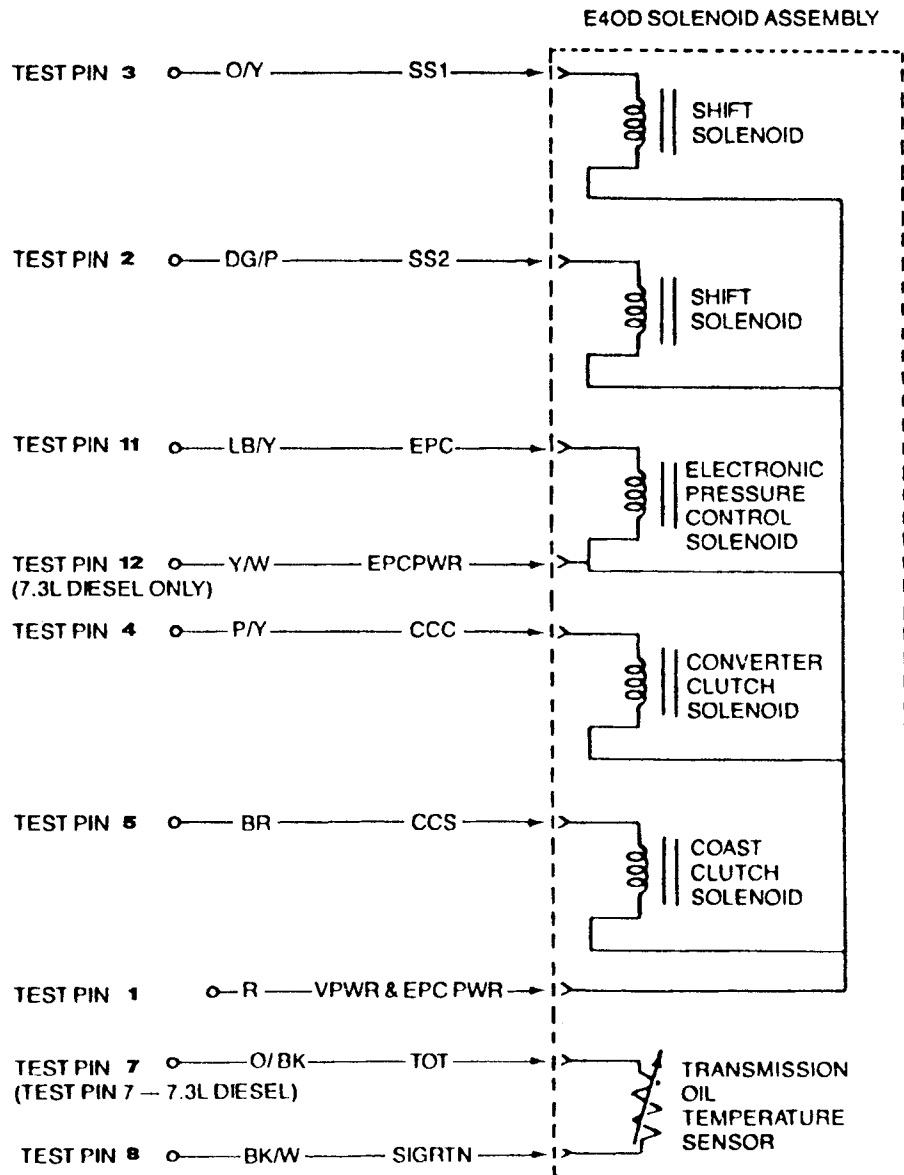
10 VOID

11 EPC - Use an ohmmeter to check the resistance between pins 11 & 12 it should be 4.0 - 6.5 ohms.

12 EPC - Use an ohmmeter to check the resistance between pins 11 & 12 it should be 4.0 - 6.5 ohms.

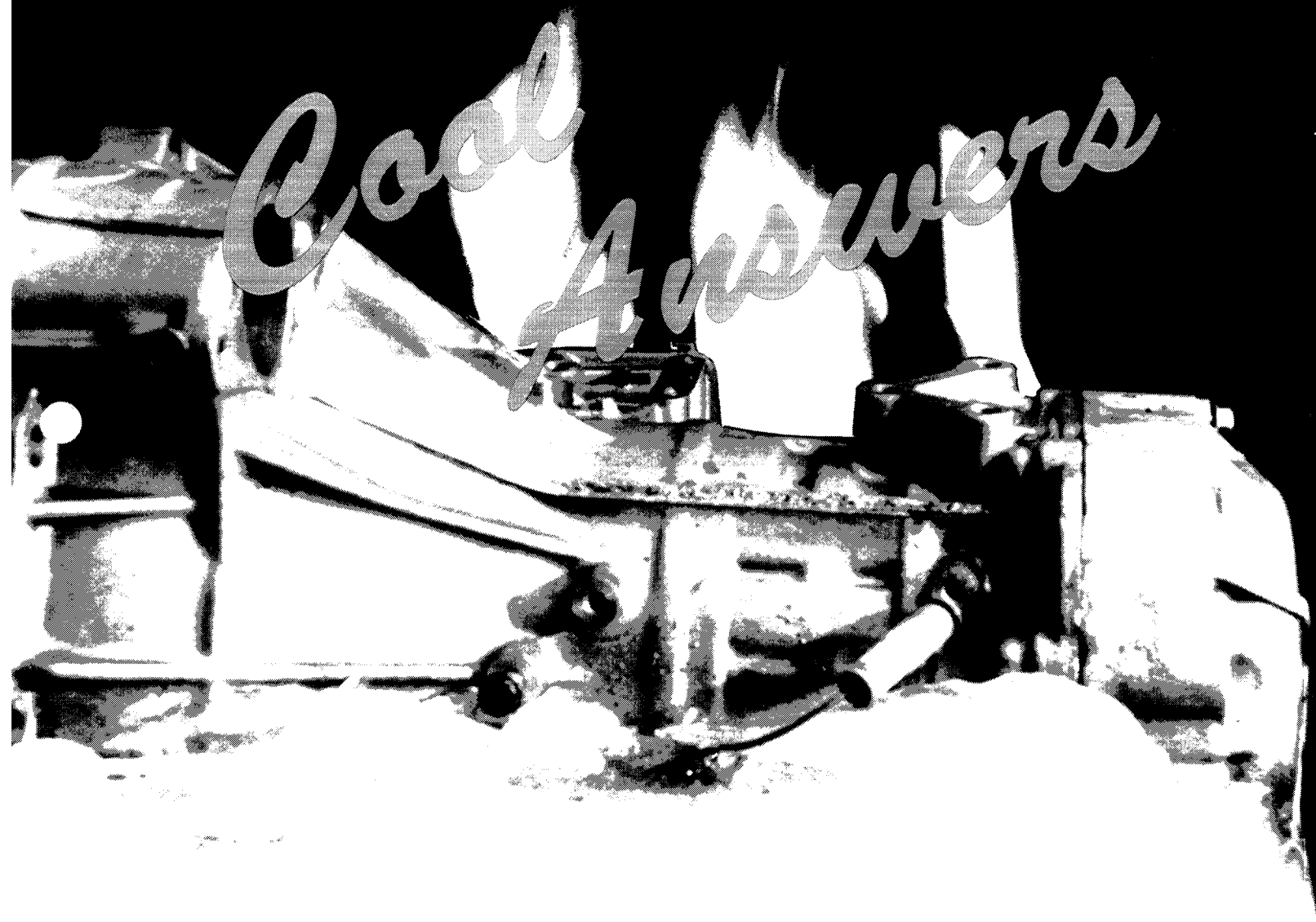
TRANSMISSION FLUID TEMPERATURE		
Degrees C	(Degrees F)	Resistance (Ohms)
0- 20	(32- 58)	37K- 100K
21- 40	(59-104)	16K- 37K
41- 70	(105-158)	5K- 16K
71- 90	(159-194)	2.7K- 5K
91-110	(195-230)	1.5K- 2.7K
111-130	(231-266)	0.8K- 1.5K

Pinpoint Test Schematic



• *Hot Questions*

Cool Answers



Technical Seminar

YOU ASKED FOR PROOF!

And here are the results.

Report on the use of LUBEGARD® ATF Supplement added to General Motors Factory Fill Automatic Transmission Fluid (Reference Fluid).

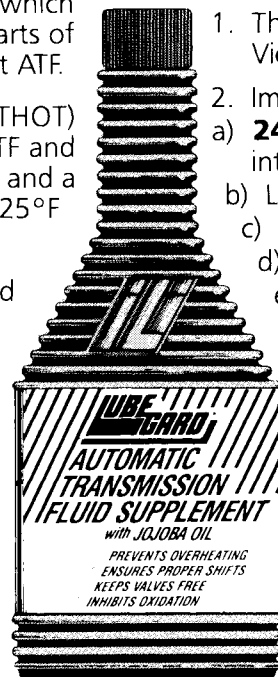
Putting LUBEGARD® ATF Supplement to the test.

Wear, heat stability and frictional properties were tested at one of the two independent laboratories in the world certified by General Motors for Dexron® II testing. These tests represent the primary mechanical bench tests for Dexron® II approval.

TESTS CONDUCTED

The tests run on the ATF with and without LUBEGARD® were:

1. Vickers® Sliding Vane Pump Wear Test which measures the wear on rubbing metal parts of a pump after 100 hours of pumping hot ATF.
2. Turbo Hydra-matic Oxidation Test (THOT) which measures the condition of the ATF and a bench stand transmission after twelve and a half days of running and shifting at 325°F with air injected into the fluid.
3. High Energy Friction Coefficient and Durability Test (HEFCAD) which measures the twisting (torque) of the motionless shaft of a set of automatic transmission clutches when stopping a flywheel moving at 3600 rpm on the other shaft in less than a second. The wheel is stopped and started 3 times per minute for 100 hours.



The ATF used was General Motors Factory Fill Automatic Transmission Fluid, the reference fluid for Dexron® II testing. LUBEGARD® ATF Supplement was added at the recommended level of 1 fluid oz per quart.

TEST RESULTS

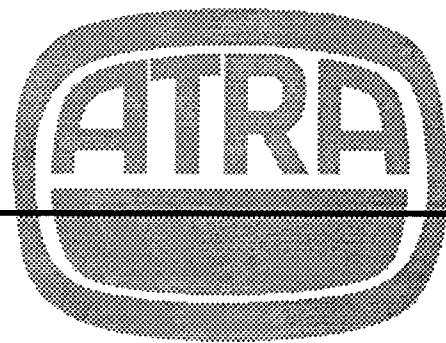
Test results on GM Factory Fill with LUBEGARD® were compared to GM Factory Fill without LUBEGARD®, they showed:

1. The wear on the contacting parts of the Vickers® Vane Pump was reduced **over 50%.**
2. Improvement in areas of Oxidative Stability:
 - a) **24%** less oxidative breakdown of the ATF into acids.
 - b) Less sludge formation.
 - c) **30%** less oxygen uptake.
 - d) **60%** less pentane insolubles.
 - e) No penalty to transmission seals or fluid viscosity.
3. The following frictional improvements were:
 - a) Smoother, more stable power transfer through the clutches with less shock, or torque peak, at the beginning or the end of clutch engagement.
 - b) No sign of extra slipperiness that might cause excess clutch slippage and wear.

Hot Questions Cool Answers

Technical Seminar

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Ventura, California 93003
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technical seminar

seminar handout

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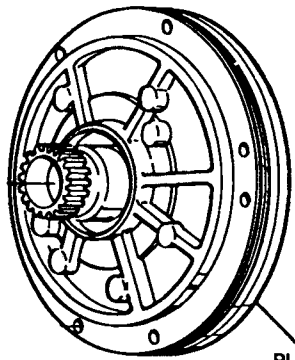
Section 8

E4OD

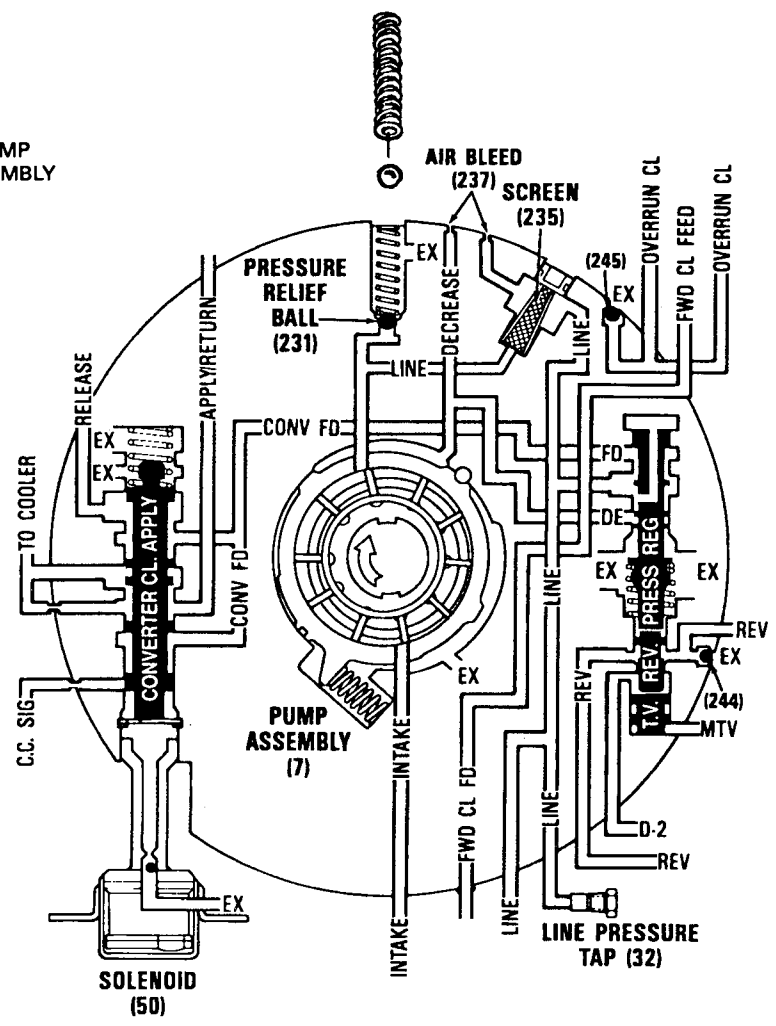
Section 9

KM175

Hydraulics



PUMP ASSEMBLY



Principles Of Hydraulics

Engineers divide the science of hydraulics into two general groups, hydrodynamics and hydrostatics.

Hydrodynamics is the study of moving liquids.

Hydrostatics is the study of liquids under pressure.

The torque converter operates according to the principles of hydrodynamics. The valve body, clutches and servos depend on the laws of hydrostatics. As you begin to understand the principles of hydraulics, diagnosis and repair time will decrease. Hydraulic schematics will become roadmaps which will show you which direction to turn when a unit is shifting early, late, hard, soft or not at all.

Liquids Resist Compression

Hydraulic devices work because liquids resist compression. If you place a piston at the open end of an air filled container, the piston would compress the air. How much the air compresses would depend on the weight of force behind the piston.

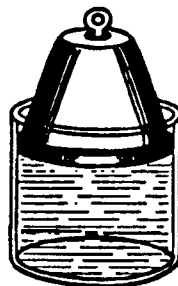
If you fill that same container with a liquid, the piston would not be able to compress the fluid. The liquid would either leak past the piston or break the container, depending on the amount of force pushing the piston.



100 LBS.



100 LBS.



Pressure Is Equal In All Directions

When you think of pressure, think of a fluid filled cylinder with a piston at one end. When you apply a force or weight to the outside of the piston, there is a pressure on the liquid inside the container.

Pressure is usually measured in pounds per square inch (PSI). Pounds per square inch tells you that the piston is pushing on every square inch of fluid with the same amount of force. This means that the pressure within the cylinder will be the same in every direction.

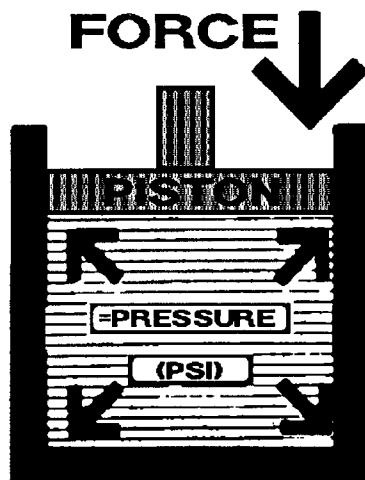
If the apply force on a one square inch piston is 100 PSI, the pressure on the walls and opposite end of the cylinder will also be 100 PSI. The pressure is the same throughout the cylinder because of the first law of hydraulics.

Pascal's Law, the first law of hydraulics, states: **Pressure on a confined fluid is transmitted equally in all directions.**

To calculate pressure:

Force Divided By Piston Area = Pressure

You don't need this formula to repair transmissions. You do, however, need to know that the pressure from a small diameter piston will be greater than the pressure from a large diameter piston.



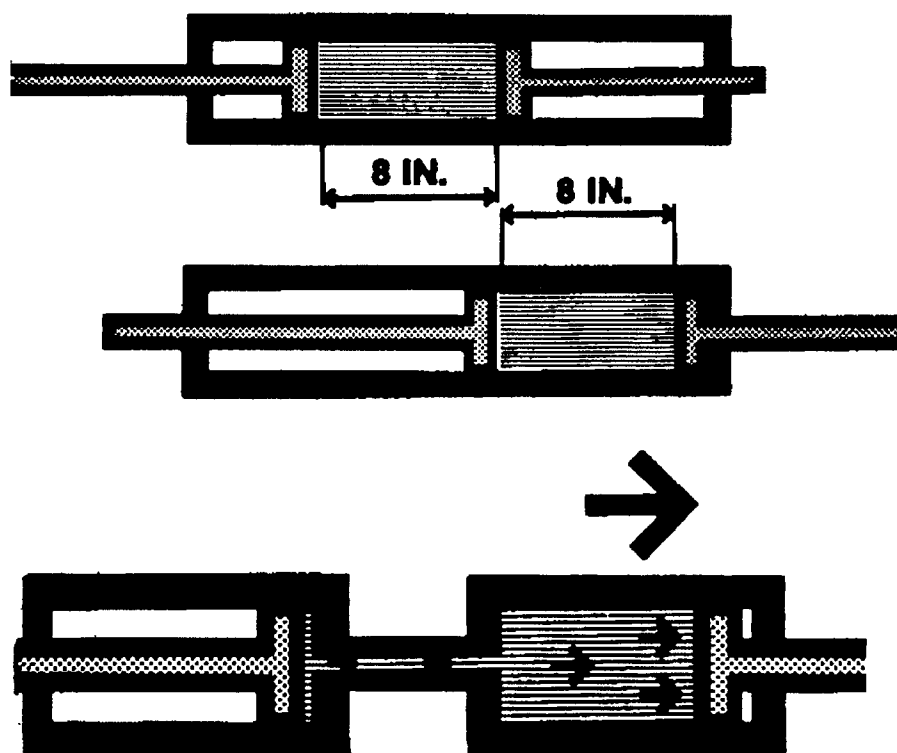
Liquids Can Transmit Motion

Since liquids resist compression, they will transmit motion or move other objects.

If a liquid filled cylinder had a piston at either end, any movement by one piston would make the other piston move.

In this case, the piston causing the action is the apply piston while the piston that is receiving the action is the output piston.

If you move the apply piston 8 inches, the output piston would also move 8 inches. Liquids can also transmit motion from one cylinder to another through tubes or passages.

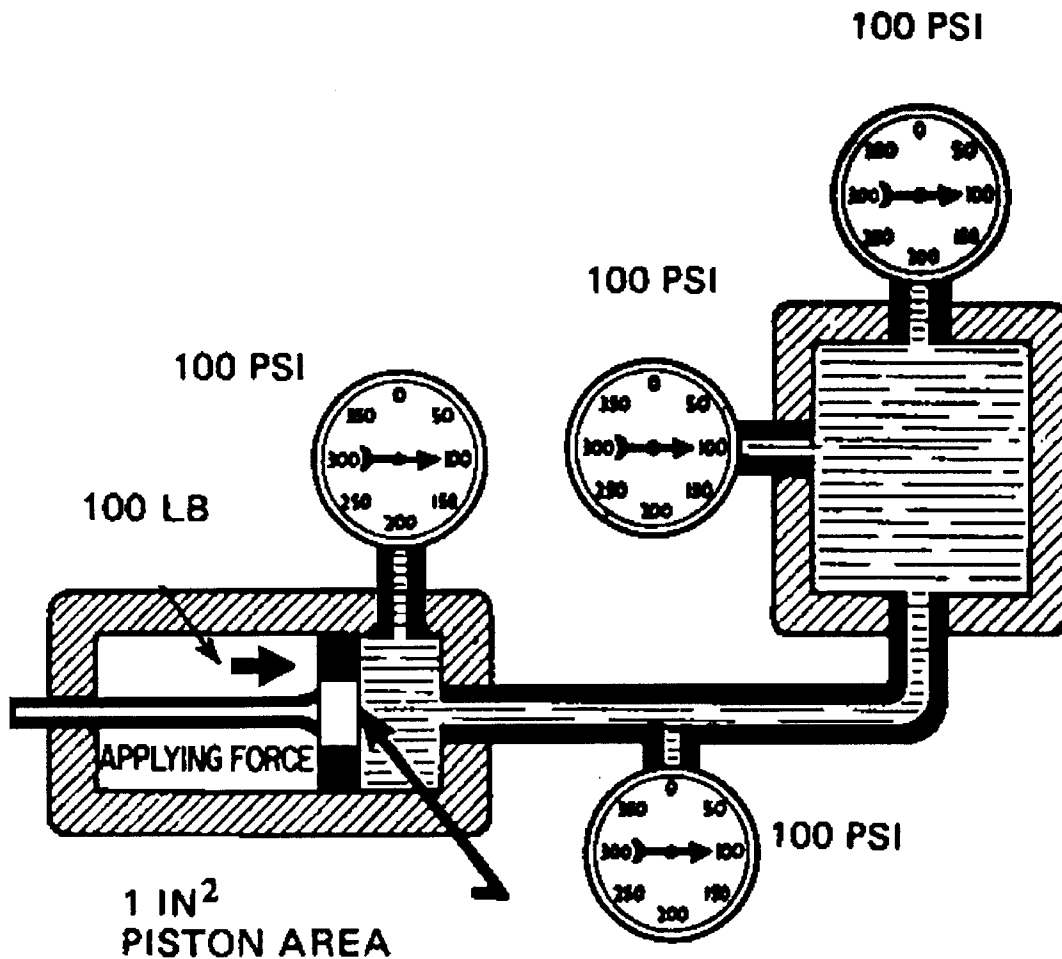


Force - Input/Output

There are two types of force, just as there are two types of pistons.

There is an input force and an output force. You measure both in pounds.

An apply force is the amount of weight or pressure on the apply piston.



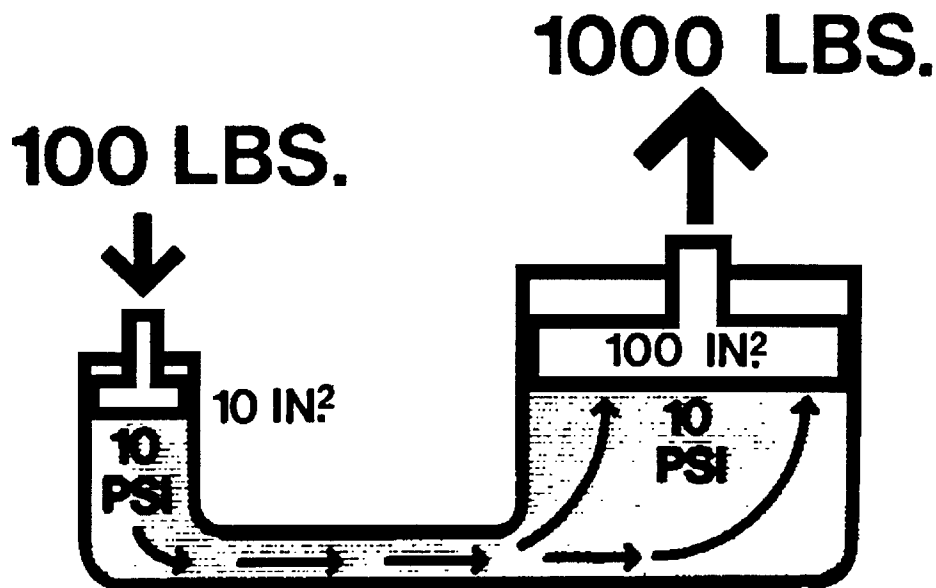
Hydraulic Leverage

Have you ever wondered how an 87 pound weakling can jack up a 3,000 lb. car and never break a sweat?

The answer is easy when you understand leverage.

If you had a 10 square inch apply piston, with 100 lbs. of force, there would be 10 PSI throughout the system. However, when you distribute 10 PSI across a 100 square inch area the output force is 1000 pounds!

Remember, that little guy really has to pump the jack handle. To get the larger piston to move 1 inch, the smaller piston would have to move 10 inches.



Hydraulic Leverage

Hydraulic leverage also works in a system that has more than one cylinder and output piston. In this example, there is a one square inch piston with 100 pounds of force applied to it.

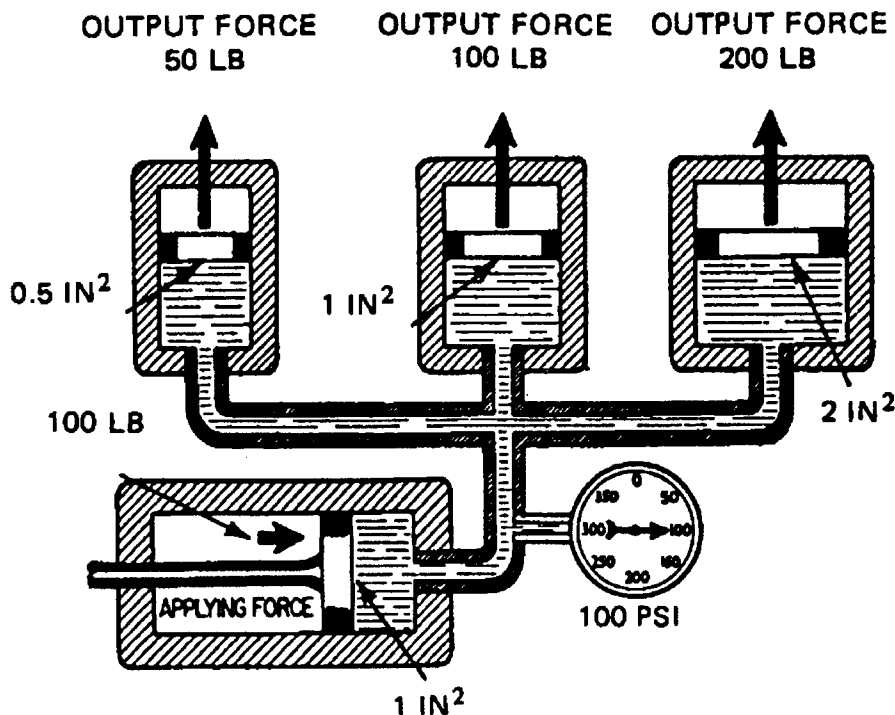
The pressure in the system is 100 PSI.

To determine the output force, multiply the line pressure times the piston area.

LINE PRESSURE (PSI) X PISTON AREA = OUTPUT FORCE

This formula means that .5 (1/2) square inch piston, with 100 PSI applied to it will produce a 50 lbs. output force.

This also means that a 2 square inch piston with 100 PSI applied to it will produce 200 lbs. of output force.



Control Flow And Pressure

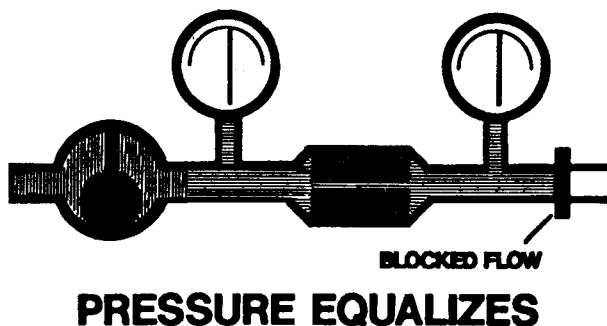
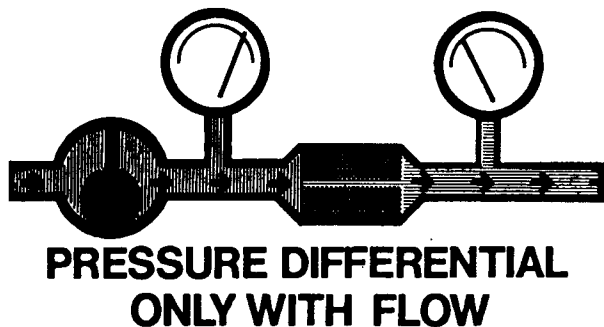
For a transmission to operate properly, it must control fluid pressure and fluid flow. If either of these two areas are not within specification, the unit may not shift properly.

The part that regulates both flow and pressure is the valve body.

There are three types of valves in the valve body. One type of valve regulates, the other type of valve directs. The third type of valve directs and regulates.

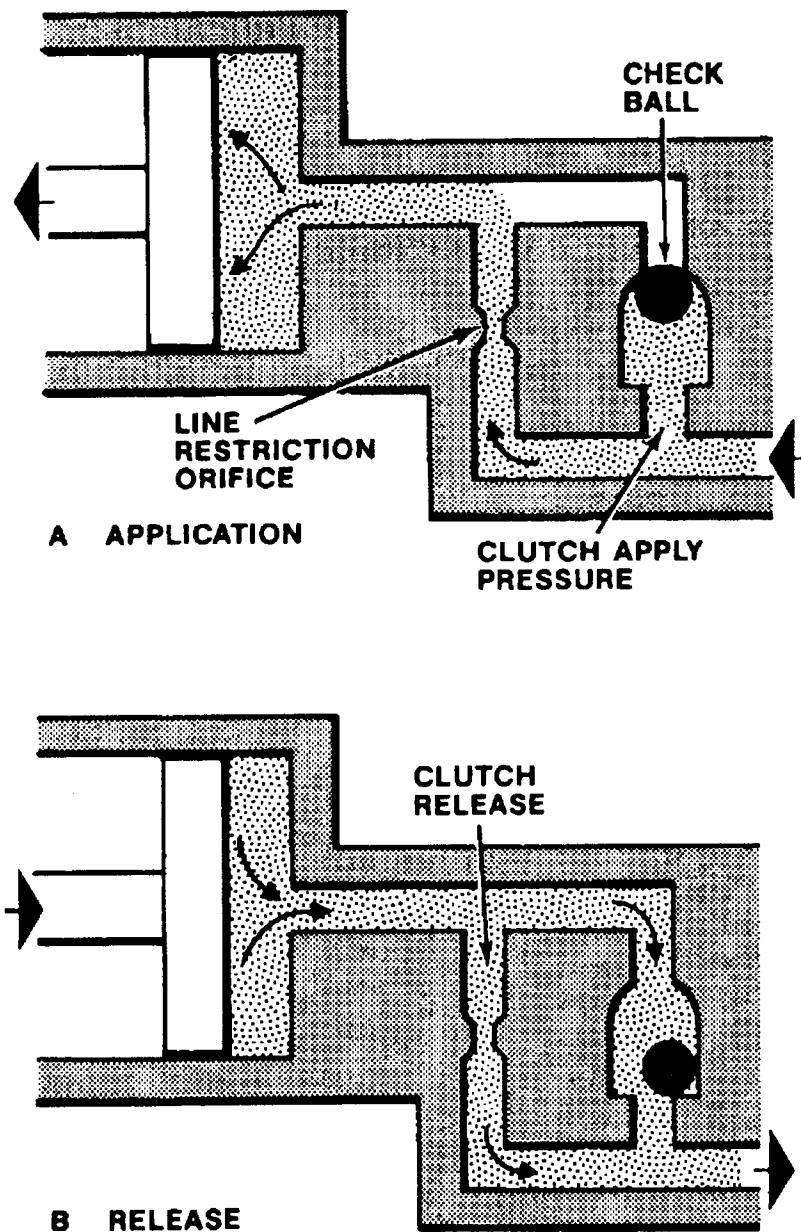
An Orifice Controls Flow And Pressure

One way to regulate the flow and pressure of fluid is to use an orifice. An orifice is a restriction in a hydraulic passage that creates back pressure and delays pressure build-up. An orifice creates a pressure drop. If you restrict or block an orifice, the transmission may not work properly.



Check Balls Regulate Flow

Check balls are small steel or rubber balls that allow fluid to flow in only one direction. When fluid is flowing in one direction, it pushes the check ball out of the way and into the open position. The fluid then flows around the ball. If the fluid begins to go in the opposite direction, it pushes the ball into its seat blocking the flow of fluid.



Separator Plates

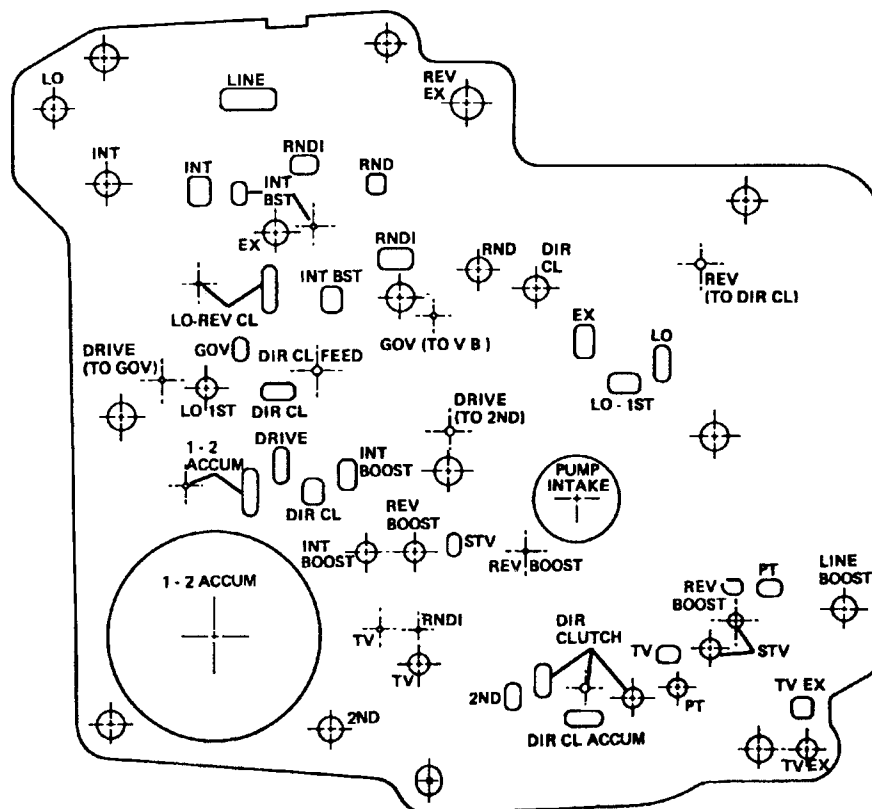
A separator plate controls the flow of fluid from one half of the valve body to the other or from the valve body to the case passages. It also creates a differential pressure through small orifices and provides an area for check balls to seat.

When the valve body sends oil through a circuit to the separator plate, the opening in the plate restricts or slows oil flow. The restricted oil keeps building up behind the plate to create a back pressure. Now, the pressure on one side of the plate is higher than the pressure on the other side of the plate.

This difference in pressure or pressure differential keeps clutches and bands from making a harsh apply.

When you make a hole or orifice in a separator plate larger, the amount of fluid flowing through the orifice increases. The increased flow means that pressure in the circuit will equalize faster.

The separator plate provides a seat location for the check balls. As you already know, you use check balls to direct the flow of fluid within the unit.



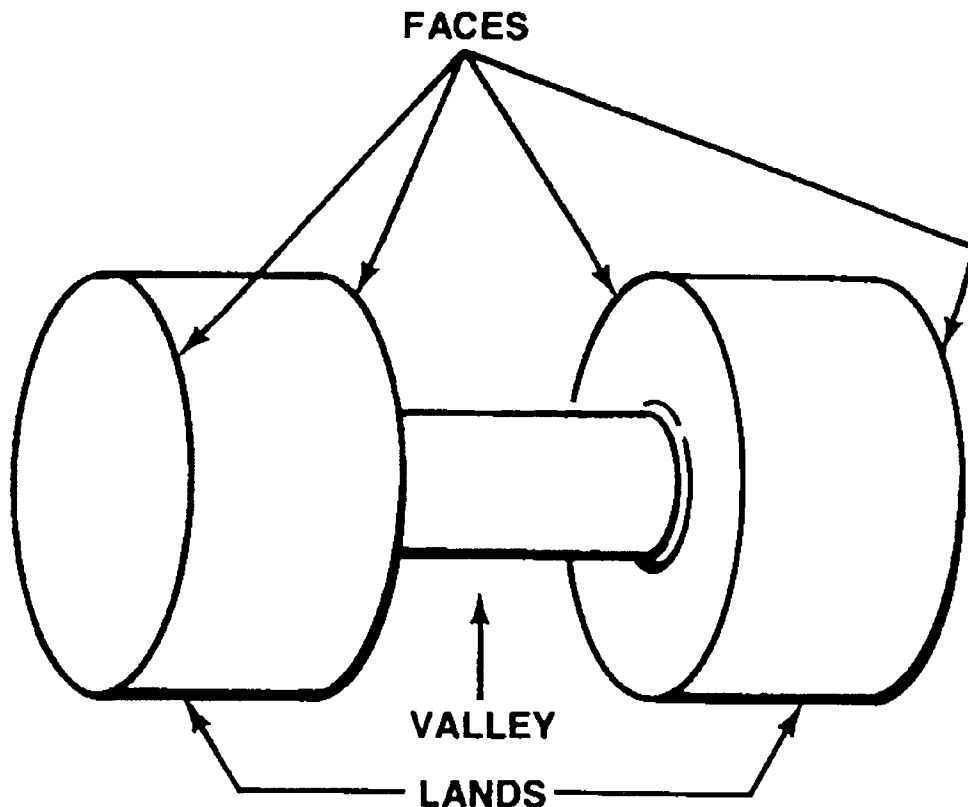
Valves

The most common valve within a transmission is a spool valve. Spool valves control fluid pressure and the direction of flow. You find them in the valve body, governor, case or pump.

There are three main parts of a spool valve: The land, valley and the face.

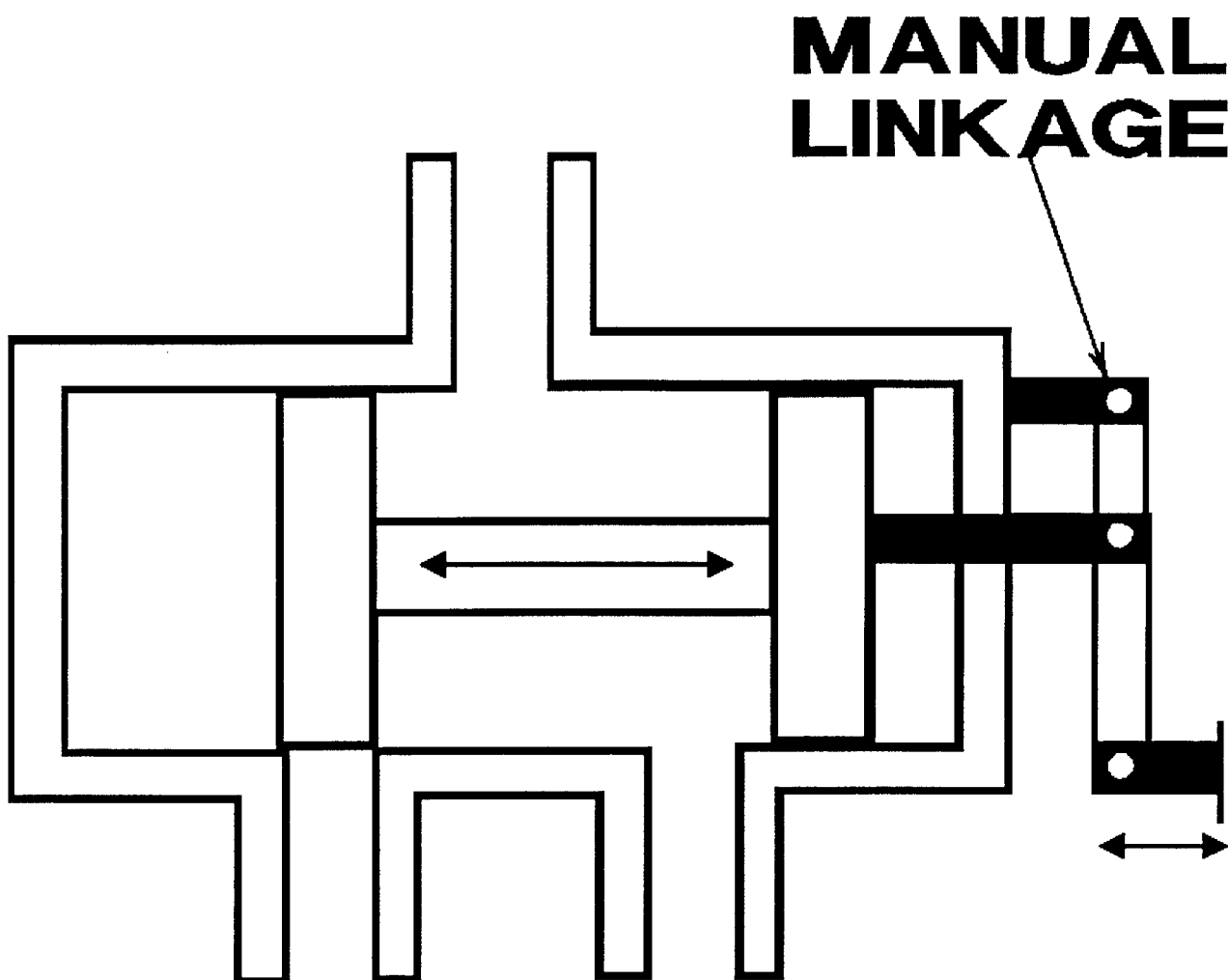
You use the land on the valve to block off passages and control fluid flow. The valley allows fluid to flow between the lands to an open passage.

Engineers closely fit the spool valve to a round bore. The valve slides in the bore on a pressurized film of liquid. Valve position opens and closes fluid passages. The fluid directed to the valve flows past the valve and enters another passageway as long as the valve position does not obstruct the flow. In the diagram below, we are directing fluid to the spool valve. The valve positioning allows fluid to flow into passageway "B". If you move the valve to the left, you would block passageway "B" and passageway "A" would open. Thus, the spool valve can direct flow. An automatic transmission spool valve typically has many lands, and is responsible for directing flow into many different passageways.



Valves Can Be Positioned Manually

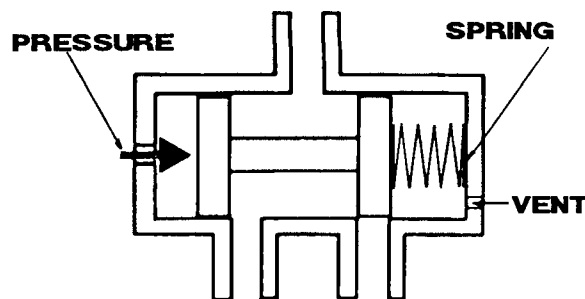
The spool valve moves back and forth in its bore to direct flow into different passageways or circuits. There are three different methods to position the spool valves - manual linkage, hydraulic pressure, and spring pressure. The diagram below shows a spool valve positioned with manual linkage. If you connect a lever to the valve, as shown, movement of the lever would cause movement of the valve. This, in turn, would change the direction of flow from one circuit to another. In an automatic transmission, you connect a spool valve to the manual linkage so the driver may select the circuit he wishes.



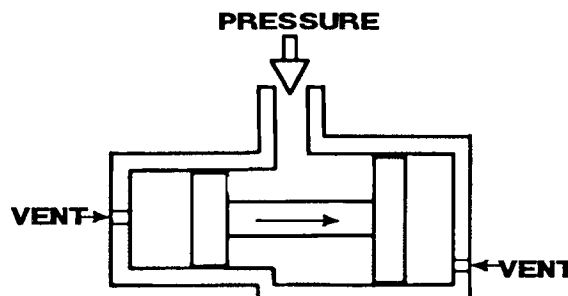
Valve Positioning

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Spring pressure and hydraulic pressure can also position a spool valve. The diagram below shows spring pressure and hydraulic pressure positioning a valve. The spring operates to hold the valve in a position to close off a passageway. Hydraulic pressure directed at the other end of the valve provides an opposing force to the spring. If the hydraulic pressure on the end of the valve increases, at some point it will exceed the spring pressure. When this happens, the valve will move to the right, compressing the spring. The fluid flows past the valve and enters the other passageway. If hydraulic pressure decreases, the spring will act to reposition the valve to its original location.



Hydraulic pressure alone may also move a valve. When two adjacent lands of a valve have different diameters, apply pressure between them gives the larger land a harder push. This compares to different sized output pistons in a hydraulic system as discussed earlier. The diagram below shows a valve with two different sized lands. Applied pressure, causes a greater force to move the valve to the right. Most of the valves in an automatic transmission have different size lands so hydraulic pressure can position them.



Hydraulic Pumps

The transmissions hydraulic system starts at the pump. The pump picks up and sends oil under pressure to the proper circuits within the case.

There are two types of oil pumps in automatic transmissions: Positive displacement pumps and variable displacement pumps.

Positive Displacement Pumps

Positive displacement pumps are very common. One type of positive displacement pump is the gear type pump found on GM, Ford and import transmissions.

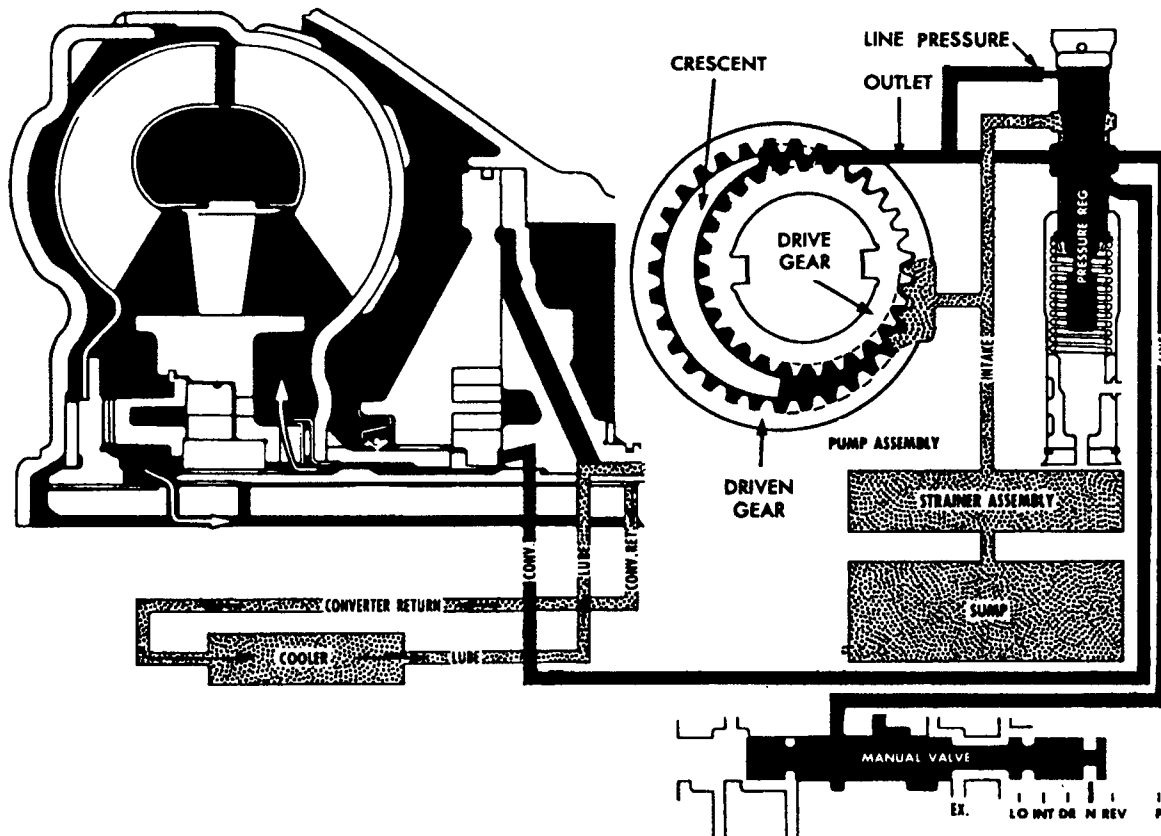
Positive displacement pumps do not have any internal controls. They cannot control pump output. Whatever the pump picks up it pushes out. Engine speed controls pump output. The positive displacement pump delivers fluid at a rate determined by how fast we are driving it. This means that the faster the pump turns, the more flow it provides and the more pressure it generates. The pressure regulator operates to hold the pressure in the system at a desired level, regardless of how fast we are driving the pump beyond the minimum speed needed.

A typical pressure regulator is on the next page. The pressure regulator is close to the pump. The regulator consists of a cylindrically shaped valve positioned in a chamber by a calibrated spring. Fluid pressure from the pump acts on the valve and spring. When the pressure rises above the required amount, the valve moves, uncovering a passageway back to the oil pan. Excess fluid from the pump goes back to the pan. Every time the pump pressure rises, the valve moves to bleed off the excess pressure. This action maintains a constant pressure at the outlet. The tension of the calibrated spring controls the pressure at the outlet. If you increase the spring tension the pressure would increase because it would take more pump pressure to move the valve into the bleed-off position. If you decrease the spring tension, the pressure would decrease.

Variable Pressure Regulator

Most automatic transmissions use a type of pressure regulator valve called a variable pressure regulator. A variable pressure regulator provides different pressures in the transmission for different operating conditions. For example, to hold the transmission in low range it may take 90 PSI. Drive range, however, may only require 50 PSI, and reverse as much as 250 PSI.

The variable pressure regulator has some provision for changing the tension of the calibrated spring. The spring tension changes when a piston or boost valve pushes against it. When requiring pressure beyond the spring setting, we send pressure to the boost valve. The valve moves against the spring, assisting the spring by increasing its tension. This action prevents the regulator valve from bleeding off pressure, and results in a high pump pressure. We call the pressure that acts on the boost valve to raise the spring force, boost pressure. When requiring less pressure, we send less fluid to the boost valve. The spring relaxes and the regulator valve can move to bleed off pressure at a lower level.



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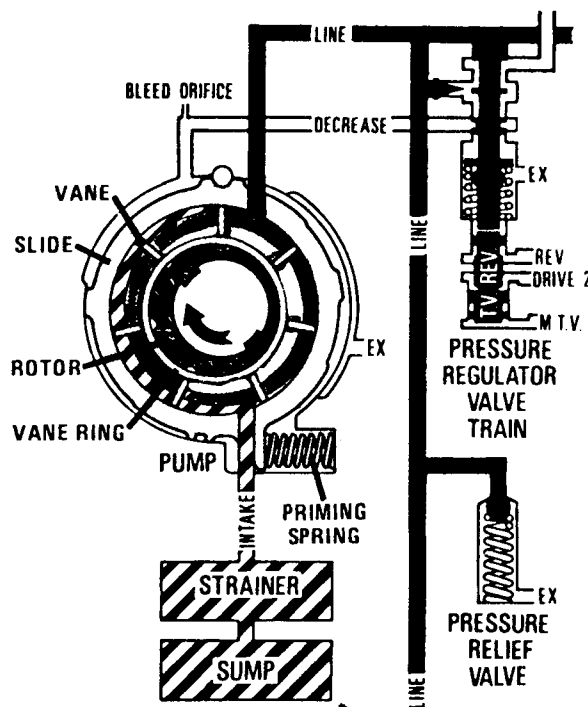
Variable Displacement Pumps

Variable displacement pumps are usually called vane type pumps. These pumps were used on 4-speed Hydro's, Jet-A-Ways and Model 5 and 10 Roto-Hydratics. Today, GM and Ford use these pumps in late model transmissions.

Like a gear pump, the engine directly drives the vane pump, but unlike a gear type pump, a vane pump can change output without changing RPM.

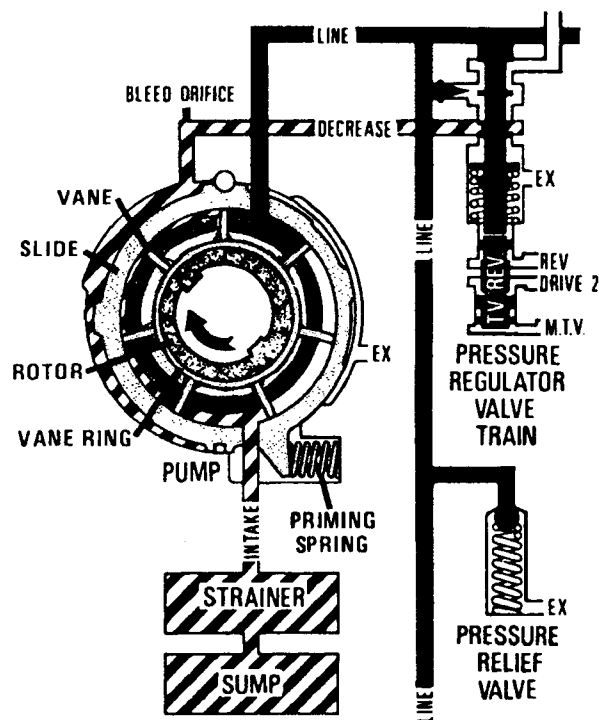
Look at the diagram carefully. The pump consists of a rotor, slide, rings, vanes and priming spring. The rotor attaches directly to the torque converter. Notice that on the right hand side of the pump, there is no oil between the rotor. The pump priming spring holds the slide in the maximum output position. Now follow the flow of oil.

The pump pulls oil through the intake passage and carries it to the top of the rotor. The pump then pushes the oil through the passage marked LINE.



Variable Displacement Pumps

When pump volume is more than the transmission needs, fluid goes back through the pressure regulator valve to the passage marked DECREASE. This return oil moves the slide against the priming spring to reduce pump output. Notice, on the right side of the pump rotor, that oil can get past the outlet and return to the intake passage. Also notice that the vanes on the intake side of the pump rotor are picking up less oil at the INTAKE passage.



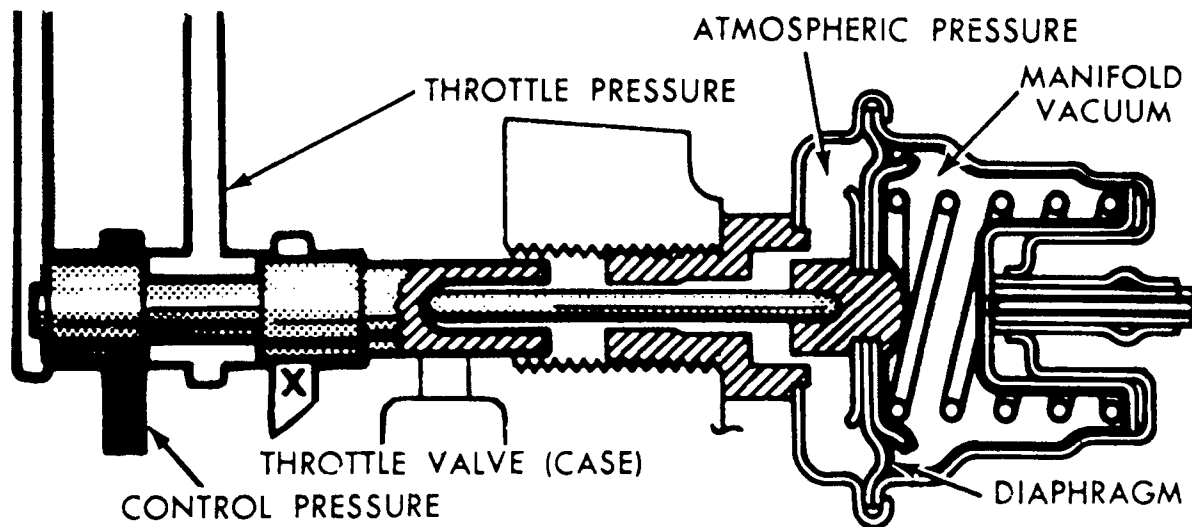
Modulator/Throttle Valve

When a driver steps on the accelerator, engine torque increases. This means that the engine is under load.

Transmission pressure should change with engine load, so the transmission can handle the increased torque. To do this the transmission must know the position of the accelerator pedal. To send this information to the transmission, the car manufacturer uses either a vacuum line and modulator or linkage. The modulator or linkage moves a valve in the valve body. We call this valve a modulator or throttle valve and it controls TV pressure. This valve acts as a regulator valve which changes line pressure into TV pressure according to throttle opening.

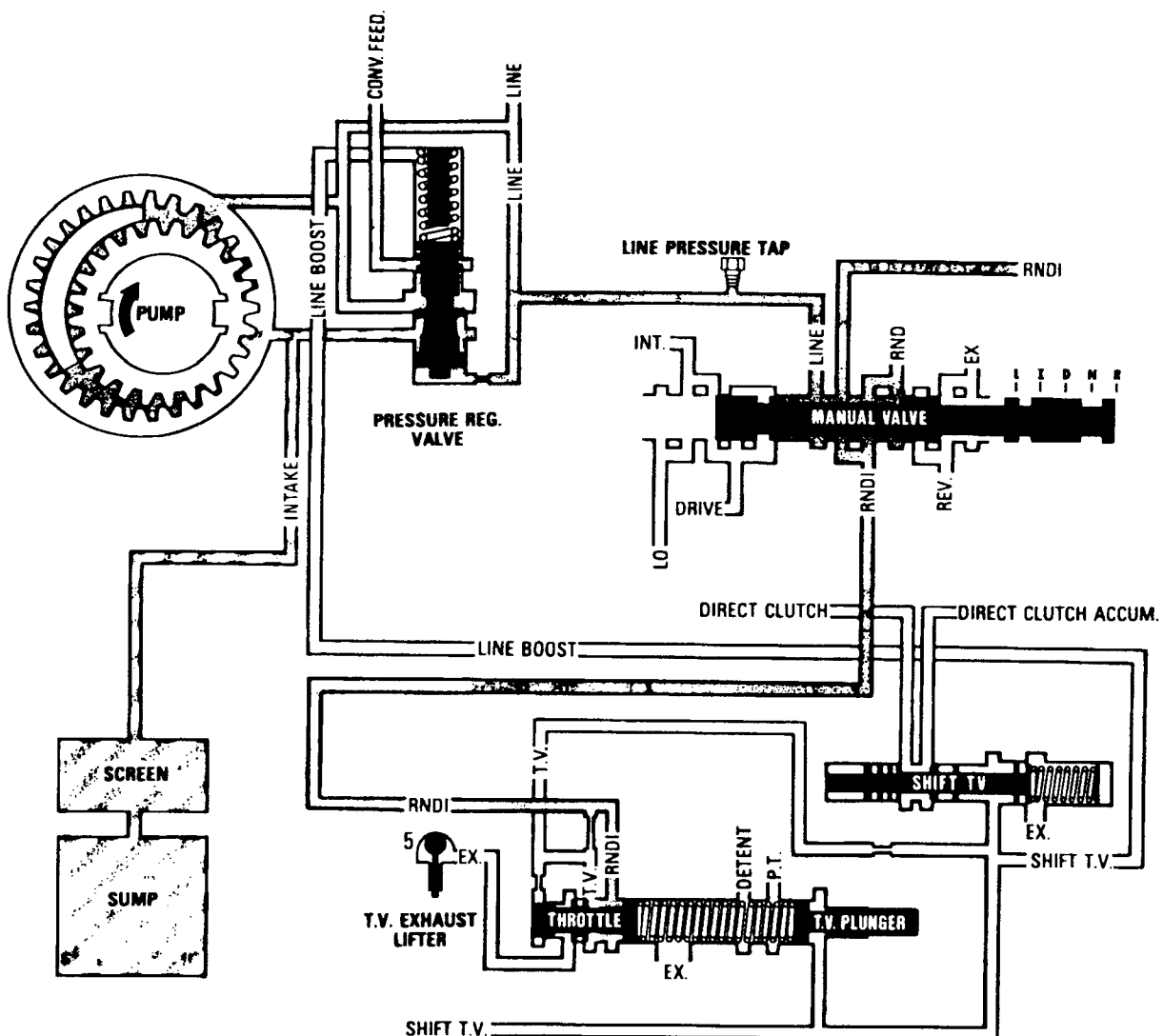
Vacuum operated transmissions use a modulator. A modulator changes vacuum signal into a mechanical force. This force moves the throttle valve. The diagram shows the modulator, pin and modulator valve. When the engine is idling, vacuum is high. The high vacuum pulls back the diaphragm inside the modulator. When the valve is in this position, it reduces pressure within the TV circuit.

When you depress the accelerator pedal, vacuum decreases. Reduced vacuum allows the spring inside the modulator to push the pin and valve back to their original position. When the valve moves back, TV pressure increases. Passages direct the TV pressure to the pressure regulator and shift valves.



Linkage Operated Throttle Valves

When you open the throttle, the throttle valve plunger pushes the throttle valve into the bore. Then, depending on how far you depress the pedal, main line pressure bleeds into the TV circuit. TV oil works on several valves including the backside of the TV plunger, the pressure regulator valve and the shift valves.



technical seminar

Governor

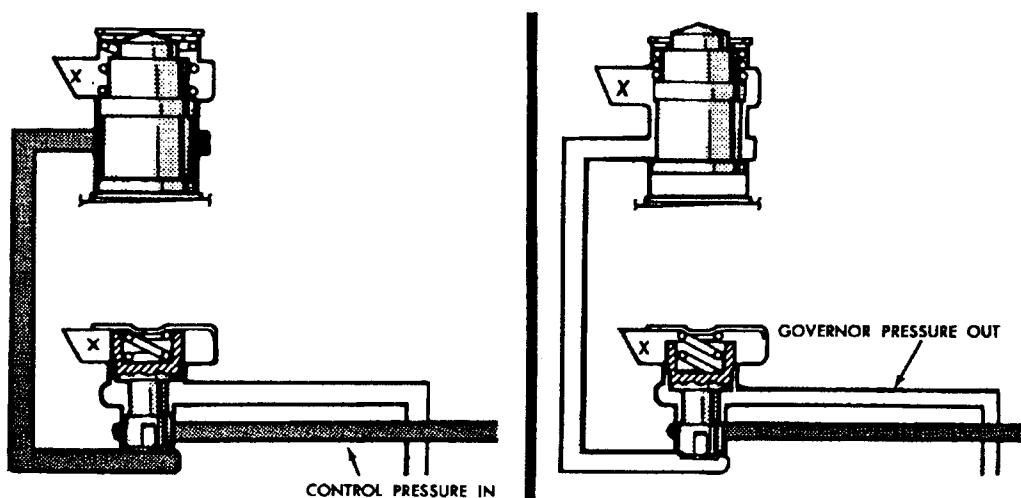
The governor is a hydraulic speedometer which uses centrifugal force to change mainline pressure to governor pressure according to vehicle speed. Governor pressure usually matches road speed. In other words, governor pressure is about 20 PSI when the vehicle is traveling at 20 MPH and about 30 PSI at 30 MPH. Governor pressure will eventually equal mainline at high speeds.

Governor pressure works against TV pressure. The two pressures work on opposite ends of the shift valves to control upshift and downshift timing.

There are three basic styles of governors. Ford, Chrysler and some imports attach the governor to the output shaft. Oil feed is through the governor support and into the governor housing through one hole. Then, depending on the speed of the vehicle, oil metered by the governor feeds into another hole called the governor oil return circuit. This oil is governor pressure which feeds the large end of each shift valve.

Ford uses two different size valves inside the governor housing. The heavier valve is the primary valve. The primary valve moves when the vehicle's speed is below 10 MPH.

The lighter valve inside the governor is the secondary valve. This valve moves after the primary valve has opened. The secondary valve is an orificing valve which increases governor pressure as road speed increases. Centrifugal force and a spring control the secondary valve.

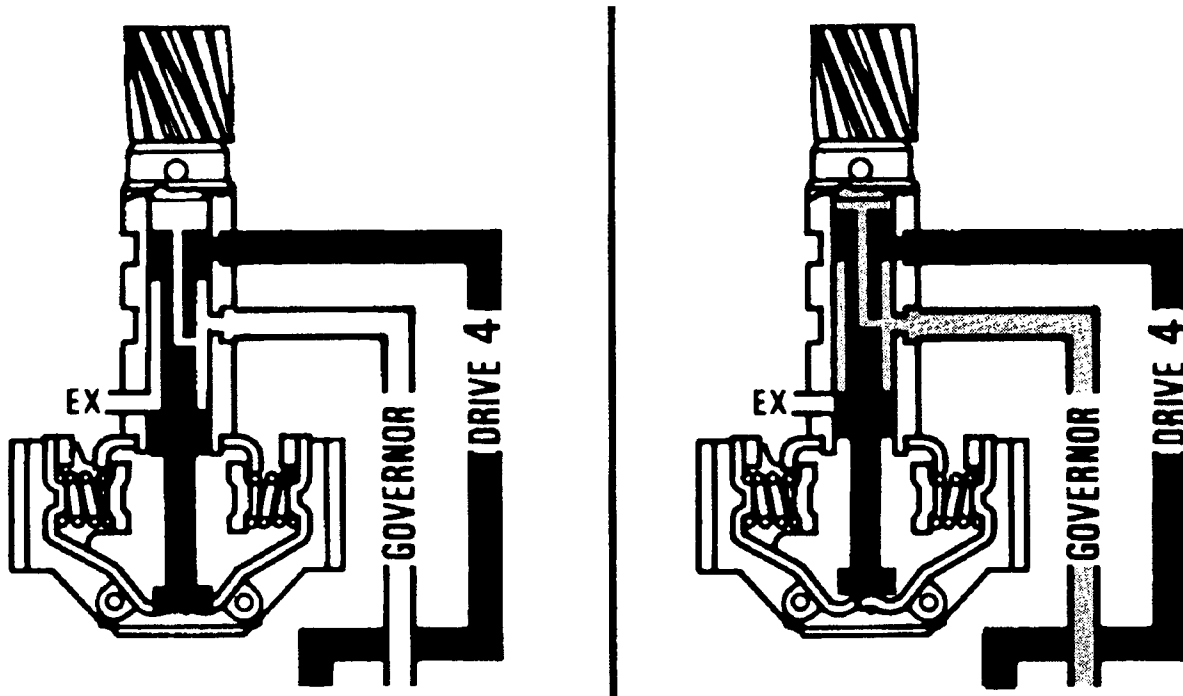


Gear Drive Governors

GM and some late model Ford governors are in a bore. They do not attach directly to the output shaft. These governors use a single valve and four weights to control oil flow. There are two primary weights and two secondary weights. When the output shaft is not turning, the valve inside the governor is in the closed position and the governor weights pull inward toward the center of governor shaft. This closes mainline pressure to the governor circuit.

As the vehicle starts to move, centrifugal force pulls the weights away from the center of the shaft. When the weights move, they push the governor valve open. Now, oil can flow into the governor circuit.

As vehicle speed increases, the valve allows more oil into the circuit until mainline and governor pressures are almost equal.



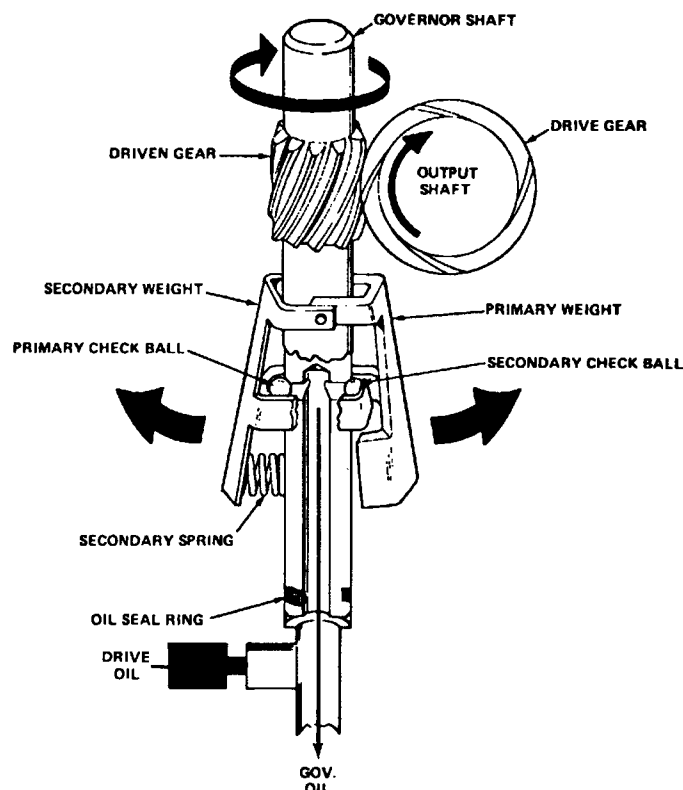
Ball Type Governors

GM and Ford also use a third type of governor. These governors consist of a drive gear, primary and secondary weights and primary and secondary check balls. One important difference between this governor and the one we discussed earlier is that a check ball style governor exhausts oil to the pan. It does not orifice pressure into another circuit. This means that governor pressure is a controlled back pressure.

When the output shaft is not turning, the drive oil inside the governor pushes the check balls off their seat. This pulls the governor weights toward the center of the governor shaft. Oil exhausts back to the pan and governor pressure is zero.

As the vehicle starts to move, centrifugal force pulls the primary weight away from the center of the governor shaft. As the weight begins to move, the check ball seats. This increases governor pressure by restricting exhaust oil to the pan.

As the vehicle speed increases, centrifugal force pulls the secondary weight away from the center of the governor shaft. This force seats the ball under the secondary weight, reducing the amount of oil that exhausts into the pan. Eventually both checkballs will fully seat and governor pressure will equal mainline.



Shift Valves

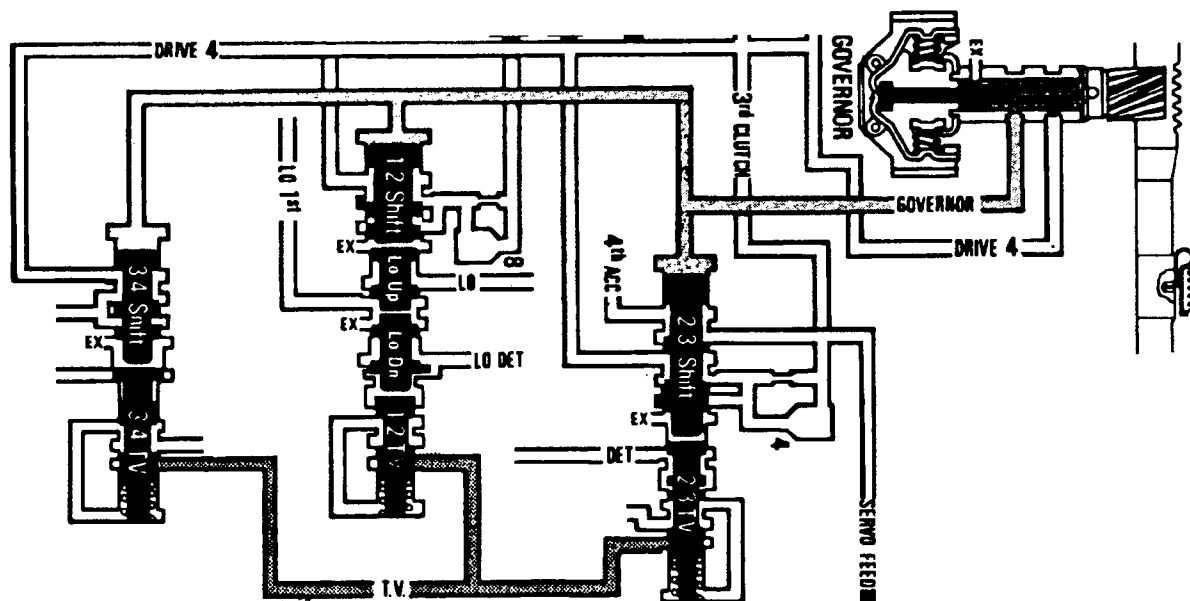
A shift valve is a hydraulic on-off switch that is either open or closed. TV pressure and governor pressure control most shift valves. TV pressure acts on one end of the valve while governor pressure acts on the other end of the valve. These pressures work against each other to move the valve. Governor pressure moves the valve to the upshift position while TV pressure moves the valve to the downshift position.

There is also a spring on the TV end of the shift valve. This spring works against governor pressure to return the valve to its downshift position.

When governor pressure is working against the 1-2, 2-3 and 3-4 shift valves, the 1-2 shift valve will always move first. The reason is simple.

Shift valves have different diameter faces. A 1-2 shift valve usually has a larger diameter face than the 3-4 shift valve. This means that more force is working against the 1-2 shift valve than there is against the 3-4. Also, the spring behind the 1-2 shift valve may have less tension than the spring behind the 3-4 shift valve.

The diameter of the face combined with the tension of the spring, makes the 1-2 shift valve easier to move than the 3-4 shift valve.

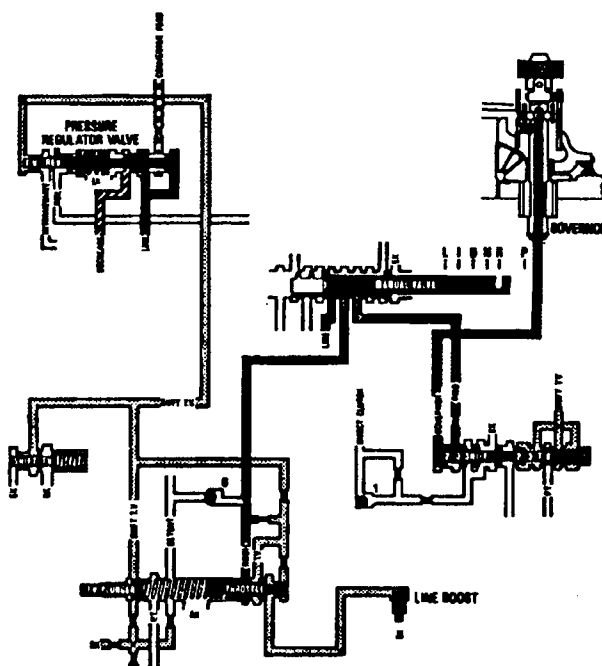


Complete Hydraulic System

Here is the complete system that up until now we have looked at one piece at a time. The pump is pushing oil into a circuit called the mainline circuit. This mainline oil goes to the pressure regulator valve and the throttle valve. The pressure regulator valve controls the pressure within the mainline circuit.

THAT'S IMPORTANT! In the oil flow chart it looks as though full pump pressure goes to the throttle valve. That is not the case. Mainline pressure at the throttle valve is not pump pressure. The pressure regulator valve reduces the pressure.

The throttle valve meters the flow of mainline oil into the TV circuit depending on the position of the accelerator pedal.



TV pressure goes to the pressure regulator and the shift valves. At the pressure regulator, TV pressure and the pressure regulator spring work to boost mainline pressure. At the shift valves, TV pressure works against governor pressure.

When does the unit shift? It shifts when governor pressure is greater than TV and spring pressure.

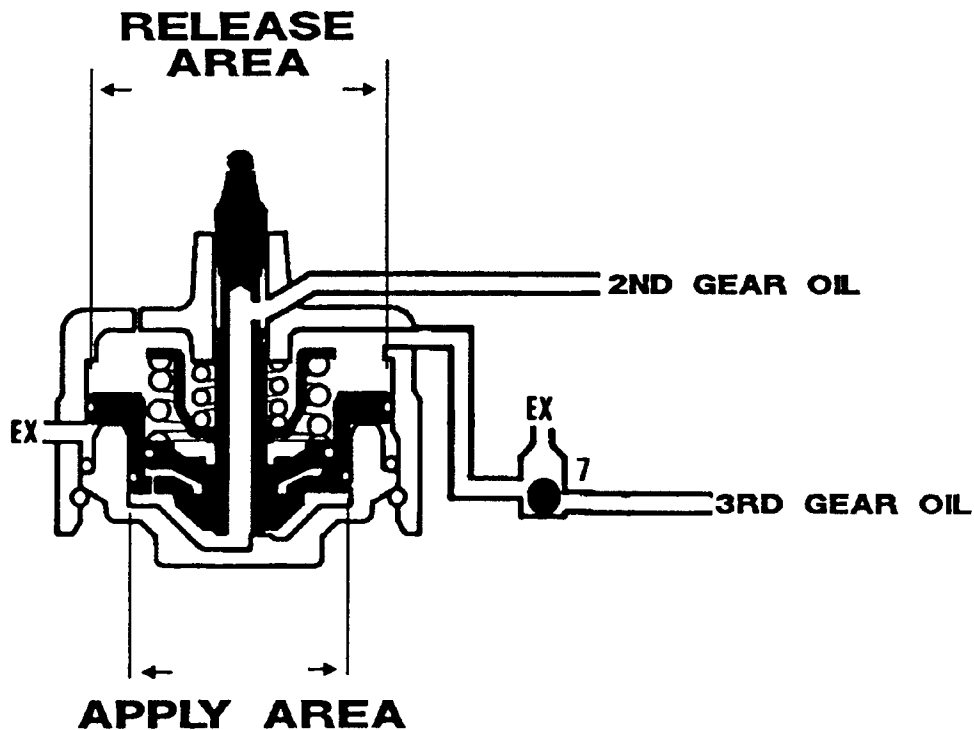
When does the unit downshift? It downshifts when throttle pressure and spring tensions are greater than governor pressure.

Servos

Servos apply and release bands. How quickly the band applies or releases determines shift quality or feel. Most servos have two sides: An apply side and a release side. The diameter of the servo's apply side controls the force of the servo apply. The diameter of the servo's release side controls the speed of the servo release. The surface area that the fluid acts on determines how hard or soft the servo will apply and how quickly it will release.

A servo piston with a large apply area will have more holding power than a piston with a smaller apply area. The larger the apply area the firmer the shift will be.

Oil pressure on the release side of the servo piston pushes the piston to the release position. The servo release spring assists hydraulic pressure during servo release.



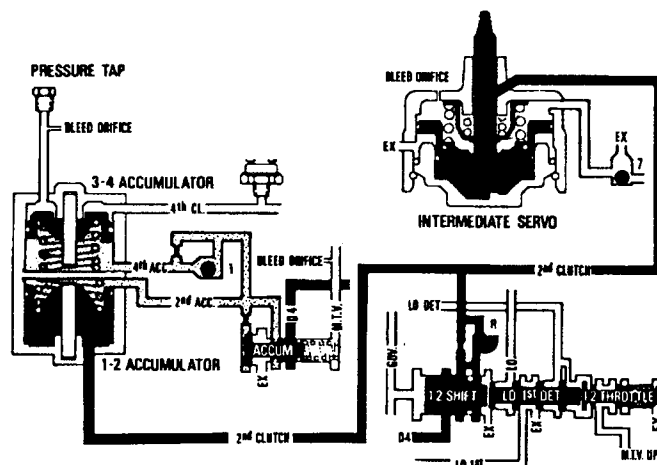
Accumulators

1. When fluid is flowing within a hydraulic circuit, there is a pressure differential wherever there is an orifice.
2. When fluid flow stops, pressure within the circuit equalizes.

If you understand these two basic laws of hydraulics, you'll understand how an accumulator works. An accumulator is a hydraulic shock absorber. It consists of a piston, spring and cylinder.

An accumulator uses a pressure differential to cushion band and clutch application and prevent a harsh shift feel. Find the accumulator in the schematic. Notice that 2nd gear oil is filling the bottom half of the cavity and that oil from the accumulator valve is filling the top half of the cavity. These two oil pressures work against each other.

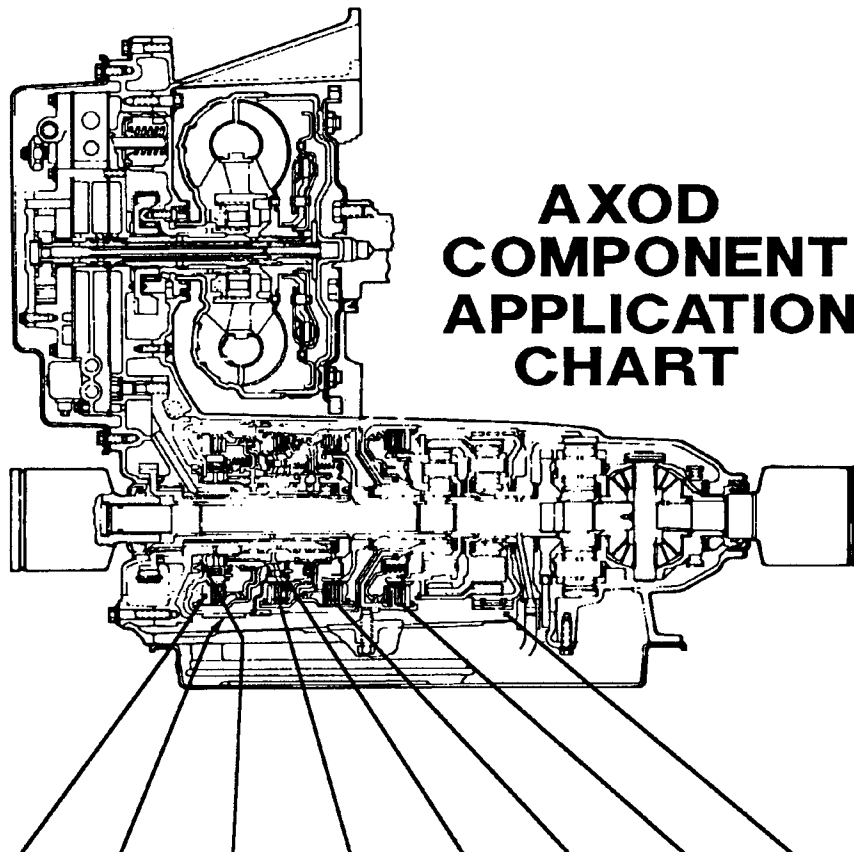
During a 1-2 upshift, second gear oil goes to the servo and the accumulator. This oil will fill the accumulator cavity and push against the piston. Simultaneously, the accumulator spring and accumulator oil pressure are pushing from the other side of the piston. The 2nd gear oil to the servo and accumulator will not equalize or reach maximum pressure until the accumulator piston stops moving. Notice that the accumulator valve has modulated TV (MTV) pressure working on one end. When the vehicle is under heavy throttle and MTV is high, the accumulator valve increases the accumulator pressure working against 2nd gear oil. This means that 2nd gear oil will not move the piston as far and that pressure in the 2nd gear oil circuit will build up faster. Faster build up means a firmer apply.



The opposite is also true. When MTV is low, the accumulator valve "bleeds off" more mainline oil pressure which lowers accumulator oil pressure. Low accumulator oil pressure means that 2nd gear oil will have to push the piston further before it stops. The longer it takes for the accumulator piston to stop moving, the softer the shift will be.

AXOD

AXOD

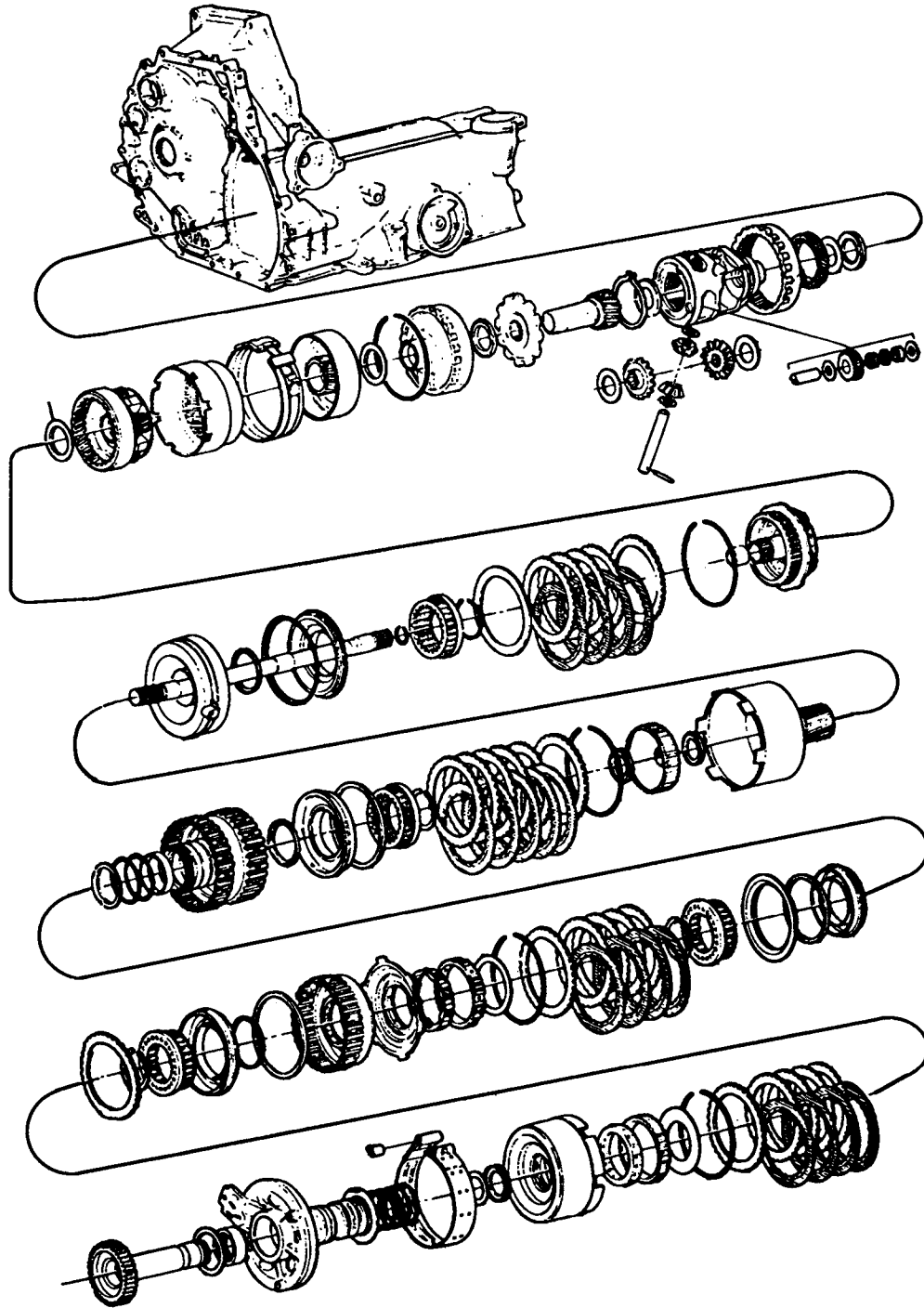


AXOD COMPONENT APPLICATION CHART

Selector Position	GEAR ENGAGED	FOR WARD CLUTCH	OVER DRIVE BAND	LOW SPRAG	DIRECT CLUTCH	DIRECT ONE-WAY CLUTCH	INTER-MEDIATE CLUTCH	REVERSE CLUTCH	LOW INTER-MEDIATE BAND	GEAR RATIO
R	Reverse									2.263:1
	1st gear									2.77:1
OD	1st decel	*								FREEWHEEL
	2nd gear	*								1.543:1
	3rd gear	*								1.000:1
	3rd decel									1.000:1
	4th gear				*					.694:1
	1st gear									2.77:1
D	1st decel	*								FREEWHEEL
	2nd gear	*								1.543:1
	3rd gear	*								1.000:1
	3rd decel									1.000:1
1	1st gear				*					2.77:1
	1st decel	*								2.77:1

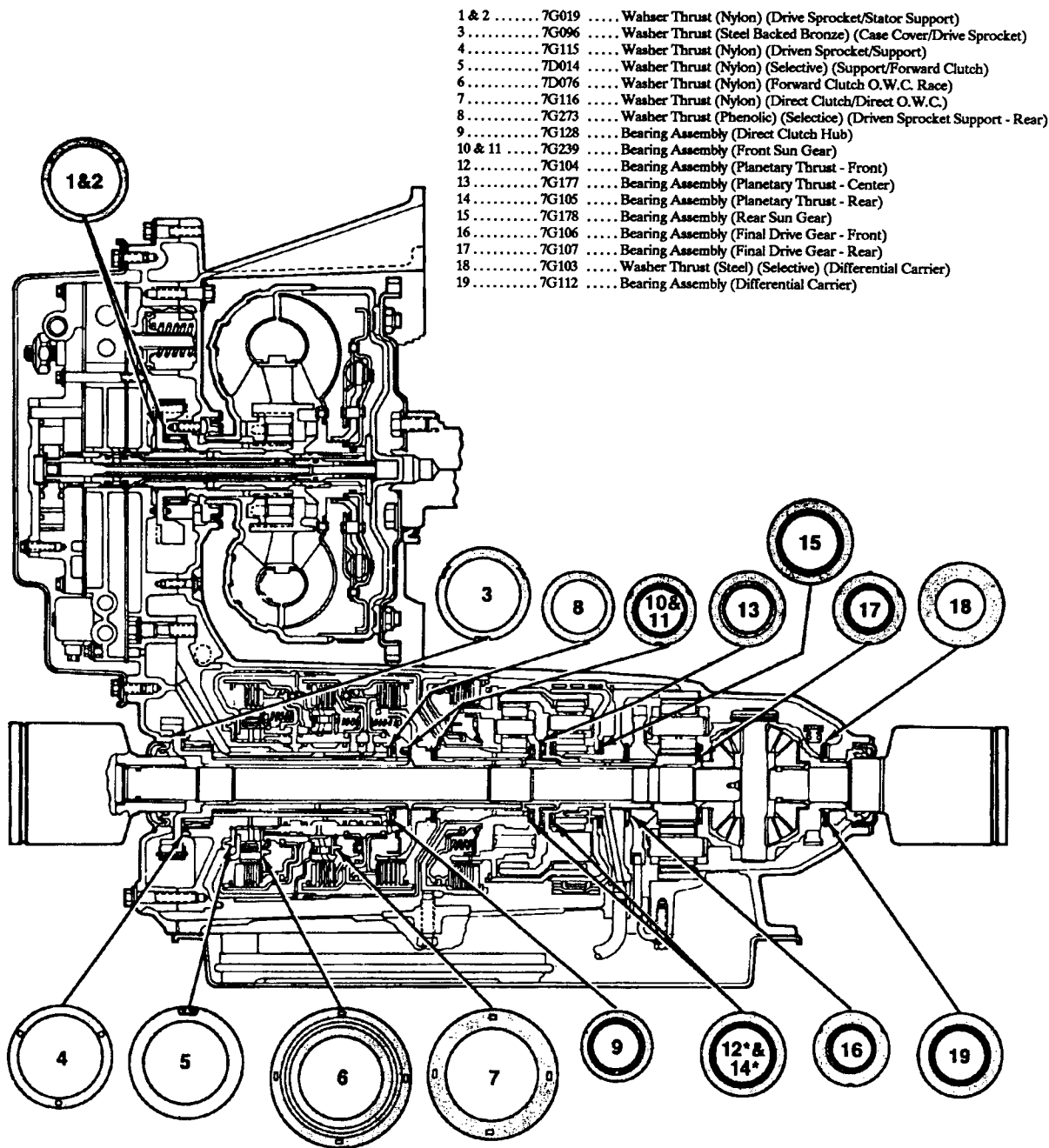
■ = APPLIED OR HOLDING * APPLIED BUT NOT EFFECTIVE

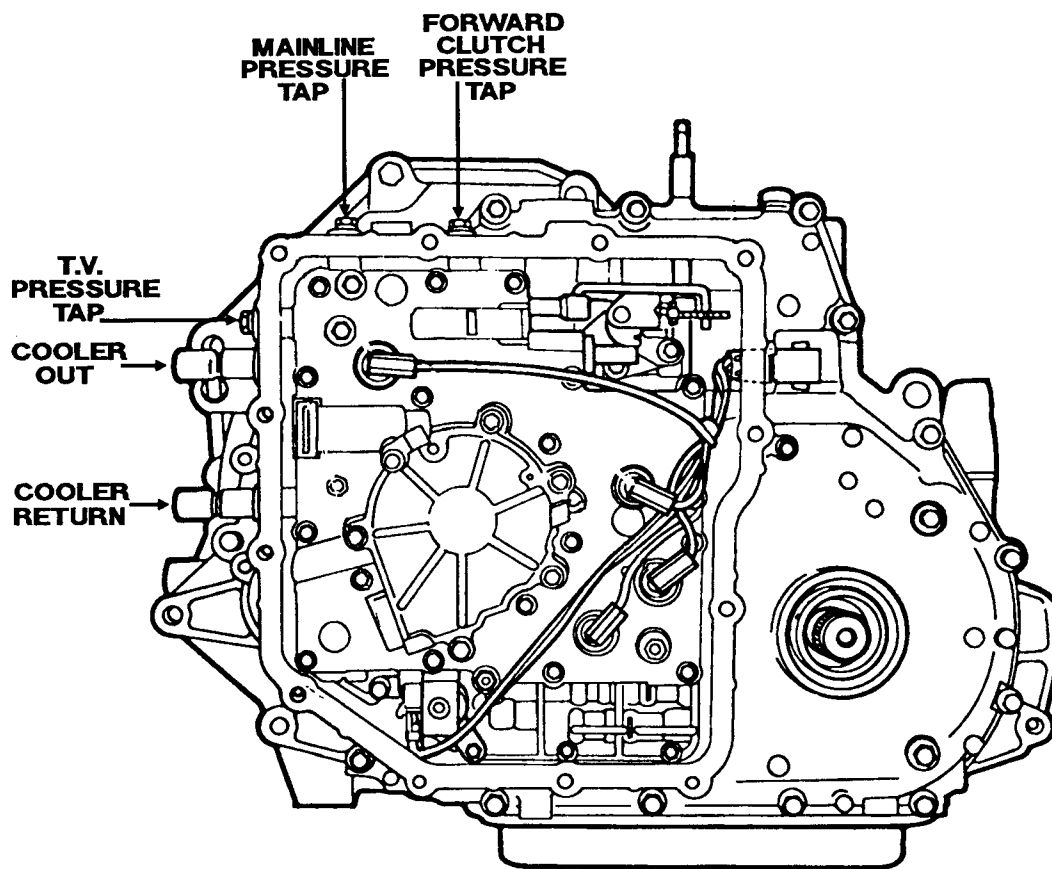
technical seminar



Thrust Washer & Needle Bearings

The AXOD contains 8 thrust washers and 9 bearing and race assemblies. Washers No. 5, 8 and 18 are selective thickness to control end play.





Set T.V. pressure to 8-14 psi with the engine at normal operating temperature and the gear selector in neutral. See page 7 for more information.

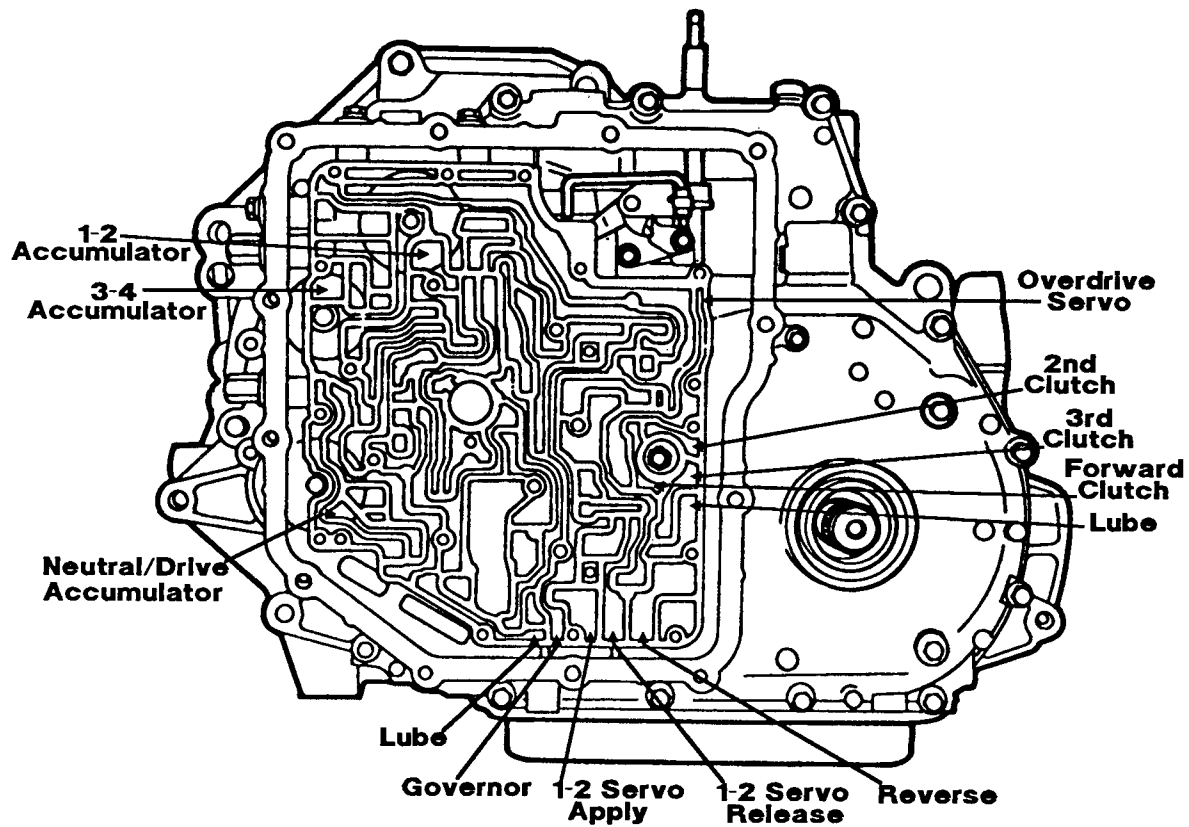
MAIN LINE PRESSURE

Range	Idle	Stall	Idle	Stall
P, N	81-95	—	80-91	—
R	93-152	242-279	93-152	248-289
Ⓓ, D	81-95	158-183	80-91	182-213
L	112-169	158-183	112-169	158-183

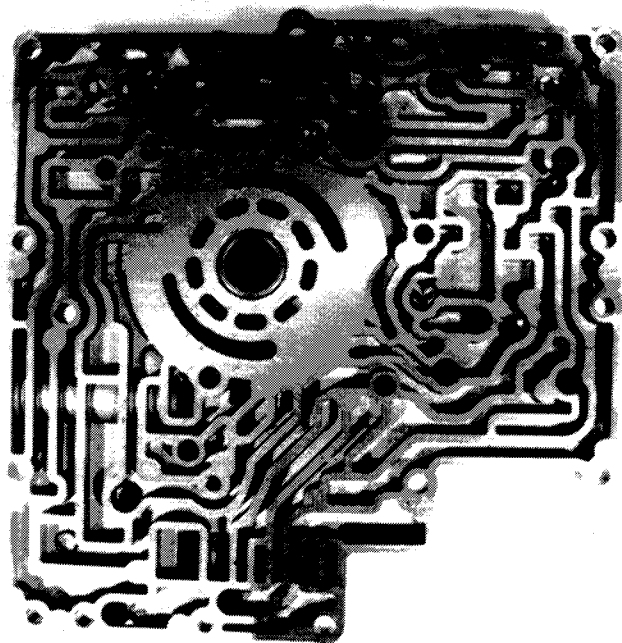
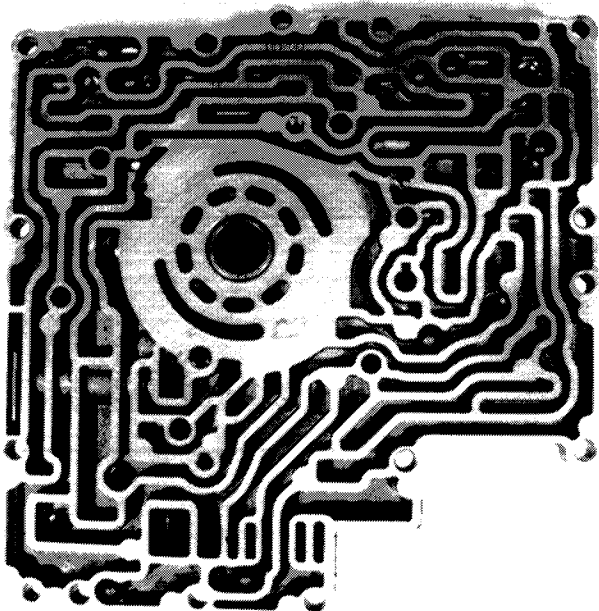
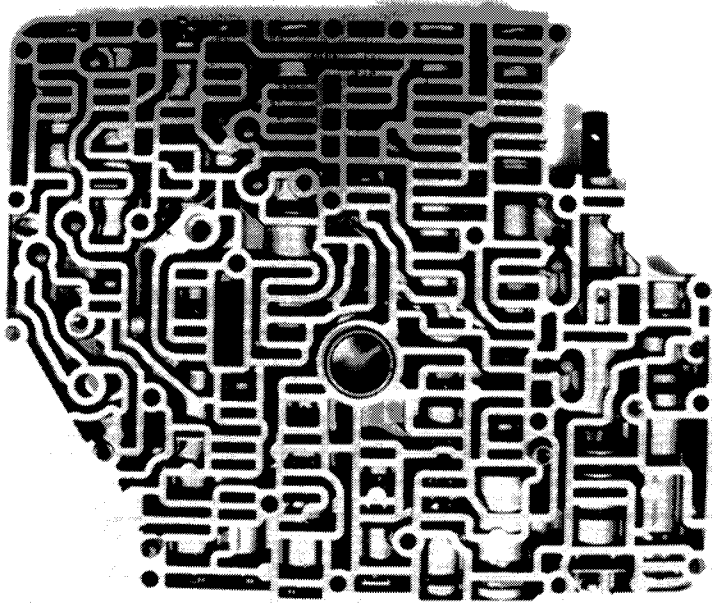
WITH A 3.0L ENGINE

WITH A 3.8L ENGINE

Air Checks

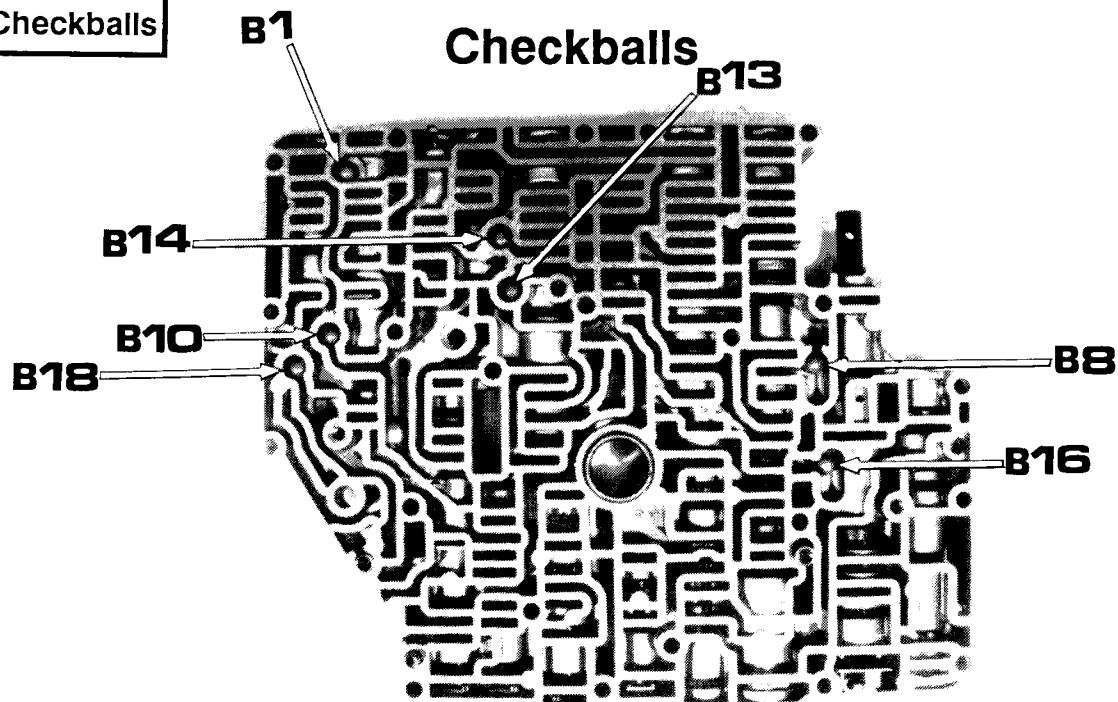


Checkballs

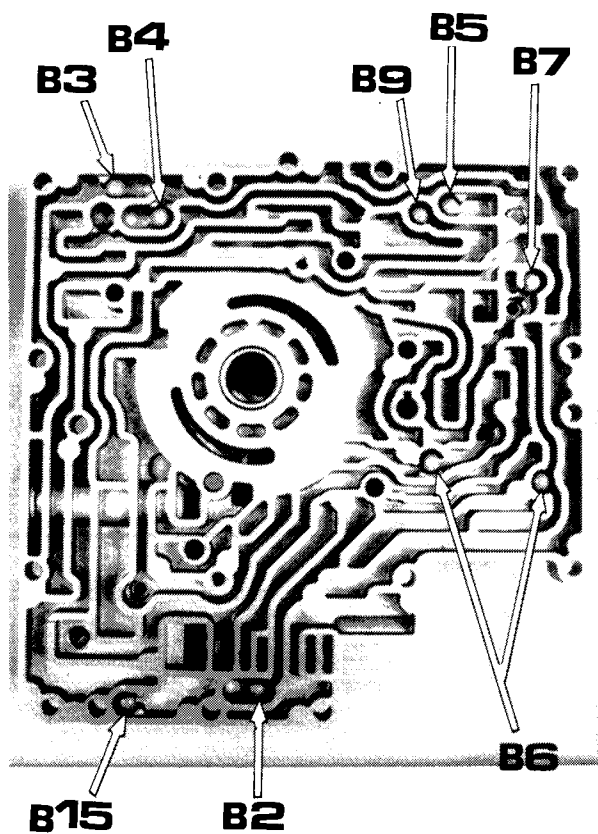


technical seminar

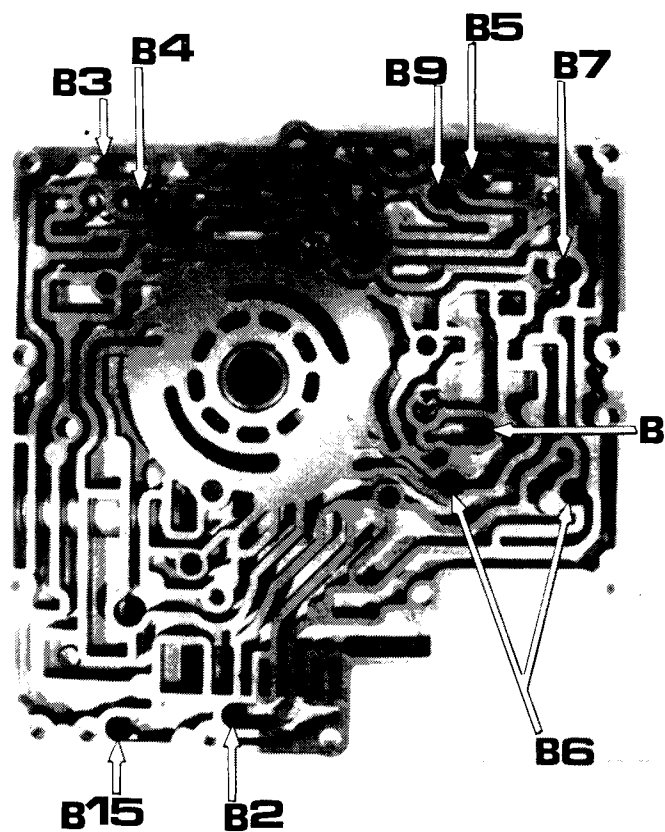
7 Checkballs



9 Checkballs



10 Checkballs



TV Pressure

Mismatching valve body, channel plate, pump or gaskets can cause uncontrollable throttle pressure.

A lose TV cable can cause a no shift condition and make the accelerator pedal very hard if not impossible to move. To fix this, turn the engine off and tighten the cable 1/8" at a time until the TV cable can be moved with the engine ON.

STEP 1

With TV cable mounted in engine bracket, make sure threaded shank is fully retracted. To retract shank, pull up on spring rest with index fingers, and wiggle top of thread shank while pressing shank through spring with thumbs.

STEP 2

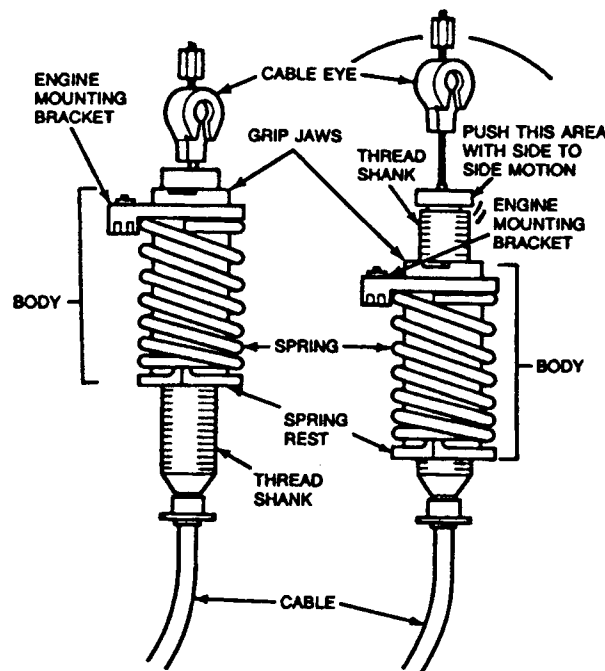
Rotate throttle lever to WOT position and release.

NOTE

Threaded shank must show movement or "ratchet" out of grip jaws. If no movement is observed, inspect TV cable system for broken or disconnected components and repeat procedure.

STEP 3

Adjust cable until TV pressure is 8-14 psi.



**AXOD Replacement Accumulator Springs
(As Ordered thru Ford)**

**1986 & 1987, All Engines
1988 - 1990 3.0 Liter Engines**

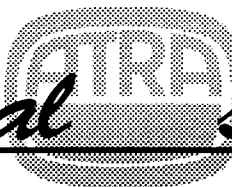
NEUTRAL - DRIVE OUTER SPRING (ORANGE)	E6DZ-7G300-A
NEUTRAL - DRIVE INNER SPRING (BLUE)	E6DZ-7G301-A
1-2 OUTER SPRING (YELLOW)	E6DZ-7G267-A
1-2 INNER SPRING (YELLOW)	E6DZ-7G326-A
3-4 OUTER SPRING (GREEN)	E6DZ-7G266-A
3-4 INNER SPRING (GREEN)	E6DZ-7F288-A

1988 3.8 Liter Engines

NEUTRAL - DRIVE OUTER SPRING (ORANGE)	E6DZ-7G300-A
NEUTRAL - DRIVE INNER SPRING (BLUE)	E6DZ-7G301-A
1-2 OUTER SPRING (BROWN)	E8DZ-7G267-A
1-2 MIDDLE SPRING (BROWN)	E8DZ-7G358-A
1-2 INNER SPRING (BROWN)	E8DZ-7G326-A
3-4 OUTER SPRING CONTINENTAL (GREEN)	E6DZ-7G266-A
3-4 OUTER SPRING TARUS & SABLE (PLAIN)	E8DZ-7G266-A
3-4 INNER SPRING (GREEN)	E6DZ-7F288-A

1989 - 1990 3.8 Liter Engines

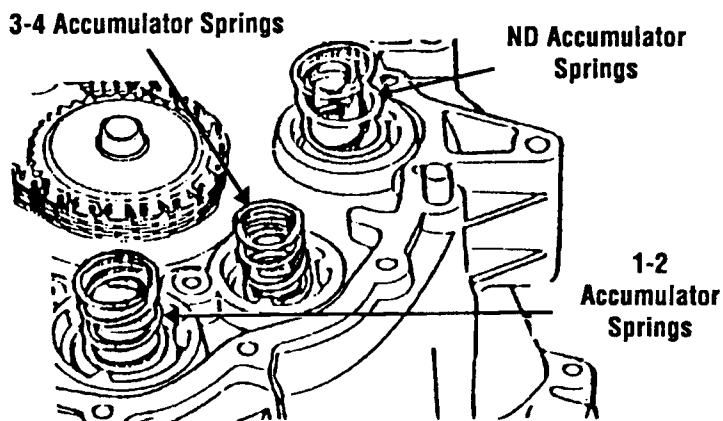
NEUTRAL - DRIVE OUTER SPRING (ORANGE)	E6DZ-7G300-A
NEUTRAL - DRIVE INNER SPRING (BLUE)	E6DZ-7G301-A
1-2 OUTER SPRING (BROWN)	E8DZ-7G267-A
1-2 MIDDLE SPRING (BROWN)	E8DZ-7G358-A
1-2 INNER SPRING (BROWN)	E8DZ-7G326-A
3-4 OUTER SPRING (WHITE)	E9DZ-7G266-A
3-4 INNER SPRING (GREEN)	E6DZ-7F288-A



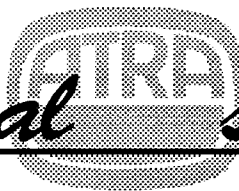
Accumulator Spring Chart

All Measurements In Inches

PART NUMBER	COLOR	DIAMETER	LENGTH	WIRE DIAMETER
E6DZ-7G266-A	GREEN	1.190"	1.515"	.091"
E8DZ-7G266-A	PLAIN	1.175"	1.690"	.098"
E9DZ-7G266-A	WHITE	1.175"	1.760"	.099"
E6DZ-7G267-A	YELLOW	1.565"	1.462"	.125"
E8DZ-7G267-A	BROWN	1.575"	1.435"	.125"
E6DZ-7F288-A	GREEN	.875"	1.450"	.080"
E6DZ-7G300-A	ORANGE	1.485"	1.790"	.135"
E6DZ-7G301-A	BLUE	1.020"	1.725"	.099"
E6DZ-7G326-A	YELLOW	1.180"	1.525"	.091"
E8DZ-7G326-A	BROWN	.905"	1.620"	.075"
E8DZ-7G358-A	BROWN	1.200"	1.460"	.099"



3-4 Accumulator	3.0L engine	2 green springs
3-4 Accumulator '88	3.8L engine	2 plain springs
3-4 Accumulator '89	3.8L engine	2 white springs
ND Accumulator	all engines	1 blue and 1 orange
1-2 Accumulator	3.0L engine	2 yellow springs
1-2 Accumulator '88	3.8L engine	3 brown springs
1-2 Accumulator '89	3.8L engine	1 brown & 2 purple



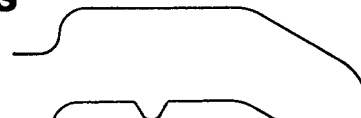
There have been a number of changes in the pumps, valve bodies, chain covers, pump and valve body separator plates and gaskets. It is important to have parts that are compatible.

For identification of the pump, valve body and chain cover use the fourth digit of the rough forge number. Pump plates are not available from Ford individually. You must buy a pump of the correct year and engine size to get a plate. We have identified the pump plates and the identification codes. When the present supply of some models of pumps is exhausted, the pump and plate will only be available as a pump and valve body assembly.

Valve body plates are available individually. We have listed the part numbers as well as the identification codes.

Pump Plates Codes

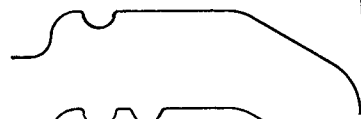
1986 No Notch



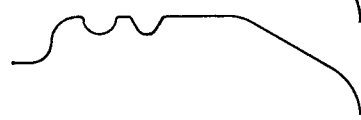
1986 Gear Tooth Notch



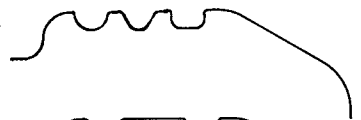
1987 Full Radius Notch



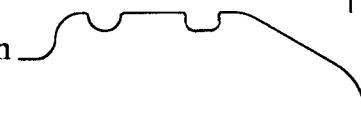
1988-1990 3.0 Liter Full Radius and Gear Tooth Notch



1988-89 3.8 Liter 9 Checkball Full Radius, Gear Tooth Notch & Square Notch



1989-1990 3.8 Liter 10 Checkball Full Radius & Square Notch

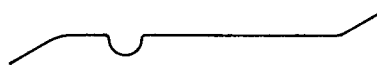


Valve Body Plate Codes

1986 Gear Tooth Notch



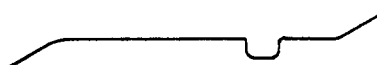
1987 Full Radius Notch



1988-1990 3.0 Liter Full Radius Gear Tooth



1988-1990 3.8 Liter Square Notch



1990 3.8 Liter Full Radius, Gear Tooth & Square



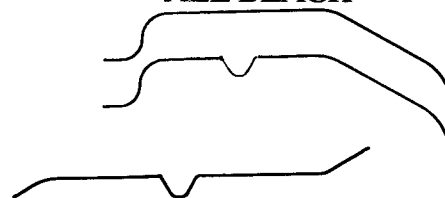


1986 AXOD ALL ENGINES

CODE NUMBERS

PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
GASKET STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

RFE6
RFE6
RFE6
ALL BLACK



VALVE BODY PLATE NOTCH CODE

DRIVE SPROCKET NUMBER OF TEETH
DRIVEN SPROCKET NUMBER OF TEETH
CHECKBALL COLOR CODE

37
36
BROWN

PART NUMBERS

PUMP
VALVE BODY
CHAIN COVER
PUMP PLATE NOT AVAILABLE SEPARATELY
VALVE BODY PLATE
PUMP TO PLATE GASKET
PUMP PLATE TO VALVE BODY GASKET
VALVE BODY TO VALVE BODY PLATE GASKET
VALVE BODY PLATE TO CHAIN COVER GASKET
DRIVE SPROCKET
DRIVEN SPROCKET
CHECKBALL (5 PER PACKAGE)

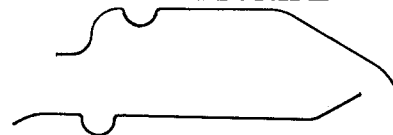
E6DZ-7A103-A
E6DZ-7A100-A
E6DZ-7G188-A
SUPPLIED WITH PUMP
E6DZ-7G348-A
E6DZ-7G331-A
E6DZ-7A136-A
E6DZ-7D100-A
E6DZ-7C155-A
E6DZ-7G129-A
E6DZ-7G132-A
E7DZ-7E195-A

1987 AXOD ALL ENGINES

CODE NUMBERS

PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
GASKET STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

RFE6 or RFE7
RFE7
RFE7
WHITE STRIPE



VALVE BODY PLATE NOTCH CODE

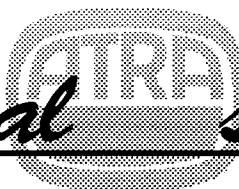
DRIVE SPROCKET NUMBER OF TEETH
DRIVEN SPROCKET NUMBER OF TEETH
CHECKBALL COLOR CODE

37
36
BROWN

PART NUMBERS

PUMP
VALVE BODY
CHAIN COVER
PUMP PLATE NOT AVAILABLE SEPARATELY
VALVE BODY PLATE
PUMP TO PLATE GASKET
PUMP PLATE TO VALVE BODY GASKET
VALVE BODY TO VALVE BODY PLATE GASKET
VALVE BODY PLATE TO CHAIN COVER GASKET
DRIVE SPROCKET
DRIVEN SPROCKET
CHECKBALL (5 PER PACKAGE)

E7DZ-7A103-A
E7DZ-7A100-A
E7DZ-7G188-A
SUPPLIED WITH PUMP
E7DZ-7G348-A
E7DZ-7G331-A
E7DZ-7A136-A
E7DZ-7D100-A
E7DZ-7C155-A
E6DZ-7G129-A
E6DZ-7G132-A
E7DZ-7E195-A



1988 AXOD 3.0 LITER ENGINE

CODE NUMBERS

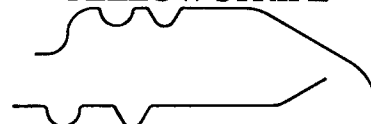
PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
GASKET STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

RFE8

RFE8

RFE8

YELLOW STRIPE



VALVE BODY PLATE NOTCH CODE

DRIVE SPROCKET NUMBER OF TEETH
DRIVEN SPROCKET NUMBER OF TEETH
CHECKBALL COLOR CODE

37

36

BROWN

PART NUMBERS

PUMP (WHEN SUPPLY EXHAUSTED NO LONGER AVAIL)
VALVE BODY (INCLUDES PUMP)
CHAIN COVER
PUMP PLATE NOT AVAILABLE SEPARATELY
VALVE BODY PLATE
PUMP TO PLATE GASKET
PUMP PLATE TO VALVE BODY GASKET
VALVE BODY TO VALVE BODY PLATE GASKET
VALVE BODY PLATE TO CHAIN COVER GASKET
DRIVE SPROCKET
DRIVEN SPROCKET
CHECKBALL (5 PER PACKAGE)

E8DZ-7A103-B

E8DZ-7A100-B

E8DZ-7G188-A

SUPPLIED WITH PUMP

E8DZ-7G348-A

E8DZ-7G331-A

E8DZ-7A136-A

E8DZ-7D100-A

E8DZ-7C155-A

E6DZ-7G129-A

E6DZ-7G132-A

E7DZ-7E195-A

1988 AXOD 3.8 LITER ENGINE

CODE NUMBERS

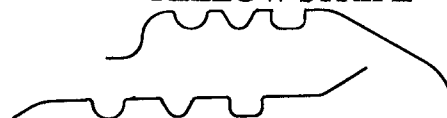
PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
GASKET STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

RFE8

RFE8

RFE8

YELLOW STRIPE



VALVE BODY PLATE NOTCH CODE

DRIVE SPROCKET NUMBER OF TEETH
DRIVEN SPROCKET NUMBER OF TEETH
CHECKBALL COLOR CODE

38

35

BROWN

PART NUMBERS

PUMP (WHEN SUPPLY IS EXHAUSTED NO LONGER AVAIL)
VALVE BODY (INCLUDES PUMP)
CHAIN COVER
PUMP PLATE NOT AVAILABLE SEPARATELY
VALVE BODY PLATE
PUMP TO PLATE GASKET
PUMP PLATE TO VALVE BODY GASKET
VALVE BODY TO VALVE BODY PLATE GASKET
VALVE BODY PLATE TO CHAIN COVER GASKET
DRIVE SPROCKET
DRIVEN SPROCKET
CHECKBALL (5 PER PACKAGE)

E8DZ-7A103-A

E8DZ-7A100-A

E8DZ-7G188-A

SUPPLIED WITH PUMP

E8DZ-7G348-B

E8DZ-7G331-A

E8DZ-7A136-A

E8DZ-7D100-A

E8DZ-7C155-A

E8DZ-7G129-A

E8DZ-7G132-A

E7DZ-7E195-A

1989 AXOD 3.0 Liter Engine

CODE NUMBERS

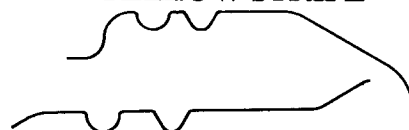
PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
GASKET STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

RFE8

RFE8

RFE8

YELLOW STRIPE



VALVE BODY PLATE NOTCH CODE

DRIVE SPROCKET NUMBER OF TEETH
DRIVEN SPROCKET NUMBER OF TEETH
CHECKBALL COLOR CODE

37

36

BROWN

PART NUMBERS

PUMP (WHEN SUPPLY IS EXHAUSTED NO LONGER AVAIL)	E8DZ-7A103-B
VALVE BODY (INCLUDES PUMP)	E9DZ-7A100-B
CHAIN COVER	E8DZ-7G188-A
PUMP PLATE NOT AVAILABLE SEPARATELY	SUPPLIED WITH PUMP
VALVE BODY PLATE	E8DZ-7G348-A
PUMP TO PLATE GASKET	E8DZ-7G331-A
PUMP PLATE TO VALVE BODY GASKET	E8DZ-7A136-A
VALVE BODY TO VALVE BODY PLATE GASKET	E8DZ-7D100-A
VALVE BODY PLATE TO CHAIN COVER GASKET	E8DZ-7C155-A
DRIVE SPROCKET	E6DZ-7G129-A
DRIVEN SPROCKET	E6DZ-7G132-A
CHECKBALL (5 PER PACKAGE)	E7DZ-7E195-A



1989 AXOD 3.8 Liter Engine, With 9 Checkball Pump

CODE NUMBERS

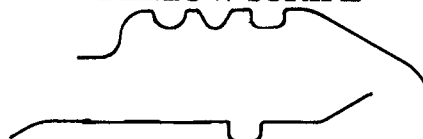
PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
GASKET STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

RFE8

RFE8

RFE8

YELLOW STRIPE



VALVE BODY PLATE NOTCH CODE

DRIVE SPROCKET NUMBER OF TEETH

DRIVEN SPROCKET NUMBER OF TEETH

CHECKBALL COLOR CODE

LINCOLN 37 TEETH

TAURUS / SABLE 38 TEETH

LINCOLN 36 TEETH

TAURUS / SABLE 35 TEETH

BROWN

PART NUMBERS

PUMP
VALVE BODY (INCLUDES PUMP)
CHAIN COVER
PUMP PLATE NOT AVAILABLE SEPARATELY
VALVE BODY PLATE
PUMP TO PLATE GASKET
PUMP PLATE TO VALVE BODY GASKET
VALVE BODY TO VALVE BODY PLATE GASKET
VALVE BODY PLATE TO CHAIN COVER GASKET
DRIVE SPROCKET

DRIVEN SPROCKET

CHECKBALL (5 PER PACKAGE)

E8DZ-7A103-A

E9DZ-7A100-B

E8DZ-7G188-A

SUPPLIED WITH PUMP

E8DZ-7G348-B

E8DZ-7G331-A

E8DZ-7A136-A

E8DZ-7D100-A

E8DZ-7C155-A

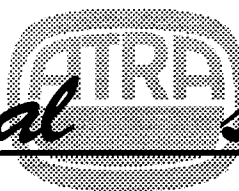
LINCOLN E6DZ-7G129-A

TAURUS / SABLE E9DZ-7G129-A

LINCOLN E6DZ-7G132-A

TAURUS / SABLE E9DZ-7G132-A

E7DZ-7E195-A



1989 - 1990 AXOD 3.8 Liter Engine With 10 Checkball

CODE NUMBERS

PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
VALVE BODY GASKET (2) STRIPE COLOR CODE
PUMP GASKETS (2) STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

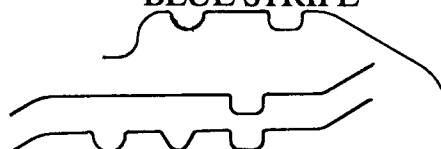
RFE9

RFE9

RFE8

YELLOW STRIPE

BLUE STRIPE



VALVE BODY PLATE NOTCH CODE

DRIVE SPROCKET NUMBER OF TEETH

LINCOLN 37 TEETH

DRIVEN SPROCKET NUMBER OF TEETH

TAURUS / SABLE 38 TEETH

LINCOLN 36 TEETH

CHECKBALL COLOR CODE

TAURUS / SABLE 35 TEETH

BROWN

PART NUMBERS

PUMP (NOT AVAILABLE SEPARATELY)
VALVE BODY (INCLUDES PUMP)

SUPPLIED WITH VALVE BODY
LINCOLN E9OY-7A100-B
TAURUS / SABLE F0DZ-7A100-B
POLICE F0DZ-7A100-A

CHAIN COVER
PUMP PLATE NOT AVAILABLE SEPARATELY

E8DZ-7G188-A

VALVE BODY PLATE

SUPPLIED WITH PUMP

PUMP TO PLATE GASKET

E8DZ-7G348-B

PUMP PLATE TO VALVE BODY GASKET

E9OY-7G331-A

VALVE BODY TO VALVE BODY PLATE GASKET

E9OY-7A136-A

VALVE BODY PLATE TO CHAIN COVER GASKET

E8DZ-7D100-A

DRIVE SPROCKET

E8DZ-7C155-A

DRIVEN SPROCKET

LINCOLN E6DZ-7G129-A

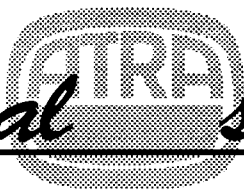
TAURUS / SABLE E9DZ-7G129-A

CHECKBALL (5 PER PACKAGE)

LINCOLN E6DZ-7G132-A

TAURUS / SABLE E9DZ-7G132-A

E7DZ-7E195-A



1990 AXOD 3.0 Liter Engine With 9 Checkball Pump

CODE NUMBERS

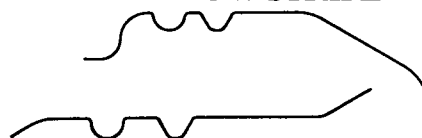
PUMP ROUGH FORGE
VALVE BODY ROUGH FORGE
CHAIN COVER ROUGH FORGE
GASKET STRIPE COLOR CODE
PUMP PLATE NOTCH CODE

RFE8

RFE8

RFE8

YELLOW STRIPE



VALVE BODY PLATE NOTCH CODE

DRIVE SPROCKET NUMBER OF TEETH
DRIVEN SPROCKET NUMBER OF TEETH
CHECKBALL COLOR CODE

37

36

BROWN

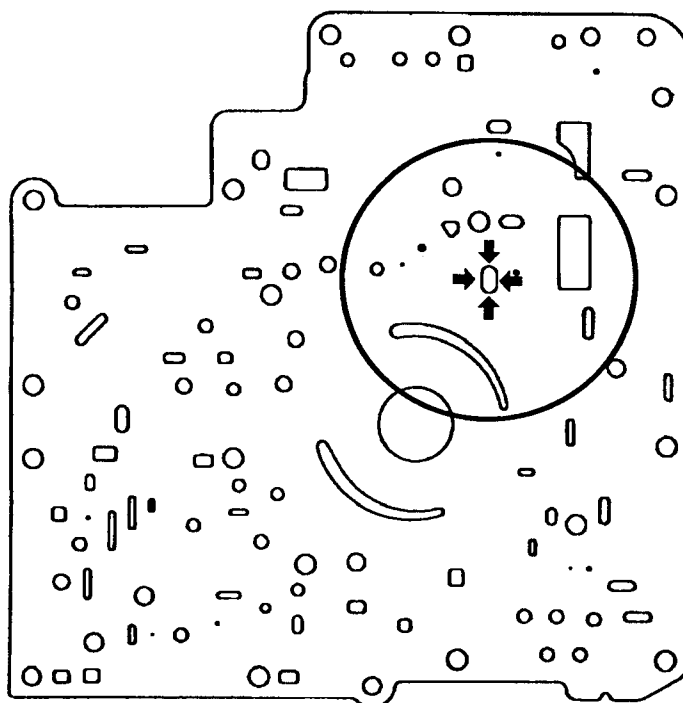
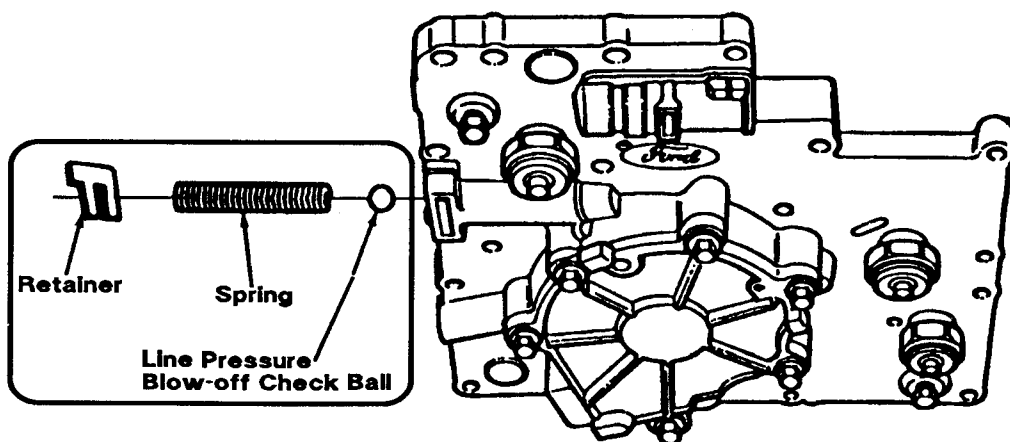
PART NUMBERS

PUMP (NOT AVAILABLE SEPARATELY)
VALVE BODY
CHAIN COVER
PUMP PLATE NOT AVAILABLE SEPARATELY
VALVE BODY PLATE
PUMP TO PLATE GASKET
PUMP PLATE TO VALVE BODY GASKET
VALVE BODY TO VALVE BODY PLATE GASKET
VALVE BODY PLATE TO CHAIN COVER GASKET
DRIVE SPROCKET
DRIVEN SPROCKET
CHECKBALL (5 PER PACKAGE)

SUPPLIED WITH VALVE BODY
E9DZ-7A100-A
E8DZ-7G188-A
SUPPLIED WITH VALVE BODY
E8DZ-7G348-A
E8DZ-7G331-A
E8DZ-7A136-A
E8DZ-7D100-A
E8DZ-7C155-A
E6DZ-7G129-A
E6DZ-7G132-A
E7DZ-7E195-A

All Pump Plates

If this hole is in the pump plate then a line pressure blow off ball, spring, and retainer must be installed. Failure to install the line pressure blow off assembly may result in a severe low pressure condition with slipping in forward and reverse.

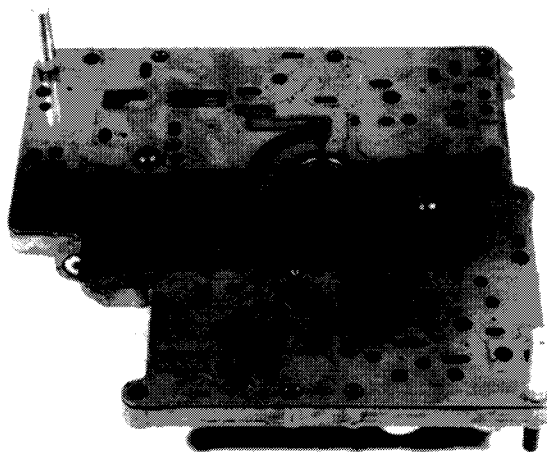


Valve Body - Pump Installation

You **MUST** use pump alignment tools. Keep in mind, the pump locates the pump drive shaft. If you don't use the tools, the pump drive shaft can damage the sleeve in the valve body. The part number is **T-2407** and can be purchased thru Trans-Tool.

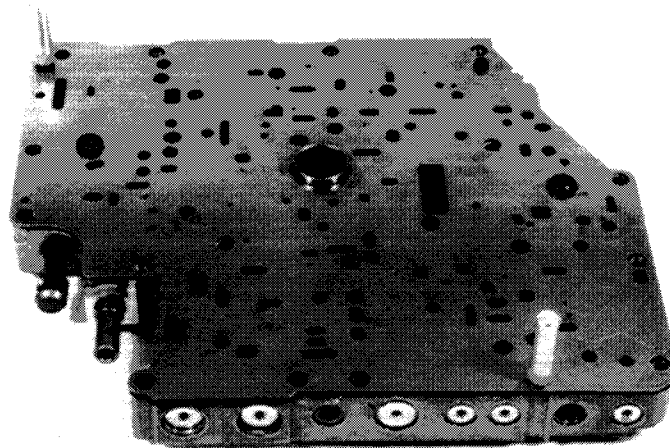
STEP 1

Use guide pins "A" and "B" to line up the pump separator plate.



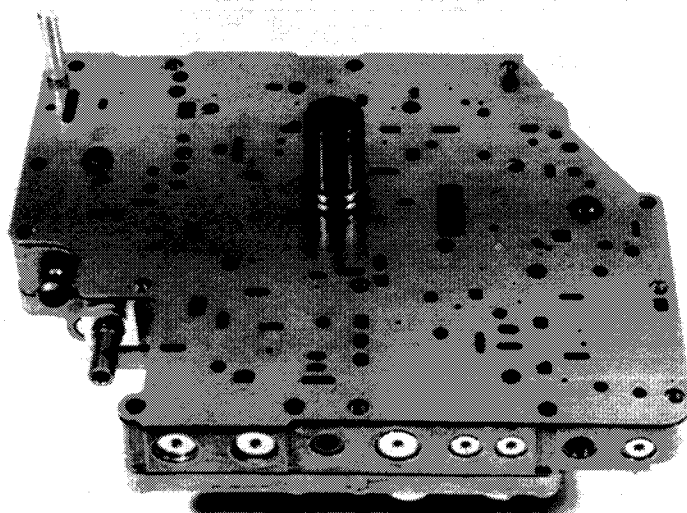
STEP 2

Use two "A" guide pins to line up the separator plate on the valve body.



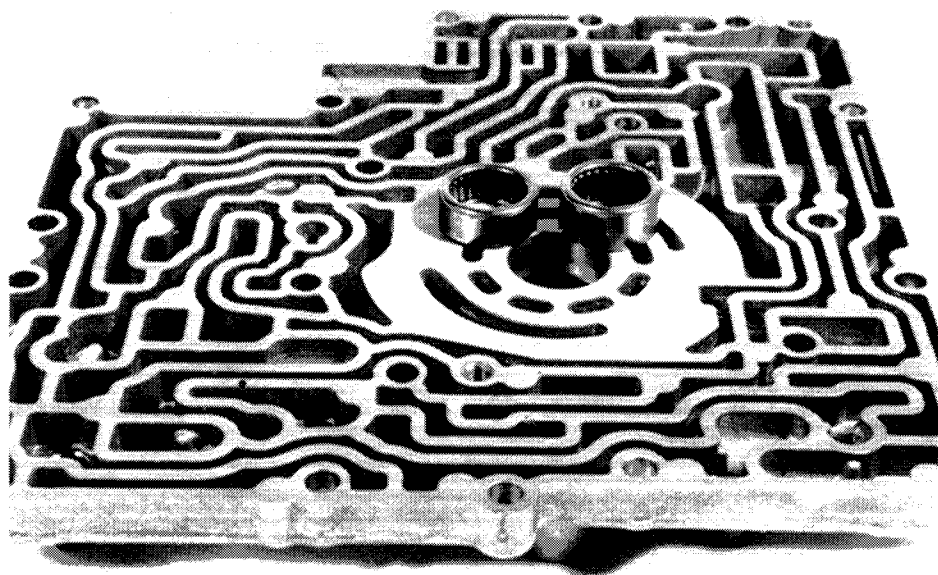
STEP 3

Use guide pins "C" and "D" to align the pump and valve body together.

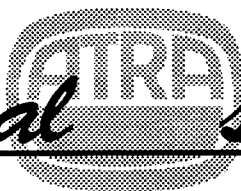


Pump Bearing Replacement

Torrington ® makes the bearing used in the AXOD pumps. The part number is B-127. Torrington ® #B-127 is sold only to Ford. Fortunately Torrington ® #B-128 will work just fine. The seal for the bearing can be purchased thru most of the major parts suppliers.



Torrington ® #B-128 is .062" taller than the original but will fit with no interference.



Coast Down Clunk

STEP 1

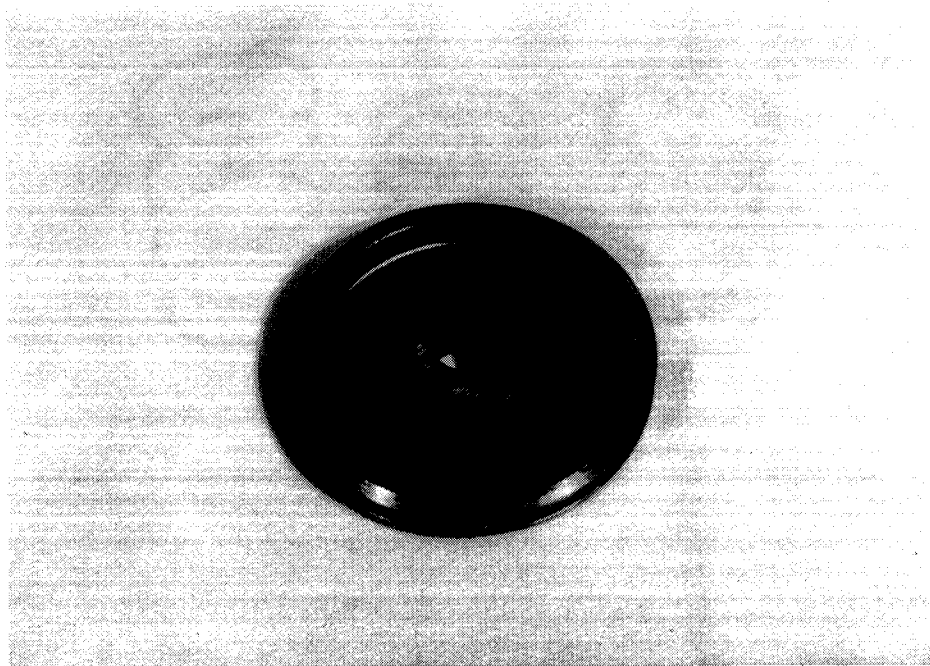
Adjust TV pressure see page 7.

STEP 2

Make sure minimum line pressure does not exceed specifications.
See page 5.

STEP 3

On a 3-2 coast down clunk, grind the
1-2 servo stop $1/16"$ to $1/8"$ as shown.



CAUTION

Step 3 is not a rebuild procedure, do this only if you have a 3-2 clunk
and have done steps 1 & 2 first.

2-3 Flare-Up

STEP 1

Adjust T.V. pressure see page 7.

STEP 2

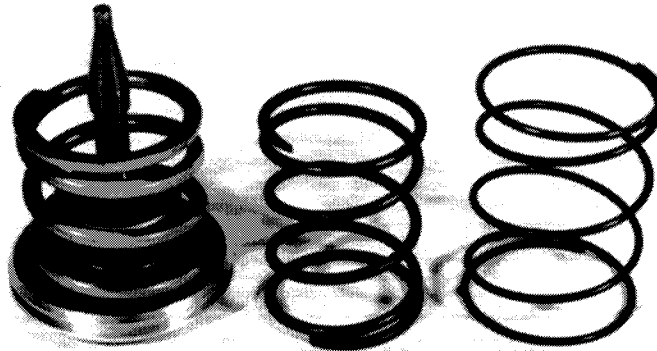
Check line pressure & line pressure rise.

STEP 3

Check servo travel see page 25.

STEP 4

Replace the 1-2 servo spring with a spring of a lighter weight. A good example is a Torque Flight 8 front servo spring. If the flare-up still exists use a C-3 rear servo spring.

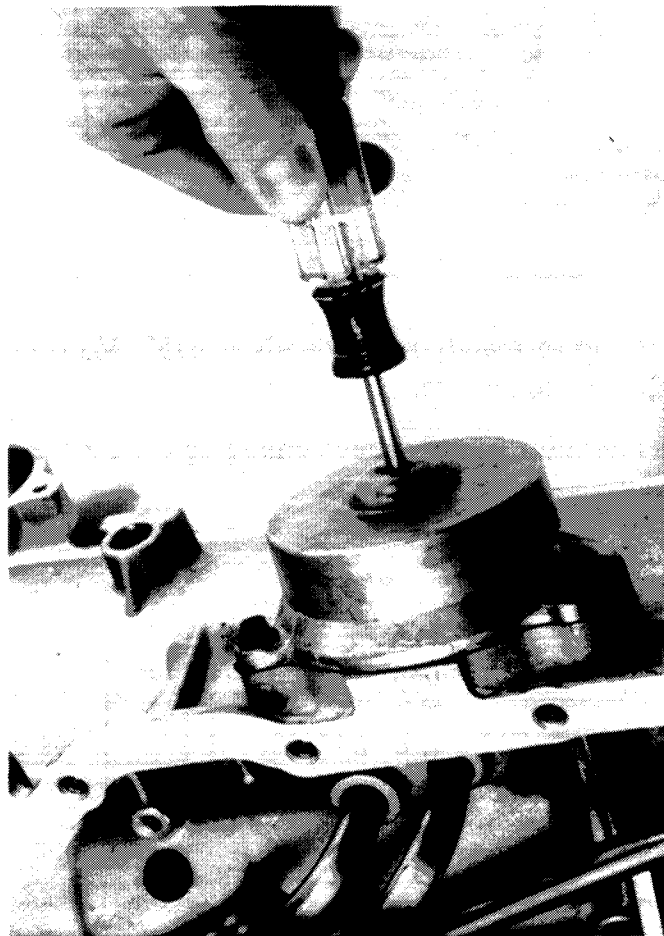


CAUTION

Step 3 is not a rebuild procedure. Only do this after you have done steps 1 and 2 and the flare-up persists.

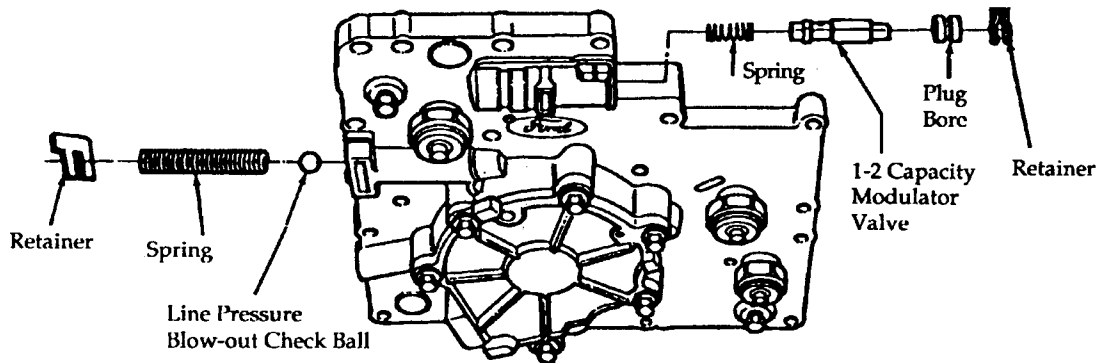
Servo Travel

Servo travel should be within .150" - .200". Make sure you are pushing on the servo pin rather than the piston.



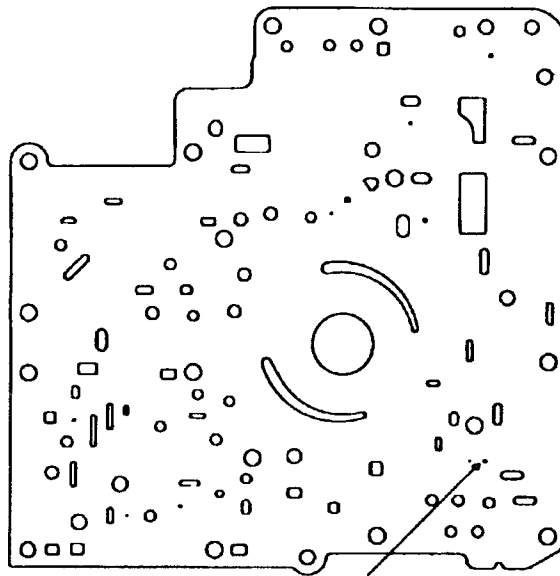
Shift Quality

Improve the 1-2 shift by installing a heavier 1-2 capacity modulator-valve spring.

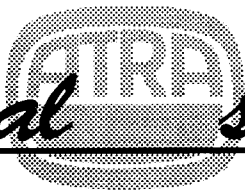


Find a spring that weighs approximately 1 1/2 pounds at .415". Many GM governor springs are very close, but weigh them to be sure.

The 2-3 shift also needs attention, so we've been enlarging the 2-3 feed hole to .093" as shown below.

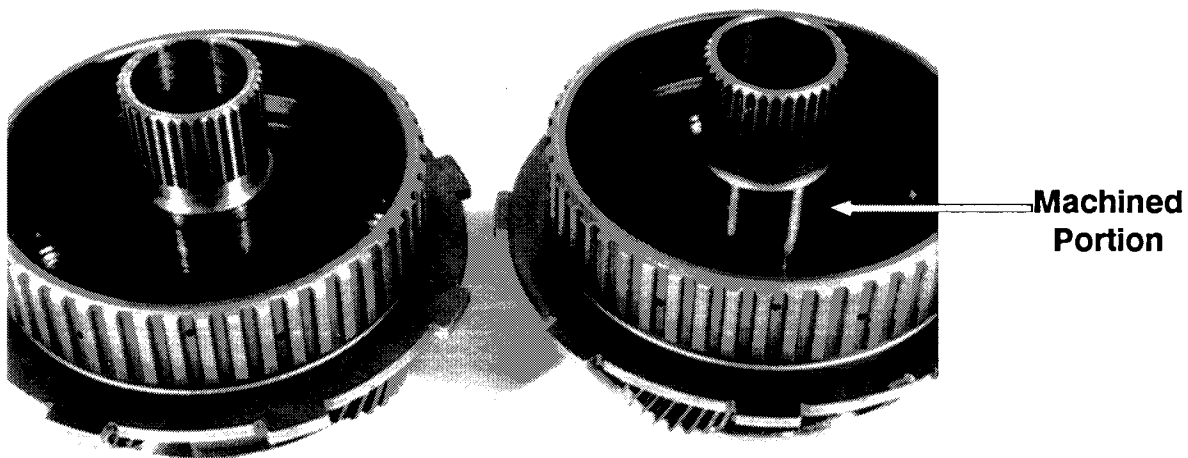


**2-3 Feed Hole
Enlarge to .093"**



Late Planet Change

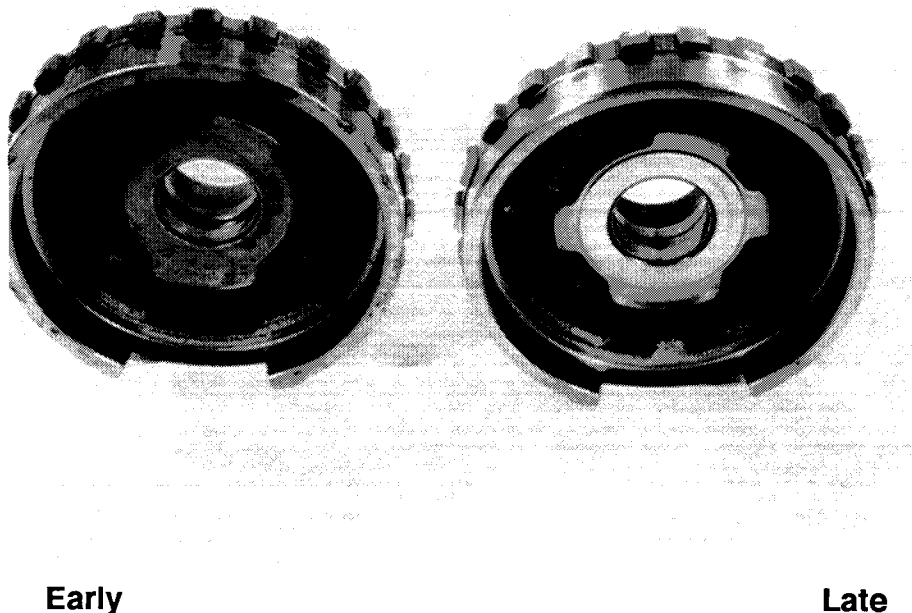
Ford has made a change to the front planet. They machined the front of the shaft so only the rear bushing of the front sun gear would be supported. The picture below shows both early & late planets.



Note: These planets will interchange.

Planet Failure

The most costly complaint is planetary-gear-train failure. When you experience this type of failure, or want to prevent it, the first thing to check is the two bushings in the rear-planetary support. Sometimes these bushings move out of position and block the lube hole between them.



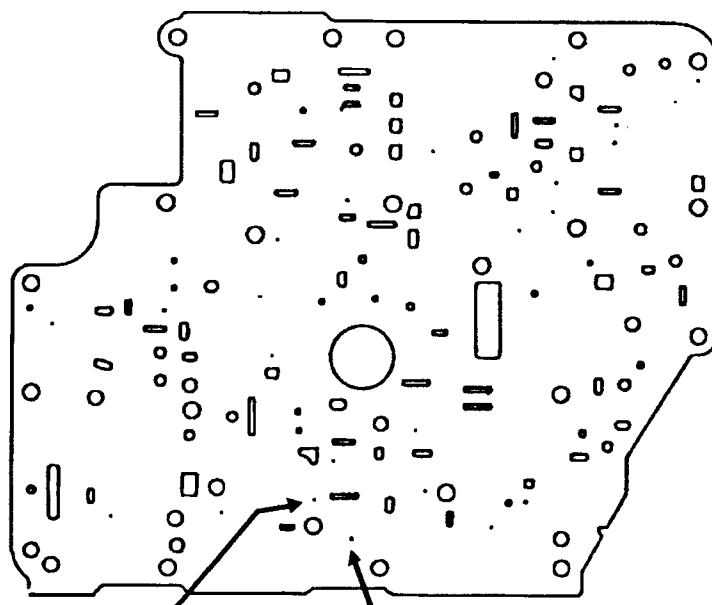
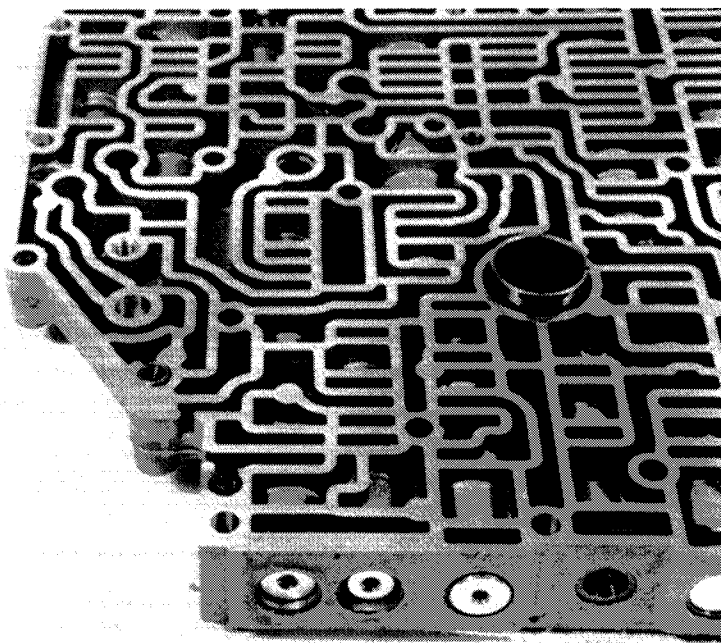
Early

Late

The 1988 and later rear support has a one-piece bushing with a hole in the center to help correct this potential problem. The late support will fit the earlier models. Part number E6DZ-7A130-A.

Planet Failure (Continued)

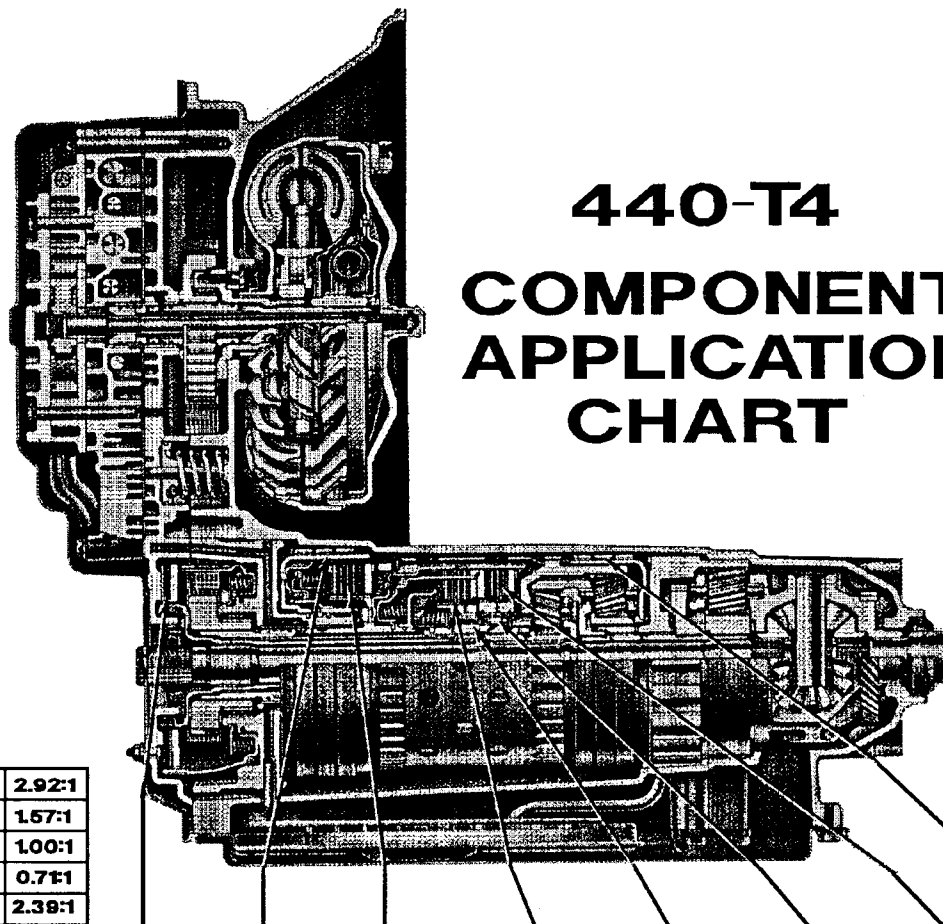
To increase lube flow, enlarge the two feed holes in the separator plate and, if necessary, trim the rear lube check-valve spring until the check valve sits about 1/16" above flush.



T/C Charge
(Converter regulator bypass)
Enlarge to 1/16"

Rear Lube
Enlarge to .076 or 5/64"

4T60 / 440-T4



440-T4 COMPONENT APPLICATION CHART

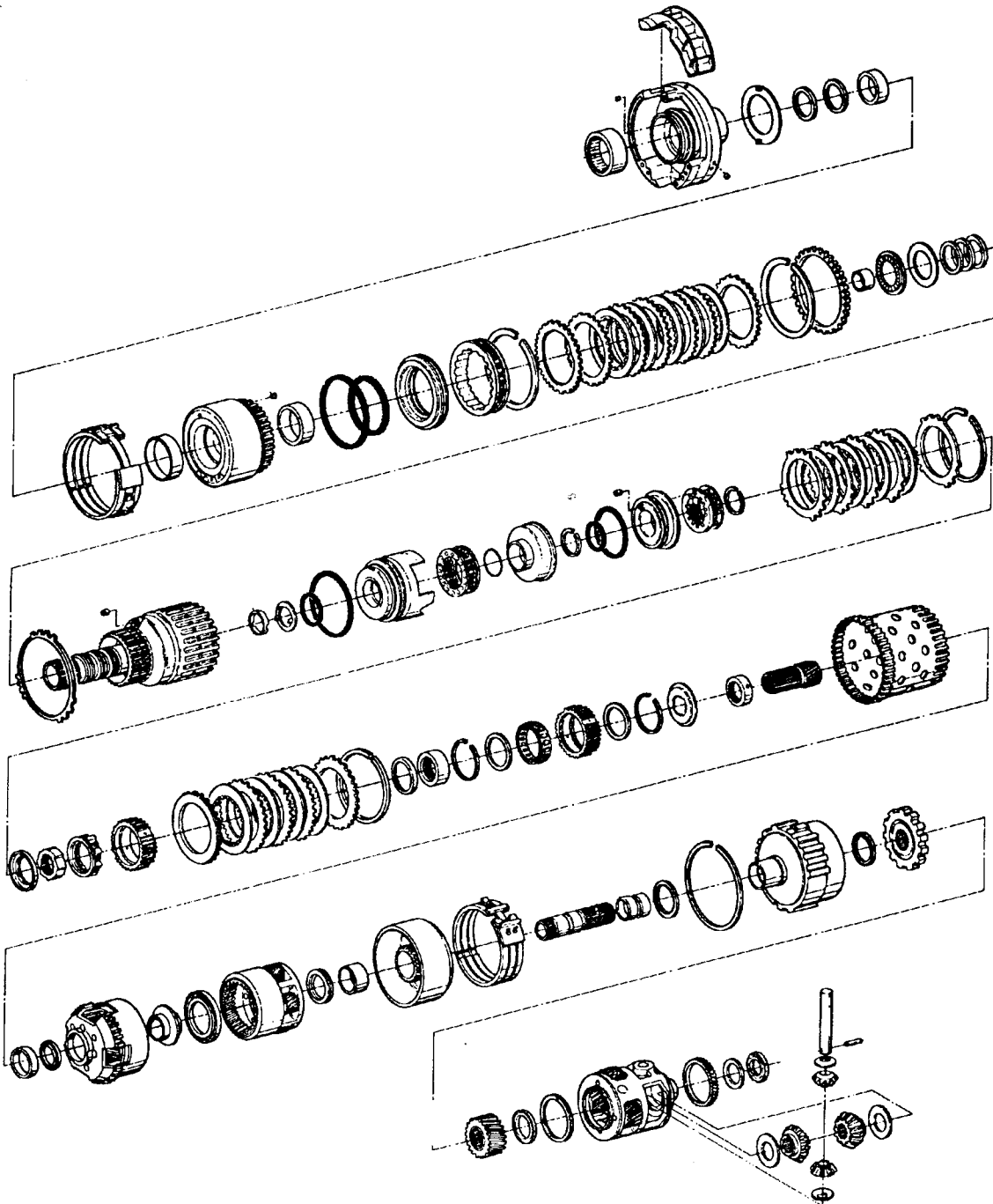
1st gear	2.92:1
2nd gear	1.57:1
3rd gear	1.00:1
4th gear	0.71:1
Reverse	2.39:1

SELECTOR POSITION		4TH CLUTCH	REVERSE BAND	2ND CLUTCH	3RD CLUTCH	3RD ROLLER CLUTCH	INPUT SPRAG	INPUT CLUTCH	1-2 BAND
NEUTRAL PARK									
OVER DRIVE	1								
	2								
	3								
	4								
MANUAL	3								
	2								
	1								
REVERSE									

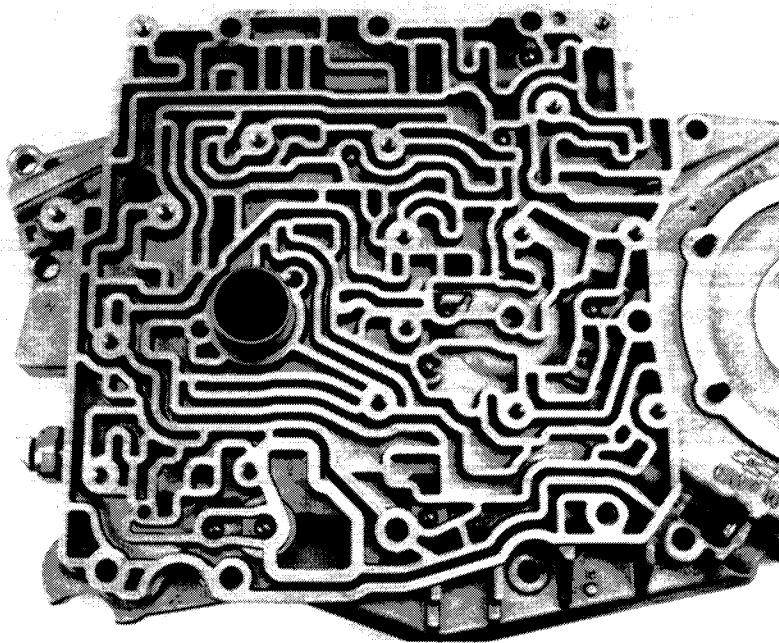
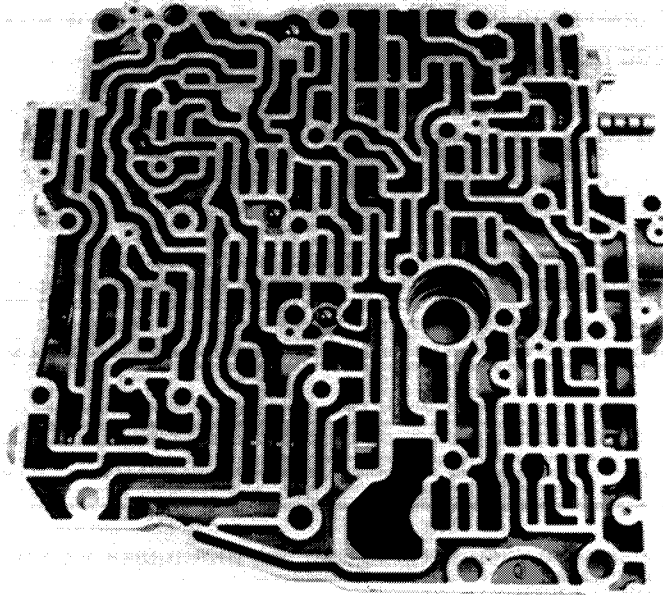
 = APPLIED OR HOLDING
  * APPLIED BUT NOT EFFECTIVE

4T60/440-T4

technical seminar



Checkballs



Engine / Transmission Relations

An important part of transmission diagnosis is to make certain the engine operates properly. If the engine operation is not correct, the transmission will receive the wrong information about engine performance.

The engine sends signals to the transmission through a vacuum line and a throttle cable. These signals basically synchronize engine torque with transmission line pressure, shift feel and shift timing.

Malfunctions in items like the air filter, spark plugs, EGR valves and other parts of the fuel, electrical and emission systems could result in improper transmission performance.

Vacuum Source Inspection

STEP 1

Attach a vacuum gauge to the modulator vacuum line at the modulator.

STEP 2

With the engine at idle (operating temperature), and the selector in the overdrive range (service and parking brakes applied), the engine vacuum should be at least 13-17 in. Hg. The gauge reading should respond quickly to throttle movement.

STEP 3

If the engine vacuum is incorrect, repair the vacuum source and repeat the road test before making any hydraulic repairs.

An incorrect engine vacuum signal at the modulator can be caused by a pinched, cut, plugged, or disconnected vacuum line. Additionally, engine mechanical as well as operating conditions related to the fuel delivery system, ignition, exhaust, or emission systems may result in incorrect engine vacuum.

STEP 4

If the vacuum source is correct, perform the On-Car Modulator System Inspection.

On-Car Modulator System Inspection

Only use the correct modulator on 440's. All gas 440's use a modulator with a diaphragm diameter of 1 3/4" + or - 1/16". Diesels use a 2" modulator.

STEP 1

Remove and plug the vacuum line at the vacuum modulator.

STEP 2

Install an auxiliary hand operated vacuum pump to the modulator.

STEP 3

Install a line pressure gauge.

STEP 4

With the engine warm and running at fast idle (approx 1200 RPM), apply the parking and service brakes and place the range selector in overdrive.

STEP 5

Observe the line pressure rise at each of the specified vacuum settings as shown in the Modulator System Evaluation Chart.

STEP 6

If all the line pressures are incorrect during this inspection, inspect the Line Pressure Circuit in the valve body. If some of the line pressures are incorrect during this inspection, inspect the Modulator and the Modulator Pressure Circuit and Line Pressure Circuit in the valve body. If all of the line pressures are correct, any malfunction your having is NOT caused by line or modulator pressure:

Modulator System Evaluation Chart

Vacuum	Line Pressure + / - 5 PSI
14	Minimum per chart (60-75)
12	No rise
10	10 lb. rise - 10 total
8	19 lb. rise - 29 total
6	18 lb. rise - 47 total
4	18 lb. rise - 65 total
2	18 lb. rise - 83 total
0	18 lb. rise - 101 total

Adjusting The Modulator

STEP 1

Disconnect the vacuum line with the engine at fast idle (approx 1200 RPM). Check the line pressure in drive, it should not be above 210 psi. If line pressure is above 210, you either have the wrong modulator OR the modulator is adjusted too far in.

STEP 2

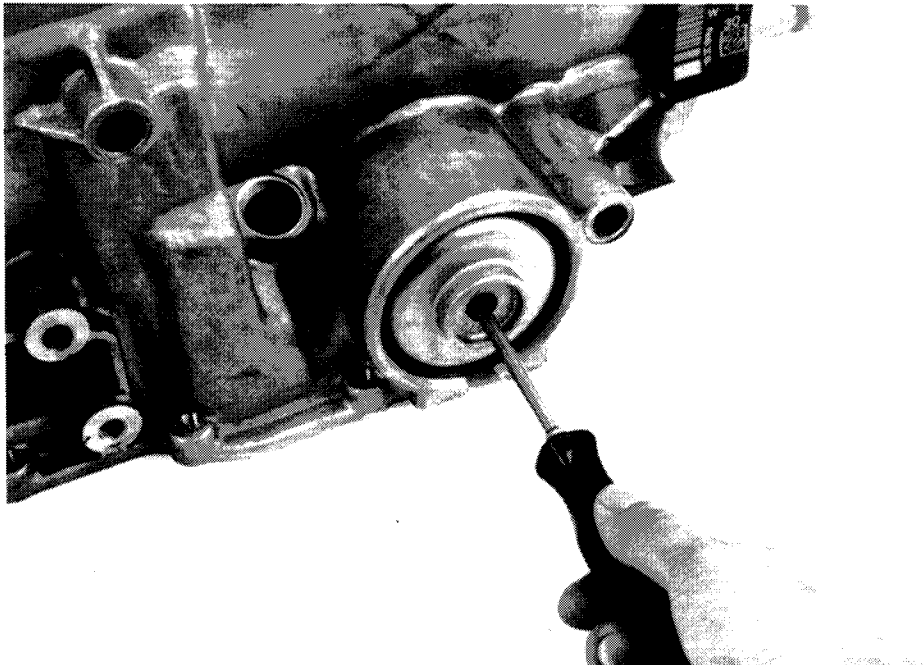
Connect a vacuum pump to the modulator. Pump in vacuum until the line pressure is at minimum (60-75). Bleed the vacuum down to 11". Line pressure should have increased at least 10 psi. Adjust the modulator until you can get a 10 psi pressure rise by 11" of vacuum.

STEP 3

Disconnect vacuum line to be sure you are still not above 210 psi line pressure.

Band Adjustment

Travel on the 1-2 band servo should be 1/8" to 1/4". The reverse servo travel should also be 1/8" to 1/4". The best way to set servo travel is with pin length. Many technicians use reverse pins in the 1-2 servo because they are much longer. They can then grind them down to get the proper clearance. To set reverse servo travel you may have to weld onto the servo pin.



Clutches

The quality of the clutches is probably more important on a 440 than any other transmission. Use only TOP quality frictions in this transmission. Sometimes a very good quality plate may still cause some shift complaints because of transmission calibration. If you ever have any doubt about 440 frictions, remember that the clutches from GM or AC/Delco will always be right.

Summary

The information on vacuum, pressure, modulators, band adjustment and clutches should correct or prevent most of the common 440 complaints we've heard on the ATRA helpline. These things must all be correct before you use the information on the following pages for problem correction.

1-2 Slip or Chatter

STEP 1

Check the 1-2 accumulator for a worn seal and/or a worn piston and shaft.

STEP 2

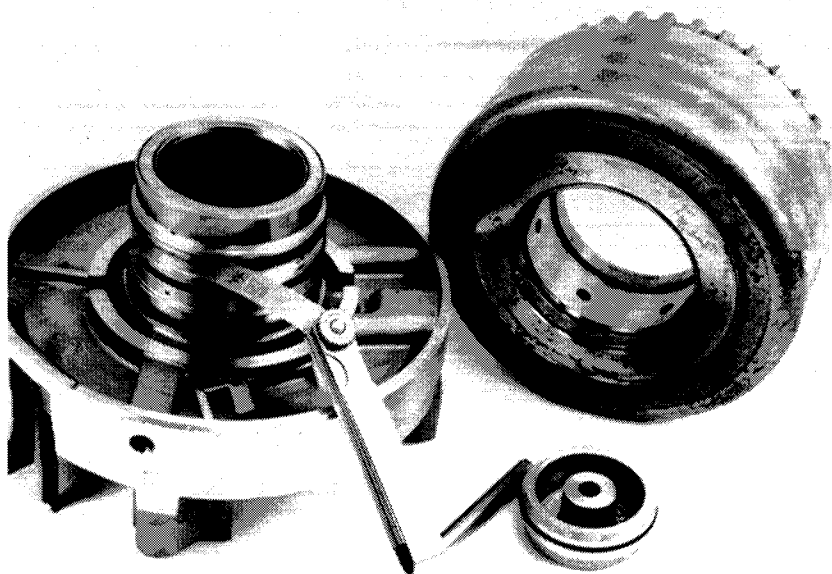
Check for ring groove wear. If a .005" feeler gauge will go in the ring groove with a new ring, then the support is worn. If you need to buy a support, buy the late style support with the Vespel sealing rings.

STEP 3

If the 2nd clutch drum bushings are worn excessively it can cause sealing rings leakage.

STEP 4

Check for ring grooves in the 2nd clutch drum. If your finger nail will catch on the groove then the drum should be replaced.



1-2 Slide Bump

Install a stronger 1-2 accumulator spring. An example might be a 3-4 accumulator spring (8649092) or a C-6 servo spring inside the existing 1-2 accumulator spring.

2-3 Slips & Flare-Ups

STEP 1

Check for a rolled or split inner lip seal in the 3rd clutch drum.

NOTE

The late seal will work in the early drum. Be careful when you put the piston in so you don't roll the seal.

STEP 2

A bad 3rd roller clutch may cause a flare-up on the shift from 2nd to 3rd.

NOTE

Always sand the outer race with sand paper before assembling the 3rd roller clutch.



TCC Shudder

STEP 1

Verify that this is not an engine problem. See Electronics page 31.

STEP 2

Try a friction modifier in the fluid.

STEP 3

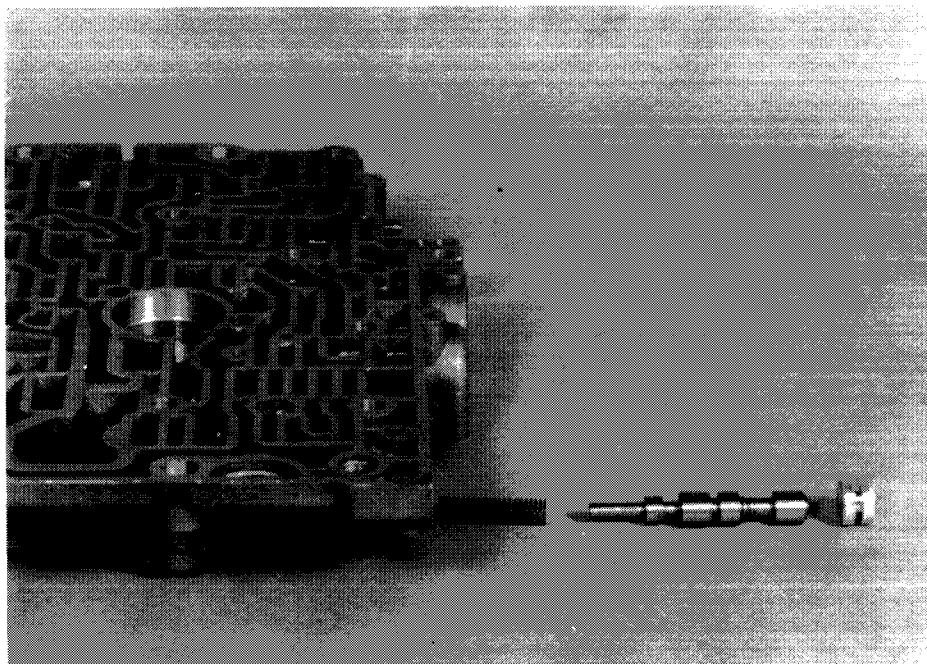
If the TCC accumulator piston and shaft are worn, replace them with part number 8646926.

STEP 4

You may increase the tension of the TCC regulator spring. If there isn't a spring, install a light spring. If there is a spring, increase the spring weight by 1 lb. Don't exceed 2 1/2 lbs or TCC re-engagement may be too rough. The working height for the spring is .750". Make sure the valve is not sticking.

STEP 5

Replace the converter.



2-1 Downshift Clunk or Wrong Gear Starts

IMPORTANT

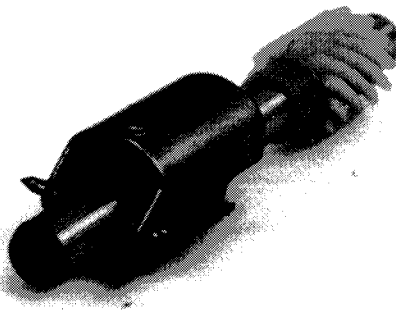
Roadtest after each step.

STEP 1

Make sure the engine idle is not above normal.

STEP 2

Verify that line pressure is normal; 60-75 in Drive.



STEP 3

Remove the primary weight governor spring. The primary weight is the heavier weight.

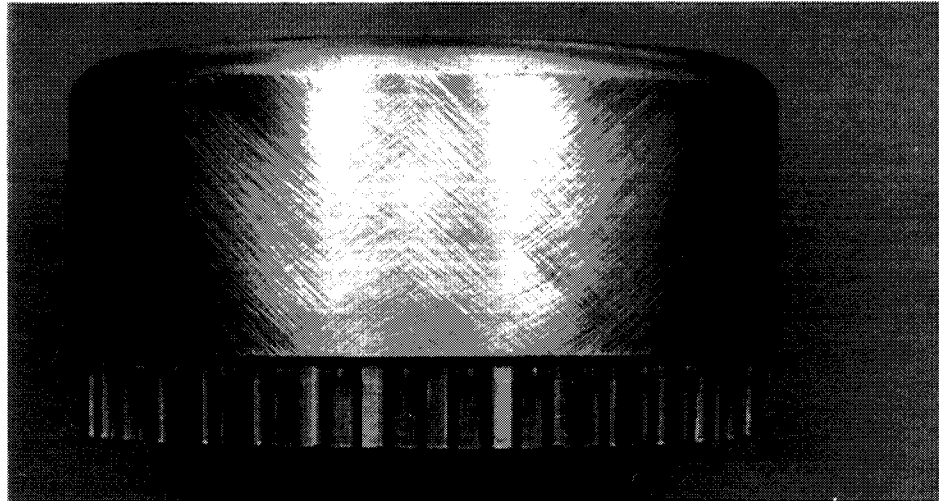
NOTE

This may delay the upshifts somewhat.

Reverse Problems

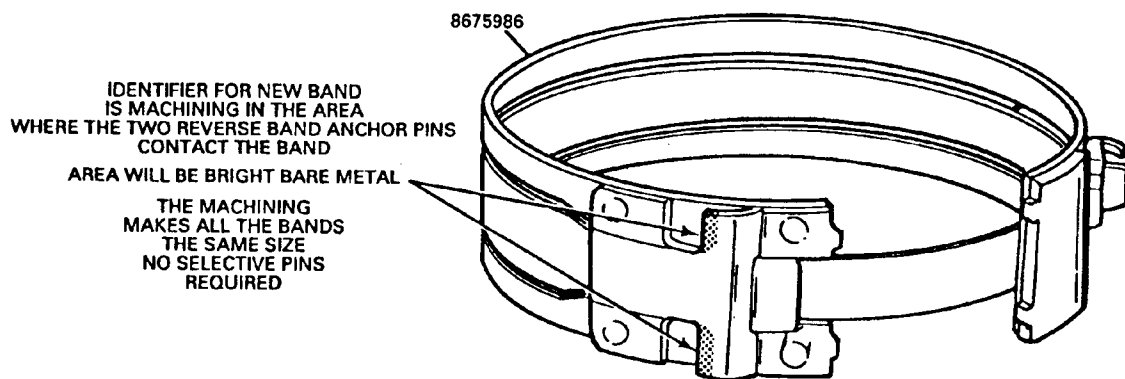
STEP 1

During rebuild sand the 2nd clutch drum's outer surface with course sand paper.



STEP 2

If the band needs to be replaced, the latest GM band is part number 8675986.

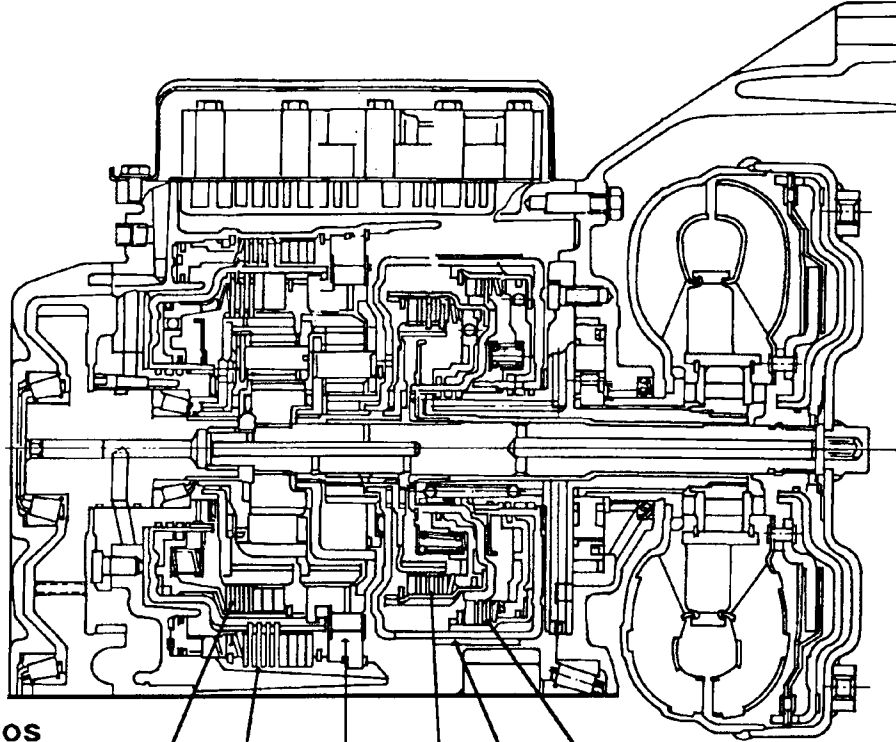


Part List

TCC SIGNAL OIL TUBE	8658060
TCC SIGNAL TUBE O'RING	8658109
QUAD SEALS	8662329
2ND CLUTCH SEALING RINGS (VESPEL)	8662330
2ND GEAR DRUM	8661912
SPROCKET SUPPORT - LATE	8662523
1-2 SERVO PIPE SEAL (VB)	8656567
1-2 SERVO PIPE SEAL (CASE)	8656568
1-2 SERVO PISTON SEAL	8658160
#7 CHECKBALL CAPSULE	8668287
VB-CHANNEL GASKET SET 1984 - 1985 1/2	8646907
VB-CHANNEL GASKET SET 1985 1/2 - ON	8646949
EARLY IMPROVED INPUT SPRAG	8646986
3RD ROLLER CLUTCH ASSEMBLY	8662676
LATE INPUT SPRAG ASSEMBLY	8662031
PLASTIC LUBE DAM	8658368
4TH CLUTCH HUB	8656355
3-4 ACCUMULATOR SPRING	8649092
TCC ACCUMULATOR PISTON & SHAFT	8646926
REVERSE BAND	8675986
2ND CLUTCH PACK (5 PLATE)	8662913
2ND CLUTCH PACK (6 PLATE)	8662914
LINE CONTROL VALVE CLIP	8658678
1-2 BAND	8675987

RL4F02A

RL4F02A COMPONENT APPLICATION



GEAR RATIOS

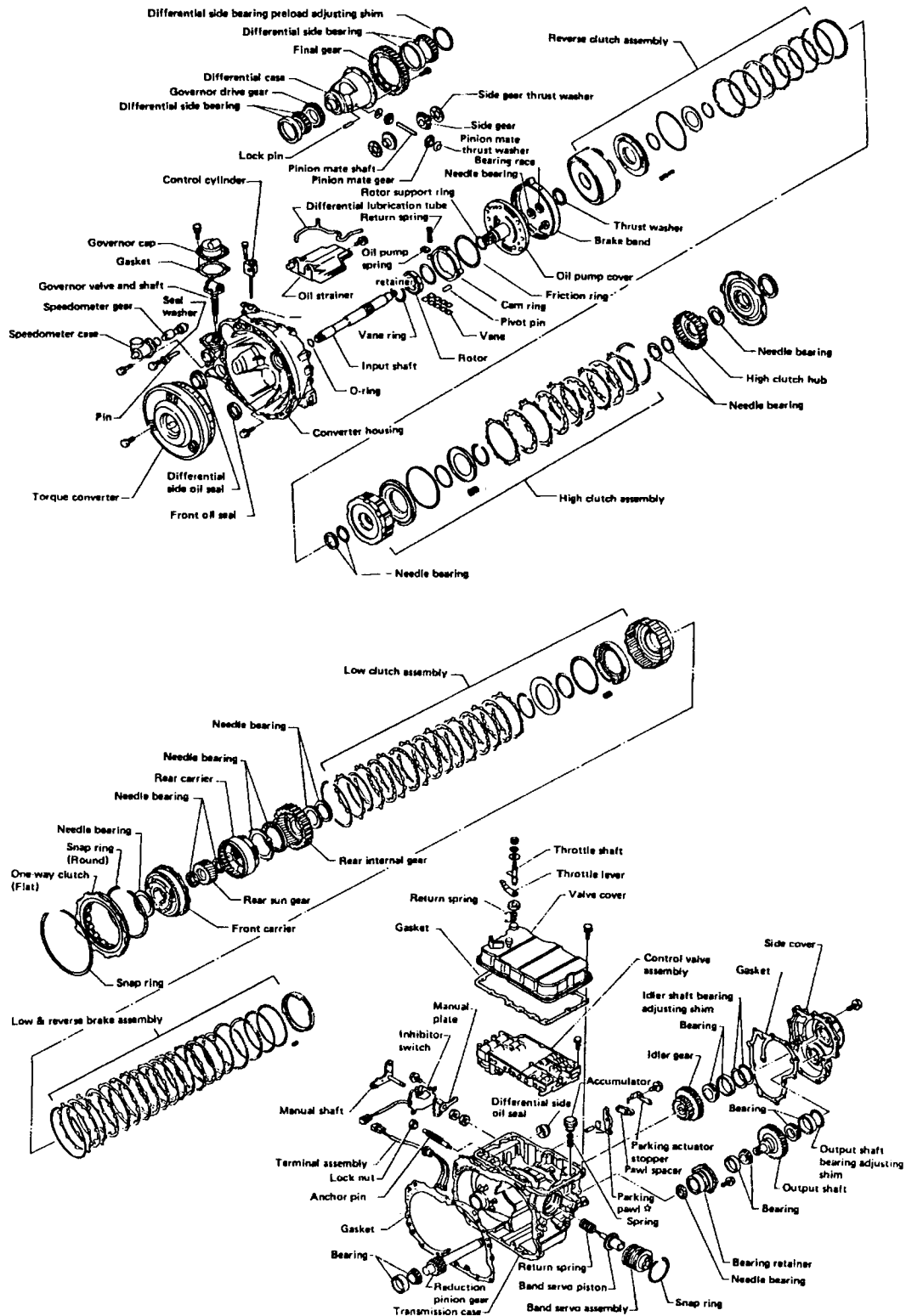
1st gear	2.785:1
2nd gear	1.545:1
3rd gear	1.000:1
4th gear	0.694:1
Reverse	2.272:1

Selector Position	GEAR ENGAGED	LOW CLUTCH	LOW REVERSE CLUTCH	SPRAG	HIGH CLUTCH	2-4 BAND	REVERSE CLUTCH
R	Reverse						
D	1st gear						
	2nd gear						
	3rd gear						
	4th gear						
2	1st gear						
	2nd gear						
1	1st gear						
	2nd gear						

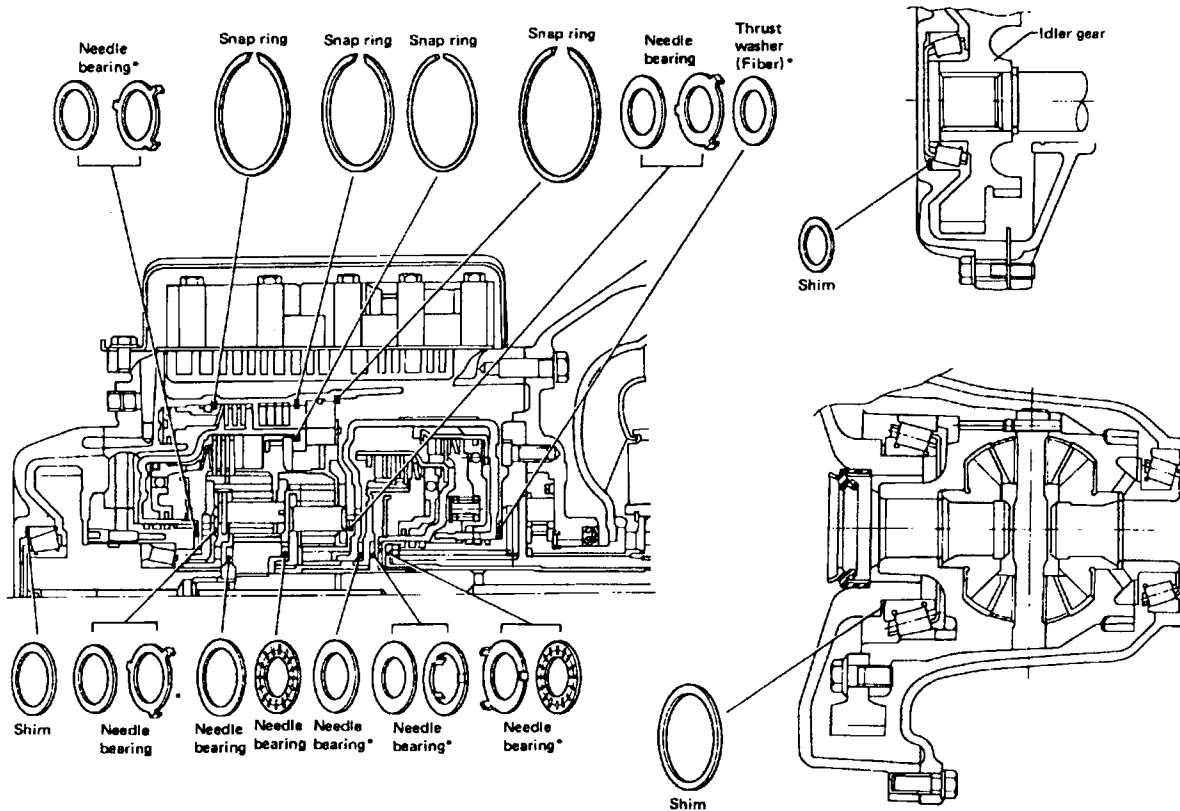
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RL4F02A

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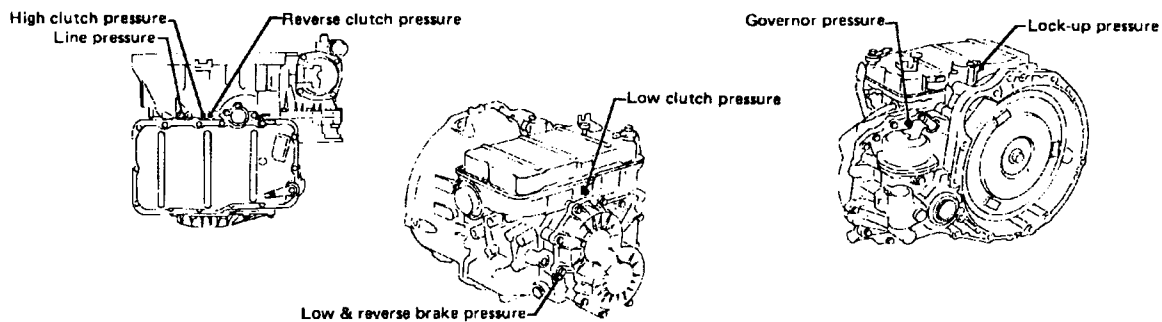


technical seminar



RL4F02A

Pressure Testing



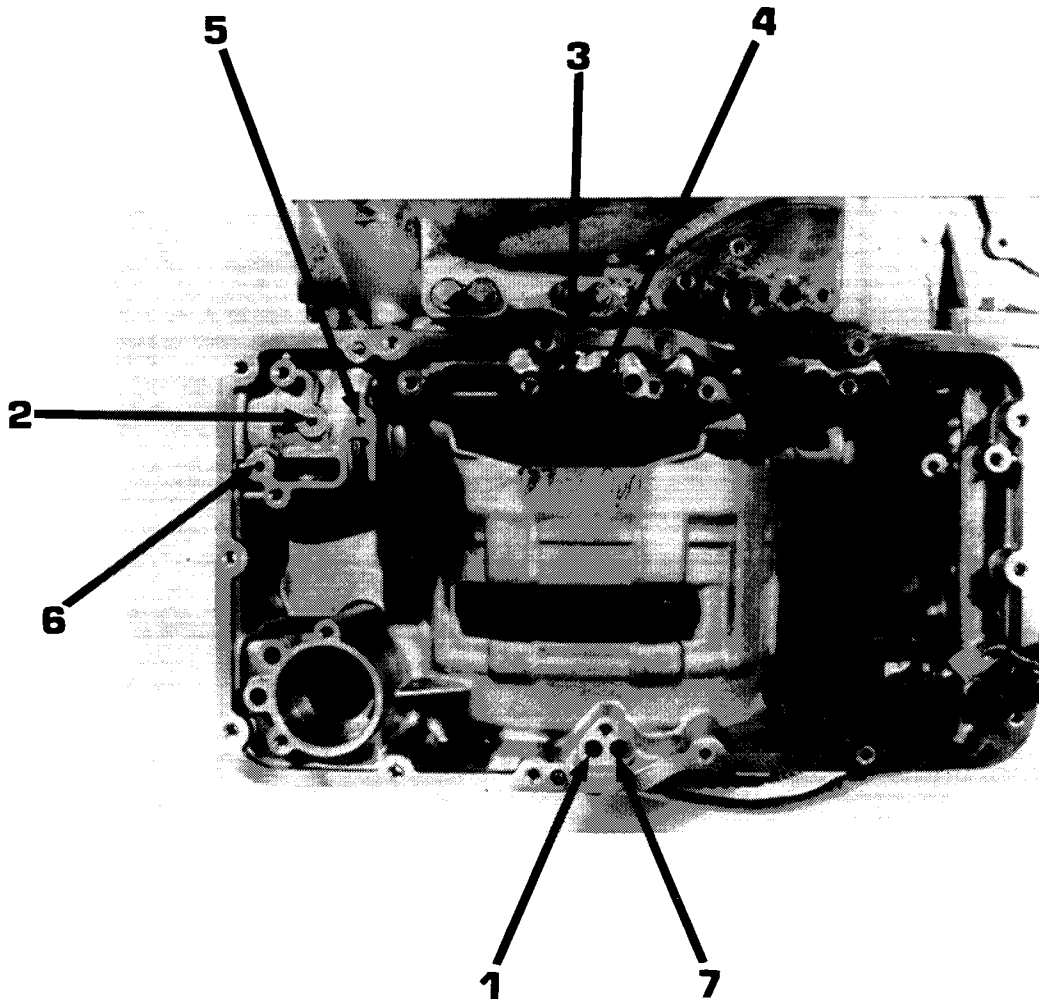
Line pressure in all ranges at idle 53 - 63 psi.

At stall 175 - 200 psi.

Governor Pressure

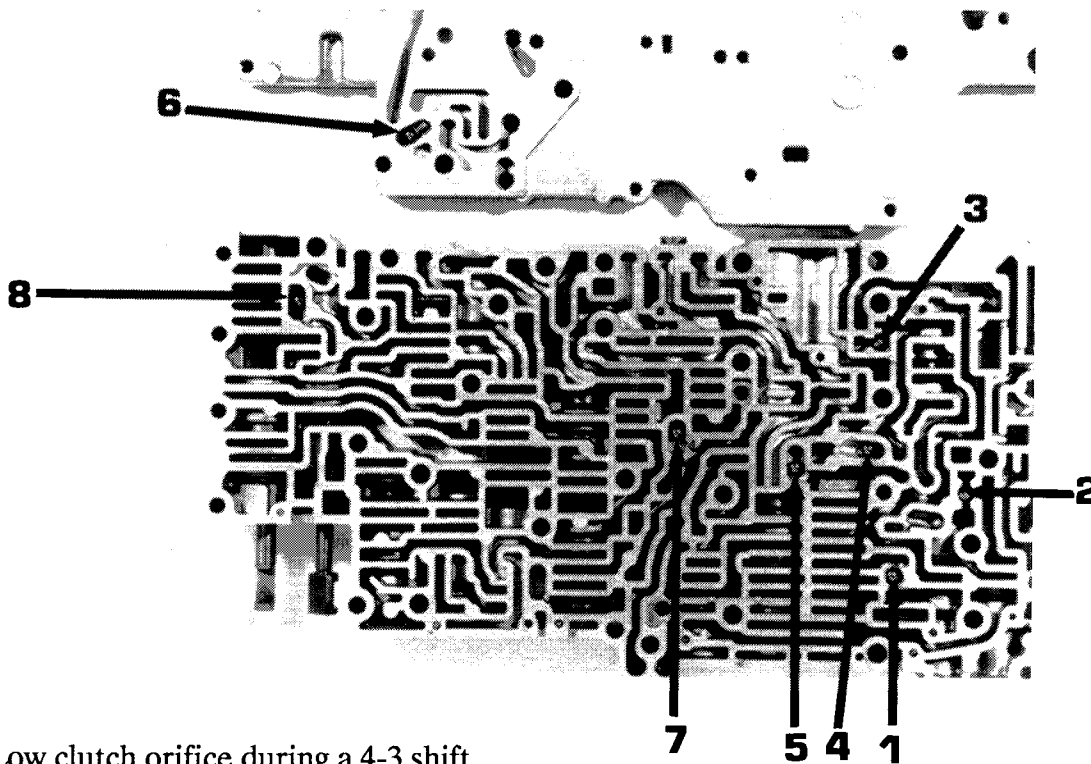
MPH	Pressure
0	0
20	13-18
55	41-50

Air Checks



- #1 Low Clutch
- #2 Servo Apply
- #3 High Clutch
- #4 Reverse Clutch
- #5 Servo Release
- #6 1-2 Accumulator
- #7 Low/Reverse Clutch

Valve Body Checkballs



#1 - Low clutch orifice during a 4-3 shift.

#2 - Servo release orifice (3-2 shift)

#3 - Servo apply orifice (1-2, 3-4 shift)

#4 - Overdrive cancel shuttle - [O.D. cancel Solenoid / Manual shift valve (D₂, L)]

#5 - Overdrive cancel shuttle - [#4 checkball / T.V. plunger (kickdown)]

#6 - Lock-up cancel shuttle - [lock-up cancel Solenoid / T.V. plunger (kickdown)]

#7 - Low / Reverse brake shuttle - [Manual control valve.]

#8 - Pressure boost shuttle - [T.V. / Manual control valve (3-2, 3-1)]

No Upshifts

STEP 1

Check line pressure see page 4. If line pressure is normal go to step 2. If line pressure is high, check for a stuck throttle valve.

STEP 2

Check governor pressure. See page 4 for governor pressure chart. Governor pressure should rise with vehicle speed (think of the pressure gauge as a hydraulic speedometer). If governor pressure is normal, check for stuck shift valves. If governor pressure is low, go to step 3.

STEP 3

Remove the governor and check it for a stripped gear. Figure 1.

NOTE

Also check it for a broken roll pin. If ok go to step 4.

STEP 4

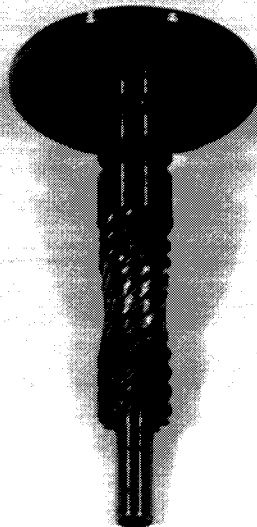
Make sure the primary governor weight isn't in backwards. The slots on the valve face the outside Figure 2. If ok go to step 5.

STEP 5

Air check the governor circuit. Put the governor shaft back in the transaxle. Blow in the governor passage and check around the valve body for leaks. Figure 3.

NOTE

If you blow in the drive passage (the other hole) air will blow out the manual control valve, that's normal, try the other hole.



No Upshifts

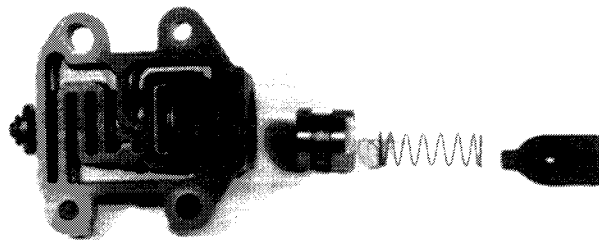


Figure 2



Figure 3

Slide 1-2 / 2-3 Flare-Up

STEP 1

Check line pressure. See page 4.

STEP 2

Remove the servo return spring.

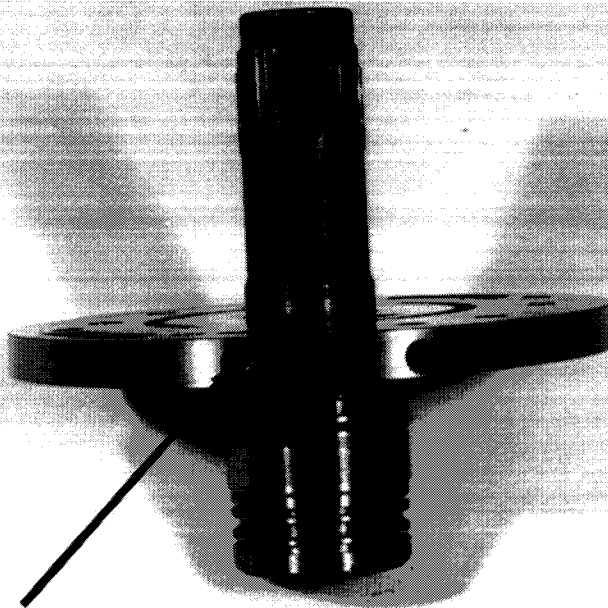


If line pressure is ok
remove this spring.

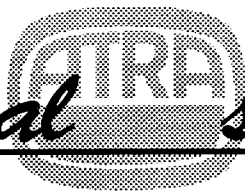
Repeated High Clutch Failure



Always bore fit the high clutch sealing rings. If the gap exceeds .003, replace the ring.



Solvent check the high clutch check valve. When you air check the high clutch, make sure the check valve doesn't leak.



Slips Forward

STEP 1

Check line pressure. See page 4. If line pressure's ok, go to step 2. If line pressure is low, check for a stuck pump slide. Figure 1.

STEP 2

Check the low clutch pressure. See page 4. If pressure is low go to step 3 if it's ok check for low clutch damage.

NOTE

Low clutch pressure should be the same as line pressure.

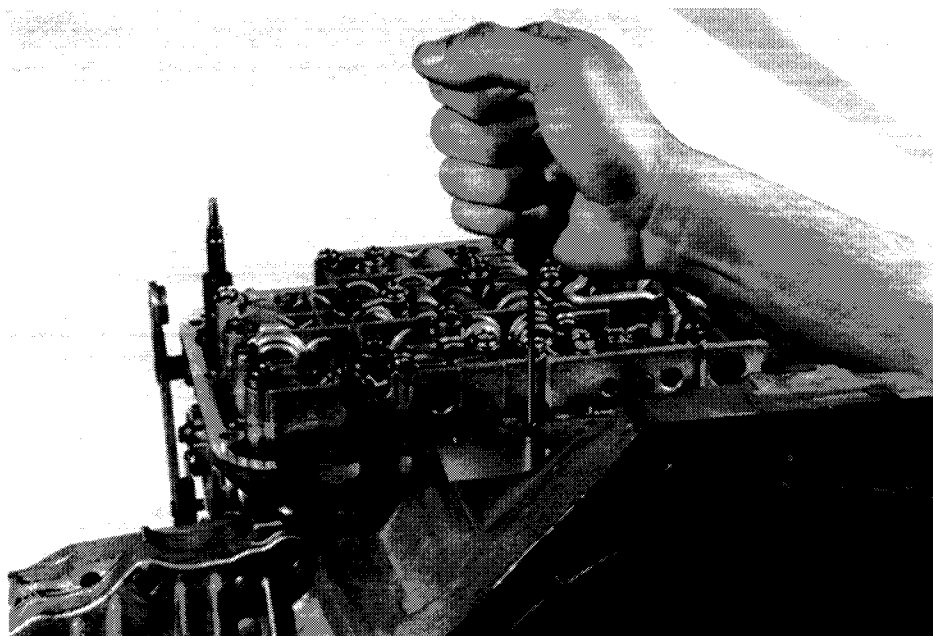
STEP 3

Check for a missing low clutch checkball. Figure 2.. If it's ok check for internal leaks.

RL4F02A

Checking for a Stuck Pump Slide

Use a long thin screw driver
to move the slide



NOTE

If the pump slide is stuck you'll have to remove the transaxle and check the clearance between the slide and the pump cover. The allowable clearance is .0004 - .0009.

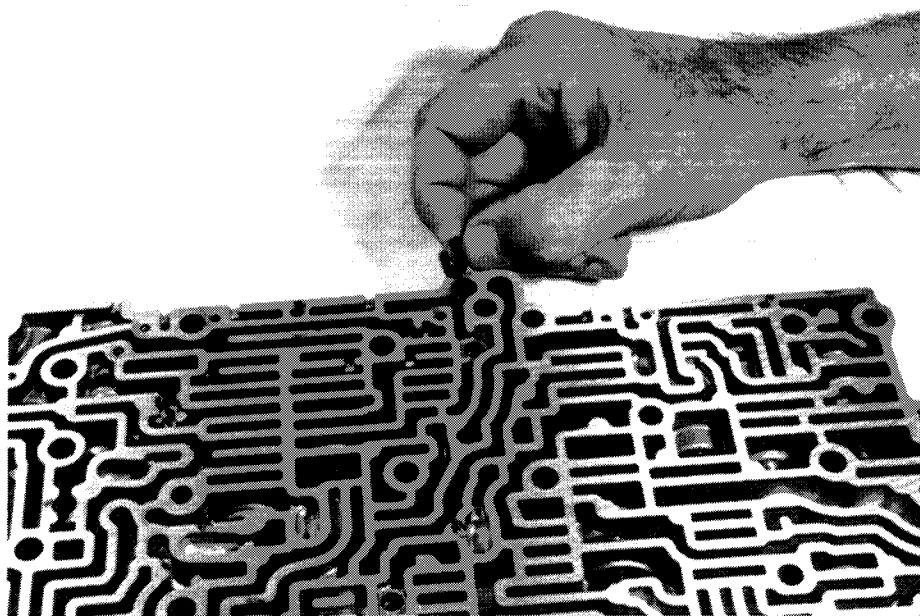
Checking the Low Clutch Check Valve

Blow air in the low clutch pressure tap.

Check here for leaks



Make sure the checkball
& retainer are in place.



Merveilleux

***NEW*
PRODUCTS**

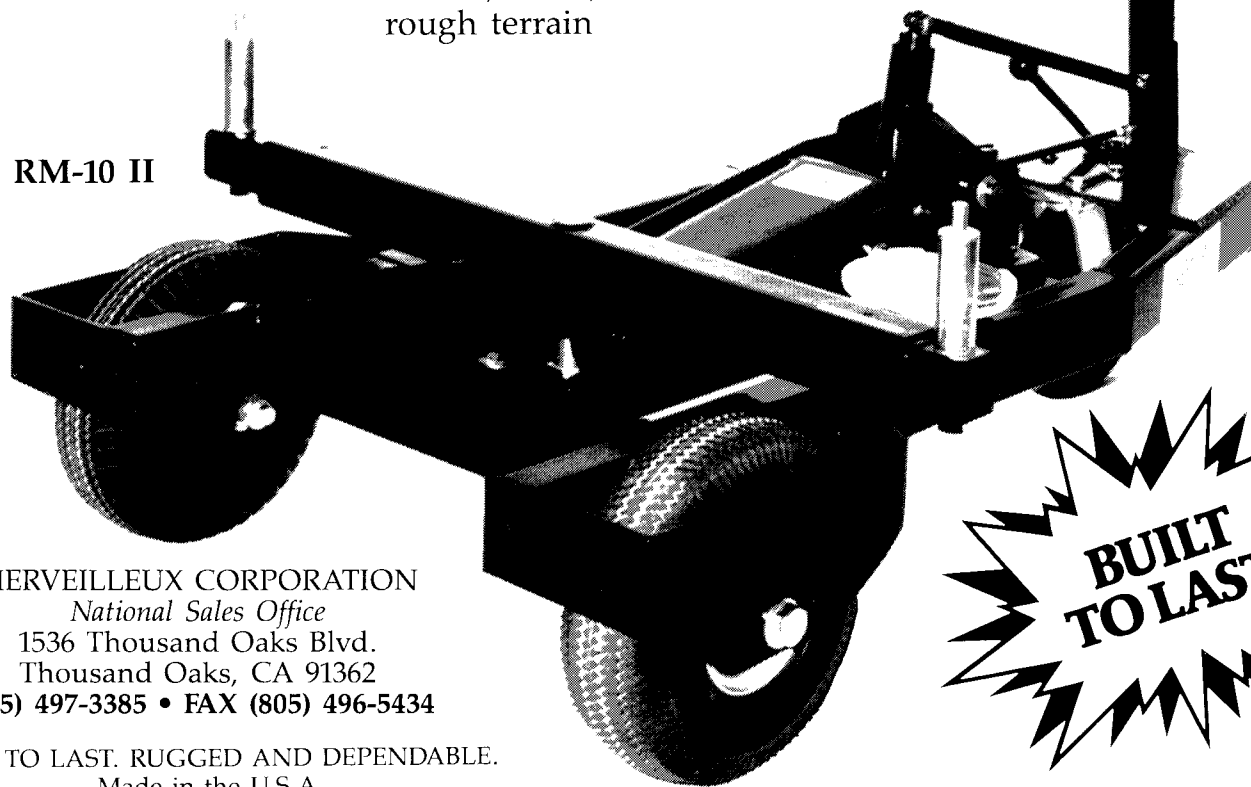
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- 6" Ground clearance
- 10" Pneumatic tires in the rear.
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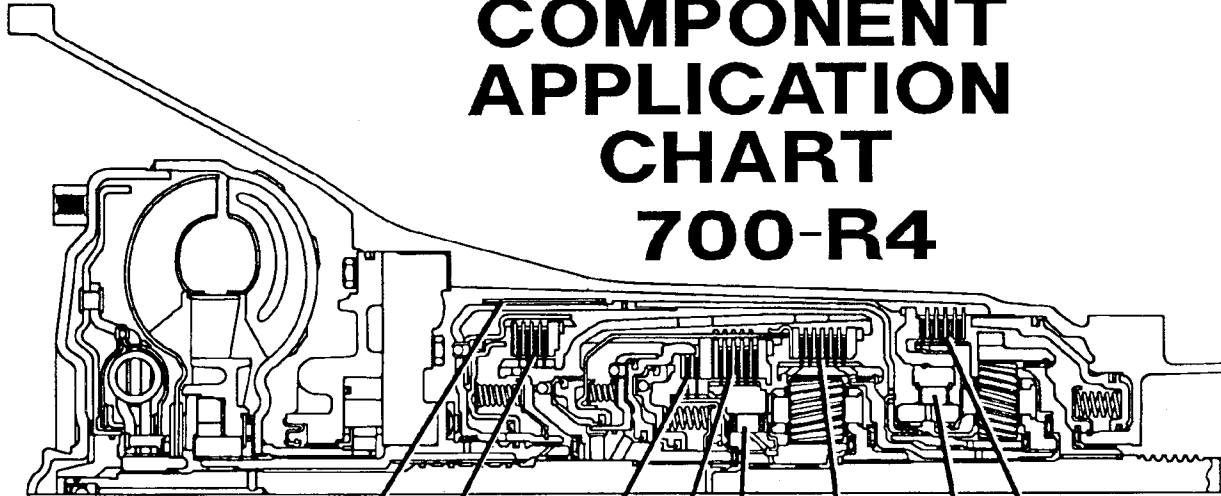
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TO LAST**

4L60 / 700-R4

COMPONENT APPLICATION CHART 700-R4



GEAR RATIOS

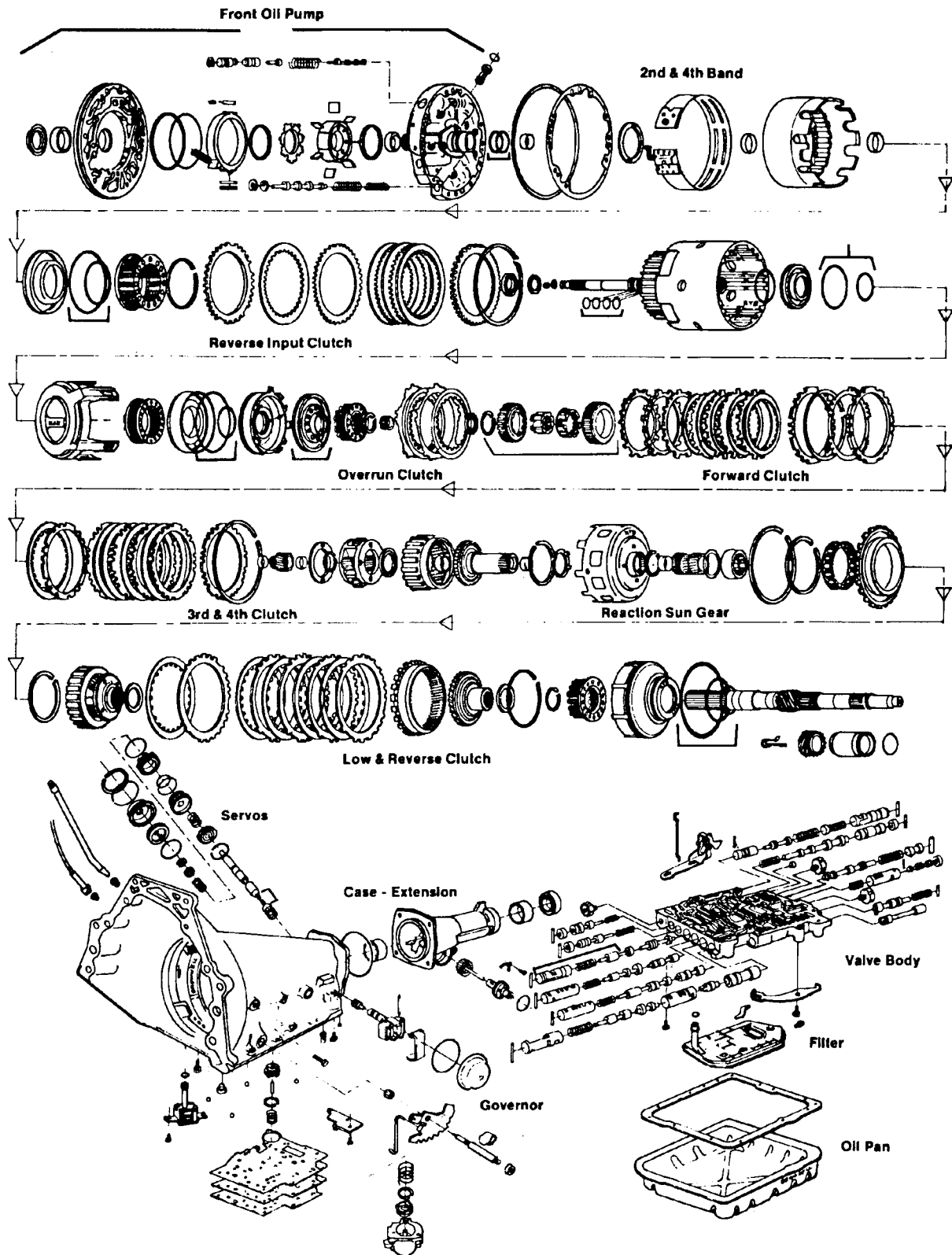
First	3.06
Second	1.62
Third	1.00
Fourth	.70
Reverse	2.29

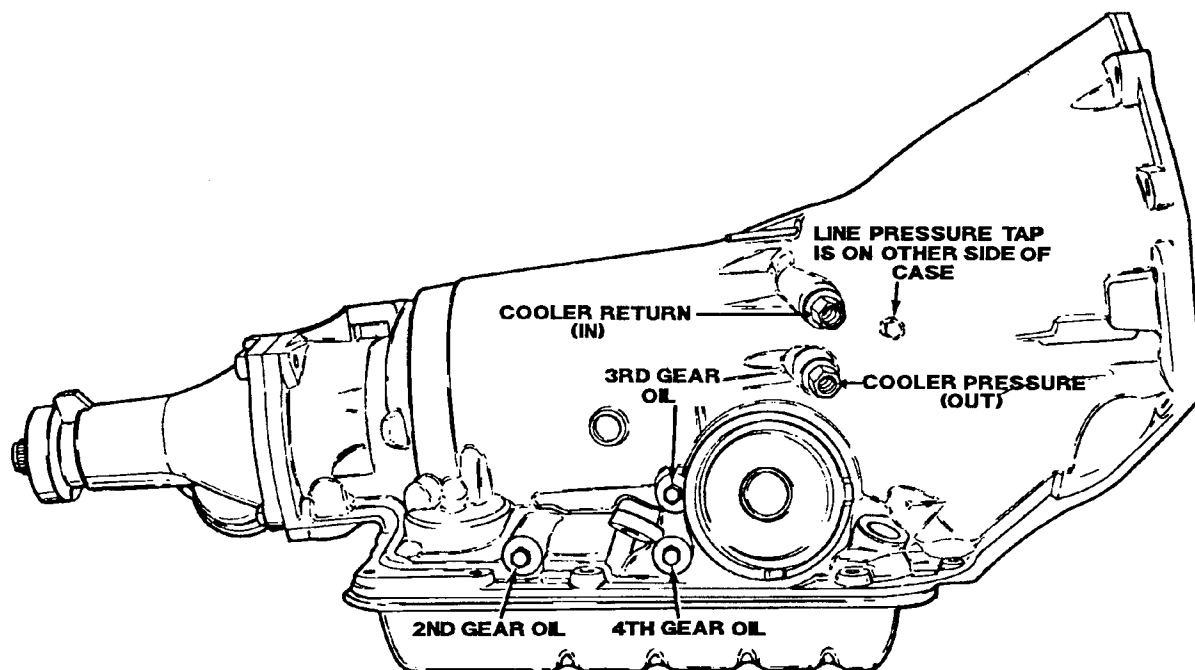
GEAR RANGE	2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO ROLLER CLUTCH	LO-REV. CLUTCH
1ST DR4								
2ND DR4								
3RD DR4								
4TH DR4								
3RD DR3					*			
2ND DR2					*			
1ST LO					*		*	
REV								

 = APPLIED OR HOLDING * APPLIED BUT NOT EFFECTIVE

4L60/700-R4

technical seminar





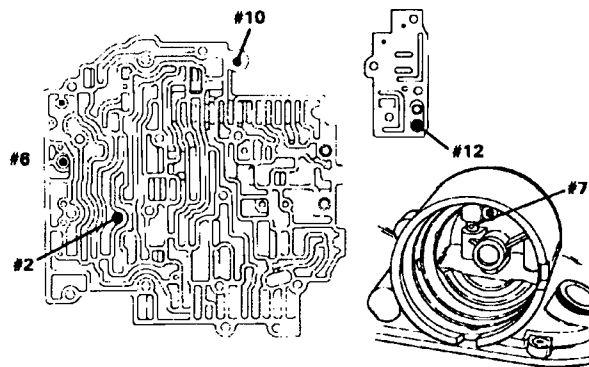
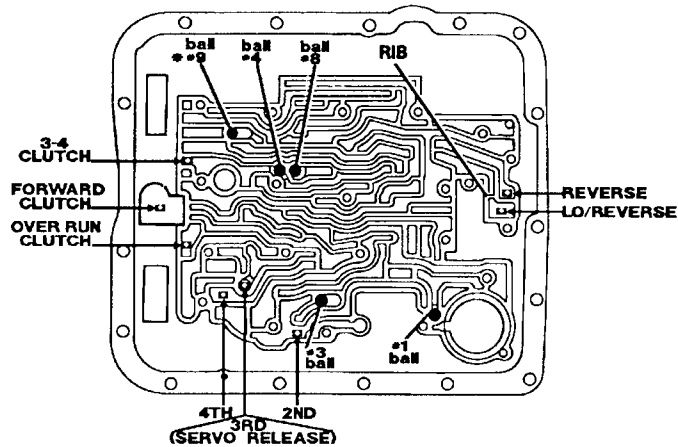
	Min	Max
Park	55-75	119-207
Reverse	92-123	195-255
Nuetral	55-75	119-207
Overdrive	55-75	119-207
Drive	55-75	119-207
2	162-187	162-187
1	162-187	162-187

87-89 Pressure Chart
Approximate: Varies depending on model

technical seminar

700-R4 Check Balls

□ = AIR CHECK PASSEGES



- #1 Fourth Accumulator Feed Orifice
- #2 Third Accumulator Feed Orifice
- #3 Part Throttle - Drive 3 Shuttle - For The 3-4 Shift Valve
- #4 3-2 Exhaust Orifice - 3-4 Clutch
- #6 Overrun Clutch Feed Orifice
- #7 Third Accumulator Exhaust Check Valve
- #8 2-4 Servo Feed Orifice - For The 1-2 Shift
- #9 Low/Detent Shuttle - For The 1-2 Shift Valve. Not Used In 1988 & Later.
- #10 T.V. Exhaust Check Valve
- #12 Forward Clutch Feed Orifice

The 1987 and later case has an orificed cup plug in the forward clutch circuit by the governor (Figure1). It's used to lubricate the extension housing bushing on units with a vehicle speed sensor instead of a speedometer gear. (The driven speedometer gear would sling oil on the extension housing bushing).

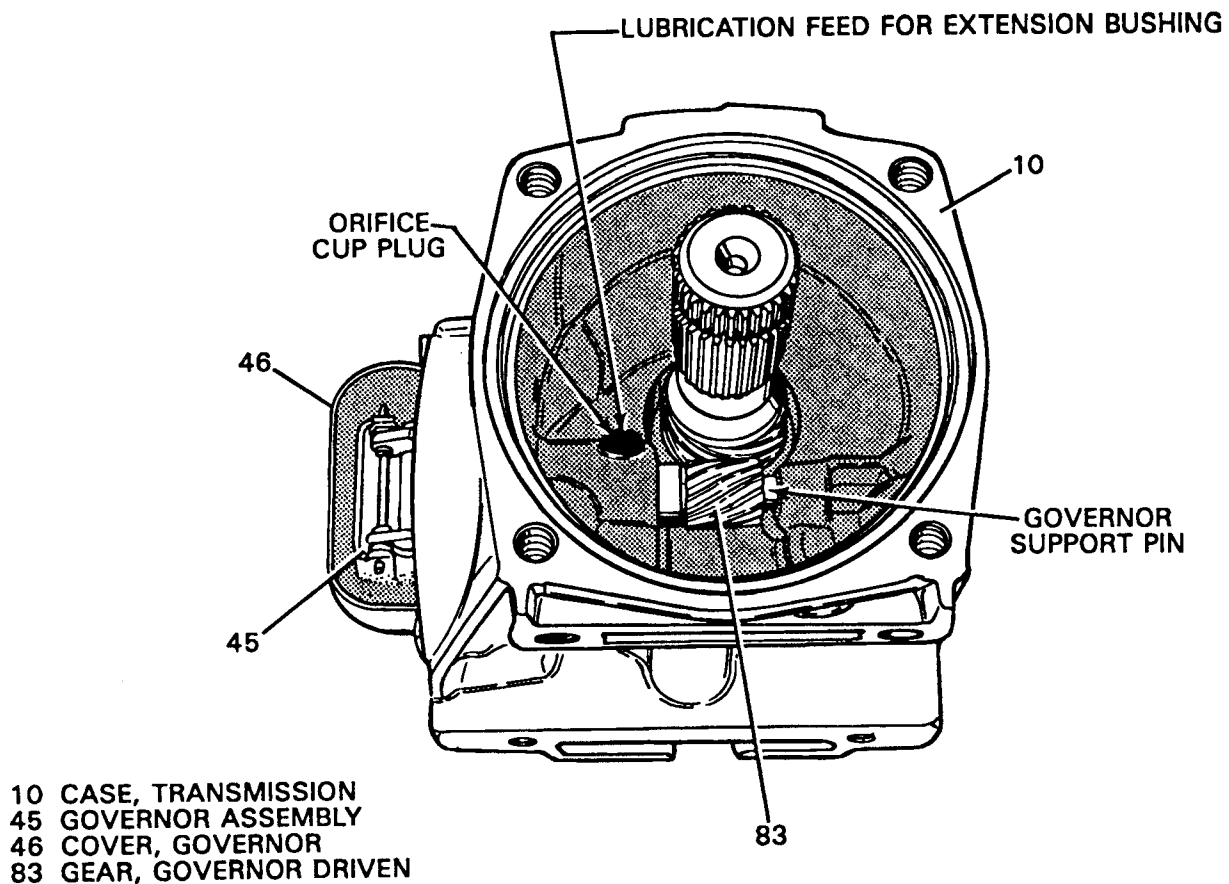


Figure 1

CAUTION

If the vehicle you're working on has a vehicle speed sensor instead of a speedometer gear, you **MUST** use a case with this orifice.

Pump

In mid '87 the pump rotor was changed to 10 vanes. (Figure 2) This was done to reduce harmonic noise. The 10 vane rotor can be used in earlier pump bodies. The plastic washer that fits between the rotor and pump body should be changed when making the update. The part number for the plastic washer is 8654734.

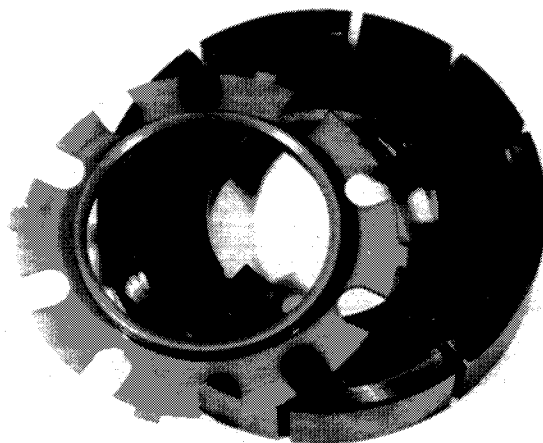


Figure 2

Pump Cover

There were two changes made to the pump cover. The first change was to leave a cup plug out (Figure 3) and modify the hole to accept the tube from the auxiliary valve body. The late cover will fit transmissions without the auxiliary valve body provided you plug the hole where the feed tube went and the pump body matches the cover.

CAUTION

Using an '87 or later pump cover in an earlier unit and not plugging the feed tube hole will result in a forward clutch circuit leak. This may cause a slipping or no movement condition with the gear selector in the overdrive position.

The second change to the pump cover was to the stator shaft. The reverse feed hole has been enlarged. (Figure 4)

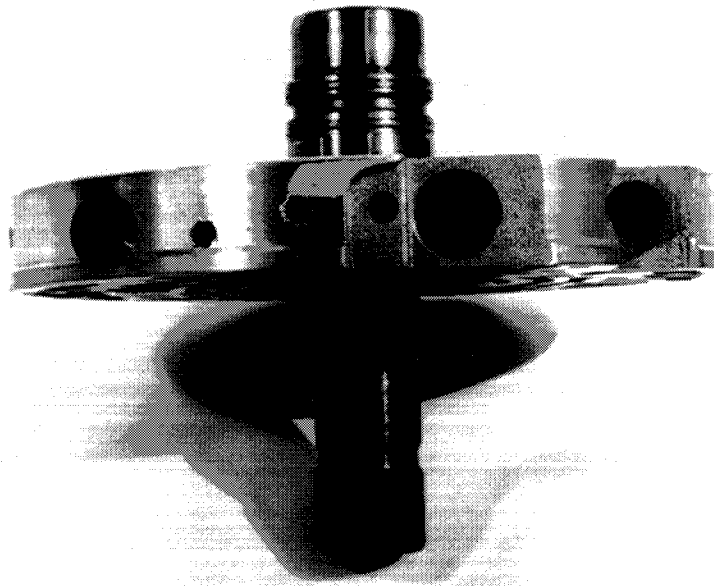


Figure 3

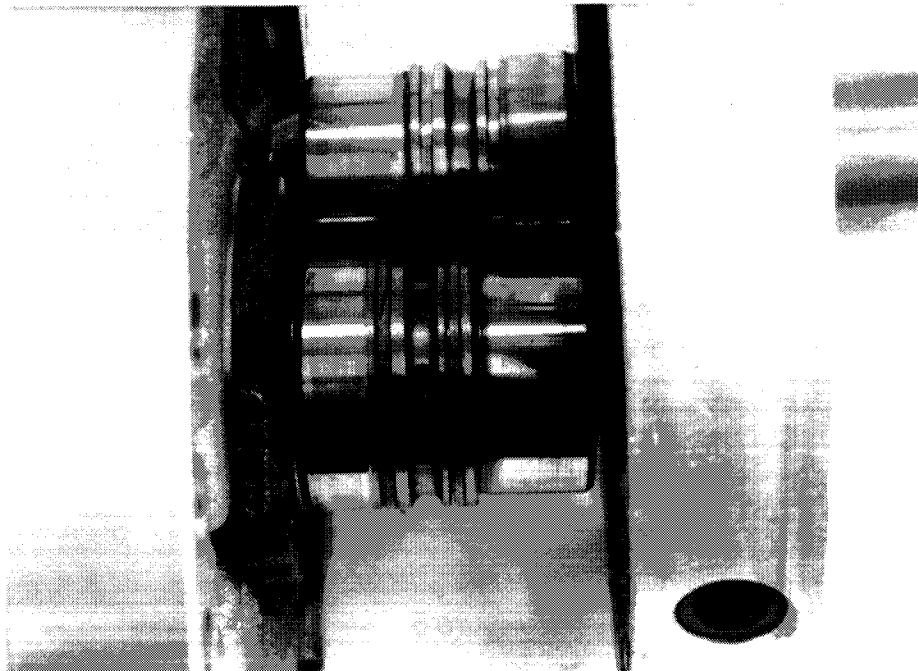


Figure 4

CAUTION

Using an '87 or later stator shaft with an '86 or earlier reverse input drum may cause a harsh reverse engagement.

Forward Sprag

The forward sprag as of early '87 has two more sprag elements (28 total). The complete sprag assembly will retro-fit into all units, just leave out the black planet washer. (Figure 5)

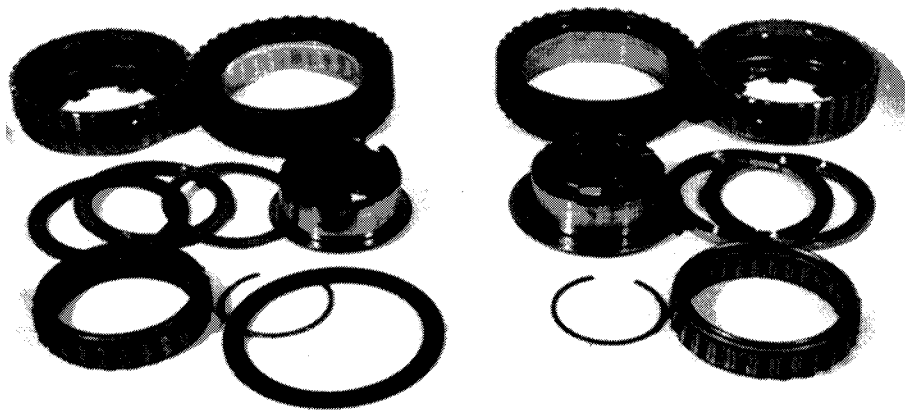


Figure 5

Valve Body - Separator Plate

The #5 check ball has been eliminated from the 1987 & later valve bodies (Figure 6). The 1987 valve body is interchangeable with '82 - '86 valve bodies, the separator plate is not. In 1988 the TCC shift valve assembly was completely eliminated (it was still used thru 1987 in trucks). The 1988 & later valve bodies are not interchangeable with 1987 valve bodies unless you use a 1987 separator plate. The #9 check ball was eliminated in 1988 (Figure 7). An easy way to tell if you need a check ball in a bathtub is - If there are two holes in the separator plate (above a bathtub) use a check ball, if there is only one hole, don't use a check ball. (Figure 8)

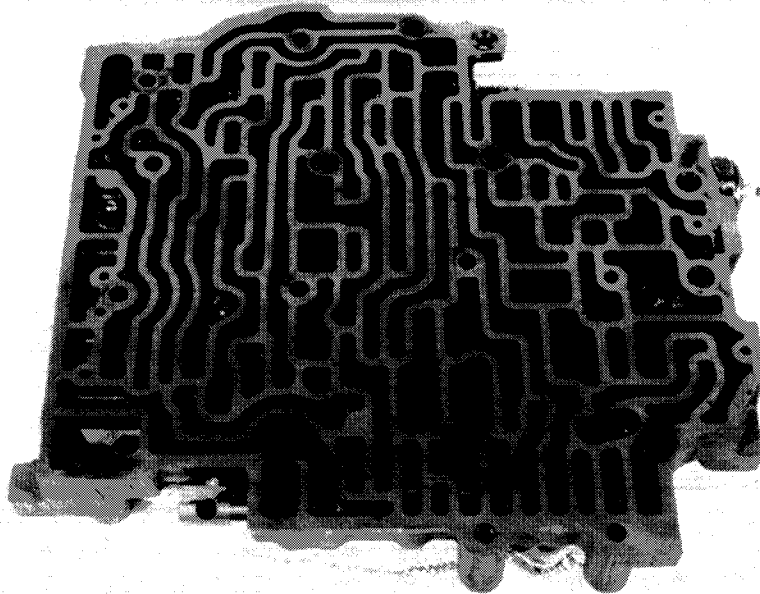
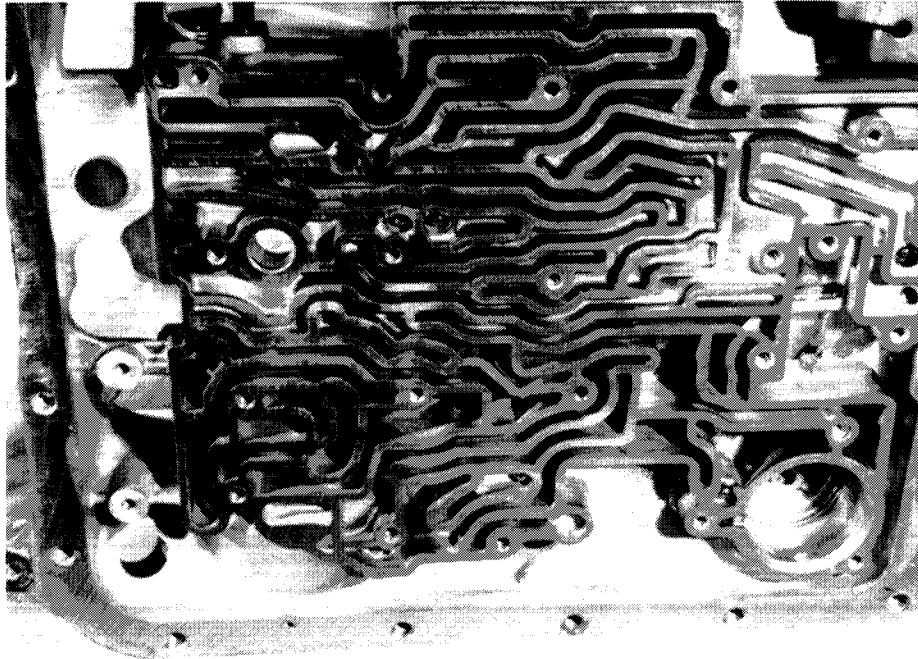


Figure 6

The #9 check ball is missing



1988 and later

Figure 7



There's only one hole in the separator plate so don't put a check ball there.

Figure 8

Low Roller Clutch

The rollers in the low roller clutch were made .150" longer. (Figure 9)

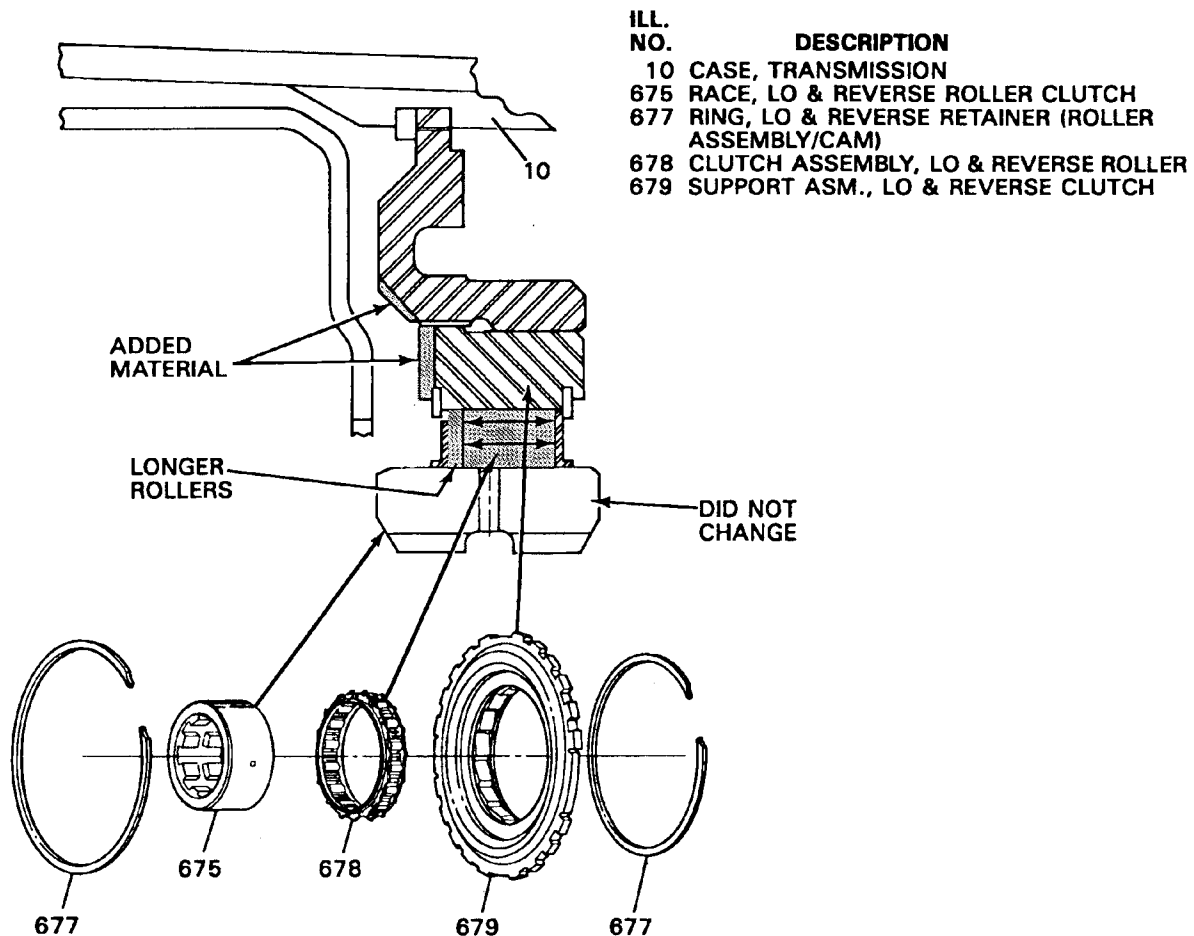


Figure 9

Note: Early & late roller clutch parts should not be interchanged but they will interchange as a complete set.

Some 1987 and later 4L60's have an orificed checkball capsule pressed into the case. (Figure 10)

The purpose of the orifice was to slow down the oil feeding the low/reverse piston, giving a smooth apply. The orifice was omitted on later units.

NOTE

If the capsule or ball is missing, it's ok to leave it out.

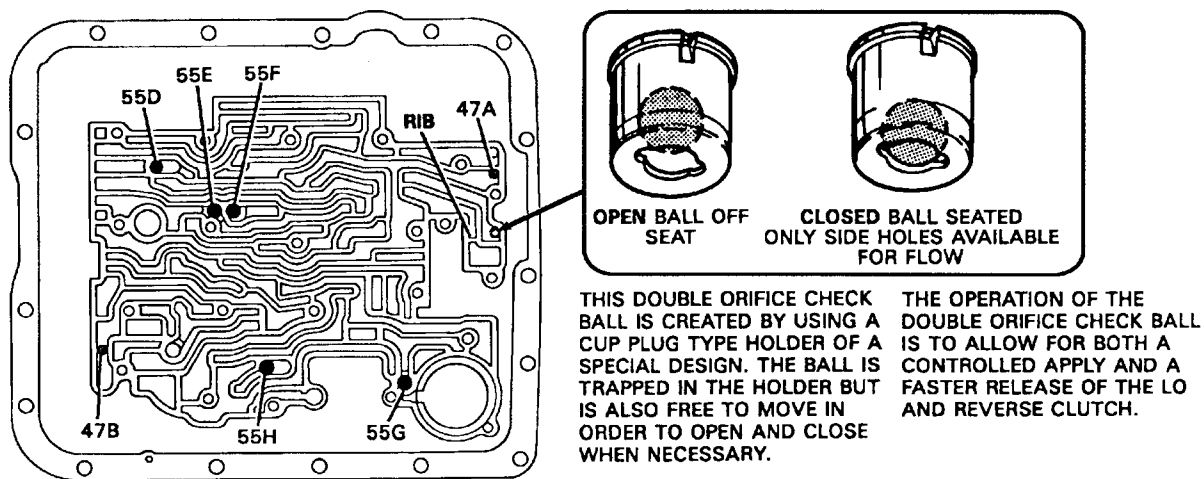


Figure 10

Reverse Input Clutch

There were several changes made to the 4L60 reverse input clutch in 1987. First of all, the piston is now made of aluminum and has a coned wave plate on it. The piston also has a larger outside diameter and requires a different outer lip seal. The pressure plate is selective and comes in 4 sizes (Set clearance to .040"-.076"). Figure 11 shows both the early and late reverse clutch assembly.

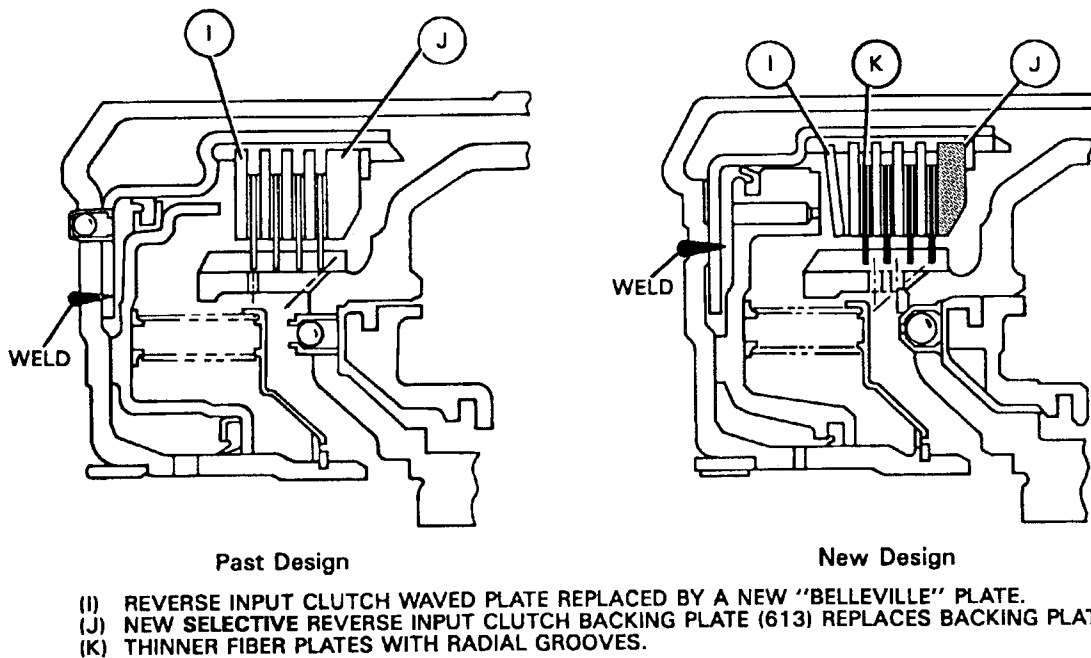


Figure 11

NOTE

REVERSE PISTON MODIFICATION. Do this on all 4L60's with an aluminum piston.

STEP 1

Plug the bleed hole in the piston. Figure 12

STEP 2

Drill the hole opposite the one you plugged to .045" - .062" (1/16"). Figure 13.

Figure 12
Use a set screw to
plug this hole.

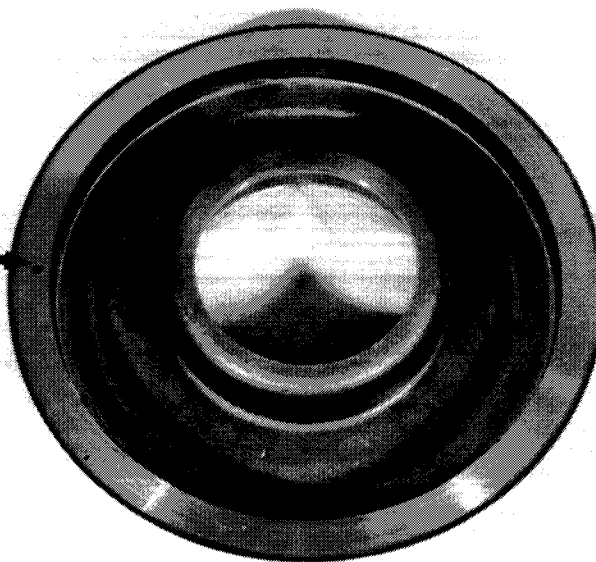
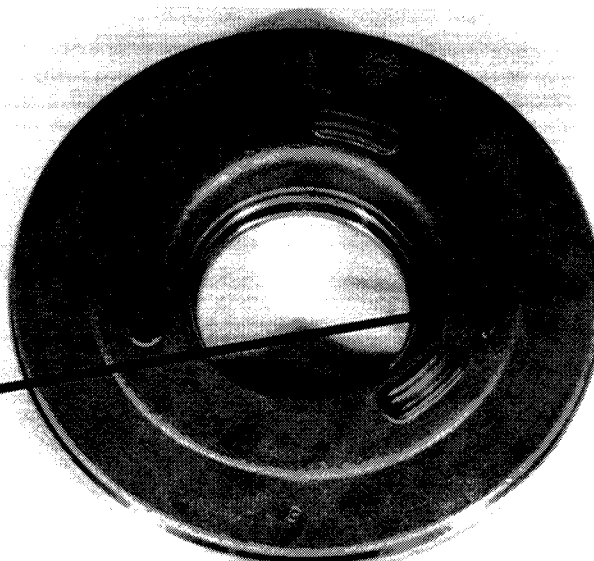


Figure 13
Drill this hole.



Selective Low/Reverse Clutch

The low/reverse clutch pack now uses a wave plate and selective steel. (Figure 14)

NOTE

You can use the wave plate and selective steel in any 4L60 provided you use the piston that goes with it.

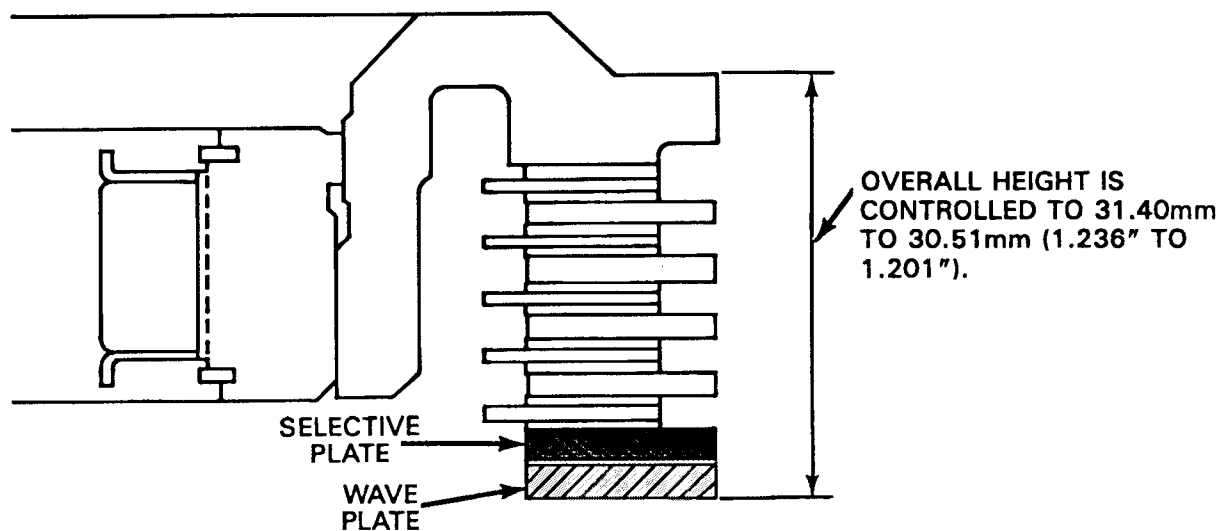


Figure 14

Input Drum

There were several changes made to the input drum. The first change was to eliminate the orifice in the turbine shaft. (Figure 15)

CAUTION

Never use a late turbine shaft on a transmission that doesn't have an auxiliary valve body. The result could be harsh forward engagements. Along with the orifice change in the turbine shaft, a change was made to the turbine shaft sealing rings. They are now solid instead of being scarf cut. (Figure 16) The solid rings can be used on any 4L60.

CAUTION

To avoid ring damage, use the seal installer tool. The TRANS-TOOL part number is T-1574. (Figure 17)

NOTE: USE CARE WHEN DETERMINING HOLE SIZE. IT IS MOST DIFFICULT TO TELL WHICH HOLE IS THE NEW DESIGN.

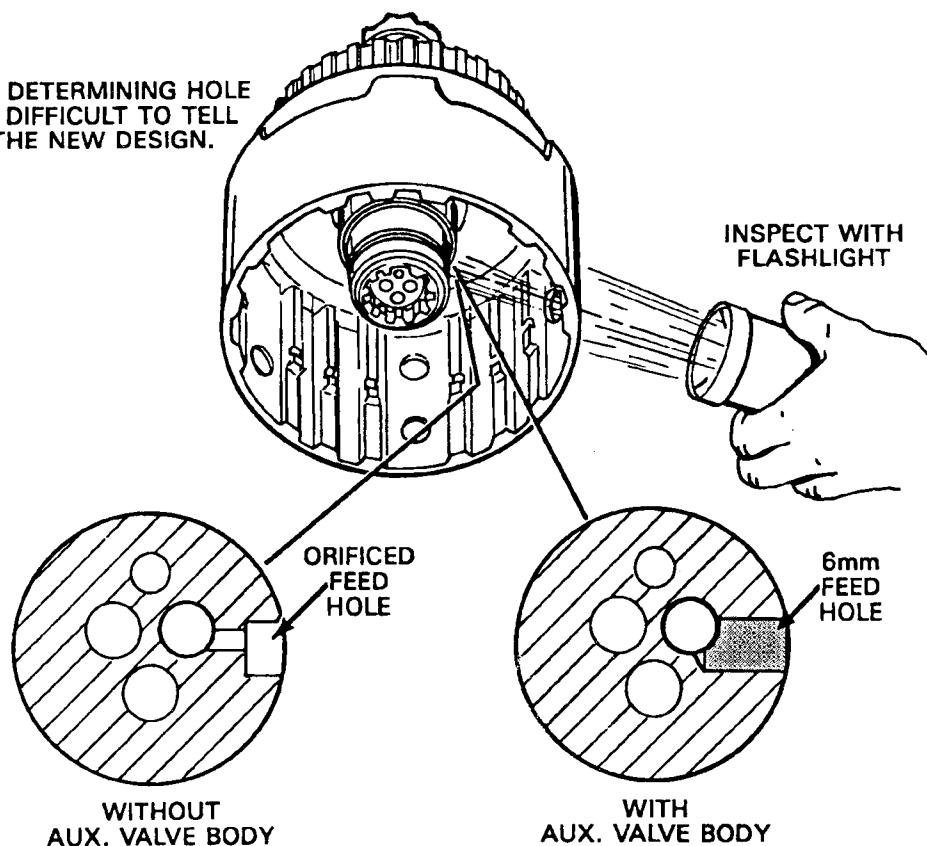


Figure 15

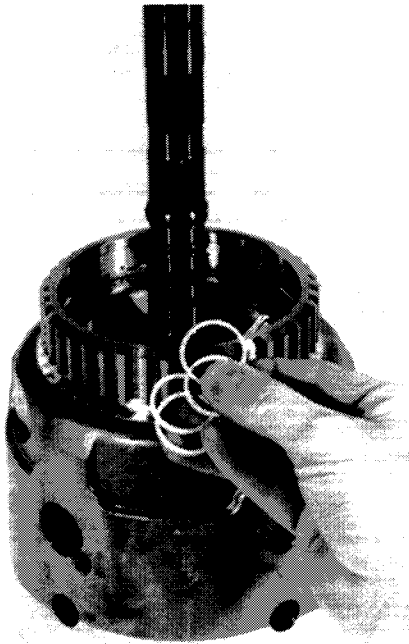


Figure 16

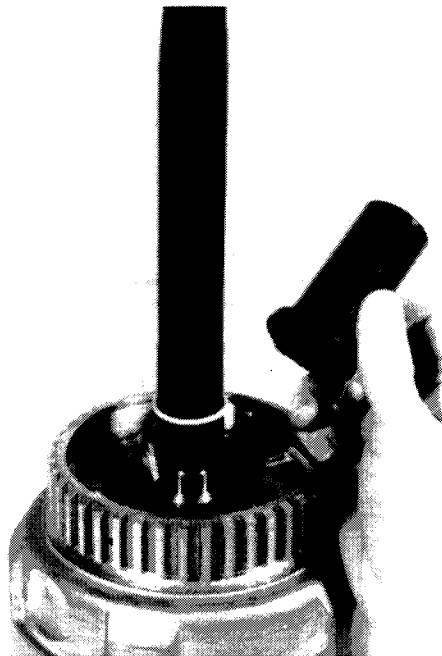


Figure 17

Input Drum

Beginning in mid '87 a stepped apply plate is used in the 3-4 Clutch. The 3-4 clutch now comes with either 5 or 6 friction plates. To accommodate the 6 clutch set up, the splines on the front ring gear were made longer. Figure 18

The input clutch housing was changed where the forward clutch pressure plate sits. (Figure 19) The diameter of the forward clutch pressure plate was made smaller to accommodate the new dimensions of the drum. The new forward clutch pressure plate is now selective.

CAUTION

Don't use the late (smaller) forward clutch pressure plate in an '86 or earlier clutch housing. The result may be a noise in Park and Neutral.

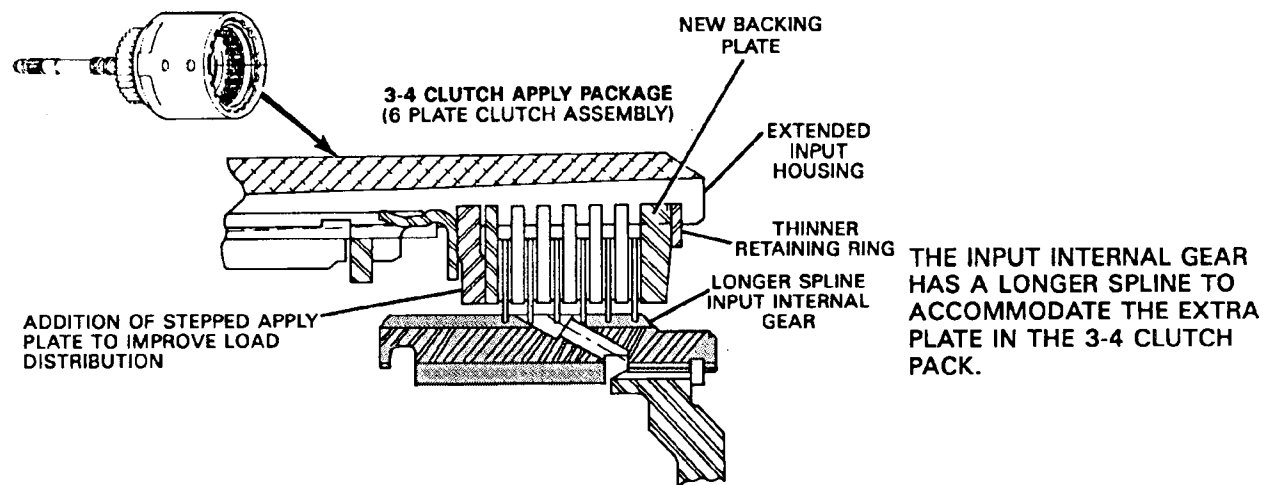


Figure 18

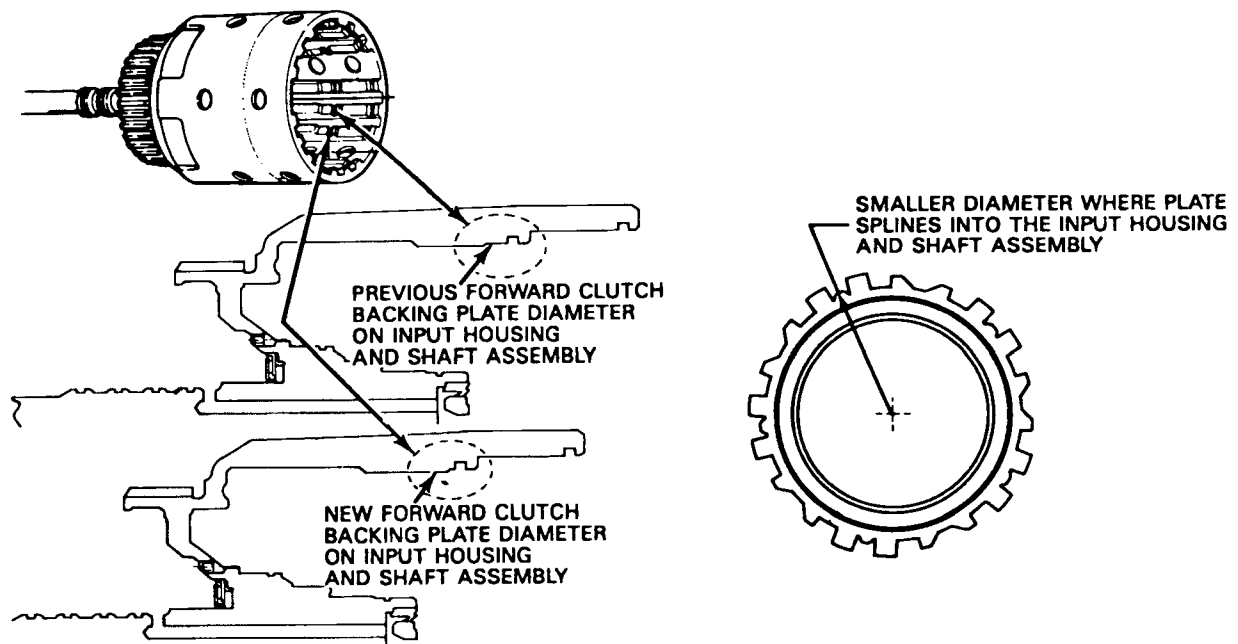
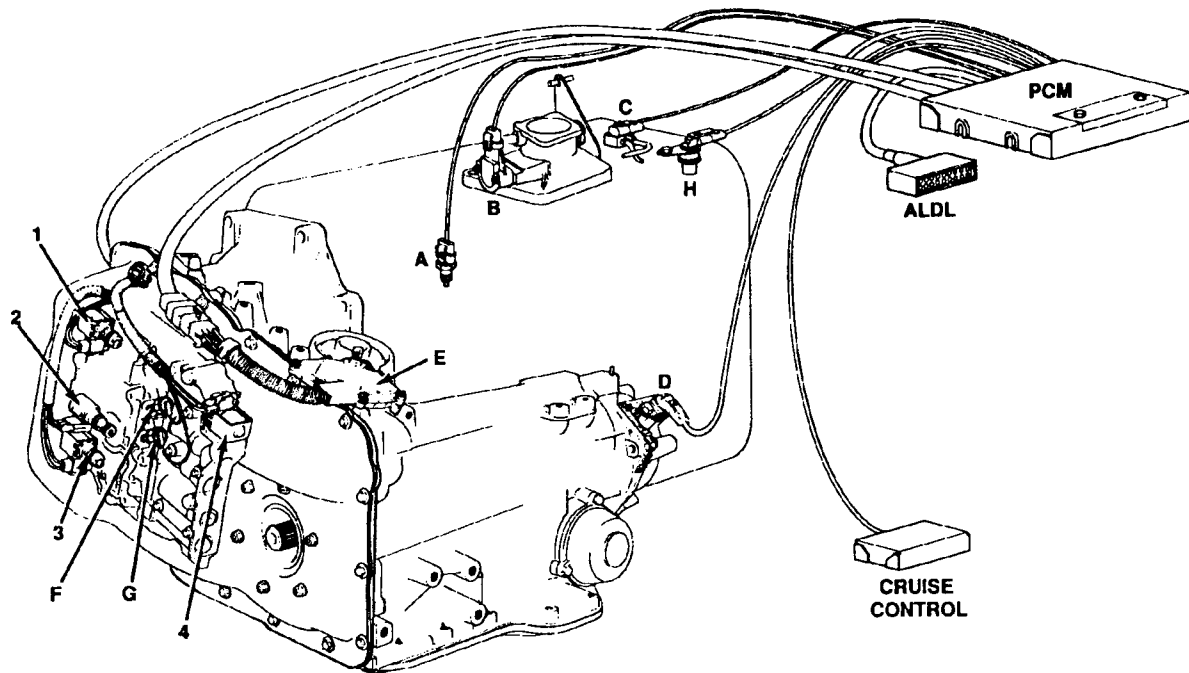


Figure 19

Electronics



ELECTRONIC CONTROLLERS

POWERTRAIN CONTROL MODULE (PCM)
ALDL CONNECTOR

CRUISE CONTROL

ELECTRONICALLY CONTROLLED

1 SHIFT SOLENOID "A" (315)

2 PWM SOLENOID (325)

3 TCC SOLENOID (315)

4 SHIFT SOLENOID "B" (315)

PWM
SYSTEM
ONLY

TCC
ACCUMULATOR
SYSTEM
ONLY

INFORMATION SENSORS

A COOLANT TEMPERATURE
SENSOR (CTS)

B THROTTLE POSITION
SENSOR (TPS)

C VACUUM SENSOR (VS)

D VEHICLE SPEED SENSOR
(VSS) (10)

E PARK NEUTRAL INDICATOR
SWITCH

F 4TH CL DISCREET
SWITCH (218)

G LO DISCREET SWITCH (218)

H ENGINE SPEED SENSOR

Typical Automotive Computers

Based On GM Applications

Semiconductor devices make possible the electronic "brains" called microprocessors in today's automobiles. The microprocessor and its related parts, such as memory chips and interfaces, constitute a microcomputer - a machine that receives information from vehicle sensors and other components, makes decisions based on that information, and takes actions based on those decisions.

When computers don't work, they are replaced, not repaired. However, it is the technician's responsibility to first confirm whether they are working correctly or need replacing.

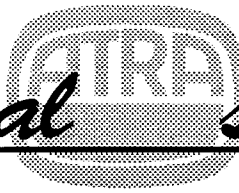
Typical Computer Applications

ECM - Engine Control Module:

- Controls basic engine functions
- Typical inputs are rpm, coolant temperature sensor, throttle position sensor, manifold absolute pressure, brake, vehicle speed sensor, etc.
- Typical outputs are fuel injection, exhaust gas recirculation, purge, fan, torque converter clutch, idle air control, etc.
- May control shift pattern

EBCM - Electronic Brake Control Module:

- Controls allowable wheel slip for optimum braking
- Typical inputs are wheel speed sensors
- Typical outputs activate solenoid valves in a hydraulic modulator to control brake action at each wheel
- EBCM tests and monitors itself and ABS system



TCM - Transmission Control Module: Introduced in 1991

- Controls basic transmission functions
- Typical inputs are rpm, throttle position sensor, manifold absolute pressure, brake, gears, speed, temperature
- Typical outputs are shift solenoid A, shift solenoid B, force motor, torque converter clutch, PWM (pulse width modulation).
- May or may not be used with a fuel control system
- Controls shift pattern and shift quality

PCM - Powertrain Control Module: Introduced in 1991

- Controls both engine and transmission functions
- Integrates an ECM and TCM into one package
- Allows sharing of common inputs
- Controls shift pattern and shift quality

VCM - Vehicle Control Module: Introduction in 1992

- Controls engine, antilock brake, and transmission functions
- Integrates an ECM, TCM, BCM and ABS into one package
- Allows sharing of common inputs
- Should require less room and weight because of one box

Computer Memory

The computer can store binary code information until it's needed, and then transmit it to any other electronic devices that understand binary. The information is stored in a small electronic device called a memory chip. These memories are highly specialized. One type - the Read - Only Memory, or ROM - contains permanent information that cannot be changed. When the computer is manufactured, the programs that control the microprocessor are stored in the ROM. The microprocessor can read these instructions out of the memory, but it can't write in any new information.

Random Access Memory (RAM)

Another type of memory - the Random Access Memory, or RAM - can be both read from and written into, and often is used for temporary storage of information that does change. This constitutes the "learning" portion of the ECM. For example, if the microprocessor receives a measurement that it will need to make several different decisions, it will write the measurement into the RAM and then read it out each time it is needed.

Programmable Read - Only Memory (PROM)

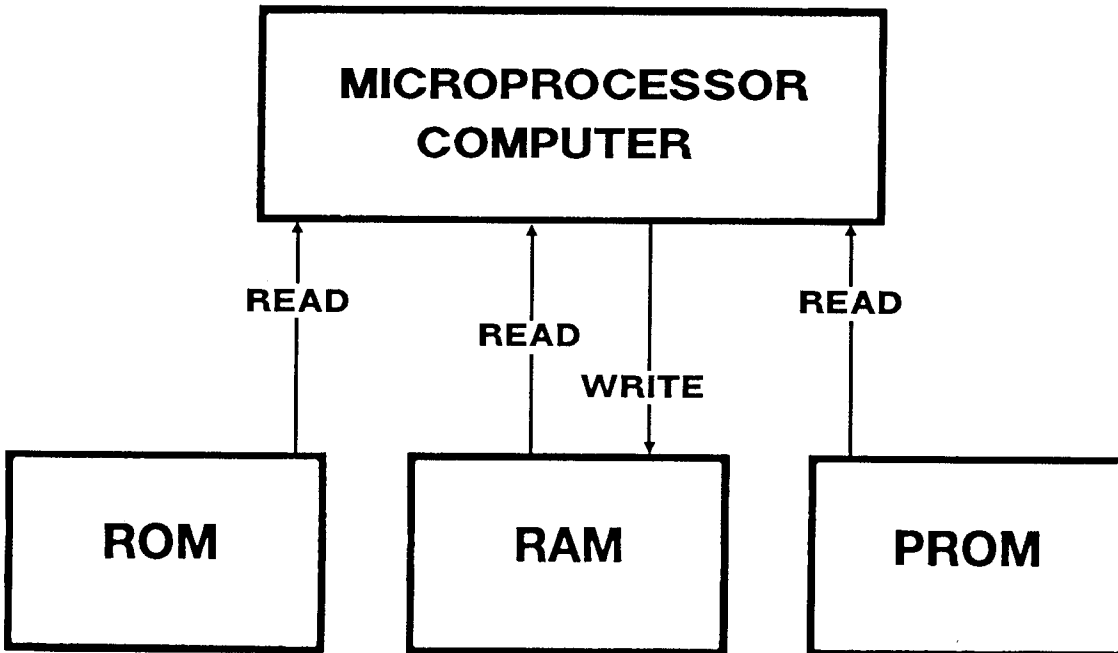
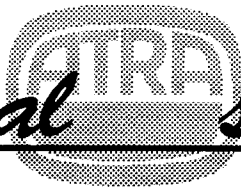
A third type - the Programmable Ready-Only Memory, or PROM - is like the ROM because it can be read from but not written to. But unlike the ROM, most can be removed from the computer and are easily accessed. The PROM chip can be removed from the computer and a new chip with different programming can be installed. In an automotive computer system, the PROM can be used to add new design information to the system without changing the original program. For example, the PROM of the Electronic Control Module (ECM) stores characteristics that vary in each model.

Electronically Erasable PROM (EEPROM)

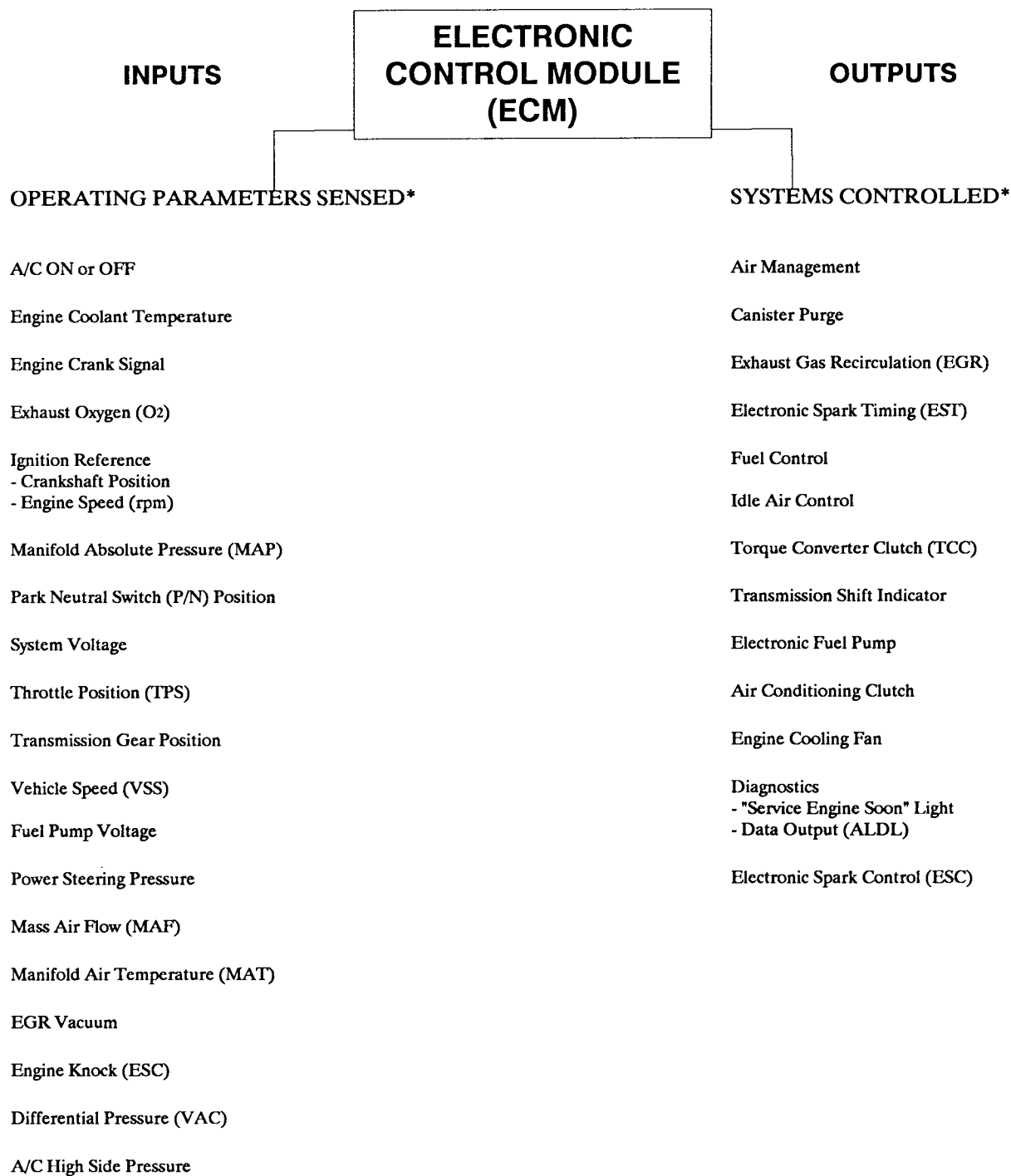
EEPROM is a PROM that can be reprogrammed electronically without removing it from the vehicle. Reprogramming requires a special tool.

Memory Calibrator (MEMCAL)

MEMCAL was introduced in 1986 on some models. It replaced the removable PROM. MEMCAL consists of a PROM and a Calibration Package (CALPAC) which is used for fuel backup, and a ESC module for spark control.



Typical ECM Inputs and Outputs



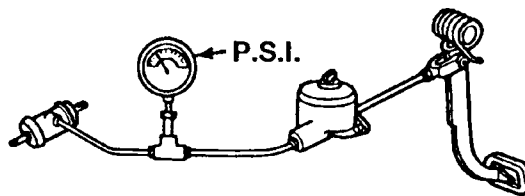
***Not all items are used on all engines**

Voltage, Current, and Resistance

VOLTAGE

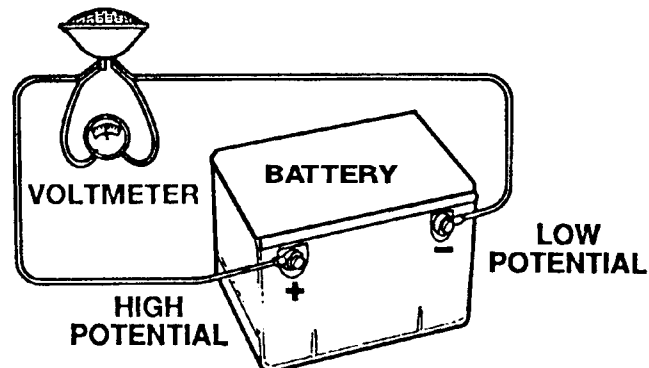
Voltage is an electrical force or pressure that causes electrons to flow through an electrical conductor (Figure 1).

**HYDRAULIC PRESSURE
(MEASURED IN POUNDS
PER SQUARE INCH)**



**HYDRAULIC PRESSURE
(MEASURED IN POUNDS PER SQUARE INCH)**

**ELECTRICAL PRESSURE
(MEASURED IN VOLTS)**



Voltage Is Electrical Pressure.

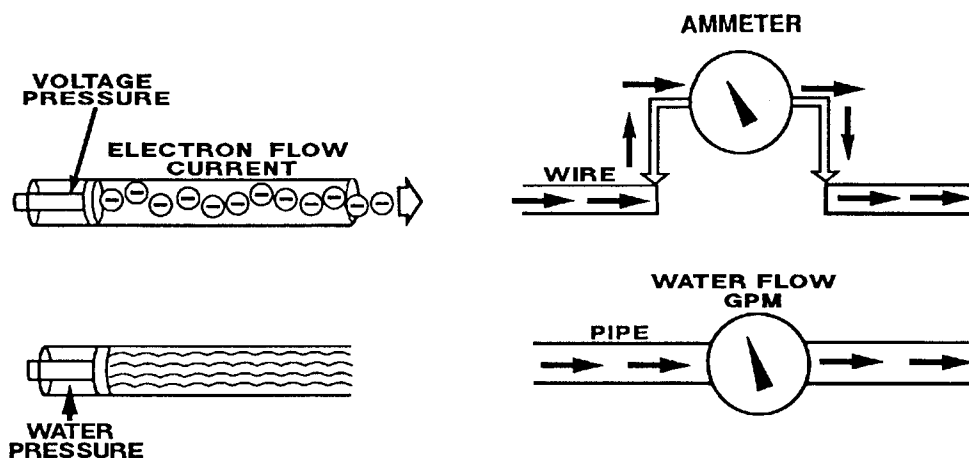
NOTE: Voltage can also be considered a measurement of the difference in "potential" that exists between two points in a circuit. Voltage can exist even when no current is flowing in a circuit.

Current

Current can flow only in substances that contain many free electrons. These substances are called conductors. The force or pressure required to push an electron and cause it to flow in a conductor is called an electro-motive force (EMF) or electron-moving force.

Current is the name given to electrical flow moving through a conductor. As water is pushed by water pressure through a pipe, current is pushed by voltage through a wire (Figure 2).

And while a flow meter measures water flow in gallons per minute, an ammeter is used to measure current flow in amperes (amps). To do this, the ammeter is inserted in the path of the current flow.



Pressure Causes Current Flow.

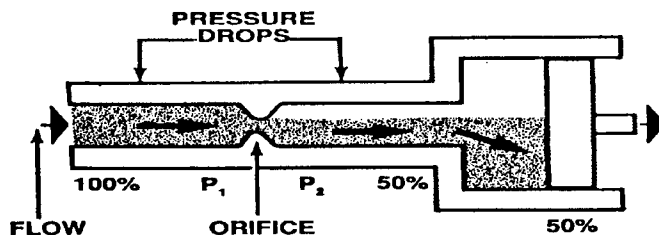
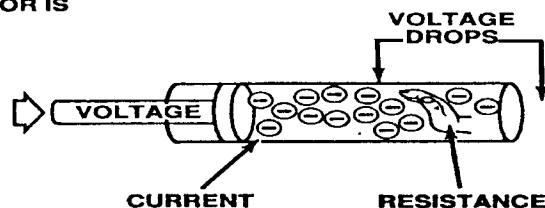
NOTE: One amp is equal to 6.28 billion-billion electrons flowing past a reference point in one second.

Resistance

All electrical components and circuits have resistance, the name given to any force that opposes current flow and slows it (Figure 3). In essence, resistance is electrical "friction," much like an orifice or other obstruction in a hydraulic system. Resistance changes electrical energy into some other form of energy, such as heat, light or motion.

Direct measurement of the resistance of a device when no current is flowing is accomplished using an ohmmeter, which provides a measurement in ohms. An indirect measurement of resistance is accomplished with a voltmeter, which can measure the voltage drop in an operating circuit to provide a display of the voltage affected by resistance in a given part of the circuit. The advent of the digital multi-meter (DMM) makes these checks easier.

THE RESISTANCE OF A CONDUCTOR IS DETERMINED BY FIVE FACTORS:
1. ATOMIC STRUCTURE
2. LENGTH
3. CROSS-SECTIONAL AREA
4. TEMPERATURE
5. PHYSICAL CONDITION



Resistance Causes Voltage (or Pressure) To Drop.

Ohm's Law Relationship

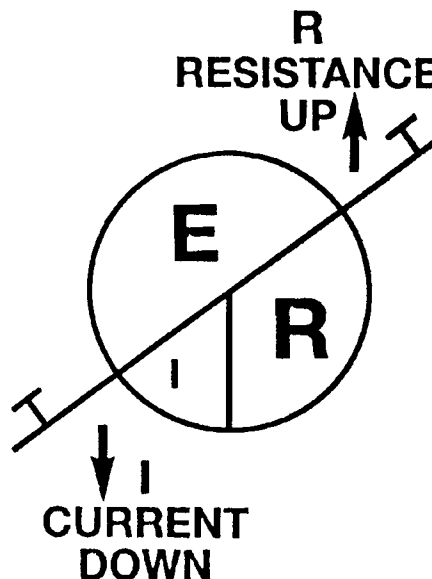
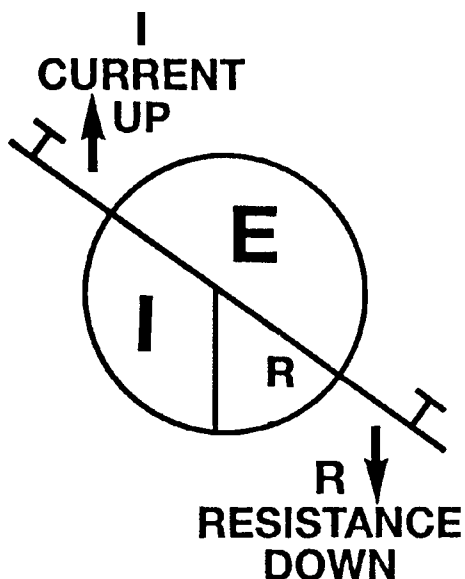
Ohm's Law Defines Electrical Behavior

Early in the 19th century, George Simon Ohm proved by experiment that a very precise relationship exists between voltage, current, and resistance. This relationship is called Ohm's Law and is stated as follows:

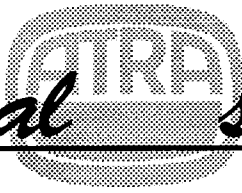
The current in a circuit is directly proportional to the applied voltage and inversely proportional to the circuit resistance.

Looking at Ohm's Law another way, it could be stated as: if the resistance is held constant and the voltage is varied, the current will follow the variation of the voltage either up or down (proportional). If the voltage is held constant and the resistance is varied, the current reacts opposite to the resistance. Increase the resistance, and the current will decrease. Decrease the resistance and the current will increase.

An easy way to remember Ohm's Law for automotive use is to think of a teeter tooter, with voltage always constant. If current is up, resistance is down. If current is down, resistance is up.



Ohm's Law, Current vs. Resistance.



Ohm's Law states that if any two values are known about a circuit, the third can be easily calculated.

Or, remember the pie chart.

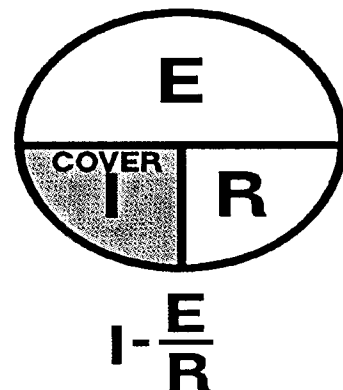
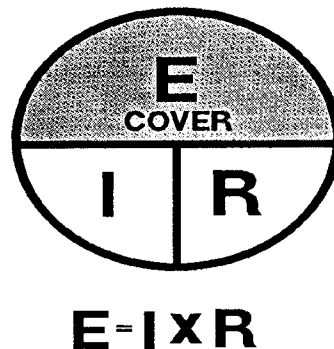
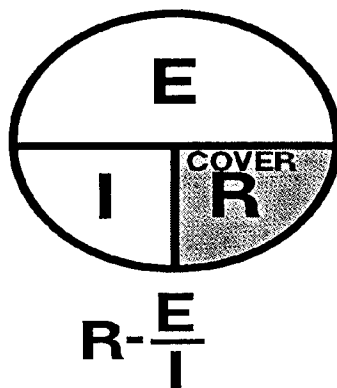
TO DETERMINE:
VOLTAGE $E = I \times R$

AMPS $I = \frac{E}{R}$

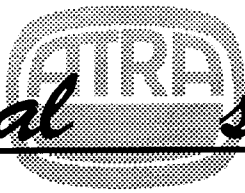
OHMS $R = \frac{E}{I}$

I-AMPS OR CURRENT
R-OHMS OR RESISTANCE
E-VOLT OR ELECT. FORCE

Calculation With Ohm's Law.

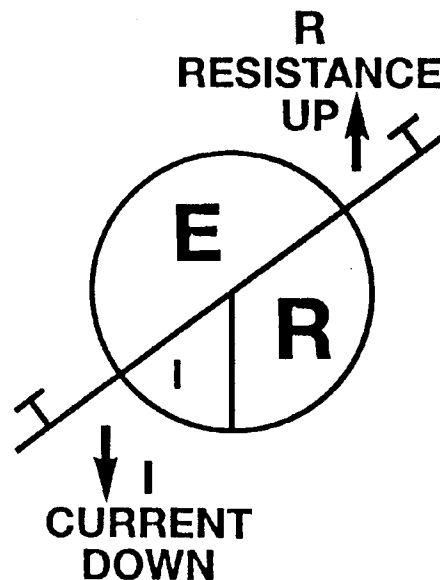
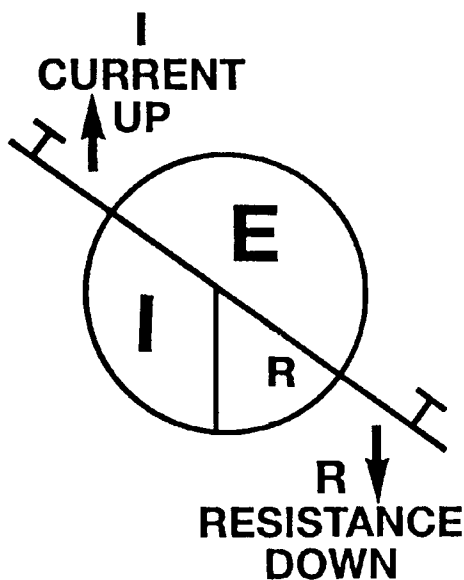


Ohm's Law Pie Chart.



You can use Ohm's Law to solve electrical problems. However, calculating precise values for voltage, current and resistance is not always practical or required. Using the concepts of Ohm's Law (with the teeter totter example) may be more practical and less time consuming.

- **CURRENT** is affected by either voltage or resistance. If voltage is low or resistance is high, current will be low. If voltage is high or resistance is low, current will be high.
- **SOURCE VOLTAGE** is not affected by current or resistance. It is either too high, too low, or its ok. If voltage is too high, current will be high. If voltage is too low, current will be low.
- **RESISTANCE** is unaffected by either current or voltage. It is either too high, too low or its ok. If it is too high, current will be low if voltage is okay. If resistance is too low, current will be high if voltage is okay. Common causes of high resistance could be poor or corroded connections. Common causes of low resistance may be short circuits as in shorted solenoid windings.

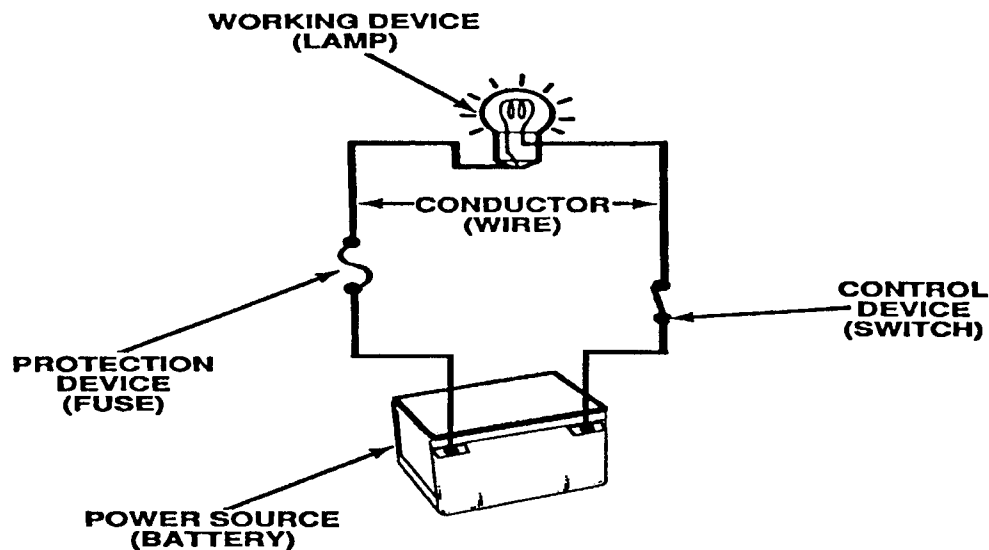


Ohm's Law, Current vs. Resistance.

Circuit Theory

A complete pathway for current flow will exist whenever two unequal charges are connected by a conductor. Completing an electrical circuit (pathway) consists not only of the conductors but includes the path through the voltage (pressure) supply.

There are several types of circuits, but all require the same basic components. A power source (battery or alternator) produces voltage. Conductors (wires, printed circuit boards) provide a path for current flow. Working devices, or loads (lamps, motors), change the electrical energy into another form of energy to perform work. Control devices (switches, relays) turn the current flow ON and OFF. And protection devices (fuses, circuit breakers) interrupt the current path if too much current flows. Too much current is called an overload, which could damage conductors and working devices.

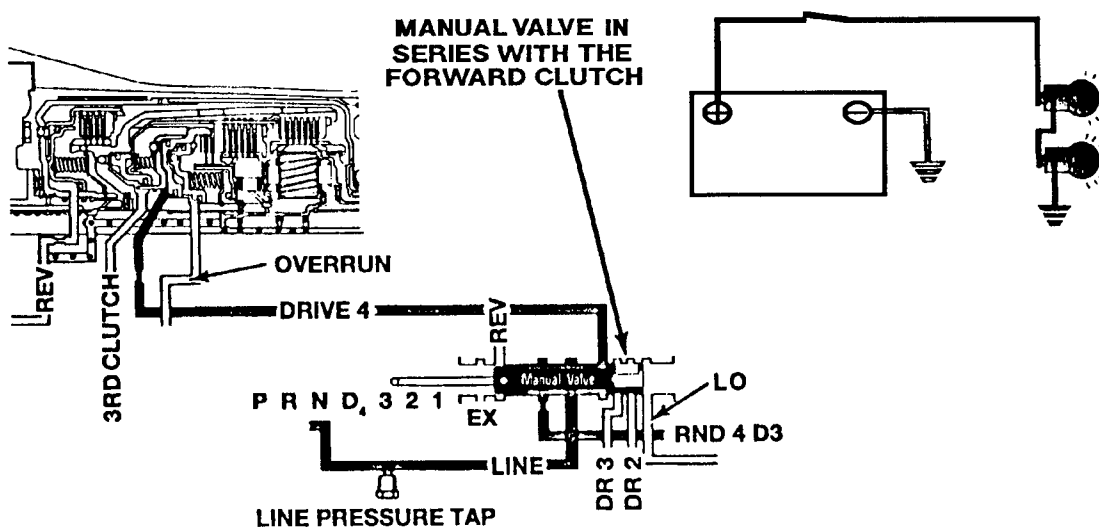


Series Circuit

A series circuit is the simplest circuit. The conductors, control and protection devices, loads, and power source are connected with only one path for current. The resistance of each device can be different. The same amount of current will flow through each, and the voltage across each will be different. If the path is broken, no current flows.

Series Circuit Laws

1. In a series circuit, the current flowing in the circuit is the same at any point.
2. Individual resistances in a series circuit add up to the total circuit resistance.
3. The sum of the individual voltage drops in a series circuit equals the applied voltage, or the source voltage.



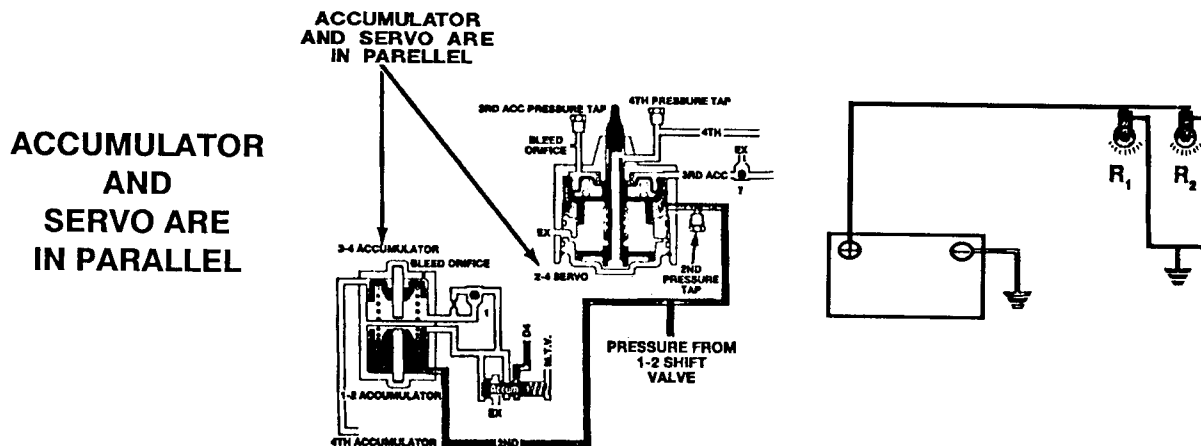
Series Circuit, Hydraulic and Electrical Equivalents.

Parallel Circuit

A parallel circuit has more than one path for current flow. The same voltage is applied across each branch. If the load resistance in each branch is the same, the current in each branch will be the same. If the load resistance in each branch is different, the current in each branch will be different. If one branch is broken, current will continue flowing to the other branches.

Parallel Circuit Laws

1. In a parallel circuit, the voltage is the same across each branch.
2. The total current in a parallel circuit is equal to the sum of the individual branch currents.
3. The total resistance in a parallel circuit is always less than the smallest resistive branch.



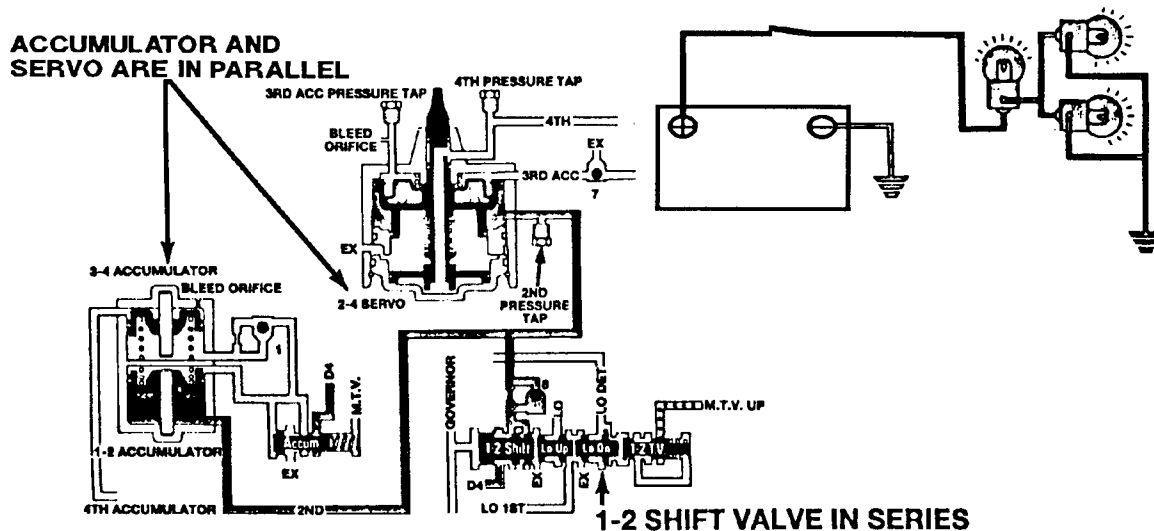
Parallel Circuit, Hydraulic and Electrical Equivalents.

Series-Parallel Circuit

A series-parallel circuit has some components in series and others in parallel. The power source and control or protection devices (fuse, switch) are usually in series; the loads are usually in parallel. The same current flows in the series portion, different currents in the parallel portion. The same voltage is applied to parallel devices, different voltages to series devices. If the series portion has an open, current stops flowing in the entire circuit. If a parallel branch has an open, current continues flowing in the series portion and the remaining branches.

Series-Parallel Circuit Laws

1. Current in the series portion of the circuit equals the sum of branch currents.
2. Circuit resistance is the sum of the parallel equivalent resistance and any series resistances.
3. Voltage applied to the parallel branches is the source voltage minus any voltage drop across loads wired in series.



Series-Parallel Circuit, Hydraulic and Electrical Equivalents.

Resistors

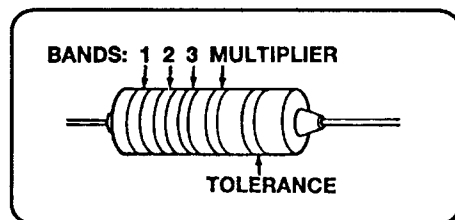
Some circuits require precision resistors to operate effectively. If a resistor is replaced, never use a resistor of a wider tolerance. This could cause improper operation of the circuit.

Resistors must be of the proper wattage value. Improperly rated components will prematurely fail. Since resistors restrict flow of electricity, electrical friction causes heat to build up within the component. The resistor must be large enough to dissipate this heat to the surrounding environment without changing its own characteristic value beyond the tolerance allowed.

*EIA Resistor Color Code

Color	Band 1	Band 2	(If Used) Band 3	Multiplier	(If Used) Tolerance
Black	0	0	0	x 1	-
Brown	1	1	1	x 10	1%
Red	2	2	2	x 100	2%
Orange	3	3	3	x 1000	-
Yellow	4	4	4	x 10,000	-
Green	5	5	5	x 100,000	.5%
Blue	6	6	6	x 1,000,000	.25%
Violet	7	7	7	-	.19%
Gray	8	8	8	-	-
White	9	9	9	-	-
Gold	-	-	-	x .1	5%
Silver	-	-	-	x .01	10%
None	-	-	-	-	20%

*Electronics Industry Association



Carbon Resistor Color Codes.

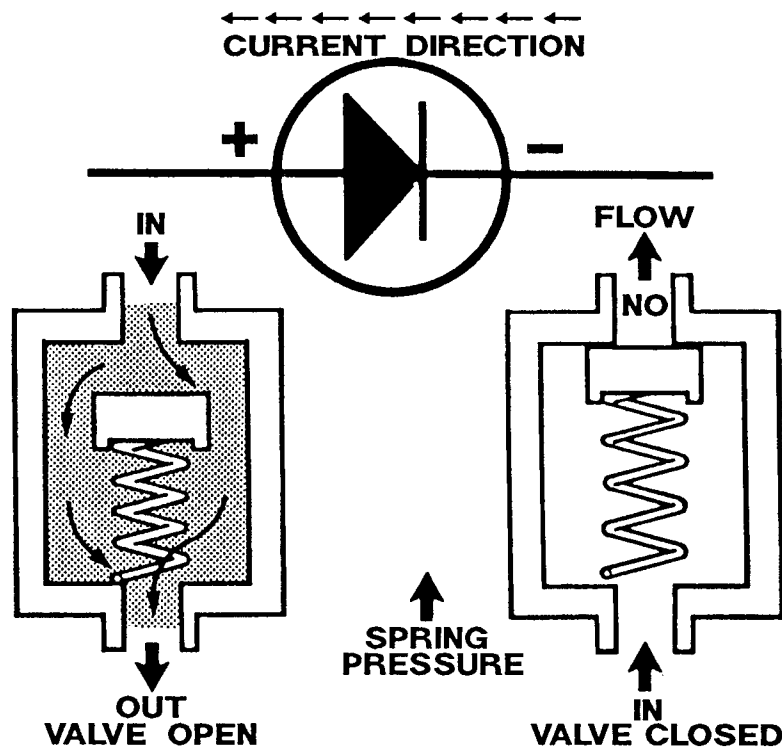
Semiconductors and On-board Computers

Diodes

Semiconductors are electronic devices, usually made from silicon or germanium. Simple semiconductors like diodes, LEDs (light emitting diodes), and Zener diodes are usually just improved switches.

Regular diodes operate much like one-way valves for current. That is, they switch ON if the polarity of the circuit is correct, and OFF if the polarity is reversed.

A diode could be called a "smart" switch. When it detects the correct polarity, it turns ON; and when it detects a reverse polarity, it turns OFF. It also monitors voltage - if the voltage (pressure) is not high enough it will not turn ON.



Diode Operation Is Similar to a Poppet Valve.

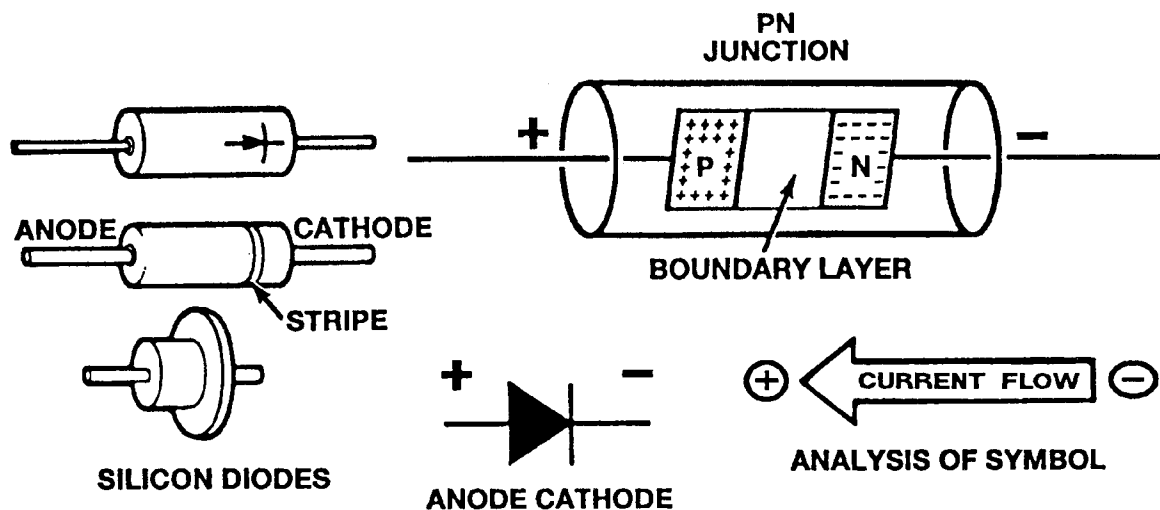
Regular Silicon Diodes

Electricity and magnetism are very much alike. This is true in the case of opposites attracting and likes repelling. In the case of magnets, opposite poles attract and like poles repel. In electricity, the same thing happens - like charges repel and opposite charges attract.

Inside the diode are some small positive (P) and negative (N) areas. Both of these areas conduct current, but at the PN junction, they are separated by a thin boundary layer.

When a diode is placed in a circuit (with a lamp or some other load also in the circuit) in the correct (forward bias) direction, the positive side of the circuit is applied to the positive side of the diode. The negative side of the circuit is applied to the negative side of the diode.

Remember that "like electrical charges repel each other". The supply voltage charges are much stronger than the diode P and N materials. The P conductive material is repelled toward the N and the N toward the P. This causes the PN junction to become a conductor, just like turning ON a switch.

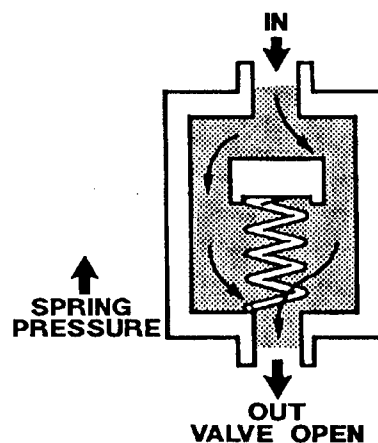
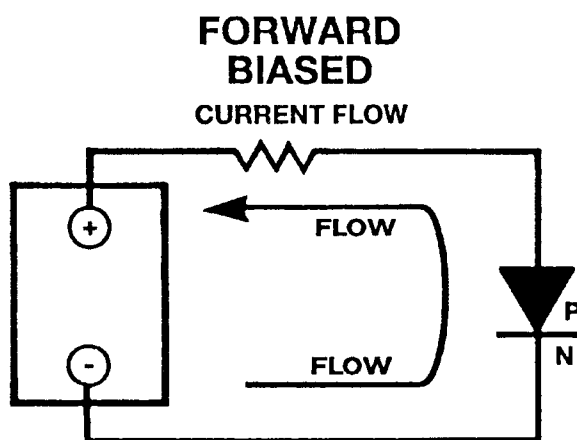


Regular Silicon Diodes.

Diode Bias

Forward Bias

The circuit in below - showing the battery negative terminal connected to the N-type material and the battery positive terminal connected to the P-type material - is known as a forward bias connection. This is the condition necessary for current flow through a diode. Silicon diodes conduct (turn on) when 0.6 to 0.7 volts are applied.

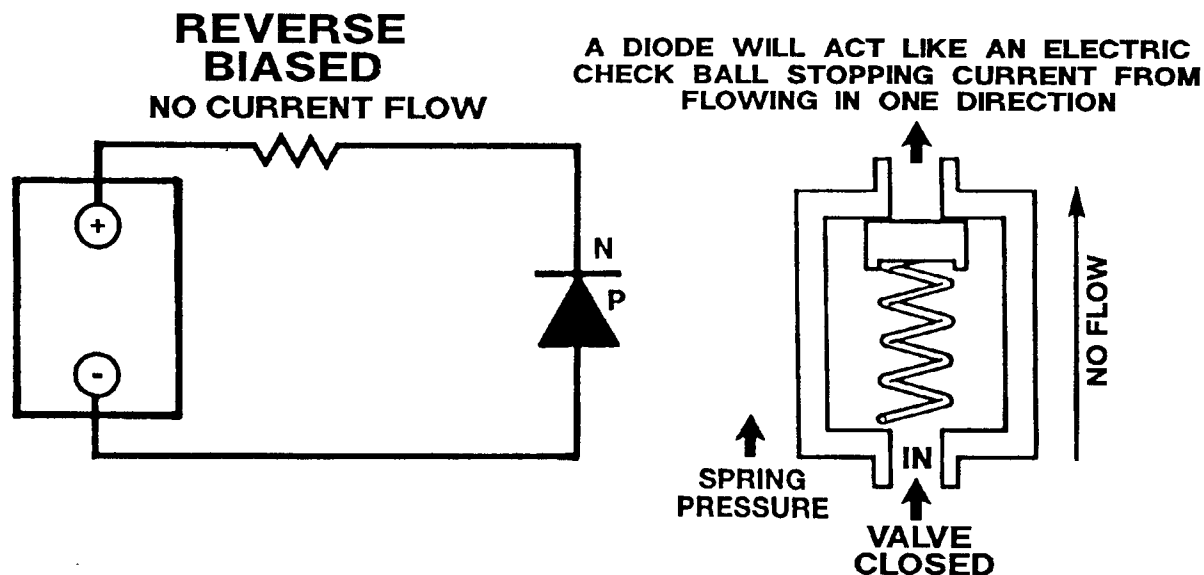


**A DIODE WILL ACT LIKE AN ELECTRIC
CHECK BALL STOPPING CURRENT FROM
FLOWING IN ONE DIRECTION**

Forward Biased Diode.

Reverse Bias

When the connections are reversed, the positive battery potential effectively creates a very high electrical resistance at the PN junction of the diode. This is called reverse bias and causes the diode to block current flow.



Reverse Biased Diode.

Excessive voltage applied to a reverse biased diode will damage the diode. This is called peak inverse voltage (PIV). Peak Inverse Voltage is the highest reverse bias voltage that can be applied to a diode junction before damage occurs.

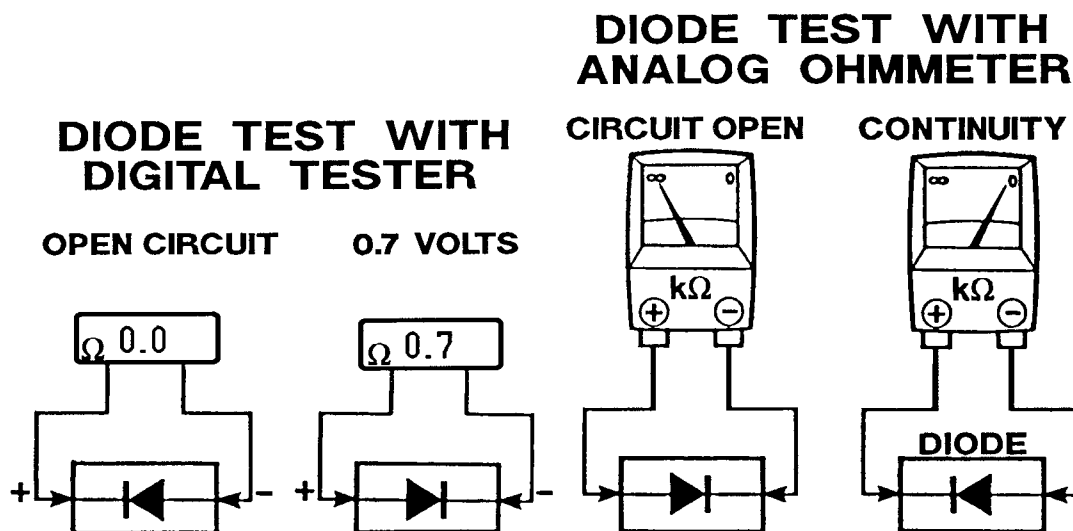
- The diode will always short before going open if reverse bias voltage is exceeded.

Testing Semiconductors

Diode Testing

Diodes can be checked with an ohmmeter, but the polarity of the meter connections is important.

Some meters (Fluke 87 DMM) have a special mode called diode test. In this mode, the readings across the diode should be 0.6 to 0.7 volt in one direction, and indicate an open circuit in the other. This indicates a good diode. If both readings are open, the diode is open; if both readings indicate continuity, the diode is shorted.



Diode Test

Sensors

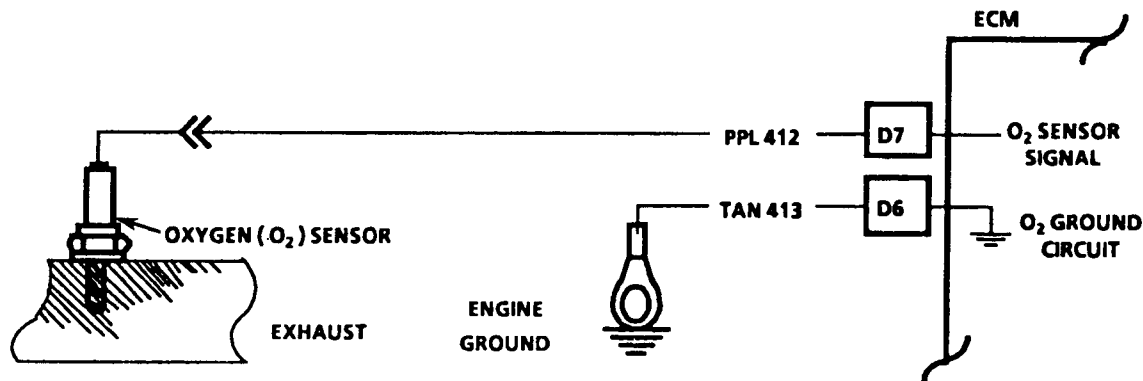
The O₂ Sensor

The O₂ sensor is located in the exhaust system ahead of the catalytic converter. The O₂ sensor measures the amount of oxygen in the exhaust gases and sends a voltage signal to the ECM. The ECM sends Bias voltage of 450 MV to the O₂ sensor.

The O₂ sensor must be hot (600° F) before it will send a signal to the ECM.

The ECM now knows if the command it is sending to the fuel system is too rich or lean. This condition is called closed loop. The O₂ sensor acts like a small battery. It has the ability to produce a low voltage signal.

When the exhaust gas is lean, the voltage output is below the bias voltage. When the exhaust gas is rich, the voltage output is high, above the bias voltage. The voltage output of a normally operating oxygen sensor will fluctuate back and forth between approximately 100 and 900 millivolts. This is called voltage switch-over and is useful information when diagnosing the system. Everytime the voltage crosses .450 bias voltage the ECM will count the cross. This is known as cross counts. If a scan tool shows cross counts occurring then the basic operation of the computer is ok.



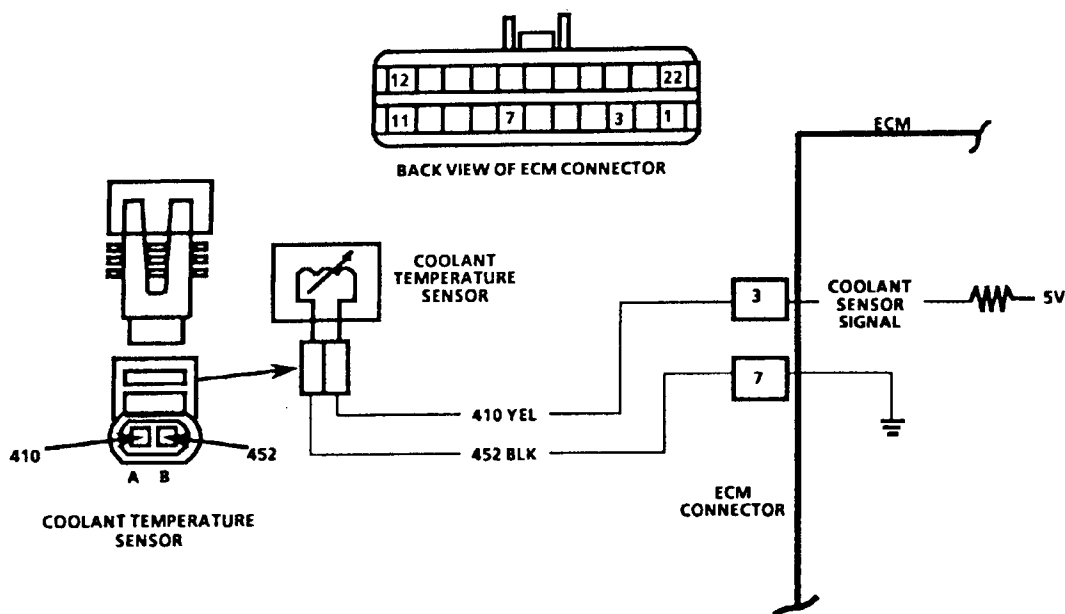
Coolant Temperature Sensor (CTS)

The CTS tells the ECM when the engine is at operating temperature. This is a thermister type sensor. The ECM sends a 5 volt reference signal to the sensor and monitors the voltage drop. When the engine is cold, the CTS has about 100,000 ohms resistance. Very little current will flow so the ECM keeps most of its 5 volt reference signal. When the engine is at operating temperature, the resistance will be under 1,000 ohms. Most of the reference voltage will now go through the CTS to ground.

The ECM uses this voltage signal to:

- Vary the air/fuel ratio between cold and hot starts.
- Change spark advance.
- Change idle speed.
- Control TCC engagement.

When the engine is cold, the ECM will not go into closed loop.



Throttle Position Sensor (TPS)

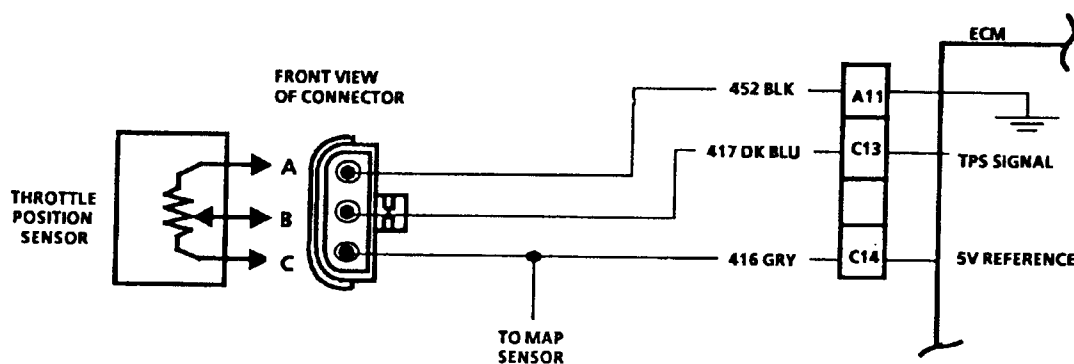
The TPS is a variable resistor that is controlled by the accelerator.

The TPS is a 3 wire sensor. As in all 3 wire sensors, 1 wire is 5 volt reference, 1 wire is ground and the center wire is return to the ECM.

The TPS receives a 5 volt reference signal from the ECM. The ECM uses the return voltage to control:

- Air/Fuel mixture
- Ignition timing
- TCC engagement

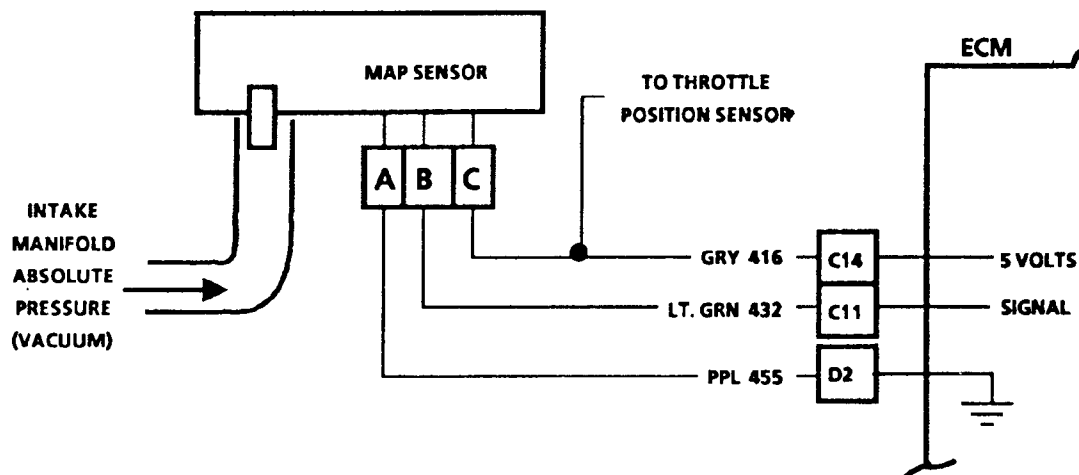
At closed throttle the return signal to the ECM is about .5 volt. At wide open throttle the signal is about 4.5 volts.



Pressure Sensors

- Manifold Absolute Pressure (MAP)
- Barometric Pressure (BARO)
- Vacuum Sensor (VS)

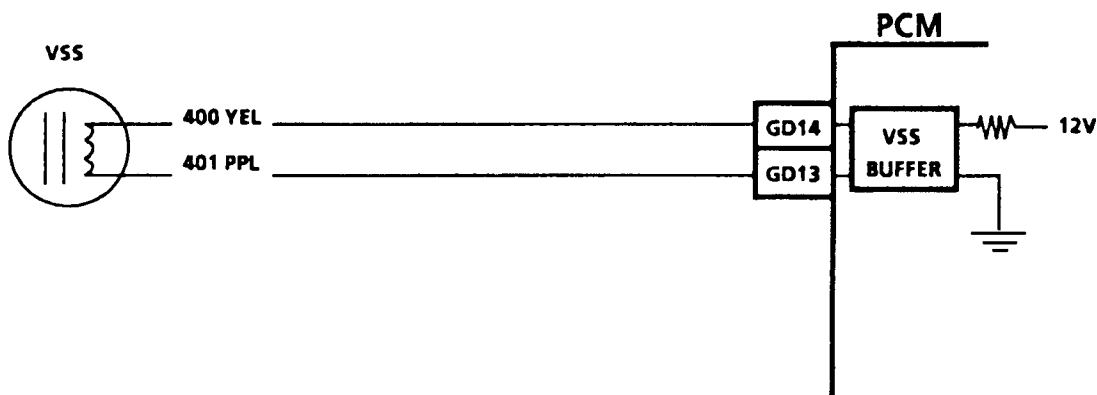
Like the TPS, pressure sensors are 3 wire sensors. Most pressure sensors are used to measure manifold vacuum. This is an engine load signal. The signal they produce is used to determine the mixture command sent to the fuel injection. These sensors also control ignition advance. Pressure sensors use a flexible resistor called a strain gauge. When the resistor is flexed, its resistance changes. This change causes a voltage change that the ECM uses to control components. As manifold vacuum decreases, return signal voltage increases. At high vacuum (closed throttle) the voltage going to the ECM is usually 1 volt or lower. At wide open throttle the voltage may be as high as 4.5 volts, depending on the system.



Vehicle Speed Sensors (VSS)

The newest type of vehicle speed sensor is a variable reluctance magnetic pickup located in the transmission case. This sensor is mounted in the case opposite the speed sensor ring. It consists of a permanent magnet surrounded by a coil of wire. As the speed sensor ring rotates an alternating current (AC) is induced in the coil from the "teeth" on the sensor ring passing by the magnetic pickup. Therefore, whenever the vehicle is moving, the vehicle speed sensor produces an AC voltage signal proportional to vehicle speed. This signal is sent to either the DRAC (Digital Ratio Adapter Controller) or the PCM depending on model application.

At the DRAC or PCM, the AC signal is electronically converted to a 5 volt square wave form. The square wave form can then be interpreted as vehicle speed by the PCM through the frequency of square waves in a given time frame. The square waves can be thought of as the speed sensor ring teeth. Therefore, the more teeth (or waves) that pass by the magnetic pickup in a given time frame, the faster the vehicle is moving. The square wave form is compared to a fixed clock signal internally within the PCM to determine vehicle speed.



Checking The Computer System

The purpose of the following tests is to allow the Professional Transmission Technician to locate the general area of a computer system malfunction. For a more complete test procedure, refer to the appropriate shop manual. The computer system has a self-diagnostic capability. Always begin computer system checks by accessing the computer's diagnostic circuit. All of the sensors which send information to the computer are assigned a two-digit trouble code. If one of these sensors malfunctions, the computer will store the sensor's trouble code in its memory and usually activate the "Check Engine" or "Service Soon" light. When the computer is in the diagnostic state, it will read out the trouble codes stored in its memory. You then have a place to start looking for the malfunction.

Diagnostic Circuit Check

- Turn the ignition "ON" and have the engine "OFF".
- The check engine light should be "ON" steady. If the check engine light is "OFF", check the bulb.
- If the bulb is good, or the light flashes intermittently, refer to the car's service manual for further checks.
- Connect a jumper between pins A and B of the 12 pin ALDL.

F	E	D	C	B	A
G	H	J	K	L	M

Checking The Computer System (Continued)

- The check engine light should flash a code 12. (If it does not flash a code 12, refer to the car's service manual for further tests.)
- If you get a code 12, note and record any additional codes. (See: How to Read Trouble Codes)
- If a 50 series code is stored, refer to the car's service manual for further tests.
- Clear the computer's long term memory, and go for another road test. (See: Clear Computer)
- Retest and record codes.
- If no codes were present in EITHER test, the computer doesn't see any malfunctions. (This does not mean that there is no malfunction.) See skewing of a sensor on page 30.
- If codes were only present in the first test, they are intermittent. Make a visual check of the circuit involved.
- If codes were present in BOTH test, the computer is seeing a current malfunction. The following codes are most likely to affect transmission performance.
- Code 14 = Shorted Coolant Temperature Circuit
- Code 15 = Open Coolant Temperature Circuit
- Code 21 = Throttle Position Sensor Circuit
- Code 24 = Vehicle Speed Sensor Circuit
- Code 32 = Barometric Pressure Sensor Circuit
- Code 34 = MAP or Vacuum Sensor Circuit

How To Read Trouble Codes

Trouble code 12 will show as one flash of the check engine light followed by a pause and then two more flashes. This will repeat two more times. Code 34 will show as three flashes followed by a pause and then 4 flashes. All codes in the computer will flash three times, starting with the lowest code, until all codes have been displayed. The computer will then start the entire sequence again beginning with code 12. If more than one trouble code is present, always start your checks with the lowest number code. Exception: A 50 series code is always checked first. An example: if a code 21 and a code 32 were present, you would diagnose code 21 first.

Clear Computer

- Turn the key "OFF".
- Remove the jumper between A and B at the ALDL.
- Disconnect the pigtail lead on the positive battery cable or the ECM fuse for 10 seconds.
- Reconnect the pigtail or the ECM fuse and the codes are erased.
- Drive the car at operating temperature for at least 5 minutes before re-checking for trouble codes.

Skewing A Sensor

Sometimes you can have a sensor malfunction and not set a trouble code. Sensors have an operating range known as a window. A typical range for a sensor would be .5 volts to 4.5 volts. If the sensor drops below .5 or rises above 4.5 volts for a certain time period (usually 30 seconds) then a trouble code will be set. If a sensor malfunctions within its window, (for example a constant 4.3 volts) a trouble code will not be set. This is known as skewing of a sensor. The only way to check a sensor malfunction like this would be with a voltmeter. The problem could be with the sensor or a bad ground or a problem with the reference signal from the computer. The voltmeter will easily find any of the problems.

STEP 1

Most sensors are 3 wire sensors. Connect the negative lead of your voltmeter to the negative post on the battery.

STEP 2

Now with the key on, use the positive lead to back probe the 3 wires of the sensor. One of the outside wires will be 5 volts from the computer. If you don't have 5 volts from the computer then check the wire at the computer. If you still don't have 5 volts the computer is bad.

STEP 3

The other outside wire is a ground. It should always read .0 volts, a range of .01 to .09 is acceptable. If the reading is .1 or above then you have a bad ground and the sensor may malfunction. Ground circuits on cars should always be checked in this manner, not with an ohmmeter.

STEP 4

The center wire is the return signal to the computer. It will vary between approximately .5 and 4.5 as the sensor is operated. For example the center wire on the TPS should be .5 volts at closed throttle and gradually climb to 4.5 volts as the throttle is slowly opened all the way. If not, the sensor is bad. All sensors are checked this way: 5 volts, good ground, proper return signal.

Current Checks

If a circuit is not operating, such as no lock-up, and no trouble codes or sensor malfunctions are found then a current (amps) check should be done on the problem circuit. When doing a current check the ammeter is ALWAYS connected in series. Current draw for lock-up solenoids and shift solenoids should be no more than .75 amps. If the current draw is greater than .75 amps the computer could be permanently damaged. If current draw is zero, then the computer never turned on that circuit regardless of what a scan tool may have said. New types of solenoids called PWM's and Force Motors are now in use on the 4T60-E and 4L80-E. These solenoids have lower resistance and draw more current in normal operation.

Field Service Mode

A final test that is useful in diagnosing TCC shudder, is to use the field service mode. When you connect terminals A and B at the ALDL with the engine running the vehicle enters the field service mode. This is the same connections you'd make for checking trouble codes but this time the engine is running. While in the field service mode the check engine light will flash 2.5 times per second to indicate Open Loop. After the vehicle warms up and enters Closed Loop the light will flash once per second. The light will be on to indicate rich exhaust and off to indicate lean exhaust. Normal operation will be a flashing light. If the flashes are at 1 second intervals this indicates a perfect 14.7:1 air/fuel ratio. When diagnosing a converter clutch shudder, watch the light. If during the shudder the light is steady on or off it indicates an engine problem causing the shudder.

Glossary of Electronic Terms

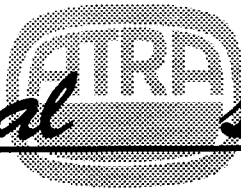
AMMETER	An instrument for measuring current flow. It may be constructed to measure alternating or direct current.
AMPERAGE	The total amount of current (amperes) flowing in a circuit.
AMPERE (AMP)	The unit of measurement for the flow of electrons in a circuit. The amount of current produced by one volt acting through a resistance of one ohm.
ANALOG SIGNAL	A signal that varies in exact proportion to a measured quantity such as pressure, temperature, speed, etc.
ANODE	In an electron tube or solid state device, the internal electrode toward which electrons flow. The positive electrode.
BIAS	The term applied to the electrical, mechanical, or magnetic force or voltage applied to a device to establish the reference point for operation. In a vacuum tube, the voltage measured between the cathode and grid.
BUFFER	A part or circuit used to reduce interaction between two electronic circuits.
BUFFER AMPLIFIER	An amplifier designed to isolate a circuit from the effects of the preceding circuit.
CATHODE	(1) The electron-emitting element of a vacuum tube. (2) The negative electrode of a device.
CIRCUIT	The complete path provided for current flow.

Glossary of Electronic Terms

COMPUTER	Any device capable of accepting information, comparing, adding, subtracting, multiplying, dividing, and integrating this information; then supplying the results of these processes in proper form.
FORWARD BIAS	A bias applied across a semiconductor in order to neutralize any repelling forces at the junction, and permit current flow in the forward direction through the device.
HERTZ	A term meaning cycle per second. Abbreviated Hz.
MULTIMETER	A test instrument with suitable switching facilities to measure voltage, current, and resistance. Also called a volt-ohm-meter.
N-TYPE MATERIAL	A material used in the construction of semiconductors in which the conduction electron density exceeds the hole density.
OHM	The practical unit for measuring electrical resistance.
OHMMETER	An instrument for measuring resistance.
OHM'S LAW	"Amperage varies in direct ratio to voltage and in inverse ratio to resistance." For example: One ampere is equal to the amount of current forced by one volt through a resistance of one ohm.
OPEN CIRCUIT	An electric installation in which the circuit is not complete (no current flow).

Glossary of Electronic Terms

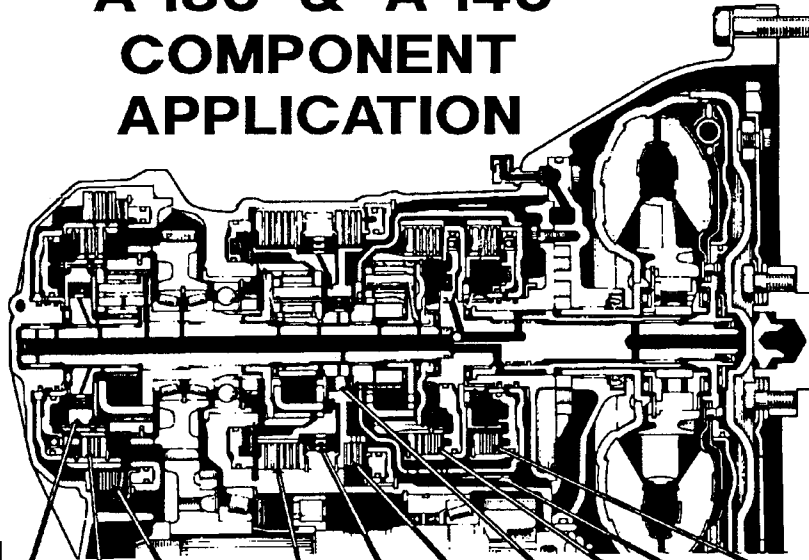
PARALLEL CIRCUIT	A method or pattern of connecting units in an electrical circuit. In a parallel circuit, all the units are connected negative-to-negative and positive-to-positive.
PNP, pnp	A transistor containing two P-type regions separated by an N-type region.
P-TYPE MATERIAL	A material used in the construction of semi-conductors in which the hole density exceeds the conduction-electron density.
PULSE WIDTH MODULATION (PWM)	Signal frequency remains constant. The percentage of time frequency remains constant. The percentage of time current to a device (rotor or solenoid) is flowing, or ON, is the duty cycle. A variation in duty cycle = PWM.
QUAD DRIVER (QDM)	Integrated circuit used to turn certain components ON or OFF. A Quad Driver Module (QDM) has four separate outputs (switches) and can turn ON or OFF up to four circuits and/or components independently.
RANDOM-ACCESS MEMORY (RAM)	A computer memory in which the data can be retrieved at a speed that is independent of its location in the memory.
READ-ONLY MEMORY (ROM)	A computer memory that is pre-programmed and used primarily for information retrieval applications.
REVERSE BIAS	An external voltage applied to a semiconductor junction to reduce the flow of current through the junction.



Glossary of Electronic Terms

SEMICONDUCTOR	A group of materials having a conductivity between that of a metal and an insulator.
SERIES CIRCUIT	A circuit in which the units are consecutively connected or wired positive-to-negative, and current must flow through all units.
SILICON	A nonmetallic element used in the manufacture of semiconductors, such as transistors.
SOLENOID	A tubular coil containing a movable core that moves when the coil is energized.
SQUARE WAVE	An essentially square - or rectangular-shaped wave. A wave that alternately assumes two fixed values for equal lengths of time with a negligible transition time between the two values.

A-130 & A-140 COMPONENT APPLICATION



GEAR RATIOS

A 1 4 0	1st gear	2.810:1	A 1 3 0
	2nd gear	1.549:1	
	3rd gear	1.000:1	
	Reverse	2.296:1	
	4th gear	.706:1	

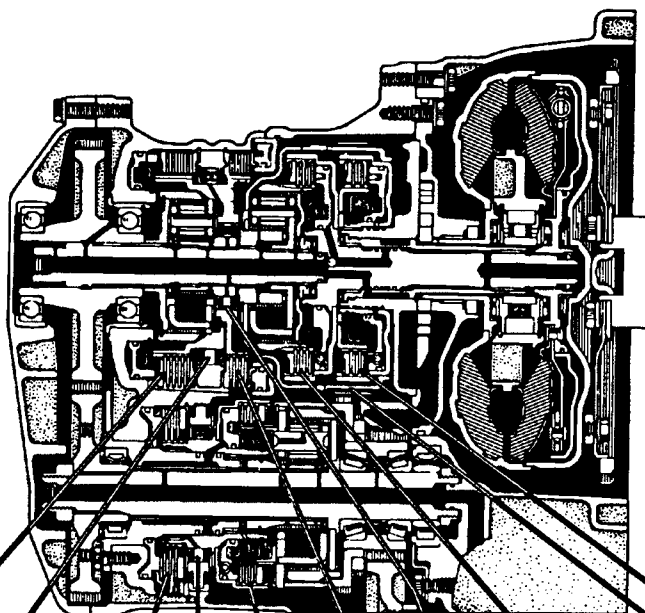
Selector Position	GEAR ENGAGED	OVER DRIVE SPRAG	OVER RUN CLUTCH	OVER DRIVE CLUTCH	LOW REVERSE CLUTCH	LOW SPRAG	INTER-MEDIATE CLUTCH	INTER-MEDIATE SPRAG	FOR WARD CLUTCH	INTER-MEDIATE BAND	DIRECT CLUTCH
R	Reverse										
D	1st gear										
	2nd gear										
	3rd gear						*				
	4th gear				140 only	140 only	140 only	140 only	140 only *	140 only	140 only
2	1st gear										
	2nd gear						*			**	
	3rd gear						*			**	
L	1st gear					*					
	2nd gear						*			**	
A-140					A-130						

 = APPLIED OR HOLDING
 * = APPLIED BUT INEFFECTIVE
 ** = ENGINE BRAKING ONLY

NOTE

Unless stated otherwise, A-130 will be used to denote A-130L, A-131L & A-132L. A-140 will be used to denote A-140E & A-140L. A-240 will be used to denote A-240E & A-240L. A-340 will be used to denote A-340E & A-340H.

A-240 SERIES COMPONENT APPLICATION



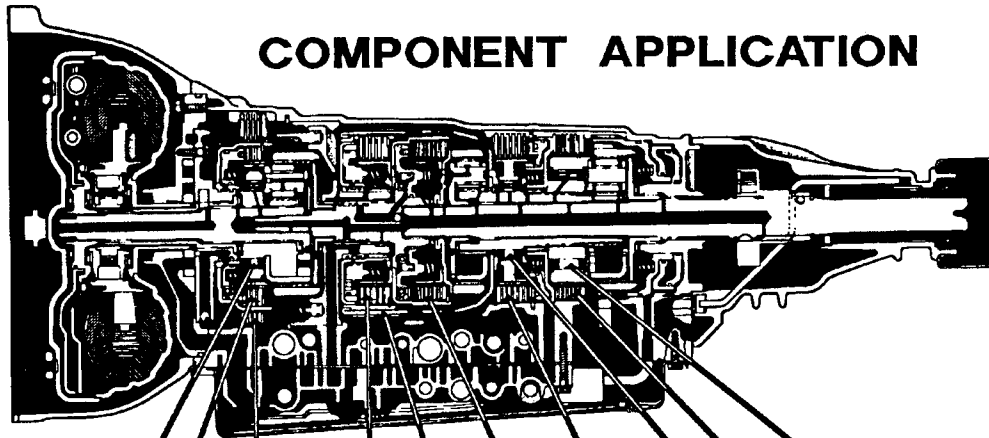
GEAR RATIOS

1st gear	3.643:1
2nd gear	2.008:1
3rd gear	1.296:1
4th gear	0.829:1
Reverse	2.977:1

Selector Position	GEAR ENGAGED	LOW REVERSE CLUTCH	LOW SPRAG	UNDER DRIVE CLUTCH	UNDER DRIVE SPRAG	OVER DRIVE CLUTCH	INTER-MEDIATE CLUTCH	INTER-MEDIATE SPRAG	FOR WARD CLUTCH	INTER-MEDIATE BAND	DIRECT CLUTCH
R	Reverse										
D	1st gear										
	2nd gear										
	3rd gear										
	4th gear						*				
2	1st gear										
	2nd gear									**	
	3rd gear						*				
L	1st gear		*								
	2nd gear									**	

 = APPLIED OR HOLDING
 * = APPLIED BUT NOT EFFECTIVE
 ** = ENGINE BRAKING ONLY

A-340 SERIES COMPONENT APPLICATION



GEAR RATIOS

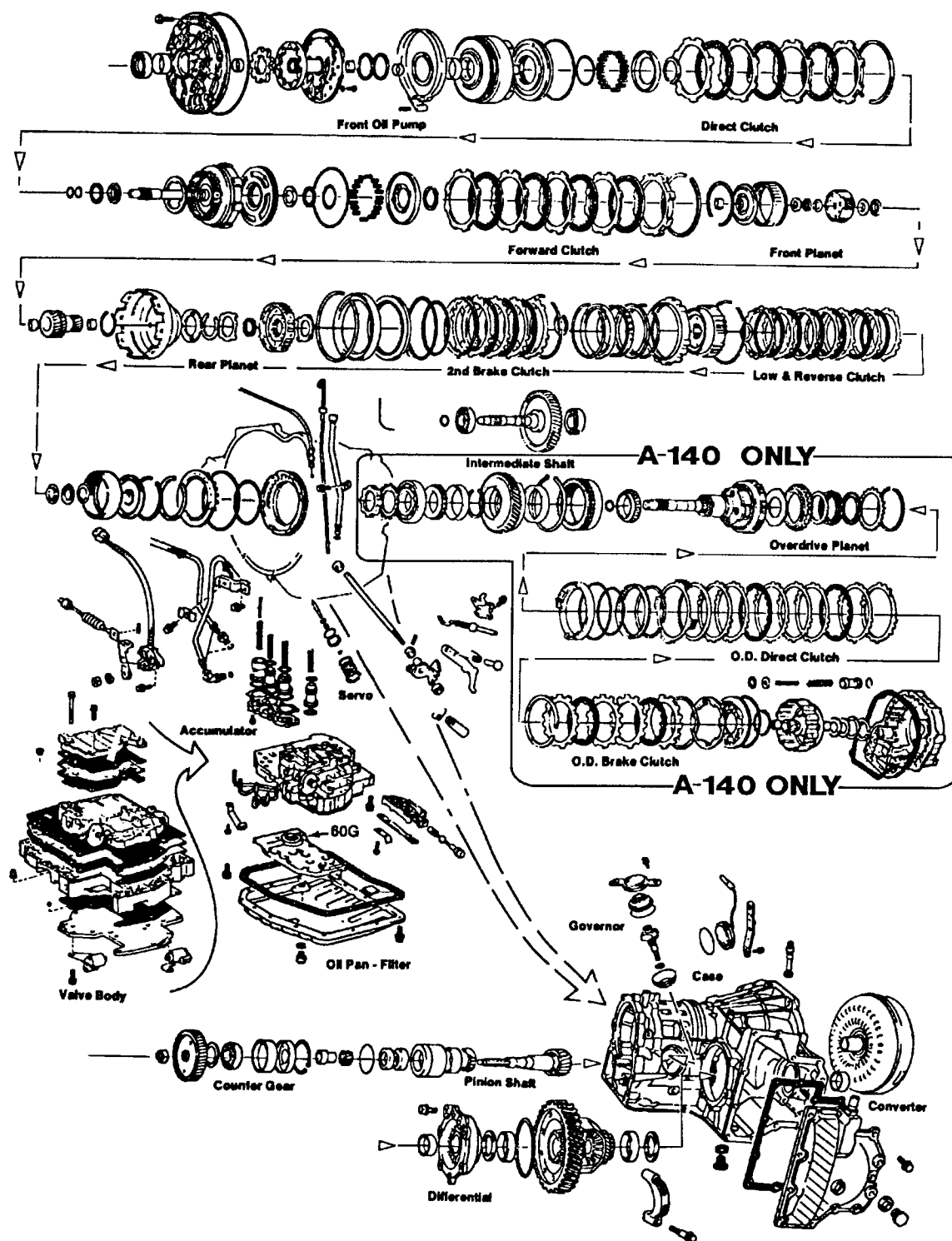
1st gear	2.804:1
2nd gear	1.531:1
3rd gear	1.000:1
4th gear	0.705:1
Reverse	2.393:1

Selector Position	GEAR ENGAGED	OVER DRIVE SPRAG	OVER RUN CLUTCH	OVER DRIVE CLUTCH	DIRECT CLUTCH	INTER-MEDIATE BAND	FOR WARD CLUTCH	INTER-MEDIATE CLUTCH	INTER-MEDIATE SPRAG	LOW REVERSE CLUTCH	LOW SPRAG
R	Reverse										
D	1st gear										
	2nd gear										
	3rd gear							*			
	4th gear							*			
2	1st gear										
	2nd gear					**			*		
	3rd gear							*			
L	1st gear										*
	2nd gear					**			*		

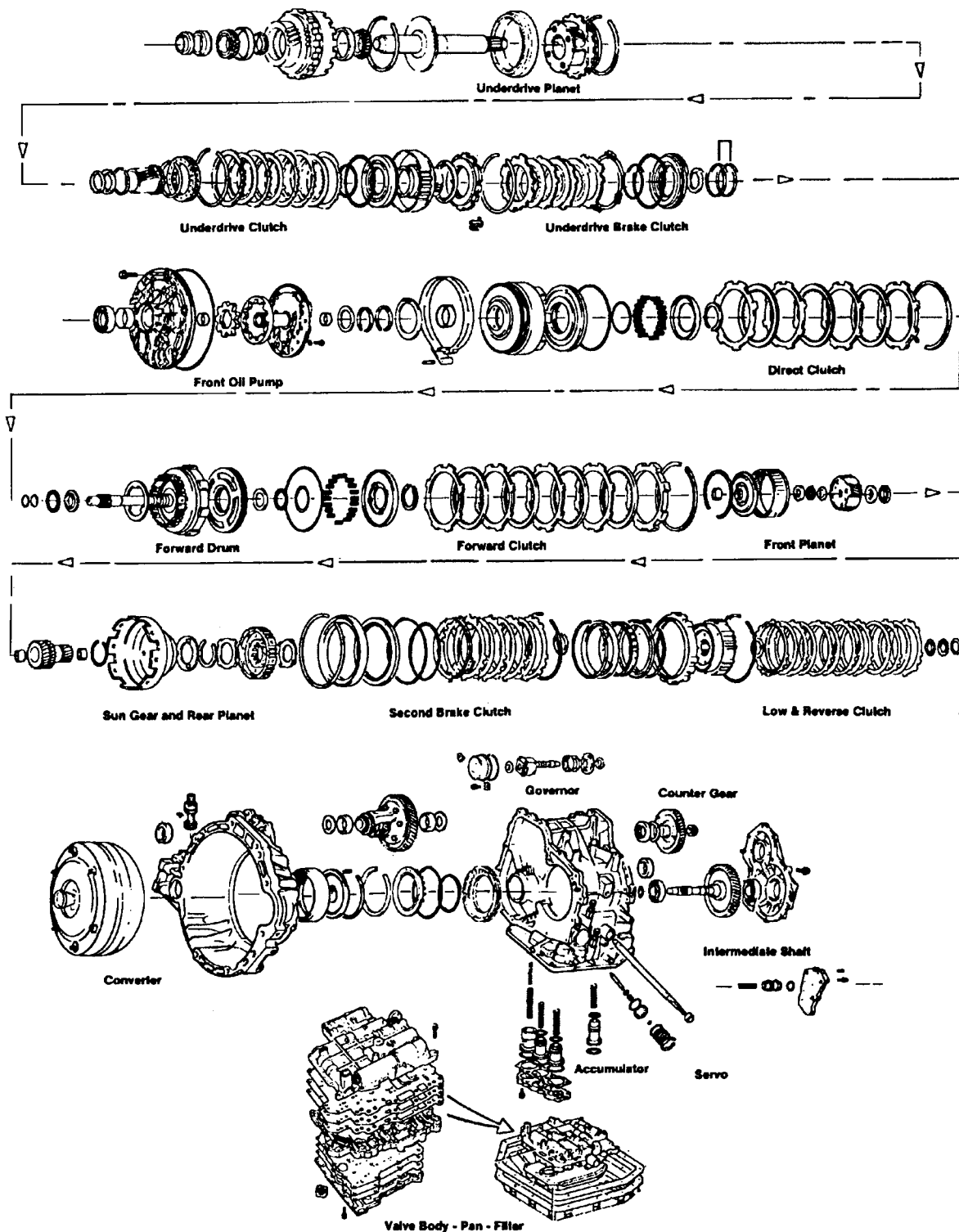
 = APPLIED OR HOLDING
 * = APPLIED BUT INEFFECTIVE
 ** = ENGINE BRAKING ONLY

technical seminar

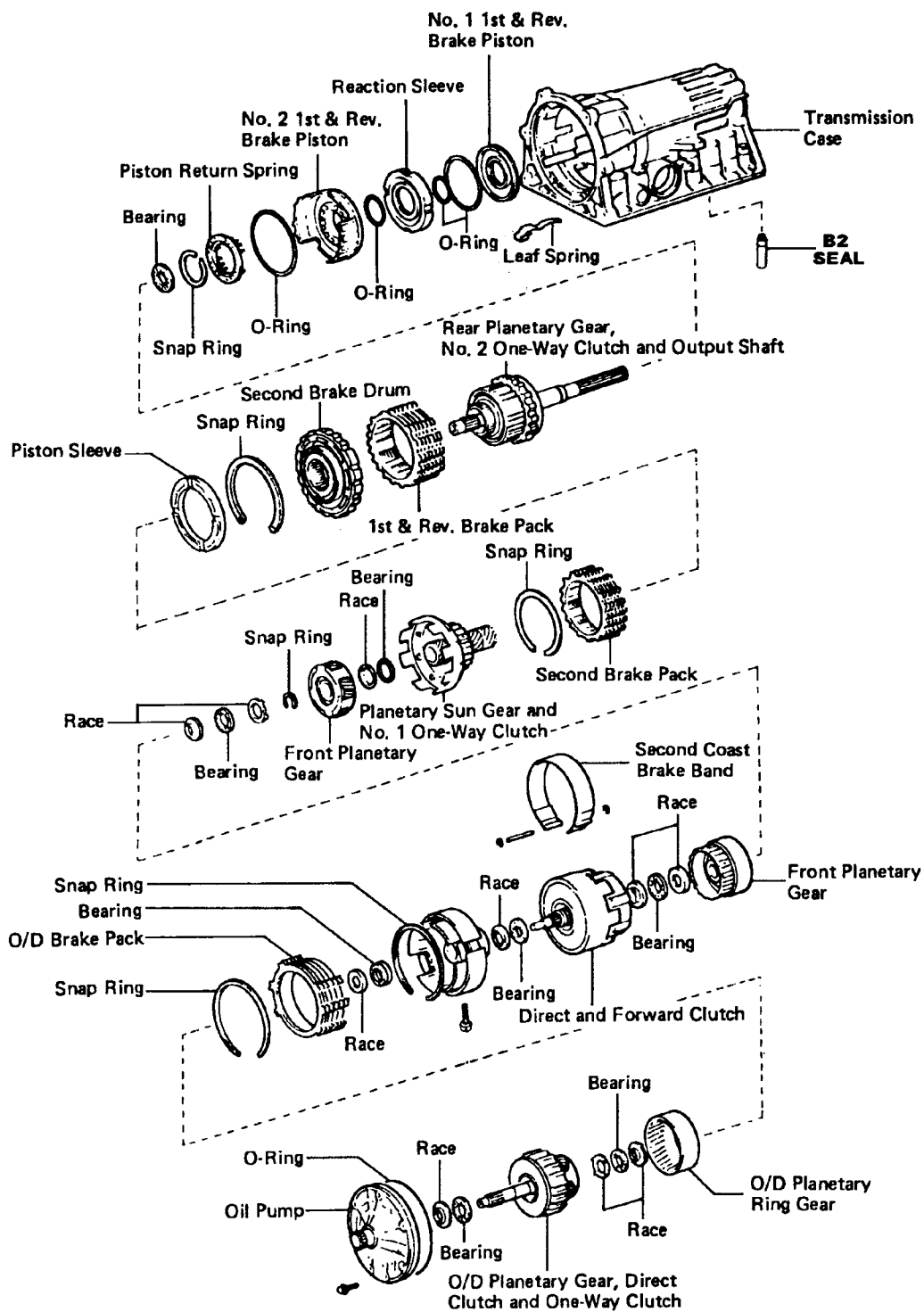
130 & 140



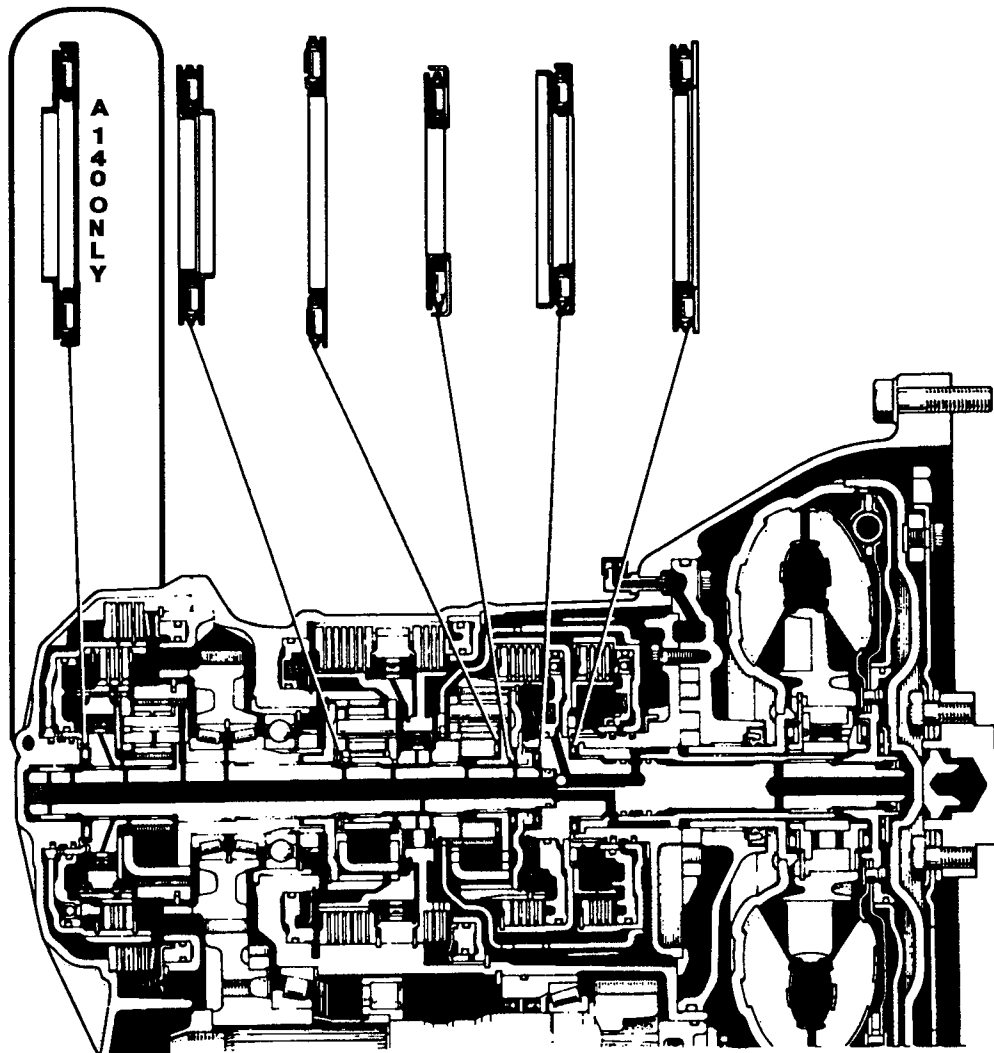
240



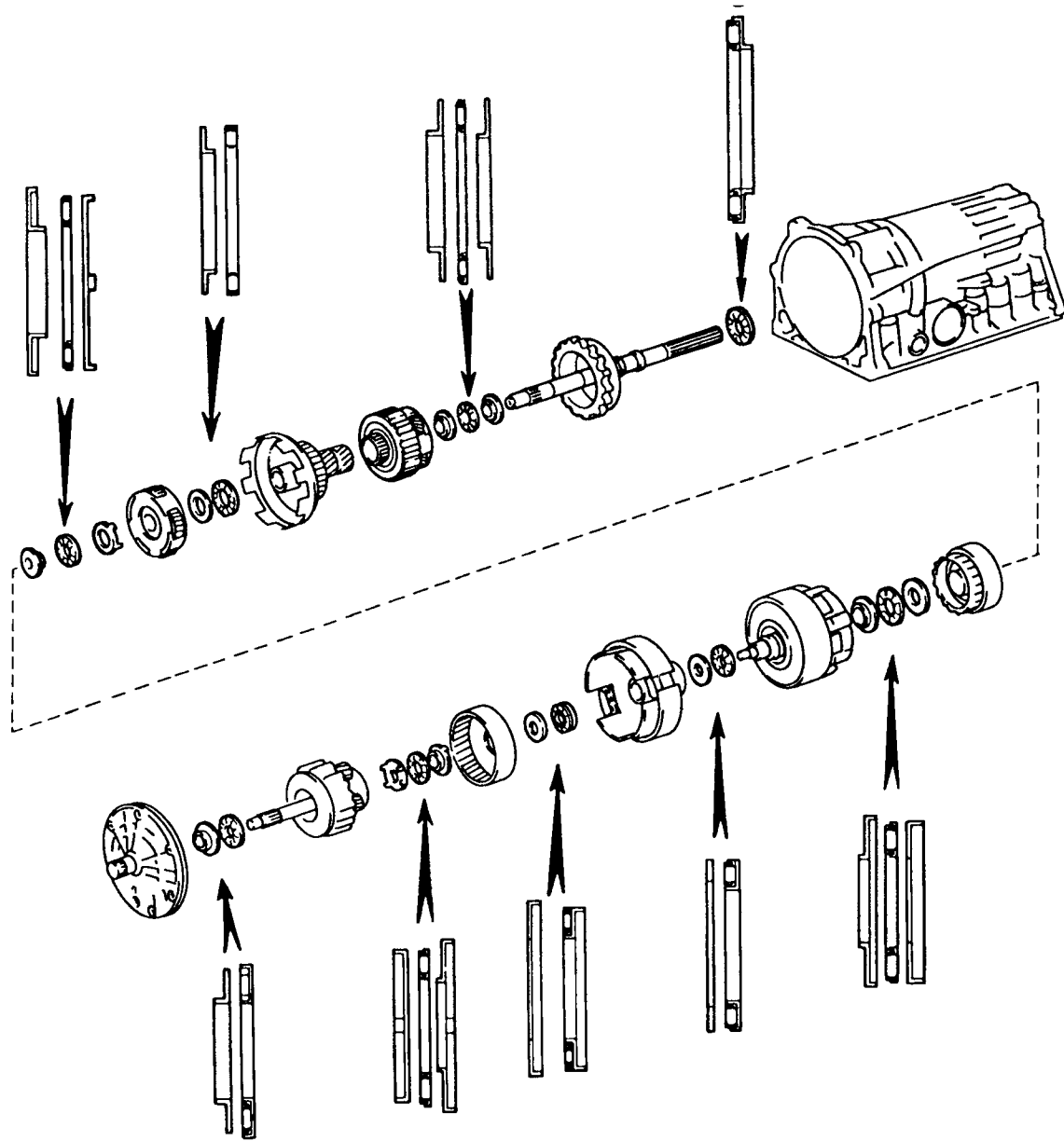
340



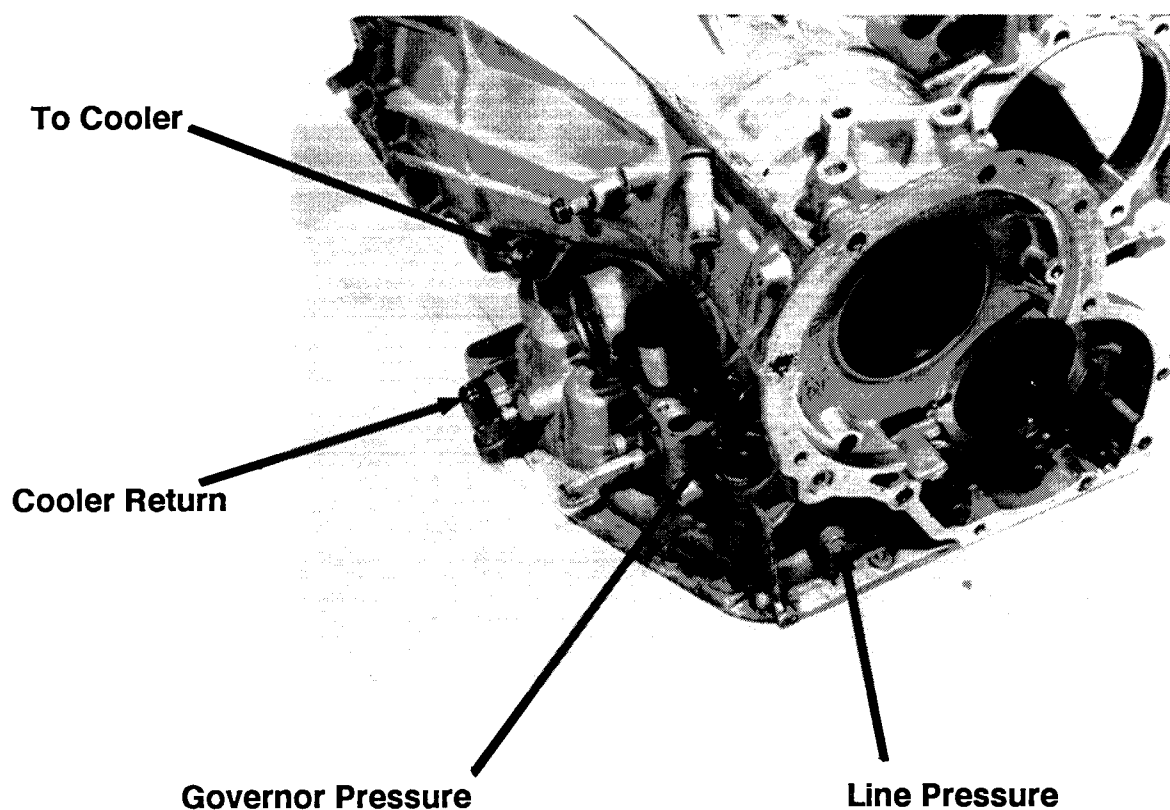
130 & 140



340



A130 & A140 Pressure Taps



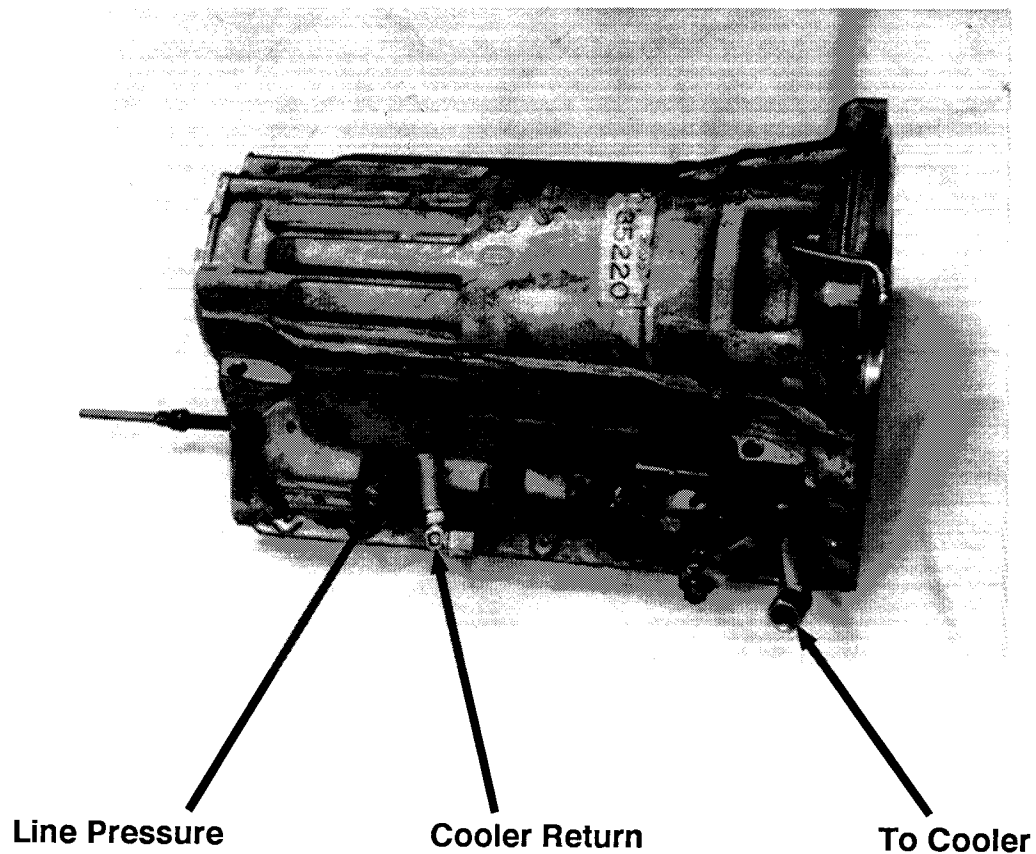
NOTE

The A140E has a governor pressure tap but there is no pressure there.

Line Pressure - PSI

	At Idle	At Stall
D	53-61	131-152
R	77-103	205-239

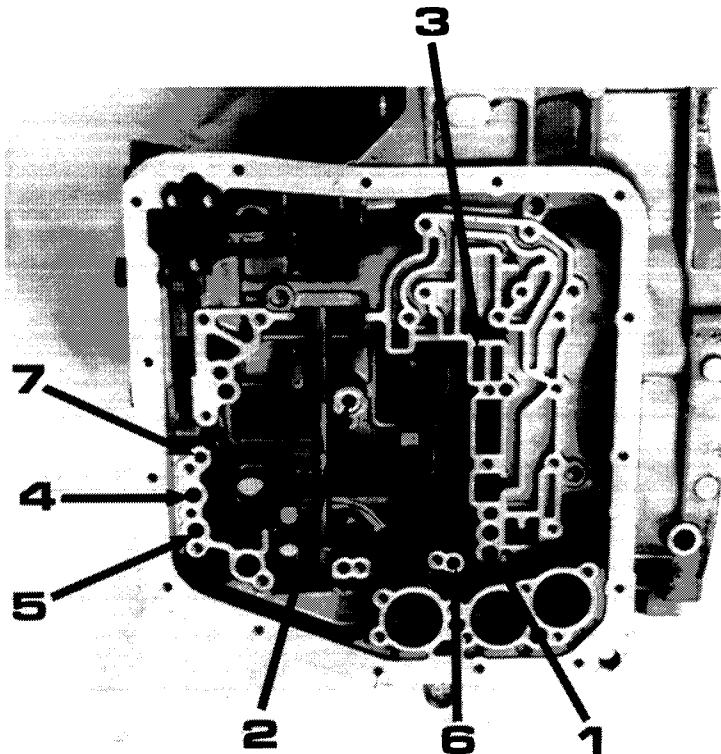
A340 Pressure Taps



Line Pressure - PSI

	At Idle	At Stall
D	55-70	135-200
R	75-90	200-250

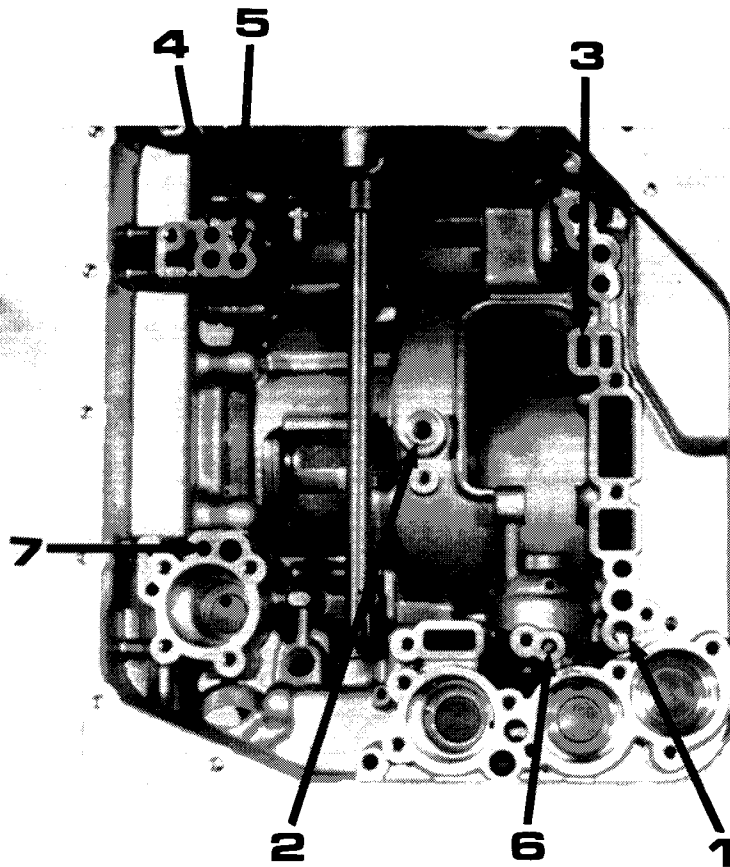
A130 & A140 Air Checks



- #1. Forward Clutch
- #2. Intermediate Clutch
- #3. Direct Clutch
- #4. * Overdrive Clutch
- #5. * Overrun Clutch
- #6. Intermediate Band
- #7. Low/Reverse Clutch

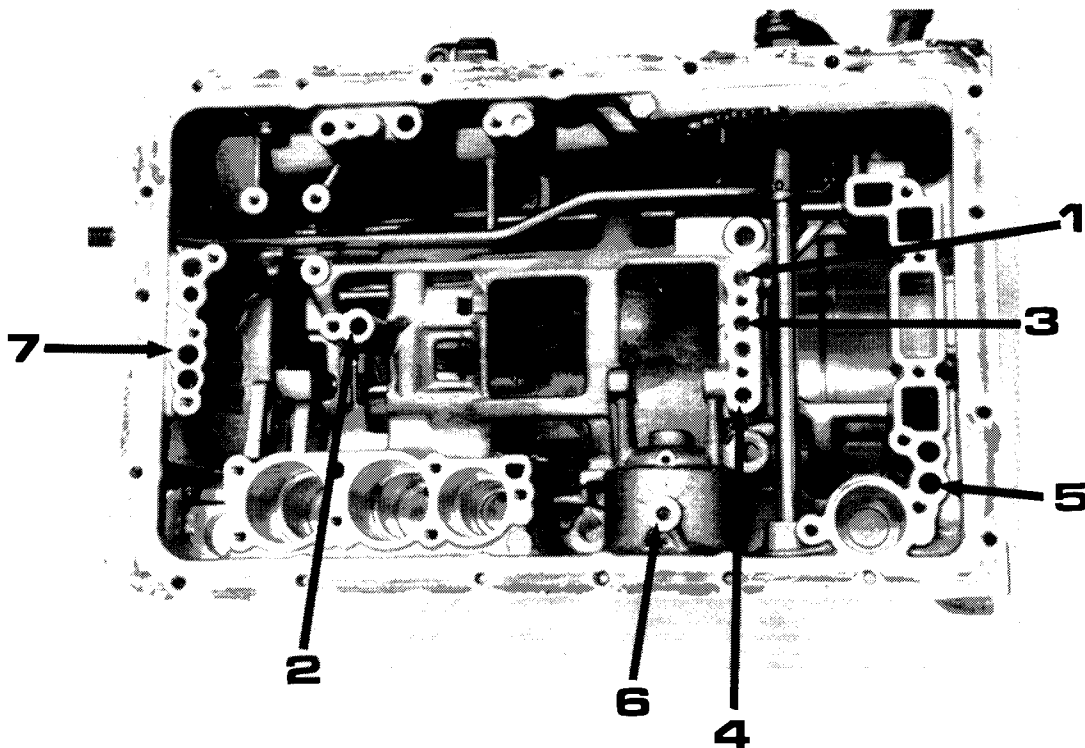
*** A140 Transaxles Only**

A240 Air Checks



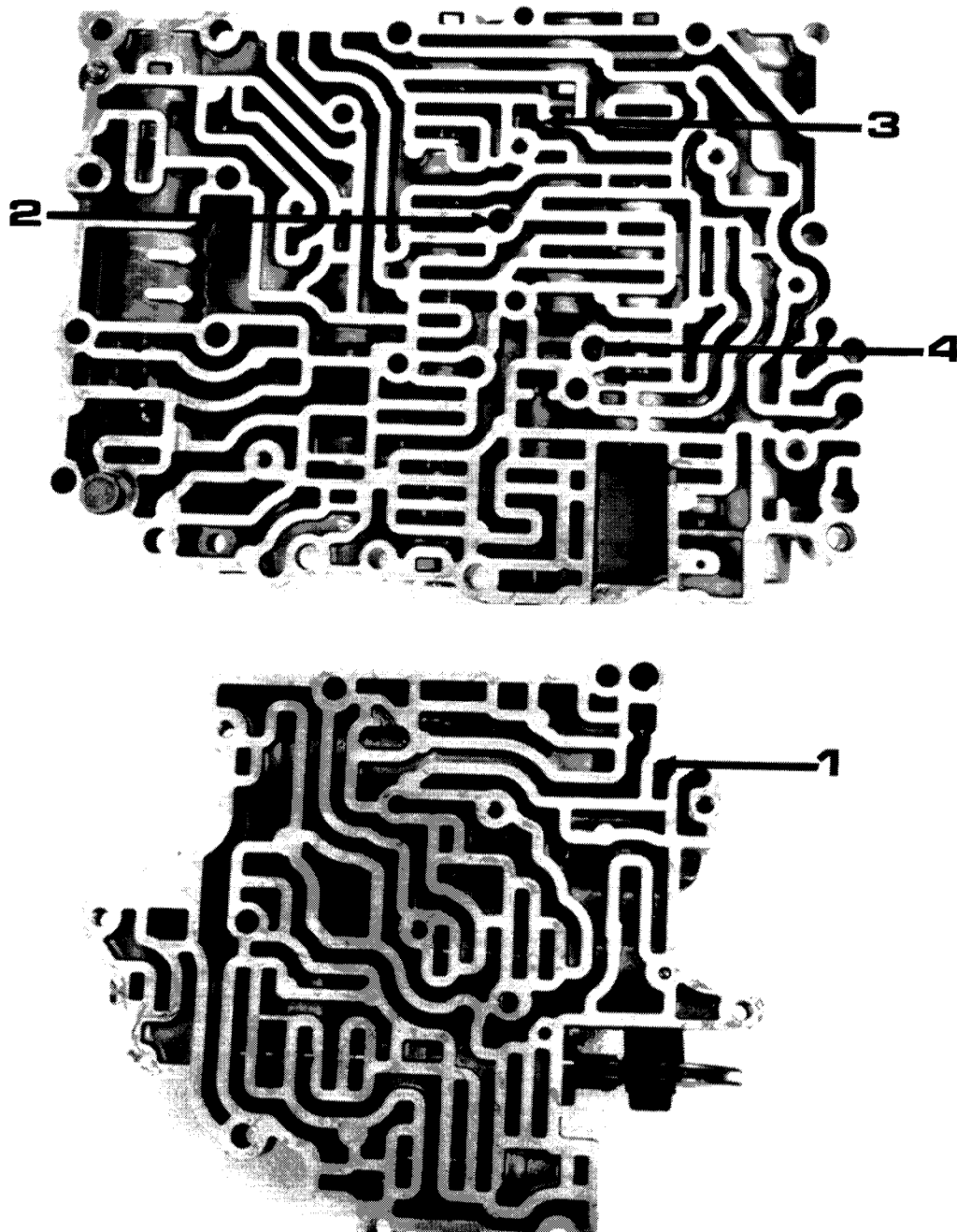
- #1. Forward Clutch
- #2. Intermediate Clutch
- #3. Direct Clutch
- #4. Underdrive Clutch
- #5. Overrun Clutch
- #6. Intermediate Band
- #7. Low/Reverse Clutch

A340 Air Checks



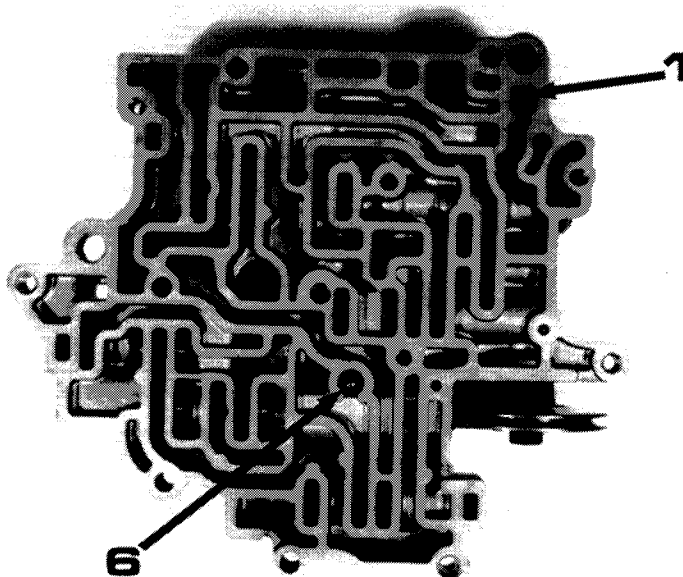
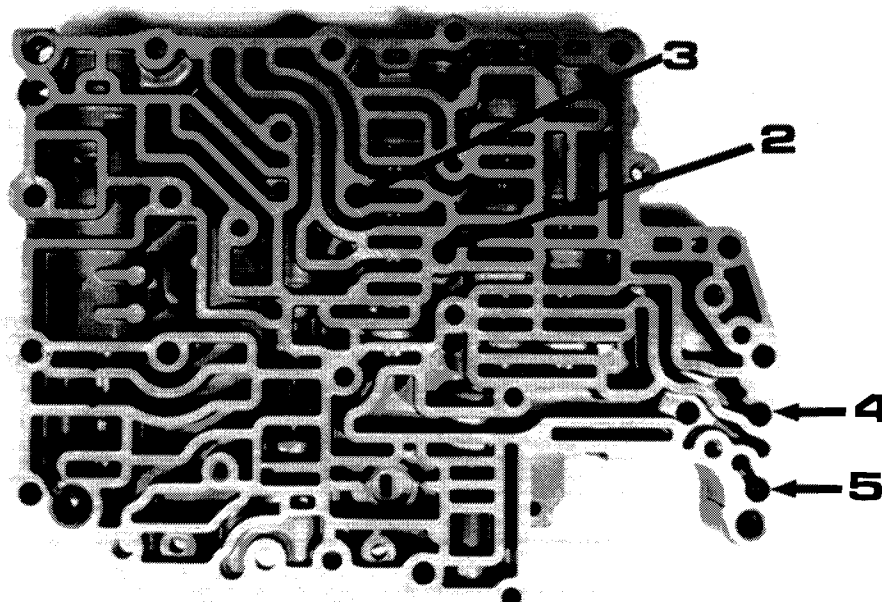
- #1. Forward Clutch
- #2. Intermediate Clutch
- #3. Direct Clutch
- #4. Overdrive Clutch
- #5. Overrun Clutch
- #6. Intermediate Band
- #7. Low/Reverse Clutch

A-130 Checkballs



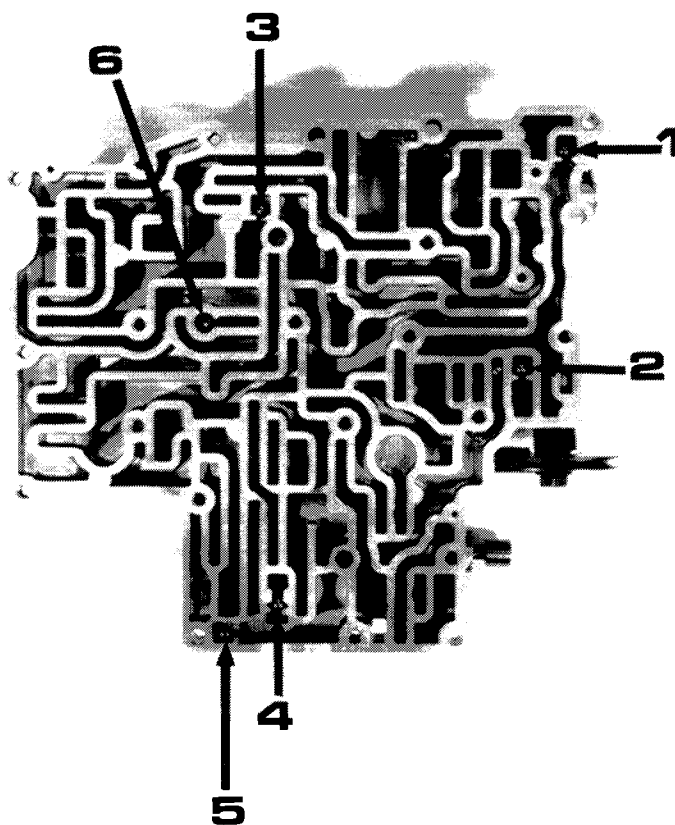
- #1. Forward Clutch Orifice
- #2. Intermediate Clutch Orifice
- #3. Direct Clutch Orifice
- #4. Second Band Orifice

A140E Checkballs

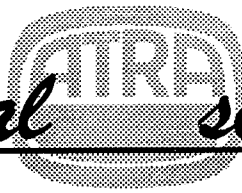


- #1. Forward Clutch Orifice
- #2. Intermediate Clutch Orifice
- #3. Direct Clutch Orifice
- #4. Overdrive Clutch Orifice
- #5. Overrun Clutch Orifice
- #6. Second Band Orifice

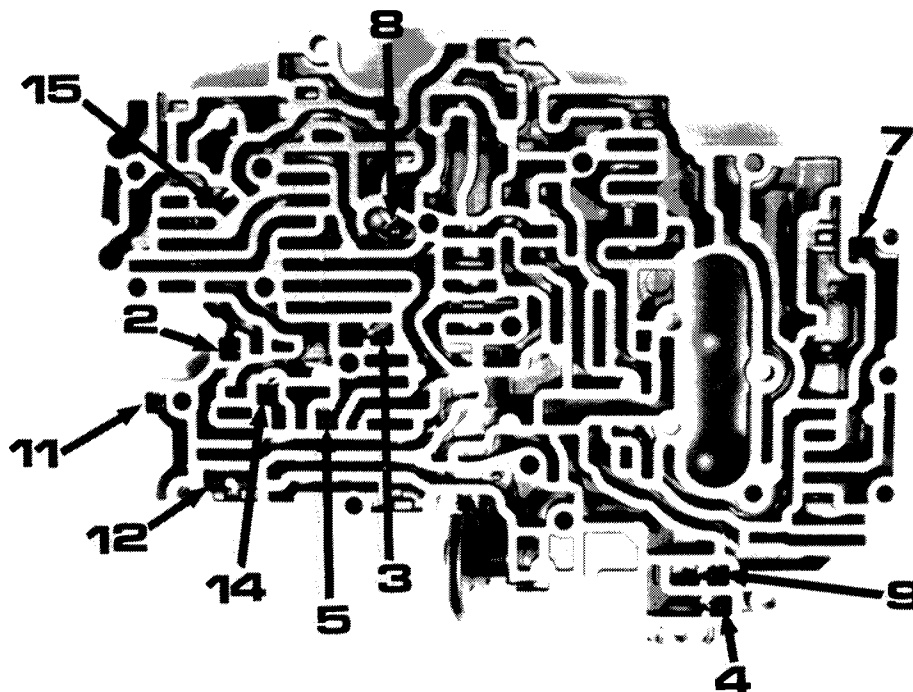
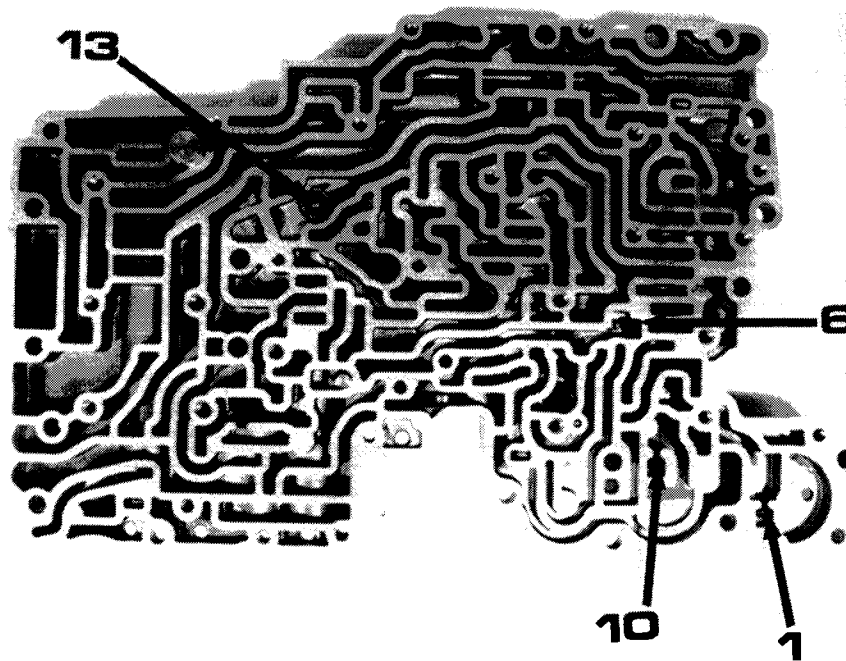
A240E Checkballs



- #1. Forward Clutch Orifice
- #2. Intermediate Clutch Orifice
- #3. Direct Clutch Orifice
- #4. Overdrive Clutch Orifice
- #5. Underdrive Clutch Orifice
- #6. Intermediate Band One Way Check Valve



A340 Checkballs



A340 Checkballs

- #1. * Intermediate Clutch Accumulator Feed Orifice
- #2. Intermediate Clutch Orifice
- #3. Direct Clutch Orifice
- #4. Intermediate Band Orifice
- #5. Overdrive Clutch Orifice
- #6. * Overdrive Clutch Accumulator Feed Orifice
- #7. Torque Converter Charge One Way Check Valve (Rubber Ball - .250")
- #8. * Direct Clutch Shuttle Ball - 3rd/Reverse (Steel Ball - .281")
- #9. Overrun Clutch Orifice
- #10. * Direct Clutch Accumulator Feed Orifice
- #11. * Intermediate Clutch Accumulator Exhaust
- #12. * Direct Clutch Accumulator Exhaust
- #13. * Forward Clutch Orifice (Steel Ball - .250")
- #14. * Overdrive Clutch Accumulator Exhaust Orifice
- #15. * Low/Reverse Clutch Exhaust Orifice

* Not used in all models

CAUTION

Installing the #8 checkball in valve bodies that do not use it will result in premature direct clutch failure. To determine if a valve body requires a #8 checkball, look at the separator plate. If there are two holes above the bathtub it needs a checkball. If there is only one hole above the bathtub it does not take a checkball.

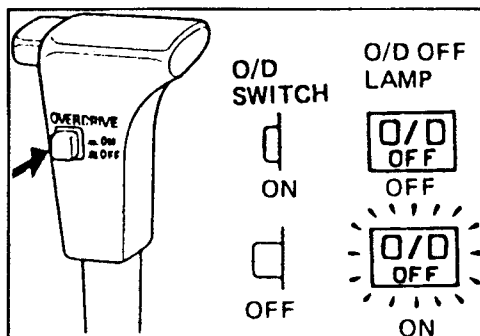
Diagnosing A No Shift Problem

STEP 1

1985 & Earlier go to page 21. 1986 & On, check for trouble codes.

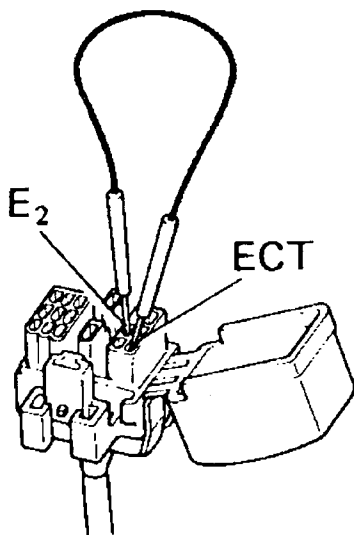
1. Turn ignition switch to ON.
2. Set O/D switch to OFF.
3. Check that "O/D OFF" lamp on the dash comes on.
4. Set O/D switch to ON.

"O/D OFF" lamp goes off.



If the light is off, go to step 2 on page 21.

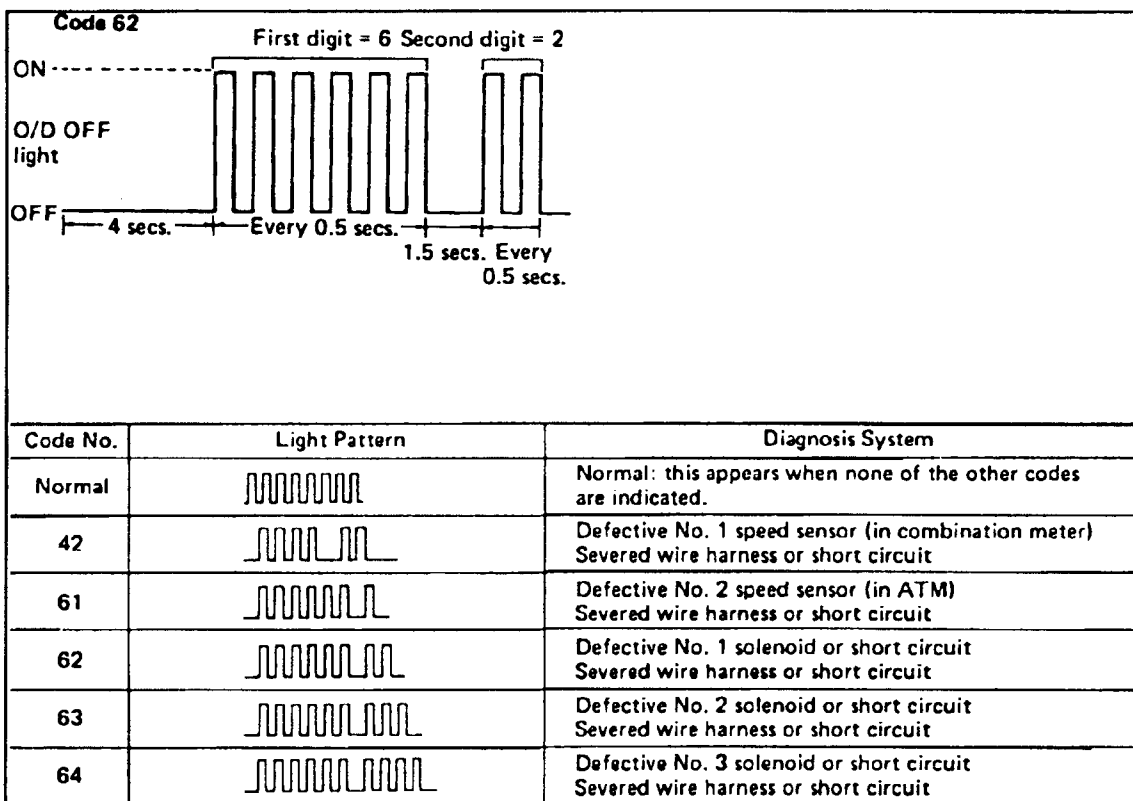
If the light is flashing, check for trouble codes. Using a jumper lead, connect terminals ECT and E1 at the service connector.



Note: ECT on late cars is called TE1

Turn the ignition on (don't start the engine). Turn the OD cancel button off. The OD off light on the dash will flash trouble codes just like a GM computer. Use the chart below to find the problem.

A-140E Trouble Codes



NOTE

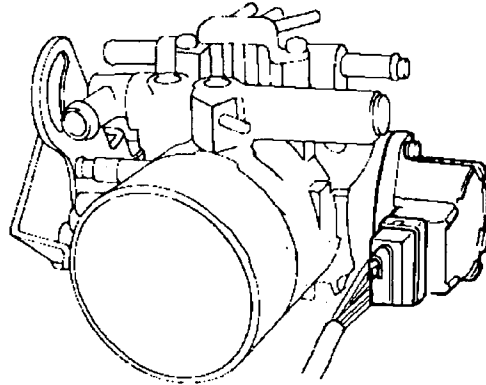
If code 61 is present, go to step 4 on page 22.

If more than one code is going to be output, the light will pause for 2.5 seconds, then indicate the next code. After all codes have been output, the light will pause for 4 seconds, then repeat the above sequence until memory is cleared.

Correct any problems that were indicated by the trouble codes. If the transaxle still won't shift, go to page 21.

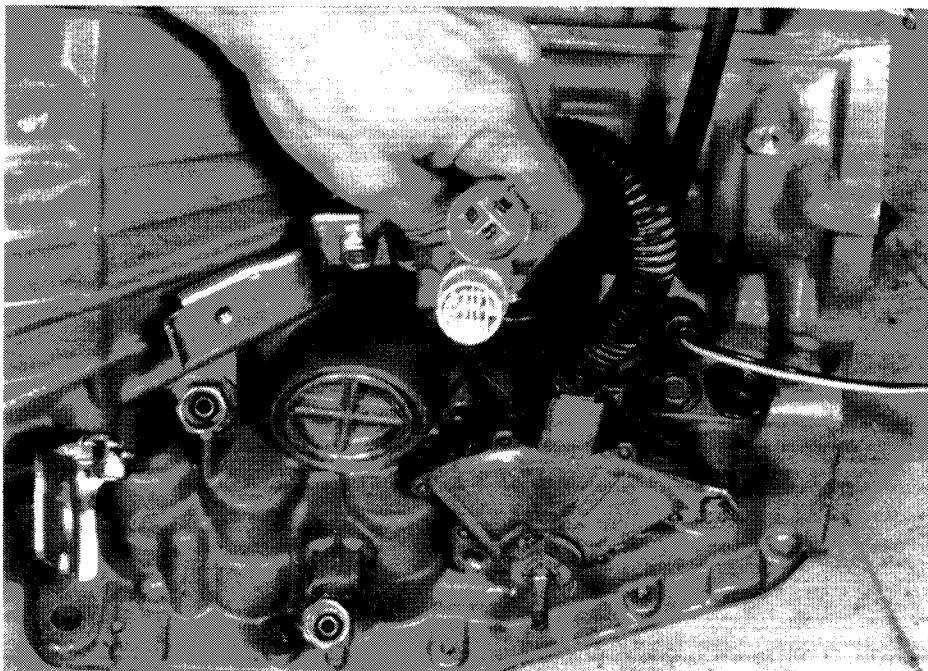
Step 2

Disconnect the throttle position switch (TPS). If an up shift occurs adjust or replace the TPS.



Step 3

The neutral start switch may cause a the "no shift" condition.



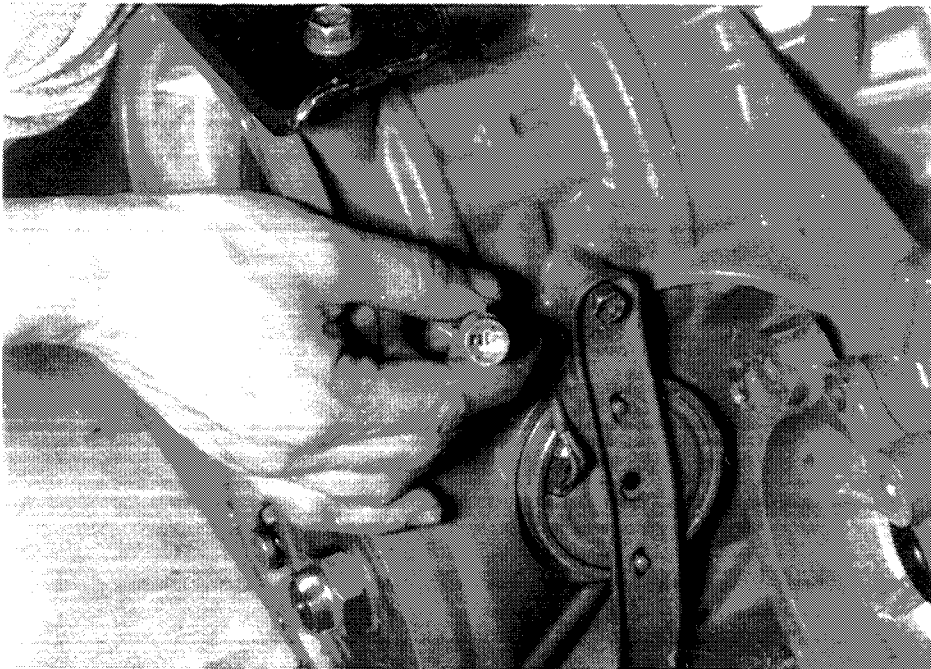
To check the neutral start switch, disconnect the wire harness, if an up shift occurs adjust or replace the switch.

STEP 4

Check the vehicle speed sensor. (Ignition off.)

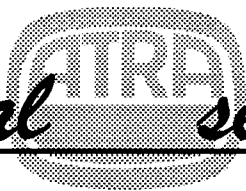
Locate the SP2 terminal at the computer see page 29. With the wire harness to the ECT computer unplugged connect an ohmmeter to the SP2 terminal and ground, turn the drive wheels of the car. The ohmmeter should fluctuate between zero ohms and infinite resistance.

If no fluctuation occurs, connect the ohmmeter to the two VSS leads at the transaxle.



If fluctuation now occurs check the wires leading to the VSS for opens or shorts. One wire goes to body ground and the other goes to the SP2 lead of the ECT computer.

If fluctuation does not occur check the rotating magnet on the drive pinion for damage. If the magnet is ok, replace the VSS.



Quick Checking The Transaxle

STEP 5

Disconnect the wiring harness at the transaxle. Using a wishbone lead (figure 1) attach the single lead to the positive battery terminal. Use the chart in figure 2 to shift through the different ranges by connecting the appropriate wires with the wishboned jumper lead.

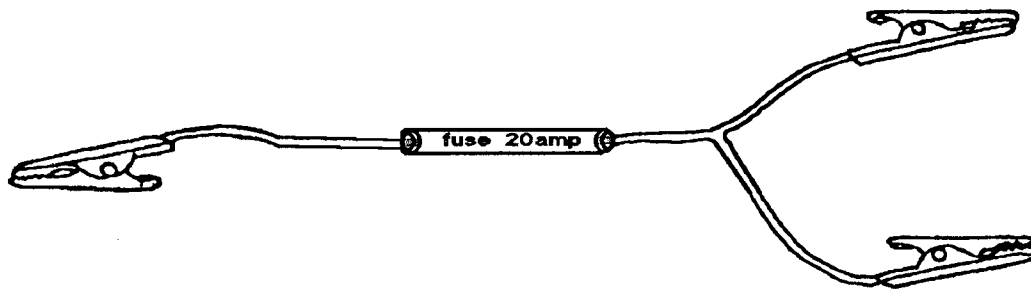


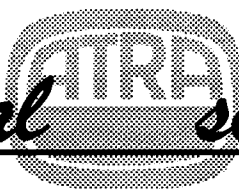
Figure 1

	White Wire	Black Wire
1st Gear	connected	disconnected
2nd Gear	connected	connected
3rd Gear	disconnected	connected
4th Gear	disconnected	disconnected

Figure 2

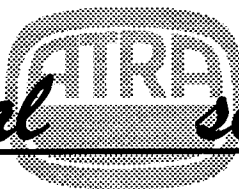
If the transaxle shifts correctly, the no shift condition is external. Go to step 6 checking pin voltage.

If the transaxle doesn't shift, the problem is the valve body, the solenoids, or internal.



Step 6

Terminal	Measuring condition	Voltage (V) DENSO computer	Voltage (V) AISIN computer
L1-GND	Throttle valve fully closed Throttle valve fully closed to fully open Throttle valve fully open	5 5 to 0 0	12 12 to 0 0
L2-GND	Throttle valve fully closed Throttle valve fully closed to fully open Throttle valve fully open	5 5 to 0 to 5 5	12 12 to 0 to 12 12
L3-GND	Throttle valve fully closed Throttle valve fully closed to open Throttle valve fully open	5 5 to 0 to 5 to 0 to 5 5	12 12 to 0 to 12 to 0 to 12 12
IDL-GND	Throttle valve fully closed Throttle valve opening above 1.5*	0 12	0 12
SP1-GND	Standing still (Cruise control OFF) Vehicle moving (Cruise control OFF)	5 or 0 2.5	5 or 0 2.5
BK-GND	When brake pedal is depressed When brake pedal is not depressed	12 0	12 0
2-GND	2 range Except 2 range	10-16 0-2	10-16 0-2
L-GND	L range Except L range	10-16 0-2	10-16 0-2
N-GND	N range Except N range	10-16 0-2	10-16 0-2
L-GND	L range Except L range	10-16 0-2	10-16 0-2
N-GND	N range Except N range	10-16 0-2	10-16 0-2
S1-GND		12	12
S2, SL-GND		0	0



Terminal	Measuring condition	Voltage (V) DENSO computer	Voltage (V) AISIN computer
OD1-GND	Coolant temp. below 50°C (122°F)	0	0
	Coolant temp. above 50°C (122°F)	5	12
OD2-GND	O/D main switch turned ON	12	12
	O/D main switch OFF	0	0
IG-GND	Ignition switch ON	12	12
SP2-GND	Standing still	5 or 0	5 or 0
	Vehicle moving	4	4
PWR-GND	PWR pattern	12	12
	NORM pattern	0-2	0-2
+ B-GND		12	12
*PKB-GND	Engine running Parking Brake lever pulled	0	0
	Engine running Parking Brake lever released	12	12

***Only Celica**

Case Tag Identification

Tag #	Transmission Type	Years	Drive Train
03-50	A-40D	'77-Aug. '81	RWD
03-51	A-40D	'77-Aug. '81	RWD
03-50	A-40D	'82-UP	RWD
03-51	A-40D	'82-UP	RWD
03-55	A-40	'72-Aug. '81	RWD
03-56	A-41	'80-UP	RWD
03-70	A42D	'82-UP	RWD
03-70L	A-42DL	'84-UP	RWD
03-71	A-43D	'81-UP	RWD
03-71L	A-43DL	'81-UP	RWD
03-71LE	A-43DE	'81-UP	RWD
03-72	A44DL	'84-UP	RWD
03-72L	A45L	'84-UP	RWD
03-75	A-43	'72-UP	RWD
RN66	A340H	'85-UP	RWD/4WD
RN61	A340E	'85-UP	RWD/4WD
HJ-60	A440F, L	'86-UP	RWD/4WD
AE82	A130L	'84-UP	FWD
AE82	A131L	'84-UP	FWD
CV10	A140E	'83-UP	FWD
SV11	A140L	'83-UP	FWD
AW11	A141E	'86	FWD
ST161	A142L	'86-UP	FWD
ST162	A42L	'86-UP	FWD
CE80	A240E	'85-UP	FWD
CE80	A240L	'85-UP	FWD
AL-21	A55	'79-UP	FWD
AL-25	A55F	'79-UP	FWD/4WD
SV-25	A540E	'89-UP	FWD

Stacked Shifts Computer Controlled Versions Only

Stacked shifts, very early uncontrollable shifts or seems like no power could be a computer or solenoid problem. To diagnose this problem, perform the following test.

STEP 1

Raise the drive wheels.

STEP 2

Disconnect the harness to the transaxle that goes to the solenoids.

STEP 3

Connect a + 12v lead to the white wire and the black wire on the transaxle harness.

STEP 4

Start the engine and put the gear selector in Drive (the transaxle should be in 2nd gear).

STEP 5

Raise the engine idle to 1200 rpm.

STEP 6

Pull the T.V. cable all the way to the maximum position.

STEP 7

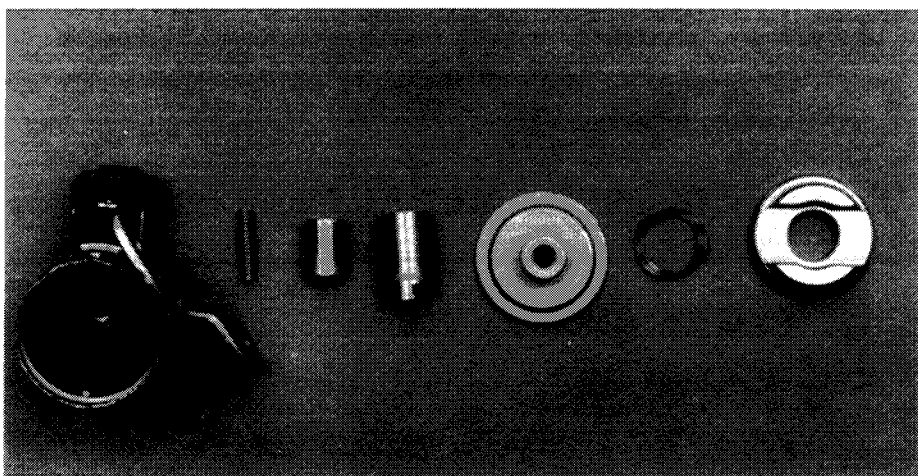
Does the transaxle shift out of 2nd?
NO - stacked shift problem is computer related. Go to page 29.
Yes - If it shifted out of 2nd, clean or replace the solenoids as needed. Go to page 28.

Stacked Shifts Computer Controlled Versions Only (Continued)

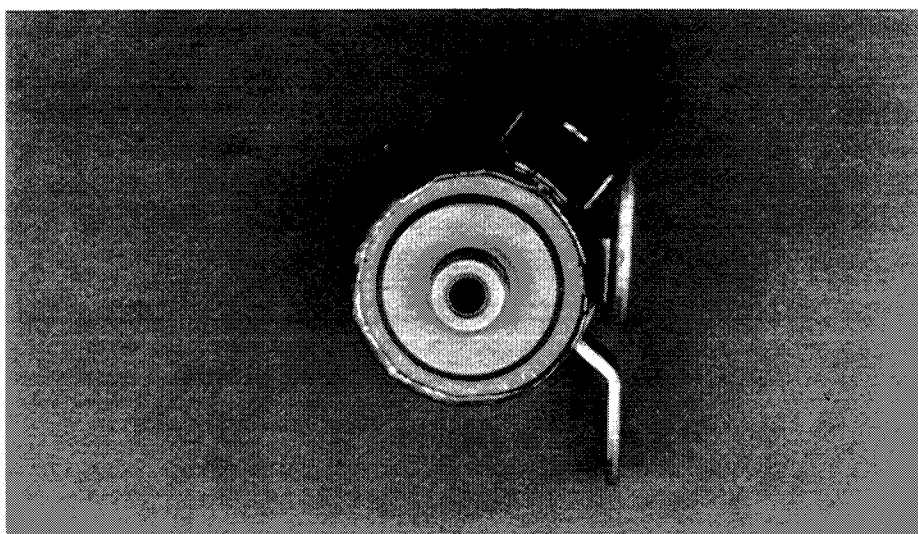
Solenoid Cleaning

The shift solenoids are normally closed solenoids and must be energized in order to clean them. Use a low amperage + 12v dc supply (500 ma). Open the solenoid and flush it with solvent.

If the solenoids are still clogged, you can carefully peel the backing off and disassemble them.



Once you clean all the parts, reassemble the solenoid and carefully bend the backing into place.

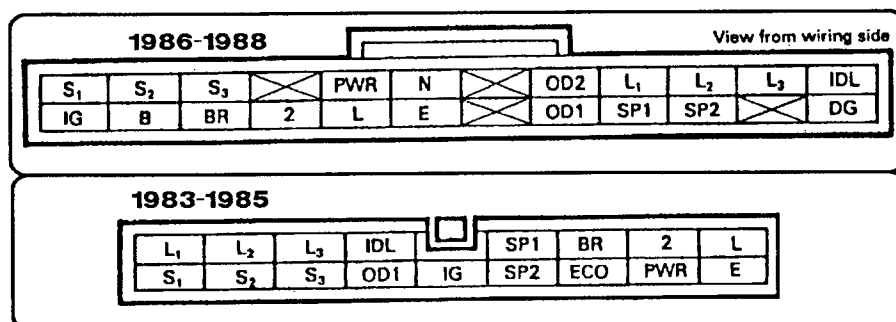


Stacked Shifts Computer Controlled Versions Only (Continued)

T.P.S. Check

With the ignition on (engine off) and your foot off the brake, check the voltage at the DG terminal. To do this, connect the positive lead of your volt meter to the DG terminal and connect the negative lead to a good ground. At closed throttle the voltage reading should be zero. As the throttle is slowly opened to maximum the voltage should increase in 1 volt steps to 8 volts.

If the voltage is low, disconnect the wires at the IDL, L1, L2, and L3 terminals of the ECT computer.



Make sure you mark the wires so they go back in the connector correctly. Ground the terminals of the ECT computer according to the chart below and check for the appropriate voltage at the DG terminal.

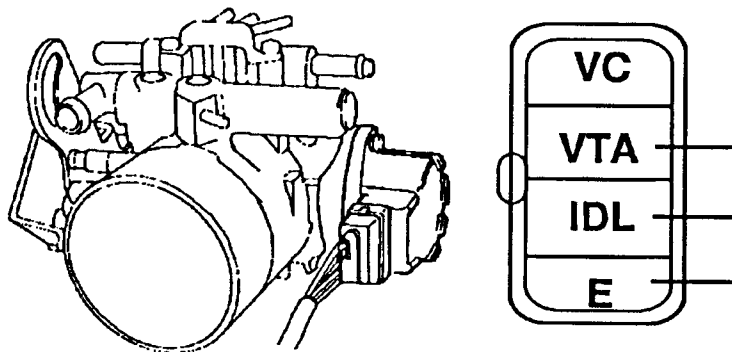
Ground Terminal (s)	Volts
IDL	0
NO WIRES GROUNDED	1
L3	2
L2 & L3	3
L2	4
L1 & L2	5
L1 & L2 & L3	6
L1 & L3	7
L1	8

Stacked Shifts Computer Controlled Versions Only (Continued)

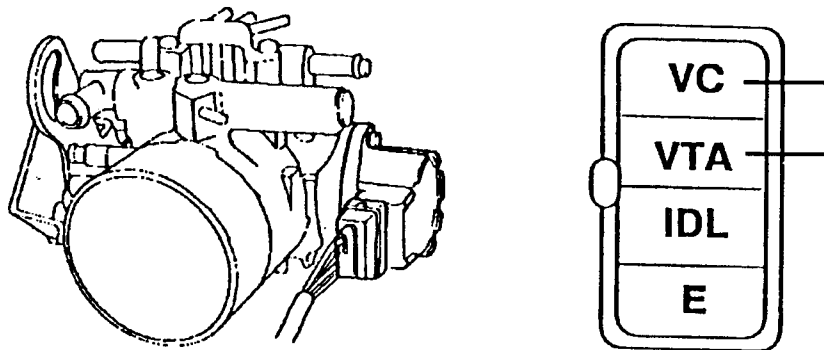
NOTE

If the DG voltage reading that is stuck at +8v, check to make sure the brake switch isn't closed and there are no open circuits to the shift solenoids.

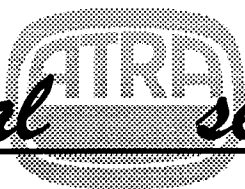
- If the voltage works according to the chart and it has a 5 or 6 wire TPS, replace the TPS.
- If it has a 4 wire TPS, you must check the TCCS ECU before condemning the TPS. The TCCS ECU is a converter that changes the analog signal of the TPS to a digital signal.
- To check the TCCS ECU, turn the ignition off. With the IDL, L1, L2, and L3 wires connected at the ECT computer, disconnect the harness to the TPS. Connect terminals VTA, E and IDL together.



- Now turn the ignition "on" and check the DG voltage. It should be 0 volts. Turn the ignition "off". Now connect the VC and VTA together.



Turn the ignition "on" and check the DG voltage. It should be +8 volts. If the voltages are correct, TCCS ECU is ok. Replace the TPS.



Toyota Part Numbers

PART NUMBERS

*TURBINE SHAFT SEALING RINGS	35712-32010
*DIRECT DRUM SEALING RINGS	35617-32010
**OVERDRIVE SHAFT SEALING RINGS	35648-32010
*SERVO SEALING RINGS	35815-32010

A131 & A140E B2 SEAL	35159-32011
A240E B2 SEAL	35159-20010
A340H B2 SEAL	35159-30010

MANUAL SHAFT PIN RETAINER (COLLAR)	90560-20006
------------------------------------	-------------

140E CRUSH SLEEVE	41231-32010
A131L CRUSH SLEEVE	41231-20020

INTERMEDIATE SHAFT NUT A-140E	90179-20004
INTERMEDIATE SHAFT NUT A-131L	90179-18001

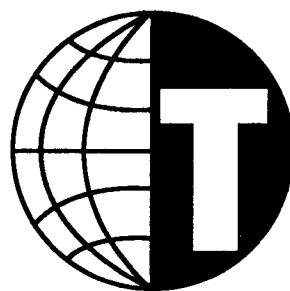
GOVERNOR SLEEVE (A130 & A141)	35145-32011
-------------------------------	-------------

LUBE PLUGS FOR O/D PLANET	90334-03001
---------------------------	-------------

*FOR A130 & A140

** FOR A140

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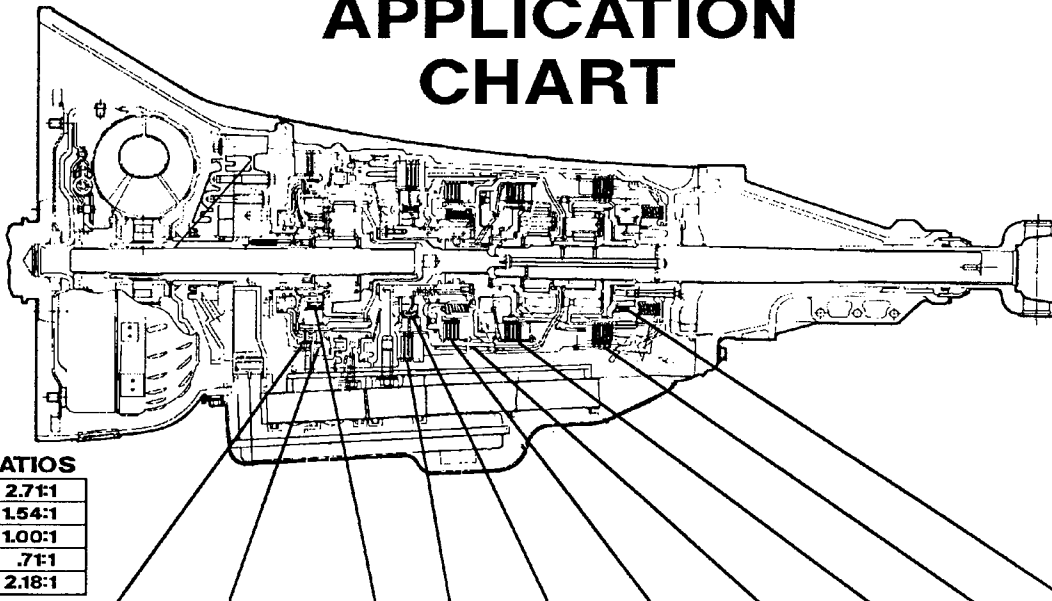
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E4OD

E4OD COMPONENT APPLICATION CHART



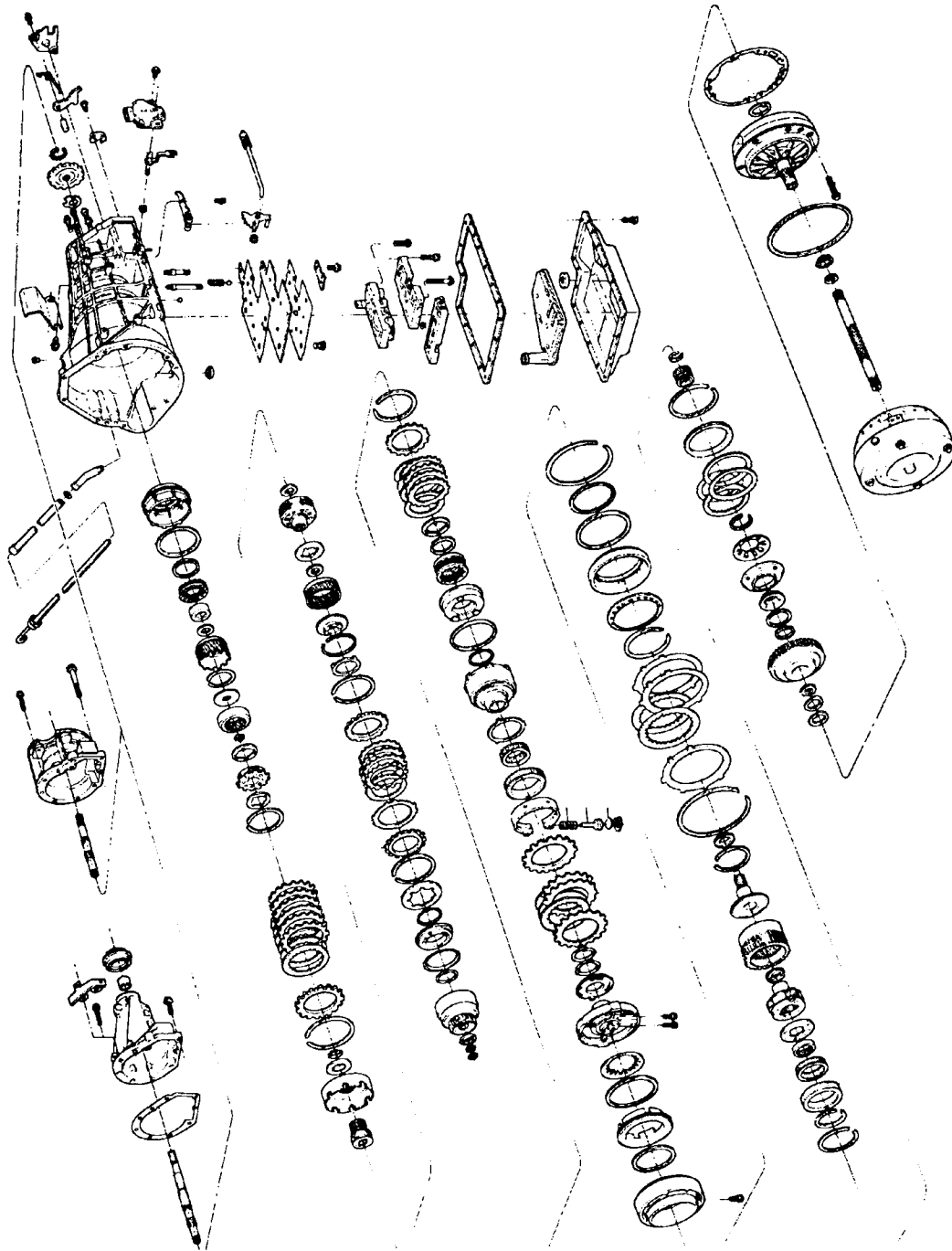
GEAR RATIOS

1ST	2.71:1
2ND	1.54:1
3RD	1.00:1
4TH	.71:1
REVERSE	2.18:1

Selector Position	GEAR ENGAGED	OVER DRIVE CLUTCH	COAST CLUTCH	OVER DRIVE SPRAG	INTER-MEDIATE CLUTCH	INTER-MEDIATE SPRAG	DIRECT CLUTCH	INTER-MEDIATE OVER-RUN BAND	FOR WARD CLUTCH	REVERSE CLUTCH	LOW ROLLER CLUTCH
R	Reverse										
D	1st gear		*								
	2nd gear		*								
	3rd gear		*								
	4th gear										
1	1st gear										
2	2nd gear										

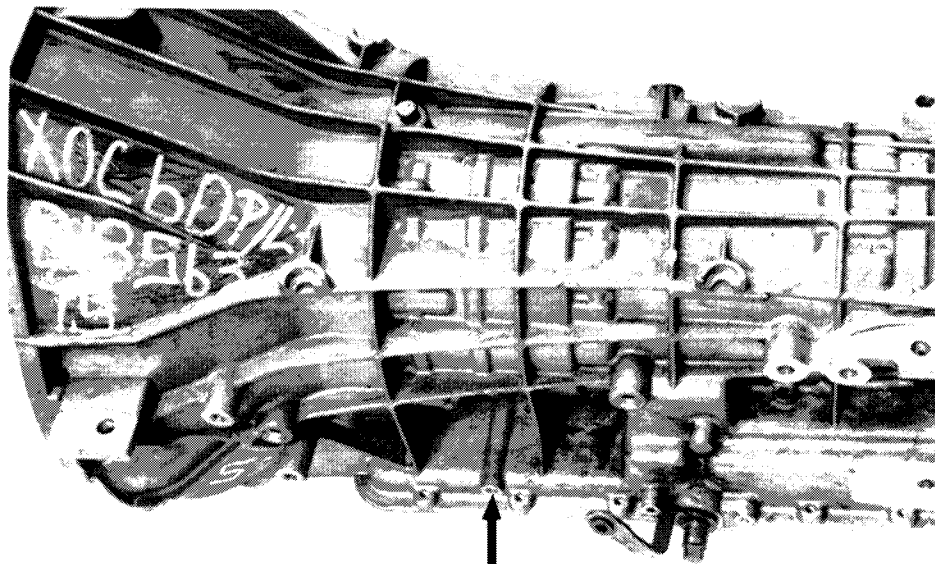
 = APPLIED OR HOLDING
 * APPLIED IN **D** WITH OVERDRIVE CANCEL SWITCH PRESSED

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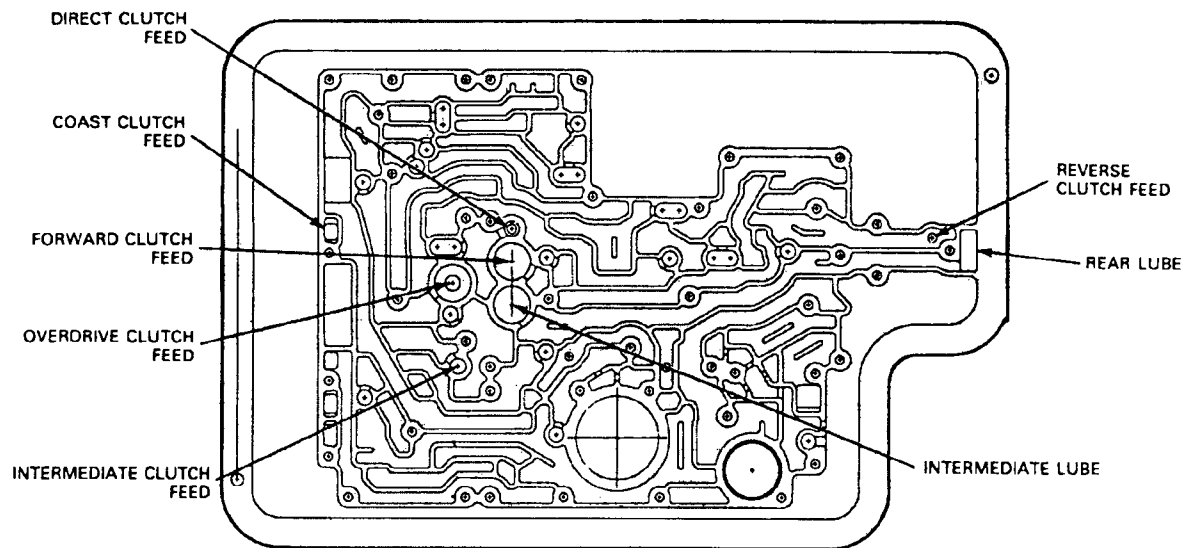
technical seminar

Range	Idle		Stall	
	5.0L			
P, N R D, 2 1	KPA 379-448 510-682 379-448 510-682	PSI 55-65 74-99 55-65 74-99	KPA — 1082-1255 1076-1200 1082-1255	PSI — 157-182 156-174 157-182
	7.3L Diesel			
P, N R D, 2 1	379-448 510-682 379-448 510-682	55-65 74-99 55-65 74-99	— 1110-1282 1076-1200 1110-1282	— 161-186 156-174 161-186
	7.5L			
P, N R D, 2 1	379-448 510-682 379-448 510-682	55-65 74-99 55-65 74-99	— 1082-1255 1076-1200 1082-1255	— 157-182 156-174 157-182

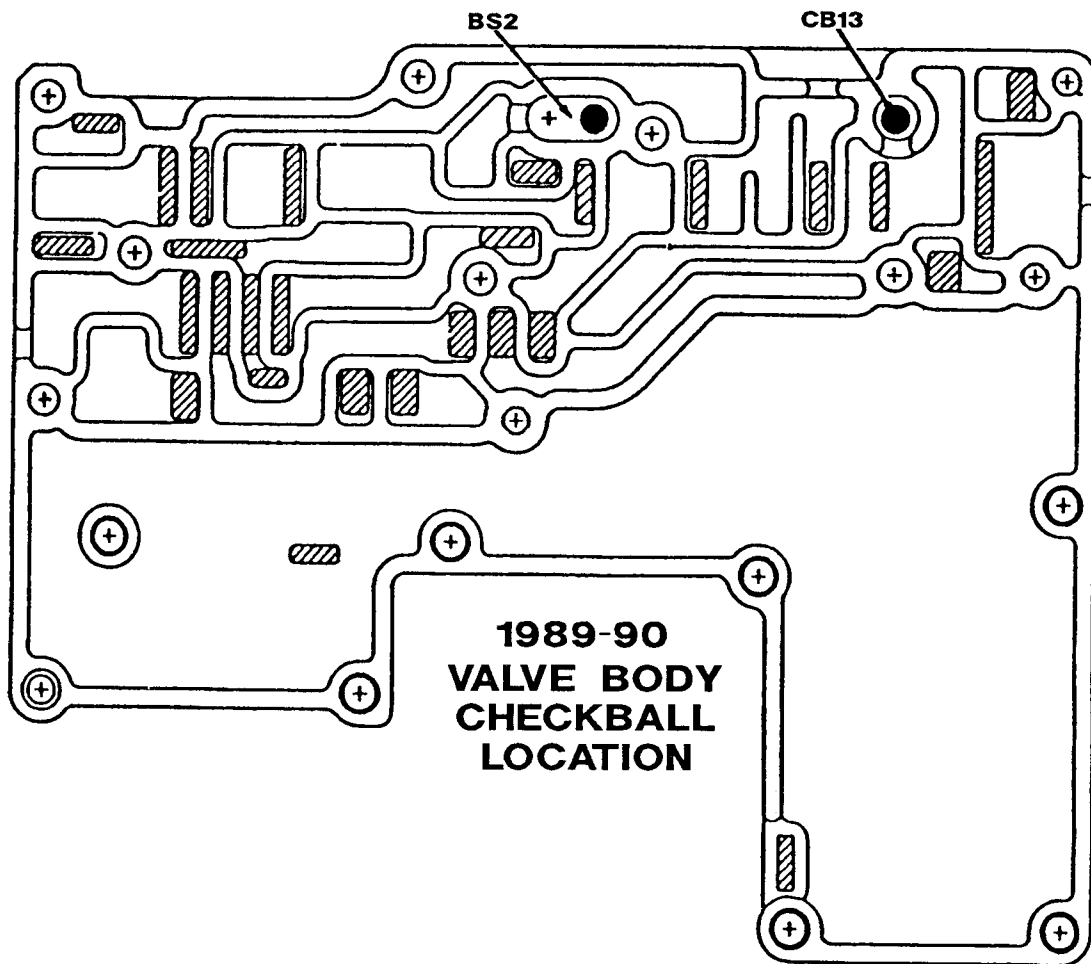


Line Pressure

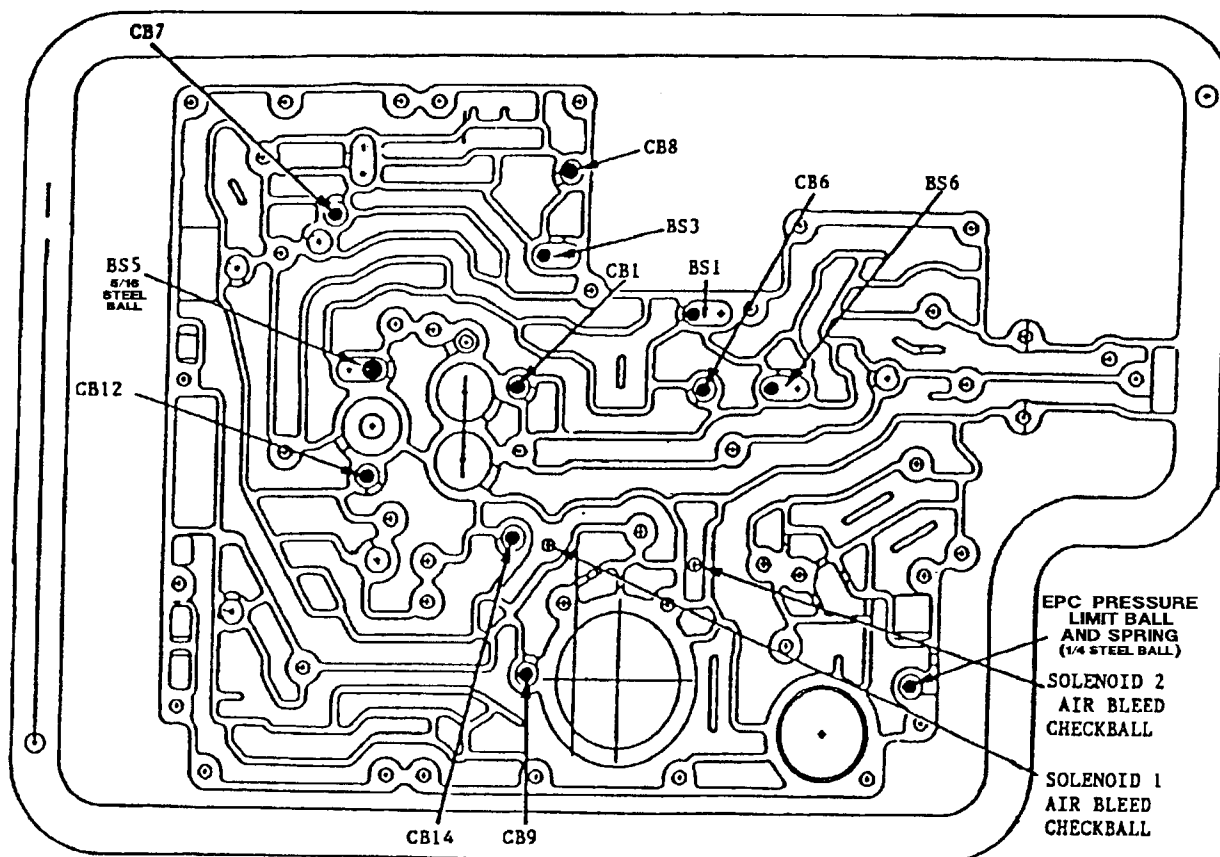
Air Checks



Checkballs

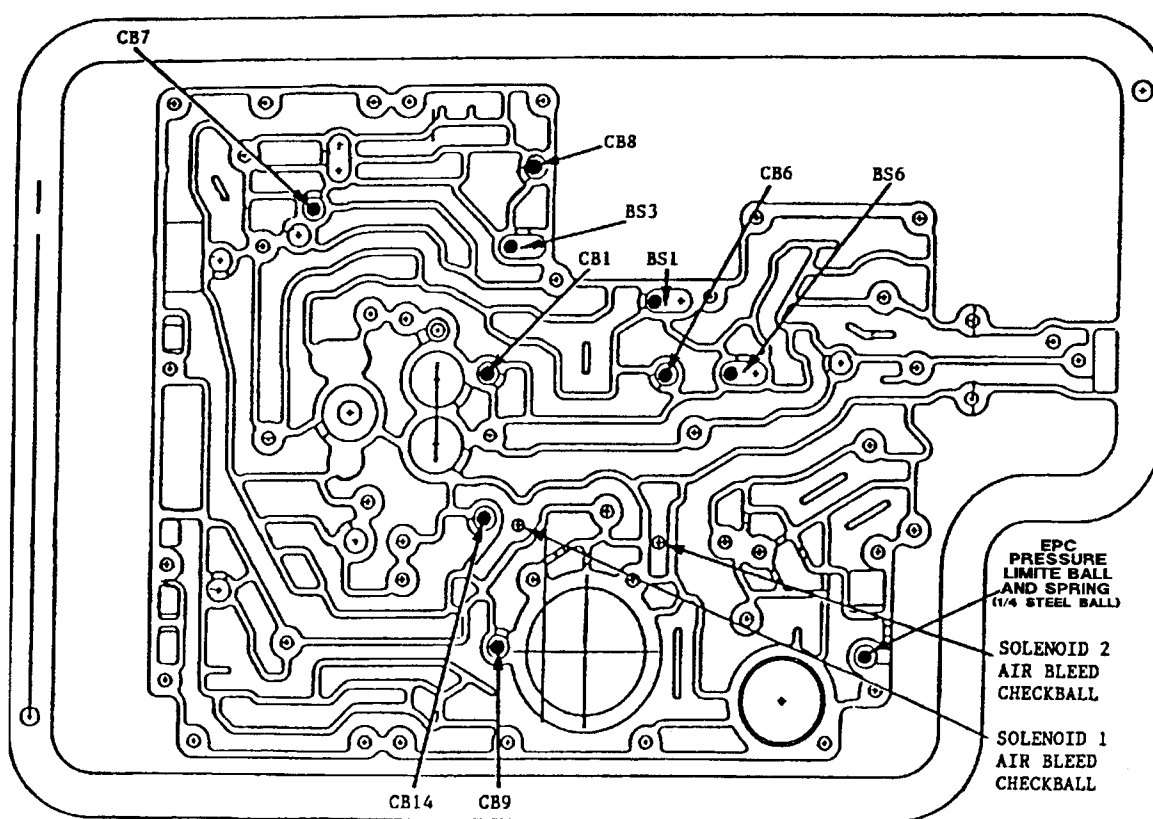


Checkballs



CHECKBALL LOCATION 1989 ONLY

Checkballs



CHECKBALL LOCATION 1990 ONLY

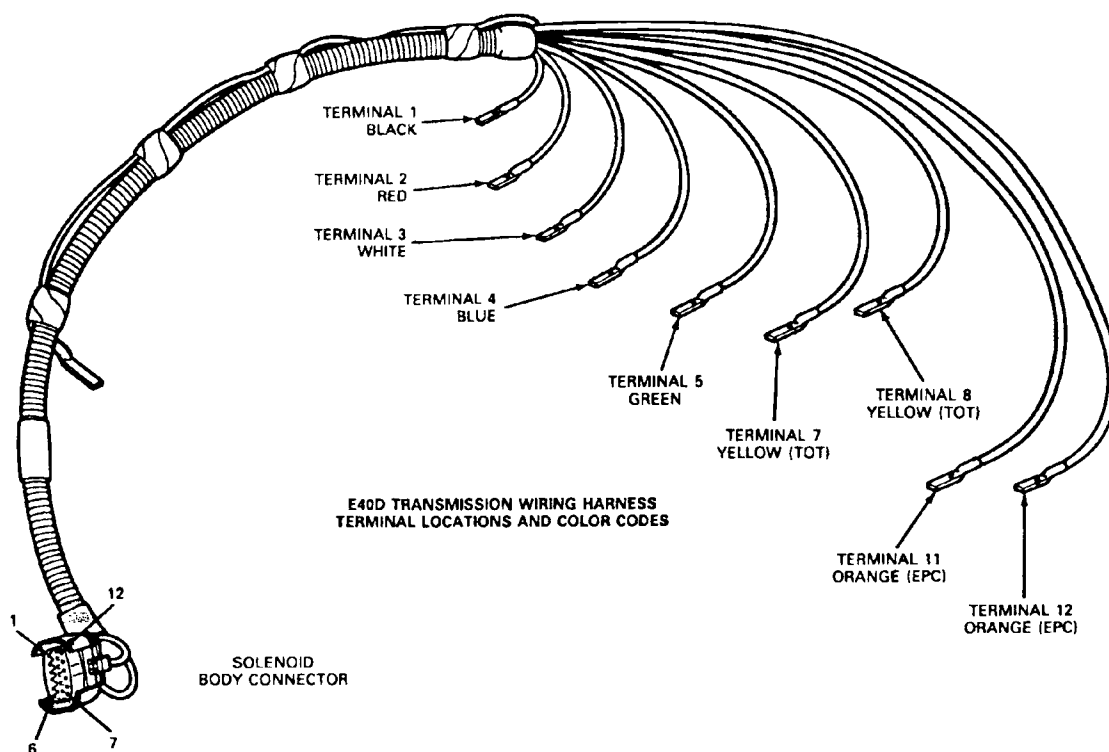
Shifting The E4OD

The E4OD can be shifted without the computer by energizing the #1 and #2 shift solenoids in the right sequence.

Connect a 12 volt lead to pin #1.

Connect a ground lead to the pin (s) in the chart below to shift the TRANSMISSION.

	Pin #3	Pin #2
1st Gear	Ground	-
2nd Gear	Ground	Ground
3rd Gear	-	Ground
4th Gear	-	-



Use the chart below to test the internal electrical components.

- Pin#**
1. + 12 volt common lead (no test for this lead).
 2. #2 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 2, it should be 20 - 30 ohms.
 3. #1 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 3, it should be 20 - 30 ohms.
 4. #3 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 4, it should be 20 - 30 ohms.
 5. #4 Solenoid - Use an ohmmeter to check the resistance between pins 1 and 5, it should be 20 - 30 ohms.
 6. Void (pin not used)
 7. TOT - Check the resistance between pins 7 & 8 use the temperature chart below for the resistance.
 8. TOT - Check the resistance between pins 7 & 8 use the temperature chart below for the resistance.
 9. Void (pin not used)
 10. Void (pin not used)
 11. EPC - Use an ohmmeter to check the resistance between pins 11 & 12, it should be 4.0 - 6.5 ohms.
 12. EPC - Use an ohmmeter to check the resistance between pins 11 & 12, it should be 4.0 - 6.5 ohms.

TRANSMISSION FLUID TEMPERATURE

Degrees C	(Degrees F)	Resistance (Ohms)
0 - 20	(32 - 58)	37K - 100K
21 - 40	(59 - 104)	16K - 37K
41 - 70	(105 - 158)	5K - 16K
71 - 90	(159 - 194)	2.7K - 5K
91 - 110	(195 - 230)	1.5K - 2.7K
111 - 130	(231 - 266)	0.8K - 1.5K

Valve Body Change

Ford made a valve body change in 1990 for the E4OD. There was also a change to the separator plate and valve body gaskets. Using the wrong year valve body gaskets will result in a no second gear condition. The easiest way to identify 1989 & 1990 valve body gaskets is to use the template on this page. The 1989 gaskets are E9TZ-7D100-B and E9TZ-7C155-B. For 1990 the part numbers changed to F0TZ-7D100-A & F0TZ-7C155-A.

1990 E4OD Valve Body Gasket Template

- Lay your gaskets on this template.
- Look in the lower right corner.
- Either 89 or 90 will be visible through a hole.
- This will I.D. which gasket you have.

89

90

Delay Engagement Forward and Reverse

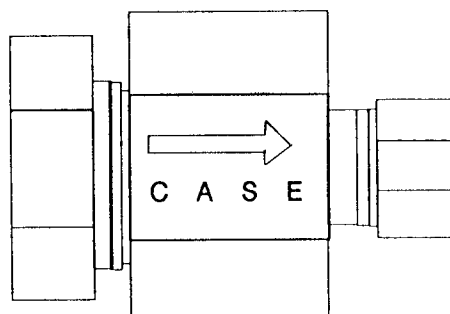
A delayed engagement in forward and reverse may be caused by torque converter drainback through the cooler return line. The 1990 Ford E4OD transmission has a check valve installed in the return line case fitting to prevent this condition. To correct this problem on 1989 models, Ford has developed a special drainback check valve. See picture below.

NOTE

This valve can be used on other transmissions using 5/16" cooler line.

CAUTION

Check valve must be installed in cooler return line with arrow pointing towards the transmission. Failure to install the check valve in the proper direction will cause severe transmission damage.



The part number is F0TZ-7D174-A

Will Not Hold In Park

On vehicles built prior to Oct. 27, 1989 the cause may be a broken snap ring on the output shaft, allowing the parking gear to move rearward. Ford has a Safety Recall (Number 90S10) on this problem.

There is a new service package available, part number F0TZ-7A040-A, that includes a new design extension housing with a "boss" cast into it to prevent the parking gear from moving rearward in case the snap ring breaks. The service package also includes a new "High Strength" snap ring and a snap ring installation aid.

The output shaft has also been re-designed. The splines have been removed from behind the parking gear snap ring groove, which creates an increased shoulder for the snap ring to help prevent the snap ring from breaking.

E4OD Extension Housing Service Package

F0TZ-7A040-A

Includes the following:

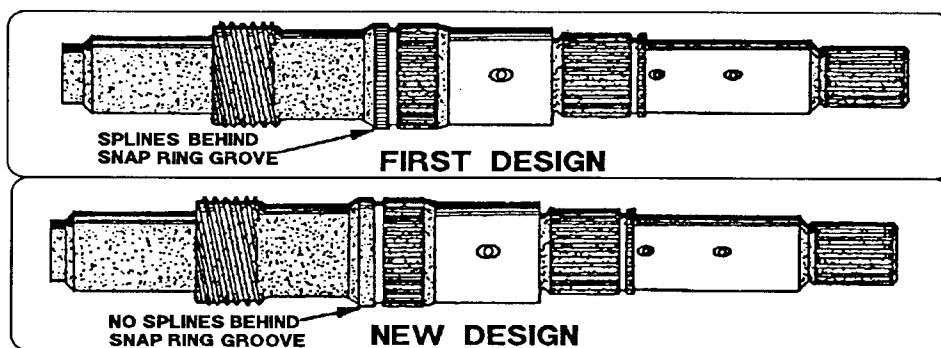
1. 2nd design extension housing with added boss.
2. New design "High Strength" snap ring.
3. Snap ring installation aid.

1989 Output Shaft, 2WD, 7T Speedo
1989 Output Shaft, 2WD, 8T Speedo
1989 Output Shaft, 4WD
1990 Output Shaft, 2WD, 7T Speedo
1990 Output Shaft, 2WD, 8T Speedo
1990 Output Shaft, 4WD

E9TZ-7060-A
E9TZ-7060-C
E9TZ-7060-B
F0TZ-7060-E
F0TZ-7060-F
F0TZ-7060-G

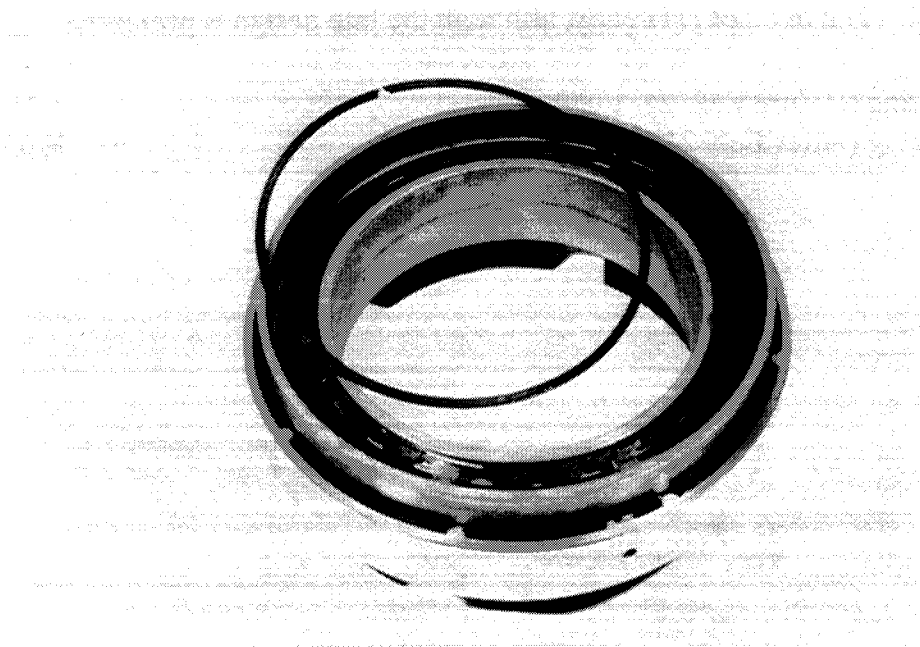
NOTE

You can identify the updated units by the output shaft.



Harsh 3-4 Shift

A harsh 3-4 shift may be caused by the O/D return spring retaining ring dislodging from its groove. Replace the ring with part number F0TZ-7A527-A.



Bearing & Race Change

The low roller clutch inner race and bearing was changed for improved durability.

The low roller clutch inner race height has been reduced by .030" to accommodate a revised hub to race bearing. The previous (before Feb. 24, 1989) inner race height was 1.043". The new design (after Feb. 24, 1989) inner race height is 1.013". (See Figure)

The original hub to race bearing was a 2 piece (open face) design. The new bearing is a 3 piece closed design. The thickness of the original 2 piece bearing is .110" and the new design 3 piece bearing is .140" thick, making it compatible with the new design inner race.

The early and late races and bearings are interchangeable as long as the race and bearing are either BOTH late or BOTH early, although the late design is preferred.

2 Piece Bearing (Before Feb. 24, 1989)

E7TZ-7D422-A

3 Piece Bearing (After Feb. 24, 1989)

E6DZ-7G178-A



A noise from the engine compartment that sounds like the transmission is downshifting or sounds like a momentary increase in engine RPM may be coming from the engine cooling fan clutch. The noise is produced when the engine cooling fan clutch engages.

Install a new design modulating fan clutch that gradually engages to reduce fan clutch noise. Use the fan clutch application chart to determine the correct service part.

Fan Clutch Application Chart

Model Year	Vehicle	Eng.	A/C	Service Part
1988-89	F-Series	5.8l	Yes	E9TZ-8A616-C
1988-89	F-Series	7.5L	Yes	E9TZ-8A616-E
1988-89	F-Series	7.5L	No	E9TZ-8A616-D
1988-89	Econoline	5.8L	Yes	E9UZ-8A616-A
1988-89	Econoline	7.5L	Yes	E9UZ-8A616-B
1988-89	Econoline	7.5L	No	E9UZ-8A616-B

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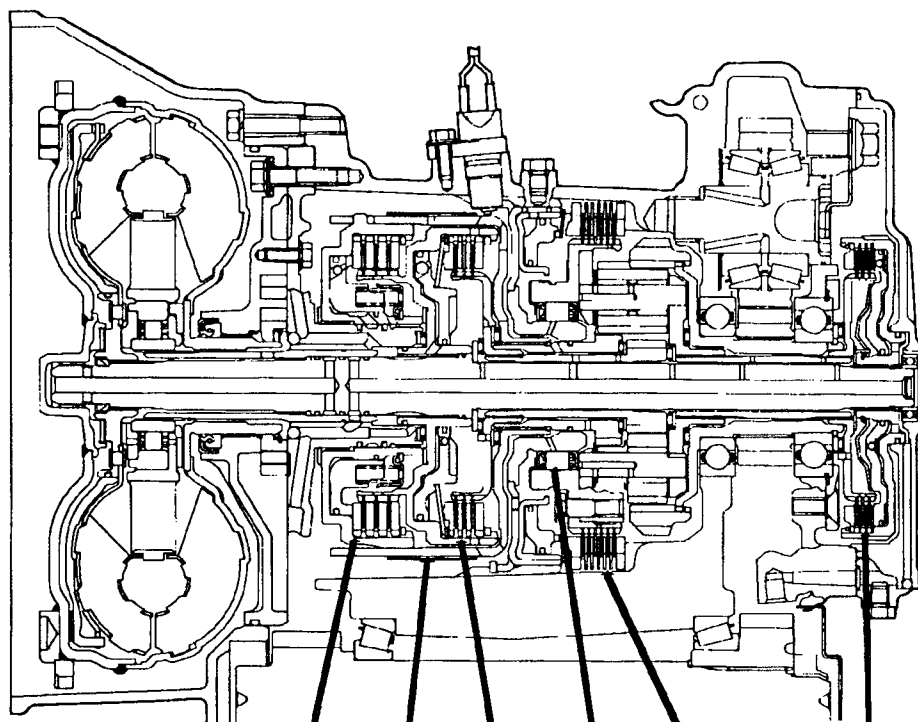
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KM175

KM175 COMPONENT APPLICATION



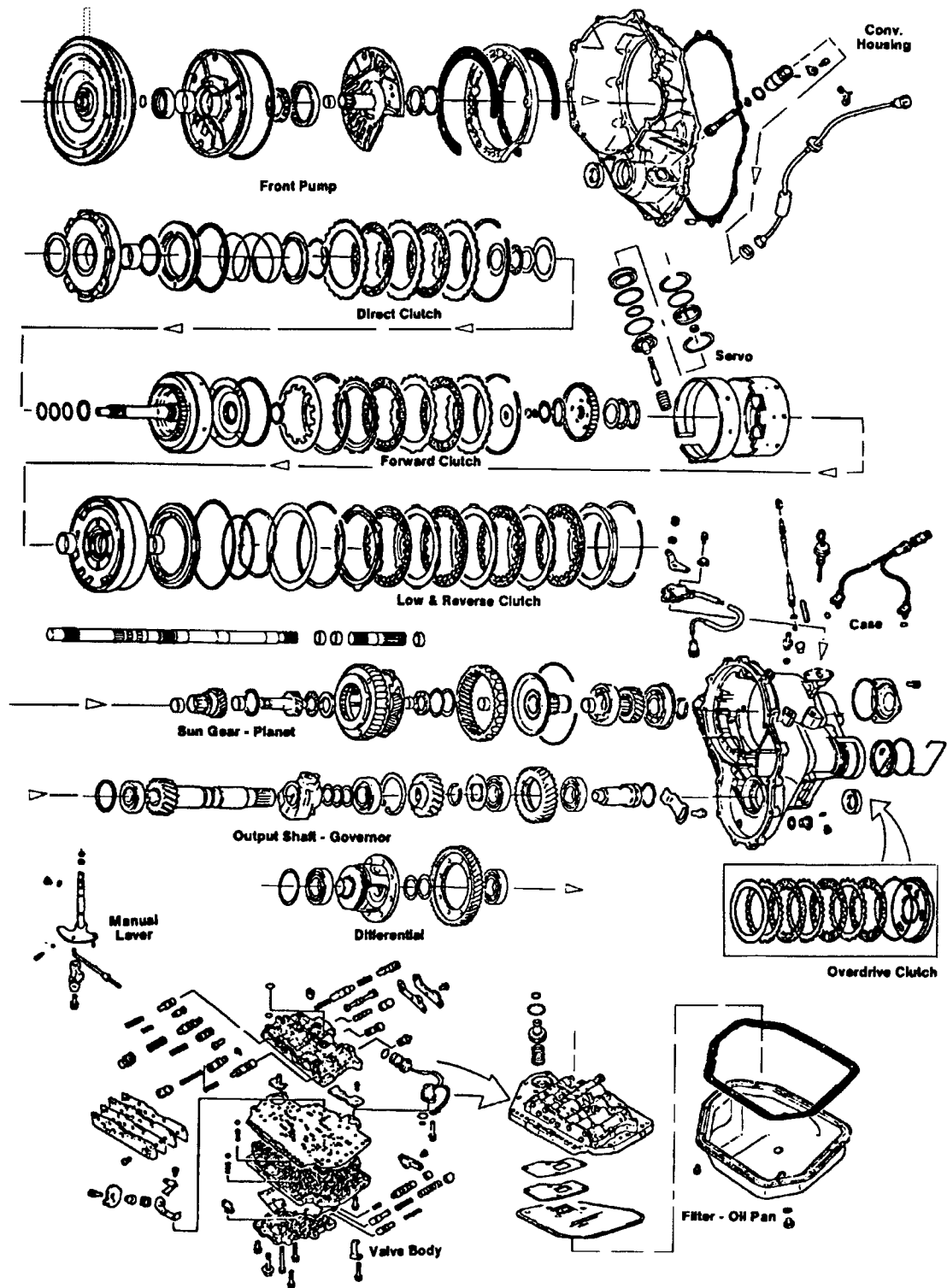
GEAR RATIOS

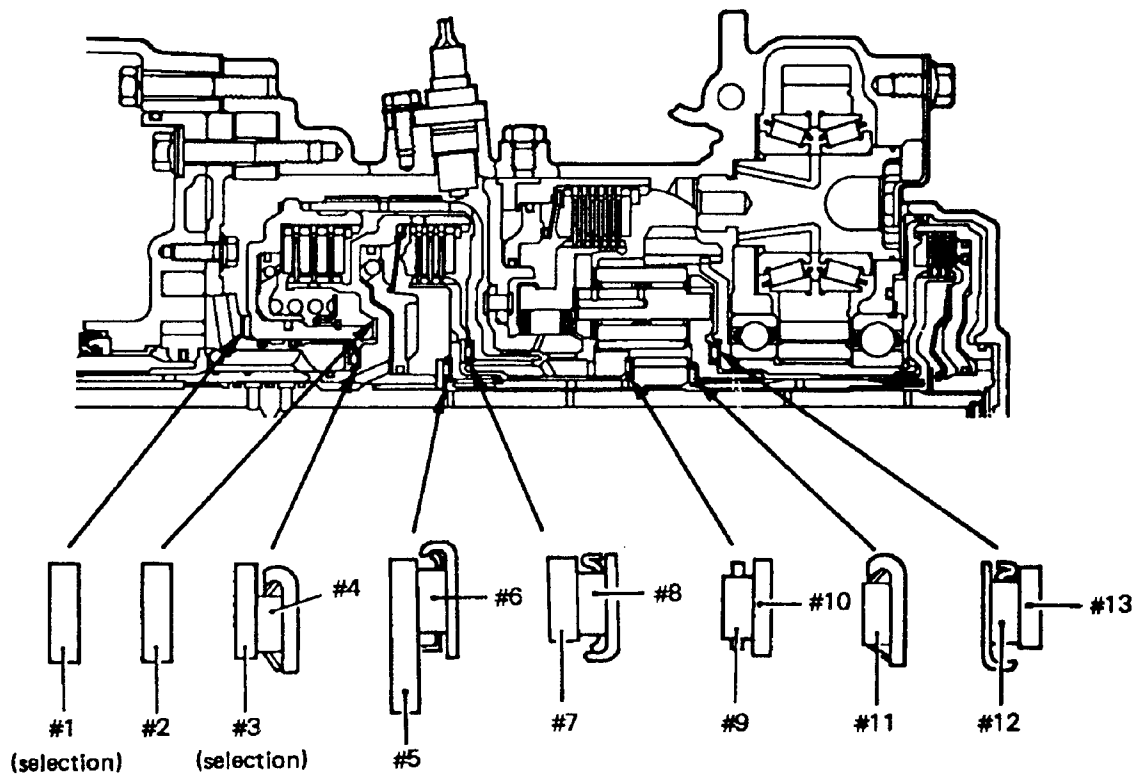
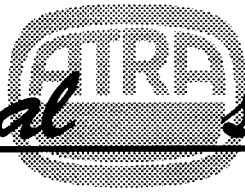
1st gear	2.846:1
2nd gear	1.581:1
3rd gear	1.000:1
4th gear	0.685:1
Reverse	2.176:1

Selector Position	GEAR ENGAGED	DIRECT CLUTCH	INTER-MEDIATE BAND	FOR WARD CLUTCH	LOW SPRAG	LOW REVERSE CLUTCH	END CLUTCH
R	Reverse						
D	1st gear						
	2nd gear						
	3rd gear						
	4th gear						
2	1st gear						
	2nd gear						
	3rd gear						
L	1st gear						
	2nd gear						

 = APPLIED OR HOLDING

technical seminar





Line Pressure Test 1986

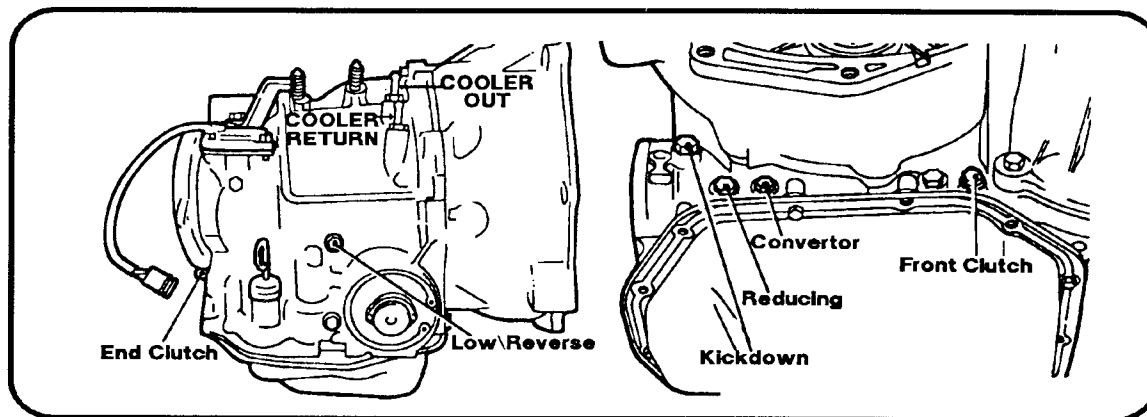
Conditions				NORMAL OIL PRESSURE IN PSI					
Select lever position	(Reference) vehicle speed MPH	Engine speed rpm	Shift position	Reducing pressure	Kickdown brake pressure	Front clutch pressure	End clutch pressure	Low-reverse brake pressure	Torque-converter pressure
N	0	Idling	Neutral	36-56	*	*	*	*	*
N	0	Approx. 2500	Neutral	*	*	*	*	*	29-34
D	0	Idling	2nd gear	36-56	15-30	*	*	*	*
D (SW-ON)	F* 68	Approx. 2500	4th gear	36-56	89-97	*	89-97	*	*
D (SW-OFF)	F* 46	Approx. 2500	3rd gear	36-56	89-97	89-97	89-97	*	*
2	F* 31	Approx. 2500	2nd gear	36-56	89-97	*	*	*	*
L	0	Approx. 1000	1st gear	36-56	*	*	*	43-60	*
R	F*	Approx. 2500	Reverse	36-56	*	165-251	*	165-251	

* MUST BE 1 PSI OR LESS

F* FRONT WHEELS FREE TO TURN

SW-ON : Switch ON the OD-OFF switch.

SW-OFF : Switch OFF the OD-OFF switch.



Line Pressure Test 1987

Conditions				NORMAL OIL PRESSURE IN PSI					
Select lever position	(Reference) vehicle speed MPH	Engine speed rpm	Shift position	Reducing pressure	Kickdown brake pressure	Front clutch pressure	End clutch pressure	Low-reverse brake pressure	Torque-converter pressure
N	0	Idling	Neutral	48-72	*	*	*	*	*
N	0	Approx. 2500	Neutral		*	*	*	*	50-64
D	0	Idling	2nd gear	48-72	15-30	*	*	*	*
D (SW-ON)	F* 68	Approx. 2500	4th gear	48-72	118-128	*	118-128	*	*
D (SW-OFF)	F* 46	Approx. 2500	3rd gear	48-72	118-128	118-128	118-128	*	*
2	F* 31	Approx. 2500	2nd gear	48-72	118-128	*	*	*	*
L	0	Approx. 1000	1st gear	48-72	*	*	*	43-60	*
R	F*	Approx. 2500	Reverse	48-72	*	234-319	*	234-319	*
	0	Approx. 1000				214 OR MORE		214 OR MORE	

* MUST BE 1 PSI OR LESS

F* FRONT WHEELS FREE TO TURN

SW-ON : Switch ON the OD-OFF switch.

SW-OFF : Switch OFF the OD-OFF switch.

Line Pressure Test 1989

Conditions				NORMAL OIL PRESSURE IN PSI					
Select lever position	(Reference) vehicle speed MPH	Engine speed rpm	Shift position	Reducing pressure	Kickdown brake pressure	Front clutch pressure	End clutch pressure	Low-reverse brake pressure	Torque-converter pressure
N	0	Idling	Neutral	52-69	*	*	*	*	NO VALUE
D	0	Idling	2nd gear	52-69	15-30	*	*	*	NO VALUE
D (SW-ON)	F* 68	Approx. 2500	4th gear	52-69	118-128	*	118-128	*	56-84
D (SW-OFF)	F* 46	Approx. 2500	3rd gear	52-69	118-128	118-128	118-128	*	56-84
2	F* 31	Approx. 2500	2nd gear	52-69	118-128	*	*	*	56-84
L	0	Approx. 1000	1st gear	52-69	*	*	*	43-60	NO VALUE
R	F*	Approx. 2500	Reverse	52-69	*	233-318	*	233-318	56-84
	0	Approx. 1000				214 OR MORE		214 OR MORE	

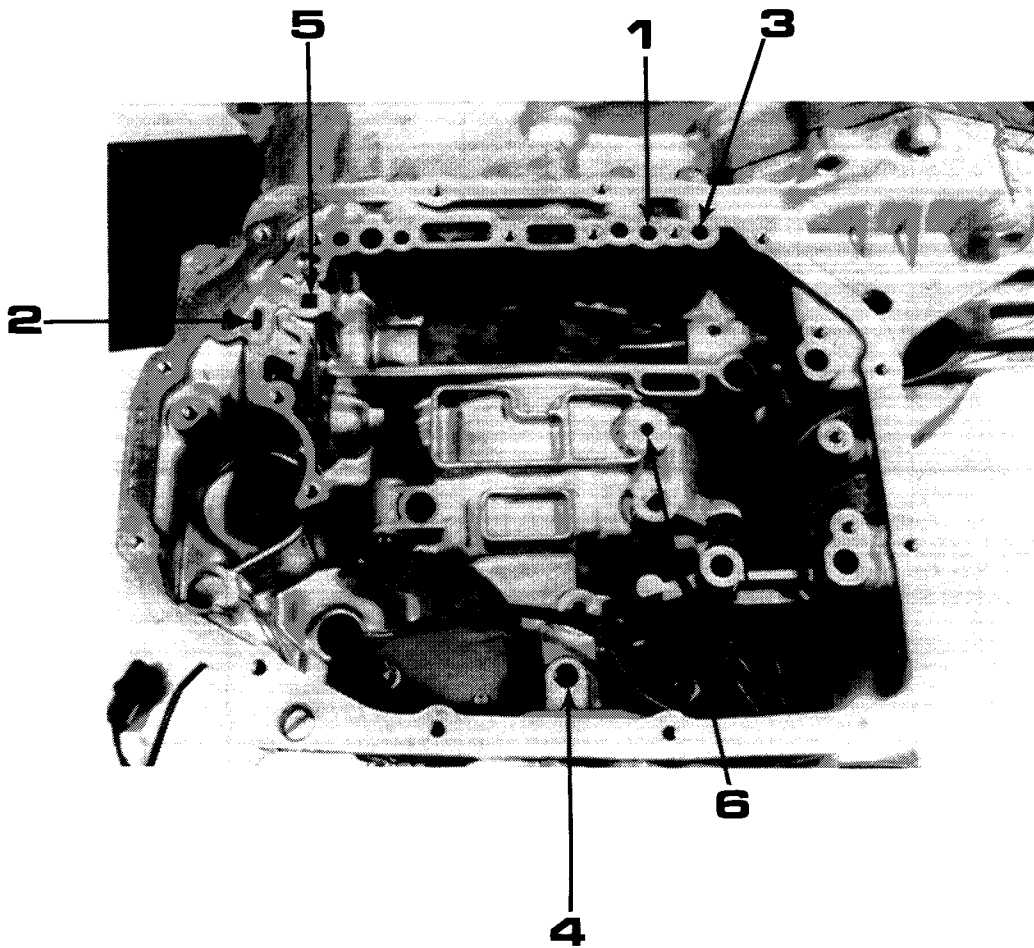
* MUST BE 1 1/2 PSI OR LESS

F* FRONT WHEELS FREE TO TURN

SW-ON : Switch ON the OD-OFF switch.

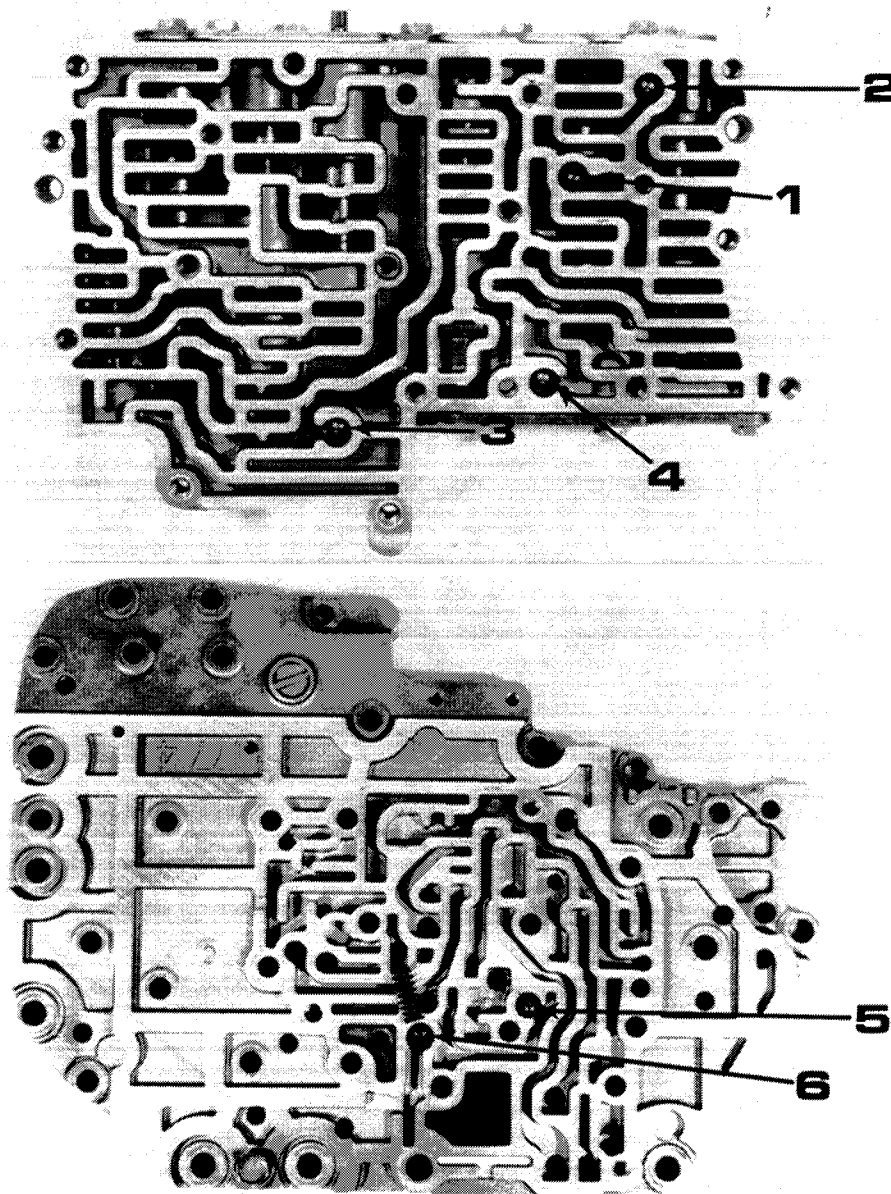
SW-OFF : Switch OFF the OD-OFF switch.

Air Checks



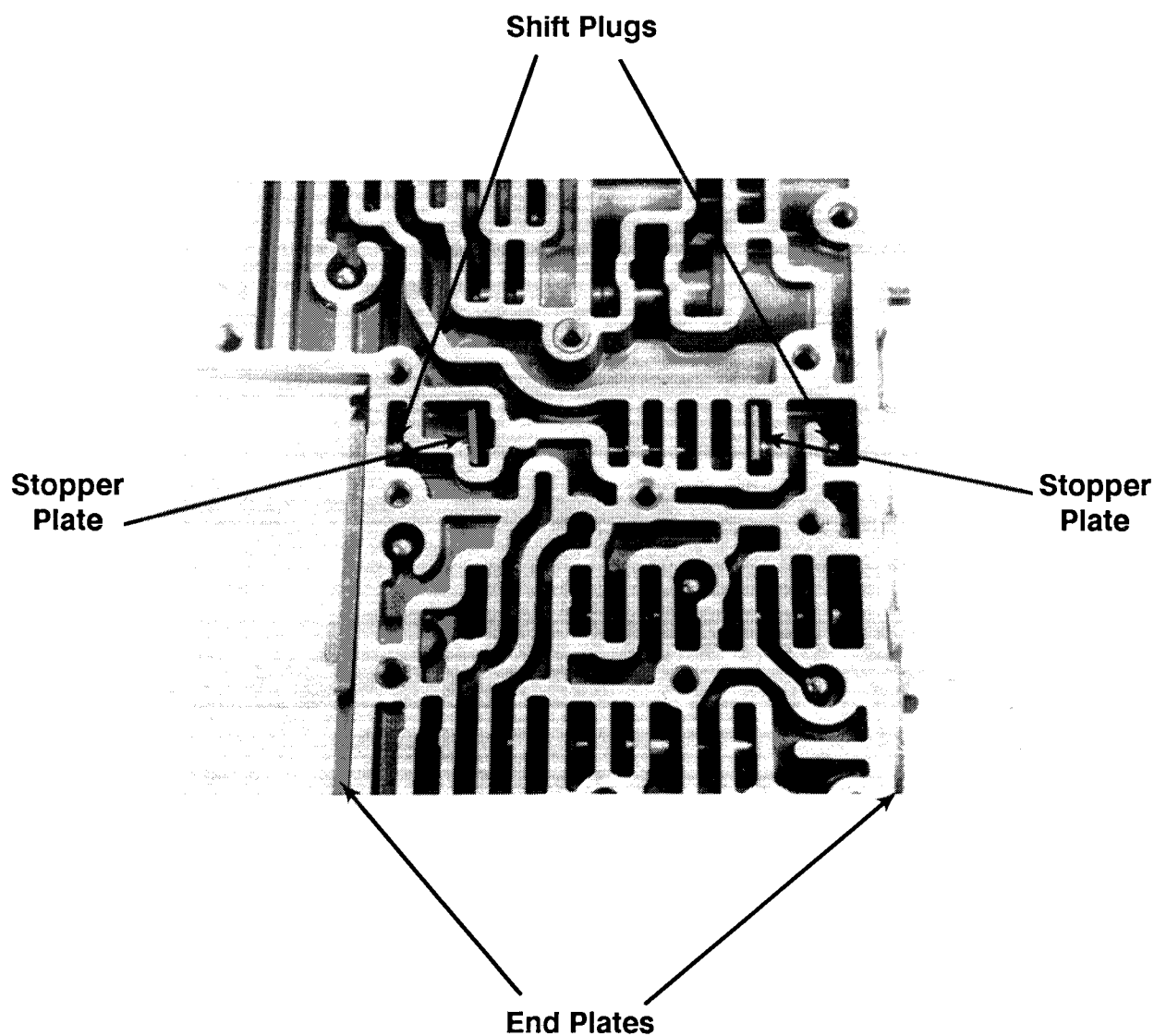
- #1.Rear (Forward) Clutch
- #2.Band Apply
- #3.Front (Direct) Clutch
- #4.End (3-4) Clutch
- #5.Servo Release
- #6.Low/Reverse Clutch

Checkballs



- #1.Rear (Forward) Clutch Exhaust Orifice
- #2.Front (Direct) Clutch Orifice - In Reverse
- #3.Rear (Forward) Clutch Feed Orifice
- #4.N-R Control Valve Bypass Check Valve
- #5.End (3-4) Clutch Valve Bypass Check Valve
- #6.Mainline Pressure Relief

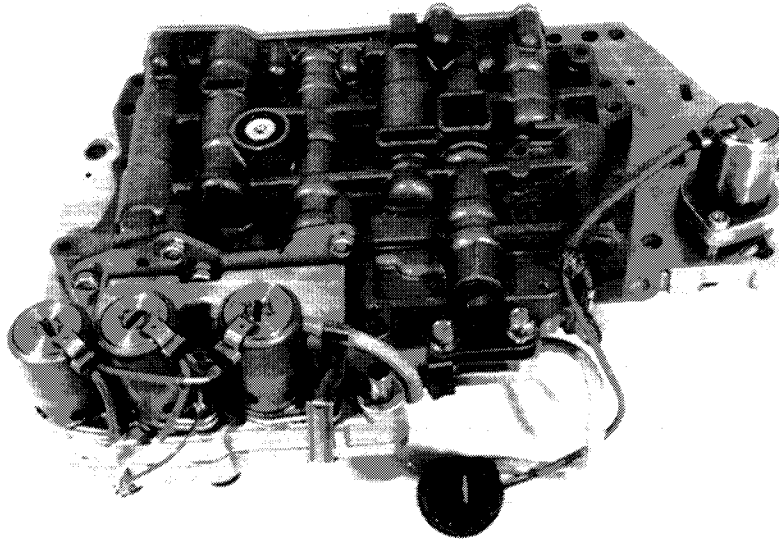
Stopper Plate & Plug Location



NOTE

Installing the stopper plates and/or plugs in the wrong locations can cause no gear change complaints or wrong gear starts. Make sure the shift plugs can touch the end plates.

Valve Body And Solenoid Assembly



NOTE

From left to right

- 1.Shift Solenoid B
- 2.Shift Solenoid A
- 3.Damper Clutch Solenoid
- 4.Line Pressure Control Solenoid

How To Identify The KM Transaxle

KM171 3 Speed Damper Clutch

- Has A Tin Servo Cover
- Has A Band Adjustment
- Has Ball Bearings On The Final Drive

KM172 3 Speed Damper Clutch

- Has An Aluminum Servo Cover
- Has No Band Adjustment
- Has Tapered Final Drive Rear Bearings

KM175 4 Speed Damper Clutch

All transmissions built prior to 1990, the end clutch housing is bolted to the main case. In 1990, the end clutch housing was cast as part of the case and renamed a 175.5.

In 1990 the identification plate on the rear of the fire wall was changed from K to the letter F.

F = Front Wheel

4 = 4 Speed

A = Automatic

21 = Transaxle Identification

F4A-21 = KM176.5

F4A-22 = KM175.5

F4A-23 = KM177

KM176.5 is a light duty version of a KM175.5.

KM177 is a non-damper clutch unit containing only 3 solenoids on the valve body.

- Pressure Control Solenoid
- A Shift Solenoid
- B Shift Solenoid

Computer Shifted KM 175 Series Transaxle

The KM 175 series is a 4 speed automatic front wheel drive transaxle with a damper clutch. The computer receives information from 10 sensors and gives output voltage to four solenoids which are the actuators of the system. The 10 sensors are:

1.	T.P.S.	=	Throttle Position Sensor
2.	Pulse Generator A	=	Kickdown Drum RPM
3.	Pulse Generator B	=	Transfer Driven Gear RPM
4.	Ignition Coil	=	Engine RPM
5.	Inhibitor Switch	=	Selector Lever Position
6.	Water Temperature Sensor	=	Engine Coolant Temp
7.	Accelerator Switch	=	Accelerator On/Off
8.	O.D. Off/On Switch	=	O.D. Selection
9.	Kickdown Servo Switch	=	Kickdown Piston Position
10.	Vehicle Speed Sensor	=	Vehicle Speed

The four solenoids are:

1. Shift Solenoid A
2. Shift Solenoid B
3. Damper Clutch Control Solenoid
4. Line Pressure Control Solenoid

Damper Clutch Operation

This torque converter is not a typical lock up torque converter. This converter never locks up completely and always has between 1 and 10 percent slippage depending on load application to reduce the transfer of engine vibration to the transaxle. The computer keeps the damper clutch solenoid in a duty cycle (Pulse) mode. This enables the computer to keep the oil pressure on both sides of the clutch plate controlled.

Only 5 sensors give output to the computer for damper clutch operation. They are:

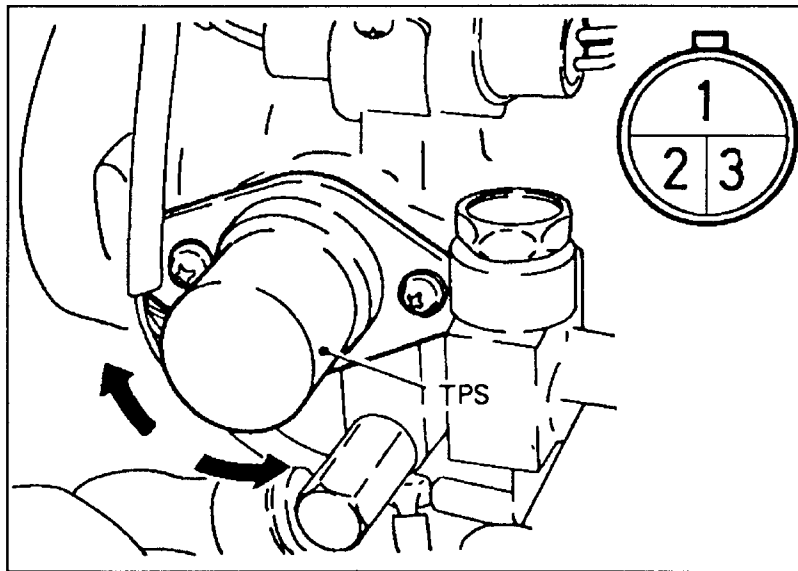
1. Ignition Coil - Engine RPM
2. Pulse Generator A
3. Pulse Generator B
4. Throttle Position Sensor
5. Water Temp Sensor

Throttle Position Sensor

The throttle valve and kickdown valve have been replaced by the TPS. The TPS keeps the computer informed as to what position the throttle plate is in and how quickly it is changing. This sensor is nothing more than a potentiometer.

A faulty throttle position switch can cause poor transmission and engine performance, early or late shift points.

The TPS can be adjusted to change the shift points. Turning the TPS clock wise will raise the shift points, turning it counter clockwise will lower them.



NOTE

Never adjust the TPS with the engine running.

Pulse Generator A

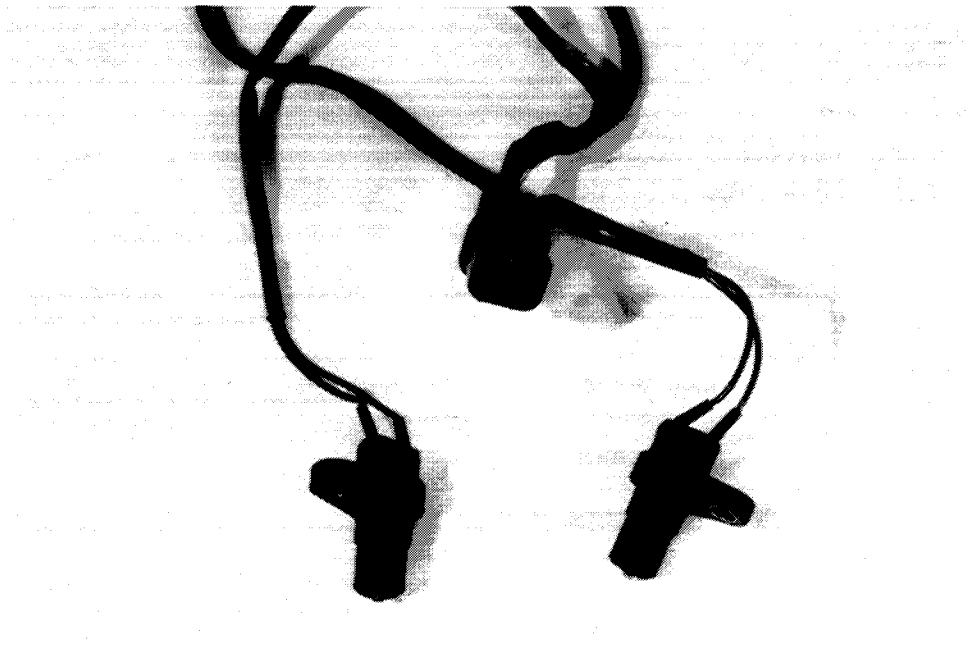
This generator counts the holes in the kickdown drum and generates AC voltage (milli-volts). The voltage varies depending on the kickdown drum RPM. This generator produces voltage in 1st & 3rd gears only when the kickdown band is not applied. The computer receives this voltage and converts it to an RPM reading.

Pulse Generator B

This generator also produces variable AC voltage (milli-volts) anytime the vehicle is in motion. The computer receives the output from this generator and converts it into vehicle speed. The computer cross-references this information with the speed sensor in the dashboard.

NOTE

If these generators are swapped in position, the computer will go into fail safe (3rd gear starts). Pulse generator A goes behind the bell-housing and has shorter wires than the B generator.



Inhibitor Switch

This switch allows for engine starting in the park and neutral ranges only. In addition to the safety start feature it completes the circuit for the backup lights in the reverse range and detects the selector lever position for the TCU.

NOTE

A faulty switch can cause a no upshift condition or up shift to 2nd only, no start in park or neutral, no reverse back up lights.

This switch is located on the transmission case on the manual selector shaft.

Water Temperature Sensor

The water temperature sensor senses the temperature of cooling water. The sensor is turned off at water temperature below 50 degrees C. This sensor is made integral with the water temperature gauge.

Resistance between A and Ground

16.2 k at -20 degrees C

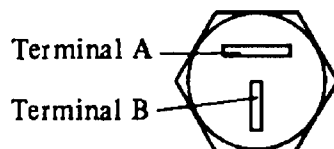
2.45 k at 20 degrees C

296 at 80 degrees C

Between B and Ground

Continuity above 50 degrees C 122 degrees F

Open Circuit below 50 degrees C 122 degrees F



Accelerator Switch

The accelerator switch is nothing more than an on/off, switch that is connected to the gas pedal linkage inside the vehicle. This switch prevents 1st gear engagement and engages 2nd gear to reduce vehicle creep when the vehicle is stopped and in the Drive & 2nd range. This switch also eliminates damper clutch engagement during deceleration.

To Test The Switch

STEP 1

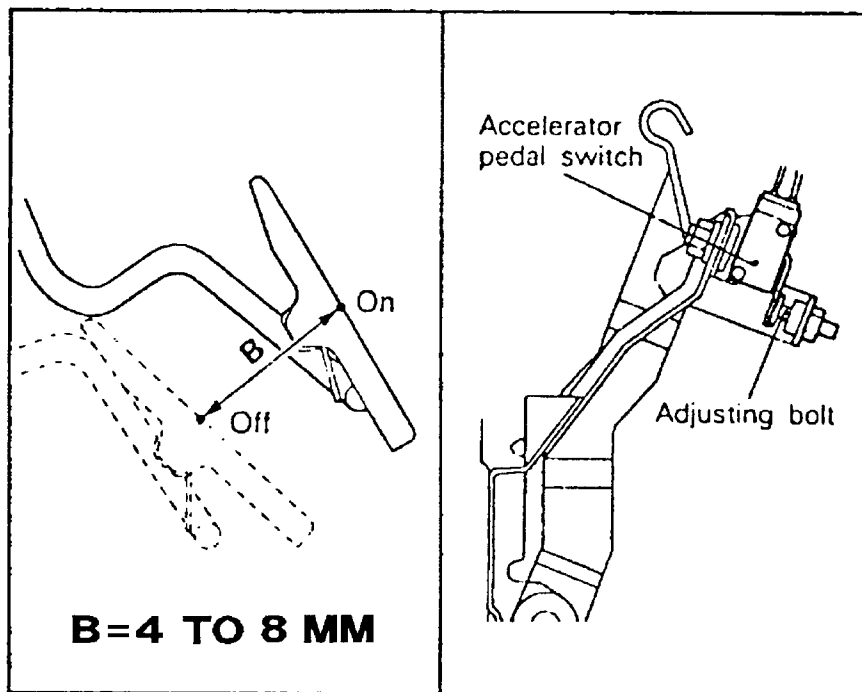
To check the function of this switch there should be continuity through the switch when the gas pedal is released, if not adjust it.

STEP 2

There should be no continuity at approximately 5% movement of the pedal, if there is, adjust it. If adjustment is not possible, replace it.

NOTE

If this switch is stuck in the closed position, you will have poor acceleration, no damper clutch operation, and transmission overheating with 2nd gear starts.

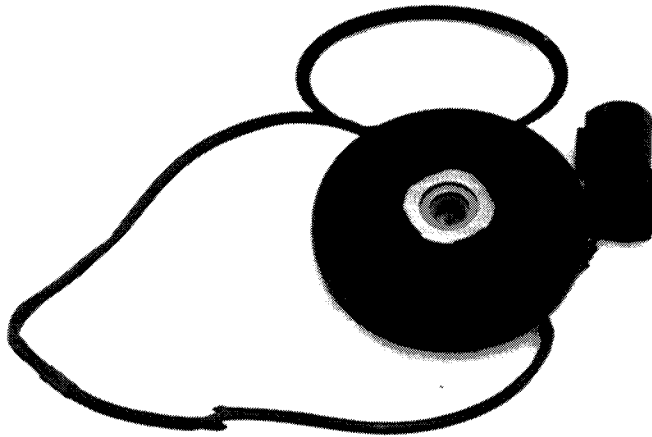


Kickdown Servo Switch

The kickdown servo switch is used to let the computer know if the servo is on or off. During the 1-2 shift, the computer will lower line pressure when it sees the servo leave the cover.

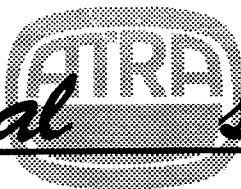
This is to give the transmission a smooth shift feel. Once the shift has finished, the computer raises line pressure back to normal.

This switch is nothing more than an on/off switch and is non-adjustable.



NOTE

A faulty kickdown switch can cause erratic shifting complaints.



Testing The Kickdown Switch

STEP 1

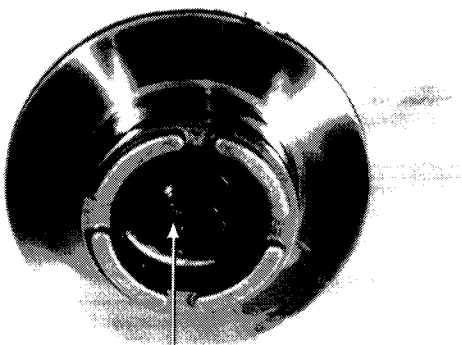
With the engine off, there should be continuity between the switch single terminal connector and the transmission case. If not, replace the switch.

STEP 2

With the engine running, the selector lever in the Drive position and the emergency brake applied, there should be no continuity between the single terminal connector and the transmission case. If there is, replace the switch.

NOTE

Should, for some reason, the servo piston pin need to be removed from the piston, extreme care should be taken not to lose the special E clip which holds the pin to the servo piston. Replacing this E clip with a clip having an outside diameter that is too large, can interfere with the operation of the kickdown switch.



E Clip

Vehicle Speed Sensor

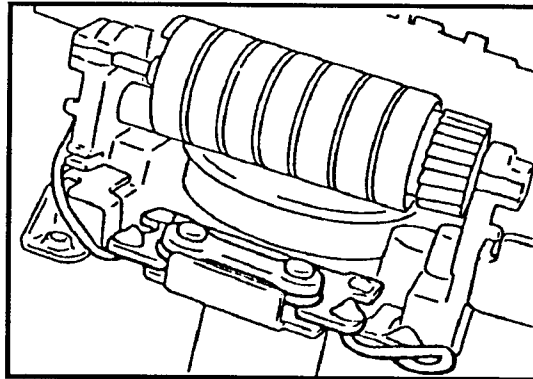
Two types of vehicle speed sensors are used:

- A reed switch type located in the speedometer on vehicles fitted with conventional needle type gauges.
- A pulse generator type located in the transaxle on vehicles fitted with LCD instrumentation.

The vehicle speed sensor provides the computer with a pulse signal proportional to vehicle speed.

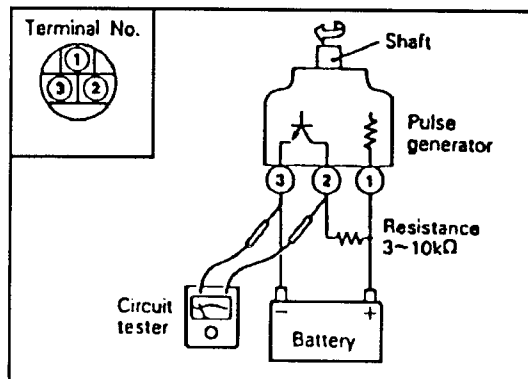
Reed Switch Type

- With the speedometer removed, connect an ohmmeter between the reed switch positive terminal and ground.
- Rotate the speedometer drive.
- Ohmmeter should alternate between an open and closed circuit four times every revolution (i.e. four pulses per revolution).



Pulse Generator Type

- With the pulse generator removed from the transaxle, connect a 3000 - 10000 ohm resistor as shown in diagram.
- With a voltmeter connected as shown, rotate the pulse generator shaft. The voltmeter should pulse four times per shaft revolution.



3rd Gear Starts

When the computer senses a transaxle problem, it puts the transmission into a failsafe mode (3rd gear and reverse only).

Failure codes may be extracted from the computer ELC 4 at connector. With an analog voltmeter set on the 12 volt DC scale.

NOTE

If the ignition switch is turned off, failure codes will be erased from the computers memory. The vehicle must then be re-driven, until the malfunction occurs again. All trouble codes must be extracted with the ignition switch on.

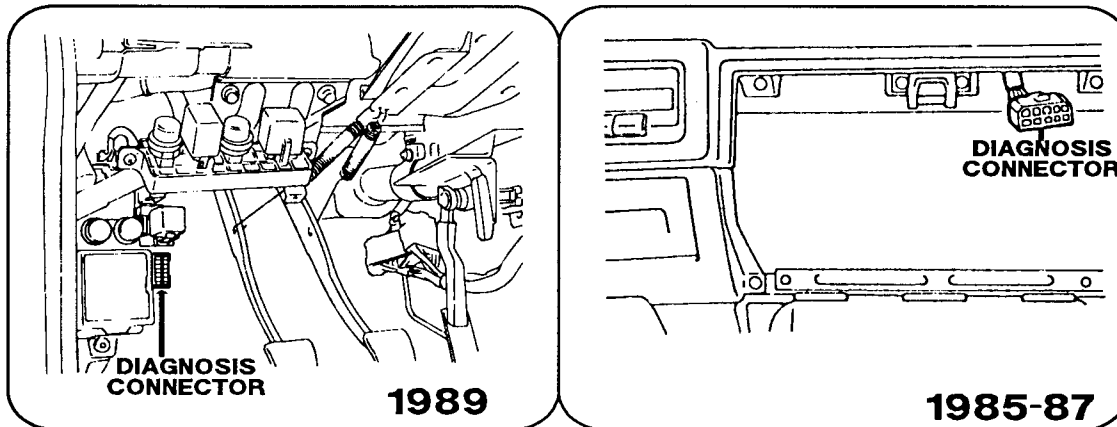
NOTE

If two or more malfunctions occur at the same time, only the one detected first will be indicated. Therefore, it is possible that a different malfunction pattern is displayed after the first malfunction is corrected.

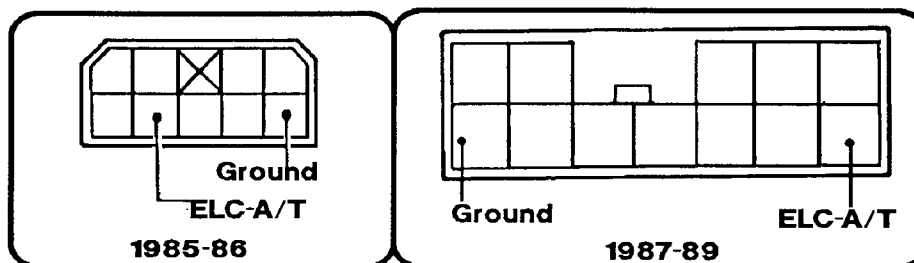
Checking For Trouble Codes

When the voltmeter is connected to the ELC-A/T terminal, the needle will swing from 0 volts to 12 volts. Each code has six pulses starting with a 4 second on pulse and ending with a 2 second off pulse. The timing of these pulses from the TCU (seconds on) (seconds off) determines the trouble code.

CONNECTOR LOCATION



CONNECTOR TYPE



1985 Codes

No.	Failure display code	Diagnosis	Suspected defective point
1 *		When restoration cannot be made by making RESET because micro processor (computer) is defective	• Power voltage low (charging system) • Computer
2 *		When 1st speed signal is detected during operation at high vehicle speed	• Pulse generator B • Computer
3 *		When vehicle speed detected by pulse generator B is considerably lower than actual vehicle speed	• Pulse generator B • Computer
4 *		When shift control solenoid valve A does not operate in response to computer's instruction.	• Shift control solenoid valve A • Computer
5 *		When shift control solenoid valve B does not operate in response to computer's instruction	• Shift control solenoid valve B • Computer
6 *		When kickdown servo switch signal is different from that of selected speed	• Kickdown servo switch • Pressure control solenoid valve • Computer
7		When shift is not completed	• Pulse generator A • Pressure control solenoid valve • Computer
8 *		When pressure control solenoid valve is not driven in response to computer's instruction	• Pressure control solenoid valve • Computer
9 *		When engine speed is diagnosed to be over 6,500 rpm	• Pulse generator B • Ignition coil (ignition signal system) • Computer
10 *		When kickdown drum speed is diagnosed to be over 6,500 rpm	• Pulse generators A and B • Computer
11		When damper clutch control solenoid valve enters directly-coupled state	• Damper clutch control system • Computer
12		No ignition signal	• Ignition coil • Ignition signal system • Computer

* = FAIL SAFE OR HELD IN THIRD GEAR

NOTE: WHEN KEY IS TURNED FROM OFF TO ON CODE 12 INDICATES THE DIAGNOSIS FUNCTION IS NORMAL

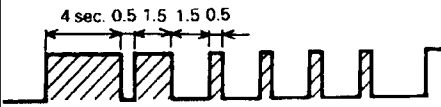
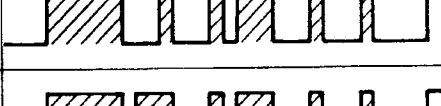
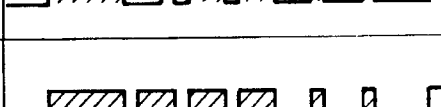
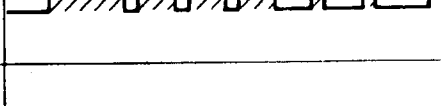
1986 Codes

Number	Malfunction indication code	Diagnosis	Assumed location
1 *		Microprocessor (computer) malfunction; not remedied by resetting.	• Low power-supply voltage (recharging system) • Computer
2 *		First gear signal is detected at high vehicle speed.	• Pulse generator B • Computer
3 *		Vehicle speed detected by pulse generator B is much lower than actual vehicle speed.	• Pulse generator B • Computer
4 *		Operation of shift-control solenoid valve A differs from computer command.	• Shift-control solenoid valve A • Computer
5 *		Operation of shift-control solenoid valve B differs from computer command.	• Shift-control solenoid valve B • Computer
6		Shifting doesn't finish.	• Pulse generator A • Pressure-control solenoid valve • Computer
7 *		Pressure-control solenoid valve drive differs from computer command.	• Pressure-control solenoid valve • Computer
8		Damper clutch control solenoid valve is directly connected.	• Damper clutch control system • Computer
9		No ignition signal.	• Ignition coil • Ignition signal system • Computer

* = FAIL SAFE OR HELD IN THIRD GEAR

NOTE: WHEN KEY IS TURNED FROM OFF TO ON CODE 9 INDICATES THE DIAGNOSIS FUNCTION IS NORMAL

1987 Codes

Number	Malfunction indication code	Diagnosis	Assumed location
1 *		Microprocessor (computer) malfunction; not remedied by resetting.	• Low power-supply voltage (recharging system) • TCU
2 *		First gear signal is detected at high vehicle speed.	• Pulse generator B • Vehicle speed sensor • TCU
3 *		Vehicle speed detected by pulse generator B is much lower than actual vehicle speed.	• Pulse generator B • Vehicle speed sensor • TCU
4		Operation of shift-control solenoid valve A differs from computer command.	• Shift-control solenoid valve A • TCU
5 *		Operation of shift-control solenoid valve B differs from computer command.	• Shift-control solenoid valve B • TCU
6 *		Kickdown servo switch signal differs from gear.	• Kickdown servo switch • Pressure-control solenoid valve • TCU
7 *		Shifting doesn't finish.	• Pulse generator A • Pressure-control solenoid valve • Valve body, clutch, brake, seal, etc. • TCU
8 *		Pressure-control solenoid valve drive differs from computer command.	• Pressure-control solenoid valve • Poorly grounded ground strap • TCU
9		Damper clutch control solenoid valve is directly connected.	• Damper clutch control system • TCU
10		No ignition signal.	• Ignition coil (ignition signal system) • TCU

* = FAIL SAFE OR HELD IN THIRD GEAR

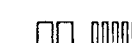
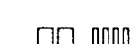
NOTE: WHEN KEY IS TURNED FROM OFF TO ON CODE 10 INDICATES THE DIAGNOSIS FUNCTION IS NORMAL

1989 Codes

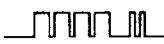
FAIL-SAFE ITEM

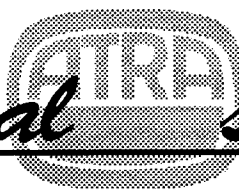
Output code		Description	Fail-safe	Note (relation to fault code)
Code No.	Output pattern (for voltmeter)			
11	5V 0V	Malfunction of the microprocessor	3rd gear hold	When code No.31 is generated 4th time.
12		First gear command during high speed driving	3rd gear (D) or 2nd gear (2, L) hold	When code No.32 is generated 4th time.
13		Damaged or disconnected wiring of the pulse generator B system	3rd gear (D) or 2nd gear (2, L) hold	When code No.33 is generated 4th time.
14		Damaged or disconnected wiring, or short circuit, of shift control solenoid valve A	3rd gear hold	When code No.41 or 42 is generated 4th time.
15		Damaged or disconnected wiring, or short circuit, of shift control solenoid valve B	3rd gear hold	When code No.43 or 44 is generated 4th time.
16		Damaged or disconnected wiring, or short circuit, of the pressure control solenoid valve	3rd gear (D) or 2nd gear (2, L) hold	When code No.45 or 46 is generated 4th time.
17		Shift steps non-synchronous	3rd gear (D) or 2nd gear (2, L) hold	When either code No. 51, 52 53 or 54 is generated 4th time.

1989 Codes (Continued)

Fault code	Fault code (for voltmeter)	Cause	Remedy
21	5V 0V 	Abnormal increase of TPS output	• Check the throttle position sensor connector. • Check the throttle position sensor itself. • Adjust the throttle position sensor. • Check the accelerator switch (No. 28: output or not). • Check the throttle position sensor output circuit harness.
22		Abnormal decrease of TPS output	
23		Incorrect adjustment of the throttle-position sensor system	
24		Damaged or disconnected wiring of the oil temperature sensor system	• Check the oil temperature sensor circuit harness. • Check the oil temperature sensor connector. • Check the oil temperature sensor itself.
25		Damaged or disconnected wiring of the kickdown servo switch system, or improper contact	
26		Short circuit of the kickdown servo switch system	
27		Damaged or disconnected wiring of the ignition pulse pick-up cable system	• Check the ignition pulse signal line.
28		Short circuit of the accelerator switch system or improper adjustment	• Check the accelerator switch output circuit harness. • Check the accelerator switch connector. • Check the accelerator switch itself. • Adjust the accelerator switch.
31		Malfunction of the microprocessor	• Replace the control unit.
32		First gear command during high-speed driving	• Replace the control unit.
33		Damaged or disconnected wiring of the pulse generator B system	• Check the pulse generator B output circuit harness. • Check pulse generator B itself. • Check the vehicle speed reed switch (for chattering).

1989 Codes (Continued)

Fault code	Fault code (for voltmeter)	Cause	Remedy
41		Damaged or disconnected wiring of the shift control solenoid valve A system	• Check the solenoid valve connector. • Check shift control solenoid valve A itself. • Check the shift control solenoid valve A drive circuit harness
42		Short circuit of the shift-control solenoid valve A system	
43		Damaged or disconnected wiring of the shift control solenoid valve B system	• Check the solenoid valve connector. • Check shift control solenoid valve B itself. • Check the shift control solenoid valve B drive circuit harness.
44		Short circuit of the shift control solenoid valve B system	
45		Damaged or disconnected wiring of the pressure control solenoid valve system	• Check the solenoid valve connector. • Check the pressure control solenoid valve itself. • Check the pressure control solenoid valve drive circuit harness.
46		Short circuit of the pressure control solenoid valve system	
47		Damaged or disconnected wiring of the damper clutch control solenoid valve system	• Check the solenoid valve connector. • Check the damper clutch control solenoid valve itself. • Check the damper clutch control solenoid valve drive circuit harness.
48		Short circuit of the damper clutch control solenoid valve system	
49		Malfunction of the damper clutch system	• Check the damper clutch control solenoid valve drive circuit harness. • Check the damper clutch hydraulic pressure system. • Check the damper clutch control solenoid valve itself. • Replace the control unit
51		First gear non-synchronous	• Check the pulse generator output circuit harness. • Check the pulse generator connector. • Check pulse generator A and pulse generator B themselves. • Kickdown brake slippage.

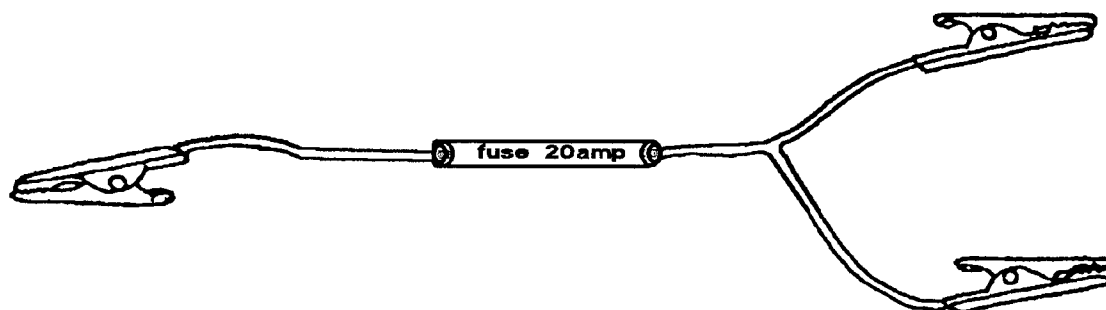


1989 Codes (Continued)

Fault code	Fault code (for voltmeter)	Cause	Remedy
52		Second gear non-synchronous	• Check the pulse generator A output circuit harness. • Check the pulse generator A connector. • Check pulse generator A itself. • Kickdown brake slippage.
53		Third gear non-synchronous	• Check the pulse generator A output circuit harness. • Check the pulse generator connector. • Check pulse generator A and pulse generator B themselves. • Front clutch slippage. • Rear clutch slippage.
54		Fourth gear non-synchronous	• Check the pulse generator A output circuit harness. • Check the pulse generator A connector. • Check pulse generator A itself. • Kickdown brake slippage.

Quick Check

Use a wishbone lead to energize the shift solenoids. Connect the single end to +12 volts. Use the chart below to shift through the gears.



Mitsubishi KM175 Series

1st Gear	A & B Solenoids Are Energized
2nd Gear	B Solenoid
3rd Gear	None
4th Gear	A Solenoid

NOTE

These solenoids are normally closed.

Bind-Up in Reverse Or Drive

A bind up in reverse or drive can be caused by a broken crimp on the parking rod. This can also cause an all time park engagement. In some cases, pulling the shift lever to the manual low position can move the parking rod far enough to pull the unit out of park.

Normal Rod



Broken Rod



NOTE

The crimps on the park rod act as a stop to locate the park rod bullet when the parking pawl is in the park position only.

STEP 1

To diagnose this condition, do not move the selector lever to any other position.

STEP 2

Turn the ignition switch off.

STEP 3

See if the vehicle will roll freely.

STEP 4

If the vehicle will not move, suspect a broken crimp on the parking rod.

Slips in 2nd & 4th

Harsh 2-3 upshift and/or 4-3 downshift. Harsh 1-2 upshift and/or 2-3 slip.

All of the above problems can be related to excessive servo bore wear. The servo bore should always be inspected very closely.

To check the servo bore for wear.

STEP 1

Use a butt cut teflon ring and bore fit the ring in an area of the servo that looks the least worn.

STEP 2

Move the ring to different areas in the servo bore and check the ring end gap at its widest point with a feeler gauge.

STEP 3

For ring end gaps that are .003" or less, use the standard rings.

STEP 4

For ring end gaps of more than .003" but less than .060", use the oversize rings.

STEP 5

For ring end gaps that exceed .060" the case must be replaced.

NOTE

Never use teflon rings on the servo piston.

No Movement Or Slippage In All Ranges After Rebuild

A no movement condition and/or a slippage in all ranges can be caused by a lack of converter fill oil.

Use the following procedure to verify.

STEP 1

Check cooler out line for cooler flow. Oil flow should be at least one quart in 20 seconds. If there is no oil flow see step 2.

STEP 2

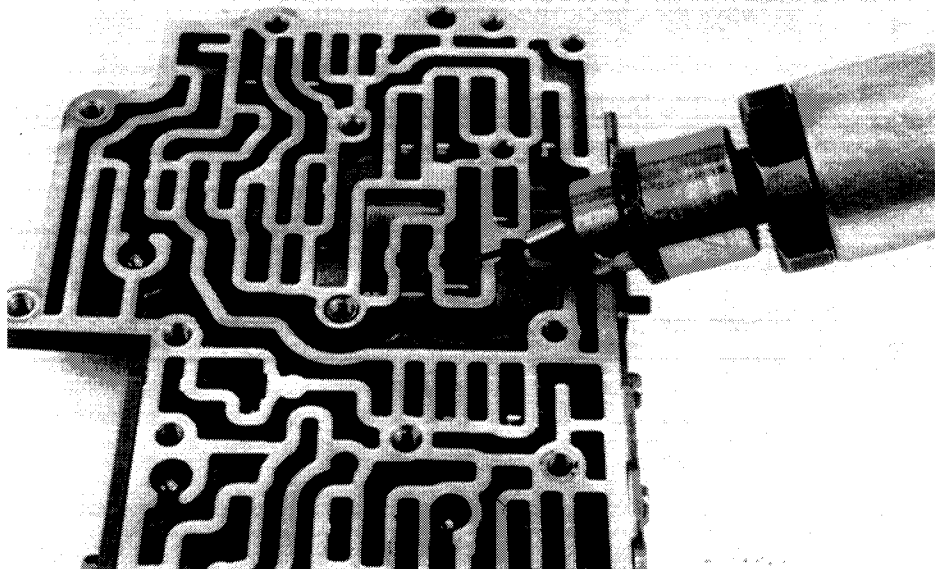
Attach a 0-300 pressure gauge to the low reverse pressure port. If line pressure is normal go to step 3.

STEP 3

Remove valve body and drill a .060 hole in the valve body casting as shown.

NOTE

In most cases this can be avoided by prefilling the torque converter.



No Forward After Rebuild

Can be caused by a missing checkball in the pump.



This 5/16 ball seals forward clutch oil in all ranges except 4th & reverse. Repeated forward clutch failure can be caused by this checkball not seating properly.

STEP 1

Always air check the forward clutch circuit.

STEP 2

Assemble both halves of the pump and install the forward drum & shaft into the pump.

STEP 3

Apply 15-20 lbs of air pressure to the forward clutch apply port.

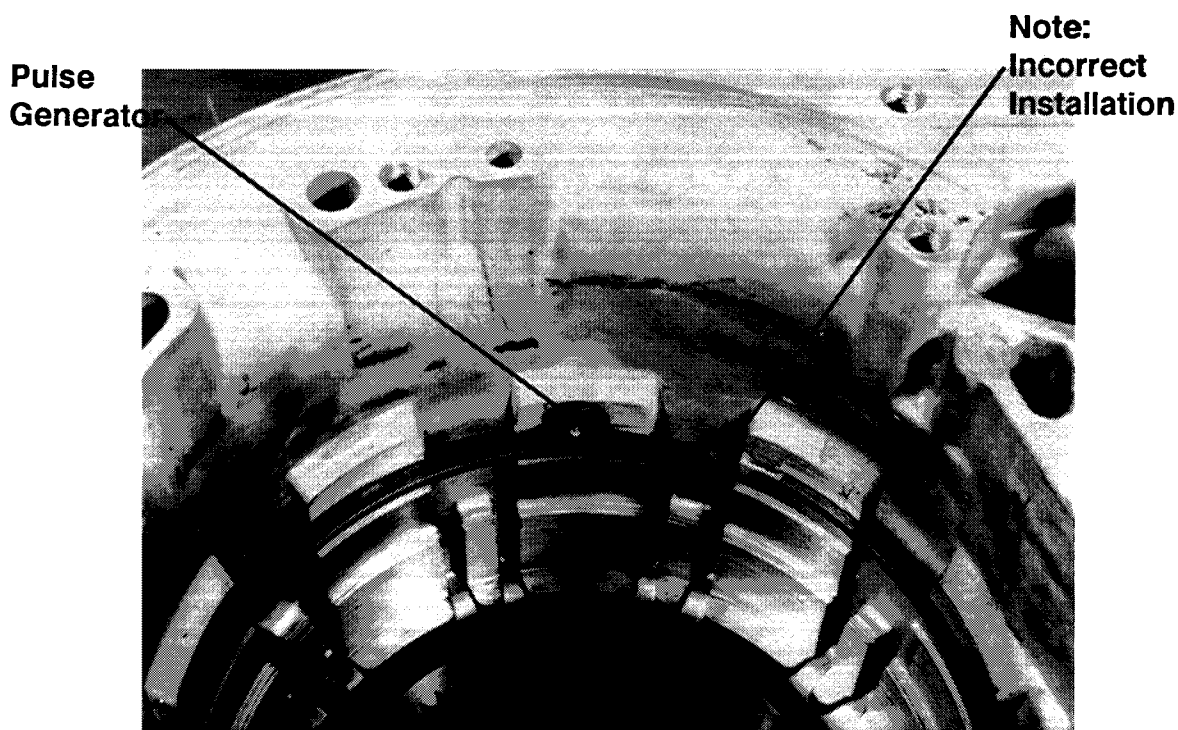
STEP 4

Watch for cross leaks or exhaust at the other port openings in the pump.

Reverse & 2-3 Bind-Up Or 2nd Gear Starts

Mitsubishi added a snap ring to the late model KM case. This snap ring locks the low / reverse housing to the case.

Make sure the open ends of the snap ring lines up with the hole in the case for the pulse generator.



These conditions can change depending on which end of the snap ring is pushed out by the pulse generator.

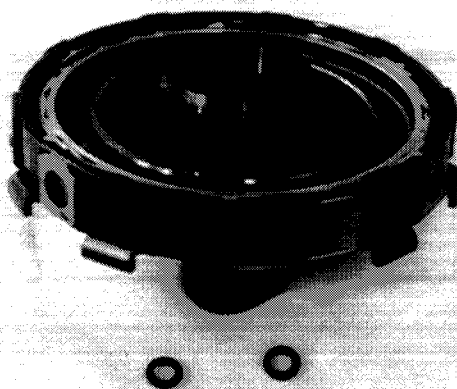
If one end gets pushed out against the sun shell, the transaxle will bind up on the 2-3 shift & in reverse.

If the other end gets pushed out it will cause 2nd gear starts.

This is seldom noticed until after an overhaul.

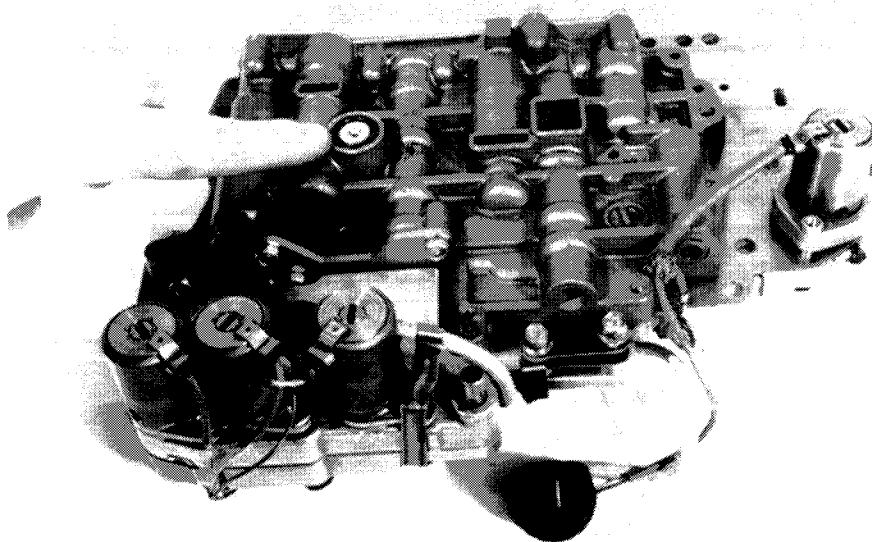
No Reverse

The low & reverse support can fit in the case more than one way. The location is important. There are 2 openings, one lines up with the low reverse feed in the case and the other with the low reverse pressure port tap on the outside of the case. Misalignment of these port openings in the case can cause a no reverse condition, no pressure port guage reading, or both. New o-rings should be installed in the center support before installation. Missing o-rings can cause a no or slipping in reverse & manual low condition.



NOTE

No reverse can also be caused by a missing o-ring between the valve body & case.



Bind-up on 1-2

Installing the sprag upside down will cause a bind up on the 1-2 up shift. With the sprag installed in the planetary and the planetary installed on the low reverse support, planetary must freewheel counter clockwise.





TECHNICAL SEMINAR HANDOUT

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*The information presented in this seminar handout
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This manual has been compiled and produced by the Automatic Transmission Rebuilders Association for the benefit and improvement of the industry. All information in this book is based on the latest data available at the time of publication. While every effort is made to attain accuracy, the Automatic Transmission Rebuilders Association cannot assume responsibility for any errors, changes and omissions that may occur nor liability for any damage to person or property to affect maintenance or repair work.



Technical Seminar Handout

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Electronics**

General Motors

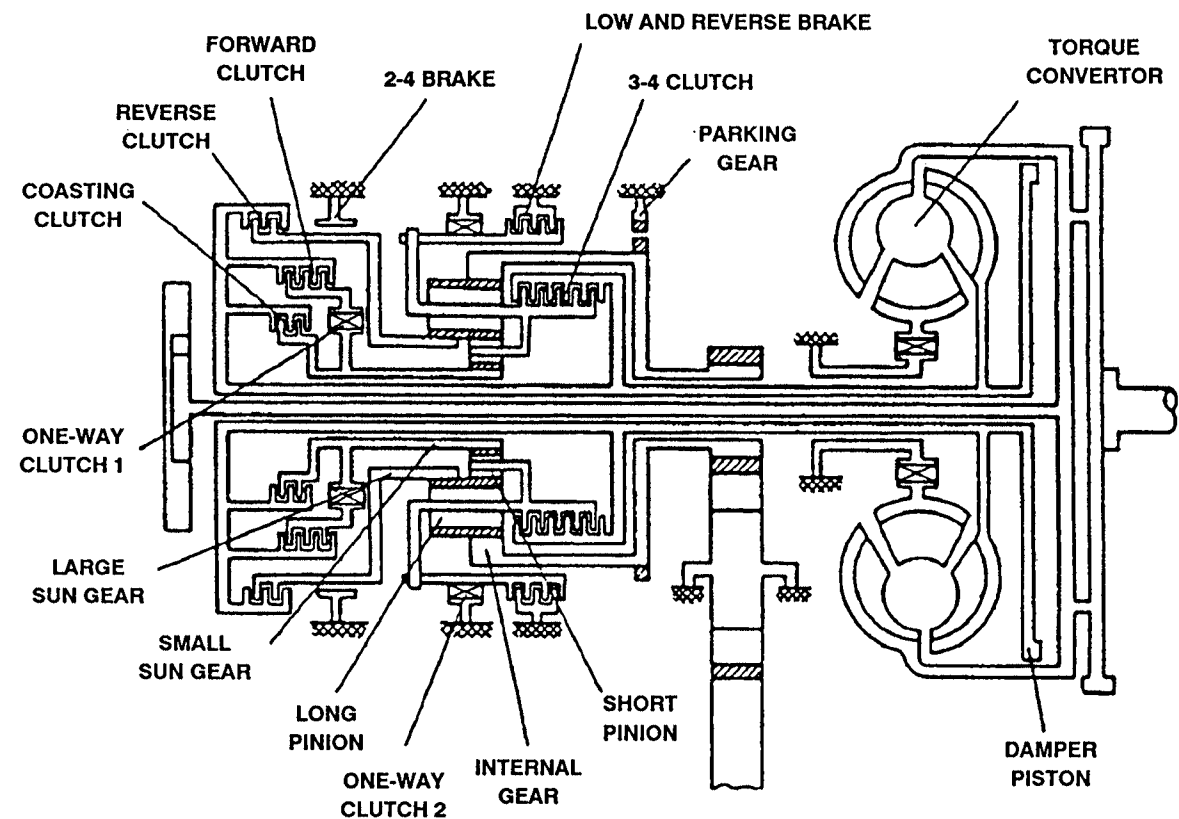
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Honda/Acura



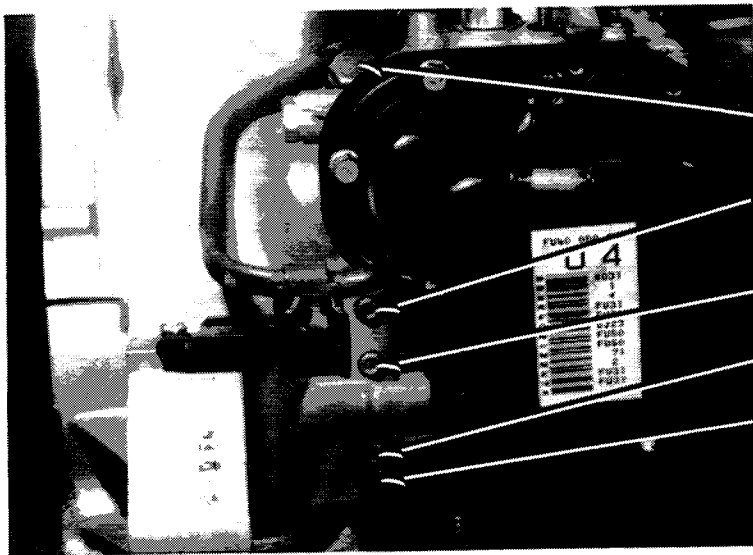
Component Application Chart

RANGE	GEAR	FORWARD CLUTCH	COASTING CLUTCH	3-4 CLUTCH	REVERSE CLUTCH	2-4 BRAKE		LOW & REVERSE BRAKE	ONE-WAY CLUTCH 1	ONE-WAY CLUTCH 2
						APPLIED	RELEASED			
P	--						O			
R	--				O		O	O		
N	--						O			
D	1ST	O					O		O	O
	2ND	O				O			O	
	3RD	O		O		⊗	O		O	
	4TH	O		O		O				
2	2ND	O	O			O			O	
	3RD	O	O	O		⊗	O		O	
1	1ST	O	O				O	O	O	
	2ND	O	O			O			O	

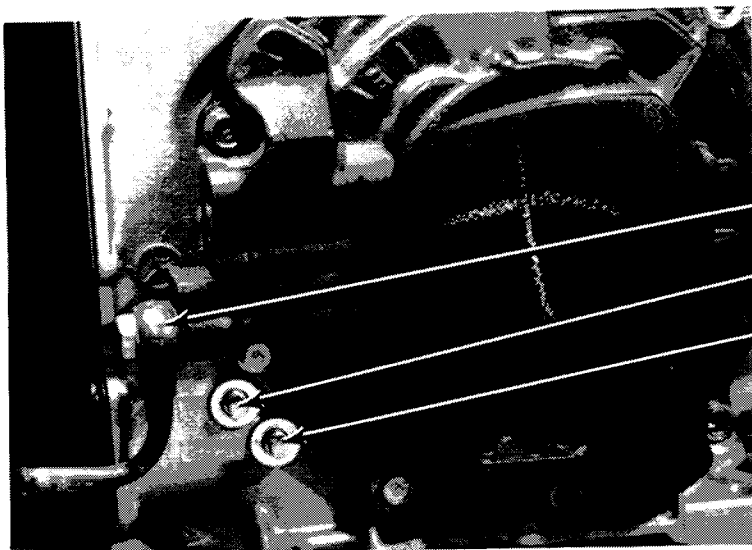
⊗ = Indicates fluid pressure to servo but band not applied due to pressure difference

Mazda G4A, Ford Probe 4EAT Pressure Tap Locations

See the Photos Below for Pressure Tap Locations



1. COOLER FEED
2. 3RD ACCUMULATOR FEED (LINE PRESSURE)
3. T/C RELEASE
4. T/C APPLY
5. 3-4 CLUTCH



1. COOLER RETURN
2. THROTTLE PRESSURE
3. LINE PRESSURE

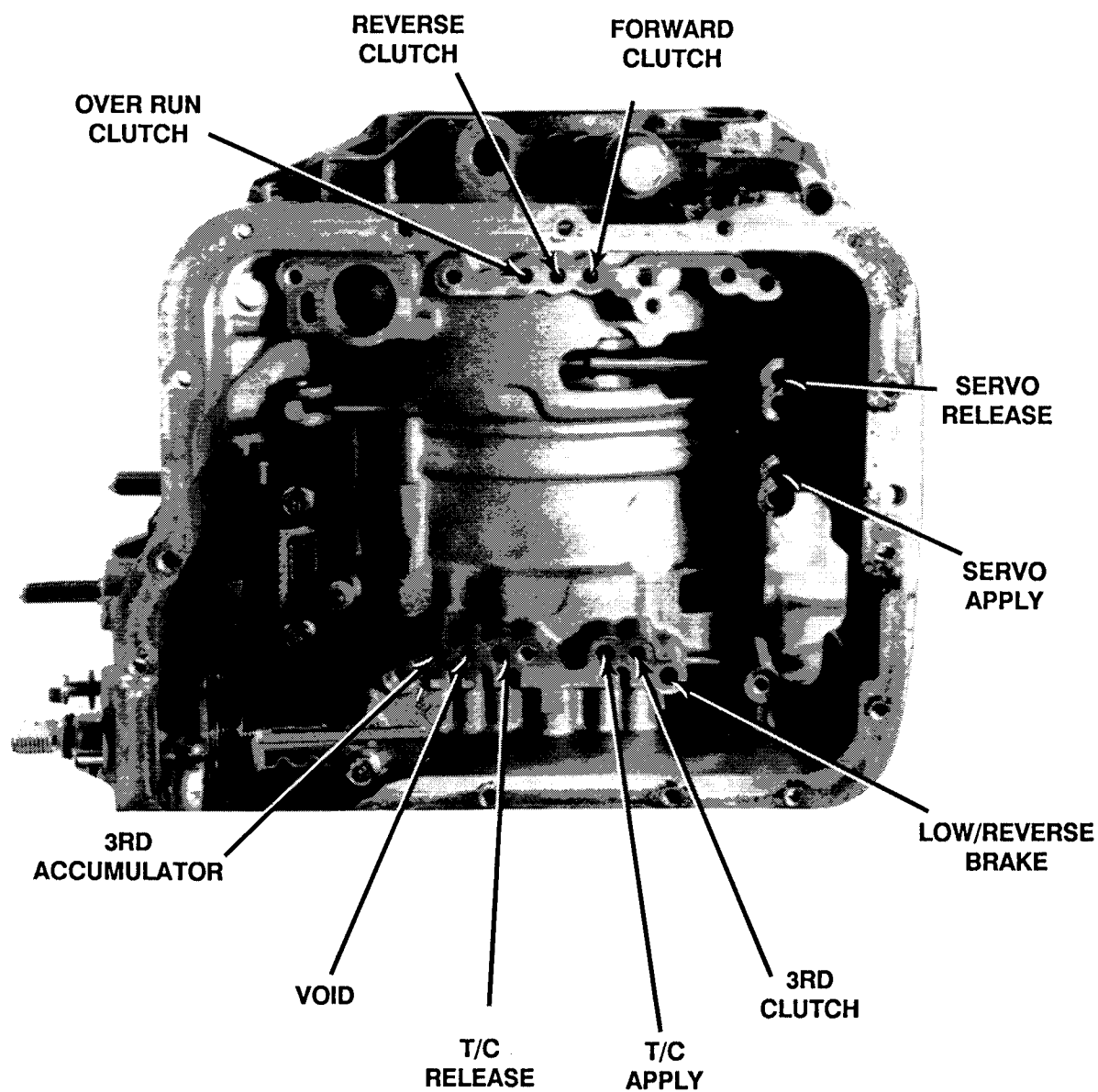
LINE PRESSURE

RANGE	D,2,1	R
AT IDLE	47-71 PSI	87-137 PSI
DURING STALL	127-151 PSI	242-292 PSI

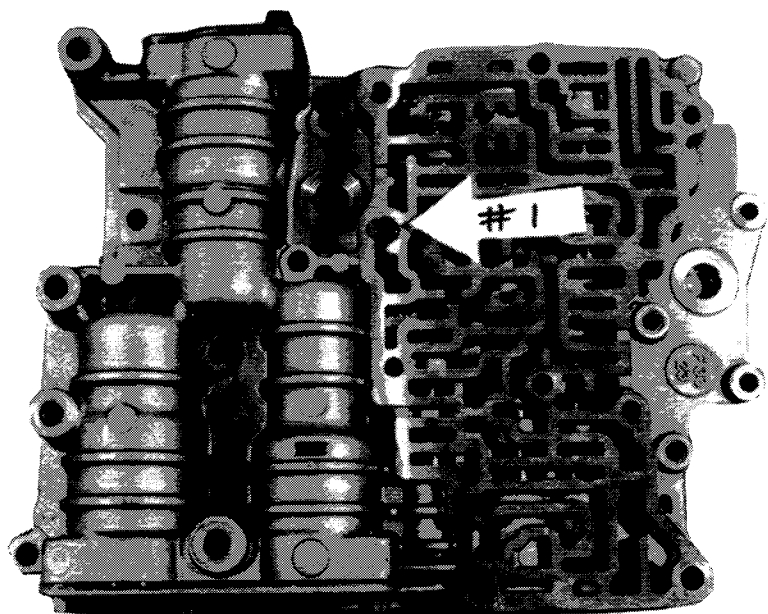
THROTTLE PRESSURE

AT IDLE	6-13 PSI, IN DRIVE
DURING STALL	78-85 PSI, IN DRIVE

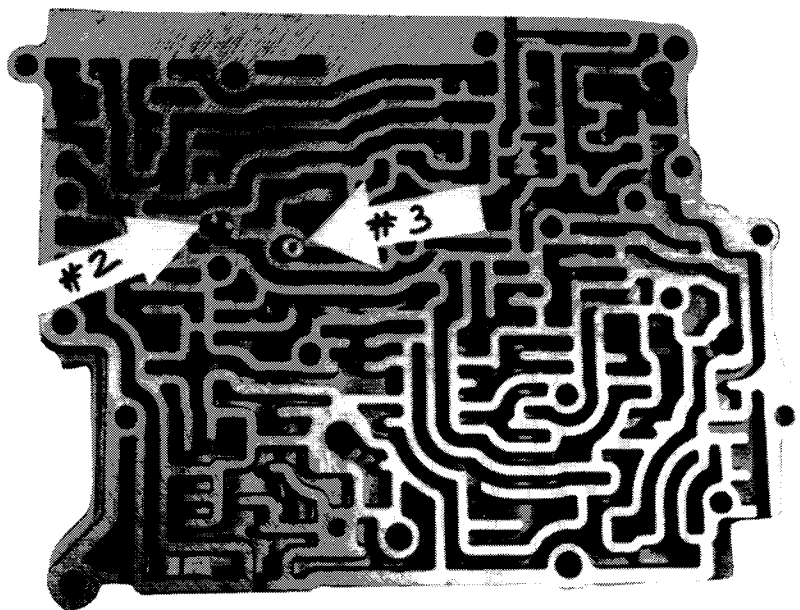
Feed Hole Locations



See the Photos Below For Orifice
Locations & Function

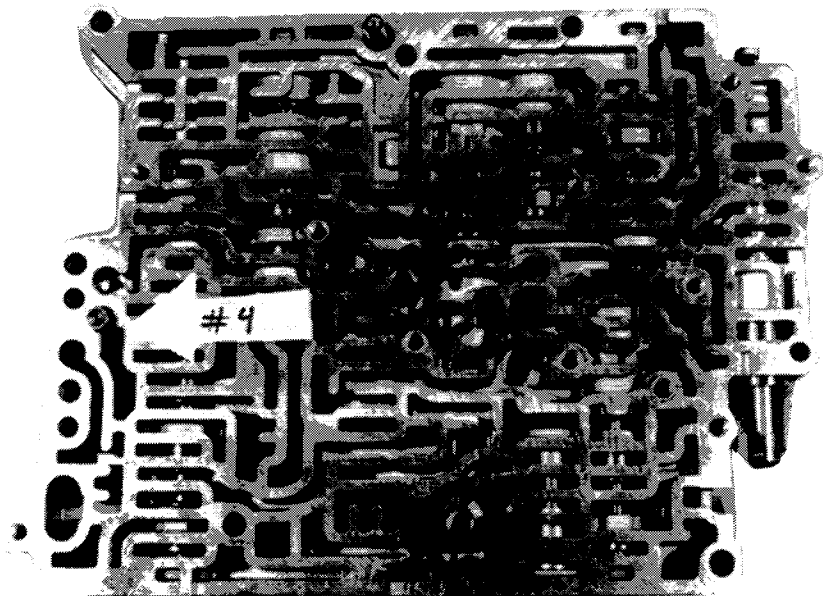


ORIFICE #	SIZE	FUNCTION
1	.031	3-4 CLUTCH FEED

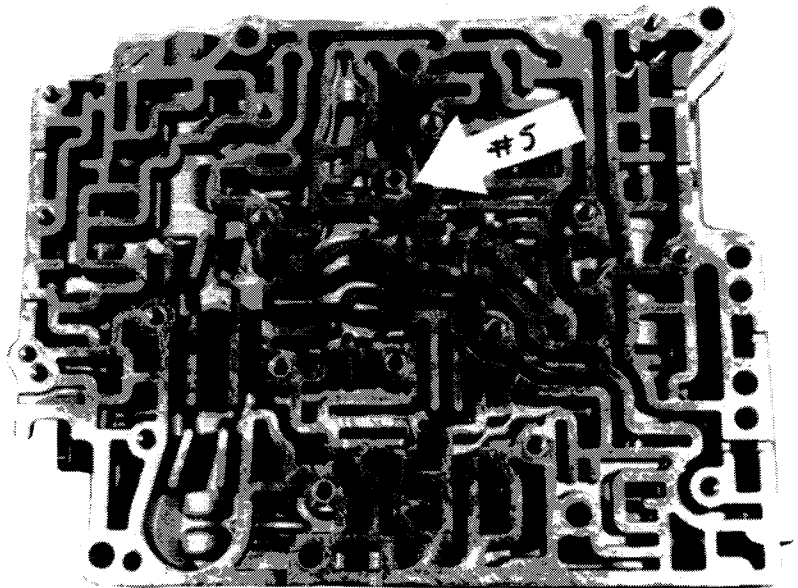


ORIFICE #	SIZE	FUNCTION
2	.077"	2-4 SERVO (3-4 SHIFT)
3	.077"	FORWARD CLUTCH FEED

Orifice Location and Function Continued

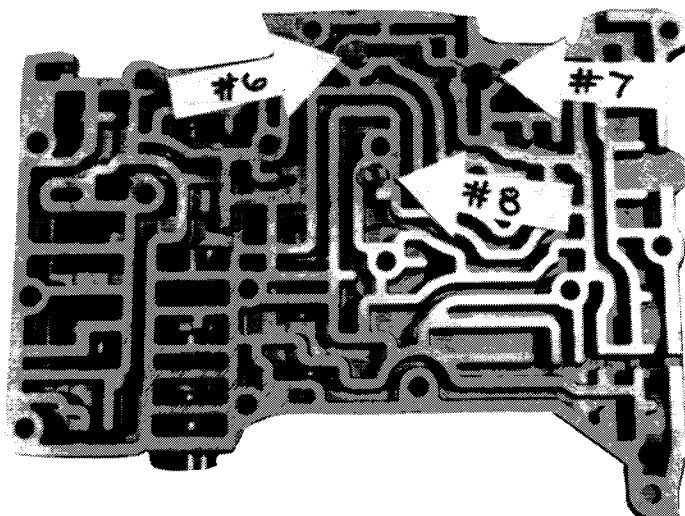


ORIFICE #	SIZE	FUNCTION
4	.031"	2-4 SERVO (1-2 SHIFT)

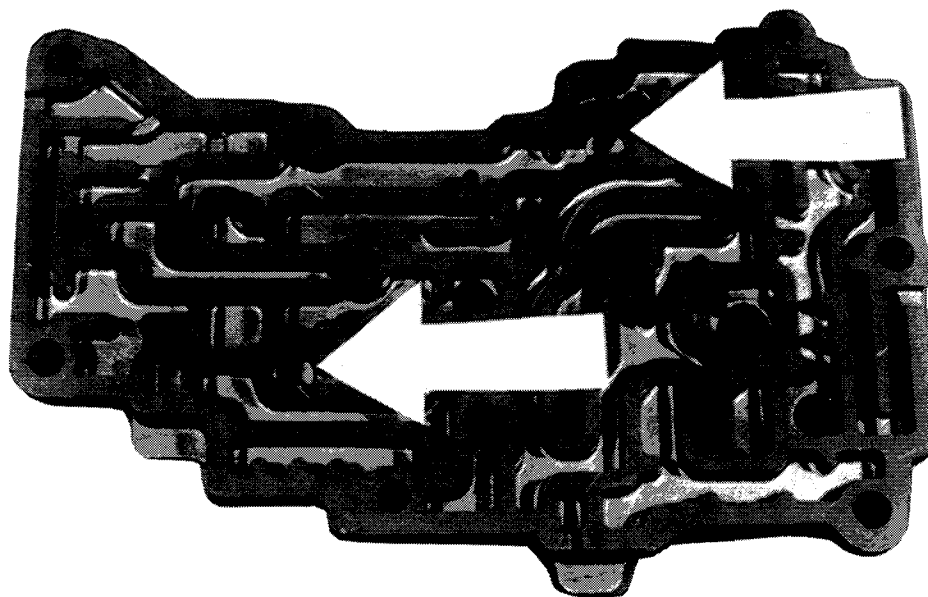


ORIFICE #	SIZE	FUNCTION
5	.116"	LOW/REVERSE BRAKE (In Manual Low)

Orifice Location and Function Continued



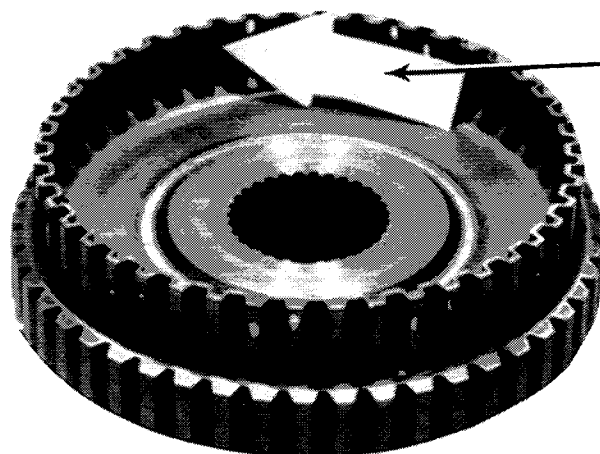
ORIFICE #	SIZE	FUNCTION
6	.039"	OVER-RUN CLUTCH FEED
7	.059"	REVERSE CLUTCH FEED
8	.077"	LOW/REVERSE CLUTCH EXHAUST (WHEN SHIFTING OUT OF REVERSE)



Some manuals show checkballs at these locations, **DO NOT** put them there.

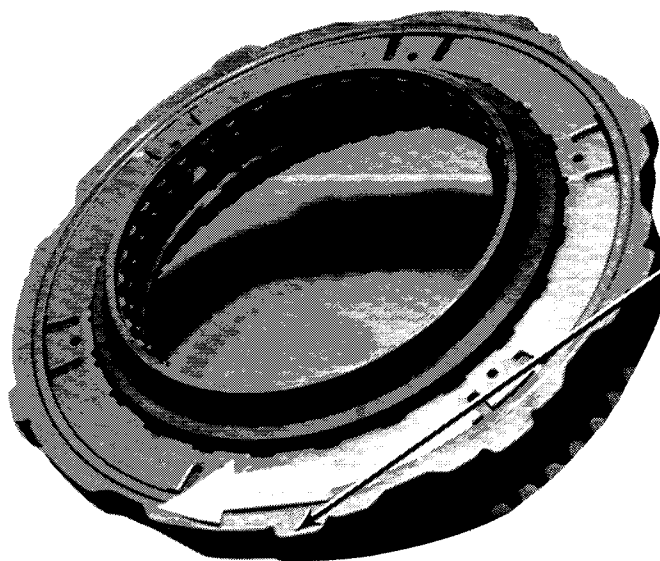
Mazda G4A, Probe 4EAT Sprag Rotation

See the Photos Below for Proper Sprag Rotation



THE INNER HUB FREE
WHEELS
COUNTER-CLOCKWISE

PHOTO OF FORWARD SPRAG - The forward sprag should free wheel counter-clockwise and hold clockwise.



THE OUTER SUPPORT
MUST FREE WHEEL
CLOCKWISE

PHOTO OF LOW ROLLER - The low roller clutch support should free wheel clockwise and hold counter clockwise.

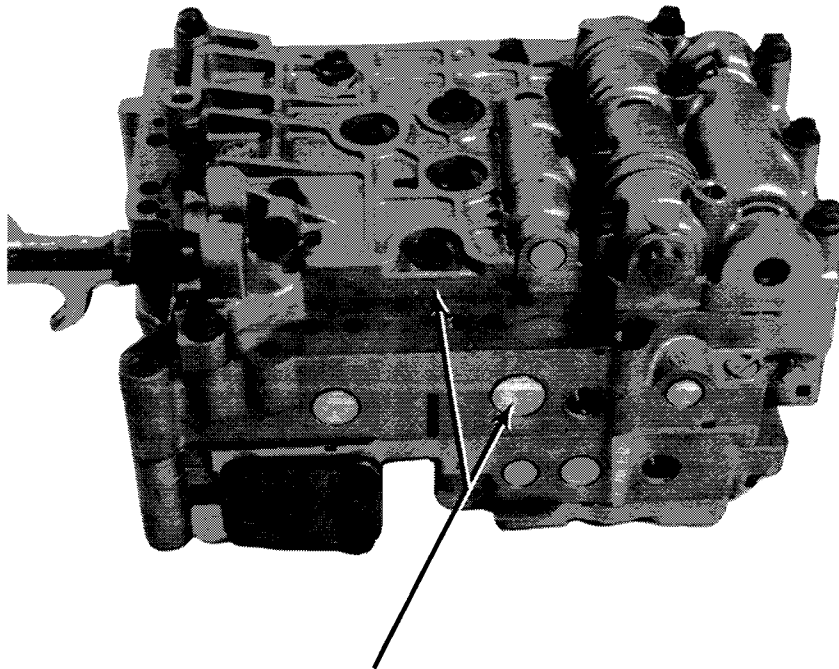
G4A-EL

Kills The Engine In Gear

A leaking lock-up circuit can cause the torque converter clutch to remain applied *. To correct this problem, 1st check the lock-up solenoid for leakage. The lock-up solenoid is normally closed. When applying air it should not leak. The next thing to do is air check the valve

body. Apply air to the valve body as show in the picture below to check for leaks.

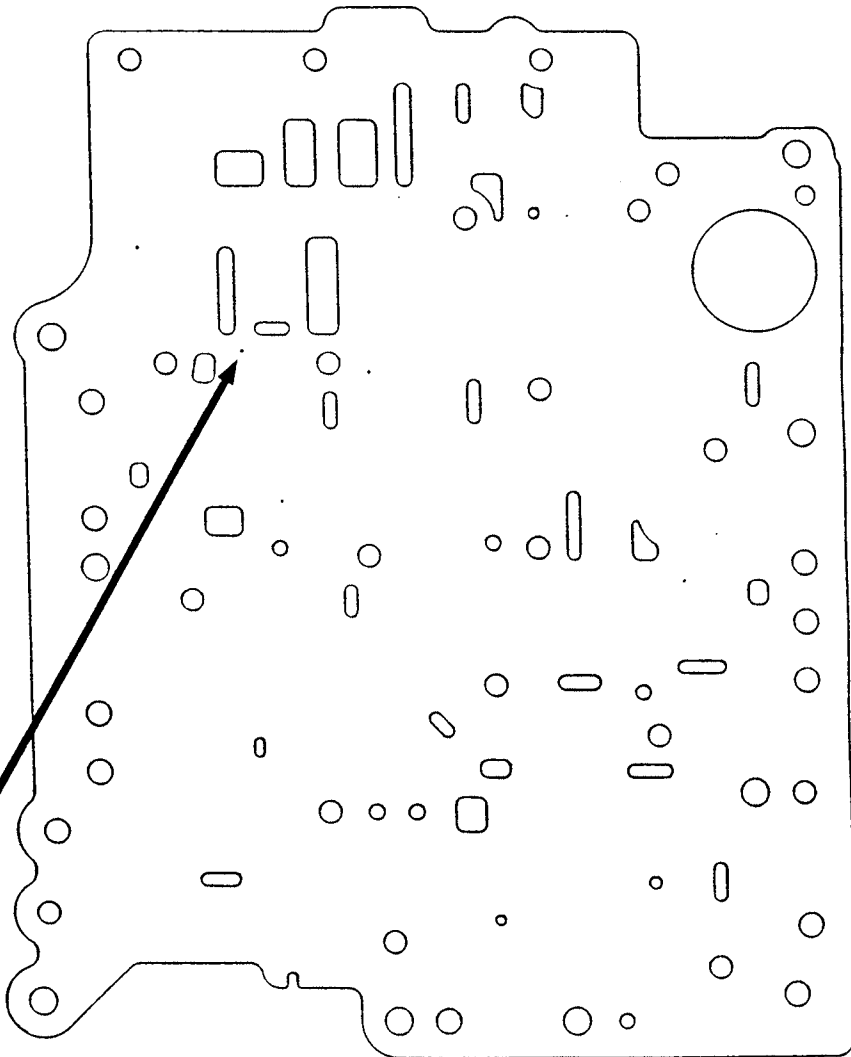
* This condition will cause the engine to stall when placing transaxle in gear.



Make sure there are no leaks at the plug or between the valve body & separator plate.

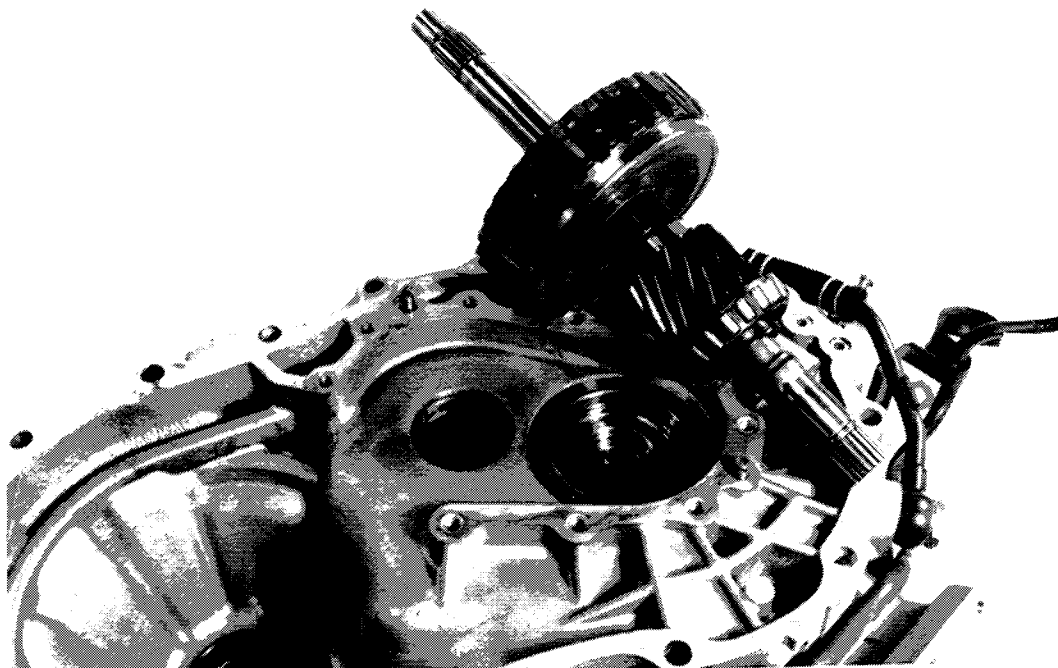
If everything checks ok, drill the lock-up solenoid feed hole in the separator plate to .040".

Main Separator Plate



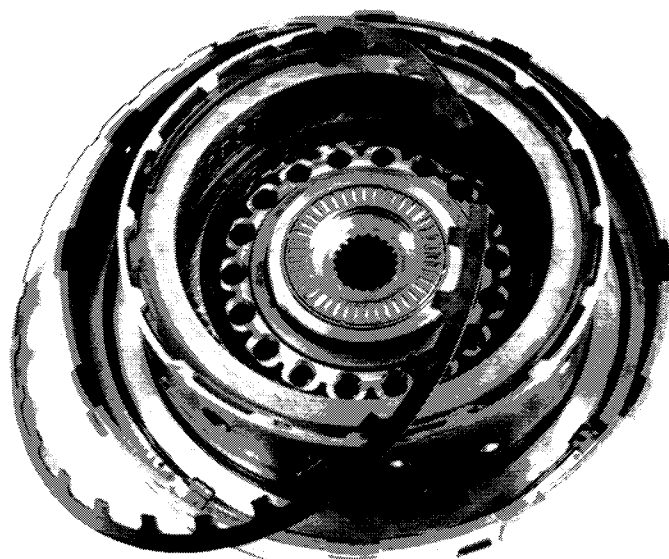
ENLARGE THIS HOLE TO .040 IF THE TORQUE CONVERTER CLUTCH KILLS THE ENGINE AT A STOP.

3-4 Clutch



Make sure you change ALL THREE sealings plus the "O" ring.

Reverse Clutch



Make sure the Belleville spring is NOT broken.

Mazda G4A-EL/Ford 4EAT

Repeated Reverse Clutch Failure

You can help avoid repeated reverse clutch failure on G4A-EL's AND 4EAT's by following three simple steps.

- 1. Always use factory sealing rings on the pump. Ford rings will work on both units. The part # is E92Z-7D019-A.
- 2. Drill a .030 hole in the reverse piston. (Figure 1) This is just like the T-35 that would cross leak in the valve body and drag the reverse band. The .030 hole creates an exhaust so the clutch won't come on while driving forward.
- 3. Enlarge the reverse feed orifice (Figure 2) by .020 to compensate for hole you drilled in the piston.



Figure 1

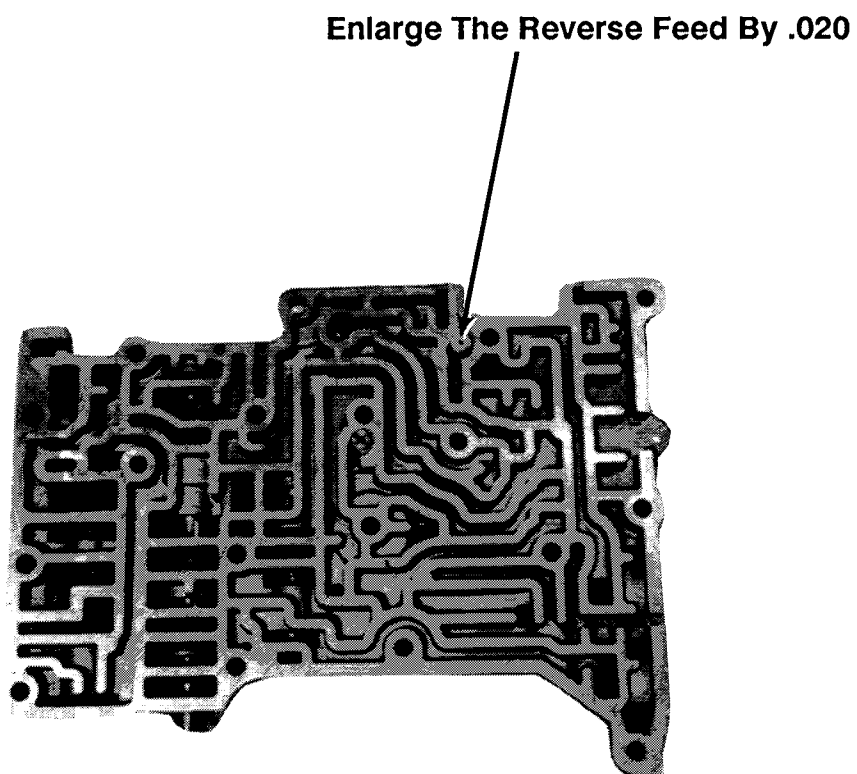
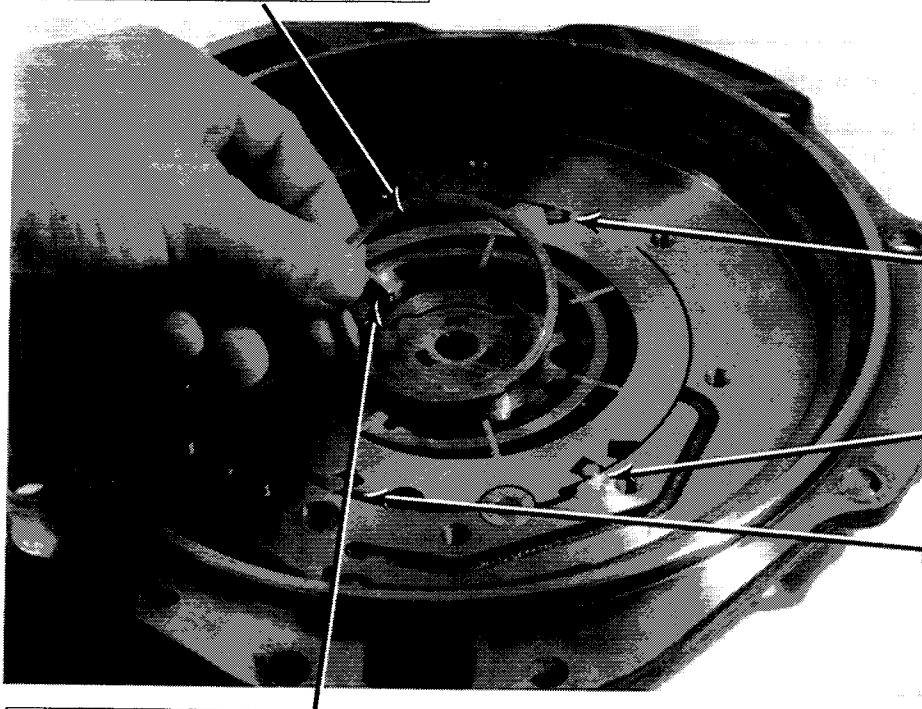


Figure 2

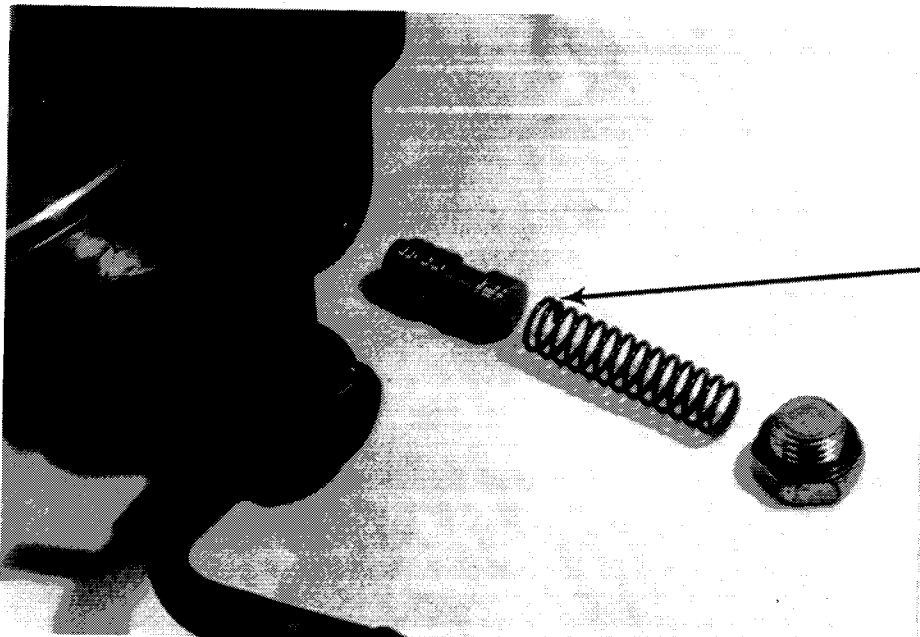
Pump Assembly

Place the solid ring on top.



Place the three pump seals bevelled side down here.

The bevelled corner of the pump vanes face the upper center of the rotor.



EARLY TYPE

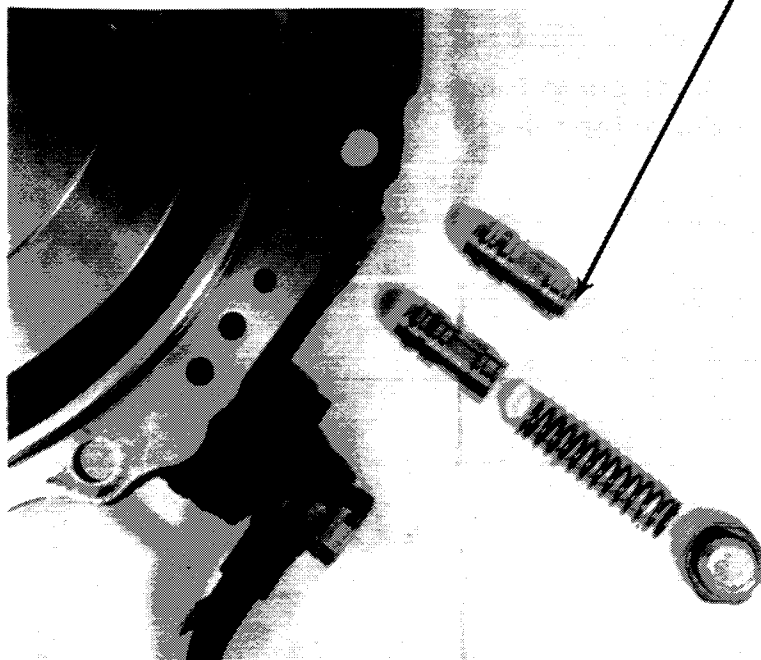
The flat side of the valve faces the spring.
(SEE NEXT PAGE)

Mazda G4A-EL/Ford 4EAT

Low Pump Pressure

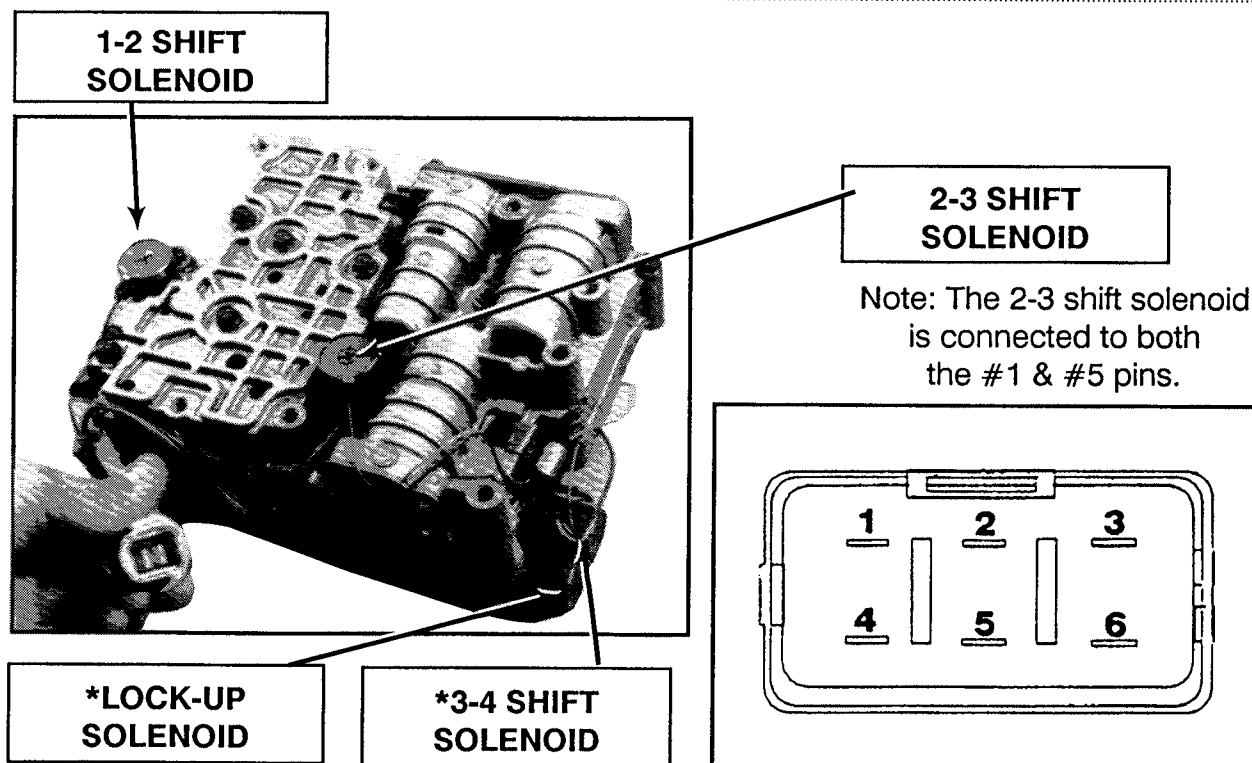
The spool valve in the pump on the G4A-EL/4EAT has been updated. The purpose of the update was to create a seat for the spring. The old valve had no seat and sometimes the spring would snag in it's bore causing low line pressure. The Ford part # is F02Z-7Z306-A. The Ford valve will work in the Mazda as well.

The Late Valve Has A Spring Seat



Mazda G4A, Ford Probe 4EAT Valve Body

Photo of Valve Body Showing the Solenoids



PIN #	FUNCTION
1.	2-3 SHIFT SOLENOID
2.	3-4 SHIFT SOLENOID
3.	
4.	1-2 SHIFT SOLENOID
5.	2-3 SHIFT SOLENOID
6.	LOCK-UP SOLENOID

*Note: Some manuals show the 3-4 shift and lock-up solenoids reversed.

GEAR	1-2 SHIFT SOLENOID	2-3 SHIFT SOLENOID	3-4 SHIFT SOLENOID	LOCK-UP SOLENOID
------	-----------------------	-----------------------	-----------------------	---------------------

1ST GEAR	OFF	ON	ON
2ND GEAR	ON	ON	ON
3RD GEAR	OFF	OFF	OFF
4TH GEAR	ON	OFF	ON

*LOCK-UP

ON

*LOCK-UP CAN COME ON IN ANY GEAR

Mazda - G4A-EL

Terminal	Connection to	Operation	Voltage
A	Battery	IG ON	approx. 12
B	Ground	IG OFF	0
C	Back-up battery		approx. 12
D	Ground		0
E	Solenoid valve battery	IG ON	approx. 12
		IG OFF	0
F	Fluid temperature switch	Above 150°C (302°F)	0
		Below 143°C (289°F)	approx. 10-12
H	1-2 solenoid valve	"R" range	approx. 12
		"P" range	0
I	2-3 solenoid valve	"R" range	0
		"P" range	approx. 12
J	3-4 solenoid valve	"R" range	0
		"P" range	approx. 12
K	Lock-up solenoid valve	In lock-up condition	approx. 12
		Except in lock-up condition	0
L	Overdrive OFF indicator	Button out (No up-shift into "4")	0
		Button in (Up-shift into "4")	approx. 12
M	Inspection Code of EC-AT Tester		Code No.
N	(For troubleshooting)		Code No.

u	s	q	o	m	⊗	i	g	e	c	a	
v	t	r	p	n	⊗	l	j	h	f	d	b

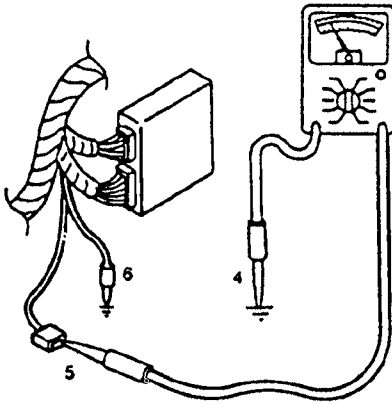
M	K	I	⊗	E	C	A	
N	L	J	⊗	H	F	D	B

Terminal	Connection to	Operation	Voltage
b	Mode switch	ECONOMY mode	0
		POWER mode	approx. 12
c	Inhibitor switch	"1" range	approx. 12
		Except "1" range	0
d		"2" range	approx. 12
		Except "2" range	0
e		"D" range	approx. 12
		Except "D" range	0
f		"P" or "N" range	approx. 0.5
		Except "P" and "N" range	approx. 12
g	Water temperature switch	Below 65°C (149°F)	0
		Above 72°C (162°F)	approx. 12
h	Kickdown switch	Accelerator depressed 7/8 or more	approx. 12
		Accelerator depressed less than 7/8	0
i	Overdrive switch	Button out (No up-shift into "4")	approx. 12
		Button in (Up-shift into "4")	0
j	Air-conditioner cut-off relay	Accelerator depressed 7/8 or more	0
		Accelerator depressed less than 7/8	approx. 12
l	Idle switch	Throttle valve fully closed	0
		Except fully closed	approx. 12
m	Brake light switch	Brake pedal depressed	approx. 12
		Brake pedal not depressed	0
n	Cruise control unit	SET or RESUME ON	approx. 0.5
		Vehicle speed drops 3 km/h (12 mph) from pre-set speed	approx. 0.5
		SET and RESUME OFF	approx. 12
p	Throttle sensor	IG ON	approx. 5
		IG OFF	0
q	Pulse generator	Throttle valve fully closed to full open	approx. 0.5-4.0
s		For one turn of reverse and forward drum	12 pulses
t			0
v	Speed sensor	For one turn of speedometer cable	4 pulses

Ford 4EAT Trouble Codes

Using the VOM

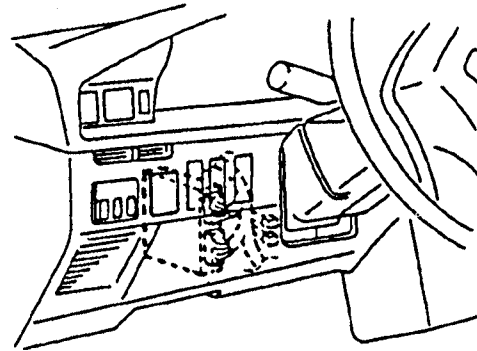
1. Set the VOM on a DC voltage range to read from 0-20V.
2. Ground the VOM (-) lead.
3. Connect the VOM (+) lead to the red wire (6-pin 4EAT STO connector).
4. Ground the single-pin 4EAT STI connector with jumper wire.



Equipment Hookup

NOTE: Refer to the illustration on this page for Quick Test connector pin orientation and STAR Tester or VOM hookup.

1. Turn ignition key off.
2. Locate the service connector.

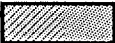


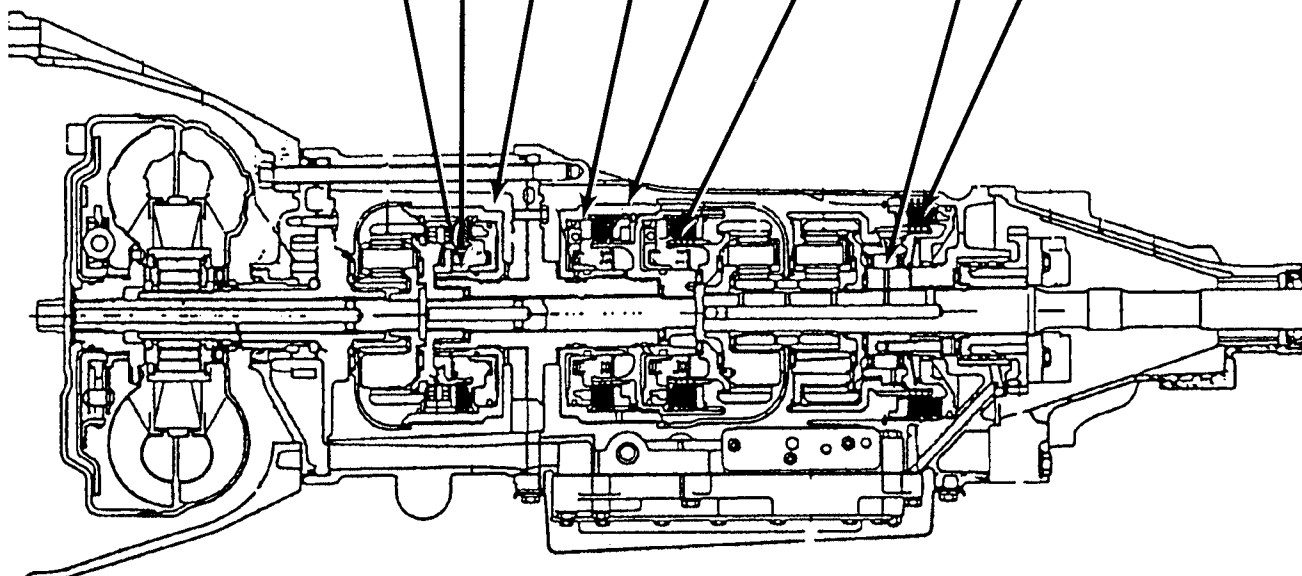
Defective System	Possible Cause	Diagnosis Indication Mode VOM	Code No.
Vehicle Speed Sensor	Failed sensor Faulty Wiring	 ON OFF	06
Throttle Position Sensor	Failed sensor Faulty wiring		12
Pulse Generator	Failed sensor Faulty wiring		55
1-2 Shift Solenoid	Failed solenoid Faulty wiring		60
2-3 Shift Solenoid	Failed solenoid		61
3-4 Shift Solenoid	Failed solenoid Faulty wiring		62
Lockup Solenoid	Failed solenoid Faulty wiring		63

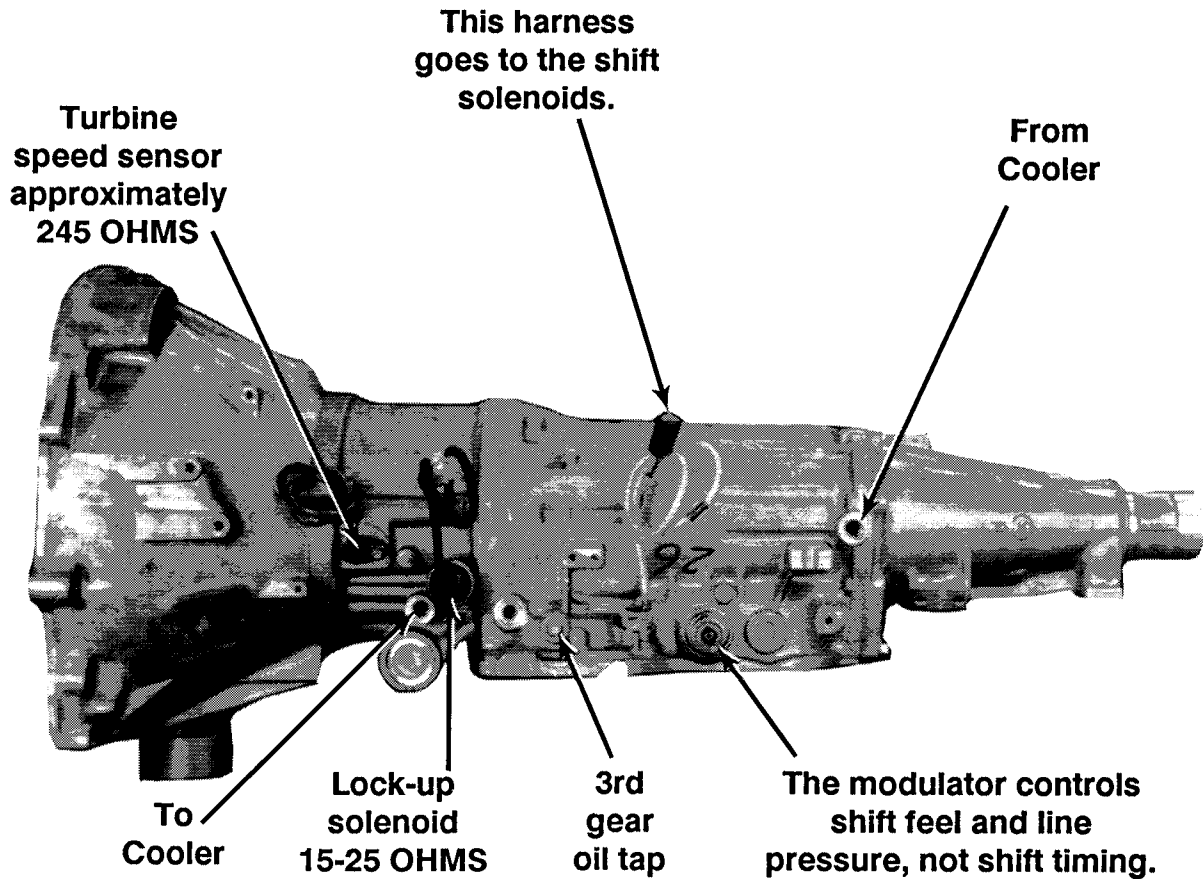
N4A-EL

Clutch and Band Application

		Direct Clutch	OD Sprag	OD Band	High Reverse Clutch	Inter-mediate Band	Forward Clutch	Low Sprag	Low Reverse Clutch
D	R								
	1								
	2								
	3								
	4								
S	1								
	2								
L	1								

 =
Applied or
holding





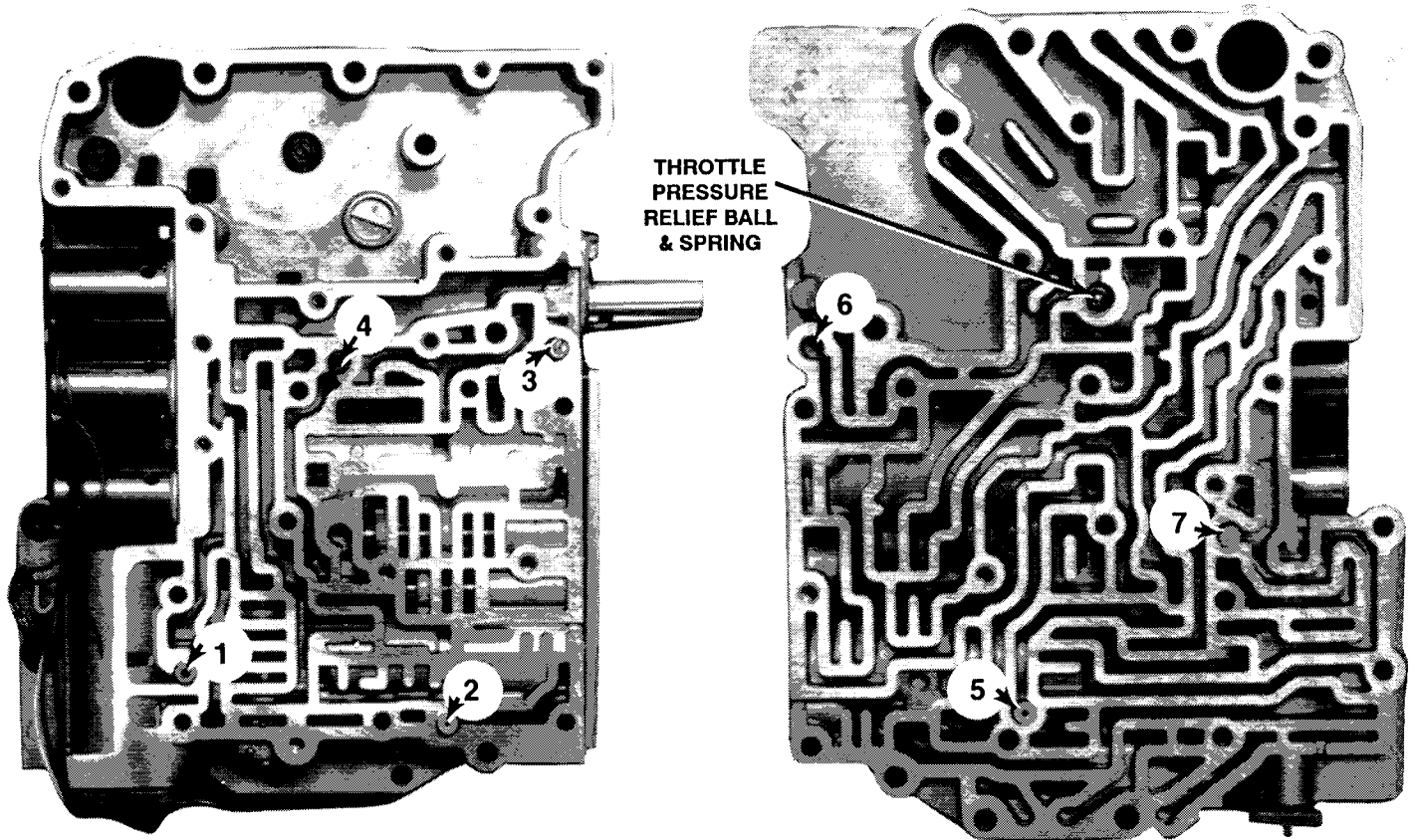
* The line pressure (forward clutch) tap is located on the right rear of the case.

PRESSURE SPECIFICATIONS

RANGE	IDLE	STALL
D, S, L	43-57	128-156
R	78-92	213-242

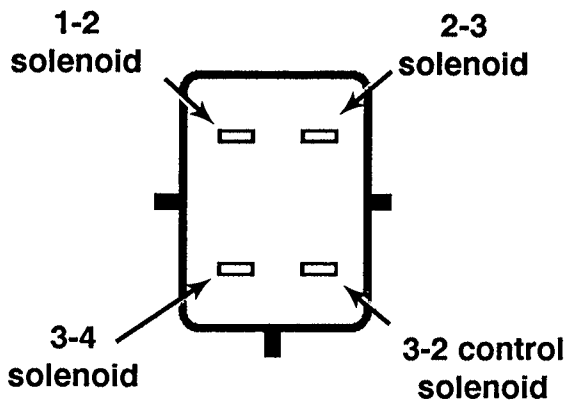
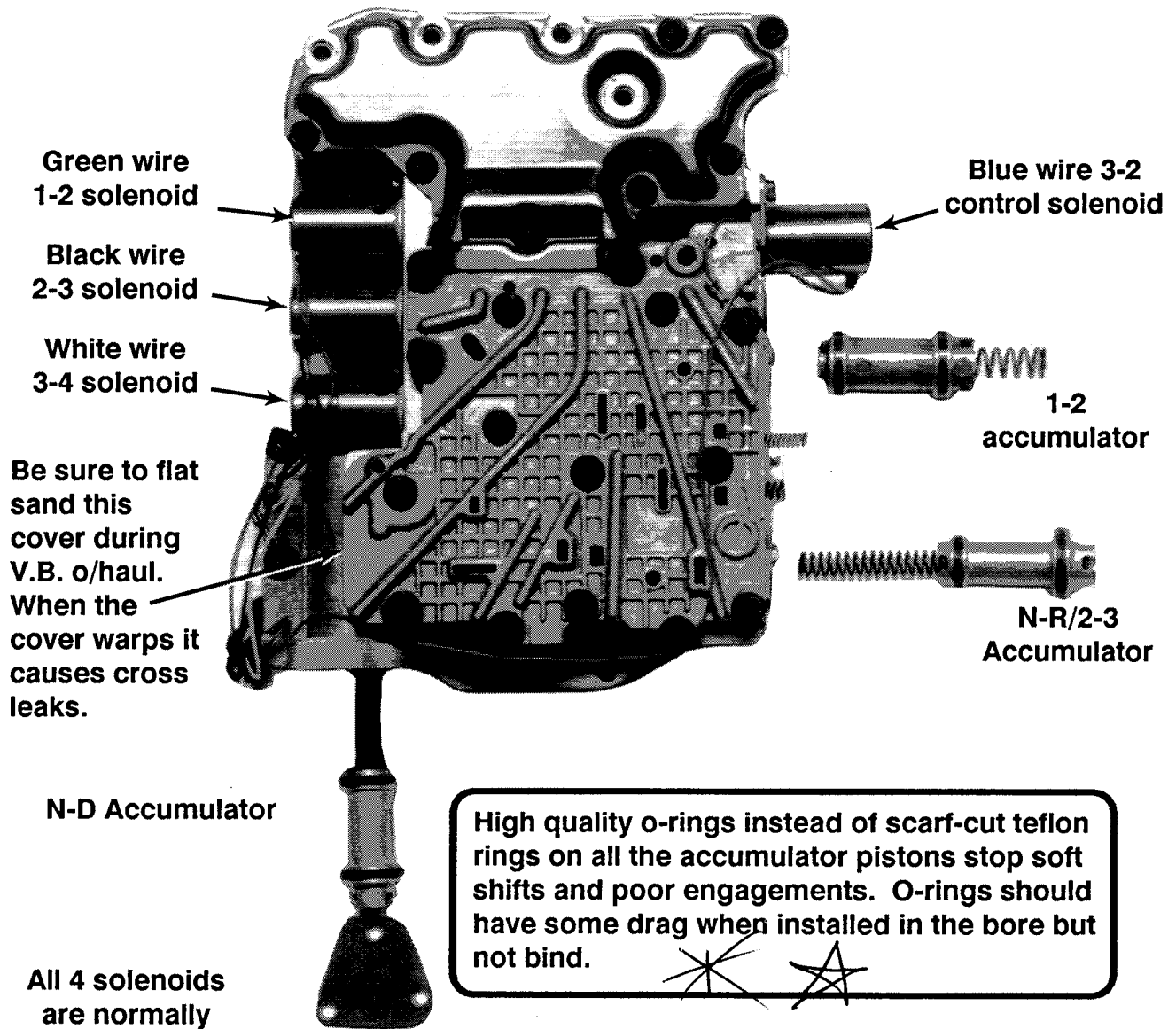
Check pressure for all forward ranges using the tap on the right rear of the case.

Check reverse pressure using the 3rd gear oil tap on the left front area of the main case.



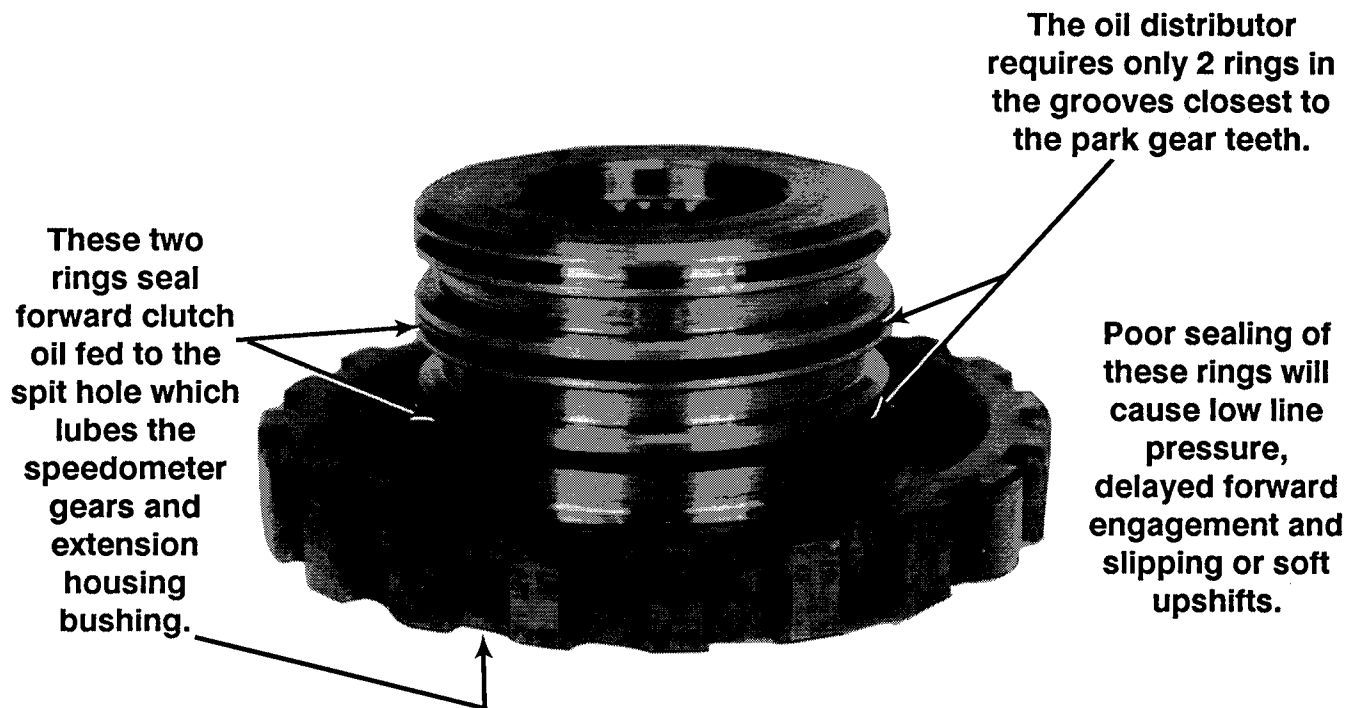
ORIFICE#	FUNCTION	SIZE STATED IN SERVICE MANUAL	ACTUAL SIZES OBSERVED IN UNITS	YEAR__	YEAR__	YEAR__	YEAR__
1	Forward Clutch Feed	.071	.097				
2	N-R/2-3 Accumulator Ex	.059	.057				
3	3-2 Control (Servo Release)	.043	.039				
4	Intermediate Servo Feed	.039	.039				
5	Direct Clutch Feed	.071	.078				
6	4-3 Control	.087	-----				
7	Reverse Control	Solid Plug	Solid Plug				

* Not all models use an orifice in location 6. The orifice sizes contribute to calibration and may vary from model to model. Use the additional columns to record the orifice sizes in your valve bodies and the year and model of the vehicle if you like. This will help you sort one out later if you get one scrambled.

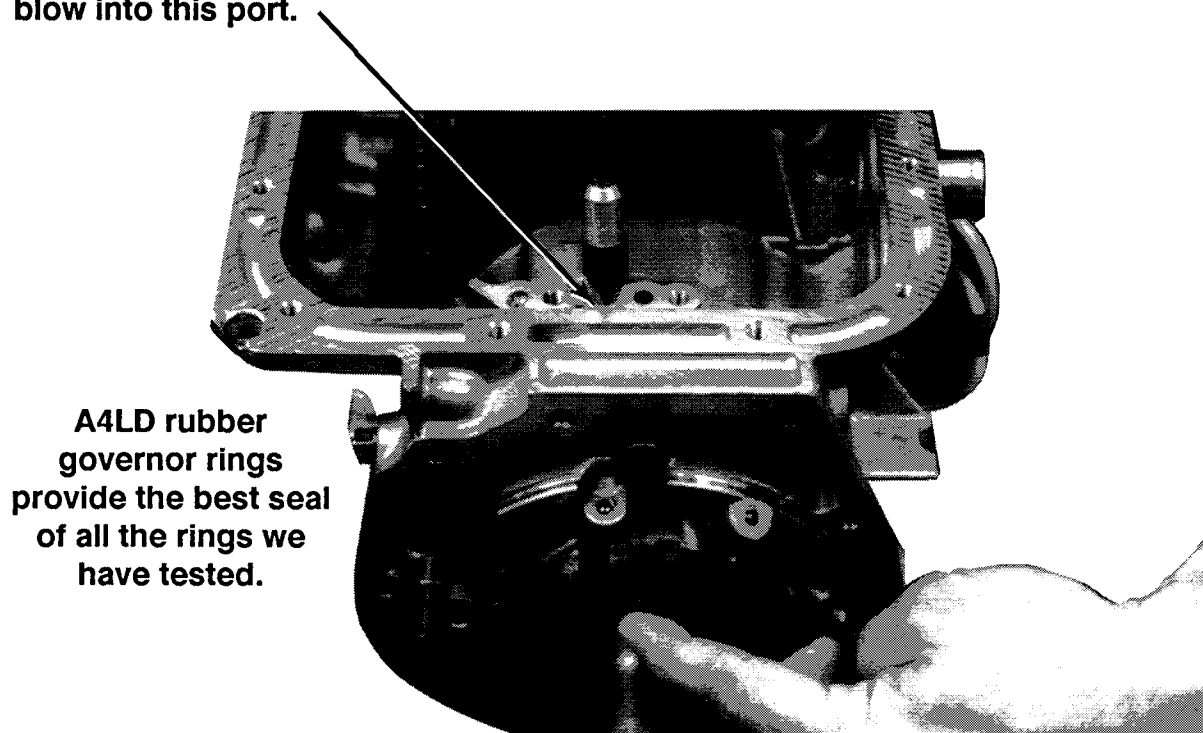


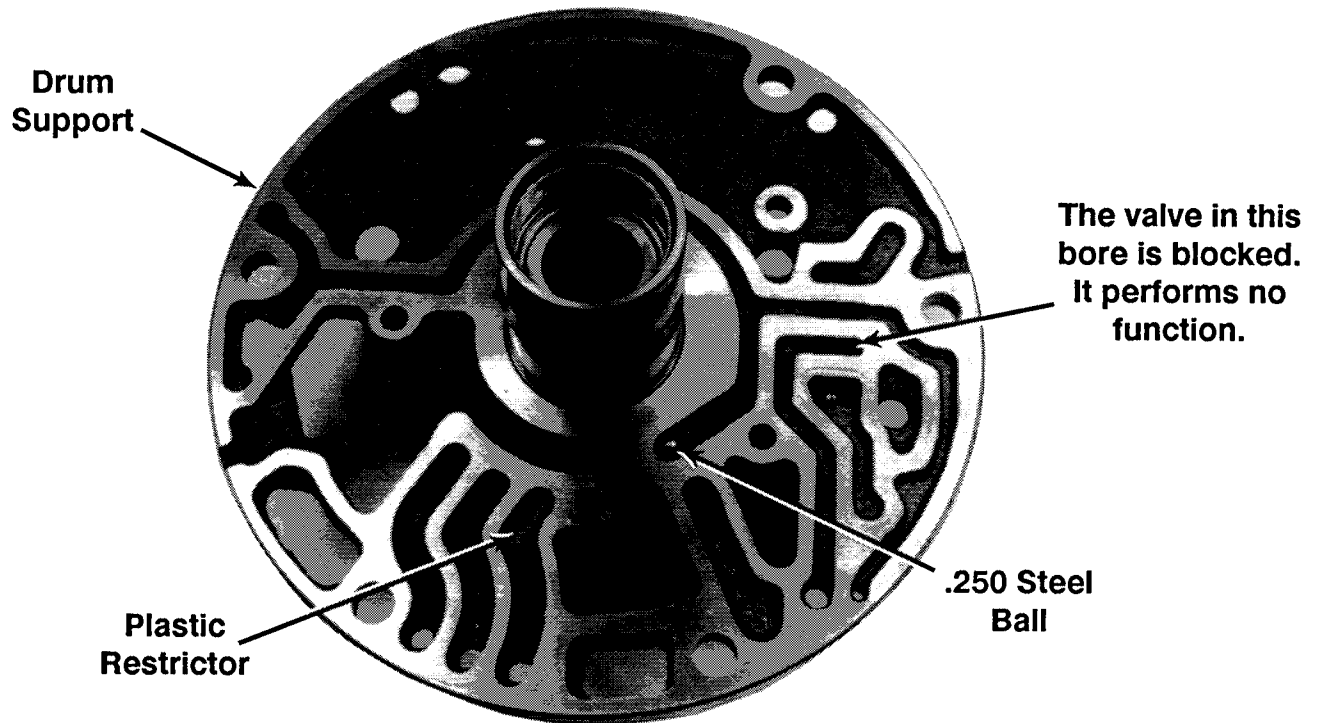
GEAR	1-2 Solenoid	2-3 Solenoid	3-4 Solenoid
1st	ON	ON	ON
2nd	OFF	ON	ON
3rd	OFF	OFF	ON
4th	OFF	OFF	OFF

* The 3-2 control solenoid controls the rate of apply of the band during a 3-2 downshift. It is not a kickdown solenoid.



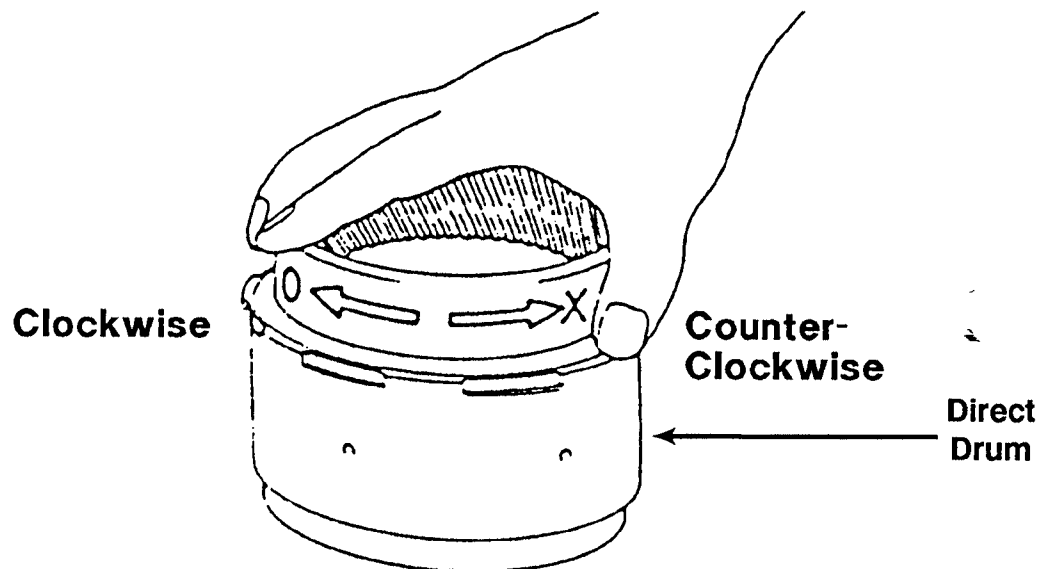
To air check the seal of these rings cover the spit hole with your finger and blow into this port.





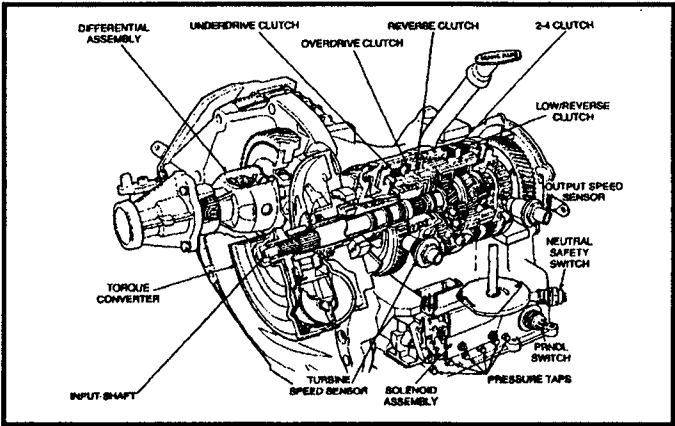
Overdrive Sprag Rotation

When properly installed the overdrive sprag will allow the ring gear to rotate clockwise and lock counter-clockwise.



NOTES

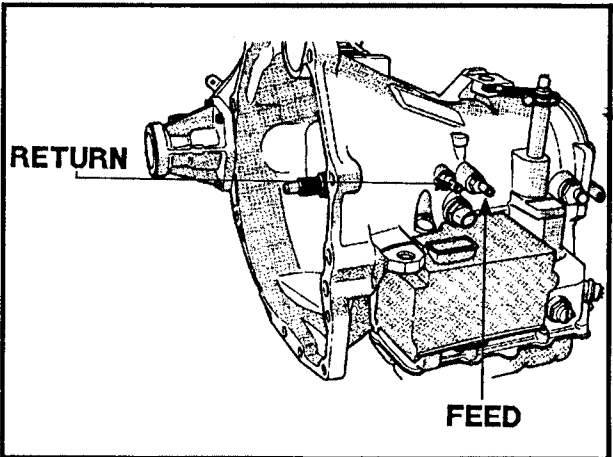
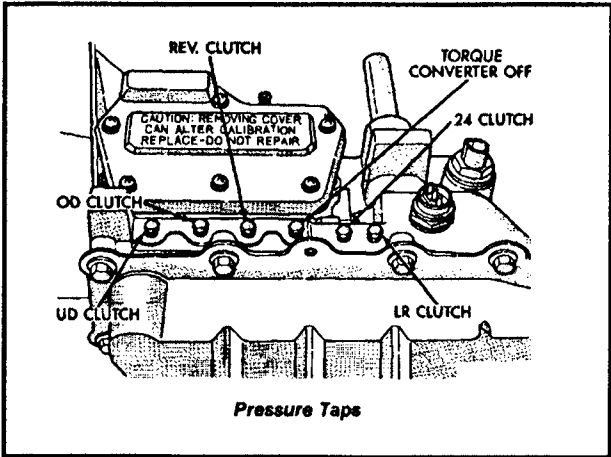
A-604 Fully Electronic FWD 4-Speed Automatic Transaxle



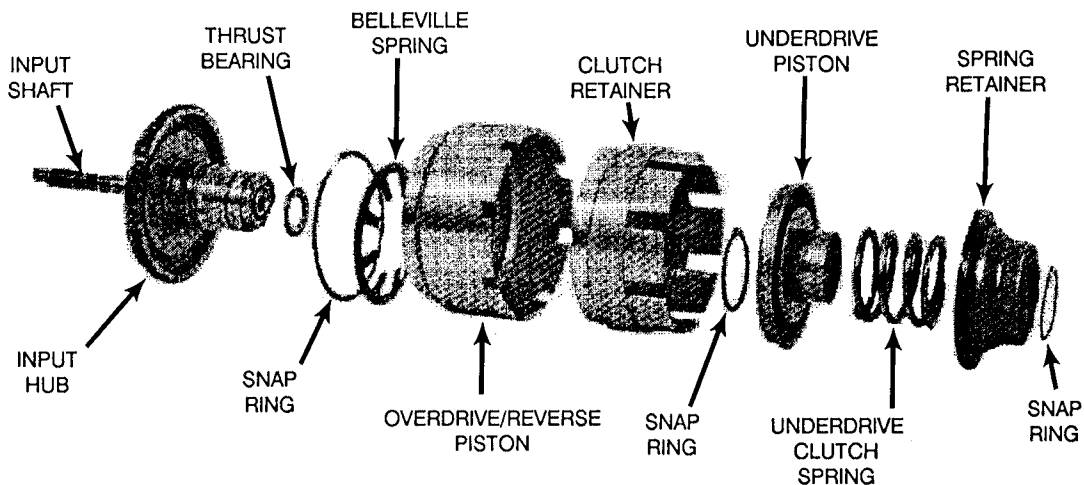
Chrysler

CLUTCH AND SOLENOID APPLICATION CHART

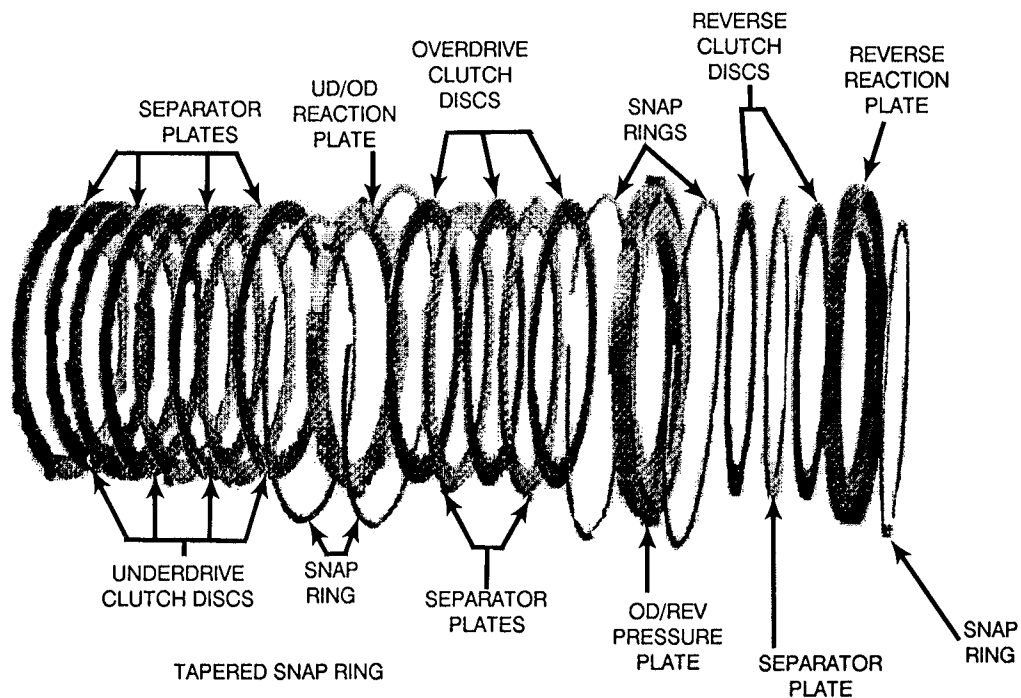
CLUTCH						SOLENOID			
GEAR	L & R	2-4	O/D	UD	REV	LR/LU	2-4/LR	UD	OD
P	X					X	X		
R	X				X				
N	X					X	X		
4TH		X	X					X	X
3RD			X	X			X		X
2ND		X		X					
1ST	X			X		X	X		



Component Identification



INPUT SHAFT, HUB, PISTONS AND RETAINER



INPUT CLUTCHES

A-604

Controllers

There have been (10) ten controllers used on Chrysler A-604 equipped vehicles. The following is a brief summary and description of improvements.

Part #'s 5234623, 5234649, 5234678

These are early 1989 controllers used on all models. these controllers would only allow a 3-1 closed throttle downshift which caused a harsh coastdown shift.

Part #4557120

This was introduced as a running change on 1989 models. It features smoother coasting closed throttle downshifts because it shifts 3-2-1 instead of 3-1, like the previous controllers. It also has new logic for improved high altitude operation. Another improvement incorporated in this controller is less 3-4 shift business when under load at highway speeds. This controller will replace #'s 5234623, 5234649 & 5234678 on all models.

Part #4557585

This controller replaced the #4557120 controller as a running change for 1990. It has further refinements of the logic to eliminate 3-4 shift busy ness when under load at highway speeds. This controller will allow the TCC to unlock in 4th gear for more available engine torque when required. This will retrofit to all years and models.

Part #4672104

New for early 1991 for all models and will retrofit to 1989.

Part #4672002

Released in late 1991, for all models, this will retro-fit back to 1989 vehicles, all models. It will not fit 1992 years.

Part #4672105

This is the latest service replacement controller for all 1989-1991 models. It has 1992 features but operates on a different C2D bus system. Therefore, it will not fit 1992 vehicles. This controller is preferred over all other controllers for 1989-1991 model years.

Part #4672203

New for 1992 all models except New Yorker, 5th Avenue and Imperial, will not retrofit to any earlier model years.

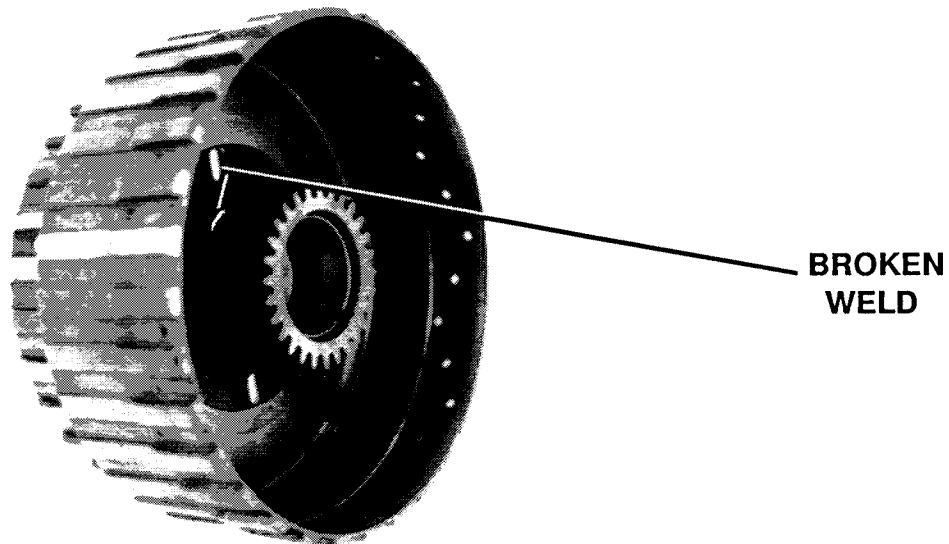
Part #4672216

New 1992 calibration for New Yorker, 5th Avenue and Imperial only. This controller will allow partial lock-up in 2nd gear for improved fuel economy. It will not retro-fit to any earlier model years.

Common Complaints and Failures

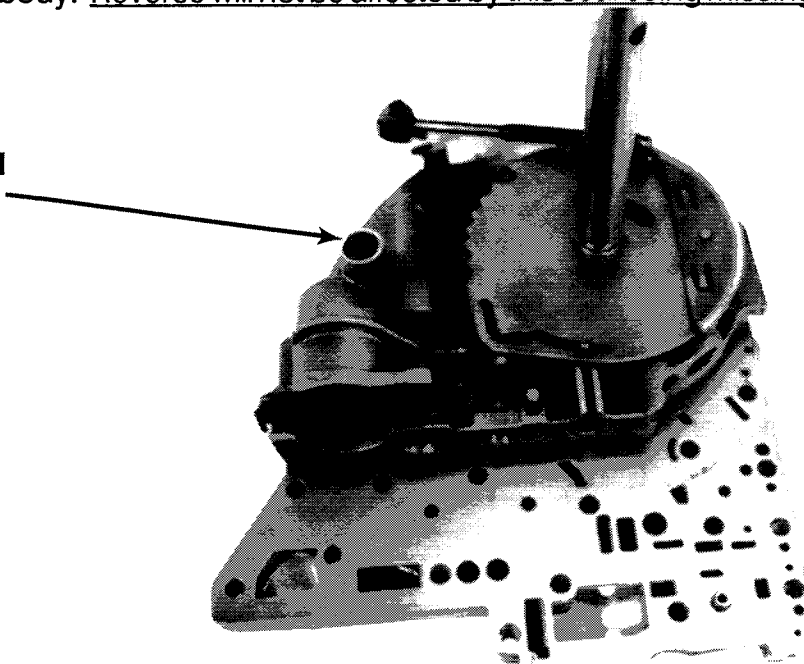
1. Stuck in 2nd after service (fluid and filter change) - A complaint of 2nd gear only (failsafe mode) after service may be caused by air in the hydraulic system which can cause improper pressure switch operation, resulting in failsafe (2nd gear only). Always run the vehicle in park until fluid level is completely full before attempting to road test the vehicle.

2. No reverse, shifts from first to neutral, then won't move until ignition is turned off. Upon restarting engine, will again shift from 1st into neutral then not move. This may be caused by a broken weld on the sun gear.



3. After overhaul or/valve body service a complaint of shifts from 1st to neutral then won't move until engine is turned off and restarted may be caused by a missing 2-4 clutch seal in the valve body. Reverse will not be affected by this seal being missing. See complaint #2 above.

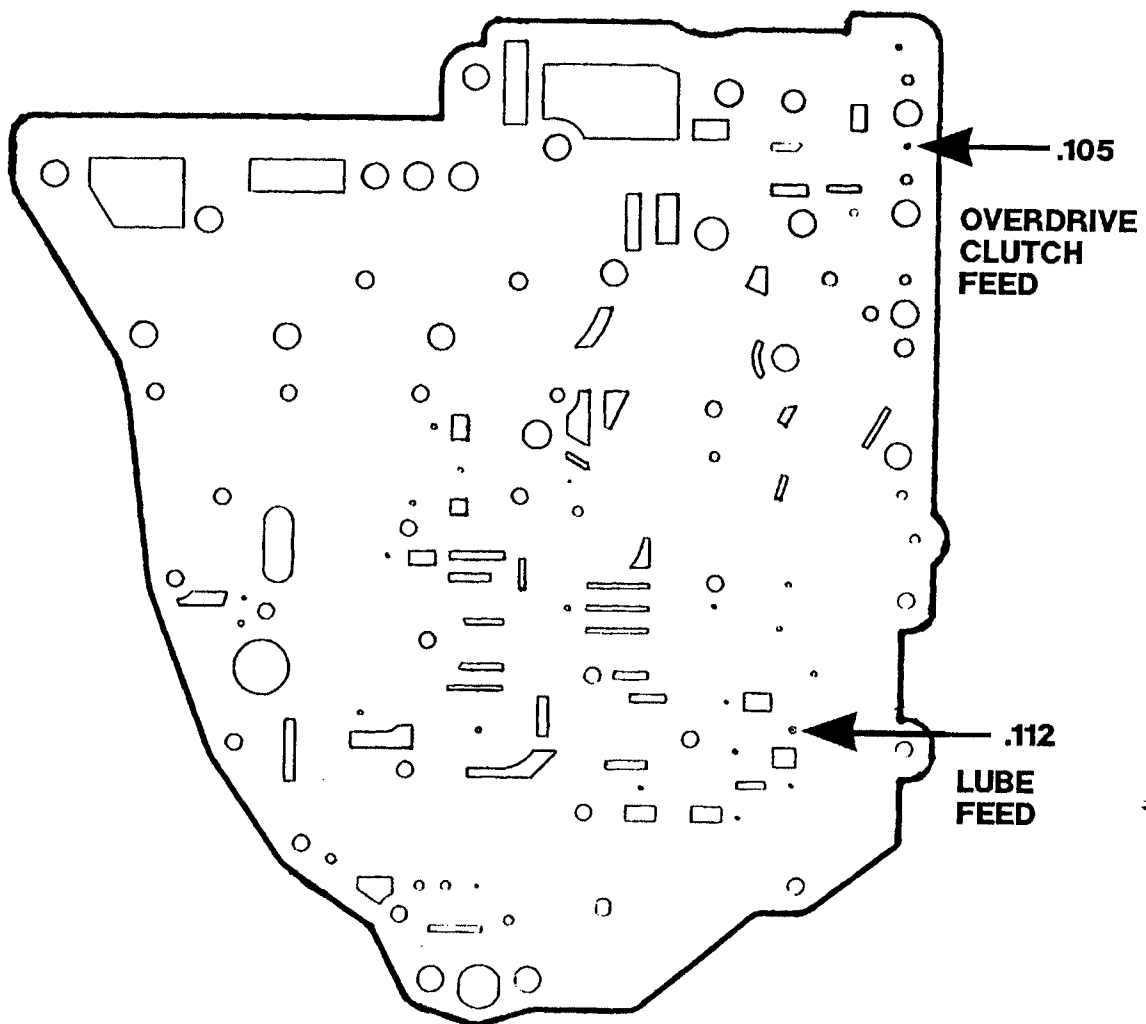
**2-4
CLUTCH
SEAL**



A-604

Spacer Plate Modification Guide

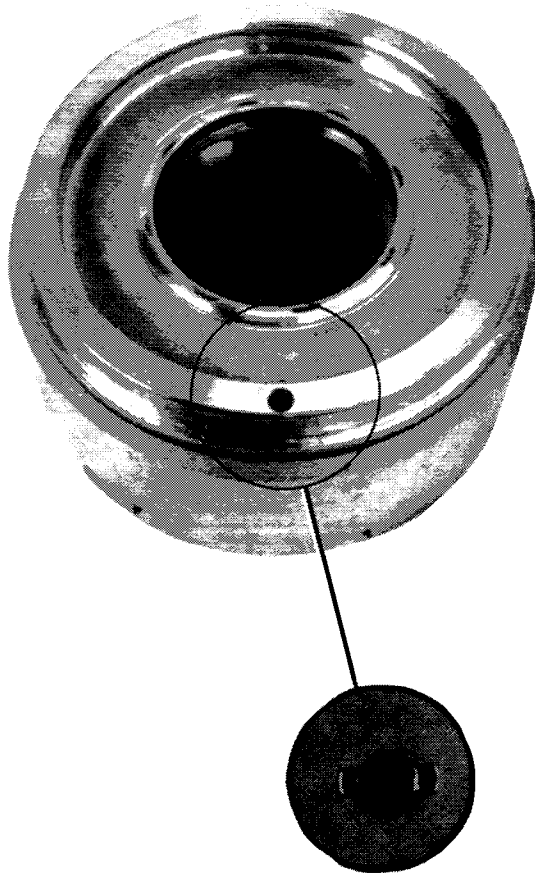
- *Modify all spacer plates as shown for all years and models.*
- *Later models already have the holes enlarged to the sizes shown.*



Burned Overdrive and/or Reverse Clutches

Burned overdrive and/or reverse clutches may be caused by the screened orifice being missing from the overdrive/reverse piston.

If the orifice is missing replace it with part #4531903 and stake it in place.



Update Information

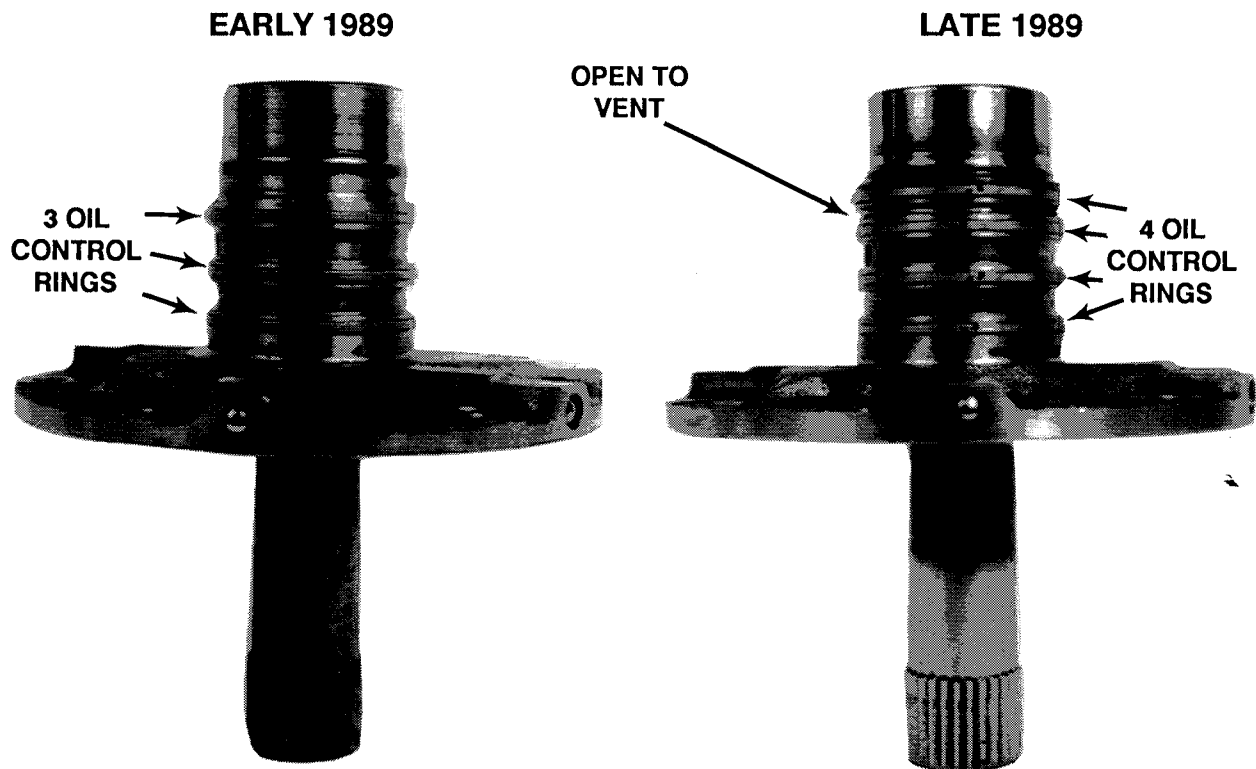
In late 1989, the A-604 input assembly was updated to help prevent damage caused by cross leaks between the overdrive and underdrive clutch circuits. Several parts were changed to accomodate this update.

There is an update kit available from Chrysler under Part #5241088 which includes:

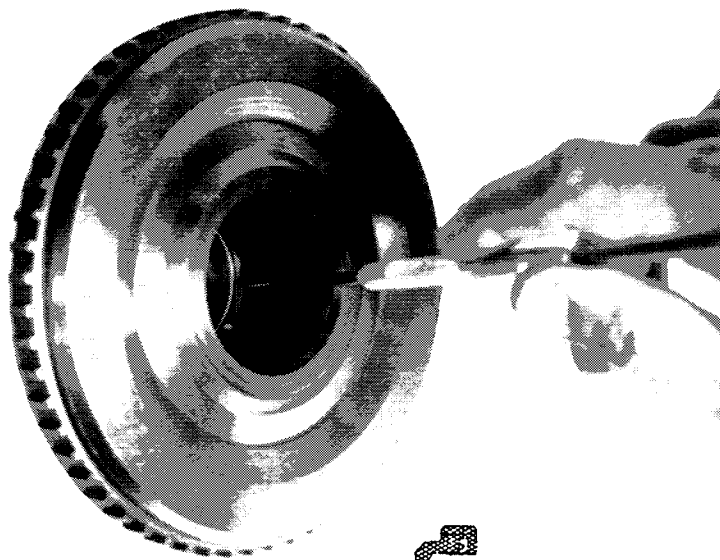
- New 4-ring pump assembly
- New input clutch hub
- New input clutch hub o-rings
- New spacer plate

A new input retainer is also required on some models, which is not included in the update kit. (See figure 3 for details) Chrysler also recommends replacement of the controller if it is part #5234623 or #5234649.

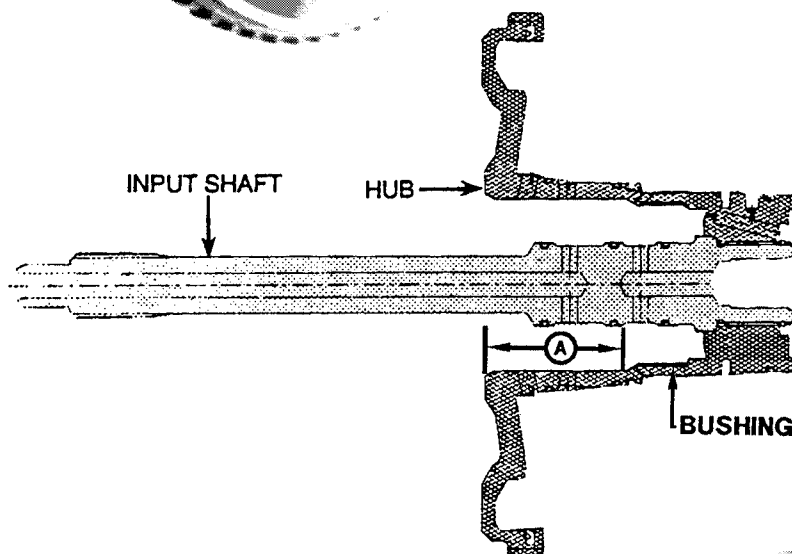
STATOR



INPUT HUB



Ring
bore is
deeper
to
accept 4
ring
stator



New input hub has wider (.125) o-ring grooves than previous models, and new larger (.103) cross-section o-rings.

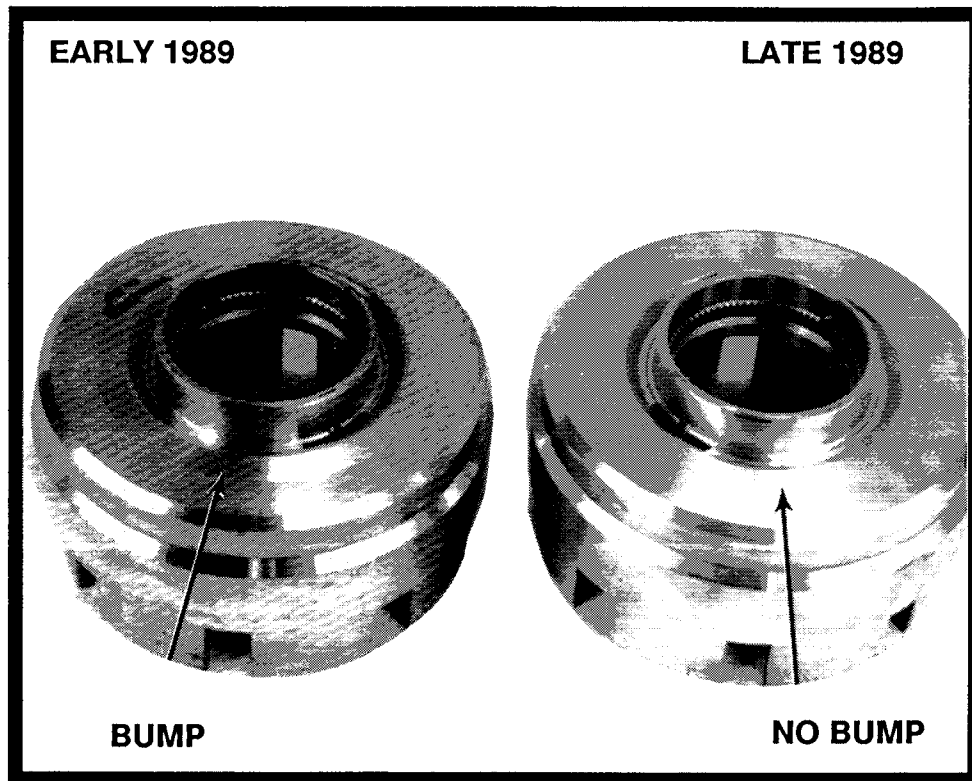
RED O-RING #6502269
BLUE O-RING #6502271



RETAINER

If your retainer has no bump then you can re-use it. If it has a bump, you must either replace it or have the bump machined off. NEVER use a retainer with a bump on it.

NEW RETAINER (NO BUMP)....#4431609



1989 to 1990 Update

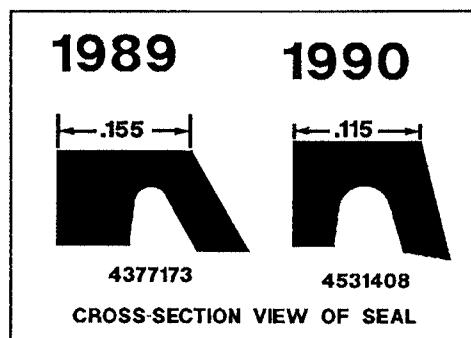
In 1990 the input assembly was changed to increase the overdrive clutches from three lined plates and two steel plates to four lined plates and three steel plates. This required several parts to be modified. Refer to the component identification and the following figures.

CHANGES

1. **INPUT RETAINER** - Top ring groove moved down .040. The outer lip seal groove is .040 shallower. Figure 1.
2. **LIP SEAL** - Base section .040 smaller to fit shallower groove. Figure 2.
3. **TAPERED RING** - (#1 in component ID) made .010 thinner.
4. Overdrive clutch thickness reduced to .072 (#2 in component ID). Overdrive steel thickness reduced to .070 (#3 in component ID).
5. Overdrive/underdrive reaction plate (#4 in component ID) made thinner. This plate is selective and comes in four different sizes to adjust underdrive clutch clearance to:
 - .215-.219 - #4531570
 - .234-.238 - #4531569
 - .253-.257 - #4531568
 - .273-.277 - #4531567

.125
BETWEEN
GROOVES

.080
BETWEEN
GROOVES



NEW
SEAL

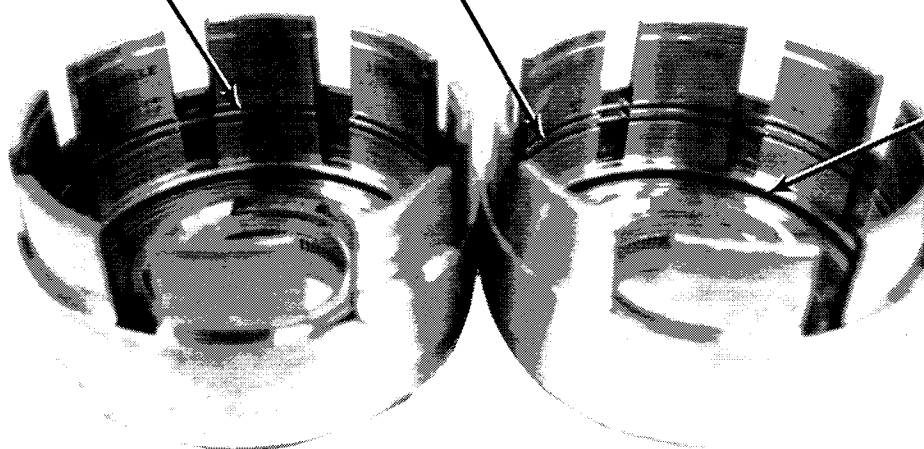


Figure 1

1990 - 1990 1/4

In 1990 1/4 the A-604 input assembly was again updated. The changes involved the input clutch hub and o-rings, the overdrive/reverse piston, the overdrive/reverse pressure plate and the input clutch retainer.

1. **INPUT CLUTCH HUB** -- The grooves are wider to accept larger o-rings. The cross section of the o-rings that fit in these grooves is larger. Figure 1.
2. The overdrive/reverse piston now has 4 slots instead of 8 slots to make it stronger. Figure 2.
3. The overdrive/reverse pressure plate now has 4 lugs instead of 8 to fit the new 4 slot piston. Figure 3.
4. The input clutch retainer has had the radius changed on the outer diameter to prevent lip seal damage during assembly. Figure 4.

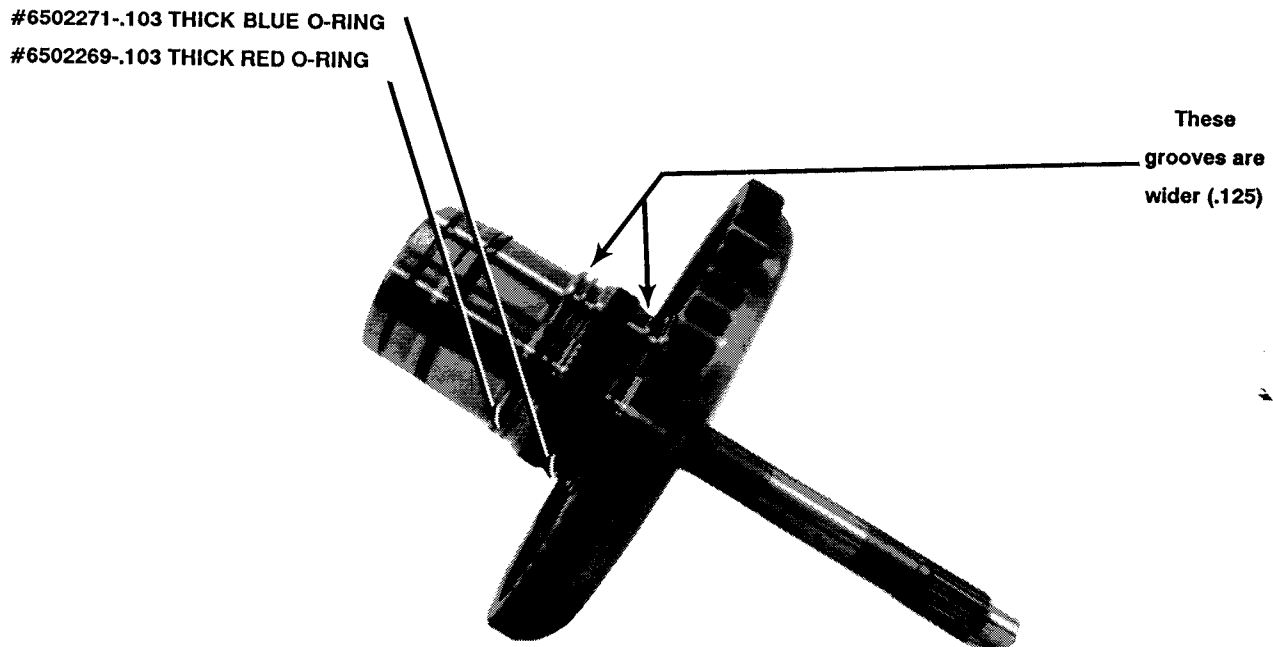


Figure 1

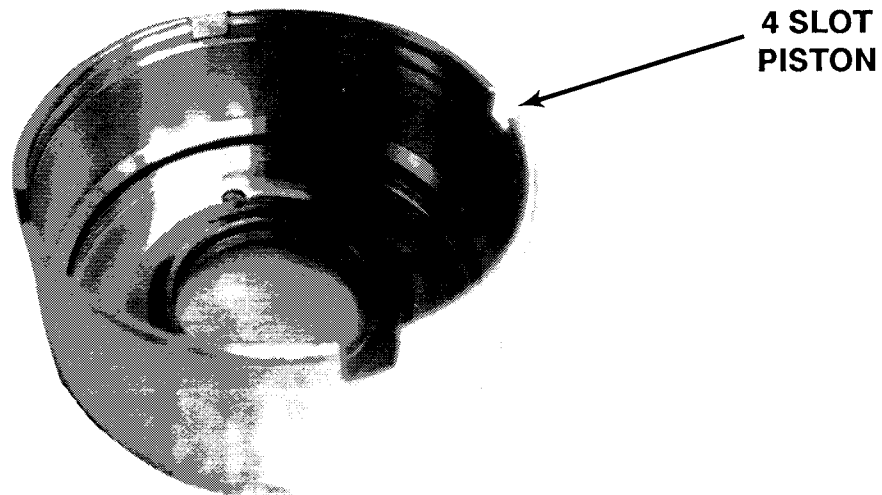


Figure 2

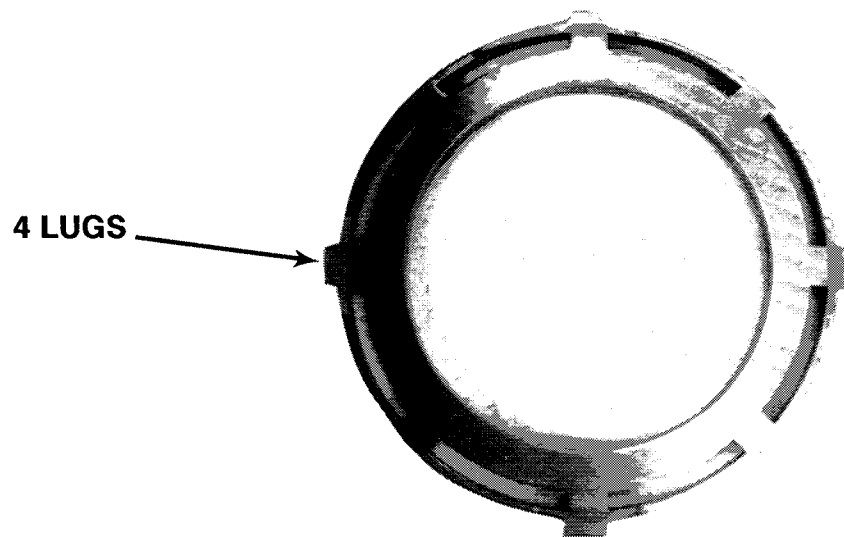


Figure 3

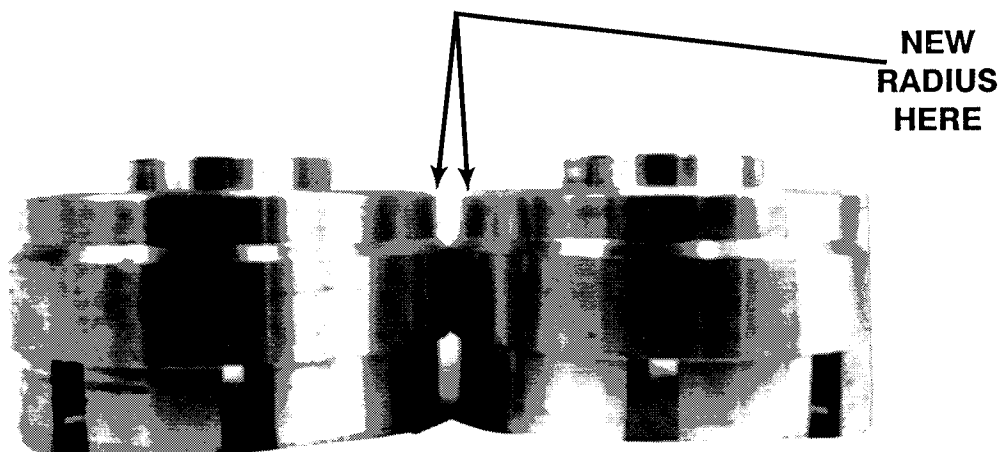


Figure 4

Assorted Assembly Tips and Information

Clutch Clearances

UNDERDRIVE CLUTCH CLEARANCE - .036 - .058 Adjust with selective plate

O/D CLUTCH CLEARANCE - .042 - .096 - No Adjustment

REVERSE CLUTCH CLEARANCE - .042 - .096 - Adjust with selective snap ring

L/R CLUTCH CLEARANCE - .042 - .065 - Adjust with selective plate

2/4/L/R Assembly Information

2/4 AND L/R plates look the same but:

2/4 clutches are .085 thick

2/4 steels are .100 thick

L/R clutches are .070 thick

L/R steels are .070 thick

The Low/Reverse reaction plate goes "step down" on assembly.

Transaxle End Play

Transaxle end play - .005 - .015 #4 washer is selective

Turbine Shaft

There are 2 different turbine shaft spline counts - 22 spline - 2.5L engines
24 spline - 3.0 & 3.3 engines

Available Gear Ratios

OUTPUT SHAFT GEAR	TRANSFER SHAFT GEAR	TRANSFER SHAFT	RING GEAR	OVERALL GEAR RATIO
55 Tooth	58 Tooth	17 Tooth	59 Tooth	2.52
55 Tooth	58 Tooth	16 Tooth	60 Tooth	2.72
59 Tooth	54 Tooth	16 Tooth	60 Tooth	2.36

Part Numbers

1989 Part Numbers

5241088 - EARLY 1989 UPDATE KIT
4431609 - LATE 1989 INPUT RETAINER
6502272 - LATE 1989 INPUT HUB ORANGE O-RING - .070
6502270 - LATE 1989 INPUT HUB GREEN O-RING - .070
4412875 - NEW INPUT HUB AND OVERDRIVE/REVERSE PISTON SEAL (FF CODE)

1990 Part Numbers

4505629 - O/D CLUTCH PLATES
4377183 - O/D STEEL PLATES
4505623 - 1990 INPUT CLUTCH RETAINER
4531408 - UNDERDRIVE CLUTCH OUTER SEAL (.115 BASE)
4531411 - UNDERDRIVE/OVERDRIVE TAPERED SNAP RING

1990 MODEL OVERDRIVE/UNDERDRIVE REACTION PLATES

.215-.219 - THICK	4531570
.234-.238 - THICK	4531569
.253-.257 - THICK	4531568
.273-.277 - THICK	4531567

1990 1/4 Part Numbers

4566310 - 4 SLOT PISTON & PRESSURE PLATE
6502271 - 1990 1/4 BLUE .103 O-RING
6502269 - 1990 1/4 RED .103 O-RING
4531637 - 1990 1/4 INPUT CLUTCH HUB

MISC.

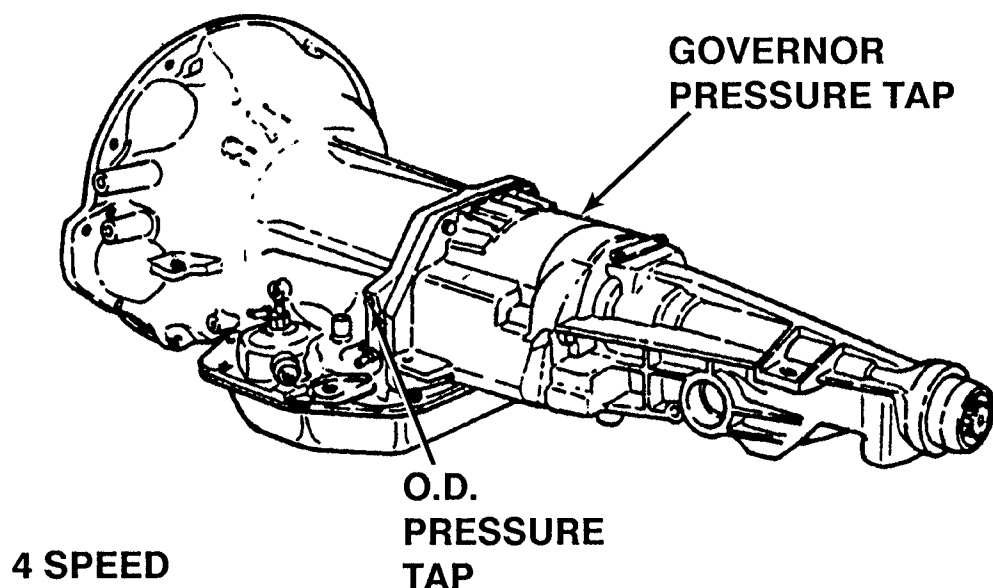
4531903 - OVERDRIVE/REVERSE PISTON SCREENED ORIFICE
4505579 - 22 SPLINE INPUT SHAFT
4412210 - 24 SPLINE INPUT SHAFT

Identification Application

Chrysler A-500 & 518

The A-500 is a four speed unit used in three Dodge truck lines. These include the mid-size Dakota, full size pick-up and the full size Van.

The A-518 is a larger unit resembling the case size of a TF-8. Besides the visual size difference the 518 did not have the lock-up convertor clutch installed until '92. The valve body previously lacked the TCC solenoid and valve line-up. The 518 has more direct clutches than the 500.

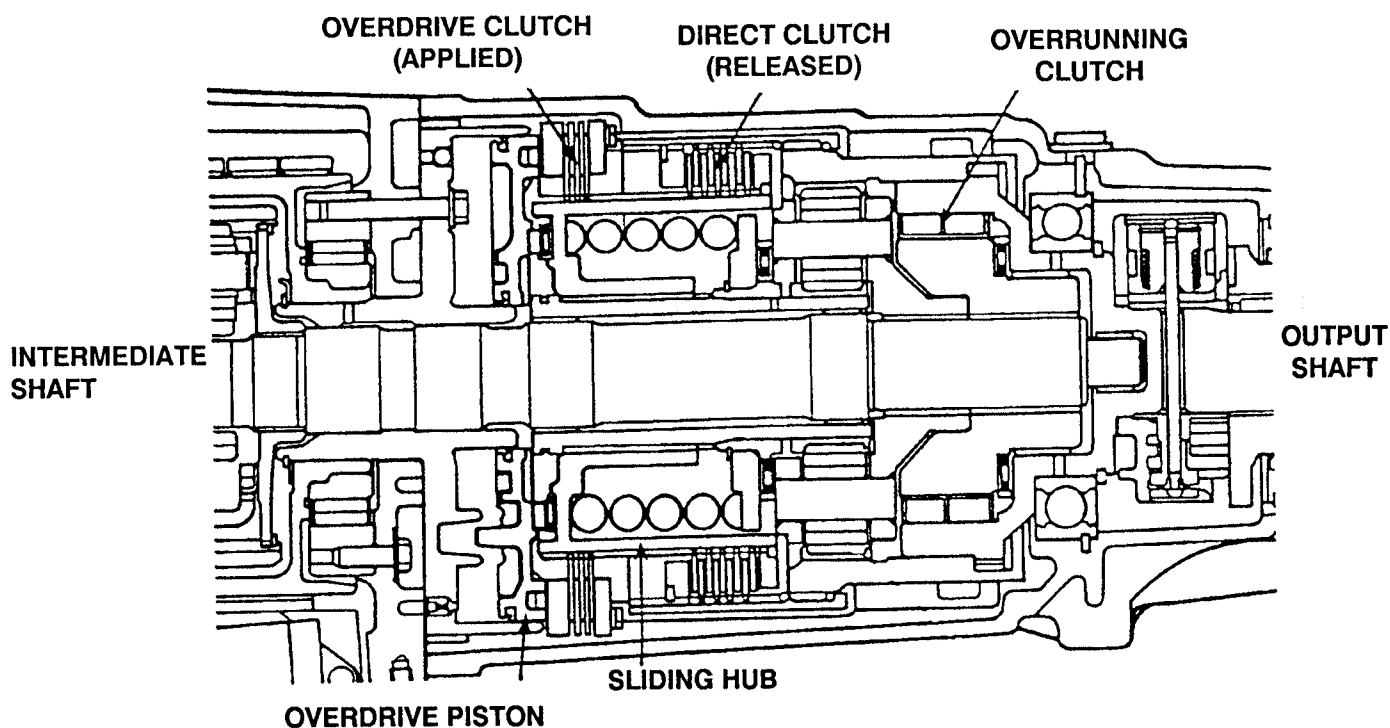
**SERIES I.D.**

B - Ram Wagon/Van
D - Ram Charger, Pick up, 4 x 2
W - Ram Charger, Pick up, 4 x 4
N - Dakota, Pick up

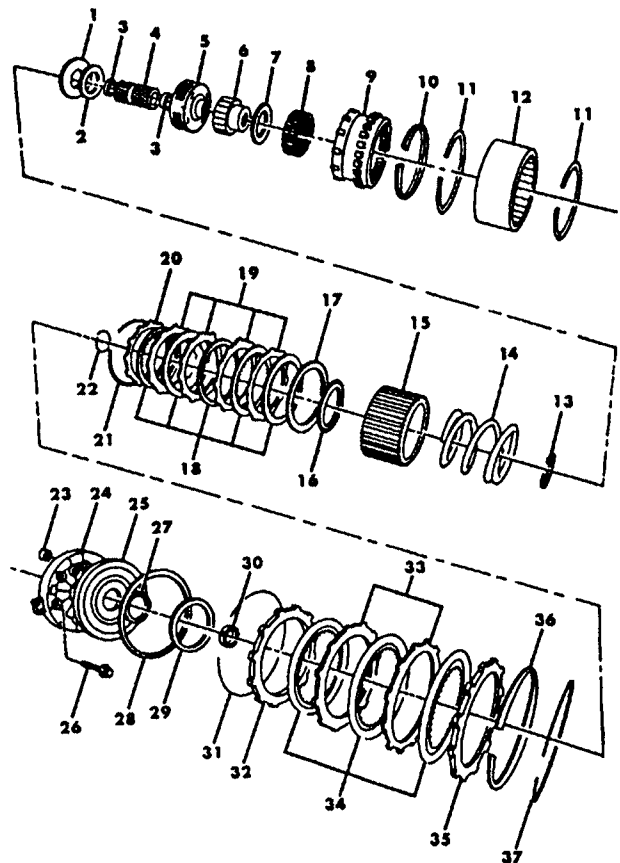
Power Flow

LEVER POSITION	GEAR RATIO	TRANSMISSION						OVERDRIVE		
		CLUTCHES				BANDS		CLUTCHES		
		FRONT	REAR	O'RUNNING	LOCKUP	K/D FRONT	REVERSE/REAR	O/D	O'RUNNING	DIRECT
P-Park										
R-Reverse	2.21	X					X			X
O-Drive										
First	2.74		X	X					X	X
Second	1.54		X			X			X	X
Third	1.00	X	X		X				X	X
O/D	.69	X	X		X			X		
2-Second										
First	2.74		X	X					X	X
Second	1.54		X			X			X	X
1-Low	2.74		X	X			X		X	X

The 500 series units both use conventional 3 speed powerflow in the front section.. Output is now transferred into the O.D. unit through an intermediate shaft.



500 - 518 Parts Identification Application



PARTS INDEX:

1	D.C. CLUTCH SPRING THRUST PLATE	#4461026
2	O.D. THRUST BEARING	#4461014
3	THROUGH (6) O.D. PLANET AND OVERRUN RACE ASSEMBLY	
7	O.D. THRUST BEARING	#4461014
8	CLUTCH ASSEMBLY	#4461015
9	O.D. ANNULUS GEAR	#4461012
10	SNAP RING	#5/14" O.D.
11	SNAP RING	6" O.D.
12	DIRECT CLUTCH DRUM	#4461040
13	DIRECT CLUTCH SNAP RING	2 3/16 O.D.
14	DIRECT CLUTCH SPRING	(800 LBS) #4461027
15	DIRECT CLUTCH HUB	#4461072
16	O.D. CLUTCH THRUST BRG.	#446724
17	DIRECT CLUTCH PRESSURE PLATE#	4461030

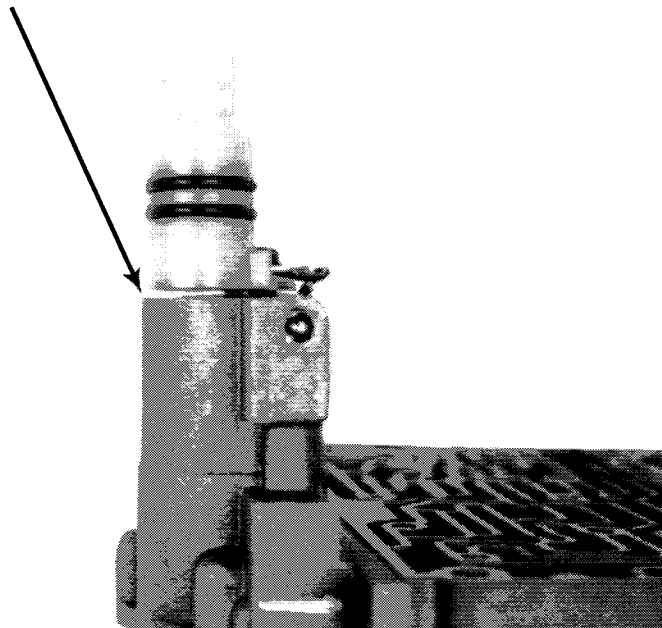
500 - 518 Parts Identification Application (Continued)

18 DIRECT CLUTCH FIBER
19 DIRECT CLUTCH STEEL

20 DIRECT CLUTCH REACTION PLATE	#4461031	
21 SNAP RING	Direct Clutch Wave	
22 SNAP RING	1 7/8"	Round
23 PISTON RETAINER FILTER (ORIFICE)	#4412583	
29 SELECTIVE THRUST PLATE(S) A-500 & A-518	.123-.125	#4431585
	.138-.140	#4431731
	.153-.155	#4431586
	.168-.170	#4431732
	.183-.185	#4431587
	.198-.200	#4431733
	.213-.215	#4431588
	.228-.230	#4431734
	.243-.245	#4431590
30 INTERMEDIATE SHAFT SELECTIVE SPACER		
	.158"	#4431916
	.175"	#4431917
	.193"	#4431918
	.211"	#4431919
31 O.D. CLUTCH PRESSURE SNAP RING (ROUND)		
32 - 35 O.D. CLUTCH PACK		

Overdrive Hydraulic/Electronics

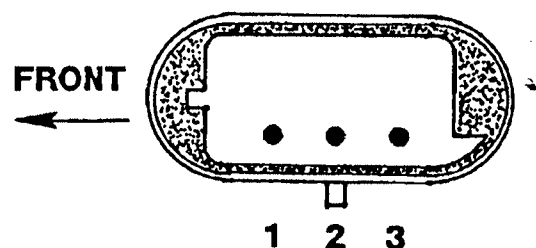
The lower valve body attaches to the existing three speed valve body. There is very limited parts compatability to earlier units.



The case connector as viewed from the top:

1. "Black" O.D. solenoid wire faces case front
2. "Red", +, common to both solenoids
3. "White" - TCC solenoid wire faces rear

ELECTRICAL TEST: 30-32 ohms 1 to 2
30-32 ohms 2 to 3
60-64 ohms 1 to 3
ground to any pin = infinity

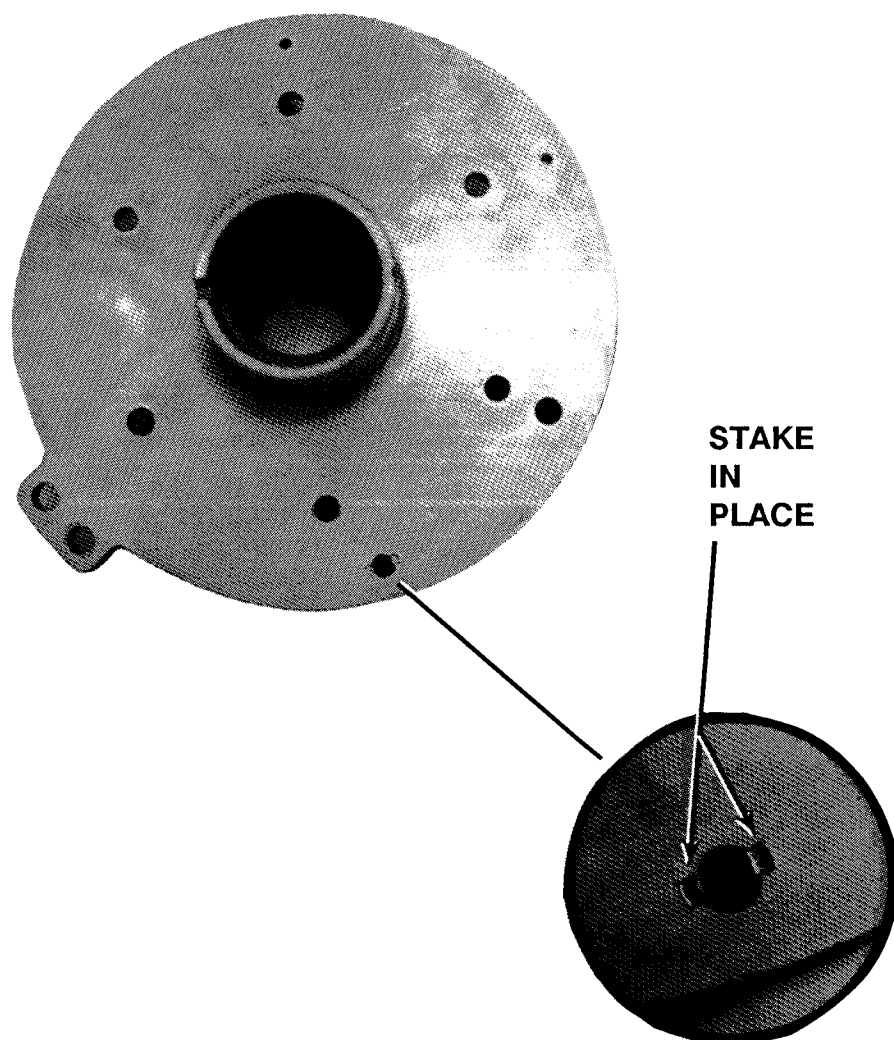


Chrysler - A500

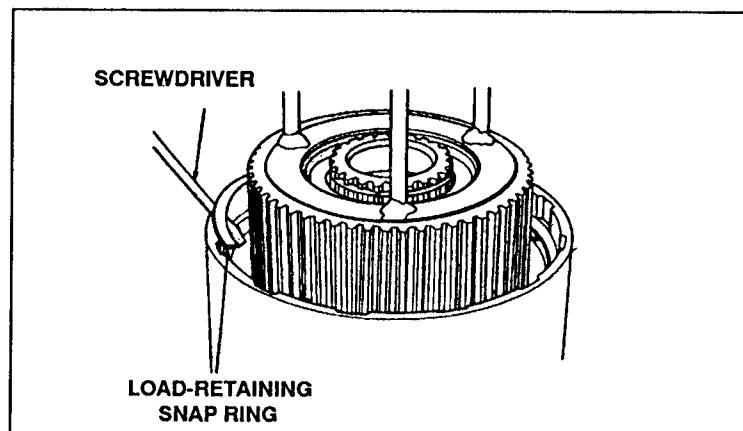
Burnt overdrive clutches may be caused by a missing screened orifice located in the intermediate shaft support.

A new orifice is available from Chrysler under part #4412583.

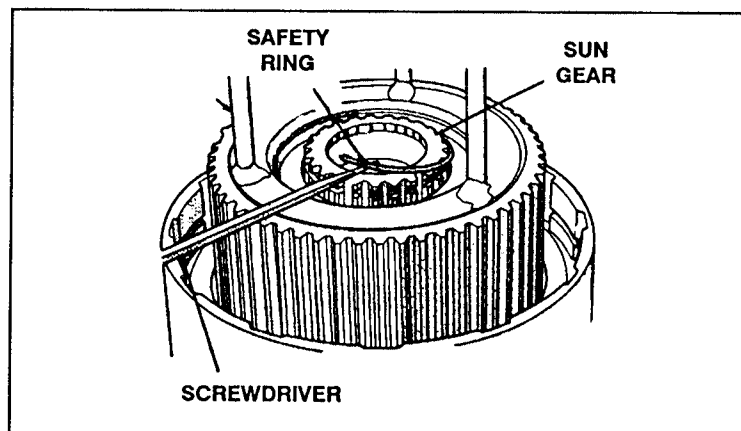
When installing the orifice be sure to stake it in place. Early 1989 units did not have the orifice staked in place from the factory. Beginning in mid-1989 the factory started staking the orifice and as a result they are less likely to blow out.



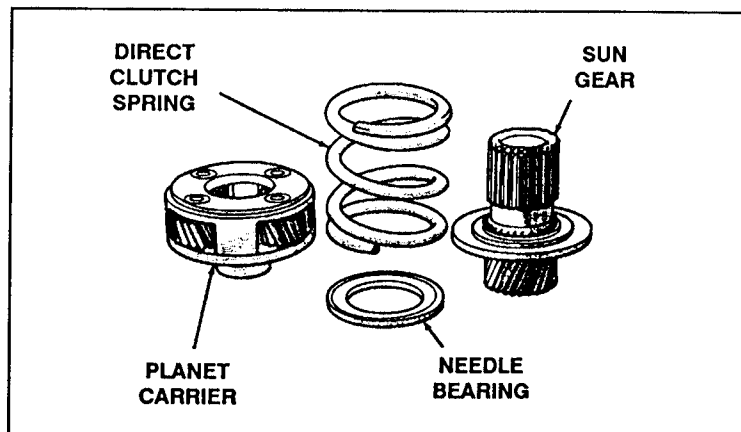
Overdrive Service Procedures



In order to dis-assemble the direct clutch a spring press with travel of at least 3" must be used and with capability of over 800 lbs.

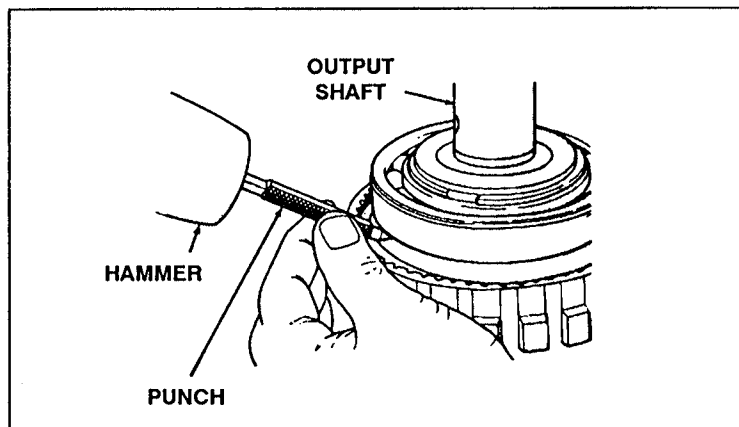


After compressing the hub with a sturdy fixture, remove the large drum snap ring first. Next remove the sun gear snap ring and carefully release the press.

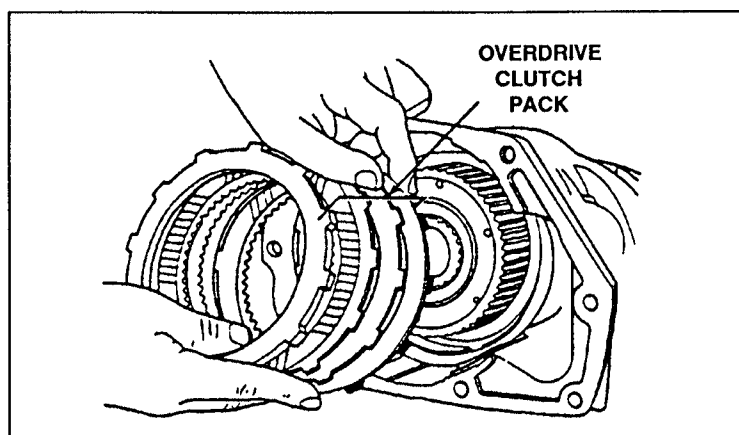
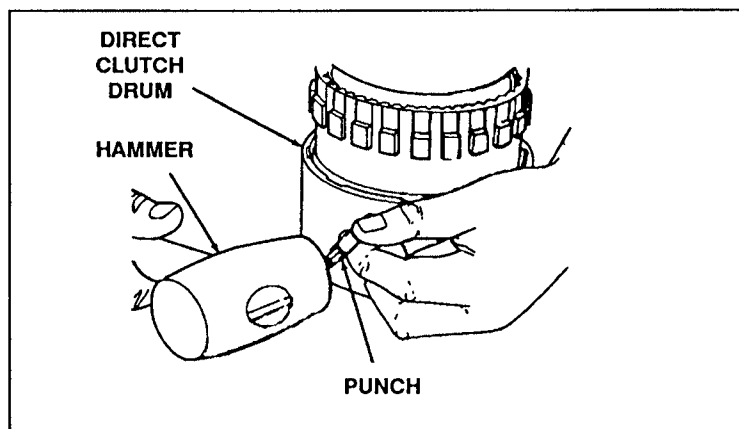


The needle bearing will take the full coil spring load upon direct clutch release.

Overdrive Service Procedures (Continued)



Chrysler Corporation suggests marking O.D. units on dis-assembly to insure proper balance upon assembly. *Figures 1 and 2.*

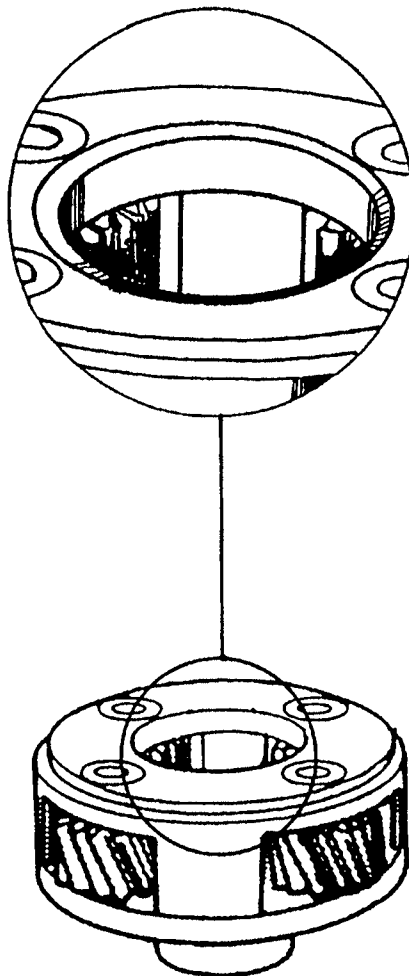


The overdrive clutch stack up uses the thickest plate on top. *Figure 3.*

A-500 Overdrive Planetary and Bearing Failure

CAUSES: Poor lube to planetary pinions. Bearing overload due to direct clutch thrust plate flexing from spring load.

REPAIR: 1. File a 45 degree chamfer on the inside edge of the planetary. The factory began chamfering all planetaries in late 89. Most replacements are chamfered but check all of them to be sure. (Figure 1)



FILE 45 DEGREE
CHAMFER .050 WIDE

Figure 1

2. Install a new O.D. thrust bearing #4461014

A-500 Overdrive Planetary and Bearing Failure (CONTINUED)

3. Install updated direct clutch thrust plate. Early unit has no index groove... (Figure 2) New plate has a machined bevel on bearing surface. (Figure 3) The late plate which has an index groove to identify it. Part #4461120.

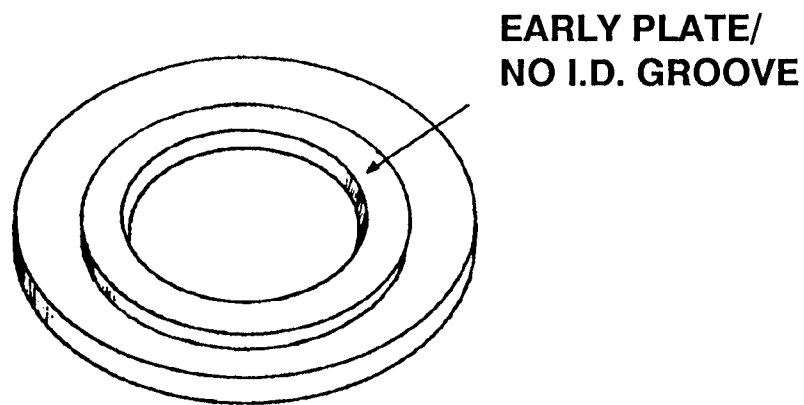


Figure 2

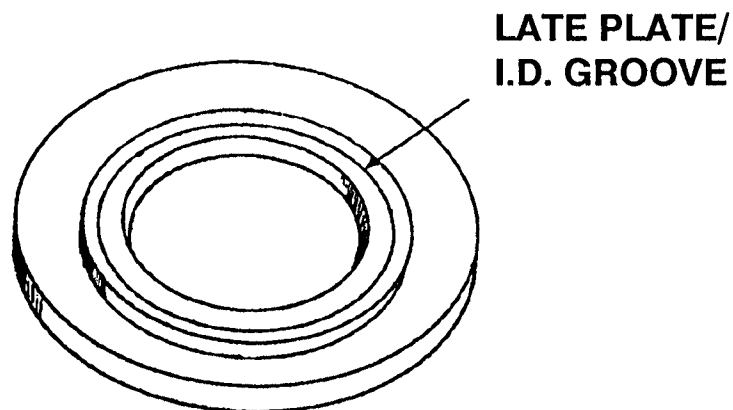
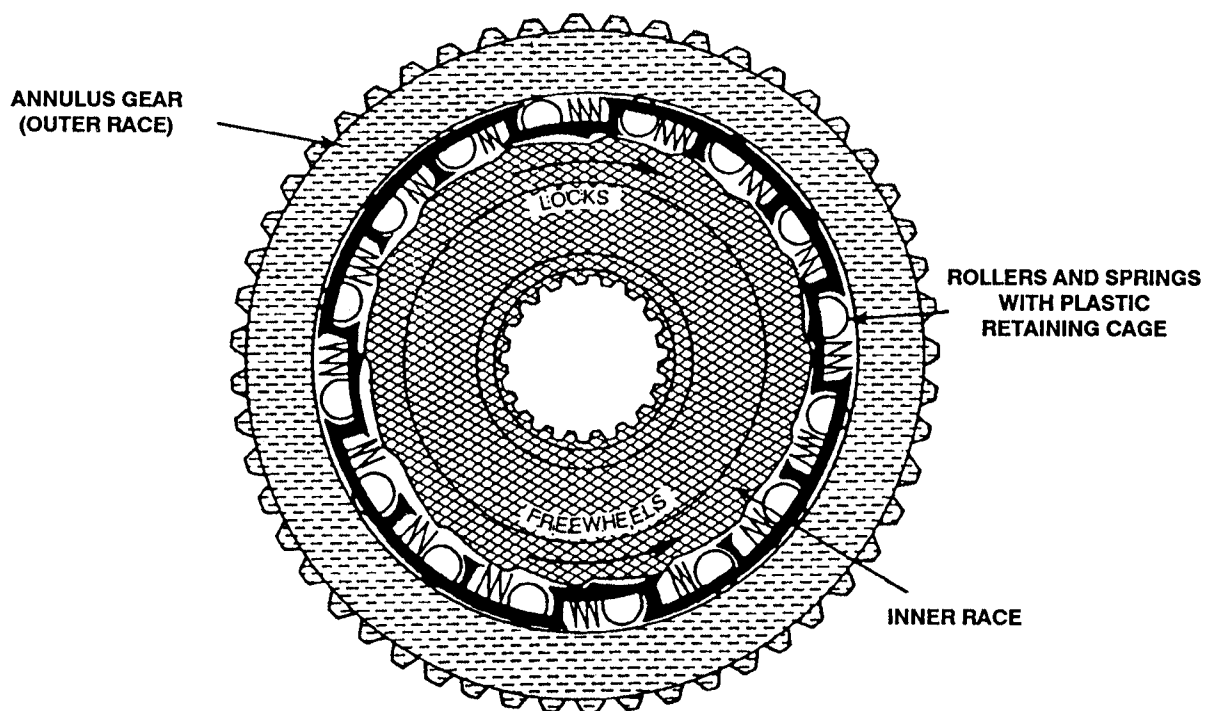


Figure 3

A-500

3-4 Flare/4-3 Flare

A 3-4 and/or a 4-3 flare may be caused by a defective overdrive roller clutch. The same symptoms can occur after overhaul if the roller clutch is installed backwards.



No 4th Gear

No 4th gear in an A-500/A-518 may be caused by improper snap ring installation. If either the "flat" snap ring or "waved" snap ring is installed in front (on top) of the overdrive clutch pack the overdrive piston will bottom on the snap ring, instead of applying the overdrive clutches.

Refer to the following figures for proper assembly.

1. Install flat snap ring first.

2. Install the waved snap ring on top of the flat ring in the same groove.

Figure 1.

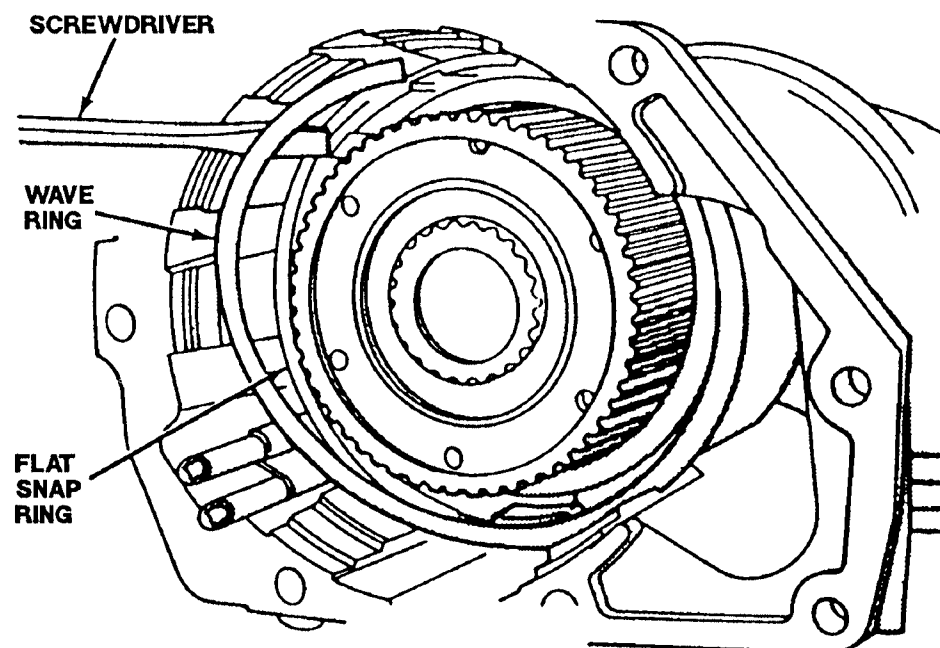
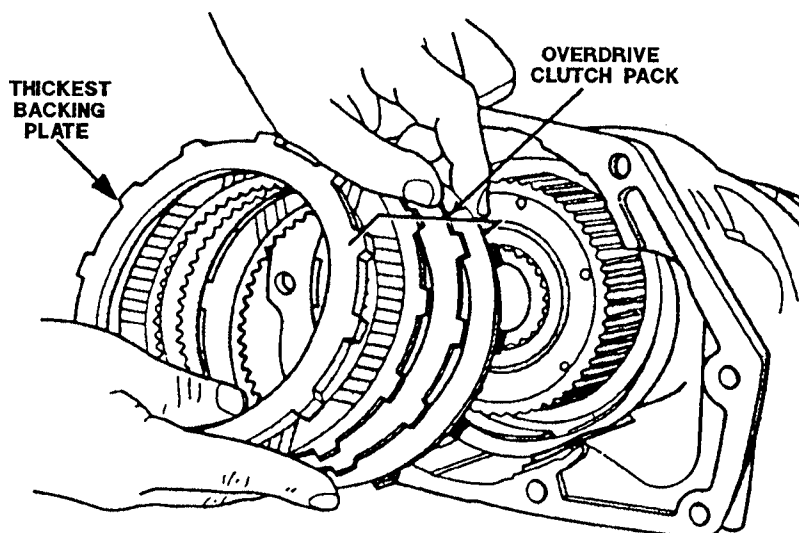
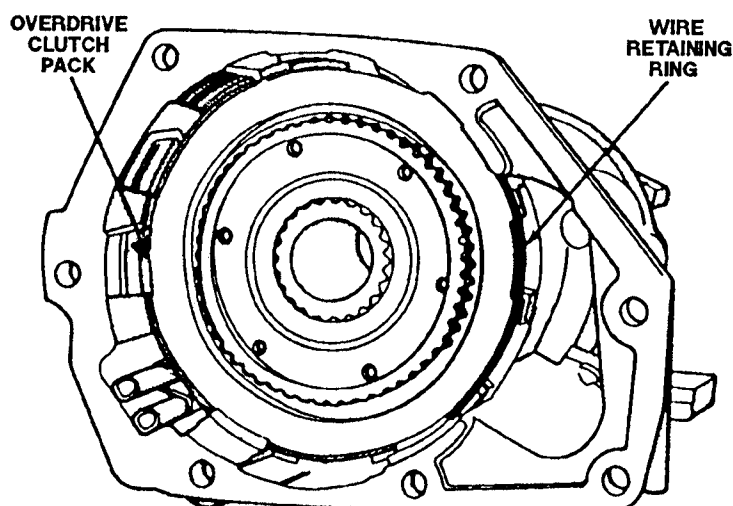


Figure 1

3. Install the overdrive clutch pack. Make sure to install the thin backing plate first, and the thick backing plate last. *Figure 2.*
4. Install the "wire" snap ring on top of the overdrive clutch pack. *Figure 3.*
5. Make sure to measure for proper thrust plate selection. See next page.

*Figure 2**Figure 3*

Chrysler A-500

Thrust Plate Selection Procedure

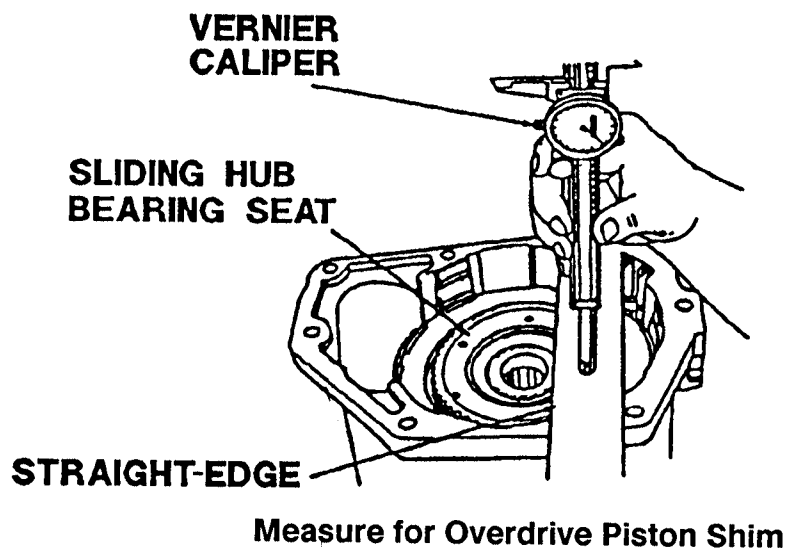
Proper thrust plate selection is very important to prevent 3-4 bind-up, slipping in reverse, and no "engine braking". Use this method to choose the proper thrust plate thickness.

- STEP 1** Assemble entire overdrive section.
- STEP 2** Support extension housing upright in a vise or holding fixture.
- STEP 3** Lay a suitable straight-edge across the extension housing gasket surface.
- STEP 4** Using a depth micrometer or a vernier caliper, measure the distance to the sliding hub bearing seat, WITH THE BEARING REMOVED.
- STEP 5** Measure in 4 places, 90 degrees apart.
- STEP 6** Add all 4 measurements together, then divide this number by 4. This is the AVERAGE MEASUREMENT.
- STEP 7** Measure the thickness of the straight-edge, and subtract this amount from the AVERAGE MEASUREMENT.
- STEP 8** Refer to the chart for selection.

EXAMPLE

Measurement	
1.	1.491
2.	1.488
3.	1.492
4.	<u>1.489</u>
TOTAL = 5.960	
DIVIDE ÷ <u>4</u>	
= 1.490--- > (AVERAGE MEASUREMENT)	
MINUS - <u>.158</u> --- > (STRAIGHT-EDGE THICKNESS)	
<u>1.332</u> --- > Compare this number to the chart	
for proper thrust plate selection.	

Chrysler A-500 (Continued)



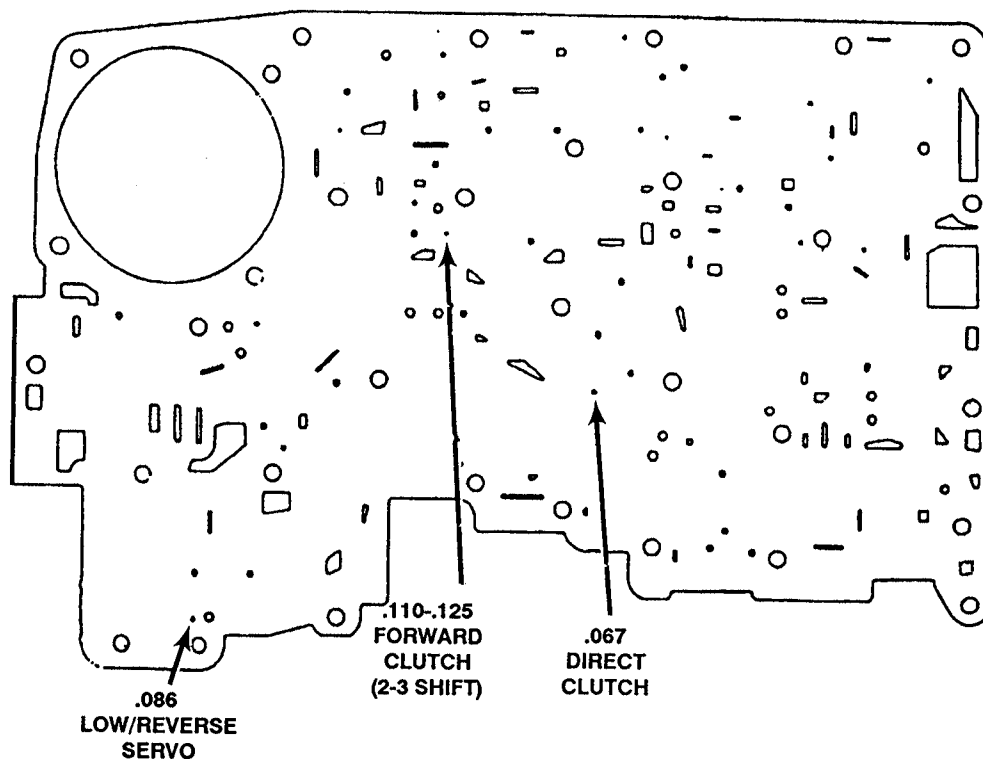
MEASUREMENT (INCHES)	SPACER PART NUMBER	SPACER THICKNESS (INCHES)
1.250 - 1.264	4431730	.108 - .110
1.265 - 1.279	4431585	.123 - .125
1.280 - 1.294	4431731	.138 - .140
1.295 - 1.309	4431586	.153 - .155
1.310 - 1.324	4431732	.168 - .170
1.325 - 1.339	4431587	.183 - .185
1.340 - 1.354	4431733	.198 - .200
1.355 - 1.369	4431588	.213 - .215
1.370 - 1.384	4431734	.228 - .230
1.385 - 1.399	4431590	.243 - .245

In this example our thrust plate selection would be part #4431587, which is .183-.185 thick.

Slips In 3rd Or Reverse, 2-3 Flare, Delayed Reverse, No 3rd Or Reverse & Direct Clutch Burn Up

Always use the viton rubber rings on the center support. Teflon at this location can leak 10-20% of the apply oil. Metal rings can leak over 25%. Direct clutch viton rings are Ford part number E5TZ-7D429-A. Drill the three holes in the separator plate as shown.

NOTE: Enlarging the direct clutch orifice more than the size shown can cause a 2-3 flare. The flare can often be corrected by removing the intermediate servo return spring.



IMPORTANT:

THESE ARE NEW SPECS ON HOLE SIZES.

A4LD

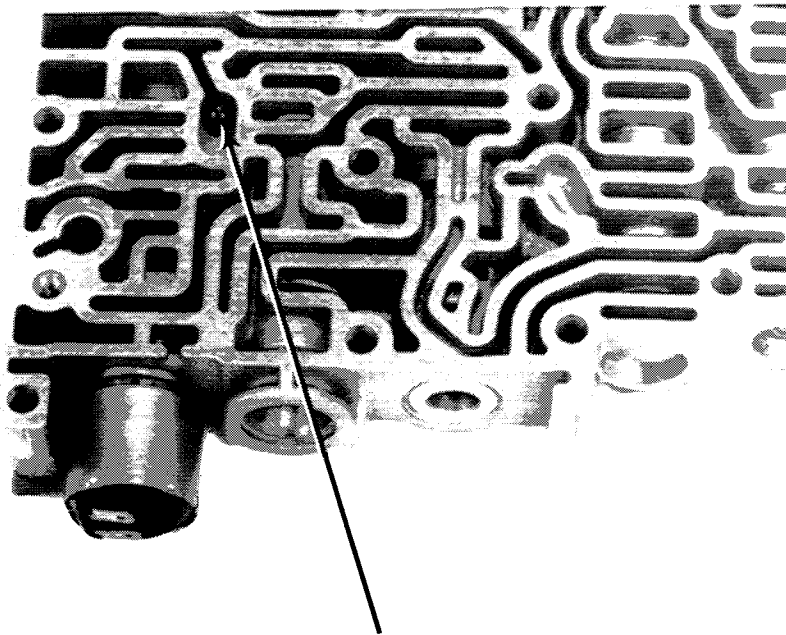
Lugs the Engine When Coming to a Stop. (The Torque Converter Clutch Won't Release.)

If you have an A4LD that lugs the engine when coming to a stop, you may have a TCC release problem. Use the following steps to correct it.

STEP 1 Disconnect the lock-up cancel solenoid wires.

The converter clutch should not apply with the wires disconnected. If it does apply, go to Step 2. If it does not apply, check for a shorted ground wire or a computer malfunction.

STEP 2 Make sure the check ball is installed.



Make sure this check ball is installed.

Figure 1

STEP 3 Make sure the solenoid isn't stuck.

With the solenoid de-energized, apply air in the end, (figure 2) air should come out of hole "B". With the solenoid energized, air should come out of hole "A".

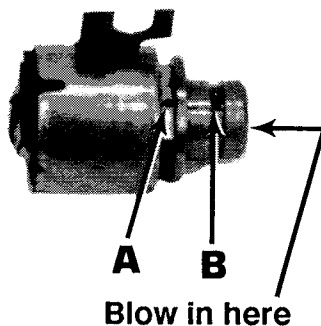


Figure 2

STEP 4 Enlarge the solenoid feed hole in the separator plate.

Enlarge the solenoid feed to 1/16" (Figure 3). If you have a separator plate with a screen in the feed hole, leave the hole alone, just make sure the screen is clean.

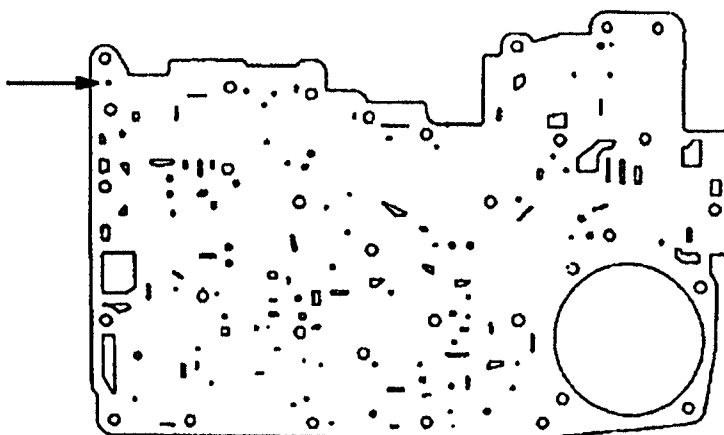


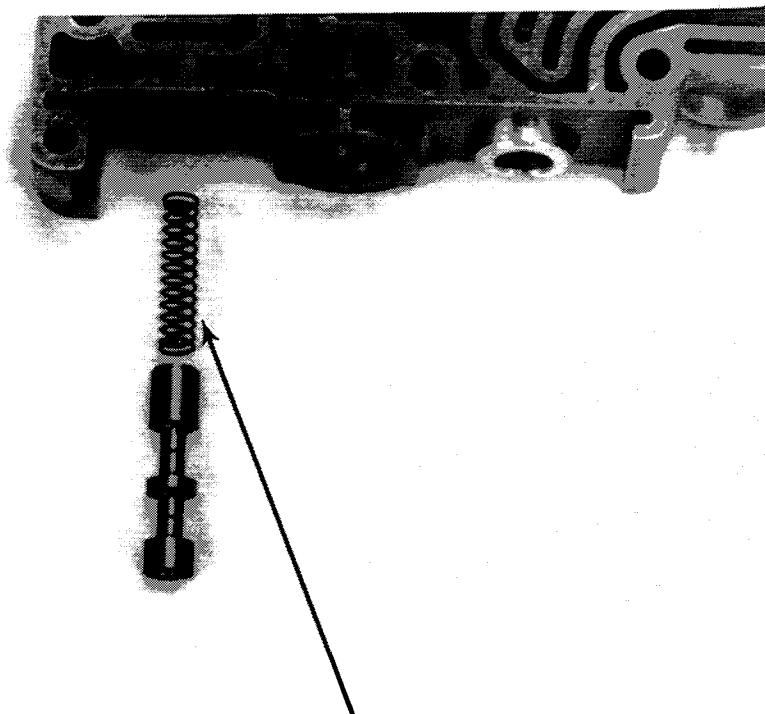
Figure 3

- STEP 5** Make sure the valve body is flat.
This is an extremely common problem.

Flat file the valve body to get rid of any high spots.

- STEP 6** Replace the shuttle valve spring.

Replace the shuttle valve spring with a spring that weighs 6 pounds at .500". Figure 4.



Use a 6 pound spring here

Figure 4

A4LD

No Movement After Rebuild

An A4LD that won't move after rebuild could be caused by no torque converter charge. The first thing to check is line pressure. If the line pressure is high you might have the wrong modulator or the modulator valve might be stuck. Figure 1 shows how to I.D. an A4LD modulator.

9/32" Deep Counter Bore

1/8" Deep Counter Bore

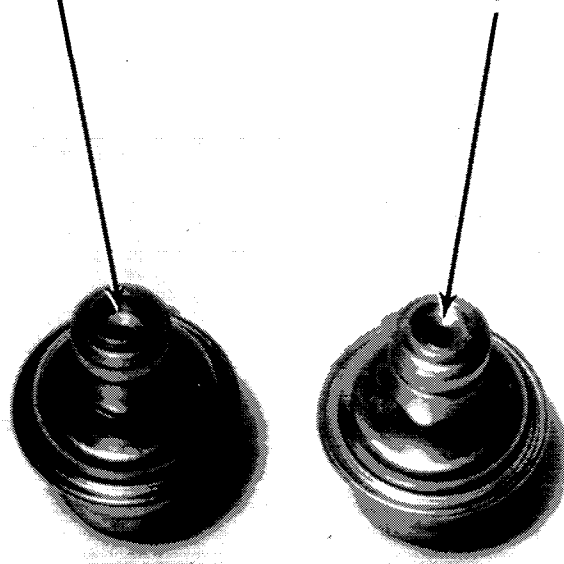


Figure 1

A4LD

C-3

If line pressure is normal, check to see if the transmission is pumping oil out to the cooler. Remove the outgoing cooler line (the bottom line) and see how much oil flows out with the engine running. You should get about one quart in 15-20 seconds. No oil to the cooler would indicate no torque converter charge. To correct this, drill a .040"-.060" hole in the valve body as shown in figure 2. Drilling this hole lets line pressure feed directly into the torque converter charge circuit.

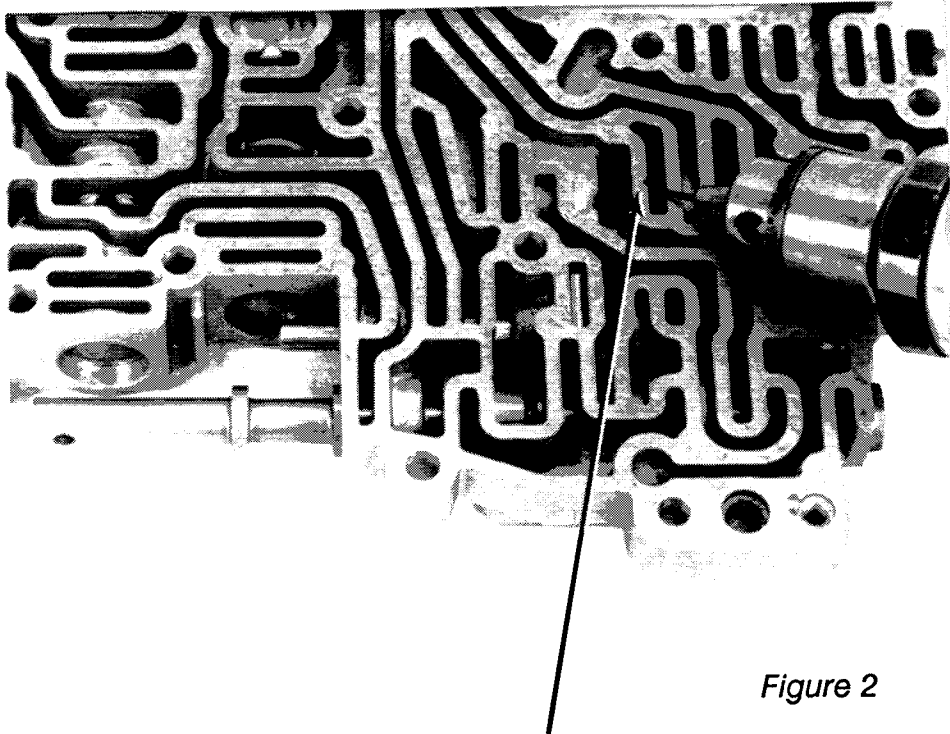


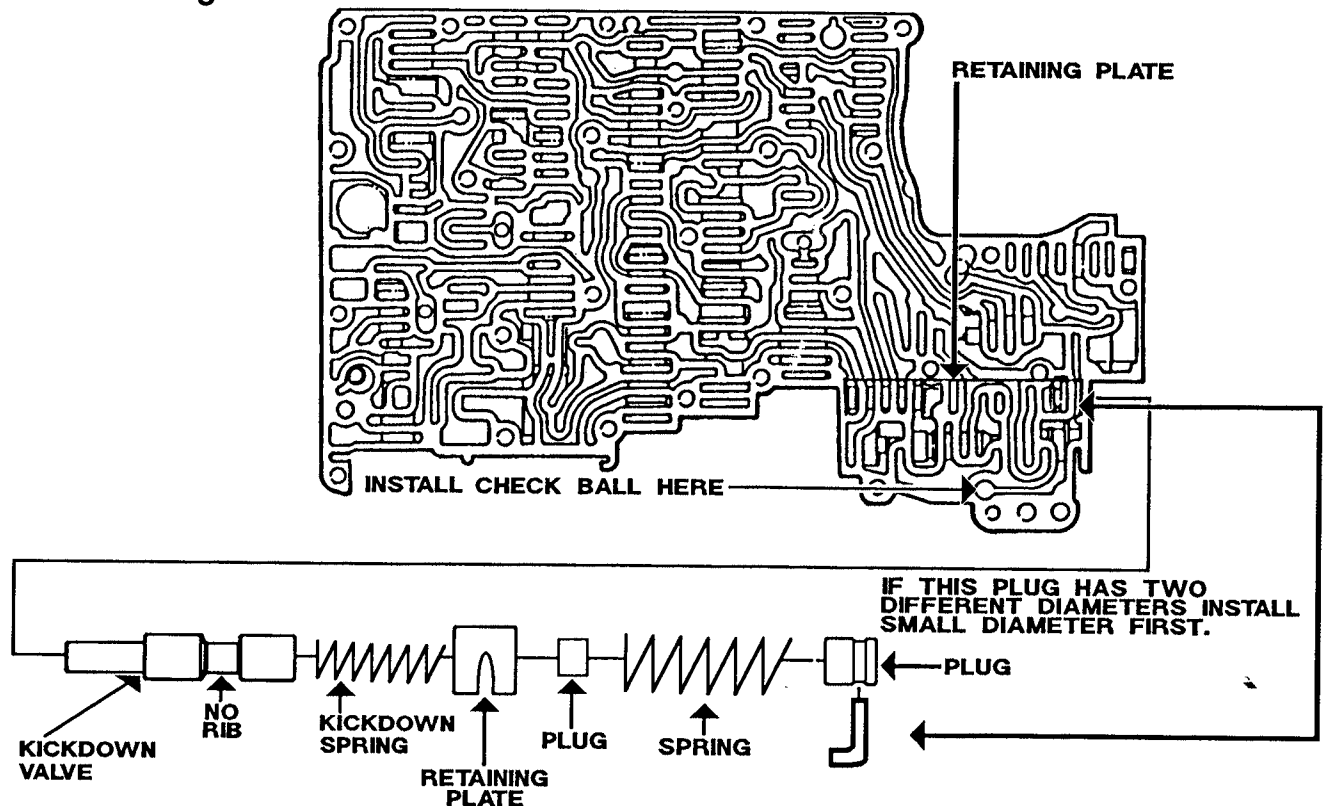
Figure 2

Drill through this wall.

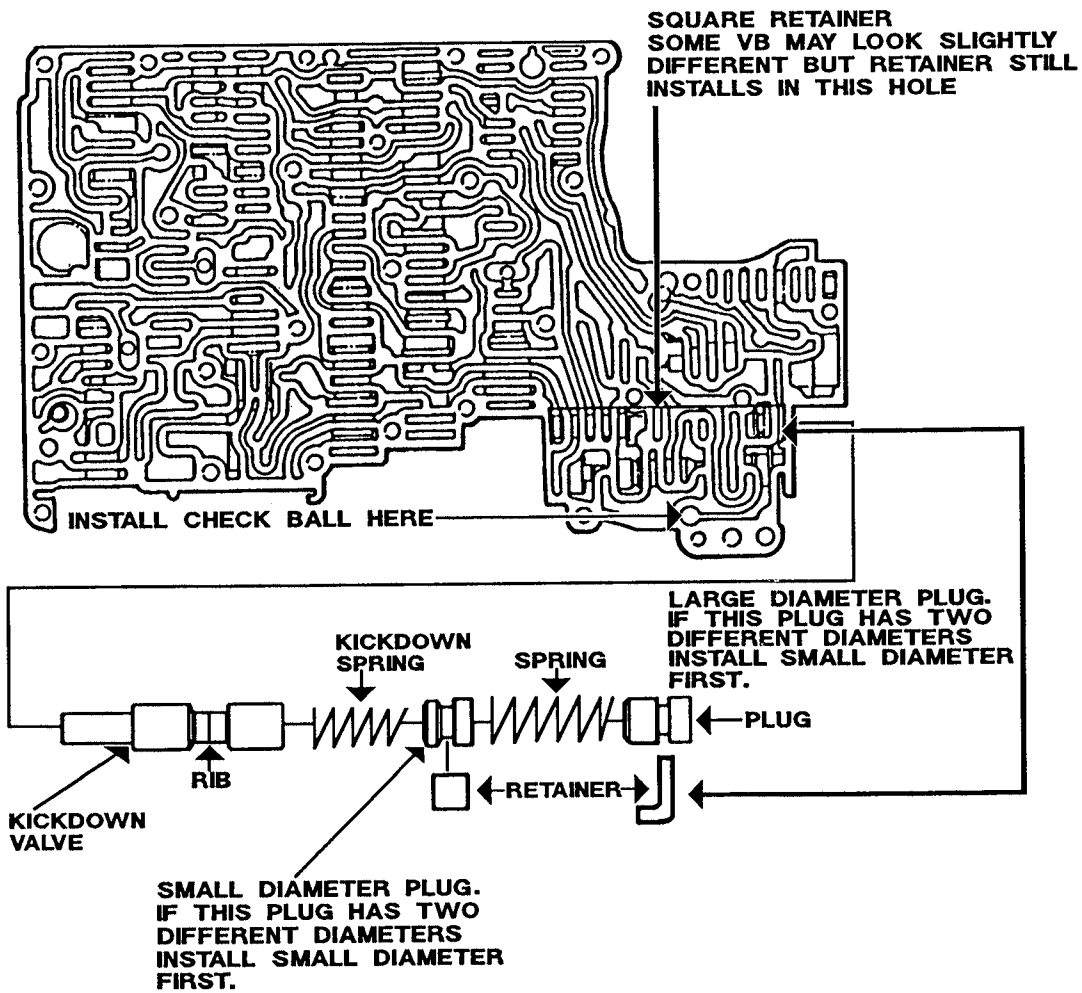
A4LD No Reverse

Some A4LD valve body assemblies do not use a check ball to cushion reverse engagement. These valve bodies are equipped with a reverse engagement control valve. Inspect your valve body for the correct assembly using the 3 drawings provided. Do not leave out the check ball on valve bodies that do not have this valve. If the reverse engagement control valve is stuck you may have no reverse.

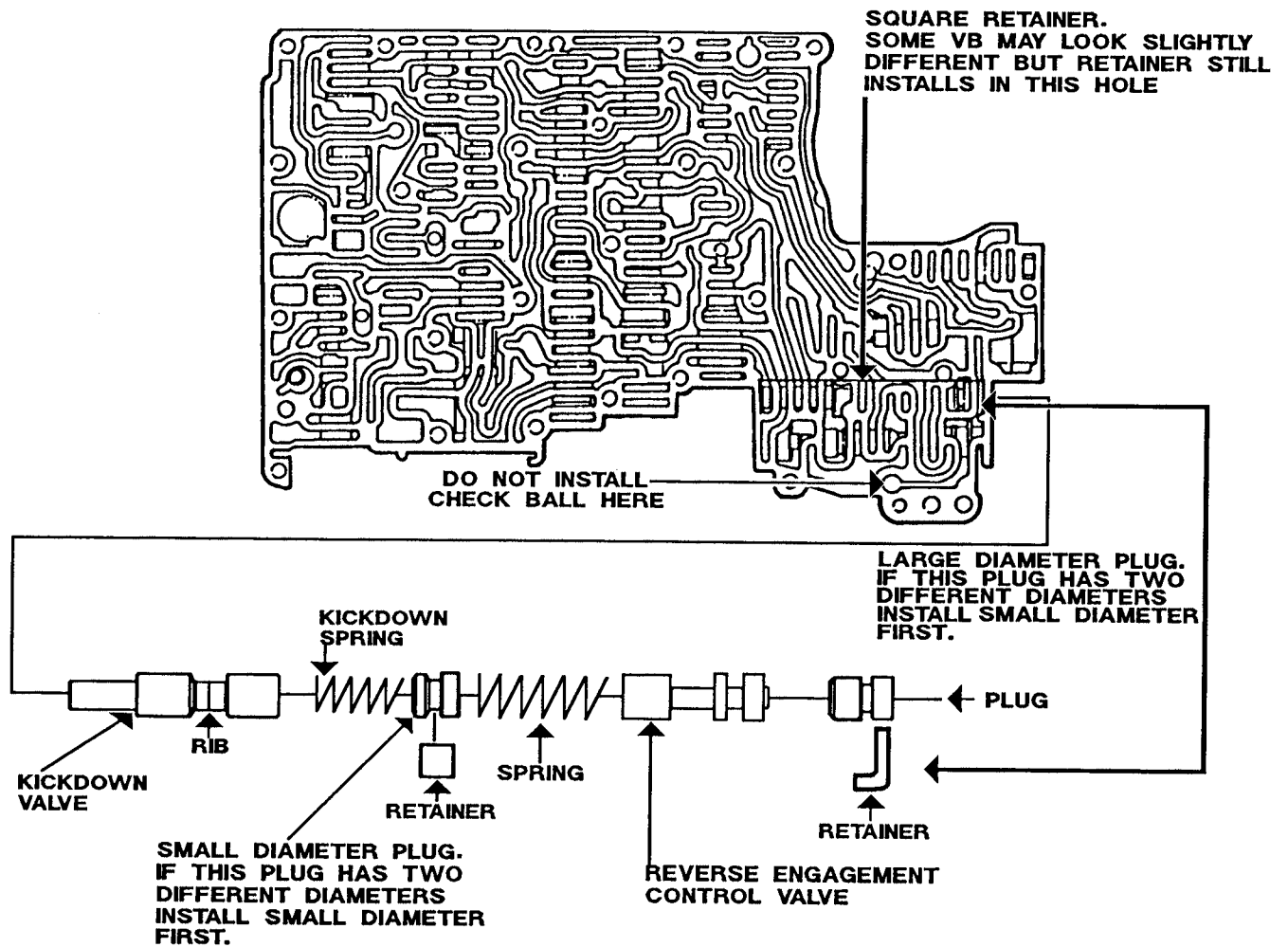
First Design



Second Design



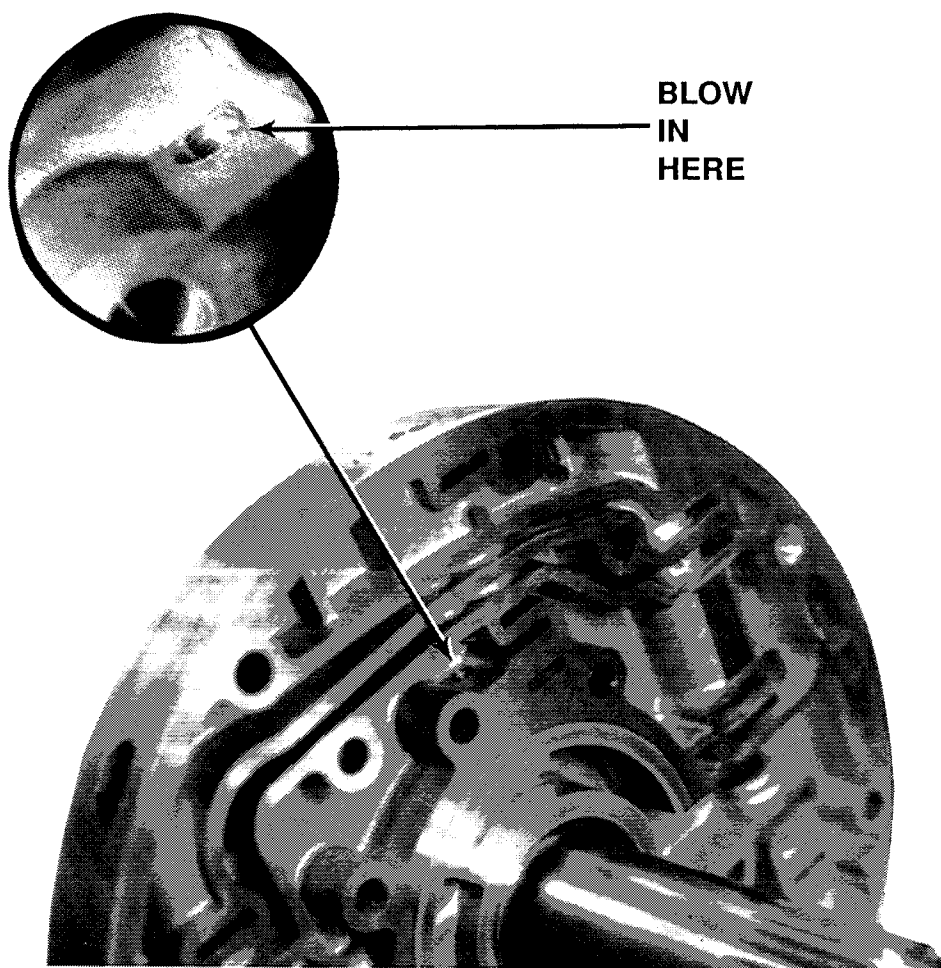
Third Design



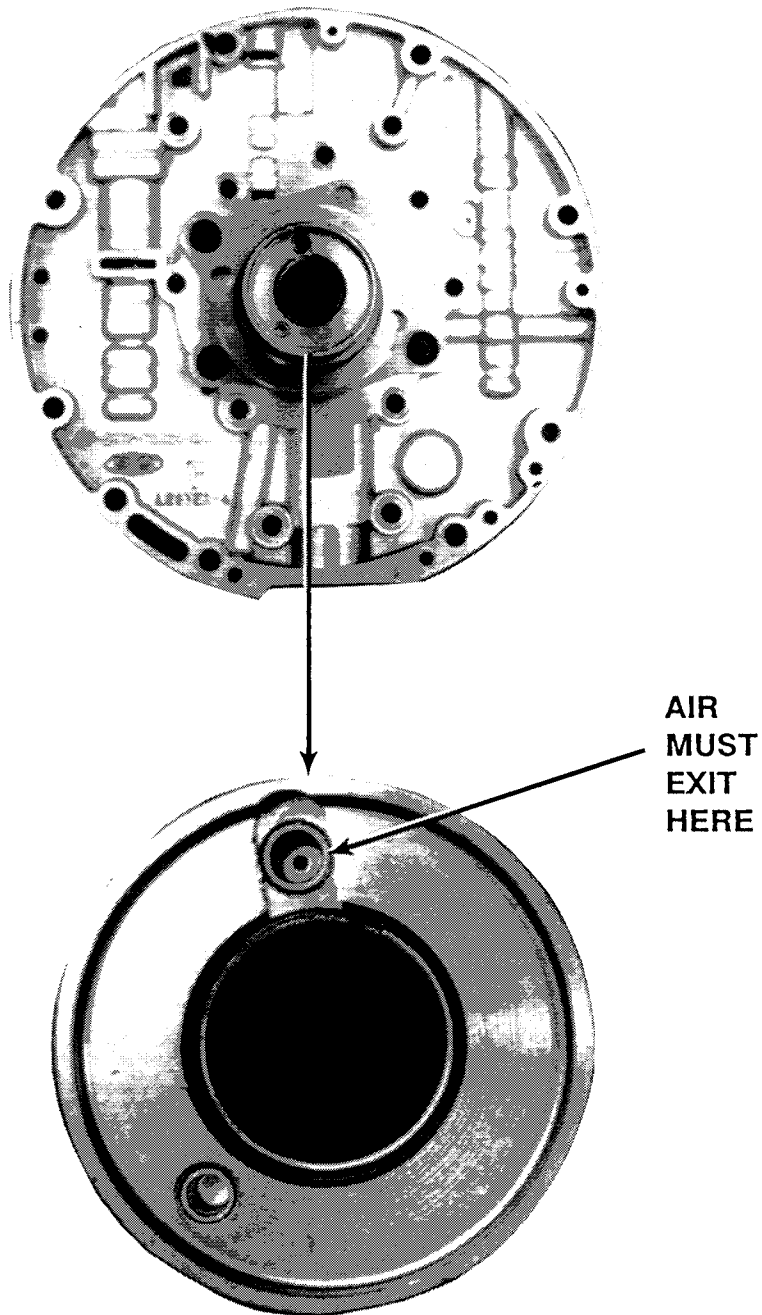
E4OD

Burned Overdrive Section

A burned E4OD overdrive planetary may be caused by restricted lube oil feed in the stator. To check for a restriction, blow into the hole shown.



Air should come out of the orificed cup plug in the rear of the stator support shaft as shown below.

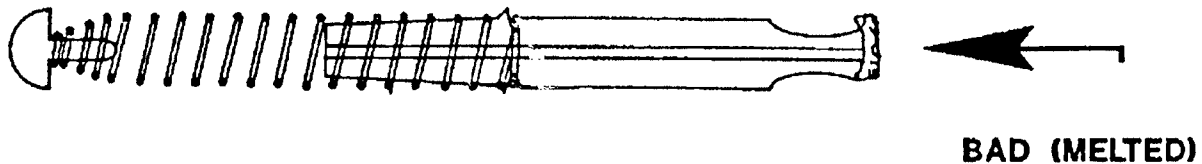
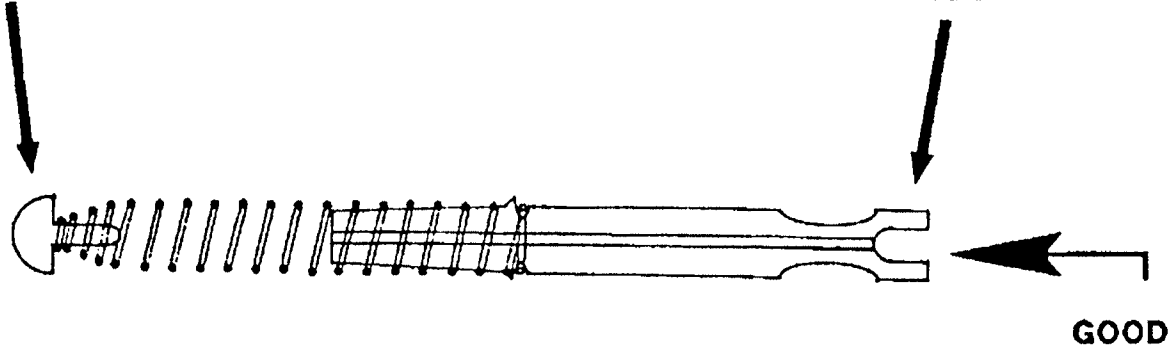


There is drain back valve assembly under the orificed cup plug in the stator shaft. The valve assembly may have melted if it was subjected to severe heat.

Thread a tap into the orificed cup plug, grab it with pliers and while wiggling it, pull it out. Underneath the orificed cup plug is the drainback valve. Remove it and inspect the end for possible damage.

THIS END GOES
INTO STATOR
FIRST

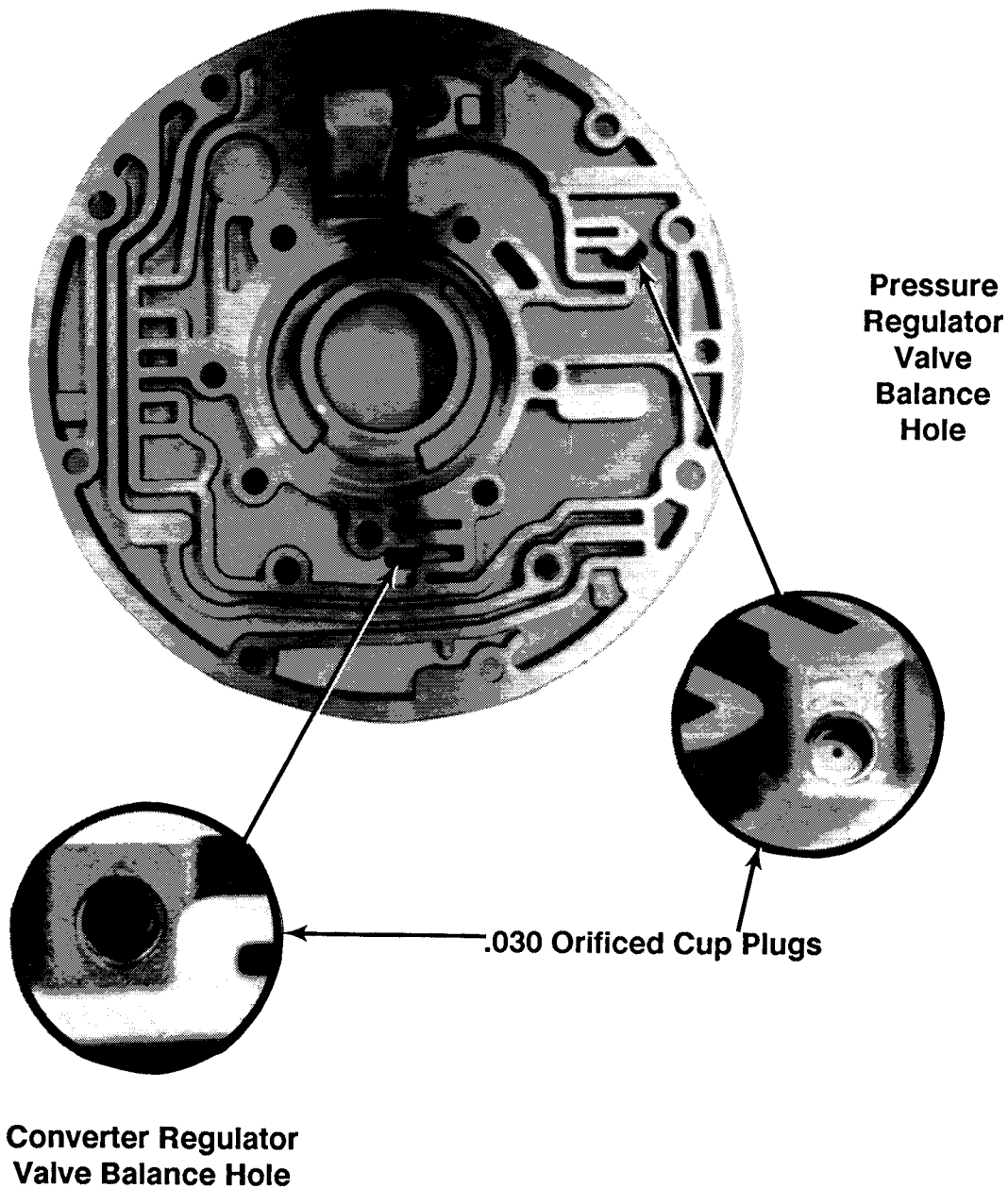
THIS END GOES
AGAINST CUP
PLUG



If the valve assembly is damaged, stator replacement is required. The valve is not sold separately from Ford.

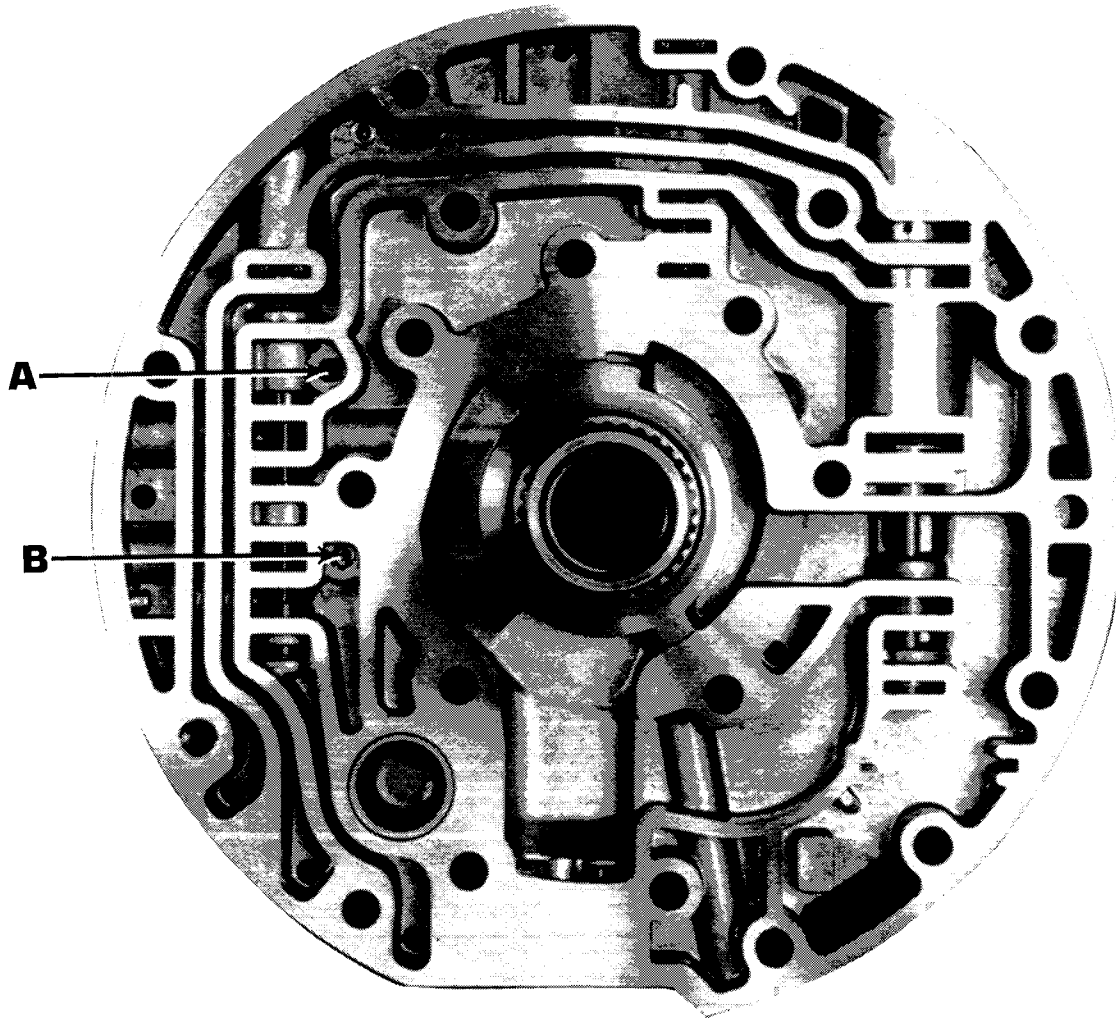
Ford E4OD Buzzing Noise

A buzzing noise in all gearshift positions, that increases with engine speed, may be caused by missing orificed cup plugs in the pump body. The orifice size in both of these cup plugs is .030.



E4OD Rebuild Tips

1. Enlarge orificed cup plug "A" to .075 for TCC exhaust.
2. Enlarge orificed cup plug "B" to .090 for cooler feed.



3. Always use metal rings on the center support and the forward drum.
4. Always check for restricted lube passage in the stator-see page 1.
5. On 1990 and later models, make sure that the rear case fitting, which contains a ball & spring, isn't clogged.
6. Always install an extra ground strap from the transmission directly to the negative battery cable. This is especially important on vehicles with extra electrical equipment installed.

E4OD Check Ball Locations

EARLY 1989 UNITS

Place balls in locations #1-#14. All balls are 5/16 diameter rubber.

LATE 1989 UNITS

Place balls in locations #1-#11. All balls are 5/16 diameter rubber except #10 which is 5/16 diameter steel.

1990-1991

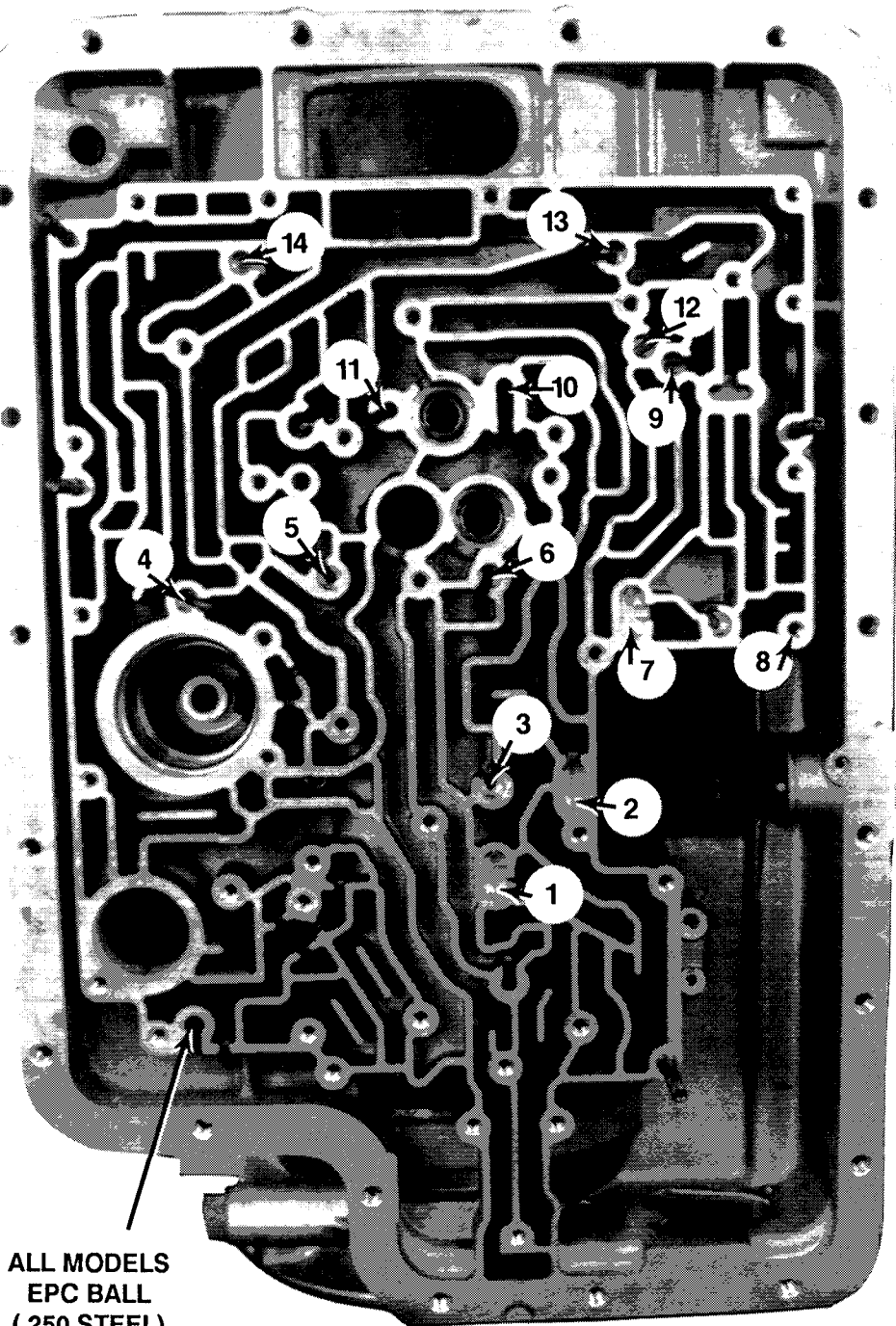
Place balls in locations #1-#9. All balls are 5/16 diameter rubber.

To determine if you have a late 89 or early 89 look for holes (ball seats) in the spacer plate above ball locations #12, #13 and #14.

Late 89 does not have holes above balls #12, #13 and #14.

There are 2 balls located in the main valve body but since they have not changed locations or size since the E4OD's introduction their locations will not be included in this bulletin.

ALL MODELS
EPC BALL
(.250 STEEL)
AND SPRING



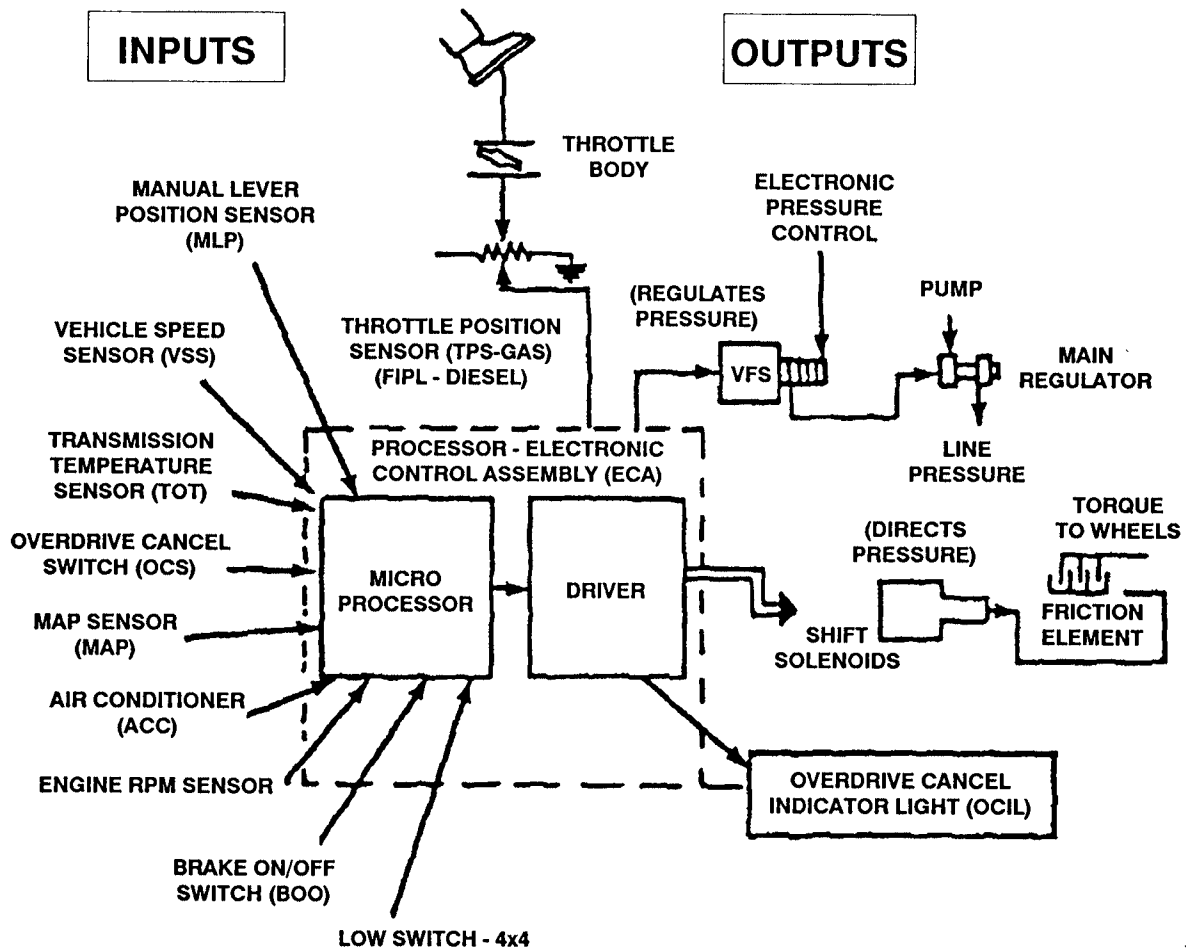
(The EPC spring weighs 3.5 lbs @ .750)

Ford Terms Glossary

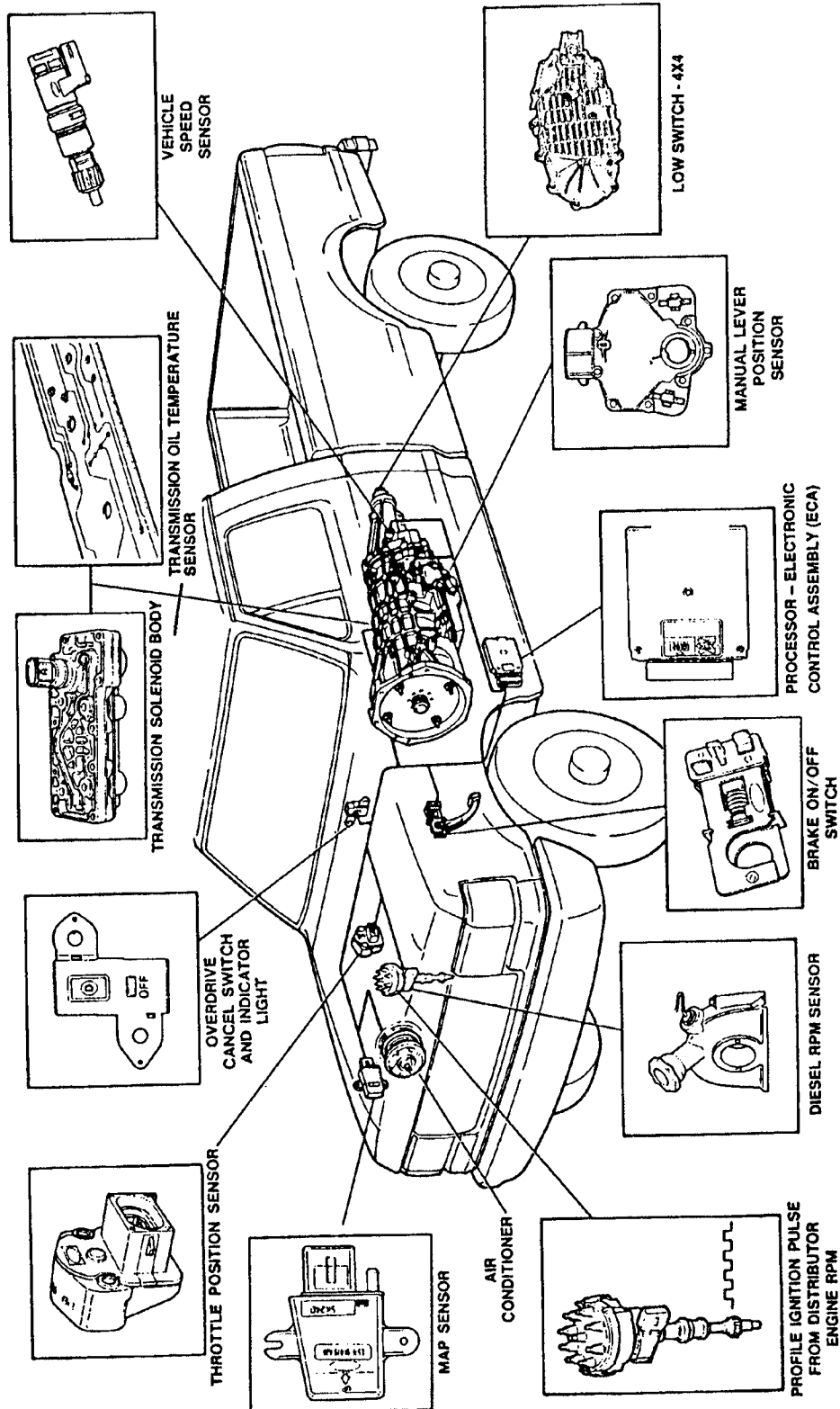
ACC	AIR CONDITIONING CLUTCH
ACT	AIR CHARGE TEMPERATURE
BOO	BRAKE ON/OFF SWITCH
BP	BAROMETRIC PRESSURE
CES	CLUTCH ENGAGE SWITCH
CCC	CONVERTER CLUTCH CONTROL SOLENOID
CCS	COAST CLUTCH CONTROL SOLENOID
DIS	COMPUTED SPARK ADVANCE
ECA	ELECTRONIC CONTROL ASSEMBLY
ECT	ENGINE COOLANT TEMPERATURE
EGO	EXHAUST GAS OXYGEN
EPC	ELECTRONIC PRESSURE CONTROL
EVP	EGR VALVE POSITION
EVR	EGR VALVE REGULATOR
FIPL	FUEL INJECTION PUMP LEVER
FP	FUEL PUMP RELAY
IDM	COIL TACH SIGNAL
ISC	IDLE SPEED MOTOR
KS	KNOCK SENSOR
MAF	MASS AIR FLOW
MAP	MANIFOLD ABSOLUT PRESSURE
MLPS	MANUAL LEVER POSITION SENSOR
NDS	NEUTRAL/DRIVE SWITCH
OCIL	OVERDRIVE CANCEL INDICATOR LIGHT
OCS	OVERDRIVE CANCEL SWITCH
PFE	PRESSURE FEEDBACK EGR
PIP	PROFILE IGNITION PICK-UP
PSPS	POWER STEERING PRESSURE SWITCH
RPM	DIESEL RPM SENSOR
SS1	TRANSMISSION SHIFT SOLENOID
SS2	TRANSMISSION SHIFT SOLENOID
TOT	TRANSMISSION OIL TEMPERATURE SENSOR
TPS	THROTTLE POSITION SENSOR
TSS	TURBINE SPEED SENSOR
VREF	REFERENCE VOLTAGE
VSS	VEHICLE SPEED SENSOR
4X4L	4 X 4 LOW SWITCH

E4OD Control System

MECHANICAL LINK

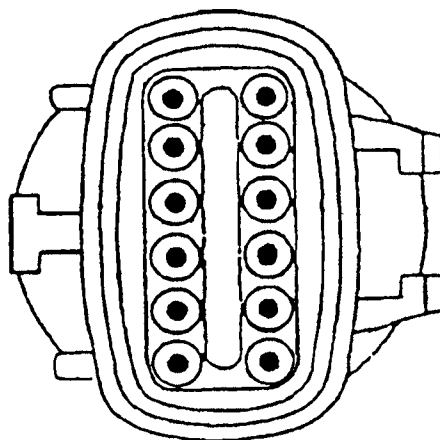


E4OD TRANSMISSION ELECTRONIC CONTROL SYSTEM, ACTUATORS, AND SENSORS



E40D Transmission Solenoid Body Terminal Identification

#6 - NOT USED
 #5 - CC SOLENOID
 #4 - TCC SOLENOID
 #3-#1 SOLENOID
 #2-#2 SOLENOID
 #1 - SOLENOID POWER



#7 - T.O.T. SENSOR
 #8 - T.O.T. RETURN
 #9 - NOT USED
 #10 - NOT USED
 #11 - EPC GROUND
 #12 - EPC POWER

LEADS BETWEEN TERMINALS

1 & 2
 1 & 3
 1 & 4
 1 & 5
 1 & GROUND
 2 & GROUND
 3 & GROUND
 4 & GROUND
 5 & GROUND
 11 & 12
 11 & GROUND
 12 & GROUND

READINGS SHOULD BE

20-30 OHMS
 20-30 OHMS
 20-30 OHMS
 20-30 OHMS
 NO CONTINUITY
 NO CONTINUITY
 NO CONTINUITY
 NO CONTINUITY
 NO CONTINUITY
 4.25 - 6.5 OHMS
 NO CONTINUITY
 NO CONTINUITY

7 & 8

DEGREES F

32 - 58
 59 - 104
 105 - 158
 159-194
 195 - 230
 231 - 266

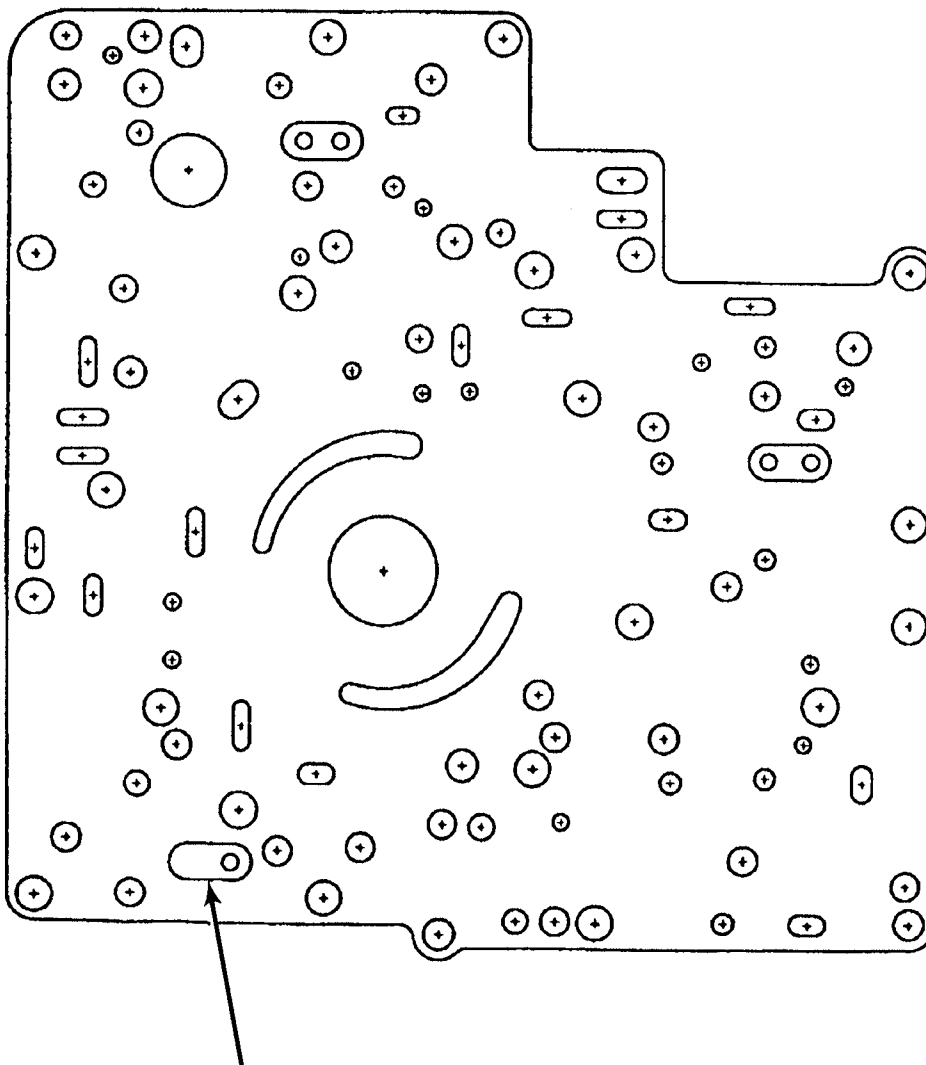
RESISTANCE

37K - 100K
 16K - 37K
 5K-16K
 2.7K - 5K
 1.5K - 2.7K
 .8K - 1.5K

AXOD-E Check Ball Locations

AXOD-E's are presently being made with 4 or 5 check balls in the pump. The valve bodies come with 7 checkballs.

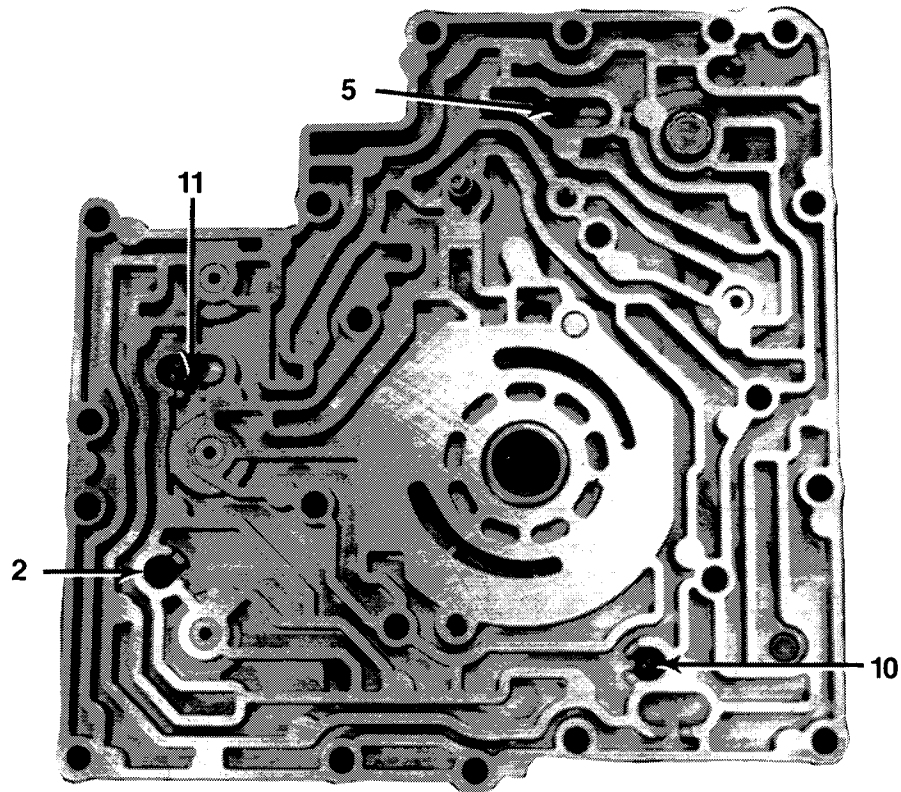
Check the pump seperator plate first.....If you have one hole in the bath tub shown, you have a type 1 set up. If you have two holes you have a type 2 set up.



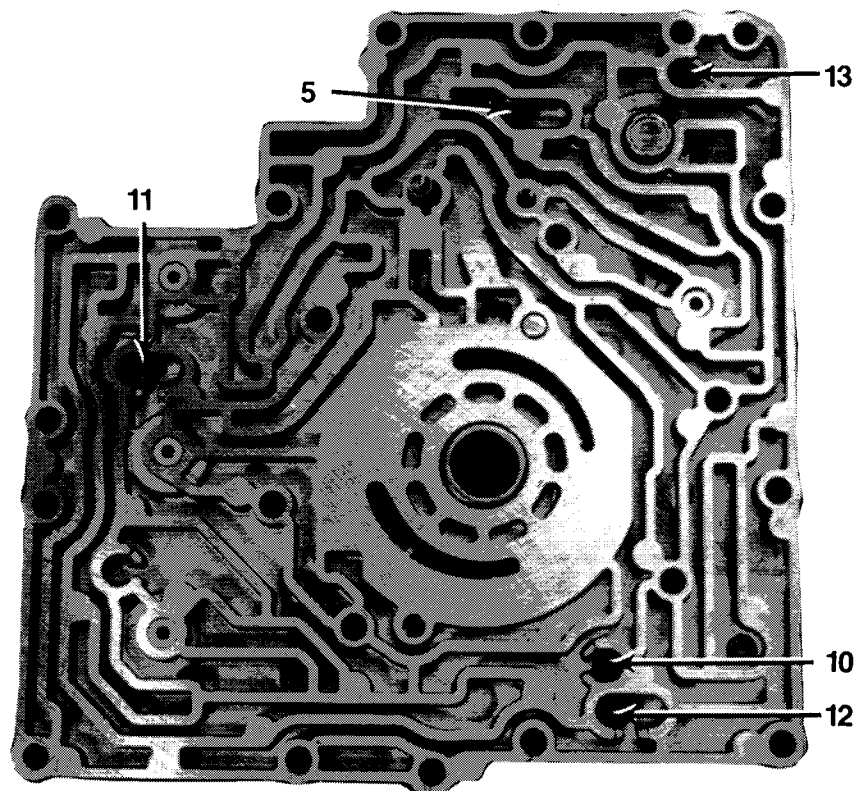
Check this location for 1 or 2 holes

NOTE: AXOD-E'S USE ORANGE STRIPPED GASKETS.

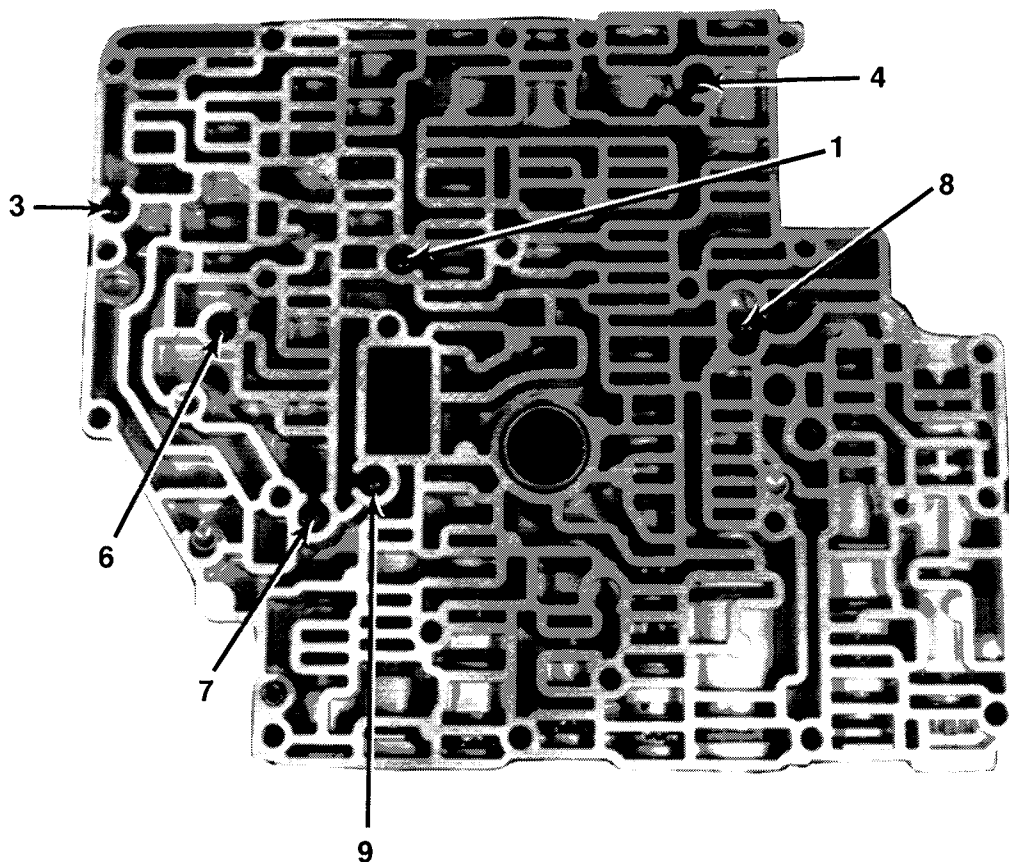
A type 1 setup looks like this... it uses 4 checkballs.



A type 2 set up looks like this... it uses 5 check balls.



All valve bodies to date use 7 checkballs.



AXOD-E Checkballs

NUMBER

- 1 Reverse clutch orifice.
- 2 Forward clutch orifice
- 3 1-2 Servo check. (Causes drive oil to go to the 2-3 servo regulator & engagement control valve before it gets to the servo.)
- 4 Overdrive servo orifice.
- 5 Forward clutch control shuttle (Shuttles 1st-2nd gear oil and reverse oil, to move the forward clutch control valve.)
- 6 1-2 Servo release check (Causes servo release oil to go thru the 3-2 control valve during a 3-2 downshift)
- 7 Direct clutch exhaust check (Causes the direct clutch oil to exhaust thru the #9 check ball during the 3-2 downshift.)
- 8 Direct clutch shuttle (Shuttles direct clutch oil & manual low oil to feed the direct clutch)
- 9 Direct clutch orifice.
- 10 Servo Release check (provides an exhaust for servo release oil in 1st & reverse.
- 11 Direct clutch oil shuttle (Shuttles between 3rd gear oil & 4th gear oil to feed the direct clutch.)
- 12 Engagement Control Valve Shuttle (Shuttles T.V. oil & 2nd gear oil to control the engagement control valve.) NOTE: Type 1 checkball configurations only use 2nd gear oil.
- 13 Forward clutch control valve feed orifice.

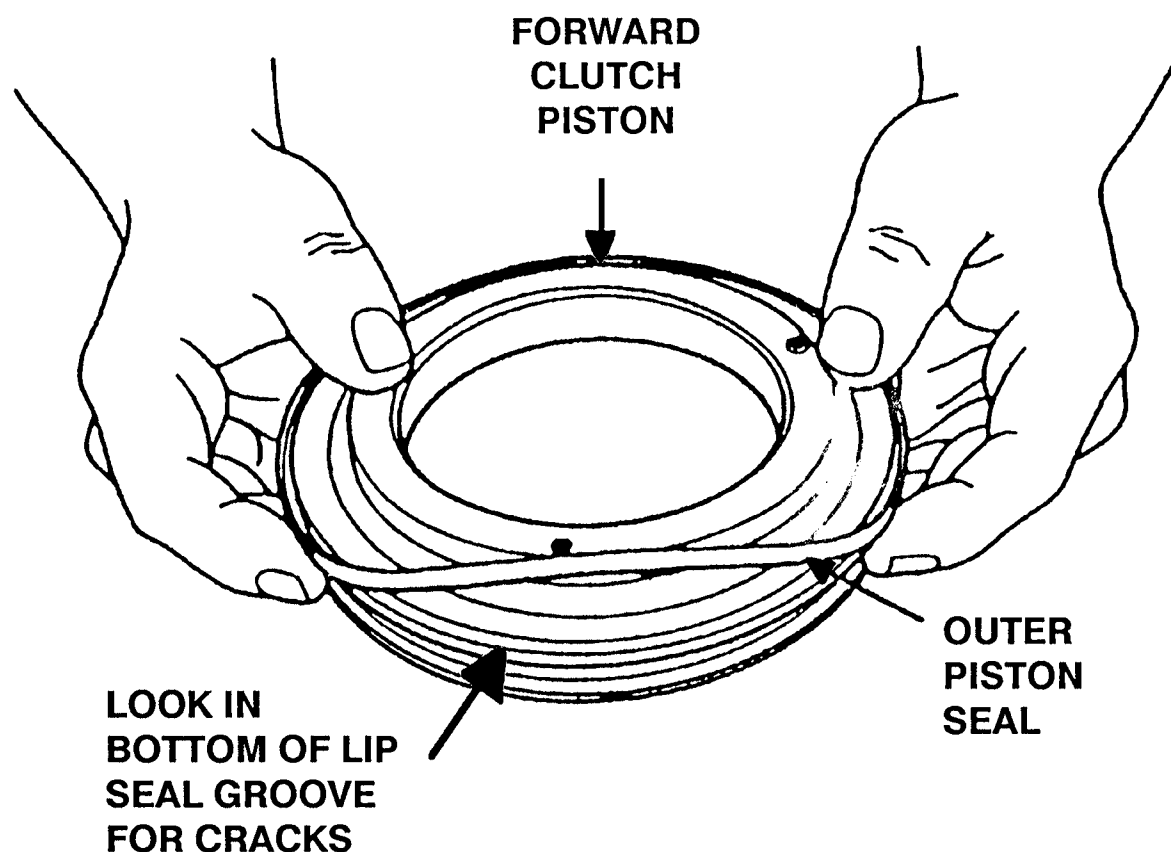
No Forward Or Slips Forward

A condition of no forward, slips in forward, or delayed engagement may be caused by a cracked forward clutch piston. These complaints are usually worse when hot.

To check for a crack, remove the outer lip seal, and insert a screwdriver into the lip seal groove. Now, twist the screwdriver and check for a crack in the bottom of the groove. Check all the way around the piston using this procedure.

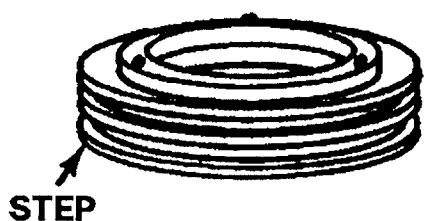
NOTE: A CRACKED PISTON MAY AIR CHECK GOOD.

DON'T TRUST AN AIR CHECK

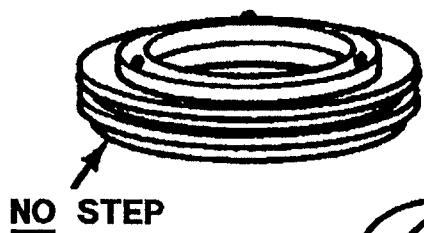


If the forward piston is cracked replace it only with either the 2nd, or preferably the 3rd design. The 2nd and 3rd design will both have the same part number. When the stock of 2nd design is depleted, the 3rd design will be furnished under the same number - F1DZ-7A262A.

AXOD/AXODE FORWARD CLUTCH PISTON



1ST DESIGN HAS A STEP

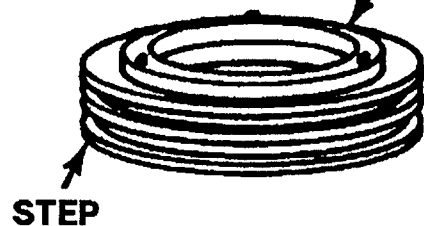


2ND DESIGN HAS NO STEP

NO STEP



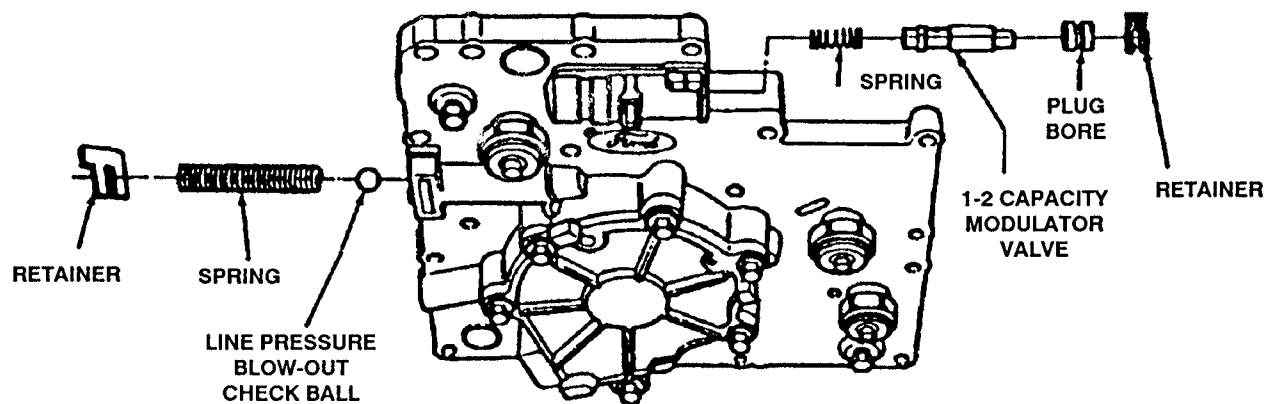
IDENTIFICATION
SYMBOL



3RD DESIGN HAS A STEP
AND AN IDENTIFICATION
SYMBOL

Shift Quality

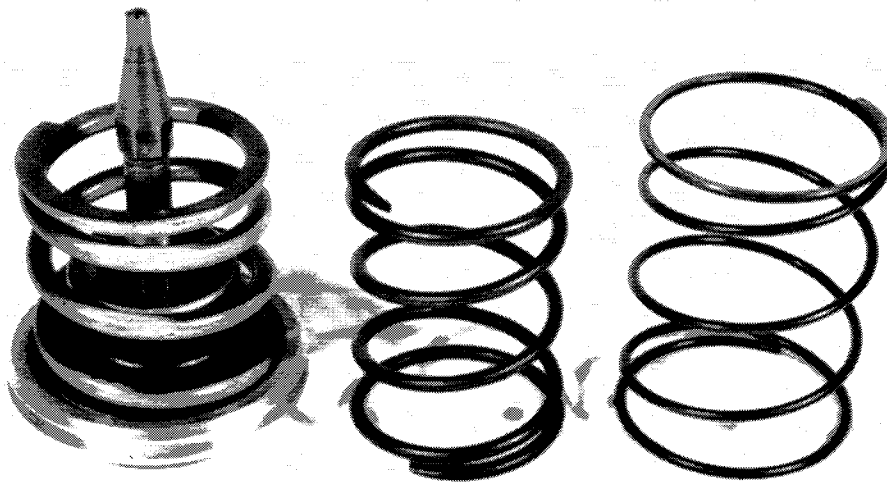
Improve the 1-2 shift by installing a heavier 1-2 capacity modulator-valve spring.



Find a spring that weighs approximately 1 1/4-1 1/2 pounds at .400". Many GM governor springs are very close, but weigh them to be sure.

2-3 Flare-Up

- STEP 1** Adjust T.V. pressure.
- STEP 2** Check line pressure & line pressure rise.
- STEP 3** Check servo travel. Should be .150" - .200".
- STEP 4** Replace the 1-2 servo spring with a spring of a lighter weight. A good example is a Torque Flight 8 front servo spring. If the flare-up still exists use a C-3 rear servo spring.

**CAUTION**

Step 4 is not a rebuild procedure. Only do this after you have done steps 1 through 3 and the flare-up persists.

TV Pressure

Mismatching valve body, channel plate, pump or gaskets can cause uncontrollable throttle pressure.

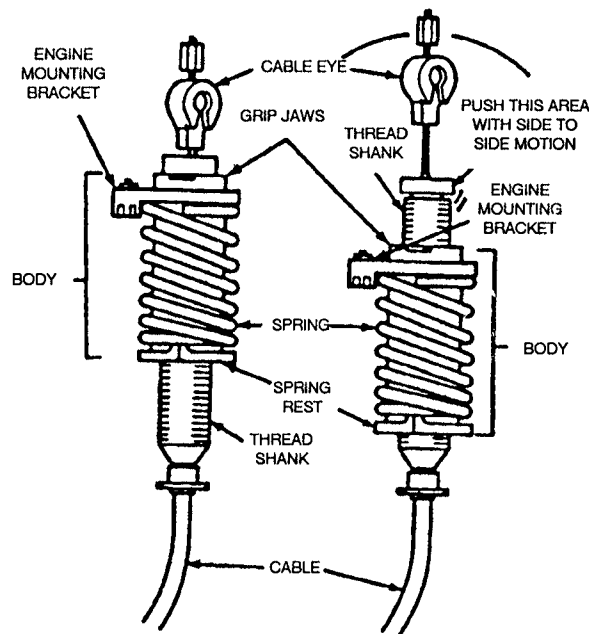
A loose TV cable can cause a no shift condition and make the accelerator pedal very hard if not impossible to move. To fix this, turn the engine off and tighten the cable 1/8" at a time until the TV cable can be moved with the engine ON.

STEP 1 With TV cable mounted in engine bracket, make sure threaded shank is fully retracted. To retract shank, pull up on spring rest with index fingers, and wiggle top of thread shank while pressing shank through spring with thumbs.

STEP 2 Rotate throttle lever to WOT position and release.

NOTE Threaded shank must show movement or "ratchet" out of grip jaws. If no movement is observed, inspect TV cable system for broken or disconnected components and repeat procedure.

STEP 3 Adjust cable until TV pressure is 12-14 psi at an idle.

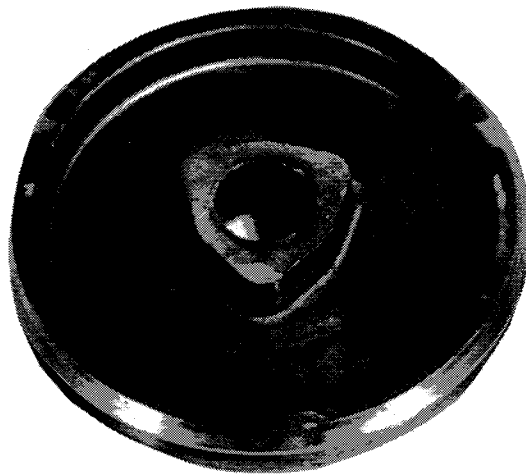


Coast Down Clunk

STEP 1 Adjust TV pressure see page 19.

STEP 2 Make sure minimum line pressure does not exceed specifications.

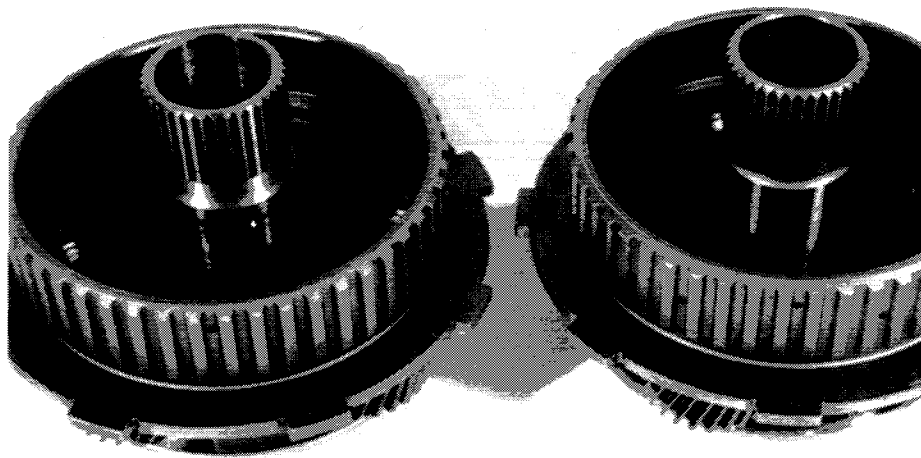
STEP 3 On a 3-2 coast down clunk, grind the 1-2 servo stop $1/16"$ to $1/8"$ as shown.



CAUTION Step 3 is not a rebuild procedure, do this only if you have a 3-2 clunk and have done steps 1 & 2 first.

Late Planet Change

Ford has made a change to the front planet. They machined the front of the shaft so only the rear bushing of the front sun gear would be supported. The picture below shows both early & late planets.

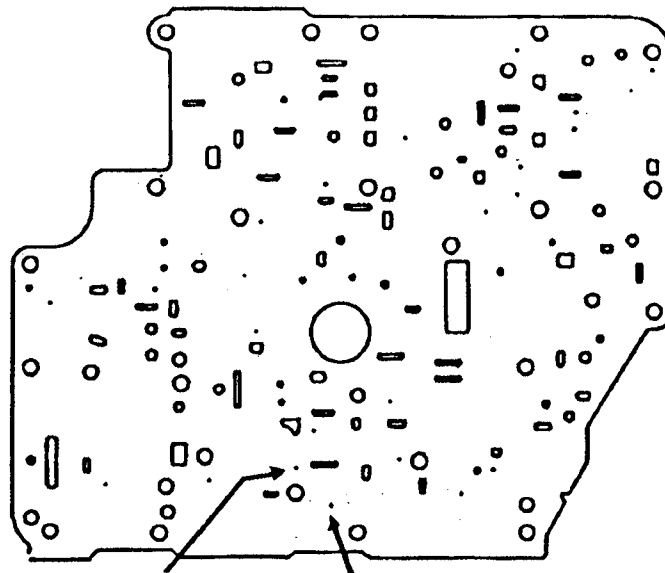
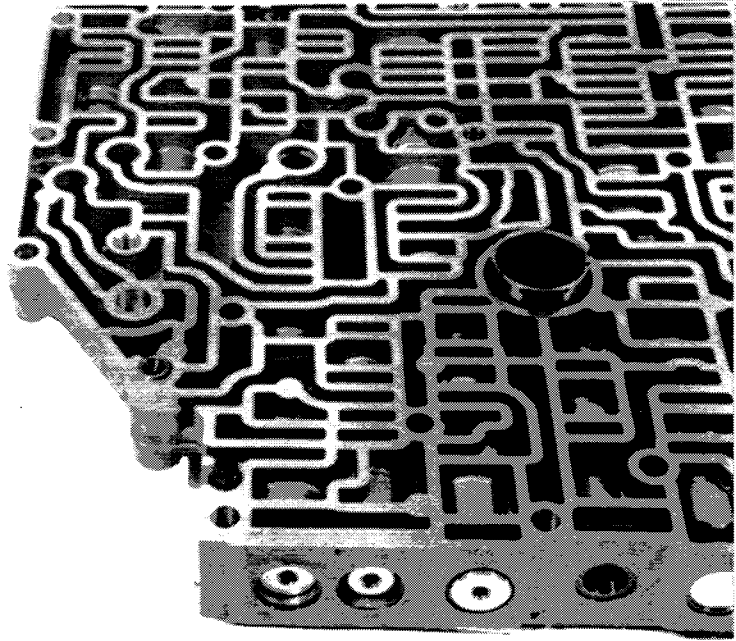


**Machined
Portion**

Note: These planets will interchange

Planet Failure

To increase lube flow, enlarge the two feed holes in the separator plate and, if necessary, trim the rear lube check-valve spring until the check valve sits about 1/16" above flush.



T/C CHARGE
(Converter regulator bypass)
Enlarge to 1/16"

REAR LUBE
Enlarge to .076 or 5/64"

AXOD-E Solenoid Application Chart

PRNDL	GEAR	ENGINE SS1 BRAKING		SS2	SS3
OD	1	NO	OFF	ON	OFF
	2	YES	ON	ON	OFF
	3	NO	OFF	OFF	ON
	4	YES	ON	OFF	ON
D -- --	1	NO	OFF	ON	OFF
	2	YES	ON	ON	OFF
	3	YES	OFF	OFF	OFF
	4	NOT ALLOWED BY STRATEGY			
1	1	YES	OFF	ON	OFF
	2	YES	OFF	OFF	OFF
	3	NOT ALLOWED BY HYDRAULICS			
	4	NOT ALLOWED BY HYDRAULICS			
R	R	NO	OFF	ON	OFF
P/N	P/N	NO	OFF	ON	OFF

AXOD-E Clutch & Band Application Chart

GEAR	OVER DRIVE BAND	FORWARD CLUTCH	LOW ONE-WAY CLUTCH	DIRECT CLUTCH	DIRECT ONE-WAY CLUTCH	INTER- MEDIATE CLUTCH	REVERSE CLUTCH	LOW INTER. BAND	RATIO
MANUAL LOW		APPLIED	HOLD	APPLIED	HOLD			APPLIED	2.77:1
DRIVE 1st GEAR		APPLIED	HOLD					APPLIED	2.77:1
DRIVE 2nd GEAR		APPLIED	O/R			APPLIED		APPLIED	1.543:1
DRIVE 3rd GEAR				APPLIED	HOLD	APPLIED			1.000:1
DRIVE 4th GEAR	APPLIED			APPLIED	O/R	APPLIED			.694:1
REVERSE		APPLIED	HOLD				APPLIED		2.263:1

NOTES

Ford Electronic Engine Control Trouble Codes

IMPORTANT POINTS PARTICULAR TO FORD:

Ford's Electronic Engine Control (EEC) system does not have the ability to be "read" as other systems do. (Example -- watching TPS voltage on a scan tool.) After the codes are retrieved, the system is best diagnosed with a tool called a break-out box. This ties into the computer system and checks the sensors and ground circuits using a Digital Multi-Meter (DMM).

Voltmeter hook-up

1. Locate the diagnostic connector and the Self Test Input (STI) gray connector (Examples on Page 2)
2. Connect "Analog volt-meter as illustrated in Figure 1 if the vehicle is an '83 1.6L the schematic in figure 2 must be used.

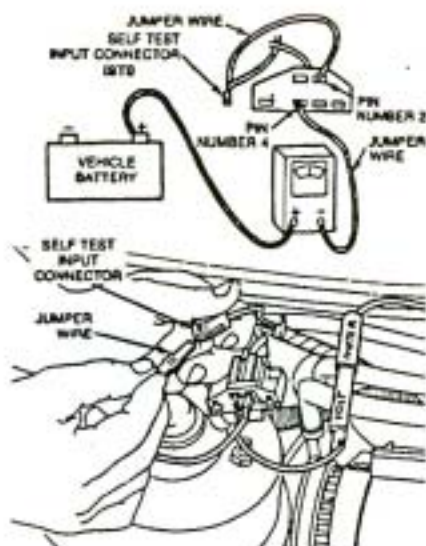


Figure 1

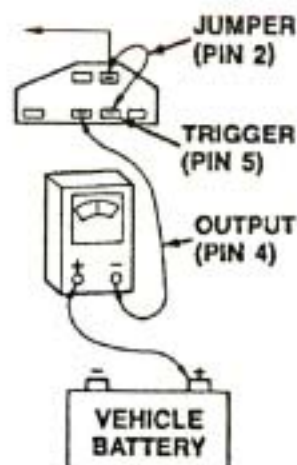
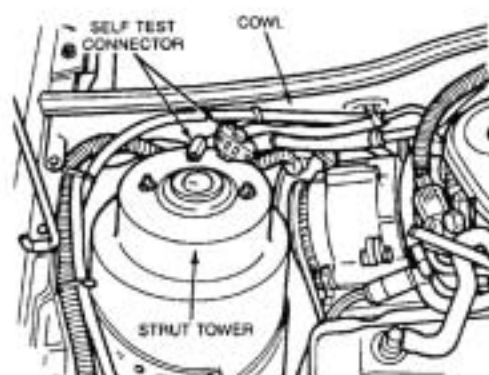
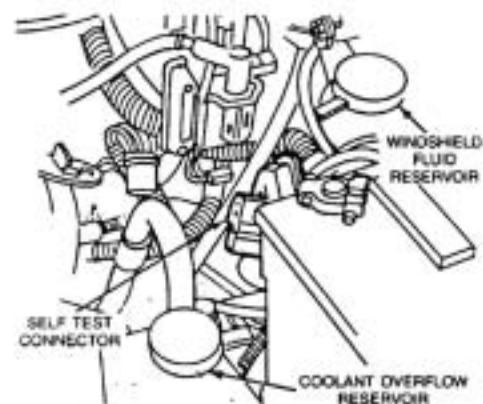


Figure 2

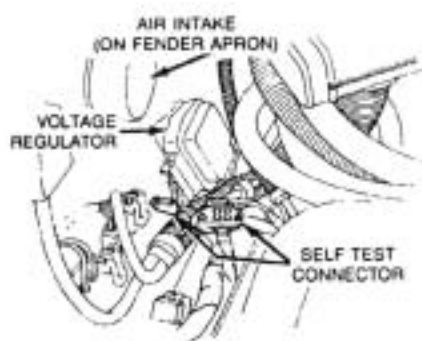
Typical STI Locations (Most Vehicles)



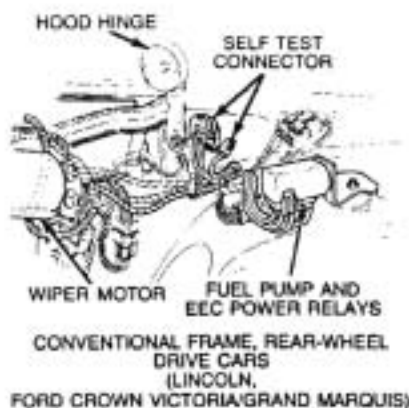
FRONT-WHEEL DRIVE CARS
(ESCORT/LYNX, EXP, TEMPO/TOPAZ)



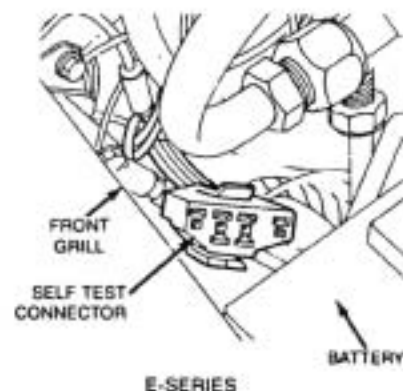
UNI-BODY REAR-WHEEL DRIVE CARS
(THUNDERBIRD/COUGAR, LTD/MARQUIS, MUSTANG/CAPRI)



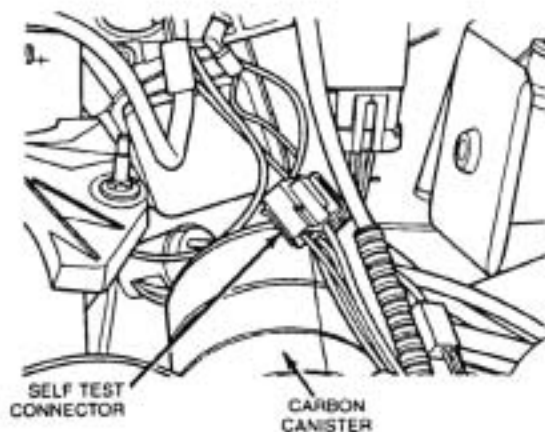
CONTINENTAL/MARK VII



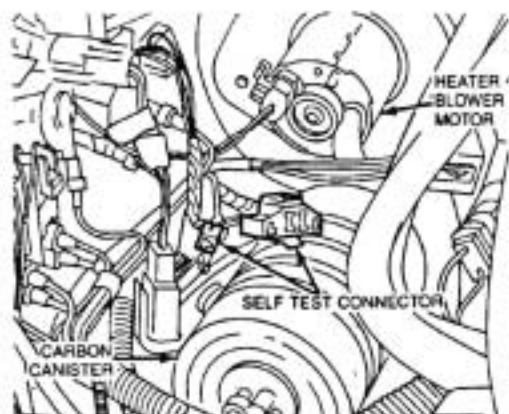
CONVENTIONAL FRAME, REAR-WHEEL
DRIVE CARS
(LINCOLN,
FORD CROWN VICTORIA/GRAND MARQUIS)



E-SERIES



F-SERIES



BRONCO/RANGER

(Always perform this test first)

KOEO - Key ON engine OFF test: (After hook-up of analog voltmeter)

STEP 1

Turn the key ON ... If diesel powered, depress the throttle to the floor for entire test! The processor will run its own self diagnostics and output "hard codes" on your voltmeter. (Figure 4)

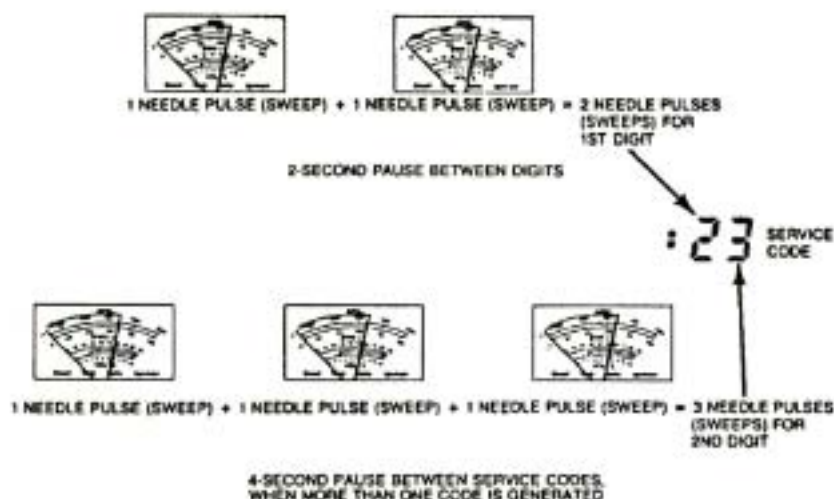


Figure 4

STEP 2

Count the needle sweeps and write down the codes in order. Watch for separator code 11 and code 10. These are not faults but indicate "no codes" and divisions between processor memory. Figure 5 is an example of "No Codes". If there were codes present, they would be displayed in the 4 second pause location.

SELF TEST OUTPUT

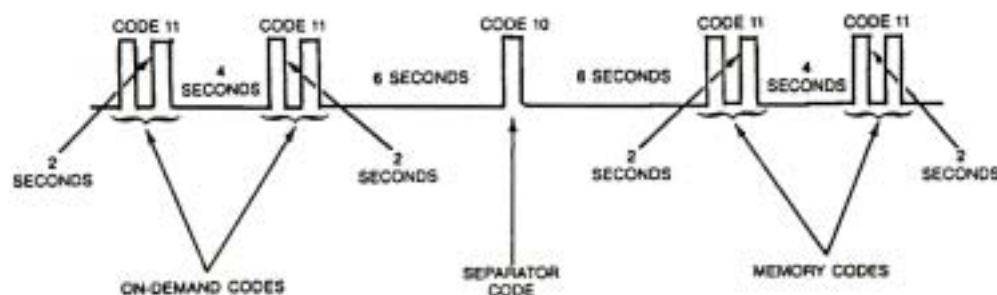


Figure 5

KOER - Key On Engine Running Test

Do this after KOEO tests. Start the engine, the first meter display will be the Engine I.D. code,

2 pulses - 4 cylinder
3 pulses - 6 cylinder
4 pulses - 8 cylinder
5 pulses - 7.3 diesel

(Verifies processor installed for proper engine.)

2nd output will be code 10 which is a single pulse on the meter.

This indicates it is time for the operator to complete the "Dynamic Tests". These tests check items listed as they are actuated.

1st STEP

Perform WOT (Wide Open Throttle).

2nd STEP

Turn steering 1/2 turn.

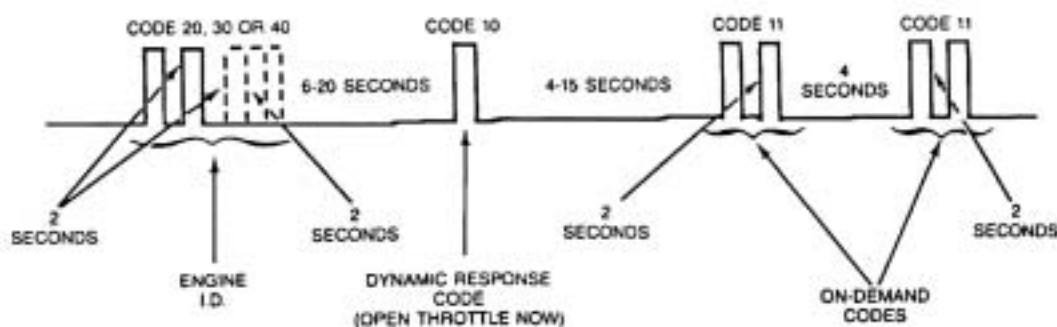
3rd STEP

Perform BOO (Brake On/Off).

4th STEP

Cycle O.D. cancel switch if equipped (E40D).

After completing steps 1 to 4, the analog voltmeter will present codes. (Figure 6)



NOTE: To erase codes ... disconnect "STI" jumper **DURING** code output.

Figure 6

E40D - Drive Cycle Test

STEP 1

Erase all existing codes by disconnecting STI connector while codes are being emitted.

STEP 2

Check transmission fluid level. Engine must be at operating temperature.

STEP 3

Transmission in "D" range ... Press O.D. cancel switch (light on)... moderately accelerate from 0 to 40 mph and allow 3rd gear shift. Hold speed and throttle steady for 15 seconds.

STEP 4

Press O.D. switch (light off). Moderately accelerate from 40 to 50 and allow 4th gear upshift. Hold speed and throttle steady for 15 seconds.

STEP 5

When transmission is in 4th gear ... lightly apply and release the brake ... hold speed and throttle steady for 15 seconds.

STEP 6

Brake to a stop, stand stationary for 20 seconds in "D". Repeat steps 3 to 6 a minimum of 4 times.

STEP 7

PERFORM KOEO (as per page 3) to retrieve any codes.

Ford Service Codes 1983 - 1990

CODE LETTERS KEY

RUN -- KOER
MEM -- Continuous codes/KOEO
OFF -- KOEO
ALL -- Displayed in all test sequences
TURBO, -NON-TURBO, -EVP, -PFE, -- Specific to engine

TWO DIGIT CODE	DESCRIPTION
none	ECA can't perform self test. Check power and grounds, if ok change ECA.
11-ALL	System pass no faults present when test was run.
12-RUN	Self test could not reach fast idle RPM spec'. Check idle control and minimum idle setting.
13-RUN	Self test could not reach low idle RPM spec'. Check idle control and minimum idle setting.
14-MEM	Profile ignition pick up problem. Check frequency and % dwell. Check for intermittent wiring problems.
15-OFF	Computer memory failure (ROM). Check for proper seating before replacing ECA.
15-MEM	Power was lost to keep alive memory recently. May have lost other memory codes.
16-RUN	RPM above the self test spec' with ISC motor fully retracted. Check ISC and minimum idle.
16-RUN	RPM too low to perform fuel test. Check for dirty throttle plates and minimum idle.
17-RUN	RPM below self test spec' with ISC retracted. Check ISC motor and minimum idle setting.
18-RUN	SPOUT (spark output from computer) circuit open during self test. Check connector.
18-RUN	Spark angle width circuit problem. Check frequency and % dwell.
18-MEM	Loss of signal from coil negative, ignition diagnostic monitor. Or SPOUT circuit grounded.
19-RUN	RPM dropped too low with ISC retracted during self test. Check ISC and minimum idle speed.
19-OFF	ECA (computer) power failure. Check reference voltage and power connections.
19-MEM	Cylinder identification signal missing or erratic. Check frequency and % dwell.
21-ALL	Engine coolant temperature out of spec' during self test. Check voltage input to ECA.
22(NON	Manifold absolute pressure sensor frequency out of spec'. Check frequency and % dwell.
-TURBO)	
22-TURBO	Barometric pressure sensor frequency out of spec'. Check frequency and % dwell.

CODE	DESCRIPTION
24-NON TURBO	Air charge temperature out of spec'. Check voltage input to ECA.
24-TURBO	Vane air temperature voltage out of spec' during self test. Check voltage input to ECA.
25-RUN	Knock signal was not sent during goose test. Be sure momentary full throttle was reached.
26-RUN	Mass air flow or vane air flow voltage out of spec during self test. Check voltage input to ECA.
26-MEM	Transmission oil temperature sensor voltage is out of spec'. Check voltage input to ECA.
28-TURBO	Vane air temperature voltage out of spec during self test. Check voltage input to ECA.
28-MEM	Loss of ignition diagnostic monitor. Check coil and module operation. (Right coil on 2.3L).
29-MEM	Vehicle speed sensor input signal too low. Check AC voltage and frequency on test drive.
31-EVP	EGR valve position signal is too low. Check voltage input to ECA.
31-PFE	Pressure feedback EGR signal is too low. Check voltage input to ECA.
32-EVP	EGR valve position signal is too low for closed position. Check voltage input to ECA.
32-PFE	EGR valve is not seated properly. Check for carbon blockage.
33-ALL	EGR valve is not opening. Check for sticking valve and manifold vacuum lines.
34-PFE	Exhaust backpressure is too high. Check exhaust system and voltage to ECA.
34-MEM	Pressure feedback EGR signal out of limits. Check voltage to ECA.
34-RUN	EGR flow is too low. Check for carbon or obstruction under EGR valve.
35-RUN	RPM too low to open EGR during self test. Check idle speed and idle control system.
35-PFE	Pressure feedback sensor voltage is too high. Check voltage input to ECA.
35-EVP	EGR valve position voltage is too high. Check voltage input to ECA.
38-MEM	Idle tracking switch open. Check voltage at ECA input.
39-MEM	AXOD transmission converter clutch is not applying properly. Watch for RPM drop at lockup.
41-MEM	(Right) oxygen sensor is not switching. Lean indication. Check voltage at ECA input.
41-RUN	(Right) oxygen sensor signal lean during self test. Check voltage at ECA input.
42-RUN	(Right) oxygen sensor signal rich during self test. Check voltage at ECA input.
42-MEM	(Right) oxygen sensor signal is not switching. Rich indication. Check input to ECA.
44-RUN	Thermactor did not operate during self test. Check diverter and bypass solenoid operation.

CODE	DESCRIPTION
45-RUN	Thermactor air was diverted to exhaust manifold during self test. Check diverter operation.
45-RUN	Distributorless ignition coil pack #1 has a problem. Check coil primary and power for resistance.
45-MEM	Distributorless ignition had primary circuit problem recently. Check all coil packs and DIS module.
45-MEM	Thermactor air did not bypass during self test. Check bypass solenoid operation.
46-RUN	Distributorless ignition coil pack #2 has a problem. Check coil primary and power for resistance.
47-OFF	4X4 switch is closed or grounded on E4OD transmission. Check voltage input to ECA.
47-RUN	Air flow low at base idle. Check for vacuum leaks and o-rings on injectors. Check voltage to ECA.
48-RUN	Air flow too high at base idle. Check ignition for miss and Vane air flow voltage to ECA.
48-MEM	Distributorless ignition coil pack #3 has a problem. Check coil primary and DIS module. (Left coil on 2.3L).
49-MEM	1-2 shift error on E4OD transmission. Road test while watching input voltage to ECA.
49-MEM	Spout signal fixed at 10 degrees BTDC for failure management. Check profile ignition pickup and ignition system.
51-ALL	Engine coolant temperature shows -40 degrees. Check voltage at ECA input.
52-OFF	Power steering pressure switch circuit open. Check voltage at ECA input.
52-RUN	Power steering pressure switch stays open or closed during self test. Check voltage at ECA input.
53-ALL	Throttle position sensor voltage too high. Check adjustment and voltage at ECA input.
54-ALL	Air charge temperature sensor shows -40 degrees. Check voltage at ECA input.
55-RUN	Key power monitor circuit open. Check voltage at input to ECA.
56-MAF	Mass air flow signal too high. Check voltage at input to ECA.
56-VAF	Vane air flow too high. Check voltage at input to ECA.
56-TRUCK	Transmission oil temperature sensor voltage shows -40 degrees. Check input voltage to ECA.
57-MEM	AXOD transmissions has open neutral pressure switch circuit. Check voltage at input to ECA.
58-VAF	Vane air temperature shows -40 degrees. Check voltage at input to ECA.
58-OFF	Idle tracking switch open. Check voltage at input to ECA.
58-RUN	Idle tracking switch closed during self test. Check voltage at input to ECA.
59-OFF	AXOD 4/3 pressure switch failed open. Check voltage at input to ECA.
59-OFF	Idle service jumper between ECA pins 23 & 24 is connected. Remove jumper for self test and normal operation.
59-MEM	2-3 shift error on E4OD transmission. Road test while watching input voltage to ECA.
59-MEM	AXOD 4/3 pressure switch failed open. Check voltage at input to ECA.
59-SHO	Low speed fuel pump circuit problem. Check signal from ECA.
61-ALL	Engine coolant temperature sensor voltage indicated 254 degrees F. Check voltage input to ECA.
62-OFF	AXOD 4/3 or 3/2 pressure switches failed closed. Check voltage input to ECA.
62-MEM	Converter clutch solenoid circuit problem on E4OD transmission. Check amp draw with engine off.

CODE	DESCRIPTION
63-ALL	Throttle position sensor voltage is too low. Check voltage input to ECA.
64-ALL	Air charge temperature indicates 254 degrees F. Check voltage input to ECA.
65-MEM	System did not go into closed loop fuel control. Check fuel control sensor operation.
65-RUN	Overdrive cancel switch did not change during self test. Check voltage input to ECA.
66-TRUCK	Transmission oil temperature sensor voltage shows 290 degrees F. Check voltage input to ECA.
66-MEM	Mass air flow or vane air flow sensor voltage is too low. Check voltage input to ECA.
67-TRUCK	Manual lever position voltage is out of range. Check voltage input to ECA.
67-OFF	Neutral drive switch is open, or AC was on during self test. Check both voltage inputs to ECA.
67-OFF	AXOD's
67-MEM	AXOD neutral pressure switch failed closed. Check voltage input to ECA.
68-VAF	Clutch switch failed. Should give neutral drive gear signal when clutch is depressed.
68-OFF	Vane air temperature indicates 254 degrees F. Check voltage input to ECA.
68-OFF	AXOD 3/2 switch failed closed. Check voltage input to ECA.
68-RUN	Idle tracking switch failed in closed position. Check voltage input to ECA.
69-MEM	Idle tracking switch failed in open position during self test. Check voltage input to ECA.
69-MEM	AXOD 3/4 pressure switch failed in open position. Check voltage input to ECA.
69-OFF	3-4 shift error on E4OD transmission. Road test while watching solenoid voltage.
70-MEM	AXOD 3/2 pressure failed in closed position. Check voltage input into ECA.
71-MEM	ECA data communications link has a circuit problem. Check for signal from ECA.
71-MEM	ECA reinitialized recently. Check for intermittent power, ignition noise, and ground problems.
71-MEM	Idle tracking switch failed in closed position with ISC motor retracted. Check voltage input to ECA.
71-MEM	Driver cluster control assembly data communications link failed. Check cluster assembly (dealer item)
72-MEM	ECA has had power loss recently. Check power, ground and for wiring problems.
72-MEM	W/ISC
72-MEM	W/DATA
72-MEM	LINK
72-MEM	W/DATA
72-MEM	LINK
72-RUN	Manifold absolute pressure sensor voltage change was too small during goose test. Check hose for leaks.
73-RUN	Throttle position sensor voltage change was too small during goose test. Sweep test sensor.
74-RUN	Brake on-off switch did not change during self test. Press brake and check voltage input to ECA.
75-RUN	Brake on-off switch was closed (brake applied) during complete self test. Check voltage input to ECA.
76-MEM	Vane air flow voltage change was too small during goose test. Check voltage input to ECA.
77-ALL	Goose test was not done properly. Repeat self test and briefly go full throttle throttle during goose test.
79-OFF	Air conditioning was on during self test. Check voltage input to ECA.

CODE		DESCRIPTION
81-OFF	SHO	Inlet air solenoid circuit has a problem. Check voltage and amp draw at ECA output.
82-OFF		Thermactor air bypass solenoid circuit has a problem. Check voltage and amp draw at ECA output.
82-OFF		Supercharger bypass solenoid circuit has a problem. Check voltage and amp draw at ECA output.
83-OFF		EGR control solenoid circuit has a problem. Check voltage and amp draw at ECA output.
83-OFF	W/ICM	High electric drive fan solenoid circuit has a problem. Check voltage and amp draw at ECA output.
83-SHO		Low speed fuel pump relay circuit has a problem. Check voltage and amp draw at ECA output.
84-OFF		EGR vent solenoid has a problem. Check voltage and amp draw at ECA output.
84-OFF	EVR	EGR vacuum regulator solenoid circuit has a problem. Check voltage and amp draw at ECA output.
85-OFF		Canister purge solenoid circuit has a problem. Check voltage and amp draw at ECA output.
85-MEM		Adaptive learn fuel control has reduced fuel to minimum limit. Look for cause of rich condition.
86-MEM		Adaptive learn fuel control has added fuel to maximum limit. Look for cause of lean condition.
86-MEM	TRUCK	Shift solenoid circuit problem. Do amp draw test with engine off.
87-ALL		Fuel pump circuit has a problem. Check voltage and amp draw at ECA output.
88-OFF		Electric drive fan solenoid has a circuit problem. Check voltage and amp draw at ECA output.
89-OFF	AXOD'S	AXOD lock up solenoid circuit has a problem. Check voltage and amp draw at ECA output.
89-OFF		Converter clutch override solenoid circuit has a problem. Check voltage and amp draw at ECA output.
91-OFF		Shift solenoid #1 has a circuit problem. Do amp draw test with engine off.
91-RUN		Left oxygen sensor voltage shows lean mixture. Check voltage and find reason for left side problem.
91-MEM		Left oxygen sensor voltage not crossing mid-point. Check voltage and find reason for left side problem.
92-OFF		Shift solenoid #2 has a circuit problem. Do amp draw test with engine off.
92-RUN		Left oxygen sensor voltage shows rich mixture. Check voltage and find reason for left side problem.
93-ALL		Throttle position sensor voltage too low with ISC motor fully extended. Sweep test Throttle sensor.
93-OFF		Coast clutch solenoid has a circuit problem. Do amp draw test with engine off.
94-OFF		Convert clutch control circuit has a problem. Do amp draw test with engine off.
94-RUN		Thermactor air control system inoperative for cylinders 5-6-7-8. Check solenoid voltage and amp draw.
95-ALL		Fuel pump power circuit has a problem. Check power from battery to fuel pump.
96-ALL		Fuel pump power circuit has a problem between ECA and Battery. Check for voltage between the two points.
96-SHO		High speed fuel pump relay has a circuit problem. Check voltage and amp draw at ECA output.
98-TRUCK		EPC failed on gas truck
99-TRUCK		EPC failed on diesel truck

3 Digit Trouble Code Conversion Chart

NOTE: If you have a '90 or later vehicle the codes may be emitted with 3 digits. These 3 digits can be referenced back to 2 digit diagnosis.

111	11	328	32	624	99
112	64	332	33	626	93
113	54	334	34	627	94
114	24	337	35	628	62
116	21	338	51	631	97
117	61	339	61	632	65
118	51	411	13	633	47
121	23	412	12	634	67
122	63	452	29	636	26
123	53	511	15	637	56
126	22	512	15	638	66
128	22	513	19	654	67
129	72	519	52	998	98
144	41	521	52		
167	73	536	74		
172	41	538	77		
173	42	539	67		
179	85	542	95		
181	86	543	96		
182	85	552	82		
183	86	553	81		
211	14	556	87		
212	18	558	EVR Circuit		
213	18	565	85		
225	25	617	49		
311	44	618	59		
312	45	619	69		
313	46	621	91		
327	31	622	92		

STEP 1:

Measure Battery Open Circuit Voltage

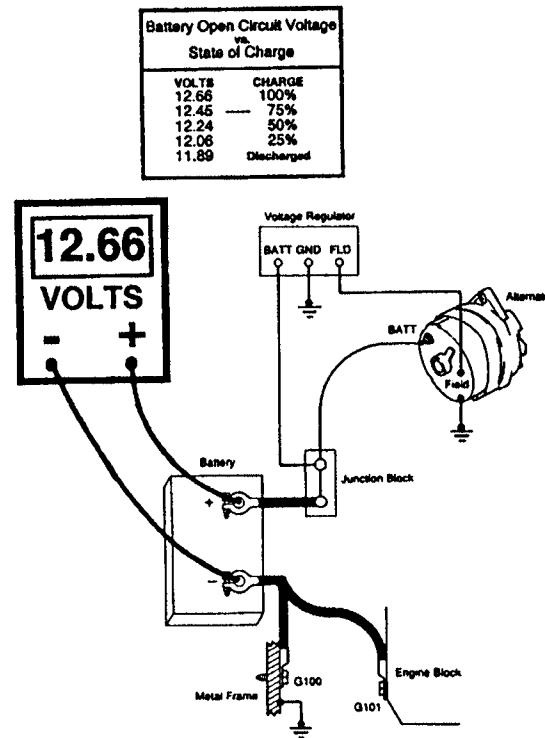
DO THIS: Engine OFF for 10-15 minutes, preferably a cold engine. Place test leads of a digital voltmeter (DVOM) at the battery terminals to measure battery's Open Circuit Voltage. If the battery has rested for 10-15 minutes most of the surface charge will dissipate by itself.

EXPECT THIS: A voltage reading between 12.66V (100% of full charge) and 12.45V (75% of full charge). Compare voltage reading to the Battery Open Circuit Voltage Chart to determine actual state of charge. If above 12.45V go to Step 3. Do not accept less than 12.45V without investigating why.

Possible problems if lower than 12.45V:

1. Low charging voltage that isn't keeping the battery up to full charge - continue running these "FIRST THINGS FIRST" procedures using Steps 2-16.
2. Previous vehicle driving time was too short to recharge the battery.
3. Perform a standard ignition key-off battery drain test to determine if drain is excessive.
4. Excessive starter motor draw (covered in Step 4).
5. Defective battery that cannot hold a charge (perform industry standard Battery Load Test).

TIPS: #1: If none of the above problems exist, the battery simply has a low state of charge. Perform Step 2. If Step 2 is good, recharge the battery before proceeding.
#2 Be sure to use a DVOM that has a DC Accuracy rating of at least + or - 0.5%. This rating is given in the owner's manual. The ideal DC Accuracy rating is + 0.1%. Do not use an analog voltmeter (VOM) because they are not accurate.



Battery Open Circuit Voltage vs. State of Charge	
VOLTS	CHARGE
12.66	100%
12.45	75%
12.24	50%
12.06	25%
11.89	Discharged

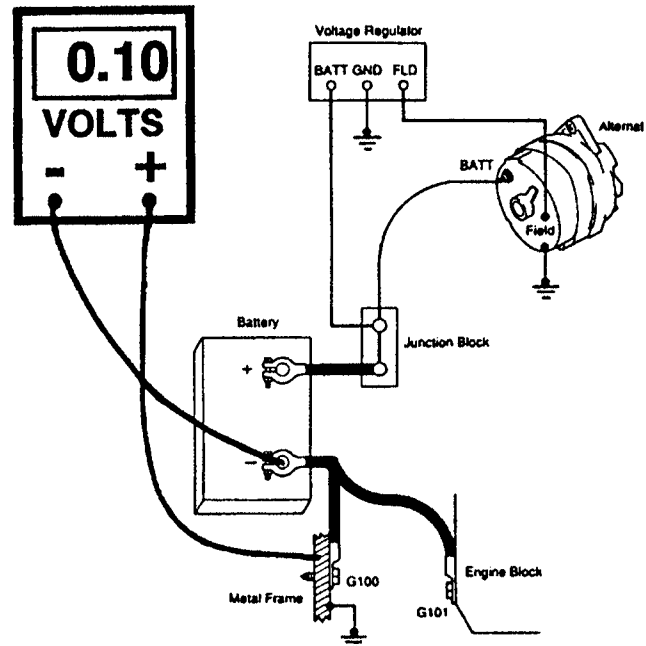
STEP 3:

Measure Accessory Ground Voltage Drop - Eng. Cold

DO THIS: Place DVOM test leads on the battery negative terminal and the vehicle metal used as the accessory ground (fender well, bulkhead, cross member, etc.). Perform this step as quickly as possible to avoid draining the battery unnecessarily.

Set Up These Conditions:

1. Engine Not Running
2. Ignition Key ON
3. Turn ON these electrical loads high beam headlights, a/c (or heater on) high blower, electric windshield wipers, radio



EXPECT THIS: The allowable voltage drop is 0.1V. Above 0.1V indicates corrosion in the connections or ground cable. Do not accept more than 0.3V because corrosion has begun to degrade the accessory ground. Clean connections and/or replace the accessory ground cable. Confirm a good voltage drop before proceeding further.

When finished with this step be sure to turn OFF all electrical loads. If reading is good go to Step 4.

Twenty Steps To Successful Transmission Repair

- 1.As you start work on a transmission, read your ATRA bulletins pertaining to that transmission. (If you do this every time, before you know it you'll have the bulletins memorized.)
- 2.Clean the entire transmission, including the valve body.
- 3.Check pumps, valve bodies, and cases for warpage.
- 4.Flat file pumps, valve bodies, and cases. (Just a few strokes with the file to knock off high spots and handling burrs.)
- 5.Check all pump gear clearances.
- 6.Check planet pinion endplay and side to side motion.
- 7.Soak all planet assemblies.
- 8.Soak all friction material for 15-30 minutes.
- 9.Sand, tumble, or replace all steel plates.
- 10.Re-surface all drums on which a band rides.(Except 700 R4)
- 11.Replace all rotating oil control rings.
- 12.Check all oil control rings and rubber products in their bores for proper fit. (Especially Imports)
- 13.Check all major support bushings and bushings that control lube oil.
- 14.Pre-lubricate all bushings and thrust washers.
- 15.Pre-lube pumps.
- 16.Pre-fill torque converters.
- 17.Use available manuals to find specifications.
- 18.Set correct clutch and band clearances.
- 19.Take the time to set total unit endplay.
- 20.Use a torque wrench on all pumps and valve bodies.

Two Important 440 Procedures Adjusting the Modulator

STEP 1

Disconnect the vacuum line with the engine at fast idle (approx 1200 RPM). Check the line pressure in drive, it should not be above 210 psi. If line pressure is above 210, you either have the wrong modulator OR the modulator is adjusted too far in.

STEP 2

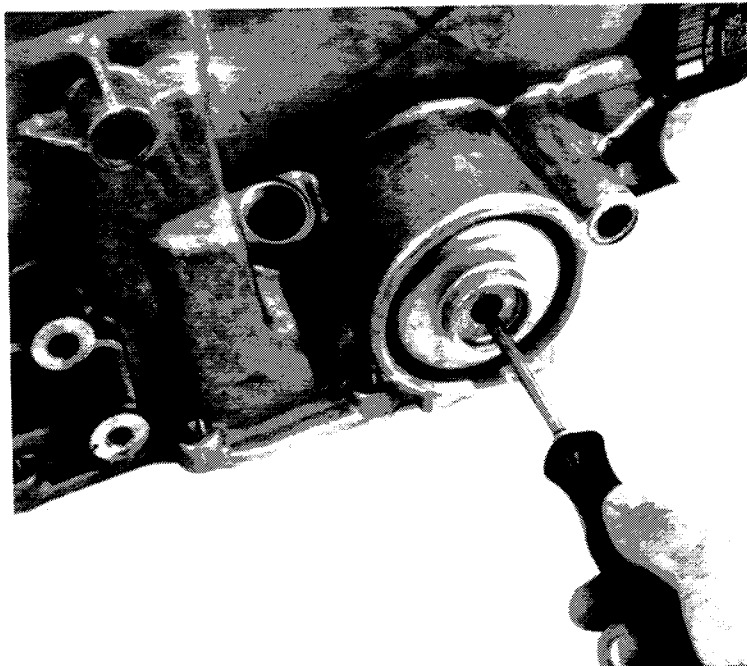
Connect a vacuum pump to the modulator. Pump in vacuum until the line pressure is at minimum (60-75). Bleed the vacuum down to 11". Line pressure should have increased approximately 10 psi. Adjust the modulator until you can get a 10 psi pressure rise by 11" of vacuum.

STEP 3

Disconnect vacuum line to be sure you are still not above 210 psi line pressure.

Band Adjustment

Travel on the 1-2 band servo should be 1/8" to 1/4". The reverse servo travel should also be 1/8" to 1/4". The best way to set servo travel is with pin length. To set servo travel you may have to weld onto the servo pin.



TCC Shudder

STEP 1

Verify that this is not an engine problem. See next page. Over 50% of 440 Lock-up shudders are engine problems.

STEP 2

Try a friction modifier in the fluid.

STEP 3

If the TCC accumulator piston and shaft are worn, replace them with part number 8646926.

STEP 4

Grind two deep flats on the 2nd land of the pressure regulator valve. *Figure 1.*

STEP 5

You may increase the tension of the TCC regulator spring. If there isn't a spring, install a light spring. If there is a spring, increase the spring weight by 1 lb. Don't exceed 2 1/2 lbs or TCC re-engagement may be too rough. The working height for the spring is .750". Make sure the valve is not sticking. *Figure 2.*

STEP 6

Replace the converter.

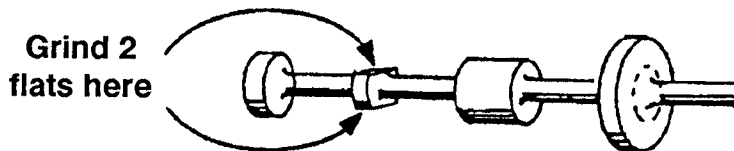


Figure 1

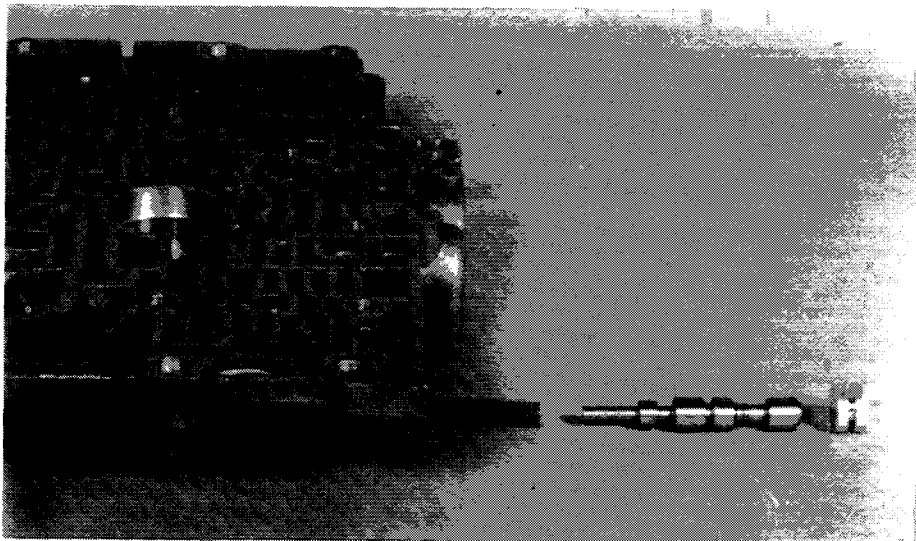
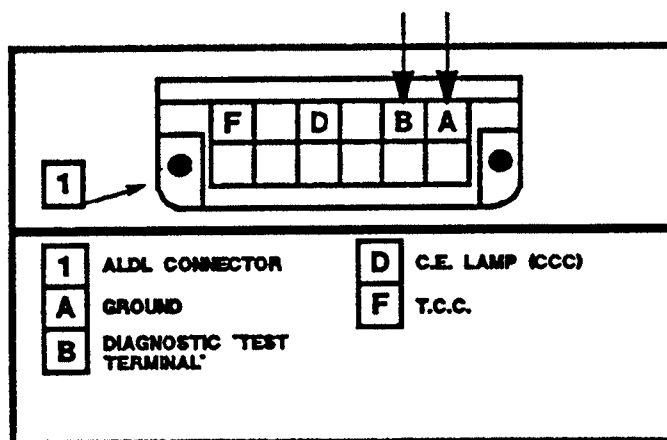


Figure 2

TCC Shudder Diagnosis

A test that is useful in diagnosing TCC shudder, is to use the field service mode. When you connect terminals A and B at the ALDL with the engine running the vehicle enters the field service mode. This is the same connections you'd make for checking trouble codes but this time the engine is running. While in the field service mode the check engine light will flash 2.5 times per second to indicate Open Loop. After the vehicle warms up and enters Closed Loop the light will flash once per second. This light will be on to indicate rich exhaust and off to indicate lean exhaust. Normal operation will be a flashing light. If the flashes are at 1 second intervals this indicates a perfect 14.7:1 air/fuel ratio. When diagnosing a converter clutch shudder, watch the light. If during the shudder the light stays on or stays off it indicates an engine problem causing the shudder.



Harsh 3-2 Detent Downshift 1985 1/2 and Later

A harsh 3-2 detent downshift may be caused by improper 3-2 control valve spring calibration or a missing or undersize feed hole in the spacer plate.

Enlarge the hole shown on the spacer plate to .045". (Figure 1) Some spacer plates may be missing this hole. If the hole is missing, lay a gasket on the plate to identify the hole location, and drill a .045" hole.

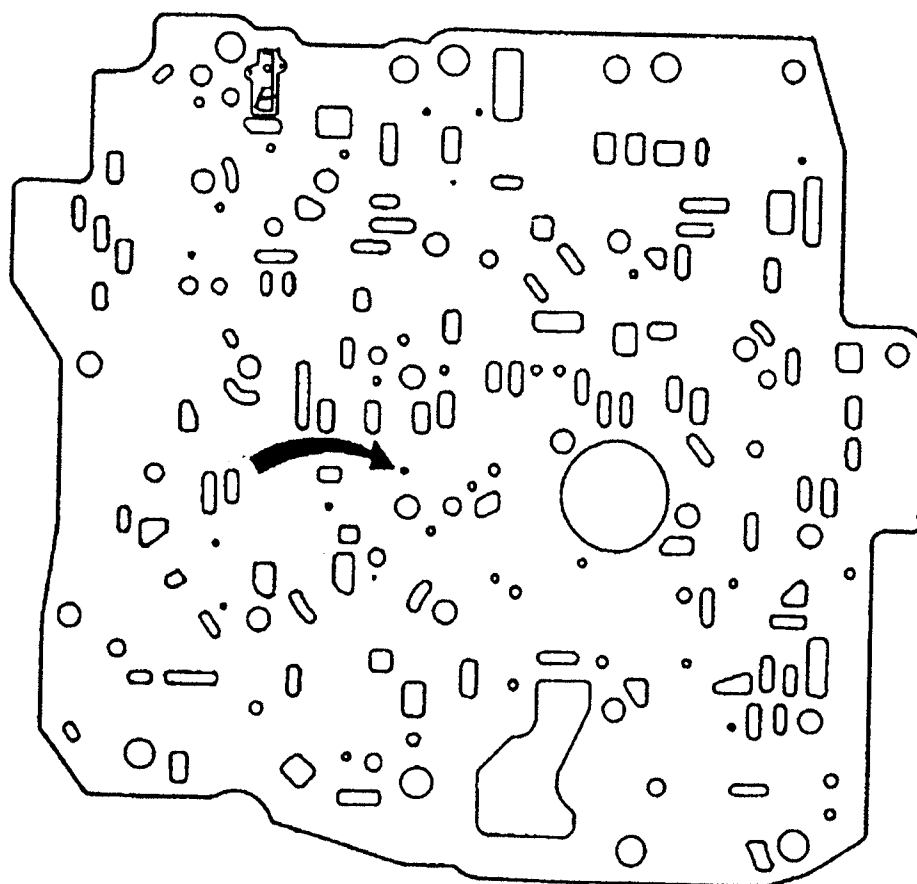


Figure 1

Remove the 3-2 control valve (Figure 2) spring and the 3-2 control valve.

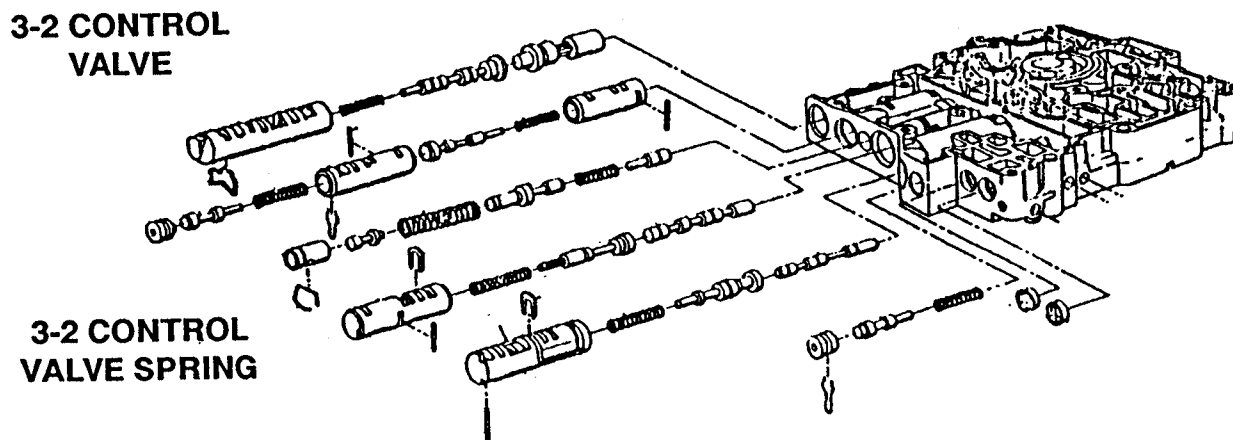


Figure 2

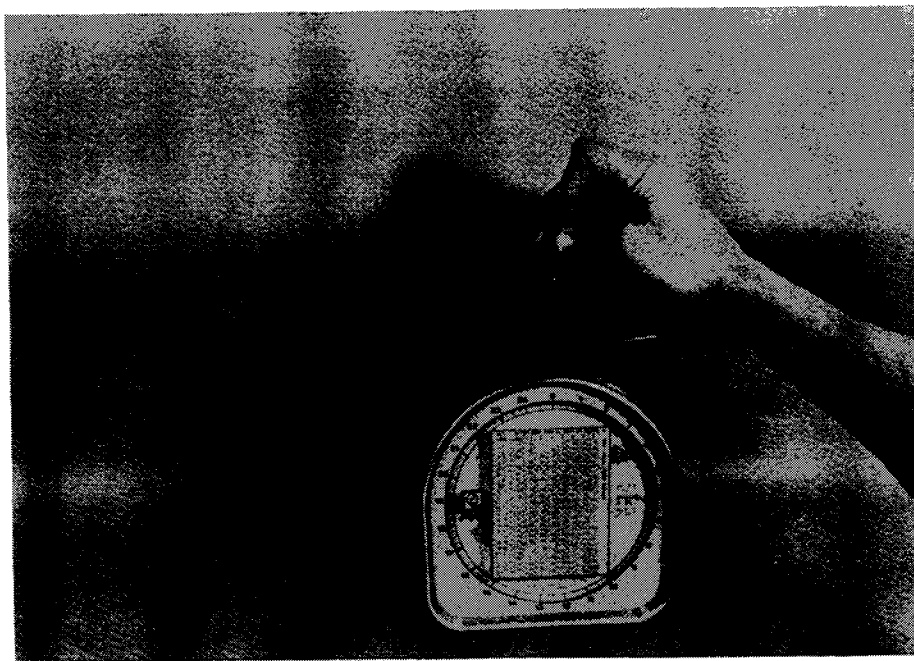


Figure 3

Place the spring over the stem of the valve, and press down on a scale until the tip of the stem just touches the scale. (Figure 3) The scale should read 5 1/2 - 5 3/4 lbs. Trim the spring as necessary until the desired weight is obtained.

Spacer Plate Interchange

85 1/2 and later 440-T4 spacer plates are matched to the 3-2 line control valve.

Refer to the following figures for identification.

One piece valves and matching plates are used with the "small" engines (2.8, 3.0, & 3.1 non-turbo). See figure 1.

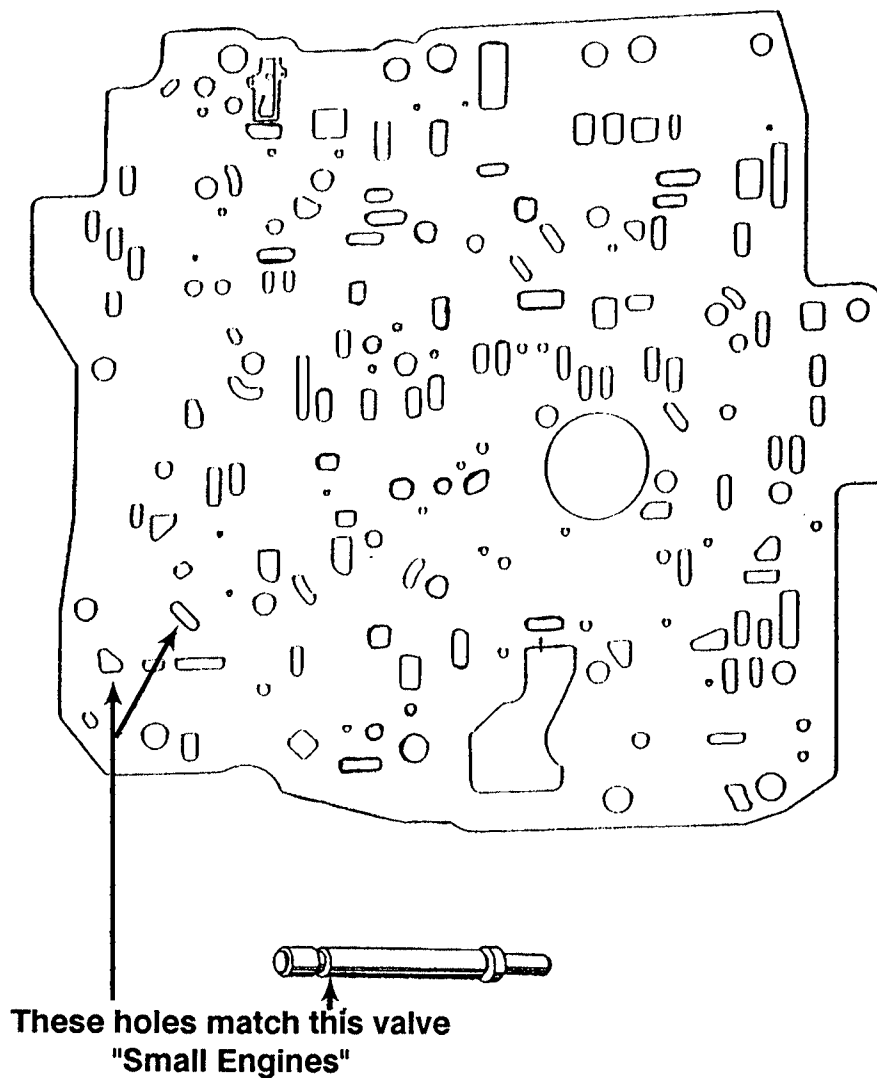


Figure 1

Two piece valve line-up and matching plates are used with "large" engines (3.1 turbo, 3.3, 3.8, 4.1, & 4.5) See figure 2.

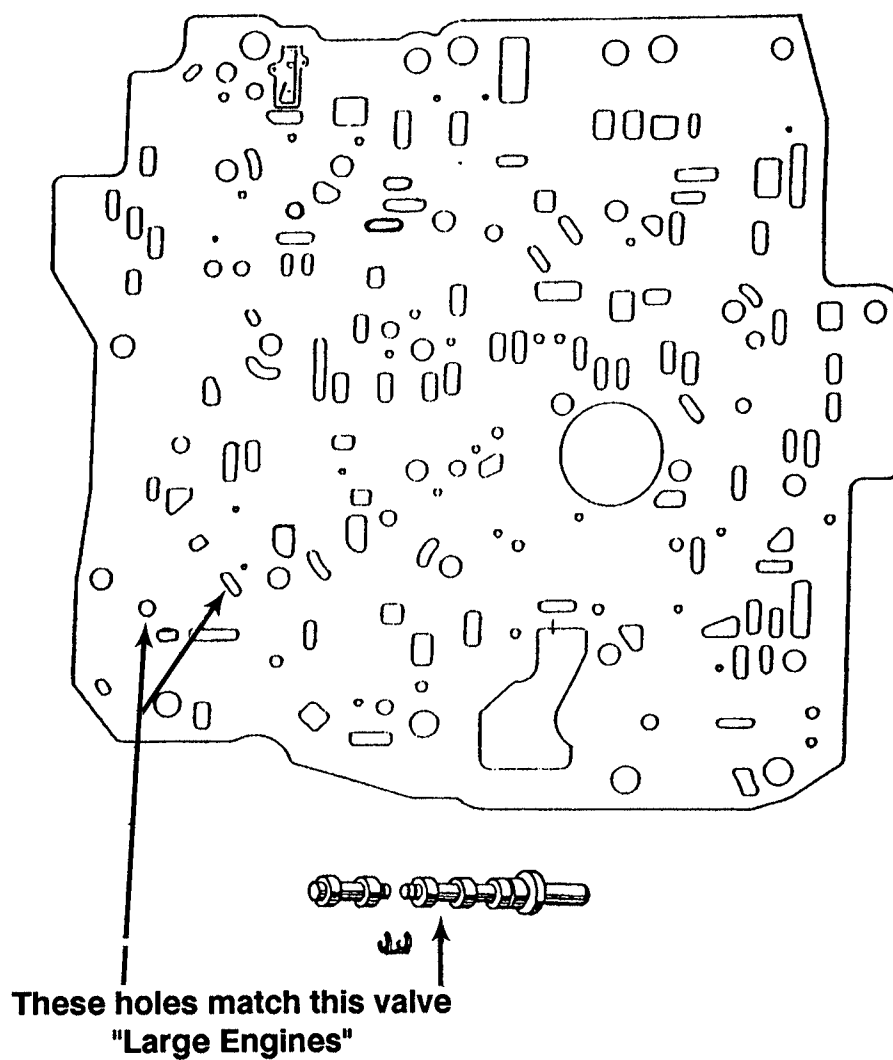


Figure 2

Spacer plates and valve line-ups are not interchangeable between "small" and "large" engine families. Keep two piece valves and plates with "large" engines, and one piece valves and plates with "small" engines.

Spacer Plate Interchange

A mismatch may be created during the replacement of either the valve body or spacer plate. The result can be a lack of T.V. pressure which can cause early upshift and no kickdown.

Measure the diameter of the 2nd land on the T.C.C. Regulator valve (See Figure 1).

IF LAND #2 MEASURES .387 DIA. THE SPACER PLATE MUST HAVE THE HOLE SHOWN BY THE ARROW.

IF LAND #2 MEASURES .335 THE SPACER PLATE MUST NOT HAVE THE HOLE SHOWN BY THE ARROW.

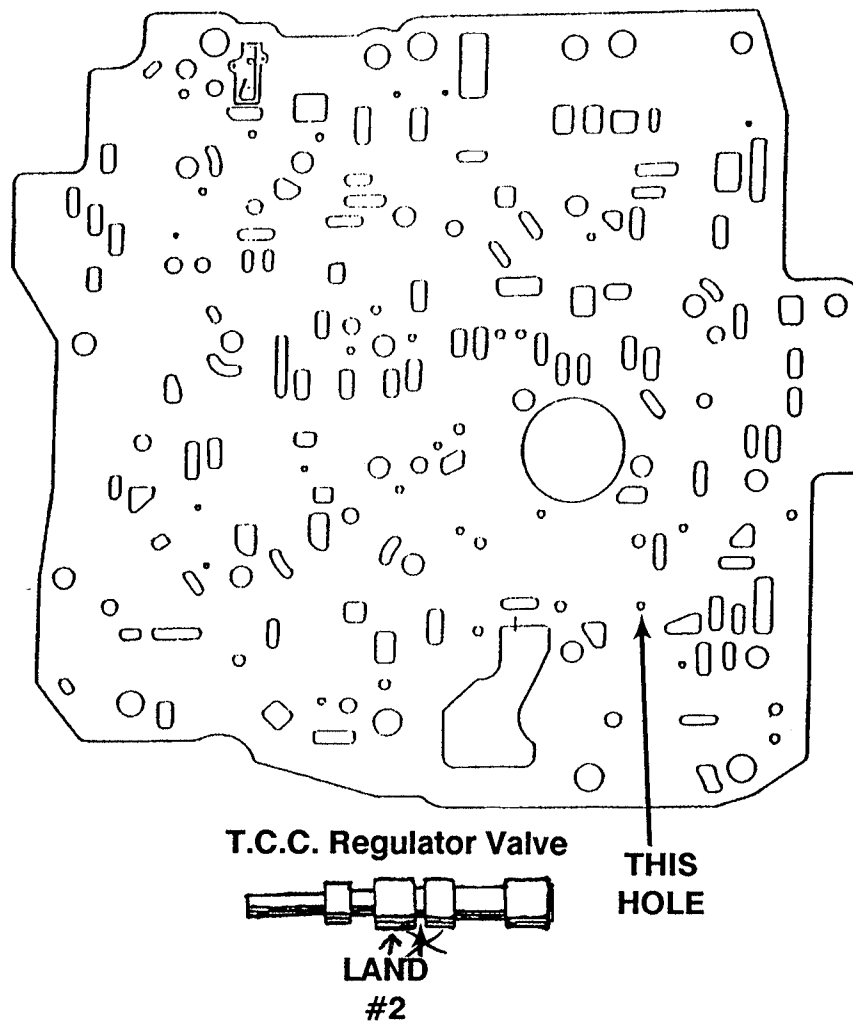


Figure 1

Honda/Acura I.D. Chart

Honda

YEAR	NO. OF SOLENOIDS	TRANS. MODEL CODE
------	------------------	-------------------

Civic/CRX

86-87	None	CA
88-90 2WD	1-External	L4
89-90 4WD*	2-Internal, 2-External	S5
91 2WD	1-External	ML4A
91 4WD*	4-External	MPSA

* USED ONLY ON CIVIC WAGONS

Prelude

83	None	AK
84-87 w/carb	None	AS
85-87 w/FI	None	F4
88-90	2-Internal, 2-External	K4
91	4-External	MY8A

Accord

83	None	AK
84-85	None	AS
86-89	None	F4
90	4-External	PX4B
91	4-External	APX4

Acura

YEAR	NO. OF SOLENOIDS	TRANS. MODEL CODE
------	------------------	-------------------

Integra

86-87	None	CA
88-89	1-External	P1
90	4-External	RO
91	4-External	MPRA

Legend

86-87	1-Internal	G4
87-89**	4-External	L5
90	4-External	PL5X
91***	4-Internal	MPYA

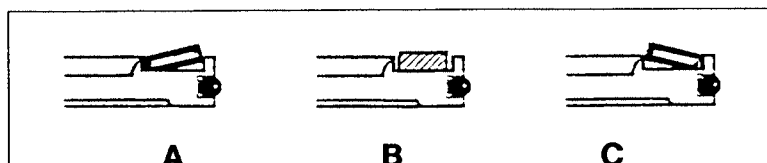
** - Includes 87 2 Door

*** - The MPYA is a longitudinal transmission with a pan

Clutch Usage Chart

MODEL	CLUTCH COUNT PER DRUM	CLUTCH DIAMETER	
		MM	IN
AK	3	106	4 5/32
AS	3	110	4 5/16
F4	3	116	4 9/16
K4	3	116	4 9/16
CA	3	110	4 5/16
L4	3	110	4 5/16
P1	3	116	4 5/16
G4	4	116	4 9/16
L5	4	116	4 9/16
S5	3	110	4 5/16
PX4B	3	120	4 3/4
RO	3	116	4 9/16
PL5X	4	116	4 9/16
ML4A	3	110	4 5/16
MPSA	3	110	4 5/16
MY8A	3	120	4 3/4
APX4	3	120	4 3/4
MPRA	4 Plates in the 2nd clutch, 3 in the other drums	116	4 9/16
MPYA	4	128	5 1/16

Clutch Cushion Chart



4 CLUTCH PAK UNITS

MODEL	1ST CLUTCH	2ND CLUTCH	3RD CLUTCH	4TH CLUTCH
AK	A	A	A	A
AS	A	A	A	A
F4	B	A	A	A
K4	A	C	A	A
CA	B	A	A	A
L4	A	C	A	A
P1	A	C	A	A
G4	B	A	A	A
L5	A	C	A	A
RO	A	A	A	A
PL5X	A	C	A	A
ML4A	A	C	A	A
MY8A	C	C	A	A
MPRA	C	A	A	A

5 CLUTCH PAK UNITS

MODEL	1ST CLUTCH	1ST HOLD CLUTCH	2ND CLUTCH	3RD CLUTCH	4TH CLUTCH
S5	A	A	C	A	A
PX4B	A	C	C	A	A
APX4	A	C	C	A	A
MPSA	A	A	C	A	A

6 CLUTCH PAK UNITS

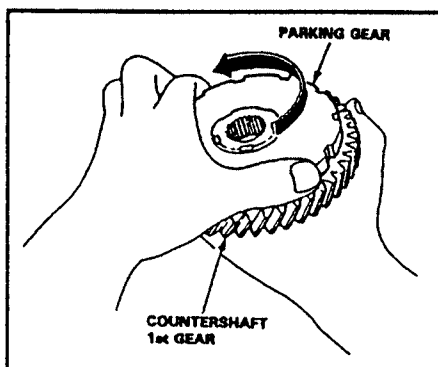
MODEL	1ST CLUTCH	1ST HOLD CLUTCH	2ND CLUTCH	3RD CLUTCH	4TH CLUTCH	REVERSE CLUTCH
MPYA	A	C	C	C	C	A

Clutch Clearance

MODEL	LOW CLUTCH	2ND CLUTCH	3RD CLUTCH	4TH CLUTCH
AK	.016-.028	.016-.028	.016-.028	.016-.028
AS	.016-.028	.026-.031	.016-.023	.016-.023
F4	.026-.033	.020-.028	.016-.024	.016-.024
K4	.026-.033	.016-.024	.016-.024	.016-.024
CA	.026-.033	.026-.031	.016-.023	.016-.023
L4	.026-.033	.026-.033	.016-.024	.016-.024
P1	.026-.033	.026-.033	.016-.024	.016-.024
G4	.026-.033	.020-.028	.020-.028	.016-.024
L5	.026-.033	.020-.028	.020-.028	.016-.024
S5	.026-.033	.026-.032	.016-.024	.016-.024
PX4B	.026-.033	.026-.033	.016-.024	.016-.024
RO	.026-.033	.020-.028	.016-.024	.016-.024
PL5X	.026-.033	.020-.028	.020-.028	.016-.024
ML4A	.026-.033	.026-.033	.016-.024	.016-.024
MPSA	.026-.033	.026-.033	.016-.024	.016-.024
MY8A	.026-.033	.016-.024	.016-.024	.016-.024
APX4	.026-.033	.026-.033	.016-.024	.016-.024
MPRA	.026-.033	.020-.028	.016-.024	.016-.024

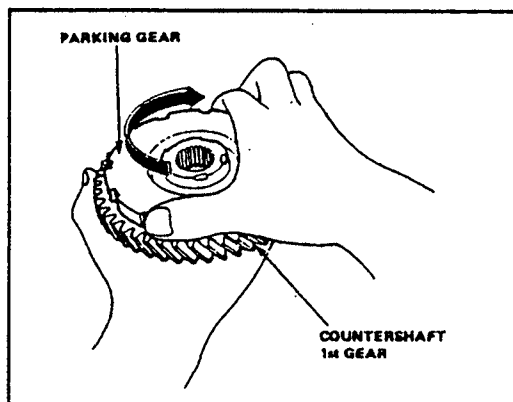
	1ST HOLD CLUTCH	REVERSE CLUTCH
S5	.026-.033	N/A
PX4B	.031-.039	N/A
MPSA	.020-.031	N/A
APX4	.031-.039	N/A
MPYA	.028-.035	.030-.037

Sprag Direction

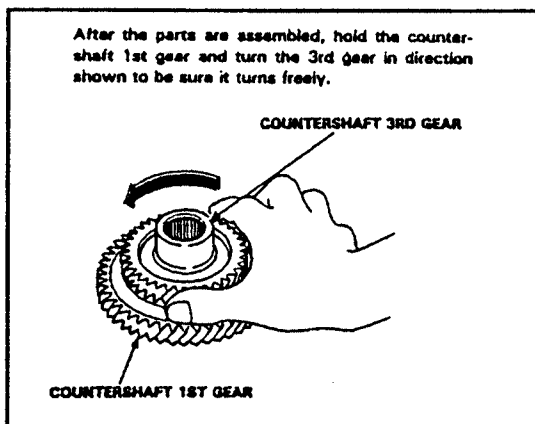


ALL HONDAS AND
ACURAS TO DATE,
EXCEPT THOSE
LISTED BELOW

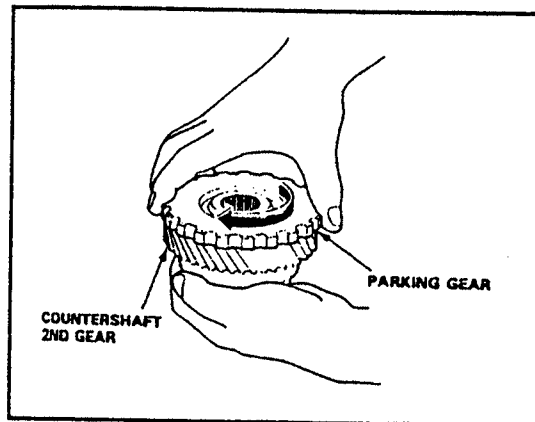
G4, L5 & PL5X



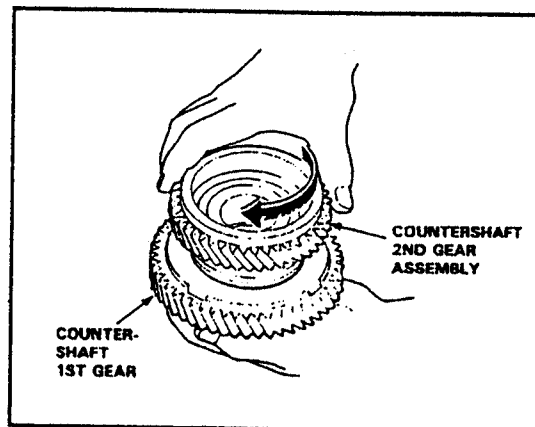
After the parts are assembled, hold the counter-
shaft 1st gear and turn the 3rd gear in direction
shown to be sure it turns freely.



APX4, PX4B



MPYA



MPYA

Honda/Acura Pressure Readings

- *Line pressure is measured at 2000 RPM in neutral or park.*
- *T.V. pressure is measured at 1000 RPM with the shifter in drive and the T.V. lever in the max position.*
- *All T.V. pressures should be 0 PSI at closed throttle. TV "B" pressure should begin to rise the instant the gas pedal is moved.*

ALL PRESSURES ARE IN PSI

	LINE	TVA	TVB	GOV	
AK	107-114	78-80	107-114	31-33	30 mph
AS	114-121	73-75	114-121	31-33	38 mph
F4	114-121	73-75	114-121	31-33	38 mph
K4	121-128	N/A	121-128	N/A	
CA *	121-128	79-81	121-128	31-32	38 mph
L4	114-121	73-75	114-121	30-31	38 mph
P1	121-128	79-81	121-128	31-32	38 mph
G4	114-121	67-69	114-121	26-28	38 mph
L5	114-121	N/A	114-121	N/A	
S5	114-121	N/A	114-121	N/A	
PX4B	114-121	N/A	108-121	N/A	
RO	71-85	N/A	111-118	N/A	
PL5X	114-121	N/A	114-121	N/A	
ML4A	114-121	73-75	110-117	30-31	38 mph
MPSA	114-121	N/A	114-121	N/A	
MY8A	121-128	N/A	121-128	N/A	
APX4	114-121	N/A	114-121	N/A	

< 1 > 71-85 with 21 Hg of modulator vacuum, 111-118 with 0 Hg of modulator vacuum.

< 2 > 111-118 with 0 Hg of modulator vacuum, 0 with 21 Hg of modulator vacuum.

* Use the L4 specs for CA models in a Civic.

Honda - Acura - Sterling

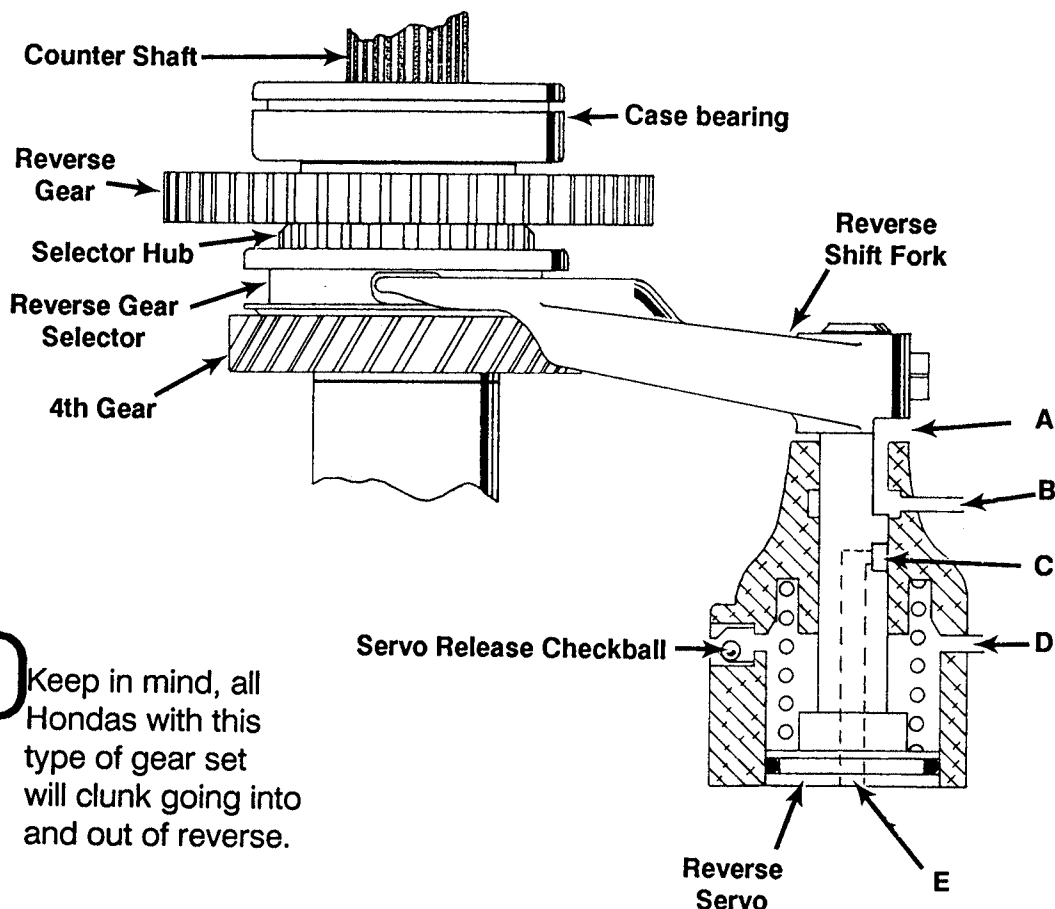
4 Speed Automatics

Noise going into or out of reverse

To fix a Honda that grinds in Reverse or out of reverse you first need to understand how it works. The normal position (i.e. park, neutral, drive, 3rd and 2nd) of the reverse/4th gear set is shown in the figure below. When the manual control valve is moved to the reverse position, oil charges the bottom of the reverse servo including port E located on the servo. As the servo moves up, port C & B will be connected. At this point, the reverse gear selector will be engaged to the reverse gear and the reverse servo oil can now flow out port B to apply the 4th clutch. When the manual control valve is moved out of reverse, pressure at port D will move the servo down to engage the 4th gear. As the servo approaches the gear position 4th clutch oil will exhaust through port A.

The grinding occurs when the reverse gear selector is between the two gears. During this time the gear set is momentarily in neutral. If the gears start turning, you'll get a grind.

NEVER shift a Honda into or out of Reverse while the car is moving.



NOTE:

Keep in mind, all Hondas with this type of gear set will clunk going into and out of reverse.

THINGS TO CHECK BEFORE A REBUILD

- **LINE PRESSURE**

Low line pressure will slow the rate that the servo will move. The longer it takes to move the shift fork from one range to another, the greater the opportunity for the gears to grind. See page 8 for pressure specs.

- **WHAT TYPE OF OIL IS IN THE TRANSAXLE?**

See if the transaxle has been serviced recently. Some oils like type "F" can cause the 4th clutch to drag. Honda oil works best.

- **CHECK TO MAKE SURE THE MAINSHAFT AND COUNTER SHAFT AREN'T BENT.**

If you can get the end cover off, rotate the two shafts and make sure they're not bent. This can cause a mechanical bind.

THINGS TO CHECK DURING A REBUILD

1. **CHECK THE REVERSE/4TH GEAR SET FOR WORN TEETH**

Worn teeth on these parts are not normally the cause of the noise but the result of these gears grinding. It is important for the smooth operation of this transaxle that these parts not be worn. If they are worn replace the gear set.



2. 4TH CLUTCH CLEARANCE.

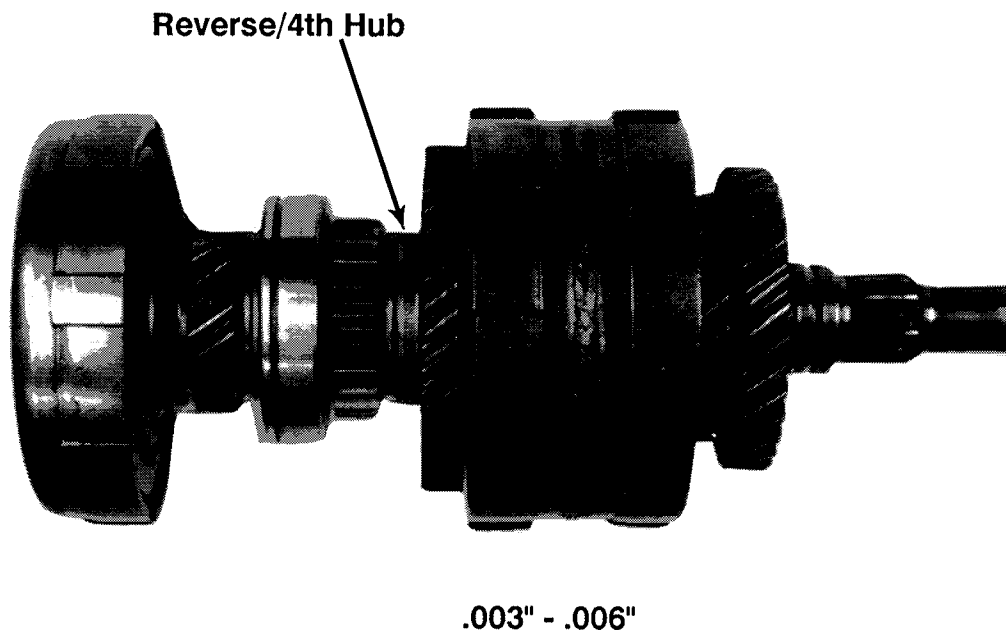
A tight 4th clutch pack will cause excessive drag. The clearance in the 4th clutch should be .016" - .024" on all models except AK: .016" - .028" and AS: .016" - .023". It may be to your advantage to favor clearances at the loose end of specs.

3. FRICTION MATERIAL

The type of friction material used will influence how the 4th clutch releases out of reverse. If the clutch doesn't break loose or if it drags, the transaxle will grind. Always use top quality frictions. If you're having problems, you might consider factory frictions. It is also important to check the clutch plates for flatness.

4. CHECK THE 4TH/REVERSE HUB CLEARANCE

Assemble the mainshaft (including the case bearing) and tighten the nut to 25 ft. lbs. The Reverse/4th hub should have .003" - .006" endplay. If you don't have any clearance, you have a misassembly or a worn Reverse/4th bearing collar.



NOTE: The Reverse/4th bearing collar is the part that the needle bearing rides on.

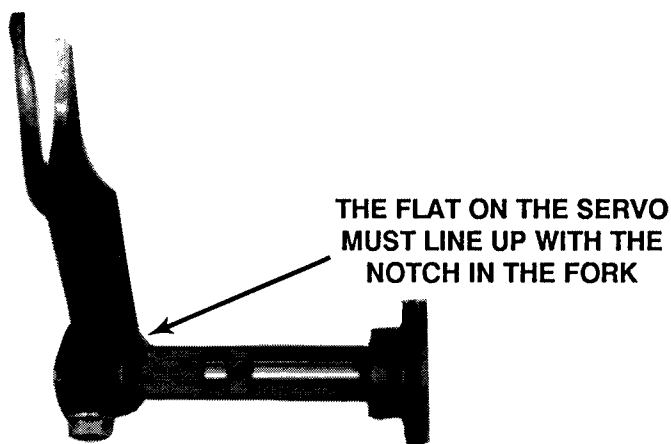
5. SERVO SHAFT & BORE

Make sure the servo shaft and bore are not scored. A damaged shaft or bore can bind the servo. The servo must be allowed to move quickly from one gear to another.

6. SERVO SHAFT BOLT

Make sure the servo has a shouldered bolt.

Using a shouldered bolt on the servo will prevent you from bolting the servo shaft on backwards. Bolting the servo on backwards will restrict port "A" (Page 9) which is the 4th clutch exhaust out of reverse.

**7. MAKE SURE THE SERVO CONTROL VALVE ISN'T STUCK**

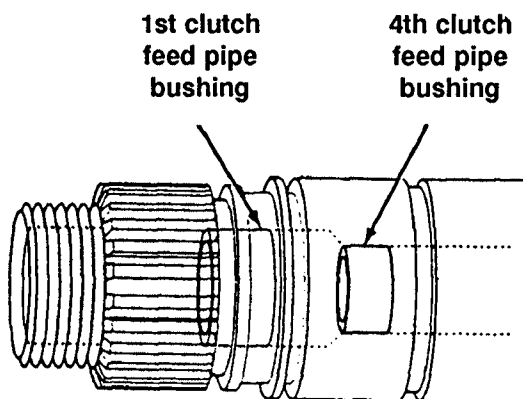
Some models have a servo control valve. This valve controls the rate of the servo apply & release. NOTE: Models without a servo control valve use an orificing checkball.

8. SERVO RELEASE CHECKBALL

Make sure this checkball does not leak. If it does, the servo will not release fast enough. (See the illustration on Page 9) This will cause a grinding noise when you shift out of reverse.

9. 1st CLUTCH FEED PIPE BUSHING

Noise from Drive to Reverse can be caused by a worn 1st clutch feed pipe bushing. If this is so, there will be a small amount of oil pressure at the 4th gear tap in drive. (Check it with the wheels stationary.) This may also cause 4th clutch failure. This is very common. Always check the feed pipe bushings.

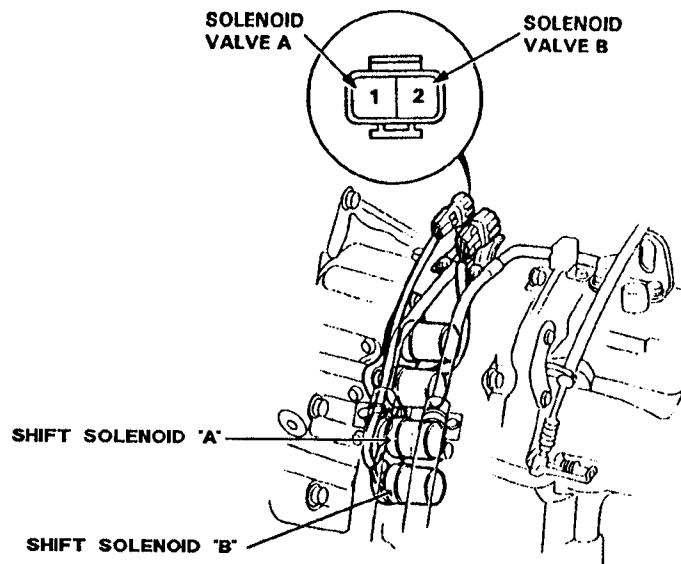


Acura 4 Speed Computer Shifted Transaxle Diagnosis

If you have a computer shifted Acura with a shift complaint like no upshift or stuck in 4th, you'll need to verify that the transaxle is capable of getting all four gears before taking the transaxle out of the car.

To do this you'll want to energize the shift solenoids with +12V for each gear. Use the chart below to shift the transaxle.

Shift control sol. valve Range (gear)	A	B
D S₃ S₄ (1st)	OFF	ON
D S₃ S₄ (2nd)	ON	ON
D S₃ S₄ (3rd)	ON	OFF
D S₄ (4th)	OFF	OFF



If the transaxle shifts properly, the problem is not in the transaxle.

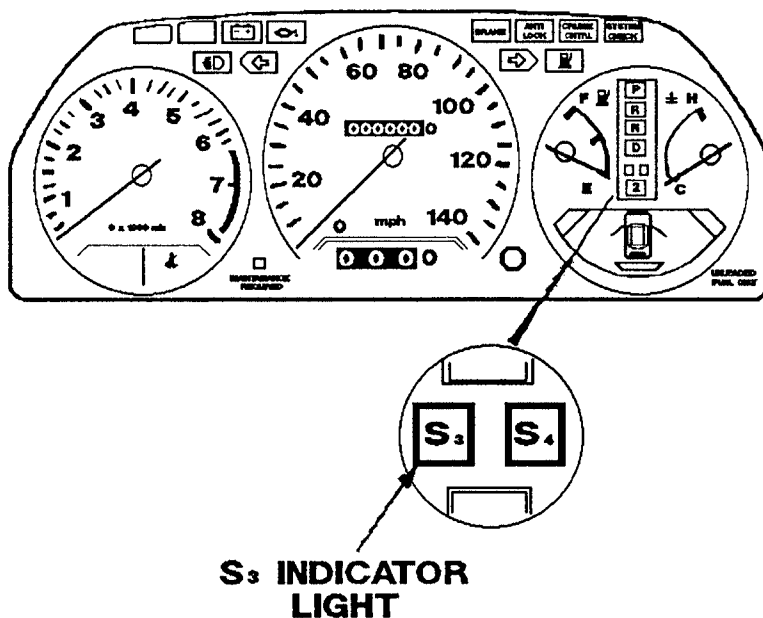
Honda/Acura 4 Speed Computer Diagnosing

Acura has been using computer shifted transmissions since 1987. The computer has a self-test feature that will signal the driver if a malfunction is present. When the computer detects a malfunction it flashes the S₃ light on the dash. Figure 1.

If the S₃ light is flashing you'll want to check for trouble codes from an LED built into the computer. If you don't get any trouble codes, check the symptoms in the trouble code chart. Pages 15 through 17 show a list of the codes and probable causes.

NOTE

This information is for models using an 18 & 12 pin connector at the computer.



# OF LED DISPLAY BLINKS	S ₃ INDICATOR LIGHT	SYMPTOM	PROBABLE CAUSE	CHK PIN#
0 *	OFF	- S₃ indicator light does not come on with the ignition switch ON (S₃ indicator light should come on for about 2 sec.). - Fails to shift (Stuck in 4th gear). - S₄ won't engage. - Fails to shift from 2nd to 1st gear when releasing brake pedal with shift lever in S or D range.	- Loosely or poorly connected power line to control unit or disconnected control unit ground wire - Open or short in S₃ indicator light wire - Faulty S₃ indicator light bulb - Open or short in S₄ switch wire - Faulty S₄ switch - Open or short in brake light switch wire	B1, B2 B6, B7 B11 A13 A12
1	Blink	- Lock-up clutch does not engage. - Lock-up clutch does not disengage. - Frequent engine stalling.	- Disconnected lock-up control solenoid valve A connector - Short to voltage in lock-up control solenoid valve A wire - Faulty lock-up control solenoid valve A	B3
2	Blinks	- Lock-up clutch does not engage.	- Disconnected lock-up control solenoid valve B connector - Open or short in lock-up control solenoid valve B wire - Faulty lock-up control solenoid valve B	B8
3	Blinks or OFF	- Lock-up clutch does not engage.	- Disconnected throttle angle sensor connector - Open or short in throttle angle sensor wire - Faulty throttle angle sensor	A15 A16
4	Blinks	- Lock-up clutch does not engage.	- Disconnected speed sensor connector - Open or short in speed sensor wire - Faulty speed sensor	A6

# OF LED DISPLAY BLINKS	S ₃ INDICATOR LIGHT	SYMPTOM	PROBABLE CAUSE	CHK PIN#
5	Blinks	- Fails to shift other than 2nd -- 4th gear. - Lock-up clutch does not engage.	- Short in the shift position console switch wire - Faulty shift position console switch	A1, A2 A3, A4 A5
6	OFF	- Fails to shift other than 2nd -- 4th gear. - Lock-up clutch does not engage. - Lock-up clutch engages and disengages alternately.	- Disconnected shift position console switch connector - Open in the shift position console switch wire - Faulty shift position console switch.	A1, A2 A3, A4 A5
7	Blinks	- Fails to shift other than 1st -- 4th, or 2nd -- 3rd gears. - Fails to shift (stuck in 4th gear).	- Disconnected shift control solenoid valve A connector - Open or short to voltage in the shift control solenoid valve A wire - Faulty shift control solenoid valve A	B4
8	Blinks	- Fails to shift (stuck in 4th gear).	- Disconnected shift control solenoid valve B connector - Open or short in the shift control solenoid valve B wire - Faulty shift control solenoid valve B	B5
9	Blinks	- Lock-up clutch does not engage.	- Disconnected A/T speed sensor - Open or short in A/T speed sensor wire - Faulty A/T speed sensor	A7
10	Blinks	- Lock-up clutch does not engage.	- Disconnected coolant temperature sensor connector - Open or short in the coolant temperature sensor wire - Faulty coolant temperature sensor	A15 A11

# OF LED DISPLAY BLINKS	S ₃ INDICATOR LIGHT	SYMPTOM	PROBABLE CAUSE	CHK PIN#
11	OFF	- Lock-up clutch does not engage.	- Disconnected ignition coil connector - Open or short in the ignition coil wire - Faulty ignition coil	A10
12 *	OFF	- Lock-up clutch does not disengage.	- Short in the cooling fan control unit wire. - Faulty cooling fan control unit.	A8
13 *	Blinks	- Late lock-up clutch engagement.	- Disconnected PA sensor connector. - Open or short in the PA sensor wire. - Faulty PA sensor	A15 A17 A9
* NOT USED IN ALL MODELS.				

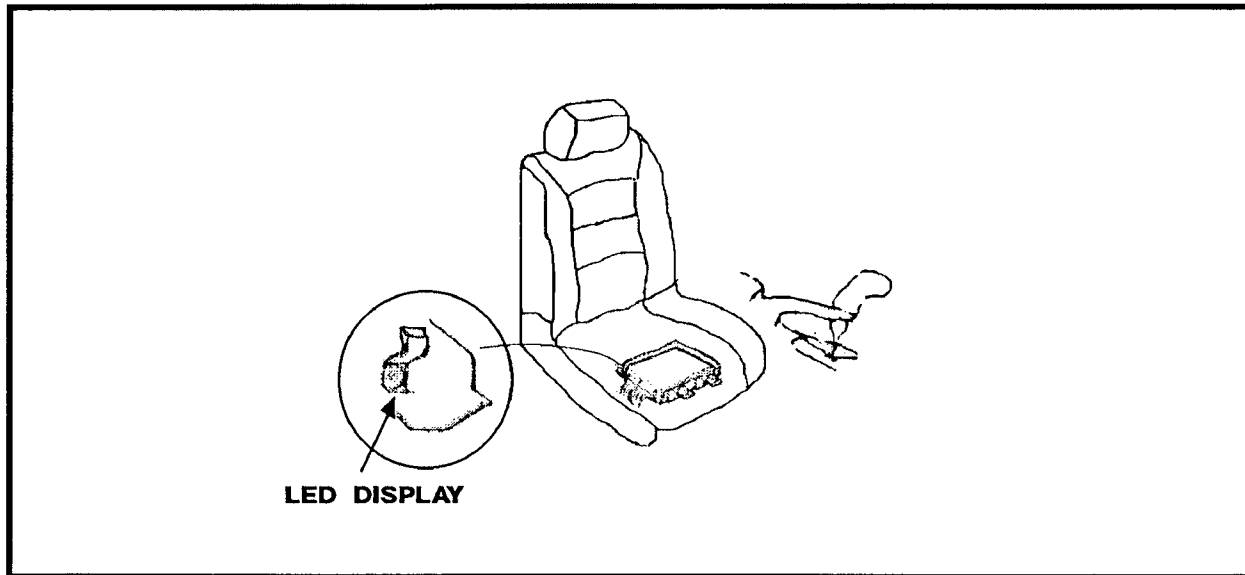


Figure 2-A

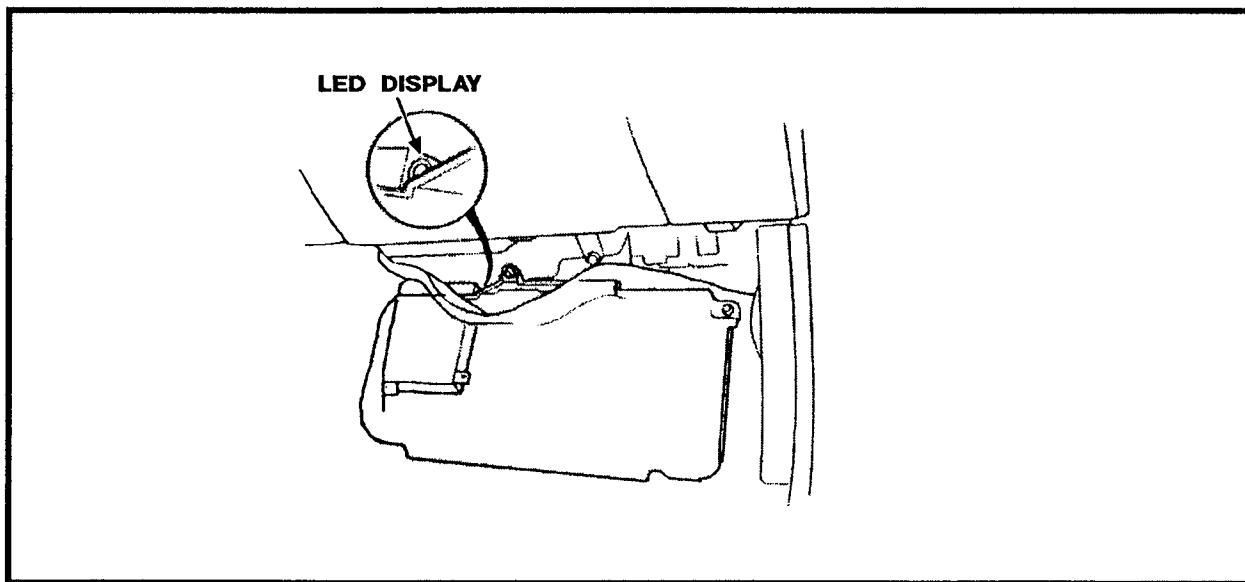
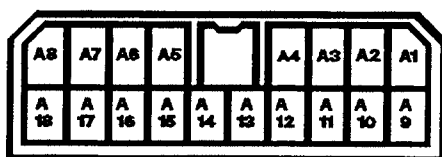
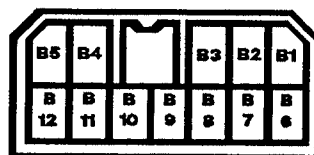


Figure 2-B

Computer Pin Checks



18 PIN CONNECTOR



12 PIN CONNECTOR

PIN #	FUNCTION	TEST
A1	Reverse Signal	Grounded in Reverse
A2	Neutral Signal	Grounded in Neutral
A3	Drive Signal	Grounded in Drive
A4	S ₃ Signal	Grounded in S ₃
A5	Manual 2nd Signal	Grounded in 2nd
A6	VSS (in the speedometer-head)	Pulsing ground signal as the front wheels are turned.
A7 **	VSS (on the transaxle)	Pulsing ground signal as the front wheels are turned.
A8	Cooling fan control signal	Check for a shorted or open wire to the cooling fan control unit pin.
A9 *	A/C clutch relay	Battery voltage with the 12 pin & 18 pin harnesses disconnected, the engine on, and the A/C compressor off.
A10	Ignition coil signal	Check for battery voltage with the engine running.
A11	Coolant temperature signal	.5-.9v with the engine running at normal operating temperature.
A12	Brake switch signal	12v with the brake pedal depressed and the ignition on.

PIN #	FUNCTION	TEST
A13	S4 Switch signal	Ground at A13 with the S4 switch pressed.
A14 *	VSS Feed	Check continuity between A14 & A7. The meter should fluctuate when you turn the drive wheels.
A15	PGM-FI ECU signal	SOLID STATE: Do not do a continuity check on this wire.
A16	TPS	Turn the ignition switch on. Voltage should be .44-.56 with the throttle closed. The voltage should increase to approx 4v at wide open throttle.
A17 *	PA (Atmospheric Pressure) Sensor	Turn the ignition switch on. The voltage should be 2.76-2.96v.
A18	S4 switch indicator light	Check for an open or shorted wire to the gauge assembly.
B1	Ground	Voltage should be less than .1v.
B2	Ignition switch	Battery voltage with the ignition on.
B3	Lock up solenoid "A" lead	16-20 ohms resistance with the 12 pin connector disconnected.
B4	Shift solenoid "A" lead	16-20 ohms resistance with the 12 pin connector disconnected.
B5	Shift solenoid "B" lead	16-20 ohms resistance with the 12 pin connector disconnected.
B6	Ground	Voltage should be less than .1v.

PIN #	FUNCTION	TEST
B7	Ignition Switch	Battery voltage with the ignition on.
B8	Lock up solenoid "B" lead	16-20 ohms resistance with the 12 pin connector disconnected.
B9	Dimming circuit lead	Check for an open or shorted wire to the gauge assembly.
B10	PFM-FI ECU signal	SOLID STATE: Do not do a continuity check on this wire.
B11	Dimming circuit lead	Check for an open or shorted wire to the gauge assembly.
B12	Power Supply	Battery voltage

* Not used on all models
** If you have a wire in pin #A14 skip this procedure

NOTES

Technical Seminar

Technical Seminar

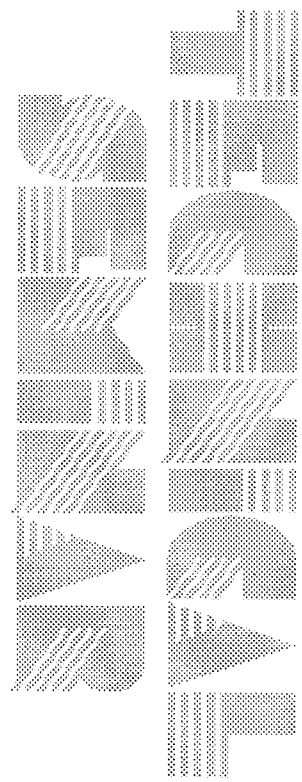


Technical Seminar

Technical Seminar



Technical Seminar



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This manual has been compiled and produced by the Automatic Transmission Rebuilders Association for the benefit and improvement of the industry. All information in this book is based on the latest data available at the time of publication. While every effort is made to attain accuracy, the Automatic Transmission Rebuilders Association cannot assume responsibility for any errors, changes and omissions that may occur nor liability for any damage to person to affect maintenance or repair work.

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Nissan-
Mazda

Chrysler

Ford

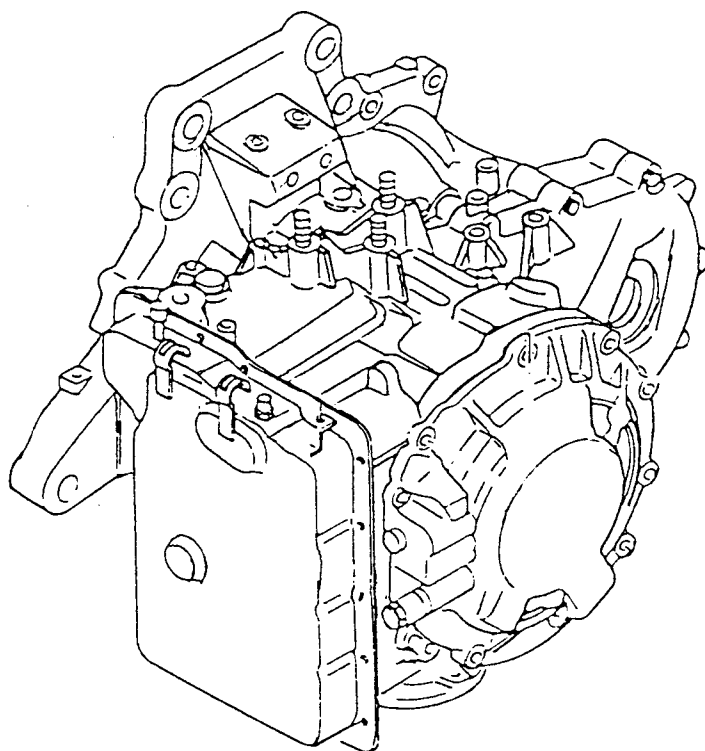
General
Motors

Honda-
Acura



Nissan-Mazda

Nissan-
Mazda



RE4R01A/R4A-EL

Component Application Chart

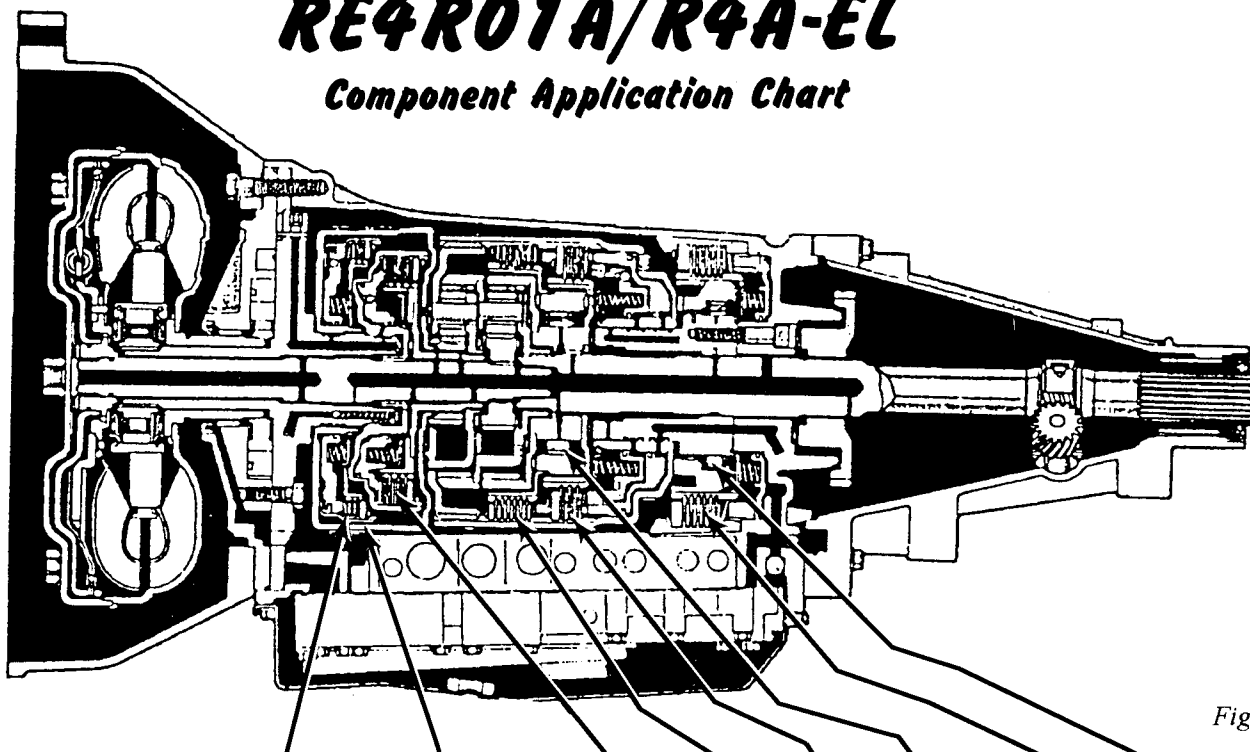


Figure 1

Selector Position	Gear	REV Clutch	BRAKE BAND			High Clutch	FWD Clutch	Over-Running Clutch	FWD One-way Clutch	LOW and Rev Brake	LOW One-way Clutch
			2nd Applied	3rd Release	OD Applied						
R	Rev	○								○	
D	1st						○	■	●		●
	2nd		○				○	□	●		
	3rd		⊗*1	⊗		○	○	□	●		
	OD		⊗*2	⊗	○	○	⊗				
S	1st						○	★	●		●
	2nd		○				○	●	●		
	3rd		⊗*1	⊗		○	○	●	●		
L	1st						○	○	●	○	
	2nd		○				○	○	●		

- *1 Hydraulic pressure is applied to both 2nd applied side and 3rd released side of band servo piston. However, because the area of the 3rd released side is larger than the 2nd applied side, the brake band does not operate.
- *2 Hydraulic pressure is applied to OD applied side, plus condition *1 above. Brake band is applied.
- Operates.
- Operates when throttle opening is less than 1/8. Engine braking effect available.
- ★ Operates when throttle opening is less than 1/8. Engine braking effect not available.
- Operates when the EC-AT control unit receive OD inhibit signal from the cruise control unit and throttle opening less than 1/8. Engine braking effect available.
- Operates when the EC-AT control unit receive OD inhibit signal from the cruise control unit and throttle opening less than 1/8. Engine braking effect not available.
- ⊗ Operates but does not transmit power.

RE4R01A/R4A-EL

Pressure Tap Identification

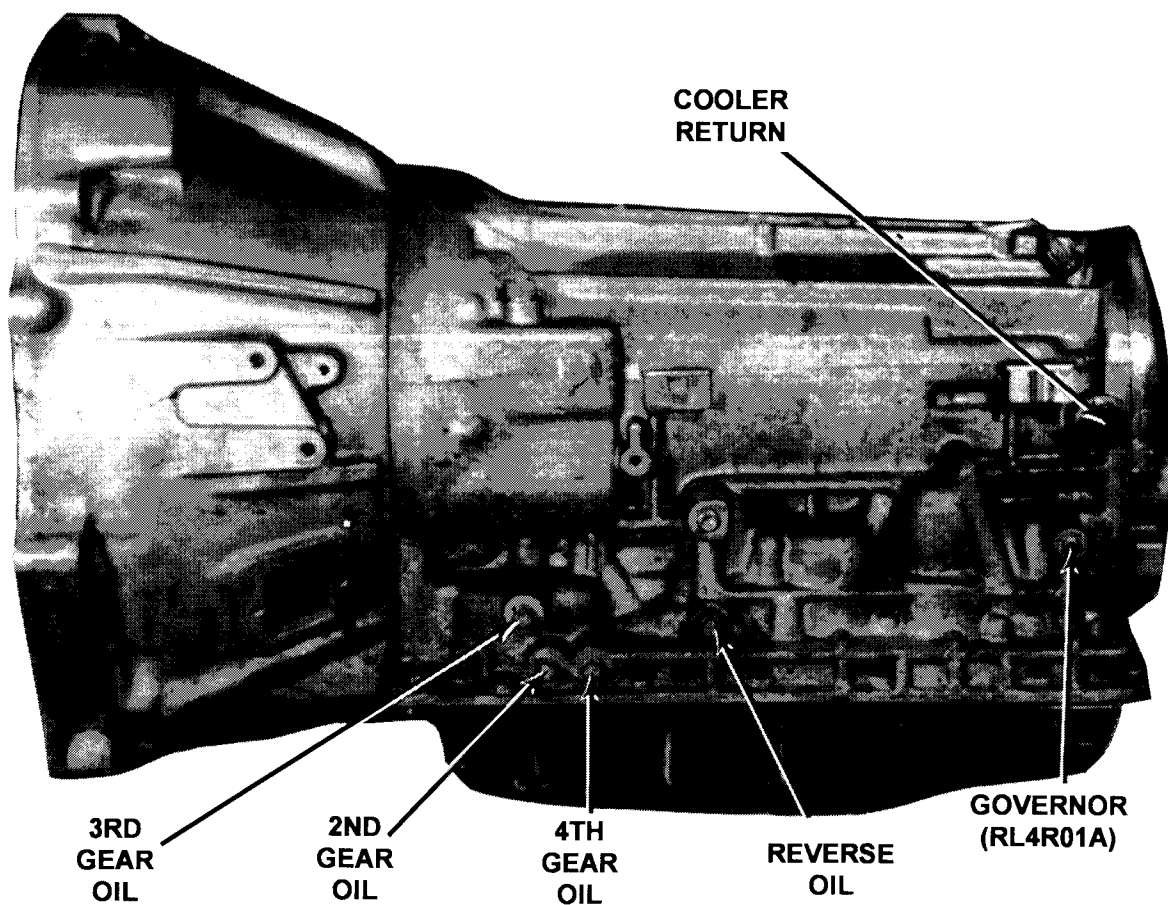
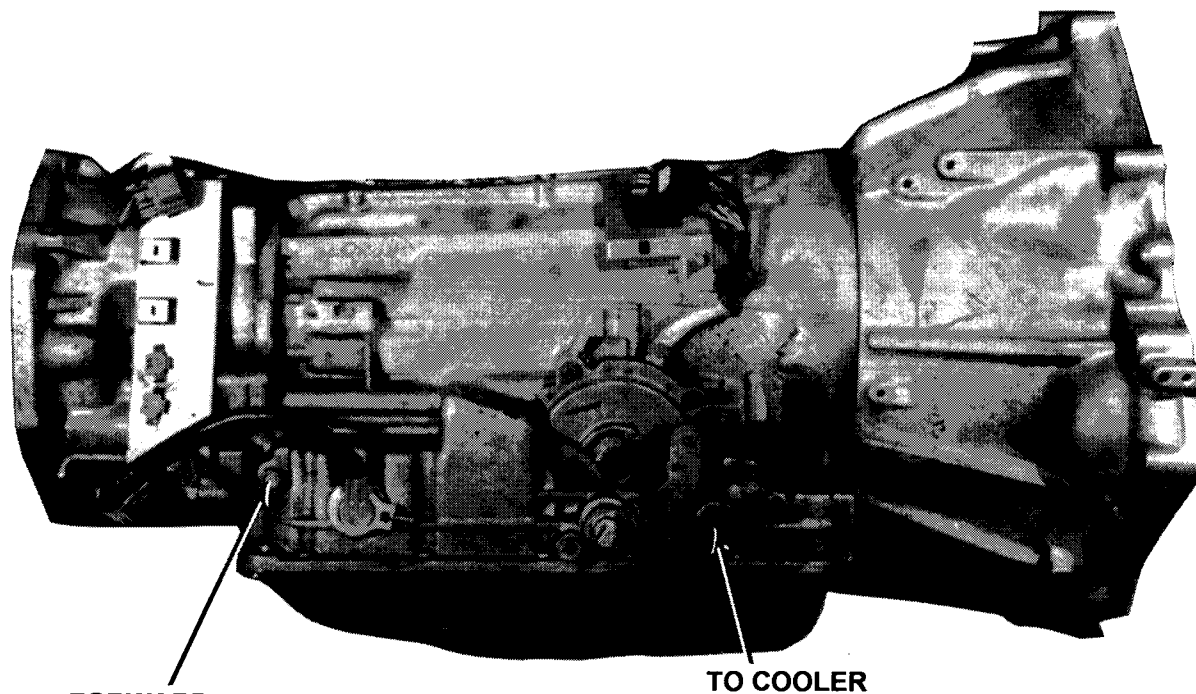


Figure 2

Figure 3

RE4R01A/R4A-EL

Pressure Specifications

Line pressure specs vary from model to model. Below are 4 charts to represent the different models and manufacturers specifications.

MAZDA MPV-2WD

	IDLE	STALL
DSL	68-74	175-186
REVERSE	88-94	219-230

MAZDA MPV-4WD

	IDLE	STALL
DSL	57-74	148-159
REVERSE	102-108	206-218

NISSAN 240SX

	IDLE	STALL
DSL	68-74	148-159
REVERSE	95-101	206-218

NISSAN PATHFINDER

	IDLE	STALL
DSL	63-68	175-186
REVERSE	97-102	219-230

Figure 4

RE4R01A/R4A-EL

Valve Body Removal and Installation

Use this picture as a guide for placement of sensors, clamps, etc. S = Short Bolt
L = Long Bolt

TO REMOVE
VALVE BODY --
REMOVE ONLY
BOLTS MARKED
S AND L

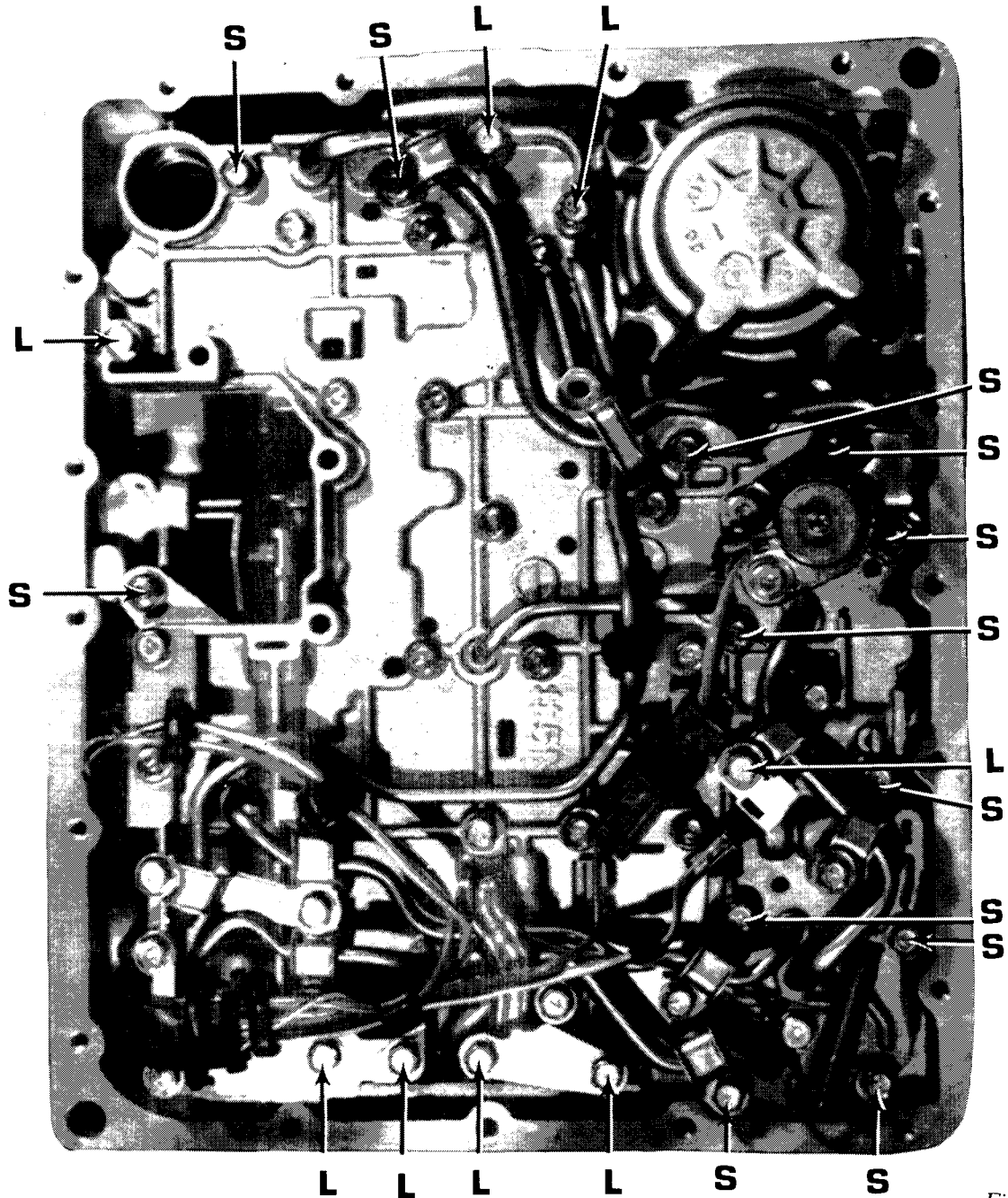


PHOTO SHOWN
WITH FILTER
REMOVED FOR
CLARITY

Figure 5

NOTE: No pipes need to be removed for valve body removal.

RE4R01A/R4A-EL

Checkball Functions and Locations

VALVE BODY CHECK BALLS

1. Overrun Clutch
2. Forward Clutch
3. Band Apply (2nd)
4. Band Apply (4th)
5. Reverse Apply
6. 3rd Apply
7. 3rd Exhaust
8. 3-2 Control
9. Low & Reverse Shuttle

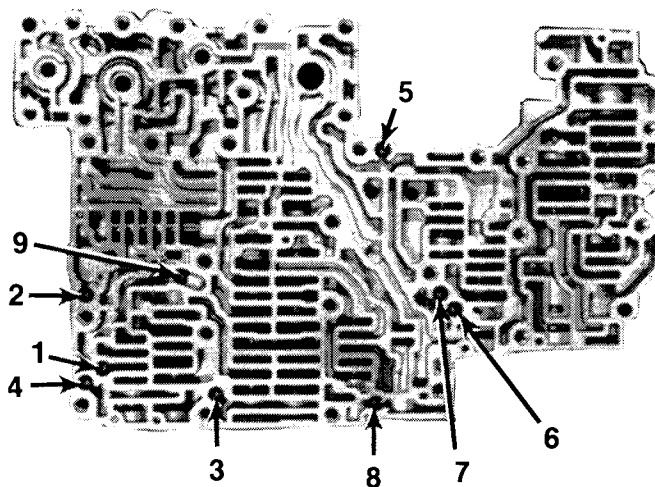


Figure 6

ALL BALLS ARE STEEL AND .218 DIAMETER

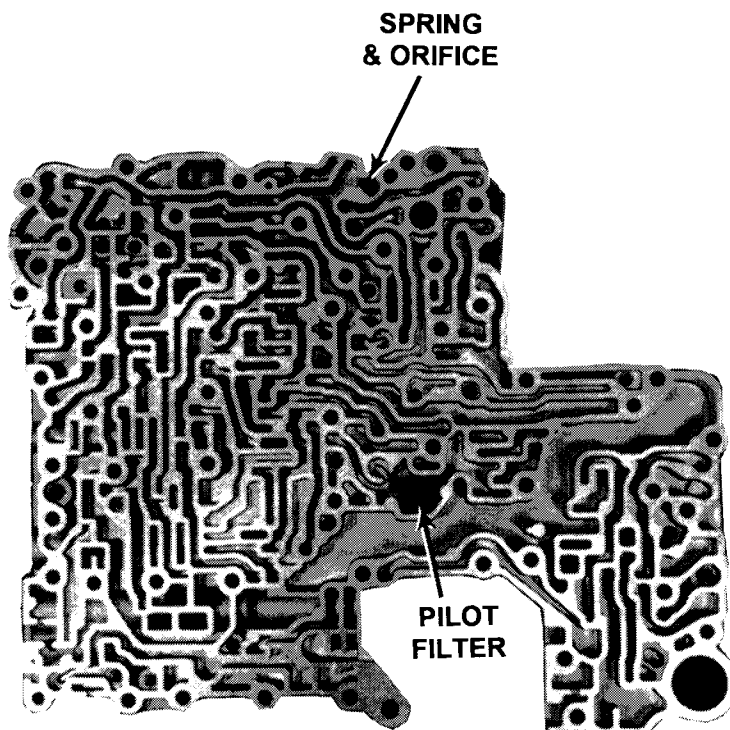


Figure 7

RE4R01A/R4A-EL

Air Check Points/Solenoid Information

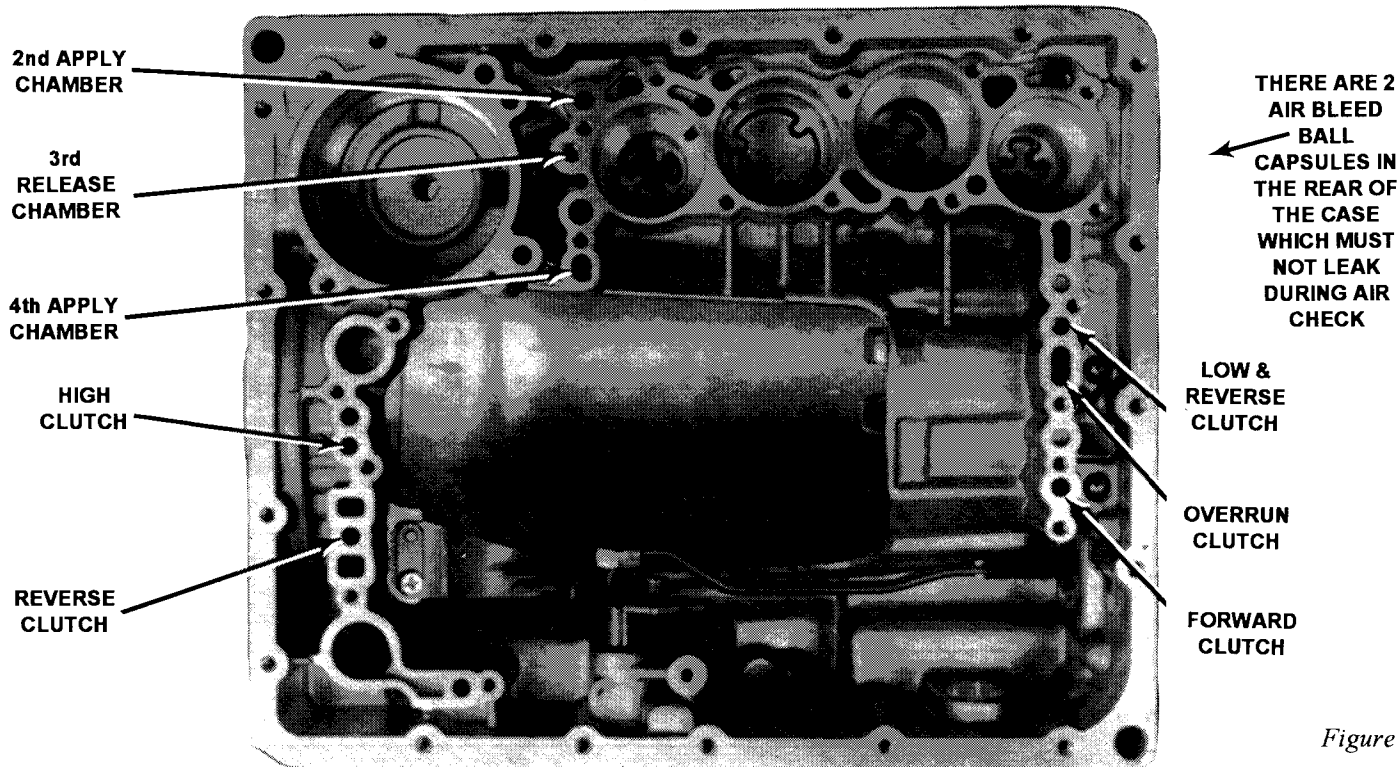


Figure 8

SOLENOID APPLICATION		
GEAR IN DRIVE	SOL A	SOL B
1	ON	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

THERMO SENSOR (2 WIRE) 2.8K Ω AT 68 DEGREES F.

LOCKUP SOLENOID UNDER HERE N.C. 10-20 Ω .

LINE PRESSURE SOLENOID - N.C. 2.5-5 Ω

SHIFT SOLENOID "B" N.O. 20-40 Ω

SHIFT SOLENOID "A" N.O. 20-40 Ω

OVERRUN CLUTCH SOLENOID N.O. 20-40 Ω

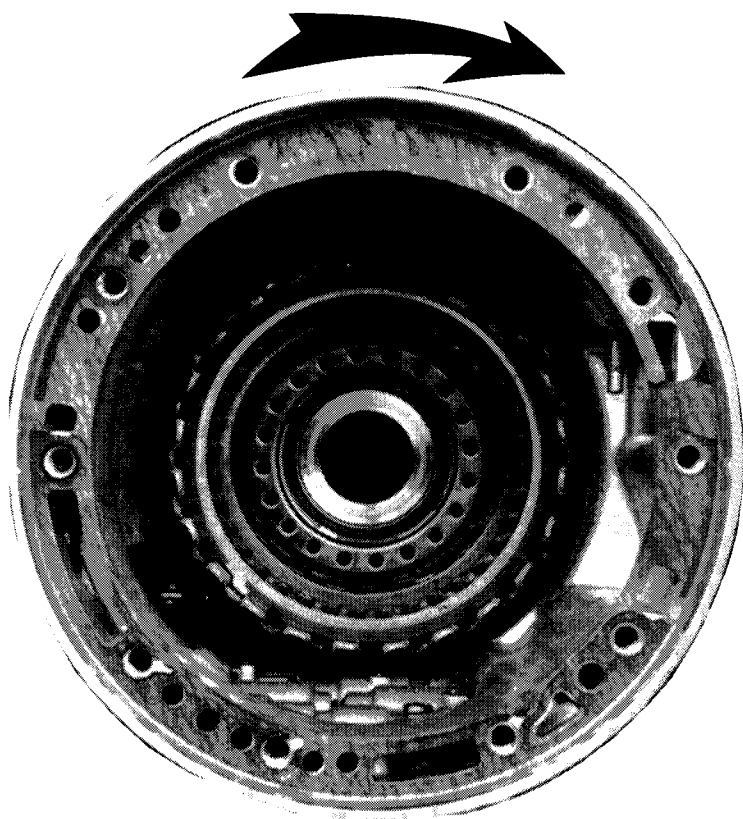
THERMO-SWITCH (SINGLE WIRE SOME MODELS)
UP TO 302 DEGREES F = OPEN
OVER 302 DEGREES F = CLOSED

N.C. = Normally Closed
N.O. = Normally Open

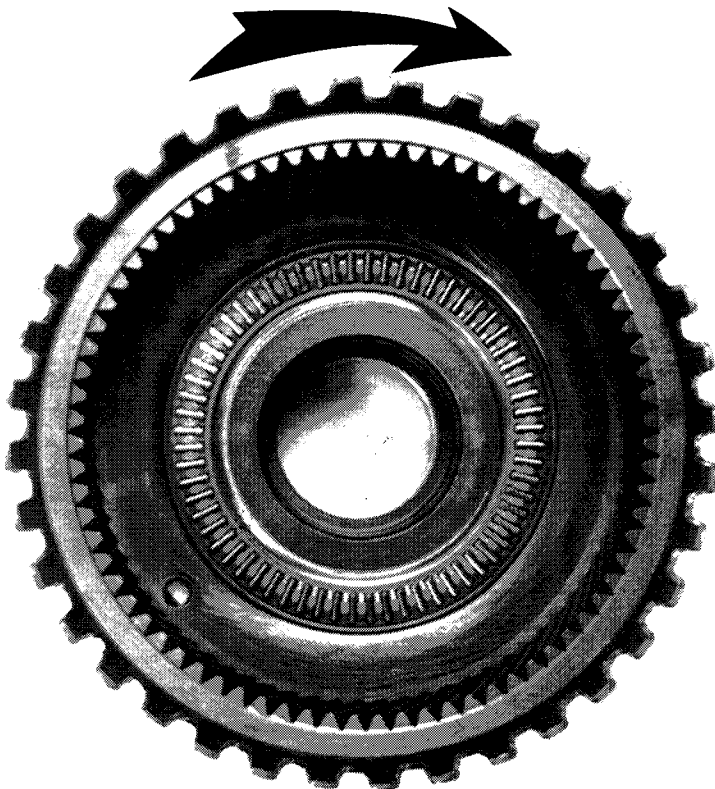
Figure 9

RE4R01A/R4A-EL

Sprag Rotation/End Play Specifications



The low sprag, when properly installed will allow the drum to rotate clockwise, and lock counter clockwise.



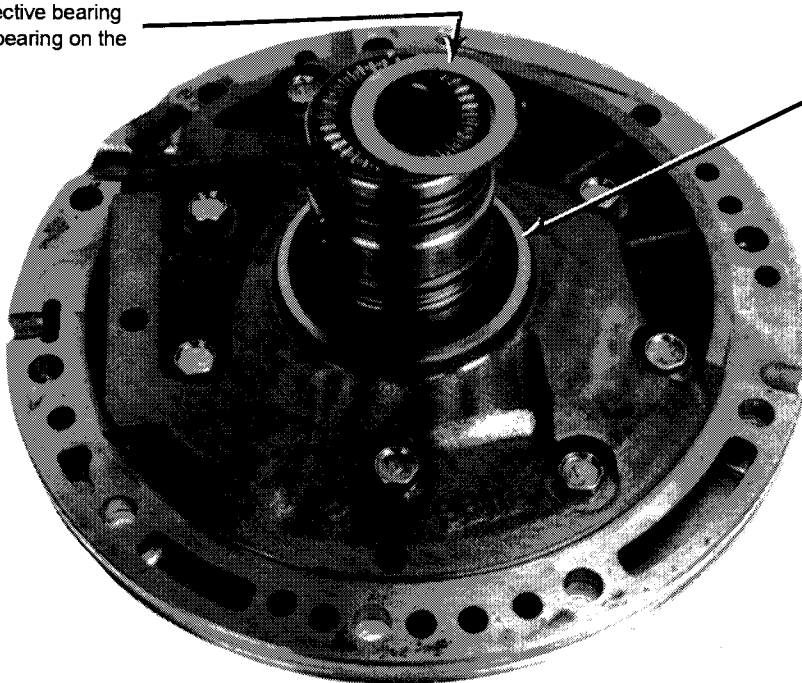
The forward (input) sprag, when properly assembled, will allow the ring gear to rotate clockwise, and lock counter clockwise.

Figure 10

Total end play is adjusted by the selective bearing race that rides against the torrigton bearing on the end of the stator.

Total end play
- .010-.020
reverse drum
end play -
.021 - .035

See Page
14 for
selective
washers



This washer is selective to adjust reverse drum end play.

Both the total end play and the reverse drum end play are most easily checked with an "H" gauge.

Figure 11

RE4R01A/R4A-EL

Burnt High Clutches/2-4 Band

Burnt high clutches and/or 2-4 band may be caused by no line pressure rise. One cause may be the slide lever binding on the edge of the pump pocket. The solution is to either purchase a NEW pump, or modify the slide lever in your pump, as shown below.

Nissan-
Mazda

FILE -- .006 - .009 from the end of the slide lever. Don't grind it on the bench grinder since that will leave a burr on the tip seal groove, which may wear out the tip seal.

Wear of the slide lever, pivot pin and the hole in the pump pocket, allow the lever to contact the wall in the pump, which binds the lever in the minimum output position.

Try to achieve
.005 - .008
clearance
between the slide
lever and the
pump body

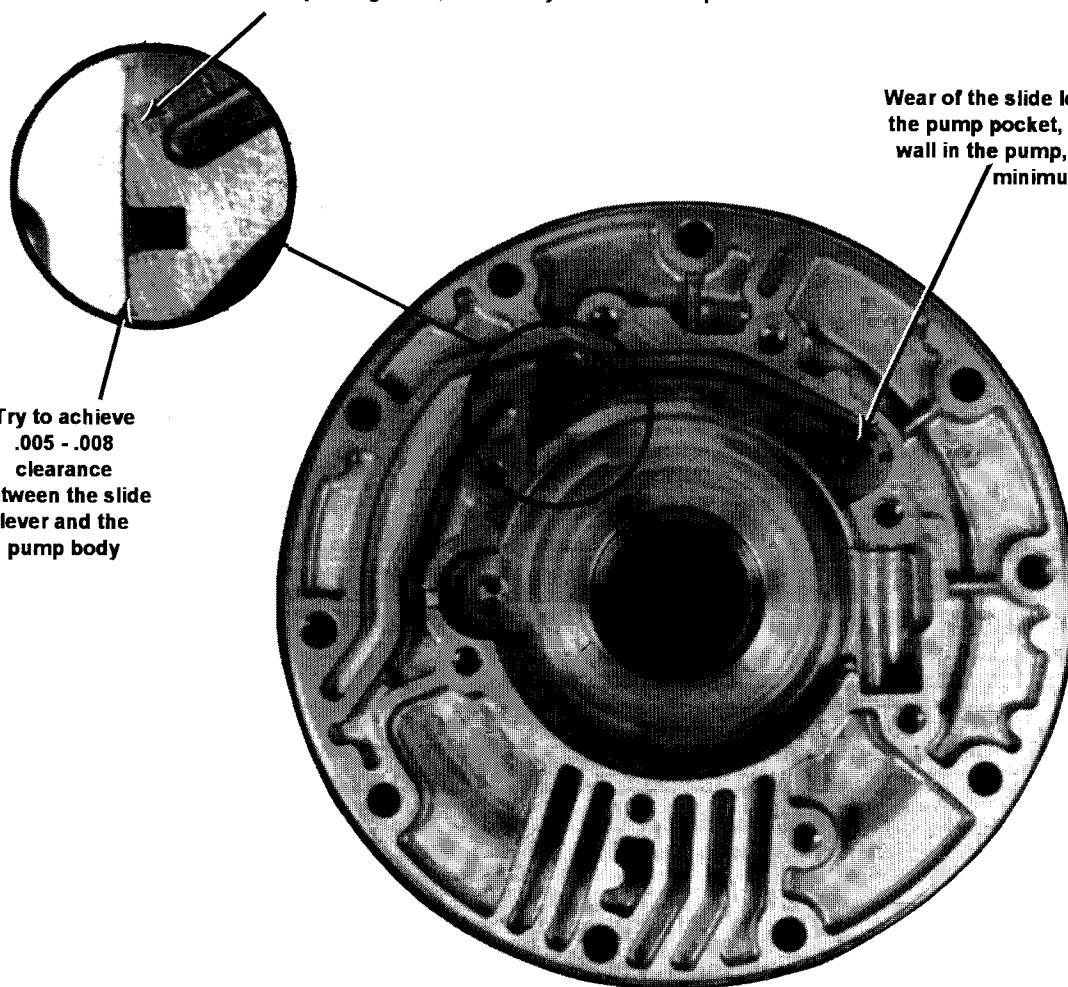


Figure 12

RE4R01A, R4A-EL

Premature Planetary Failure

Several areas require extra attention when addressing a complaint of repeat or premature planetary failure on this unit:

- #1 Clogged or Restricted Coolers
- #2 Mislocated Case Bushings
- #3 Geartrain Set-Up
- #4 Lube-Relief Valve
- #5 Filter Restrictions

COOLERS

The transmission coolers in the vehicles listed below are of the "Fin" Type design. These fin type coolers will trap any contaminants in the fluid. Once the cooler is plugged or restricted with these contaminants, lube oil to the transmission will be reduced. The fin type coolers cannot be properly cleaned using conventional methods. Cooler replacement will be required if the cooler is clogged or restricted. Acceptable cooler flow is 1 quart in 20 seconds returning to the transmission.

These Nissan vehicles are originally equipped with fin type coolers:

<i>MODEL</i>	<i>YEAR</i>
<i>300ZX</i>	<i>1990-1992</i>
<i>Truck</i>	<i>1988-1992</i>
<i>Pathfinder</i>	<i>1988-1992</i>

Mazda vehicles equipped with this transmission have not had any widespread cooler concerns.

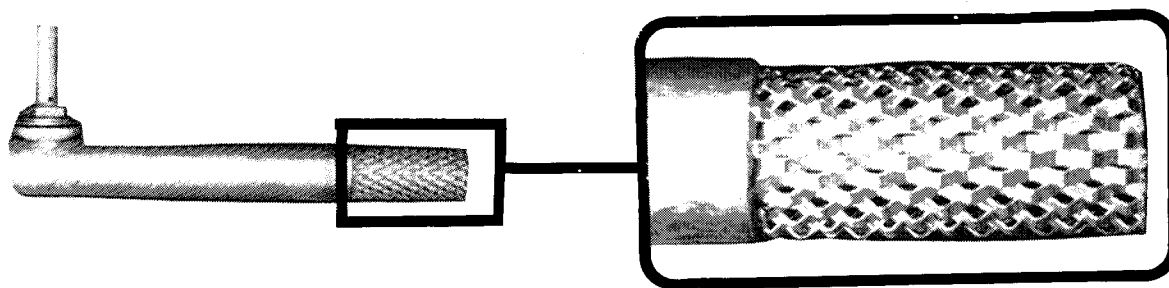


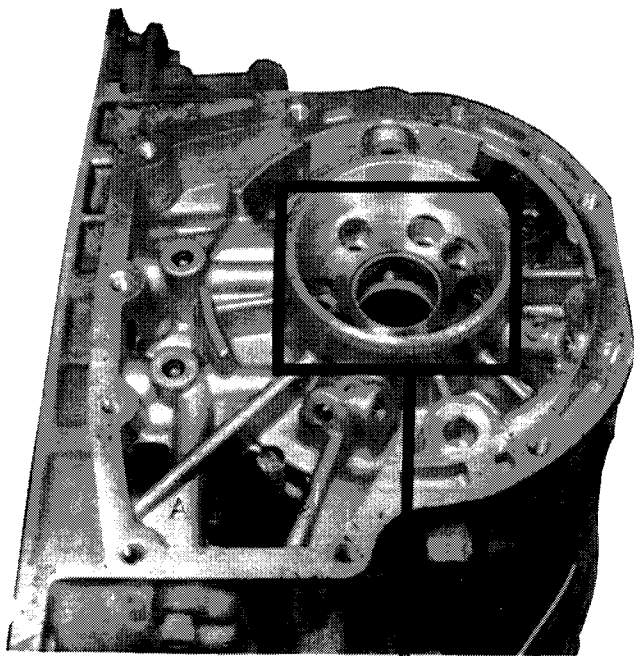
Figure 13

CUT-AWAY VIEW OF TRANSMISSION COOLER

Premature Planetary Failure (Continued)

CASE BUSHINGS

Mislocated case bushing will also cause planetary failure due to lack of lube. Lube oil is fed through the hole between the case bushings, and into the mainshaft. Make sure the bushings have not moved together, covering the hole.



NOTE: The rear case bushing should be flush with the rear edge of the bore.

The front case bushing should be approximately .150" below the front edge of the bore.

This hole must not be covered by the bushings.

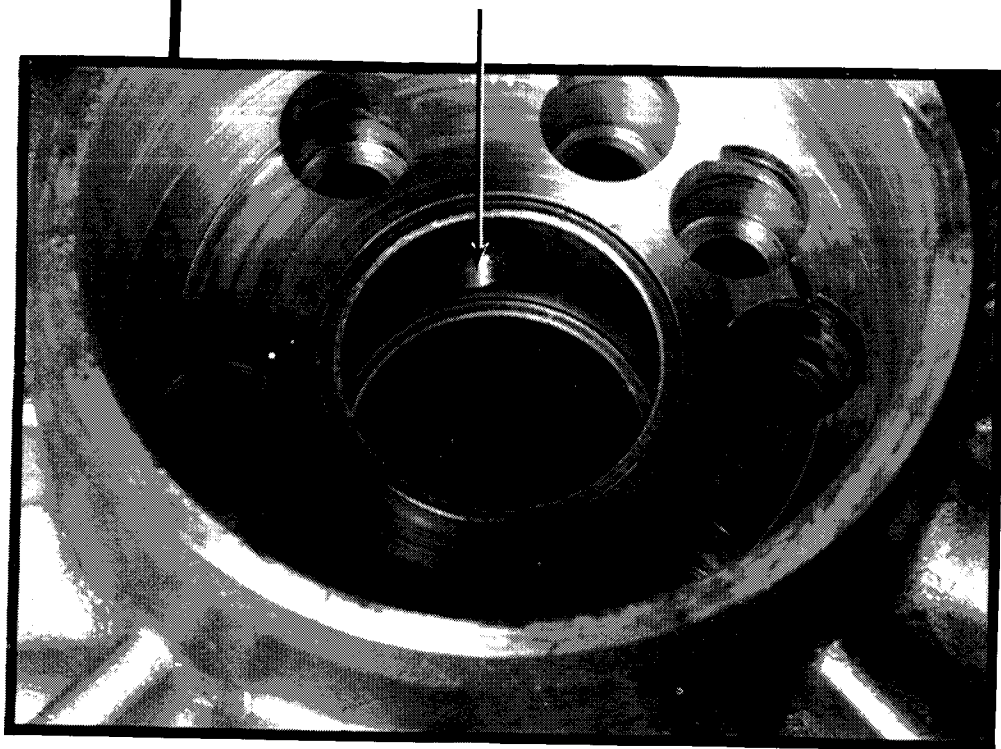


Figure 14

Premature Planetary Failure (Continued)

GEARTRAIN SET-UP

To help the lube reach the front planet, remove the sun shell bushing. This allows lube oil to flow freely out the end of the sun gear into the front planet. NEW replacement shells DO NOT have a bushing installed from the factory.

Remove the bushing from the front sun gear.

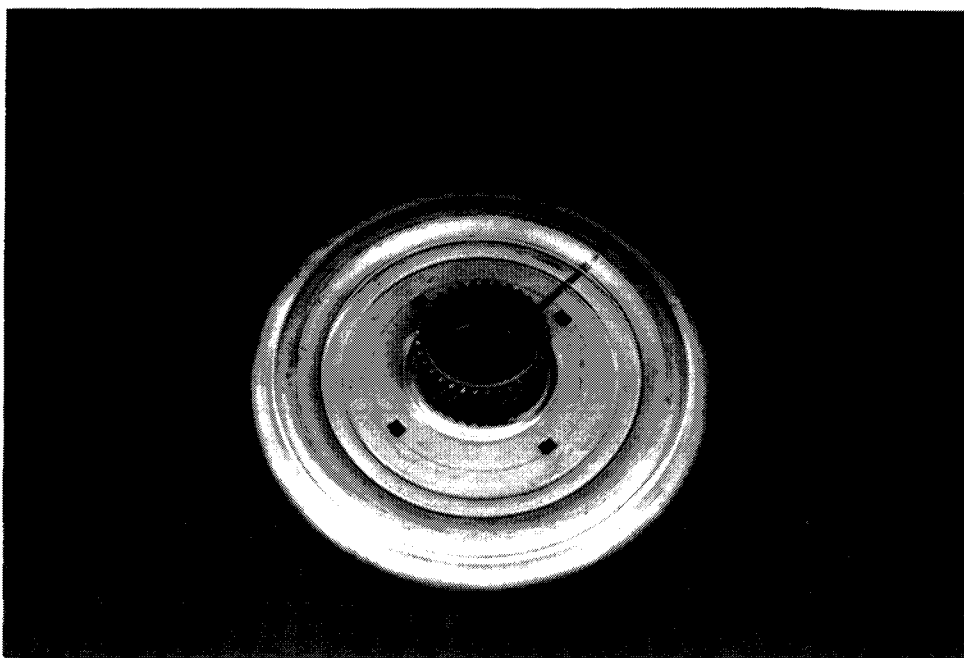


Figure 15

To prevent a potential loss of lube through clearance in the geartrain, limit end play to the minimum side of factory specifications. Listed below are the Nissan part numbers for the selective washers available. Factory specifications on end play are:

Total end play: .010 - .020

Reverse drum end play: .021 - .035

**Selective Bearing
Races**

**Pump cover to Reverse Drum
Selective Washer**

Thickness mm (in)	Part Number	Thickness mm (in)	Part Number
0.8 (0.031)	31429-21X00	0.7 (0.028)	31528-21X00
1.0 (0.039)	31429-21X01	0.9 (0.035)	31528-21X01
1.2 (0.047)	31429-21X02	1.1 (0.043)	31528-21X02
1.4 (0.055)	31429-21X03	1.3 (0.051)	31528-21X03
1.6 (0.063)	31429-21X04	1.5 (0.059)	31528-21X04
1.8 (0.071)	31429-21X05	1.7 (0.067)	31528-21X05
2.0 (0.079)	31429-21X06	1.9 (0.075)	31528-21X06

Figure 16

Premature Planetary Failure (Continued)

LUBE RELIEF VALVE AND FILTER RESTRICTIONS

Lube Relief Valve

There is a lube blow-off ball & spring in the rear of the case that vents the lube circuit at approximately 17 psi. To test it for leaks, plug the hole between the case bushings and blow a 10-15 psi regulated air supply into the rear cooler line fitting. If the blow-off ball leaks, remove the ball, spring and orificed cup plug. Thread the hole and install an allen head set screw to plug the hole. Be sure to apply *Locktite®* to the threads of the set-screw during installation.

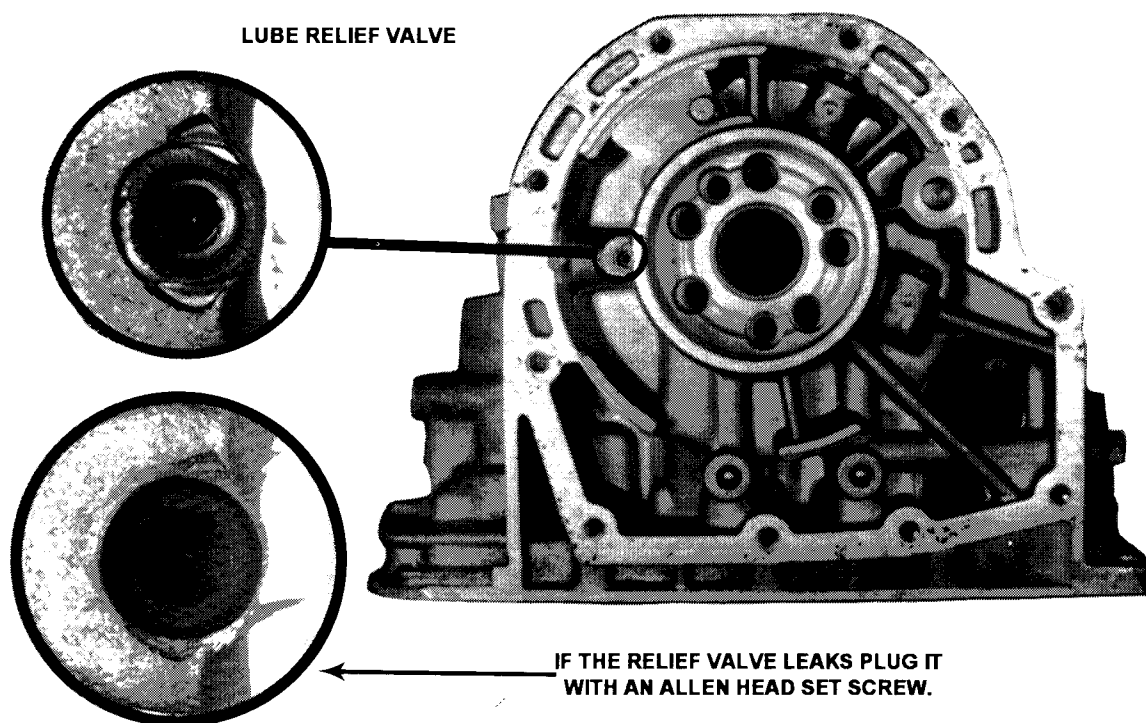


Figure 17

Filter

The life of the planetary in this unit depends on a free flowing filter to supply the lube circuit with an adequate volume of oil. A restricted filter will cause the pump to suck air which is eventually fed into the lube circuit. The filter can be restricted to the point that the unit doesn't exhibit any operational complaints but still not flow enough volume to supply the lube circuit sufficiently.

Take the extra time to thoroughly clean the valve body, and blow dust and stray fibers off new friction material. It may also be worthwhile to remove the pan and clean the filter after the vehicle has been in service for a week or two after overhaul. This will clean out any loose material that may have collected in the sump and on the filter during "break-in".

RE4F02A

Shifts 1-2-Neutral

A shift from 2nd to neutral can be caused by checkball misplacement. The #9 checkball is not used in all models. Using the #9 checkball on models not designed for it can cause a shift from 2nd to 1st which feels like a shift to neutral.

To see if you need the #9 checkball look at the separator plate. If it has one hole over the #9 bathtub it doesn't use a ball, if it has two holes it does use a ball.

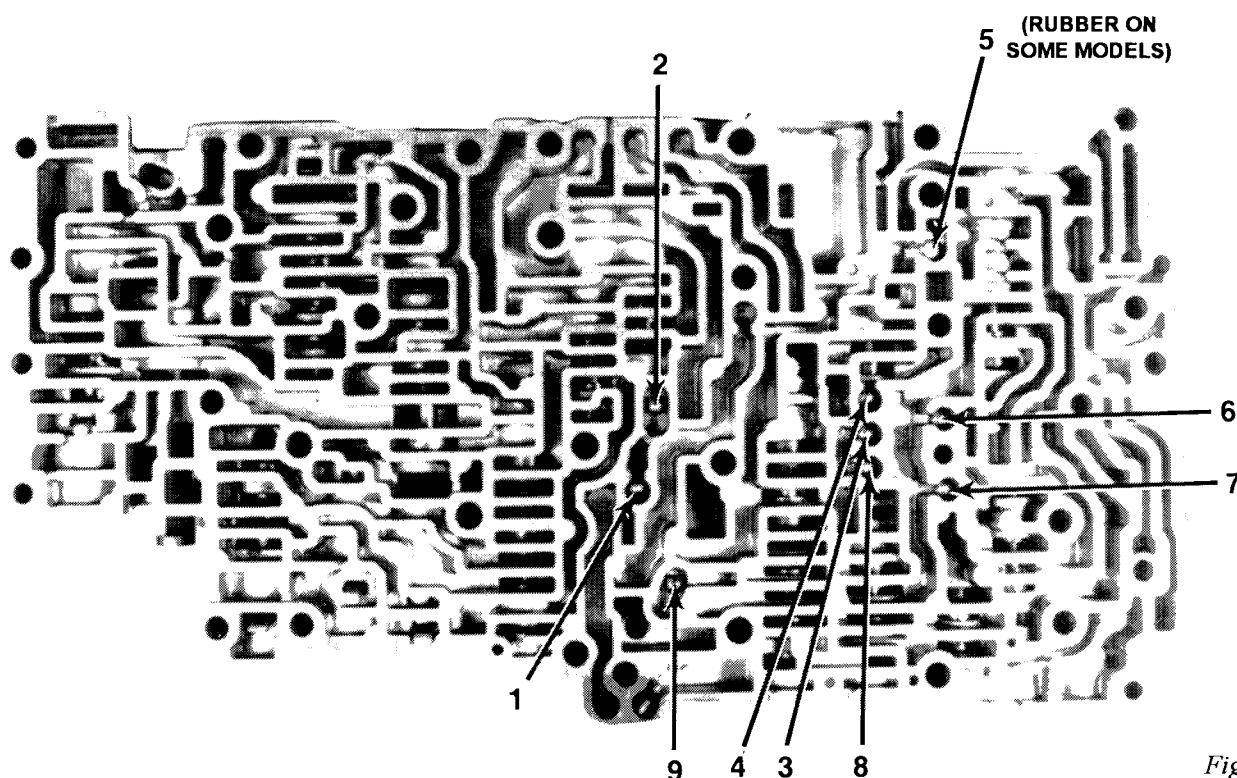


Figure 18

CHECKBALL FUNCTION

- | | |
|----------------------------------|-----------------------------------|
| #1 Low/Rev brake orifice | #6 Low clutch timing valve bypass |
| #2 Low/Rev brake shuttle | #7 Low clutch feed orifice |
| #3 High clutch feed orifice | #8 High clutch exhaust orifice |
| #4 Servo release exhaust orifice | #9 2-3 shift valve shuttle |
| #5 Servo apply orifice | |

NOTE: The checkball numbers shown here are ATRA numbers not factory numbers.

RE4F02A

Soft Shifts/Slips

A soft shift or slip complaint on an RE4F02A is usually caused by a worn out pressure control solenoid. Use the following steps to isolate the problem.

STEP 1

Check mainline pressure in drive, (see Figure 19 below).
It should be 55-66 PSI at an idle, 186-198 PSI at a stall.

If line doesn't rise (or rises very little) try the stall test again with the solenoid wires disconnected.

If the pressure rises to maximum, go to STEP 2.

If line pressure is still low you may have a stuck slide, valve body problem, a leaking pressure control solenoid or "O" ring, control cylinder, etc.

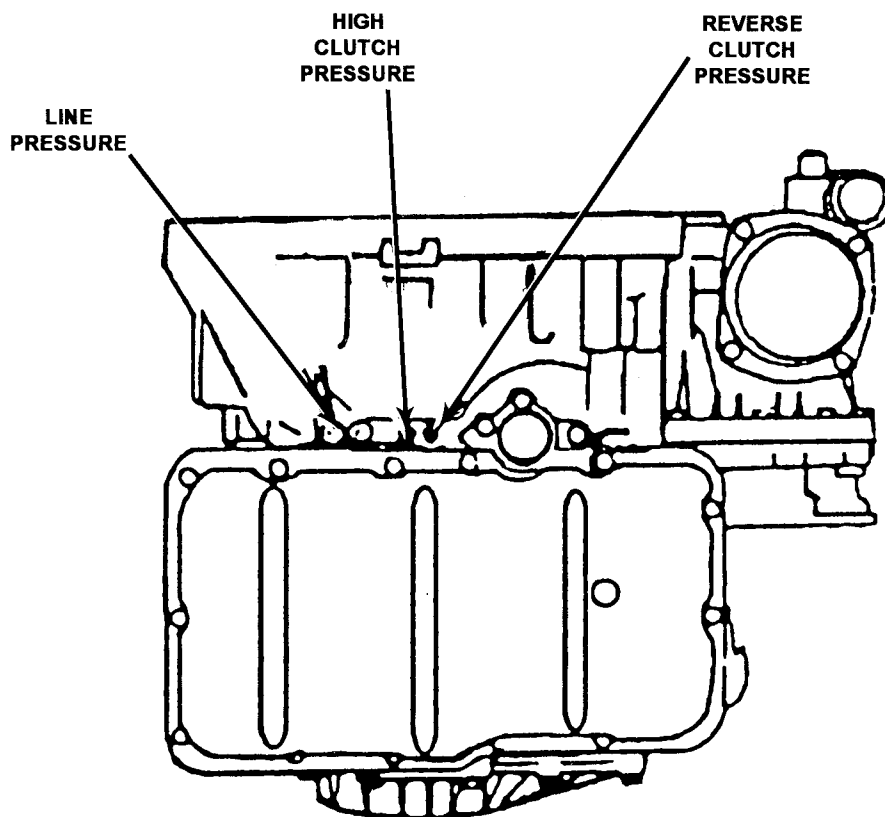


Figure 19

Soft Shifts/Slips (Continued)

To check for a stuck slide, remove the control cylinder and stick a long screwdriver down the control cylinder rod hole, (see Figure 20 below).

When you push on the screwdriver you should feel the slide move and the spring compress.

To check the solenoid, pour solvent down the neck. It shouldn't leak, if it does, replace it.

While you have the solenoid off, blow air into the valve body where the solenoid fits, (see Figure 21 on next page). You should be able to hear the Pressure Regulator boost valve stroke.

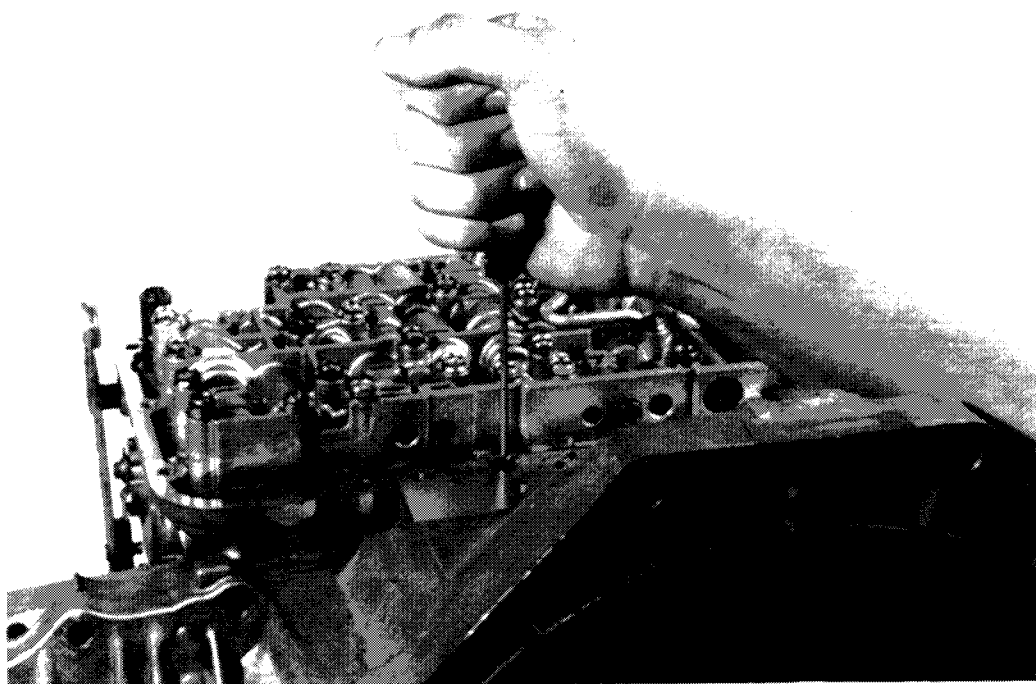
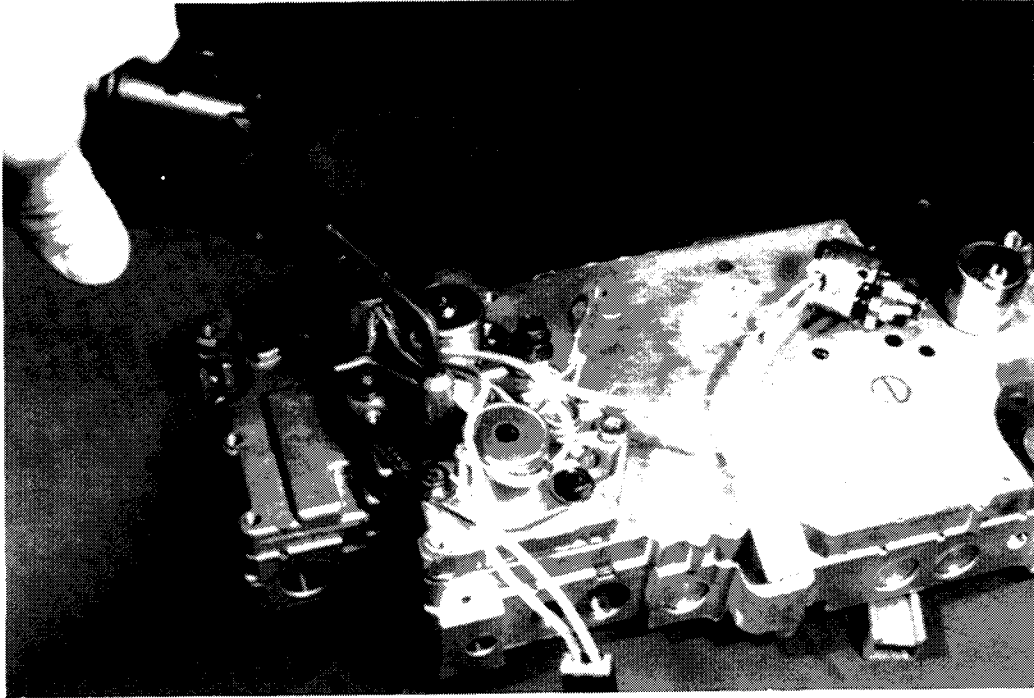


Figure 20

Soft Shifts/Slips (Continued)Nissan-
Mazda*Figure 21***STEP 2**

Check the voltage to the pressure control solenoid, (with the solenoid connected).

The voltage should be 1.5-2.5V at closed throttle and drop to .5V at WOT. If it does, replace the solenoid pack. The part number is 31940-27X66.

If the voltage does not drop, the problem is computer related (TPS, bad ground, etc.).

NOTE: *Most line rise problems are solenoid related. If the unit has more than 50,000 miles, the solenoids should be replaced during rebuild.*

G4A/4EAT

Component Application Chart

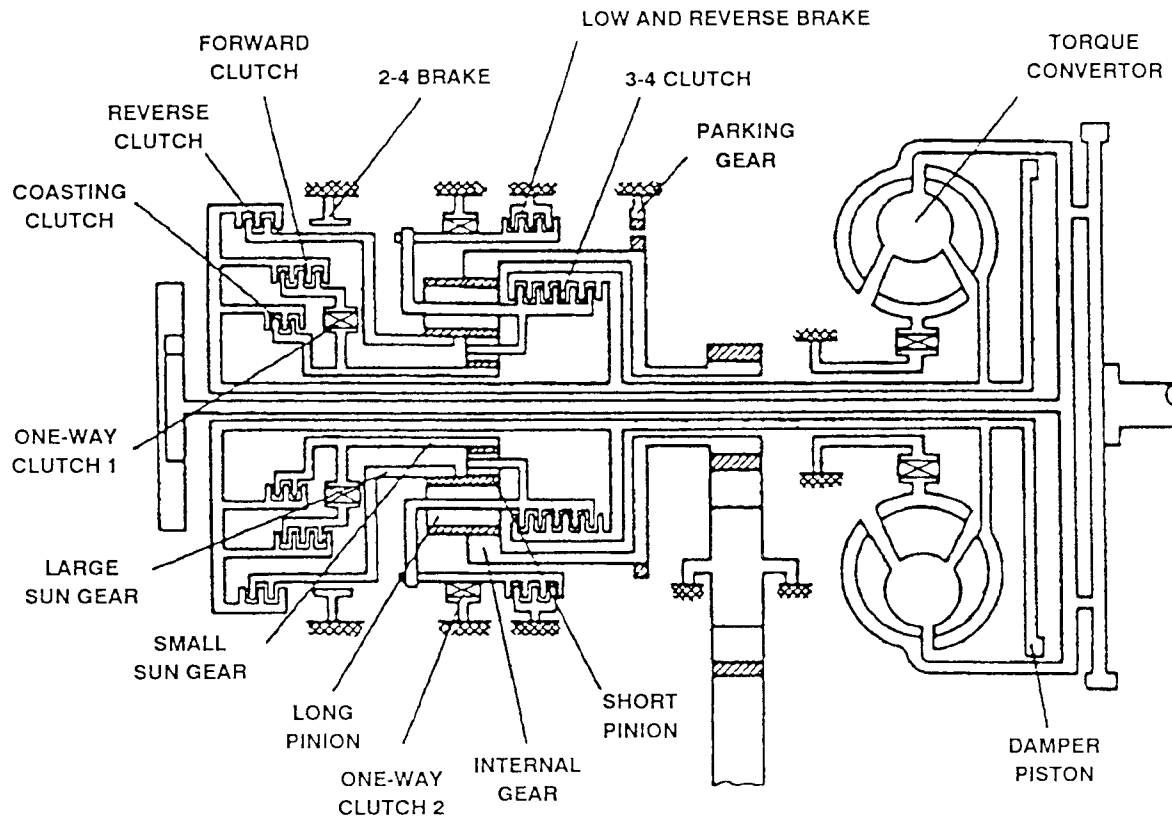


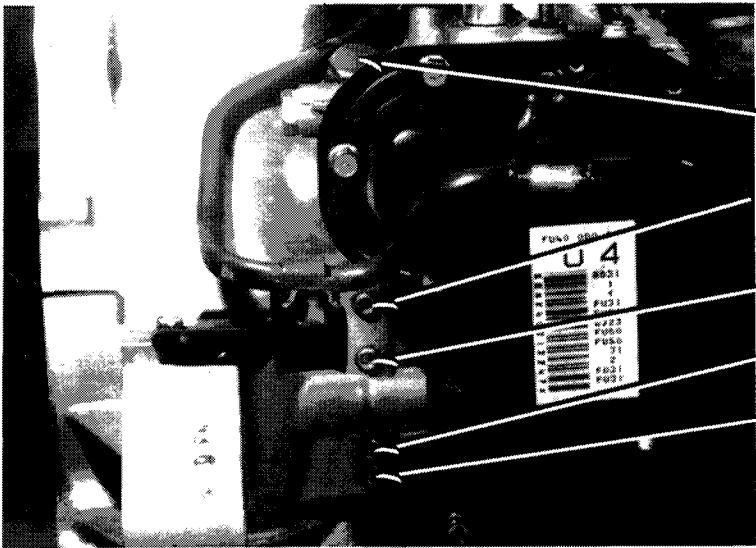
Figure 22

RANGE	GEAR	FORWARD CLUTCH	COASTING CLUTCH	3-4 CLUTCH	REVERSE CLUTCH	2-4 BRAKE		LOW & REVERSE BRAKE	ONE-WAY CLUTCH 1	ONE-WAY CLUTCH 2
						APPLIED	RELEASED			
P	--						O			
R	--				O		O	O		
N	--						O			
D	1ST	O					O		O	O
	2ND	O				O			O	
	3RD	O		O		⊗	O		O	
	4TH	O		O		O				
2	2ND	O	O			O			O	
	3RD	O	O	O		⊗	O		O	
1	1ST	O	O				O	O	O	
	2ND	O	O			O			O	

⊗ = Indicates fluid pressure to servo but not applied due to pressure difference

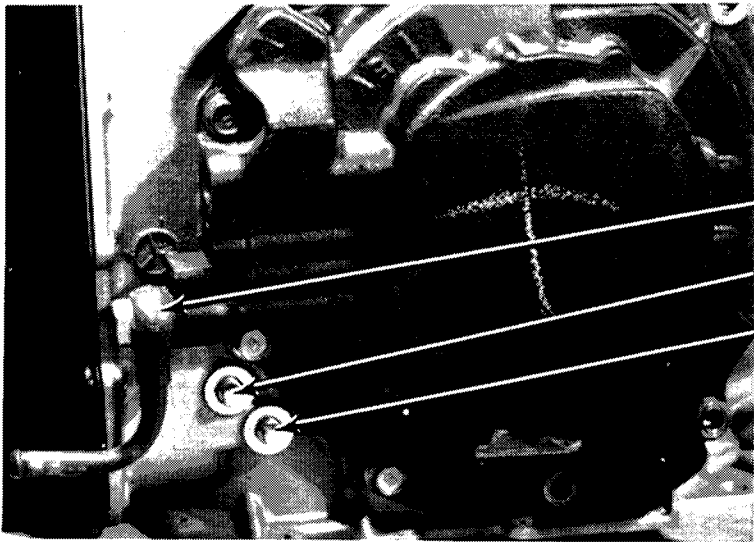
G4A/4EAT

Pressure Tap Identification and Specifications



- 1. Cooler Feed
- 2. Line Pressure
- 3. T/C Release
- 4. T/C Apply
- 5. 3-4 Clutch

Figure 23



- 1. Cooler Return
- 2. Throttle Pressure
- 3. Line Pressure

Figure 24

LINE PRESSURE

RANGE	D,2,1	R
AT IDLE	47-71 PSI	87-137 PSI
DURING STALL	127-151 PSI	242-292 PSI

THROTTLE PRESSURE

AT IDLE	6-13 PSI, IN DRIVE
DURING STALL	78-85 PSI, IN DRIVE

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G4A/4EAT

Solenoid Identification and Function

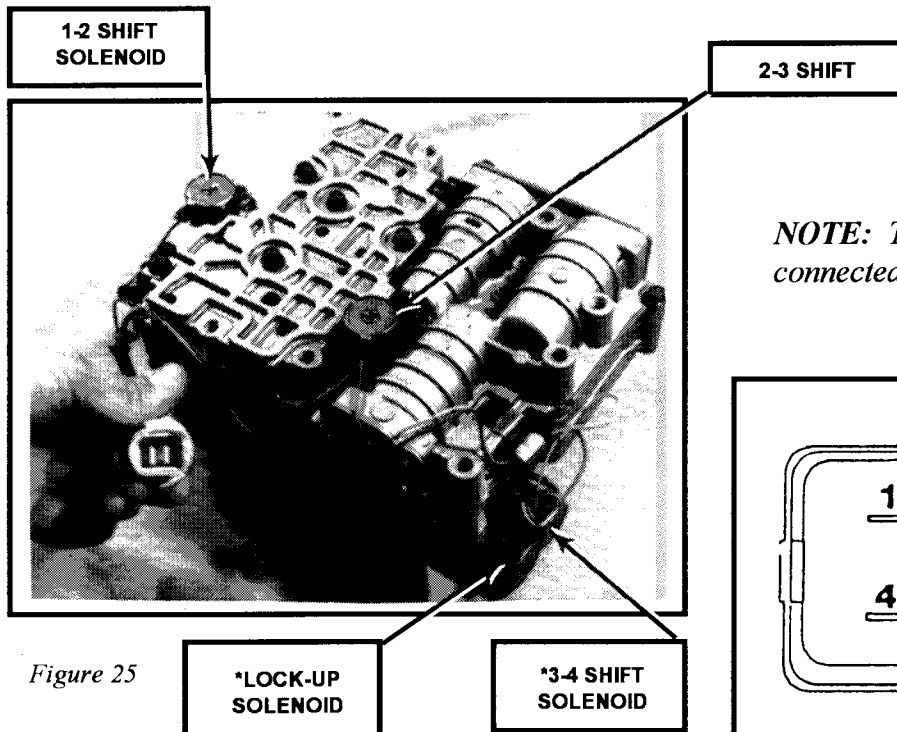


Figure 25

NOTE: The 2-3 shift solenoid can be connected to either pin #1 or #5 or both.

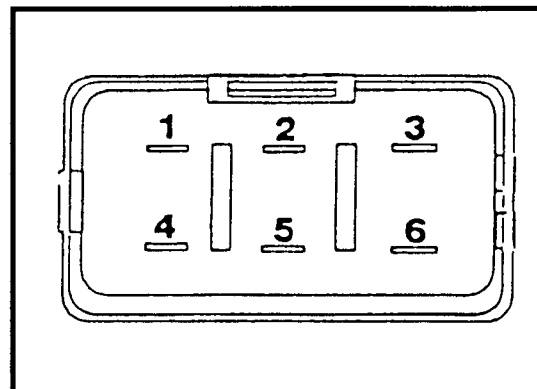


Figure 26

***NOTE:** Some manuals show the 3-4 shift and lock-up solenoids reversed.

PIN #	FUNCTION
1	2-3 Shift Solenoid
2	3-4 Shift Solenoid
3	
4	1-2 Shift Solenoid
5	2-3 Shift Solenoid
6	Lock-Up Solenoid

GEAR	1-2 SHIFT SOLENOID	2-3 SHIFT SOLENOID	3-4 SHIFT SOLENOID	LOCK-UP SOLENOID
1st GEAR	OFF	ON	ON	
2nd GEAR	ON	ON	ON	
3rd GEAR	OFF	OFF	OFF	
4th GEAR	ON	OFF	ON	
*LOCK-UP				ON
*LOCK-UP CAN COME ON IN <u>ANY</u> GEAR				

Figure 27

G4A-EL/4EAT

Solenoid Combinations

The following chart shows all of the possible solenoid combinations and the gear you will get. This can be very helpful in diagnosing solenoid problems.

SOLENOID FAILURE CHART

ON	1,2,3	2,3	3	ALL OFF	1	2	1,2	1,3
D	2nd	1st	3rd	3rd*	3rd*	1st	2nd*	4th
2	2nd	1st	3rd	3rd*	3rd*	1st	2nd*	4th
1	2nd	1st	1st	1st*	2nd*	1st*	2nd*	2nd

Figure 28

* WITH ENGINE BRAKING

- 1 = 1-2 solenoid
2 = 2-3 solenoid
3 = 3-4 solenoid

THIS CONNECTOR IS LOCATED UNDER THE BATTERY

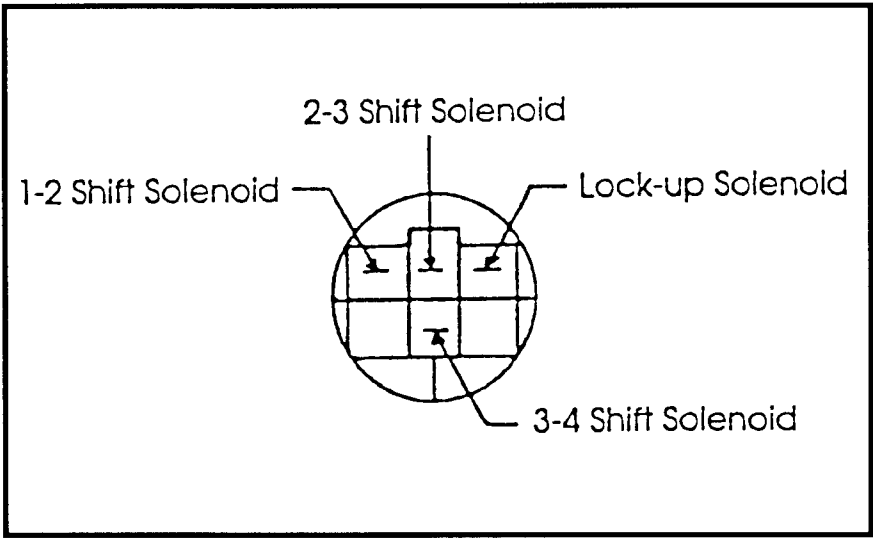


Figure 29

G4A/4EAT

Air Check Locations

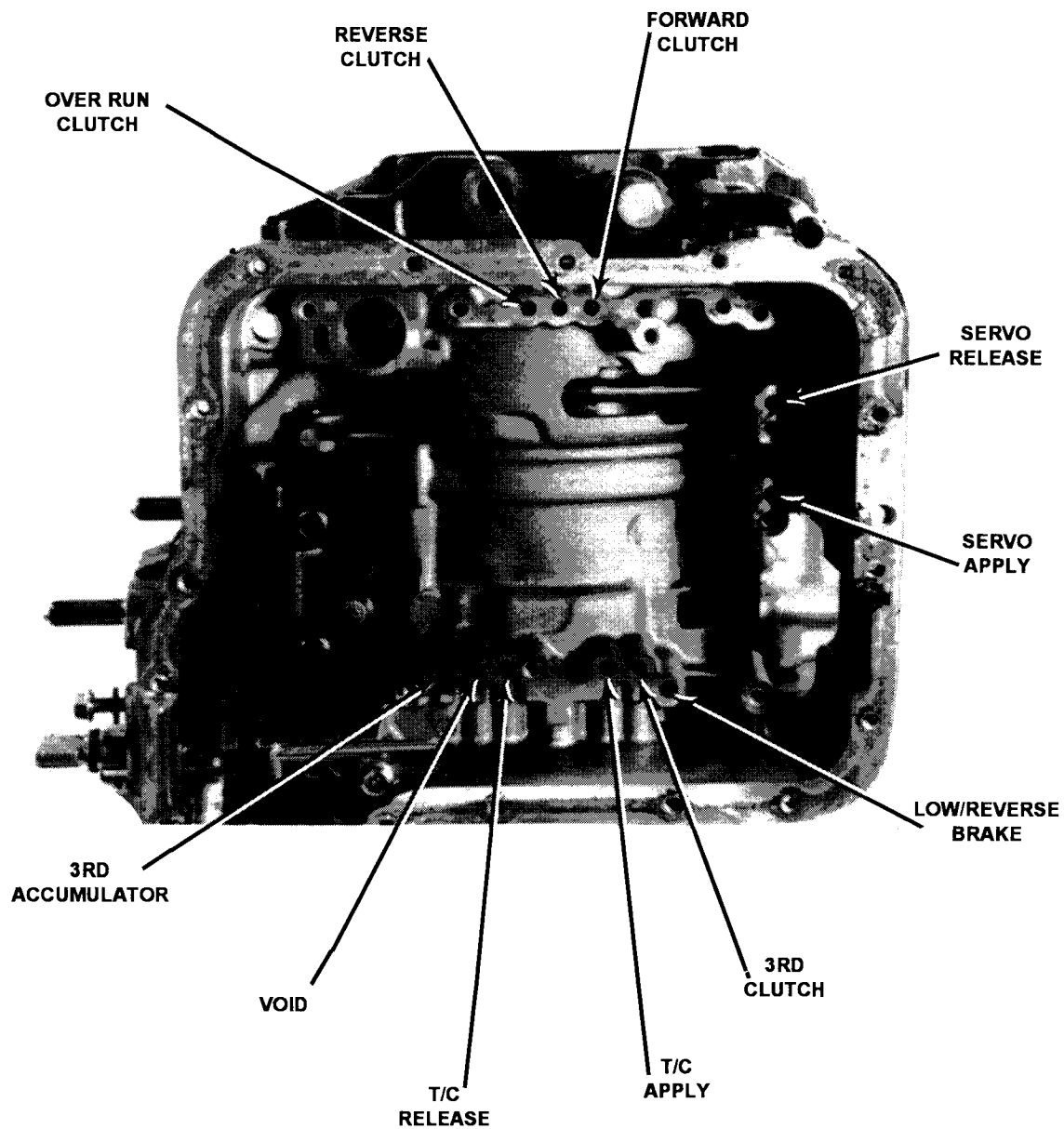


Figure 30

G4AEL/4EAT

Orifice Location and Function

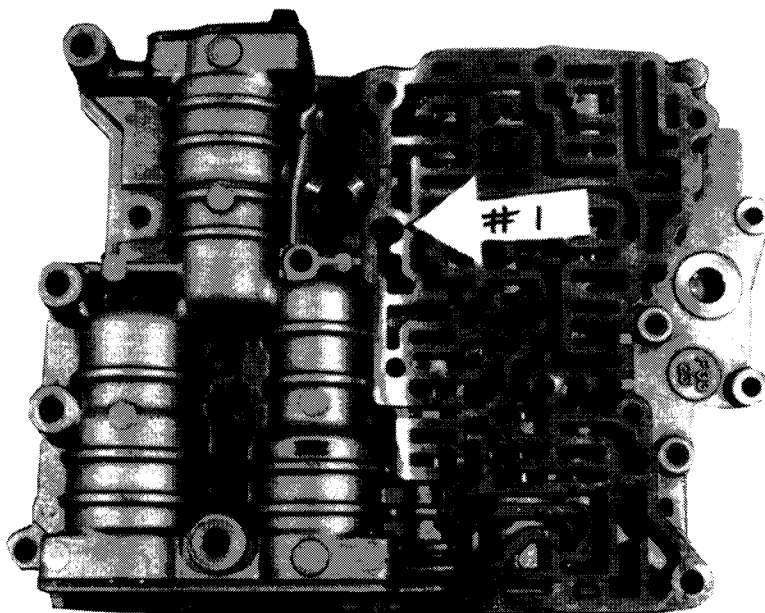


Figure 31

ORIFICE #	SIZE	FUNCTION
1	.031"	3-4 Clutch Feed

NOTE: Enlarge orifice number 1 to .040"-.043"

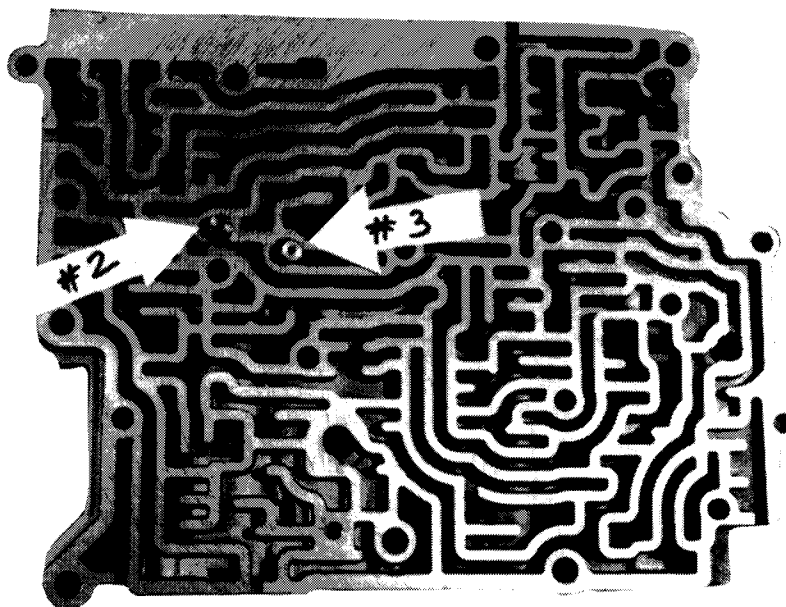
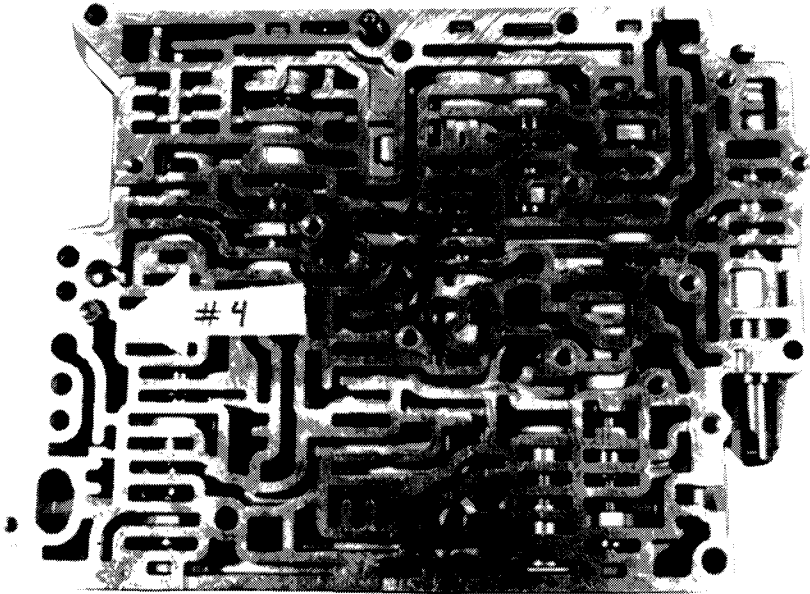


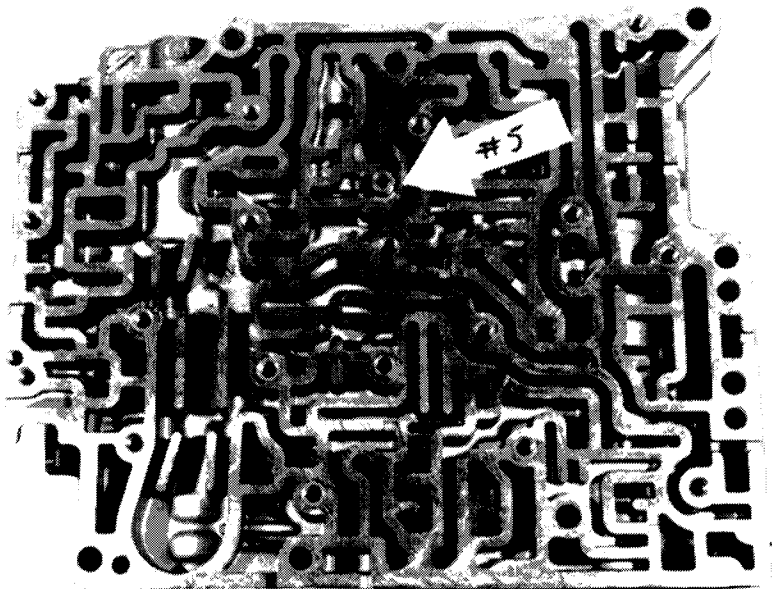
Figure 32

ORIFICE #	SIZE	FUNCTION
2*	.077"	2-4 Servo (3-4 Shift)
3	.077"	Forward Clutch Feed

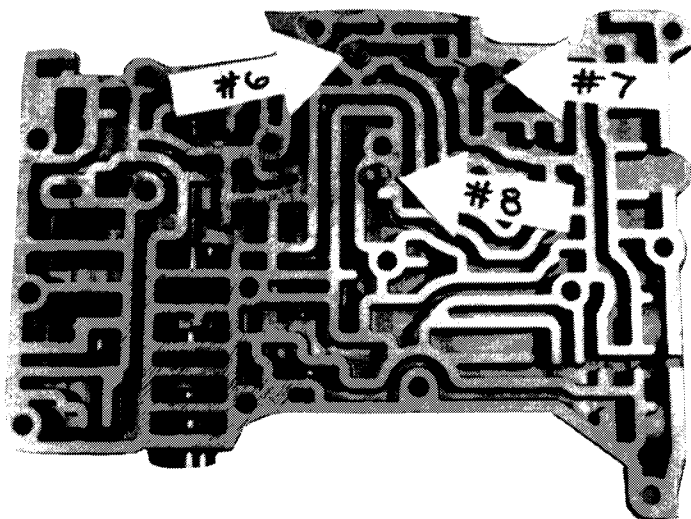
** Not used on all models.*

Orifice Location and Function (Continued)*Figure 33*

ORIFICE #	SIZE	FUNCTION
4	.031"	2-4 Servo (1-2 Shift)

*Figure 34*

ORIFICE #	SIZE	FUNCTION
5	.116"	Low/Reverse Brake

Orifice Location and Function (Continued)Nissan-
Mazda*Figure 35*

ORIFICE #	SIZE	FUNCTION
6	.039"	Over-Run Clutch Feed
7	.059"	Reverse Clutch Feed
8	.077"	Low/Reverse Clutch Exhaust (When shifting out of reverse)

G4A/4EAT

Sprag Rotation

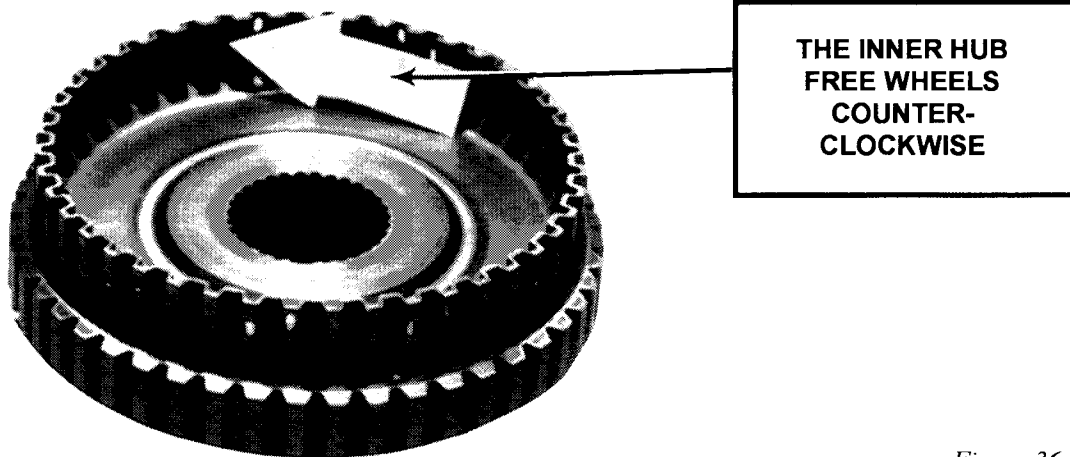


Figure 36

The forward sprag should free wheel counter-clockwise and hold clockwise.

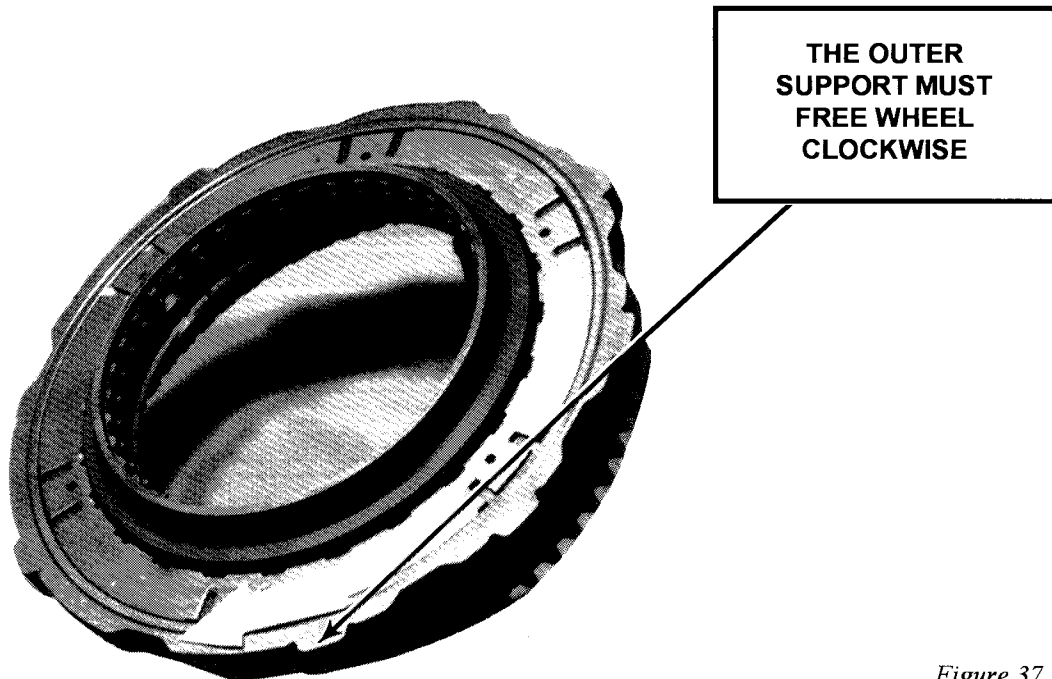


Figure 37

The low roller clutch support should free wheel clockwise and hold counter clockwise.

G4A-EL/4EAT

Kills The Engine In Gear

A leaking lock-up circuit can cause the torque converter clutch to remain applied. This condition will cause the engine to stall when placing the transaxle in gear. To correct this problem, 1st check the lock-up solenoid for leaks. The lock-up solenoid is normally closed. When applying air, it should not leak. The next thing to do is air check the valve body. Apply air to the valve body as shown in the picture below to check for leaks.

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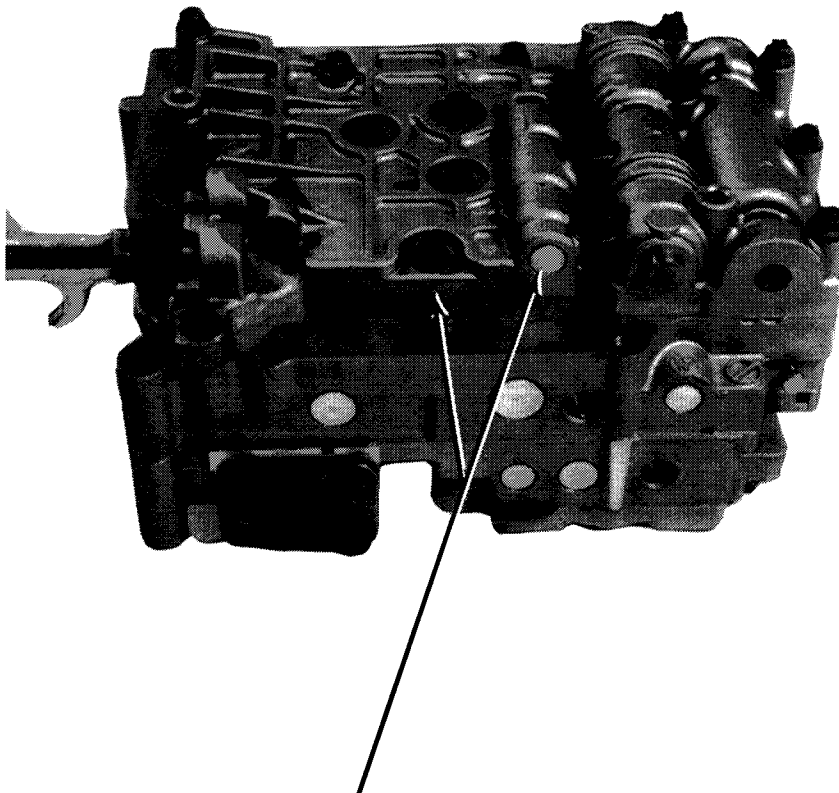


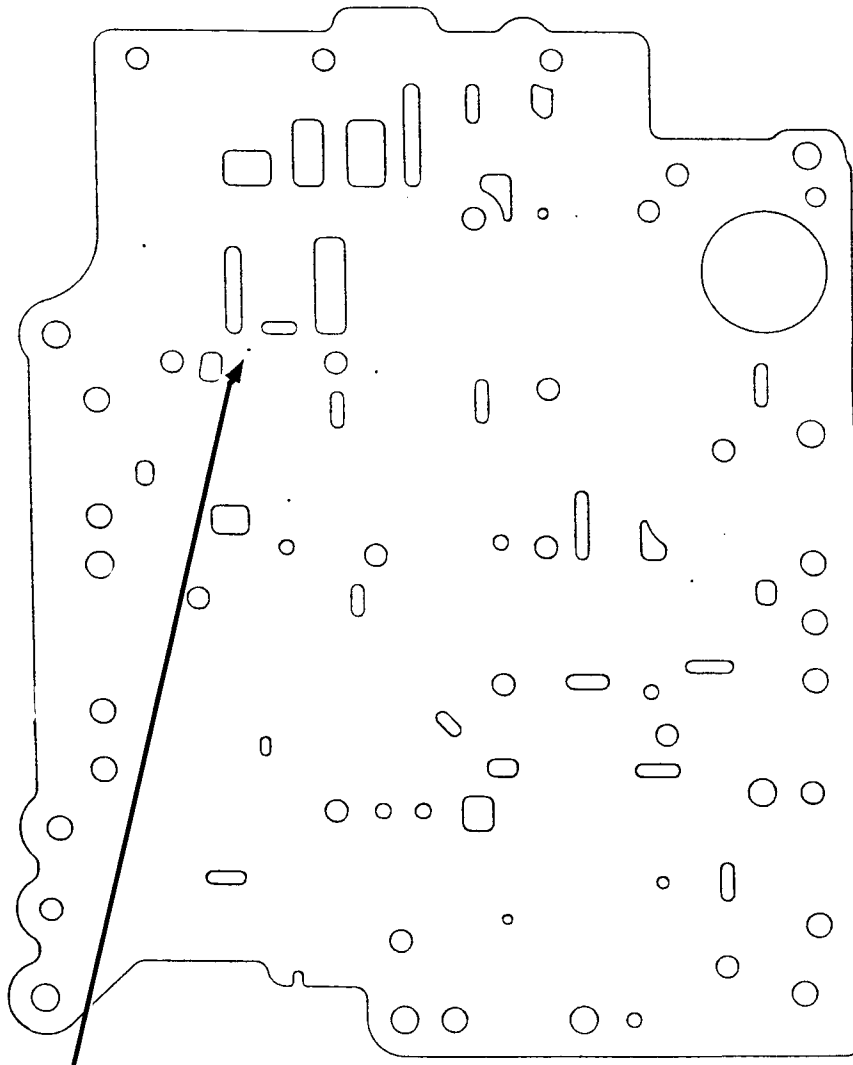
Figure 38

Make sure there are no leaks at the plug or between the valve body & separator plate.

Kills The Engine In Gear (Continued)

If everything checks ok, drill the lock-up solenoid feed hole in the separator plate to .040".

MAIN SEPARATOR PLATE



Enlarge this hole to .040 to help prevent the torque converter clutch killing the engine at a stop.

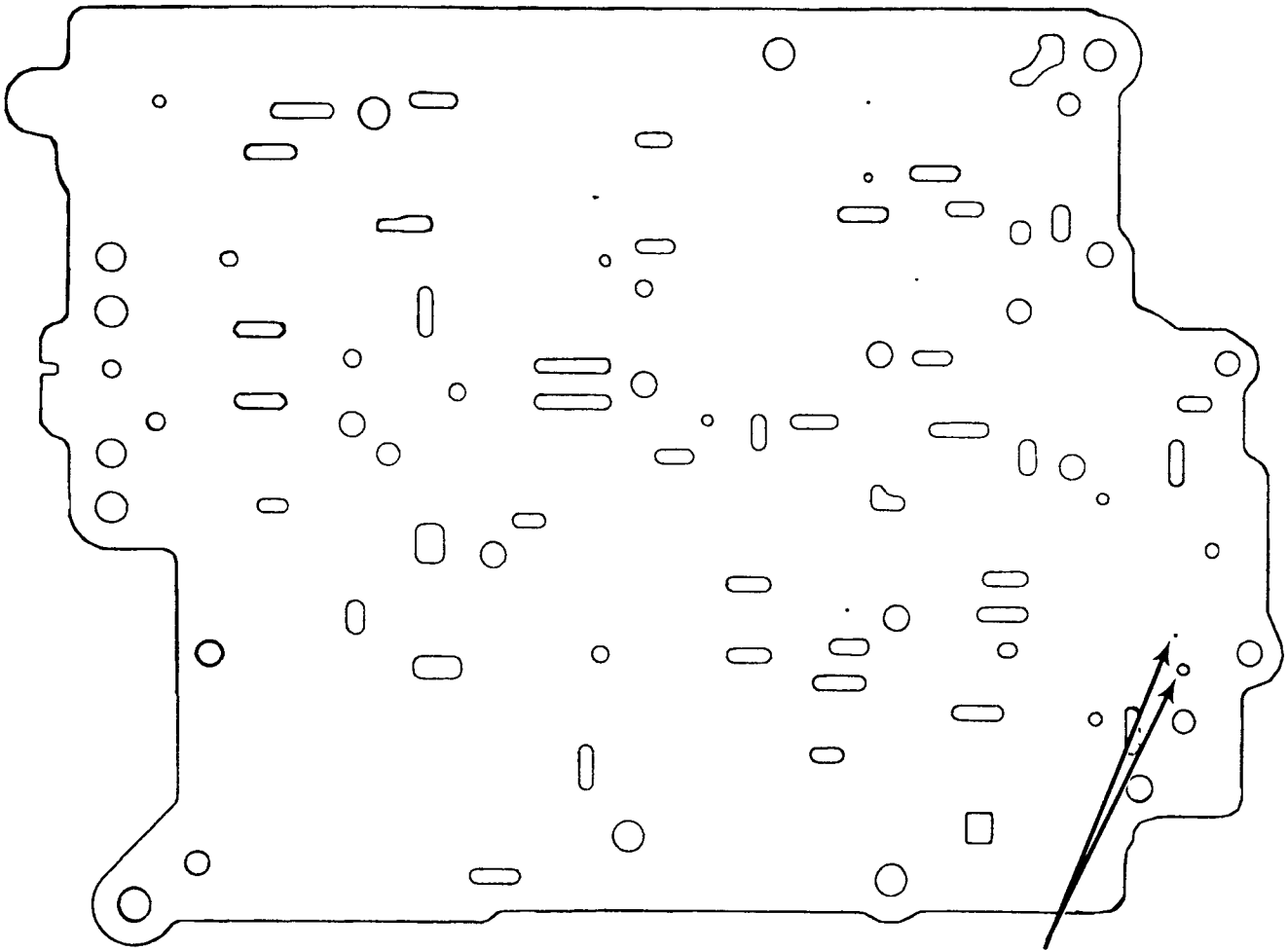
Figure 39

G4A-EL/4EAT

Erratic Pressure Rise

No pressure rise or high pressure after kickdown can be caused by the wrong valve body gaskets. When you replace the valve body gaskets make sure the T.V. balance hole isn't closed off.

Nissan-
Mazda



Check the gaskets on both sides of the plate to make sure these holes are open.

Figure 40

G4A/4EAT

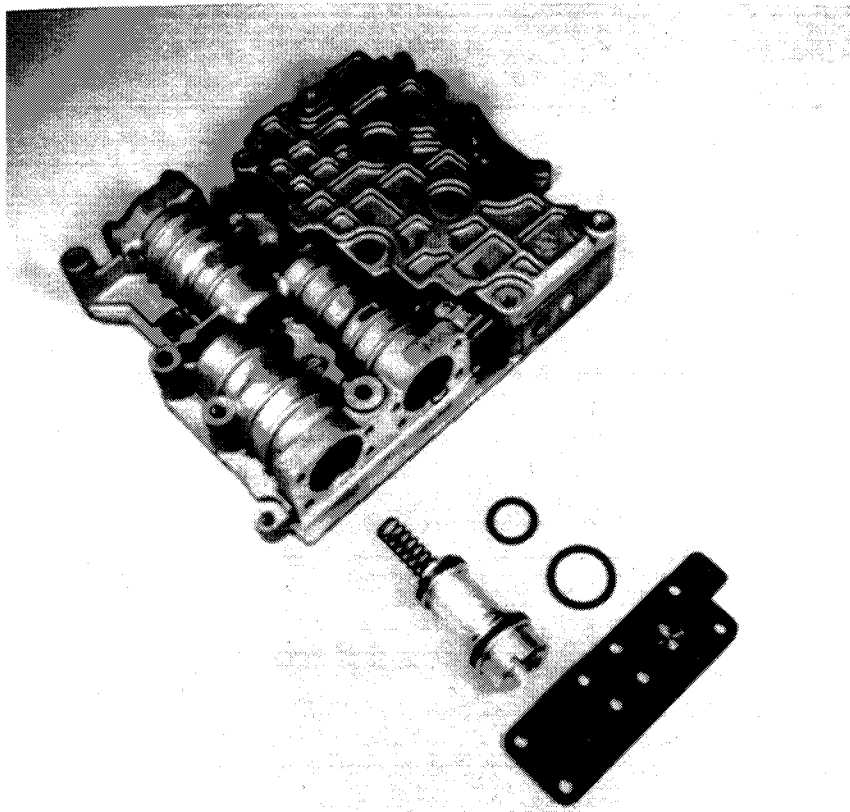
Repeated Reverse Clutch Failure

You can help avoid repeated reverse clutch failure on G4A-EL's and 4EAT's by following three simple steps.

1. Always use factory sealing rings on the pump. Ford rings will work on both units.
The part # is E92Z-7D019-A.
2. Drill a .030 hole in the reverse piston. Figure 41. (This is just like the T-35 that would cross leak in the valve body and drag the reverse band.) The .030 hole creates an exhaust to help prevent the clutch from applying while driving forward.
3. Replace the N-R accumulator seals with "O" rings. (See next page)



Figure 41

Repeated Reverse Clutch Failure (Continued)Nissan-
Mazda*Figure 42*

Replace the original N-R accumulator seals with good fitting "O" rings.

NOTE: *The N-R accumulator is in the same location as the G4A-HL.*

F4EAT

Pressure Tap Identification and Specifications

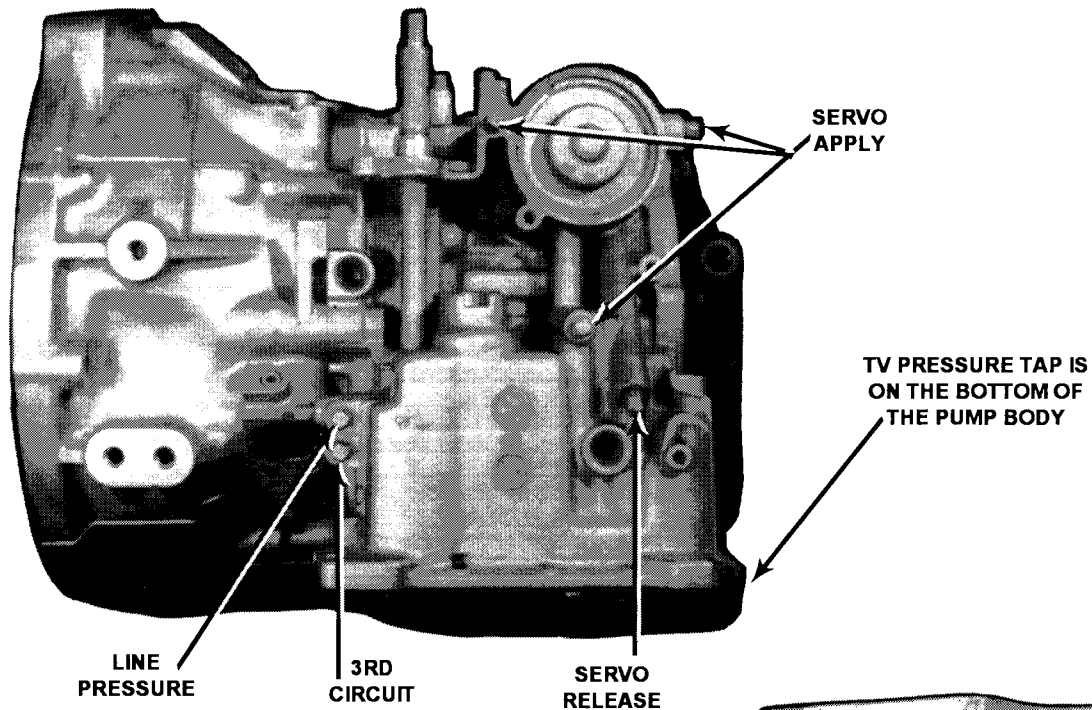


Figure 43

MAINLINE PRESSURE SPECIFICATIONS

RANGE	IDLE	STALL
D, S, L	53-65	135-155
R	85-107	220-253

TV PRESSURE SPECIFICATION

RANGE	IDLE	STALL
D	5-15	78-96

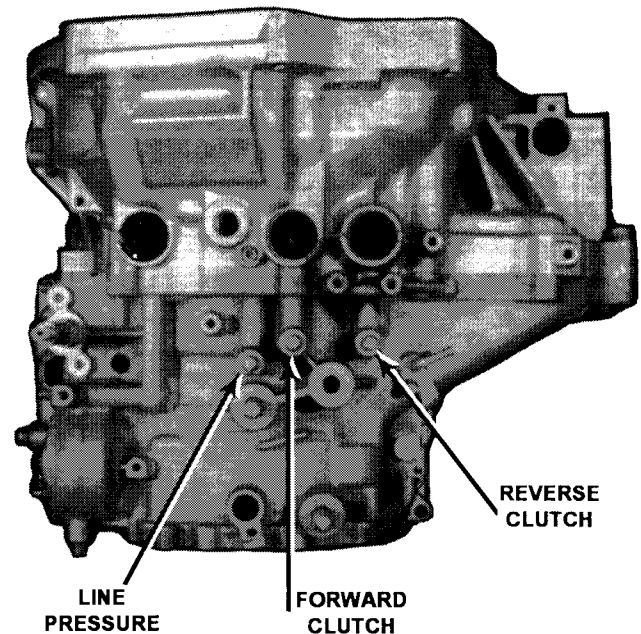


Figure 44

F4EAT

Electrical Information

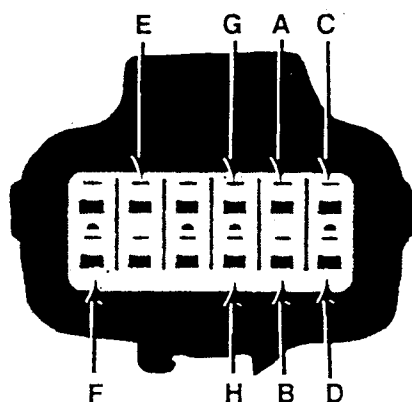
SOLENOID PATTERN

GEAR	1-2 SOLENOID	2-3 SOLENOID	3-4 SOLENOID
1st	OFF	ON	ON
2nd	ON	ON	ON
3rd	OFF	OFF	OFF
4th	ON	OFF	ON

Solenoid Resistance -13 -27 Ω

Figure 45

12 PIN TRANSAXLE HARNESS CONNECTOR



A = 1-2 Solenoid E = Thermistor
 B = 2-3 Solenoid F = Thermistor
 C = 3-4 Solenoid G = Pulse Generator
 D = TCC Solenoid H = Pulse Generator

Figure 46

The resistance of the thermistor changes according to temperature.

THERMISTOR SPECIFICATIONS	
ATF Temperature $^{\circ}\text{C}$ ($^{\circ}\text{F}$)	Resistance (k Ω)
-20 (-4)	124.8 - 142.0
0 (32)	52.0 - 57.4
20 (68)	23.4 - 25.0
40 (104)	11.1 - 12.1
60 (140)	5.6 - 6.3
80 (176)	3.0 - 3.4
100 (212)	1.7 - 2.0
120 (248)	1.1 - 1.2
130 (266)	0.86 - 0.92

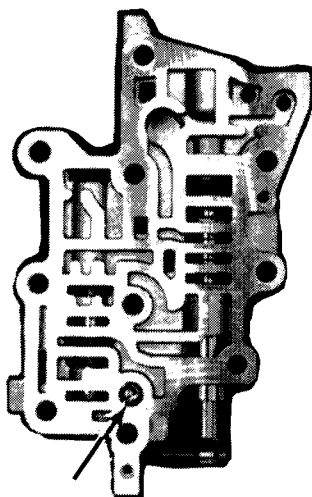
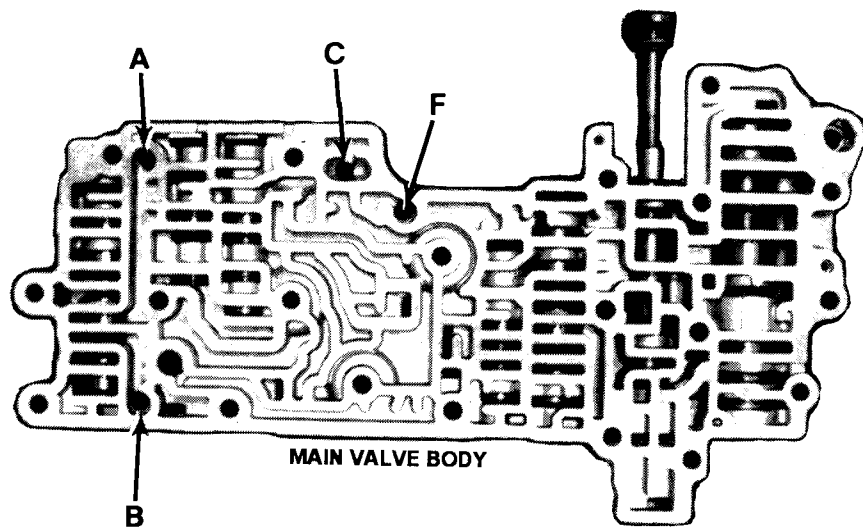
The Pulse Generator is located on top of the case, near the pump.

The resistance of the pulse generator (measured between terminals G & H) should be 200 - 400 Ω .

Figure 47

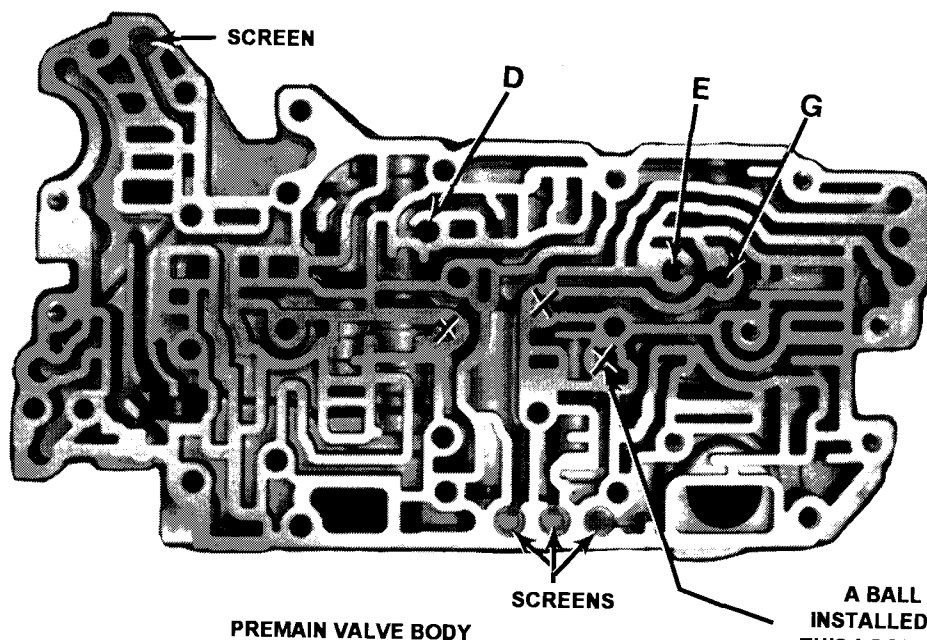
F4EAT

Valve Body Checkballs



TV LIMIT BALL & SPRING

TV LIMIT SPRING WEIGHS 2lbs 6oz @ .620



PREMAIN VALVE BODY

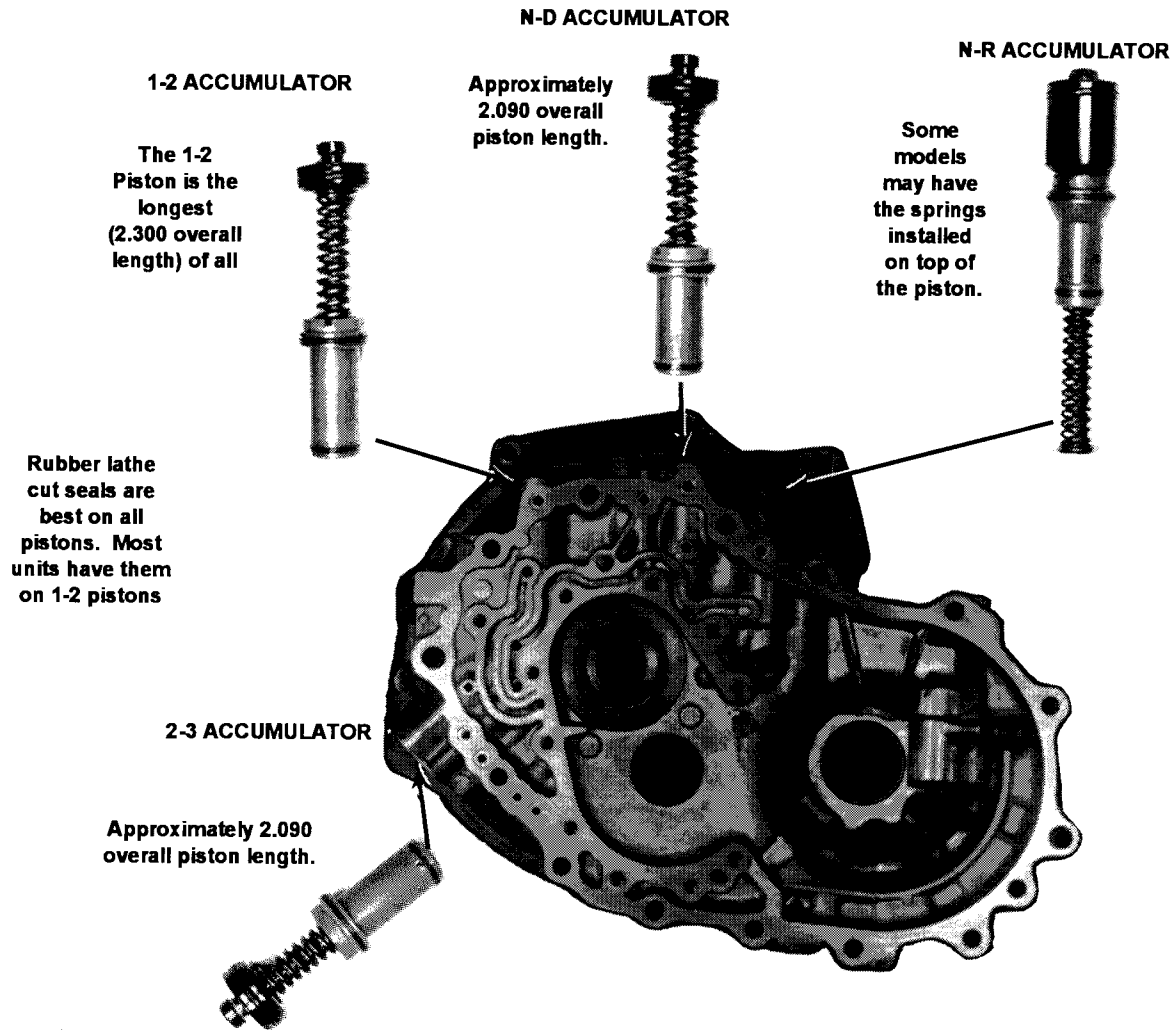
CHECKBALL FUNCTIONS

- A = Forward clutch feed
- B = Coast clutch feed
- C = Low reverse shuttle
- D = Reverse clutch feed
- E = 3rd circuit feed
- F = Low reverse exhaust (Not used on all models)
- G = 3-2 control to 3-2 timing valve (Not used on all models)

Figure 48

F4EAT

Accumulator Installation



Pistons installed in wrong locations can cause bind-ups and wrong gear starts.

Figure 49

CAUTION: There are several different arrangements of springs used in the accumulators depending on the model. Tag all springs during disassembly to eliminate confusion.

F4EAT

Air Check Points

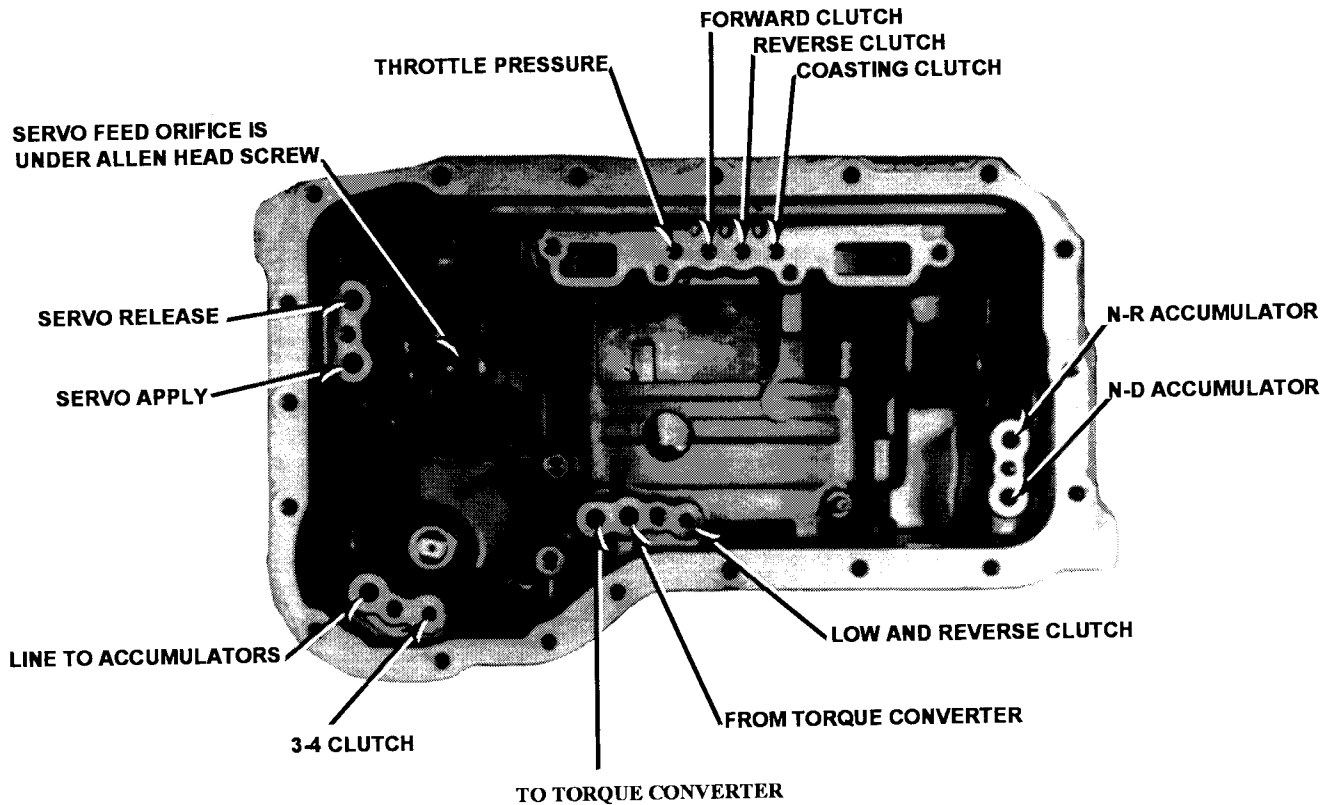


Figure 50

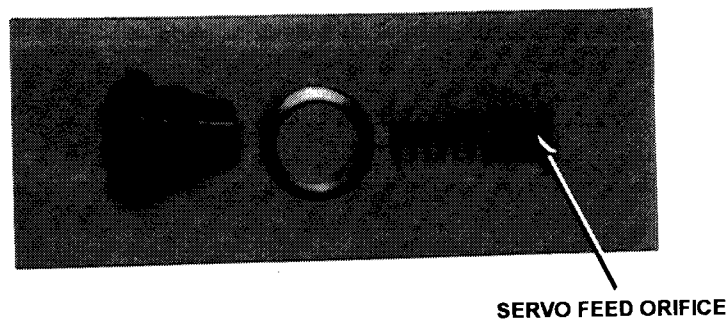


Figure 51

There is a servo feed orifice located under the big allen head screw, by the linkage. It would be a good idea to remove it for cleaning. Soap residue from hot water washing machines (or other debris) is likely to interfere with its operation.

F4EAT

Valve Body Solenoid Identification

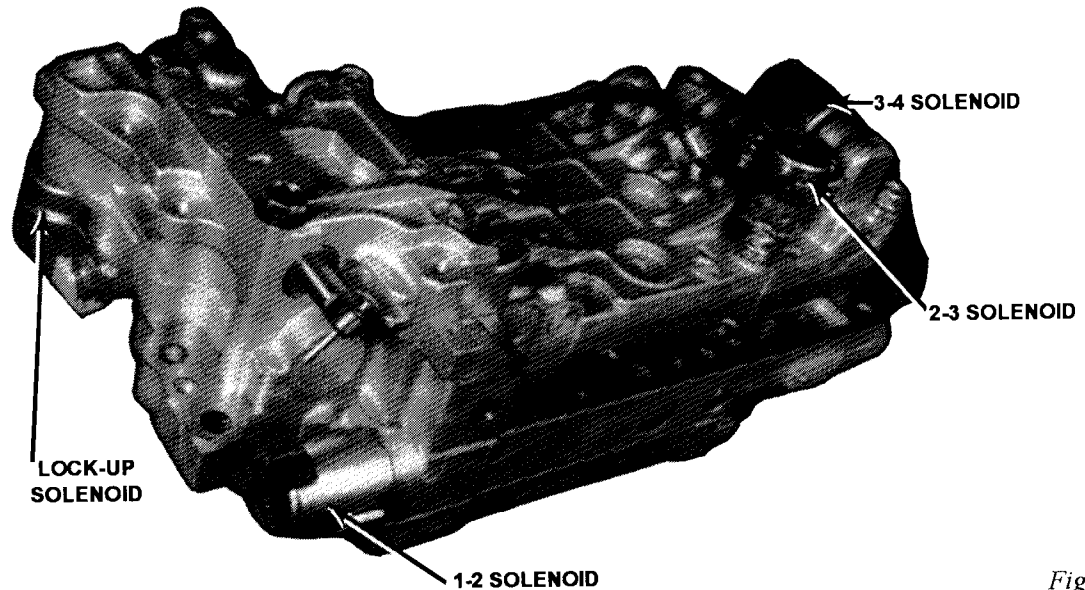


Figure 52

All solenoids are normally closed and measure approximately 13-27 Ω resistance.

All solenoids have feed screens in the valve body over the snout of the solenoids. Clean and re-install them to protect the solenoids from clogging with debris.

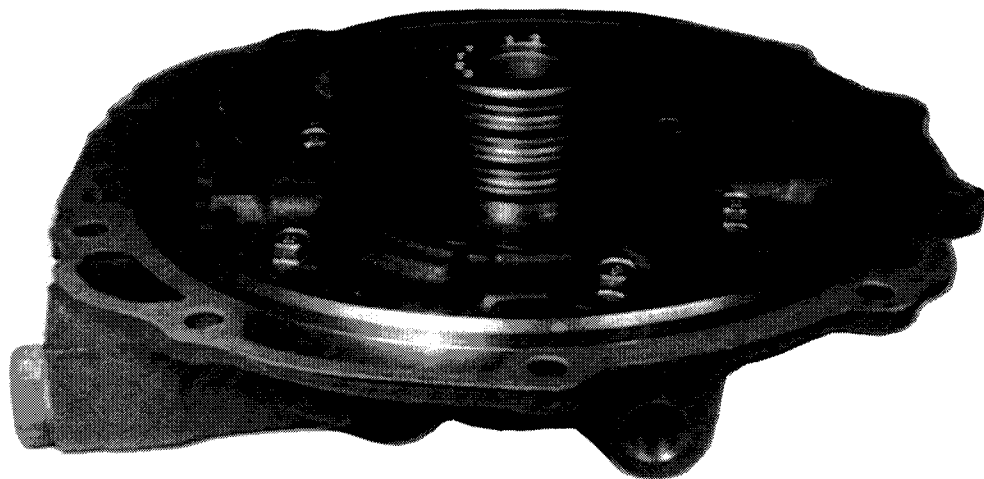


Figure 53

The 4 oil sealing rings on the pump tower are very critical.

Factory seal rings are available separately from Ford under Part #FICZ-7D019-A.

N4A-EL

Component Application Chart

		Direct Clutch	OD Sprag	OD Band	High Reverse Clutch	Inter-mediate Band	Forward Clutch	Low Sprag	Low Reverse Clutch
D	R								
	1								
	2								
	3								
	4								
S	1								
	2								
L	1								



= Applied
or holding

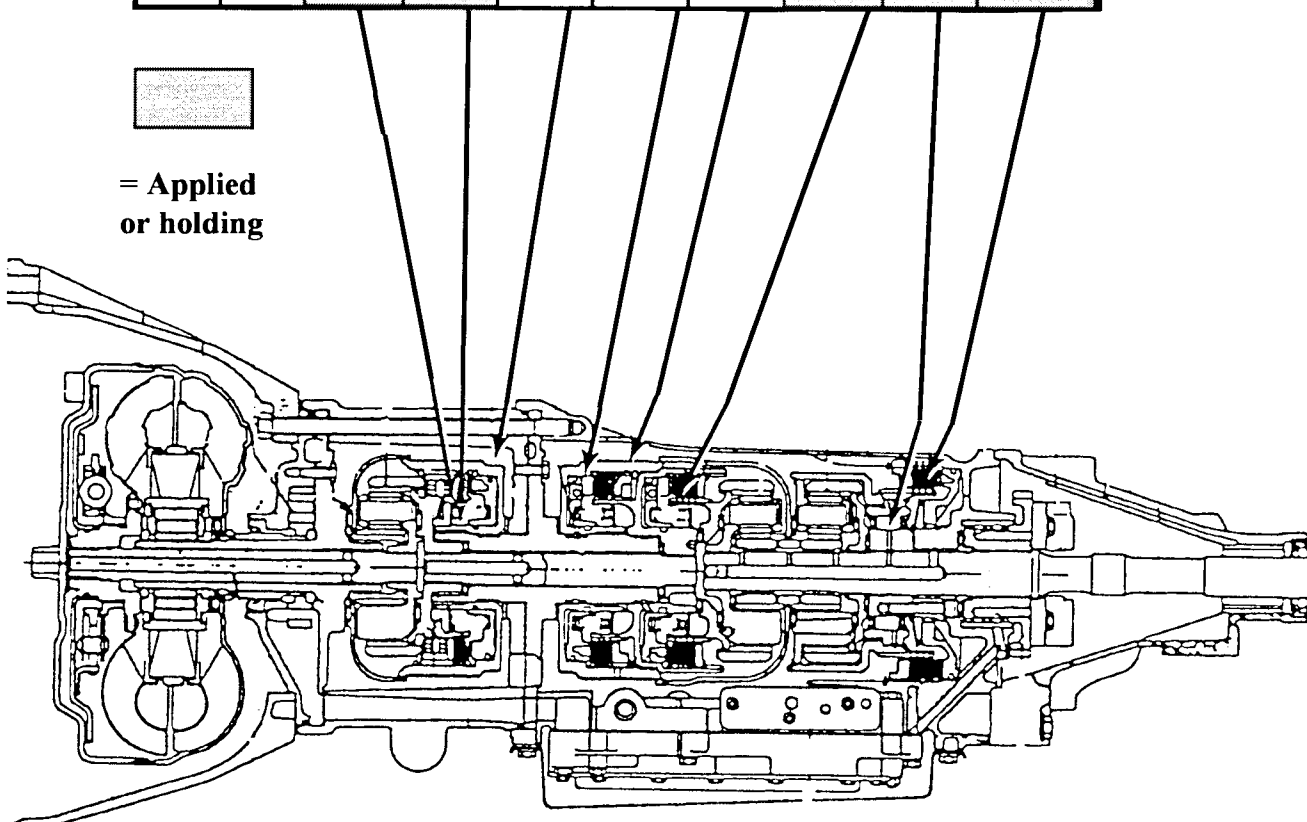
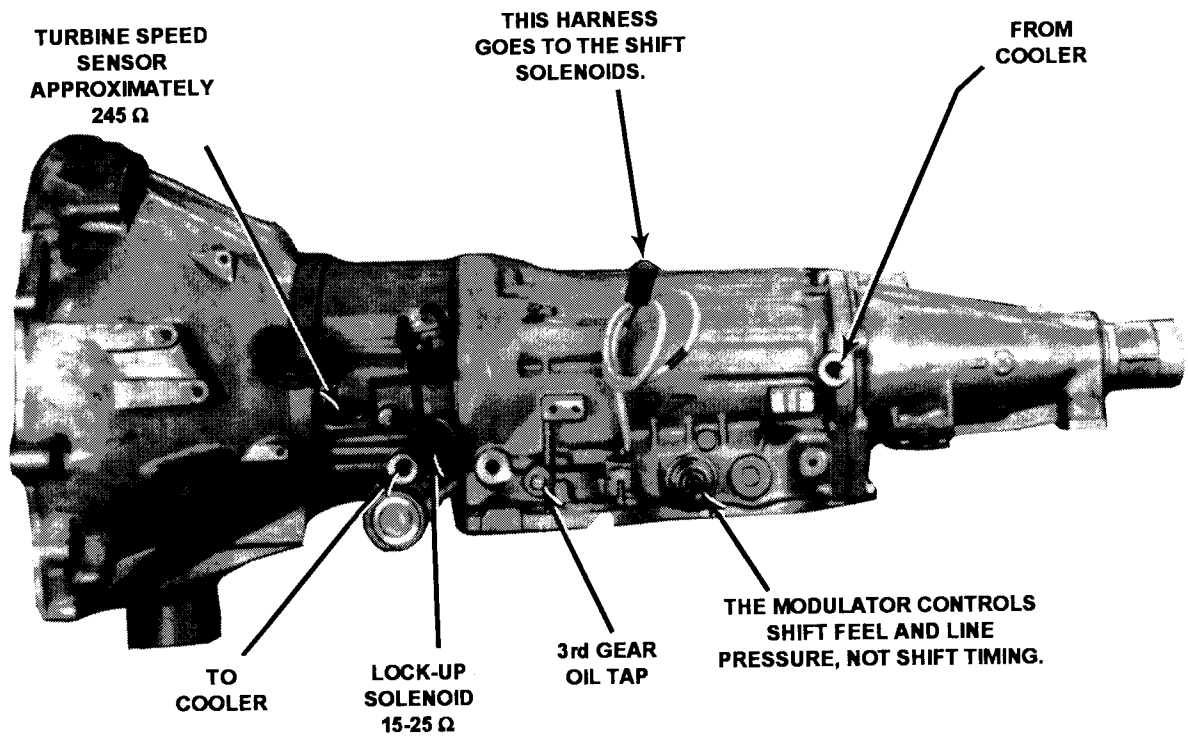


Figure 54

N4A-EL

External Component Identification



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* The line pressure (forward clutch) tap is located on the right rear of the case.

Figure 55

PRESSURE SPECIFICATIONS

RANGE	IDLE	STALL
D, S, L	43-57	128-156
R	78-92	213-242

Check pressure for all forward ranges using the tap on the right rear of the case.

Check reverse pressure using the 3rd gear oil tap on the left front area of the main case.

N4A-EL

Valve Body Orifices

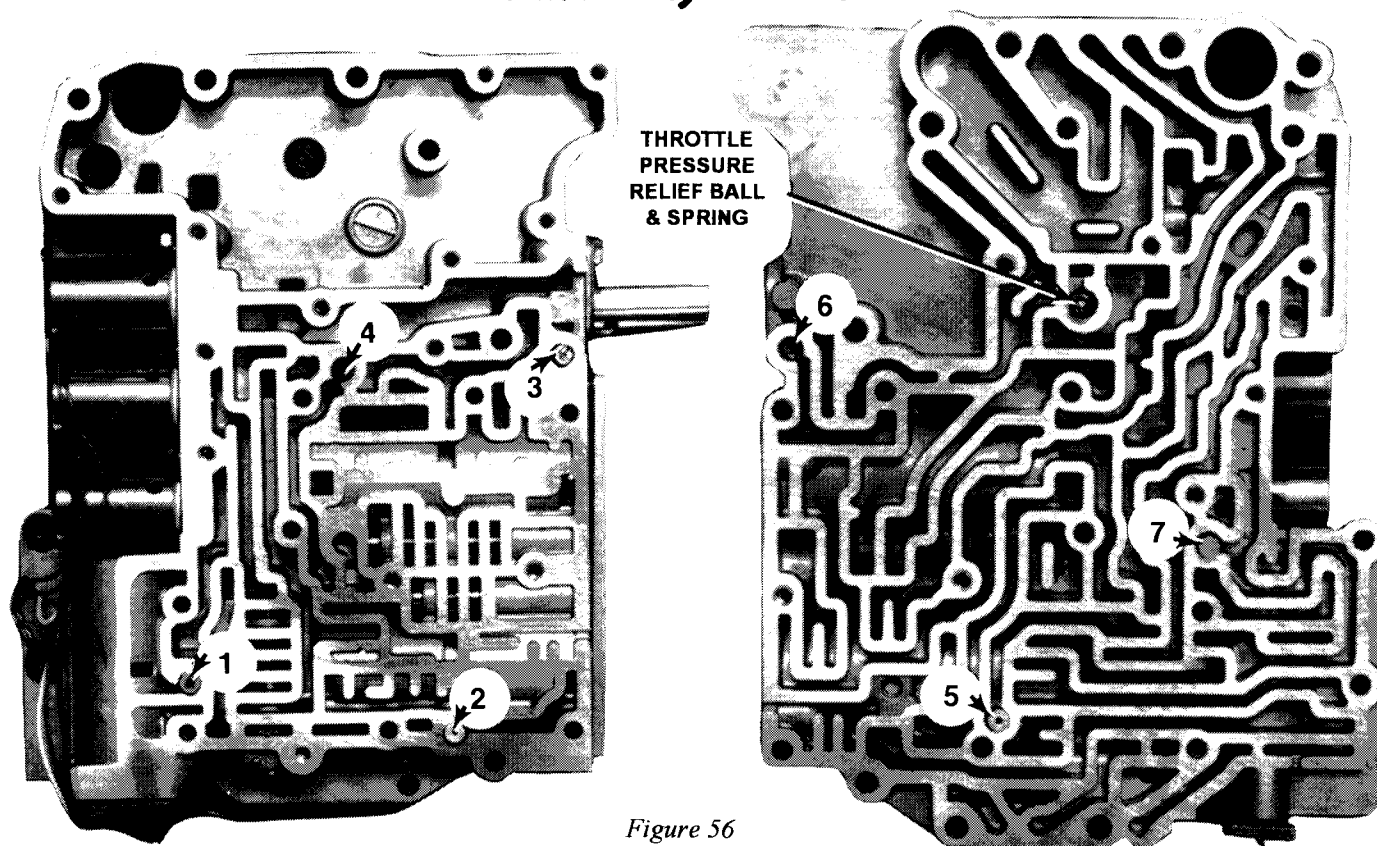


Figure 56

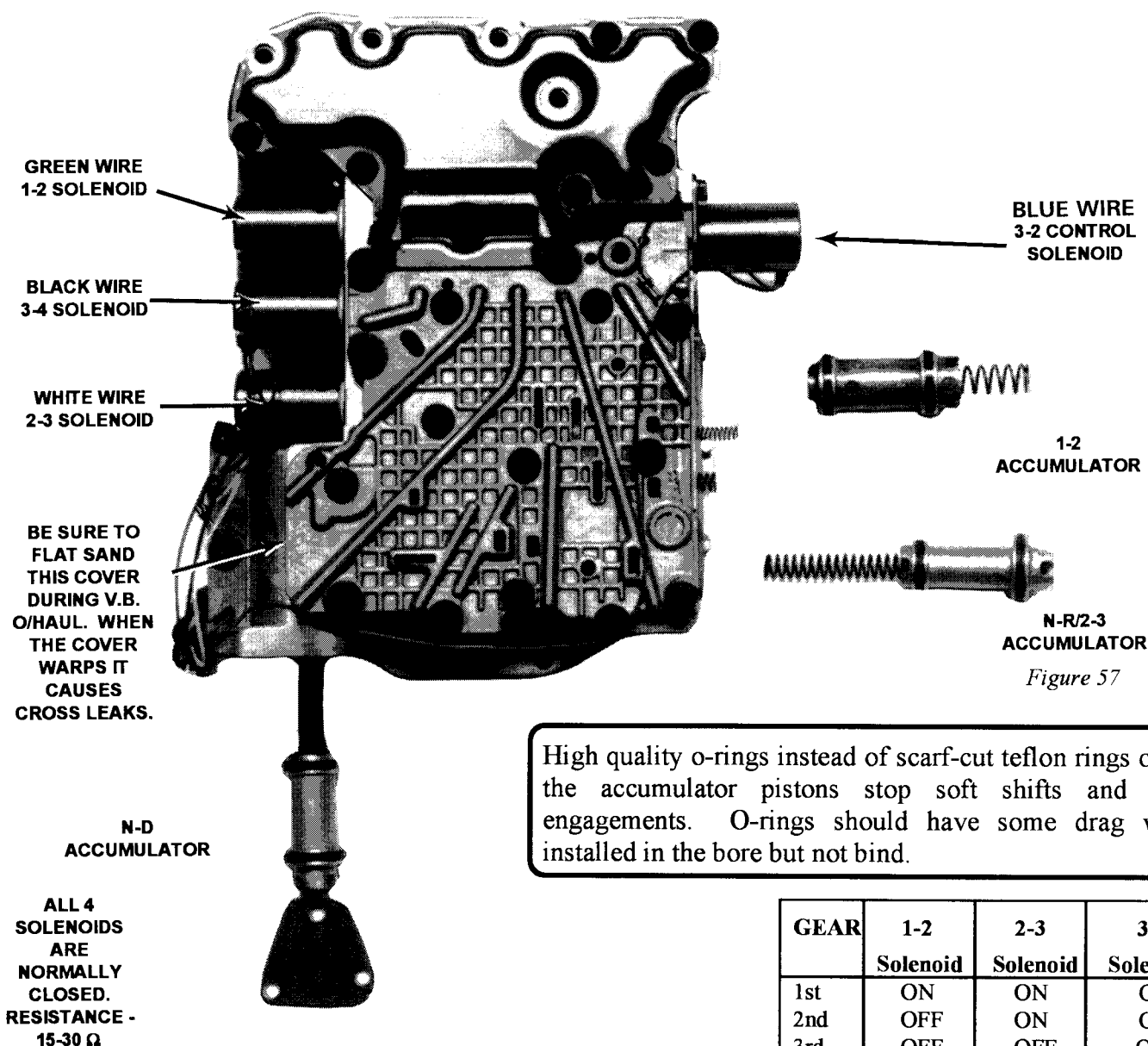
ORIFICE #	FUNCTION	SIZE	ACTUAL	YEAR	YEAR	YEAR	YEAR
		STATED IN SERVICE MANUAL	SIZES OBSERVED IN UNITS				
1	Forward Clutch Feed	.071	.097				
2	N-R/2-3 Accumulator Ex	.059	.057				
3	3-2 Control (Servo Release)	.043	.039				
4	Intermediate Servo Feed	.039	.039				
5	Direct Clutch Feed	.071	.078				
6	4-3 Control	.087	----				
7	Reverse Control	Solid Plug	Solid Plug				

NOTE: Not all models use an orifice in location 6. The orifice sizes contribute to calibration and may vary from model to model. Use the additional columns to record the orifice sizes in your valve bodies and the year and model of the vehicle if you like. This will help you sort one out later if you get one scrambled.

N4A-EL

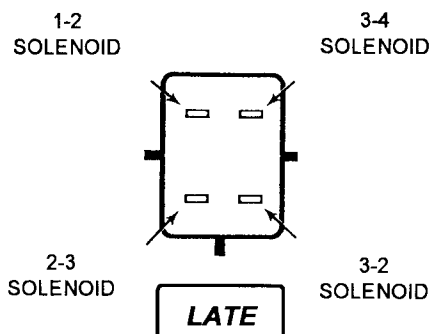
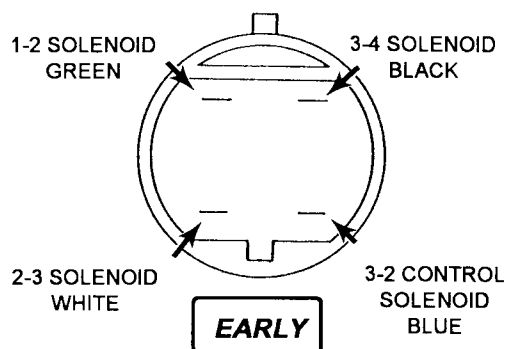
Solenoid and Valve Body Information

Nissan-
Mazda



High quality o-rings instead of scarf-cut teflon rings on all the accumulator pistons stop soft shifts and poor engagements. O-rings should have some drag when installed in the bore but not bind.

GEAR	1-2 Solenoid	2-3 Solenoid	3-4 Solenoid
1st	ON	ON	ON
2nd	OFF	ON	ON
3rd	OFF	OFF	ON
4th	OFF	OFF	OFF



The 3-2 control solenoid controls the rate of apply of the band during a 3-2 downshift. It is not a kickdown solenoid.

N4A-EL

Lube Oil Distributor

These two rings seal forward clutch oil fed to the spit hole which lubes the speedometer gears and extension housing bushing.

The oil distributor requires only 2 rings in the grooves closest to the park gear teeth.

Poor sealing of these rings will cause low line pressure, delayed forward engagement and slipping or soft upshifts.

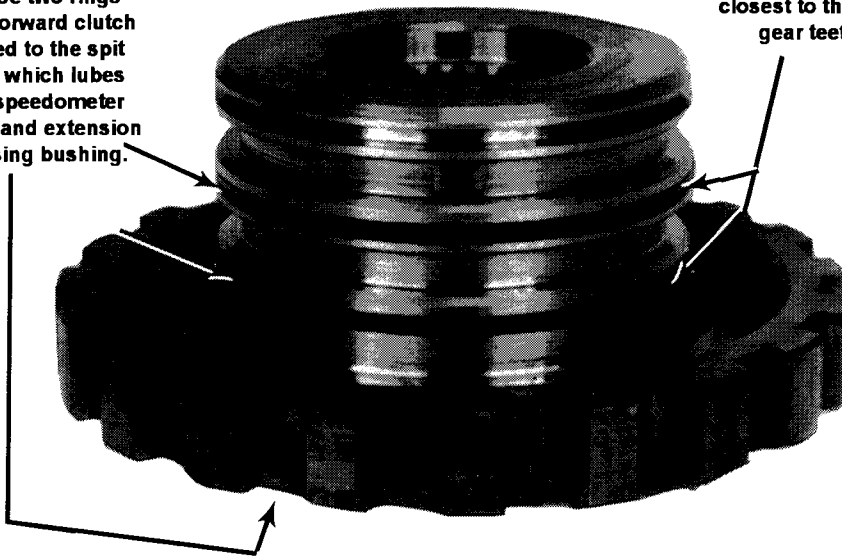


Figure 58

To air check the seal of these rings cover the spit hole with your finger and blow into this port.

A4LD Rubber governor rings provide the best seal of all the rings we have tested.

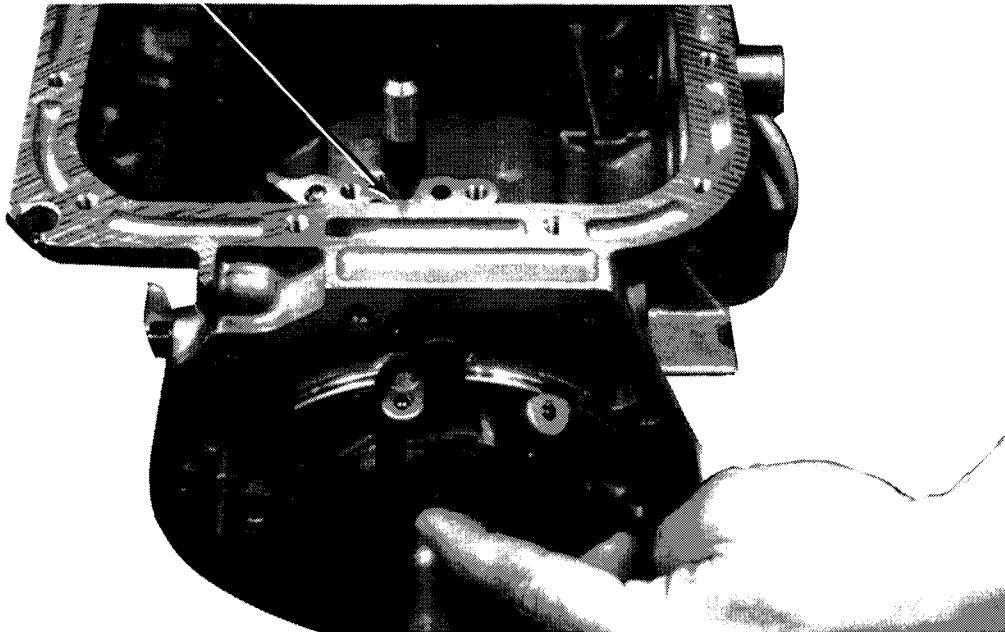


Figure 59

N4A-EL

Drum Support/OD Sprag Rotation

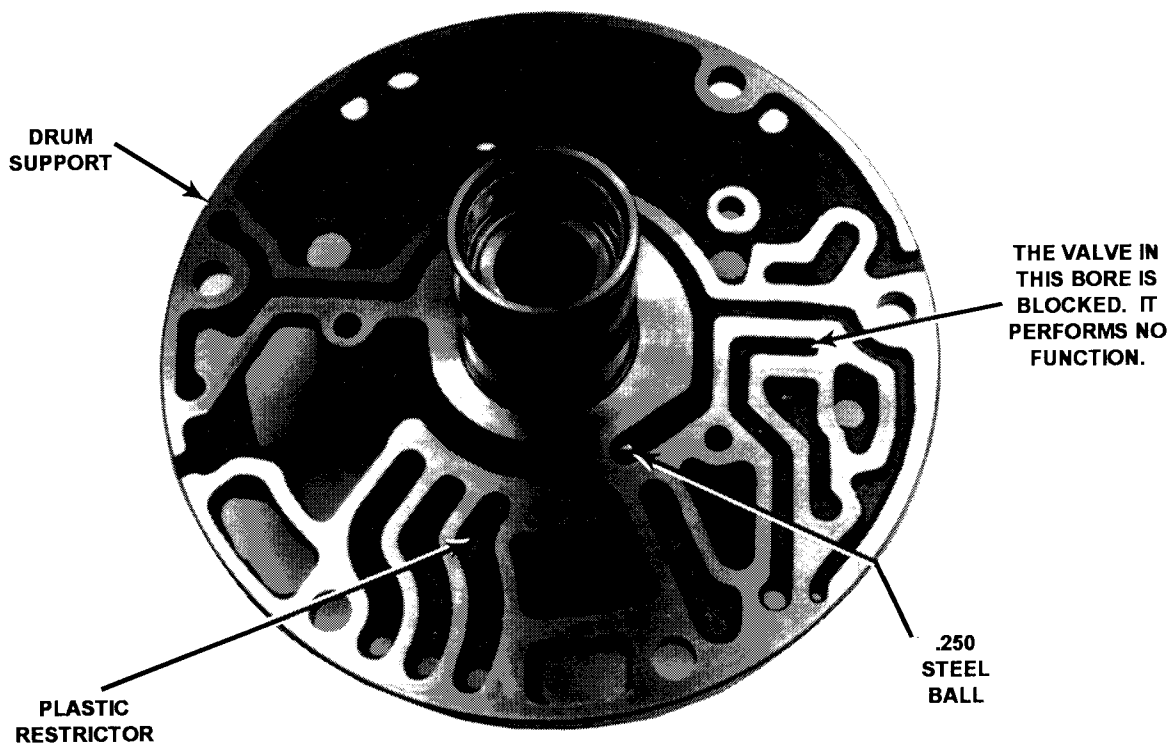


Figure 60

OVERDRIVE SPRAG ROTATION

When properly installed the overdrive sprag will allow the ring gear to rotate clockwise and lock counter-clockwise.

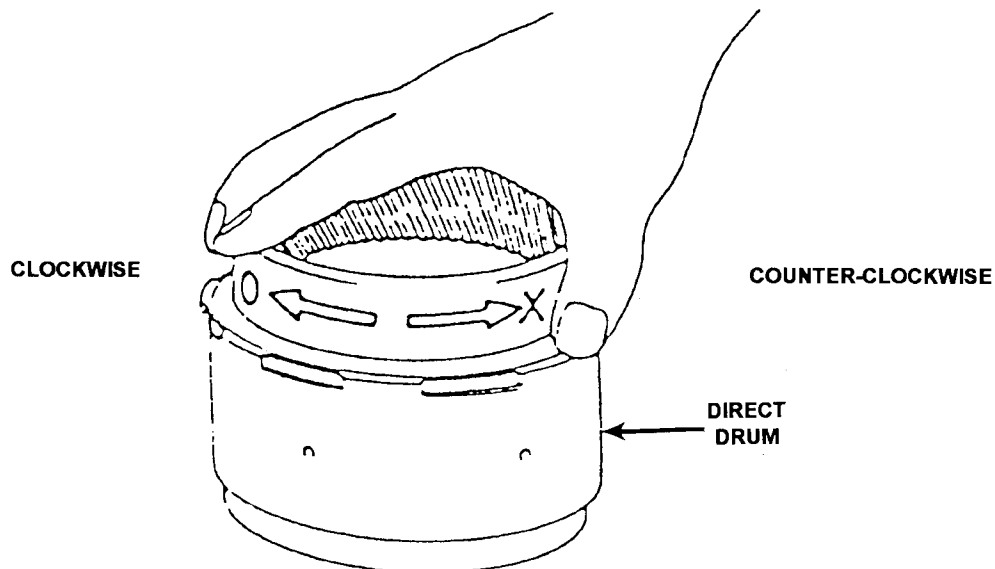


Figure 61

N4A-EL

Erratic/Intermittent Shift Complaints

Several complaints such as 3rd gear starts, no upshift, falls out of third, etc. may be caused by installing the pan bolts in the wrong holes.

There is a total of 14 pan bolts for this unit. One bolt is shorter than the other 13 bolts. This special short bolt must be installed in the hole directly under the Inhibitor Switch. Using one of the long bolts in this hole will likely damage the inhibitor switch since it will extend through the pan rail casting and damage the switch.

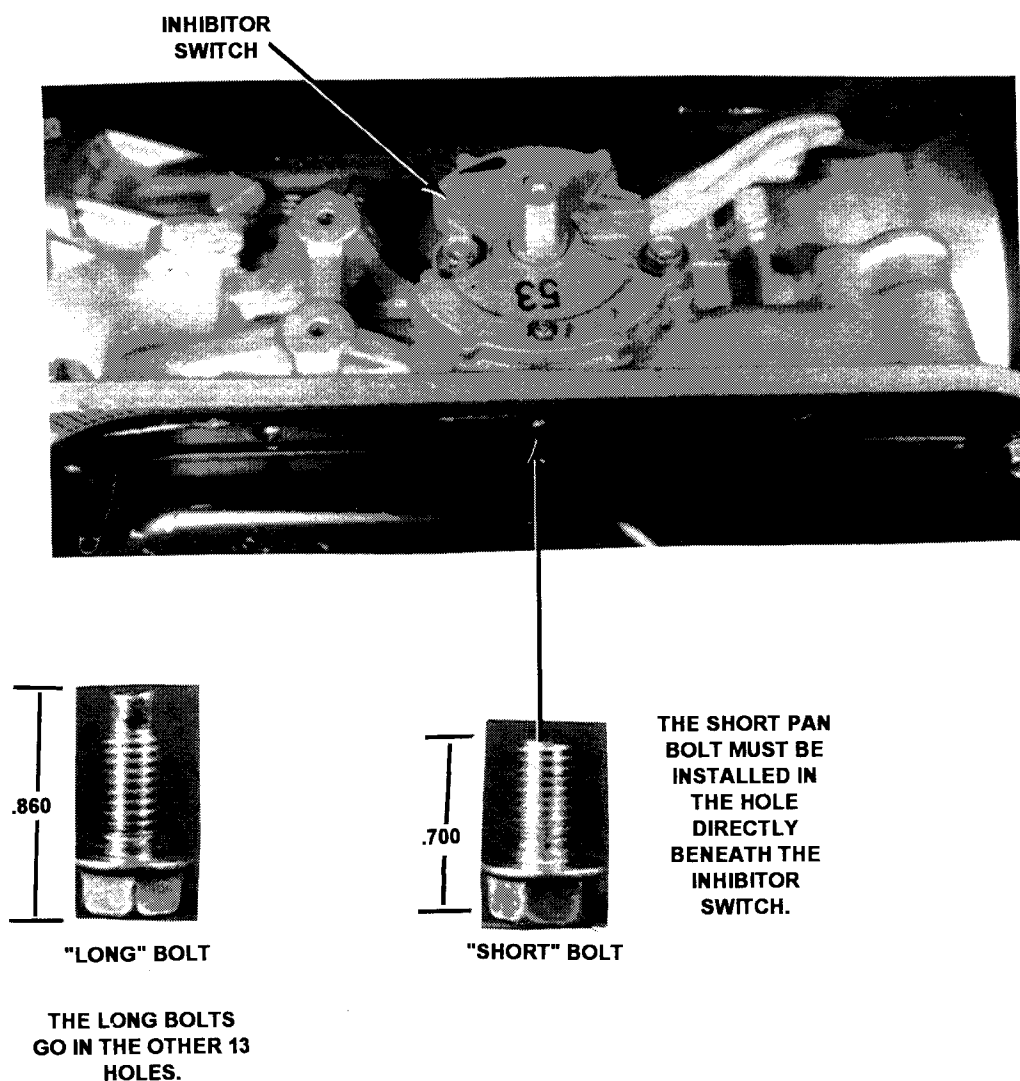


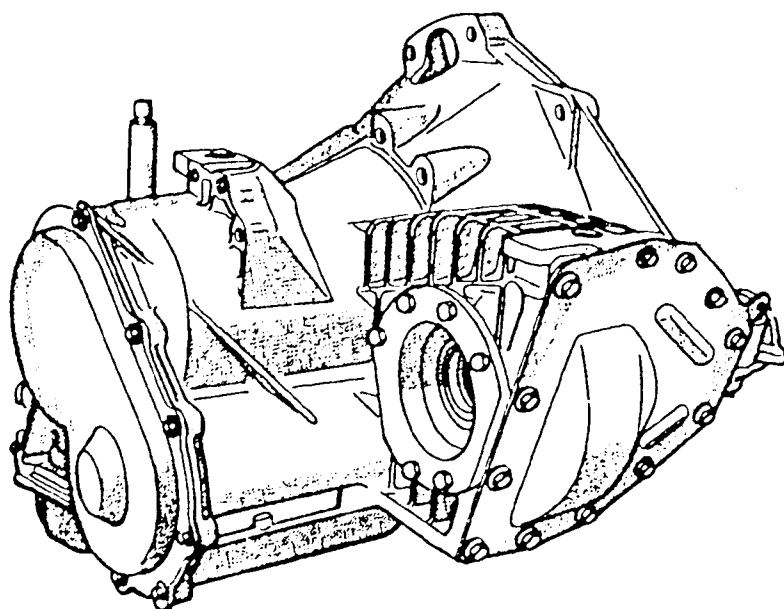
Figure 62

Notes

Notes

Chrysler

Chrysler



A-604

Component Application and Pressure Tap Identification

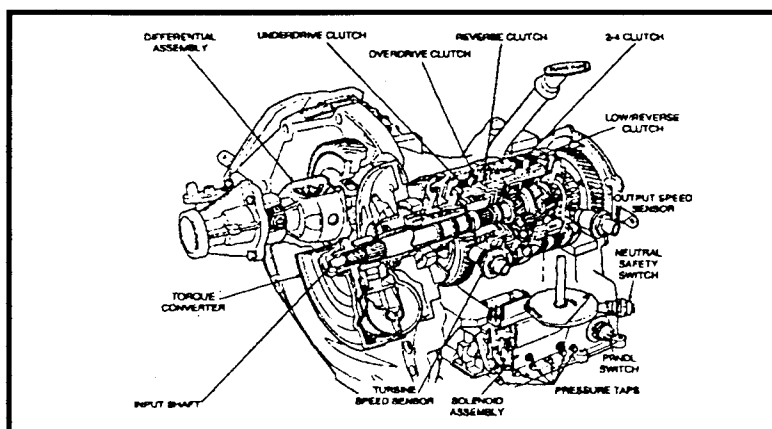


Figure 63

CLUTCH AND SOLENOID APPLICATION CHART

GEAR	CLUTCH					SOLENOID			
	L&R	2-4	O/D	UD	REV	LR/LU	2-4/LR	UD	OD
P	X					X	X		
R	X				X				
N	X					X	X		
4th		X	X				X	X	X
3rd			X	X			X		X
2nd		X		X					
1st	X			X		X	X		

PRESSURE TAPS

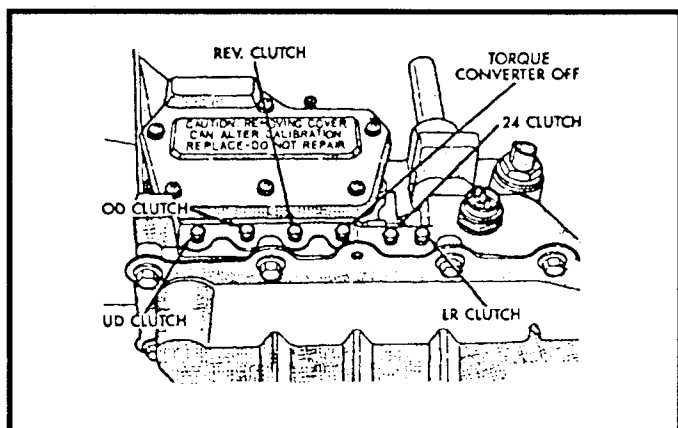


Figure 64

COOLER FITTINGS I.D.

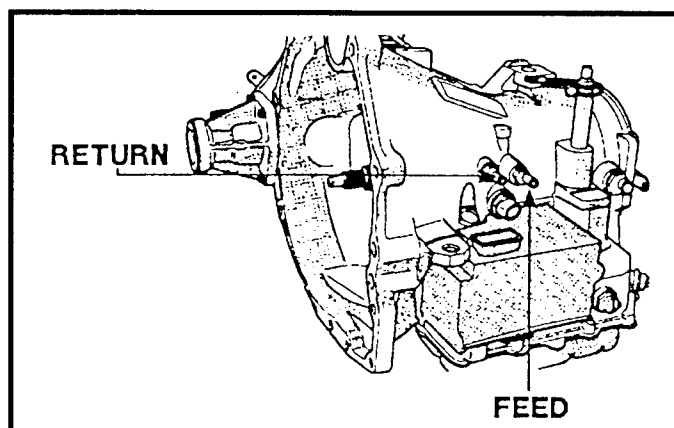


Figure 65

A-604

Controllers

The following is as brief summary of controllers used and a description of improvements.

PART #'S 5234623, 5234649, 5234678

These are early 1989 controllers used on all models. These controllers would only allow a 3-1 closed throttle downshift which caused a harsh coastdown shift.

PART #4557120

This was introduced as a running change on 1989 models. It features smoother coasting closed throttle downshifts because it shifts 3-2-1 instead of 3-1, like the previous controllers. It also has new logic for improved high altitude operation. Another improvement incorporated in this controller is less 3-4 shift busyness when under load at highway speeds. This controller will replace #'s 5234623, 5234649 & 5234678 on all models.

PART #4557585

This controller replaced the #4557120 controller as a running change for 1990. It has further refinements of the logic to eliminate 3-4 shift busyness when under load at highway speeds. This controller will allow the TCC to unlock in 4th gear for more available engine torque when required. This will retrofit to all years and models.

PART #4672104

New for early 1991 for all models and will retrofit to 1989.

PART #4672002

Released in late 1991, for all models, this will retrofit back to 1989 vehicles, all models. It will not fit 1992 years.

PART #4672105

This is a service replacement controller for all 1989-1991 models. It has 1992 features but operates on a different C2D bus system. Therefore, it will not fit 1992 vehicles.

PART #4672203

For 1992 models except New Yorker, 5th Avenue and Imperial, will not retrofit to any earlier model years.

PART #4672216

1992 calibration for New Yorker, 5th Avenue and Imperial only. This controller will allow partial lock-up in 2nd gear for improved fuel economy. It will not retrofit to any earlier model years.

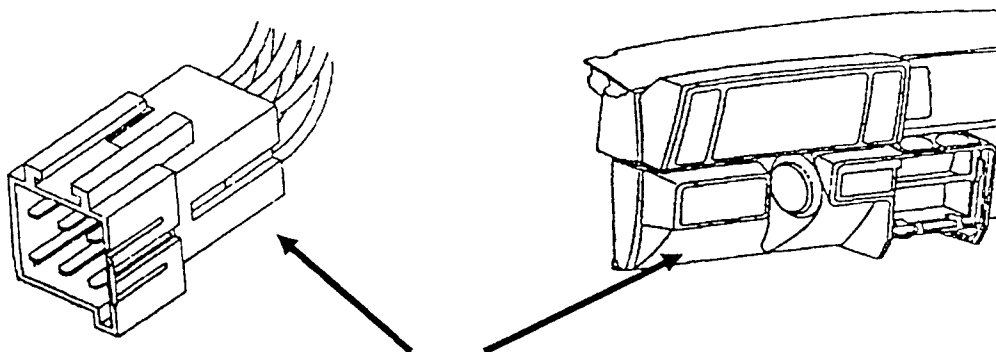
The following controllers are the latest service replacements.

YEAR	ENGINE SIZE	PART NUMBER
89-91	3.0	4713228
90-91	3.3, 3.8	4713226
92	3.0	4713229
92	3.3, 3.8	4713227
89-91	3.0	4728600*
90-91	3.3, 3.8	4728598*
92	3.0	4728601*
92	3.3, 3.8	4728599*
* FOR USE ONLY WITH 2-1 DOWNSHIFT CONCERNS		

A-604

Retrieving Diagnostic Fault Codes

Transmission trouble codes stored in the controller memory on an A-604 equipped Chrysler can only be retrieved with a scan tool connected to the bus (C²D) connector. Codes which are retrieved from the diagnostic connector located in the engine compartment are engine codes and do not directly relate to transmission codes.



The diagnostic connector looks like this, and is located under the left side of the dash.

Figure 66

Some scanners may display an unknown trouble code such as B-2. To decipher these codes, first determine the number that the letter represents as follows:

- A = 20
- B = 30
- C = 40
- D = 50
- E = 60
- F = 70

Now add the number displayed in the "unknown code" to the number represented by the letter, to determine the trouble code number.

EXAMPLES:

Unknown code - B2	Number value of unknown code letterB = 30
	Number in unknown code..... <u>2</u>
	Add together = trouble code 32
Unknown code - C1	Number value of unknown code letter C = 40
	Number in unknown code..... <u>1</u>
	Add together = trouble code 41

A-604

Diagnostic Fault Code List

CODE	FAULT	LIMP-IN
11	Internal EATX controller failure	Yes
12	Battery was disconnected	No
13	Internal EATX controller failure	Yes
14	Relay output always on	Yes
15	Relay output always off	Yes
16	Internal EATX controller failure	Yes
17	Internal EATX controller failure	Yes
18	Engine speed sensor circuit	Yes
19	BUS communication with SBEC	No
20	Switched battery	Yes
21	OD pressure switch circuit	Yes
22	2-4 pressure switch circuit	Yes
23	2-4/OD pressure switch circuit	Yes
24	LR pressure switch circuit	Yes
25	LR/OD pressure switch circuit	Yes
26	LR/2-4 pressure switch circuit	Yes
27	All pressure switch circuits	Yes
28	Illegal shifter position data	No
29	Throttle position signal error	No
31	OD hydraulic pressure switch	Yes
32	2-4 hydraulic pressure switch	Yes
33	OD/2-4 hydraulic pressure switch	Yes
36**	Fault immediately after shift	Yes
37	Solenoid switch valve stuck in LU position	No
38	Lockup control	No
39*	Speed/Ratio error	Yes
41	LR solenoid circuit	Yes
42	2-4 solenoid circuit	Yes
43	OD solenoid circuit	Yes
44	UD solenoid circuit	Yes
45	Internal EATX controller	No
46	UD hydraulic circuit	No
47**	Solenoid switch valve stuck in LR position	Yes
50**	Speed/Ratio error in reverse	Yes
51**	Speed/Ratio error in 1st	Yes
52**	Speed/Ratio error in 2nd	Yes
53**	Speed/Ratio error in 3rd	Yes
54**	Speed/Ratio error in 4th	Yes
55**	Speed/Ratio error in neutral	Yes
56**	Turbine sensor error	Yes
57**	Output sensor error	Yes
58**	Sensor ground error	Yes
60**	Inadequate element volume in LR clutch	No
61**	Inadequate element volume in 2-4 clutch	No
62**	Inadequate element volume in OD clutch	No
63**	Inadequate element volume in UD clutch	No

* Early Controllers Only

** Late Controllers Only

Figure 67

A-604

Accumulators

Complaints of harsh, abrupt up-shifts, chattering just before stopping, and even chattering or squawking upon forward engagement can be caused by improperly installed underdrive and overdrive clutch accumulators. Use these pictures to assure correct accumulator piston and spring installation direction.

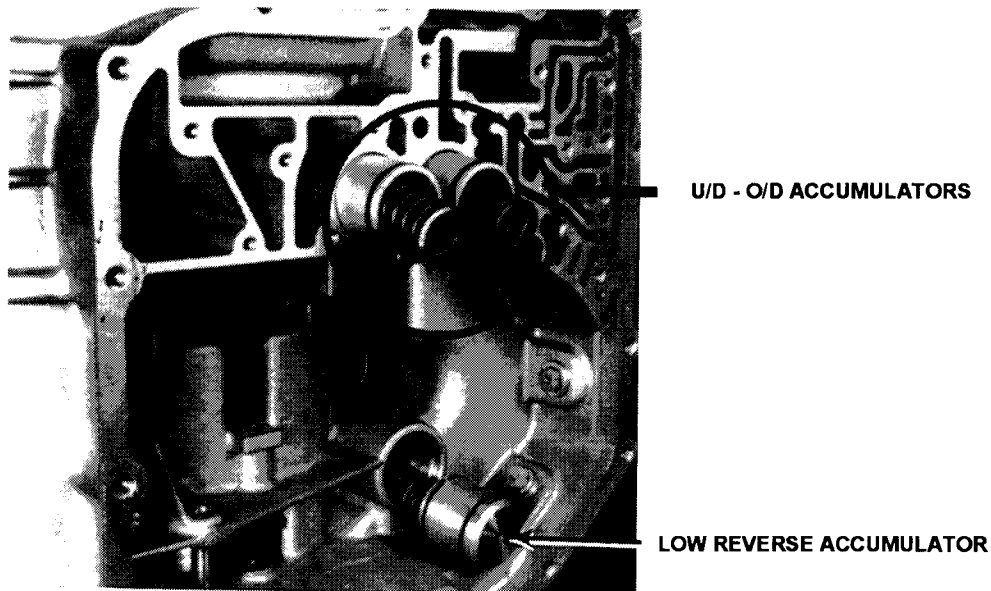
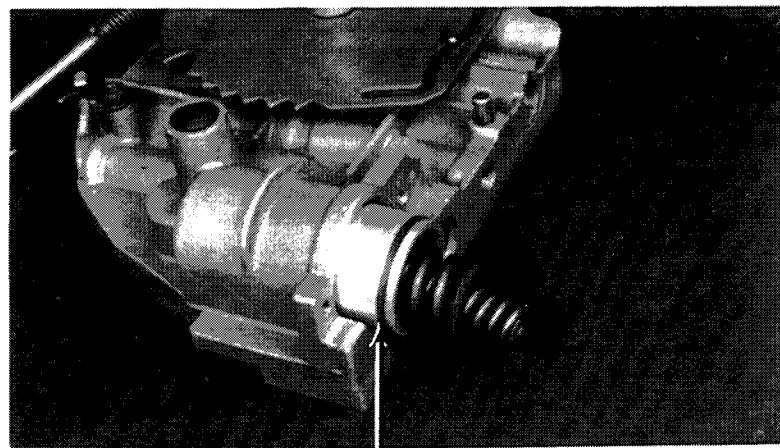


Figure 68



2-4 ACCUMULATOR

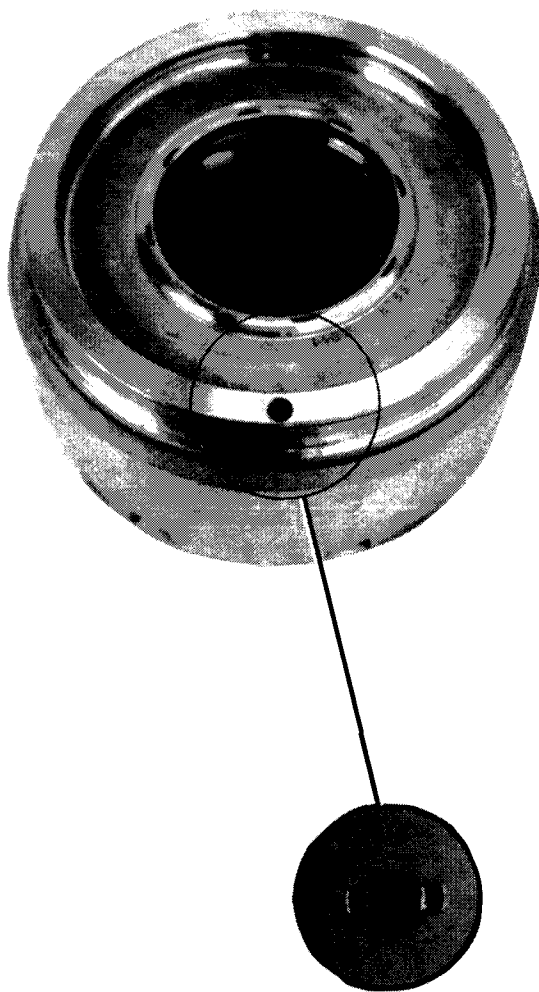
Figure 69

A-604

Burned Overdrive and/or Reverse Clutches

Burned overdrive and/or reverse clutches may be caused by the screened orifice being missing from the overdrive/reverse piston.

If the orifice is missing replace it with part #4531903 and stake it in place.



Chrysler

Figure 70

A-604

1989 to 1990 Update

In 1990 the input assembly was changed to increase the overdrive clutches from three lined plates and two steel plates to four lined plates and three steel plates. This required several parts to be modified. Refer to the component identification and the following figures.

CHANGES

1. **INPUT RETAINER** - Top ring groove moved down .040. The outer lip seal groove is .040 shallower. Figure 71.
2. **LIP SEAL** - Base section .040 smaller to fit shallower groove. Figure 72.
3. **TAPERED RING** - made .010 thinner.
4. Overdrive clutch thickness reduced to .072. Overdrive steel thickness reduced to .070.
5. Overdrive/underdrive reaction plate made thinner. This plate is selective and comes in four different sizes to adjust underdrive clutch clearance.
 - .215-.219 - #4723684*
 - .234-.238 - #4472683*
 - .253-.257 - #4723682*
 - .273-.277 - #4723681*

* These part numbers are for the second design late style plate. See page 59 for more information.

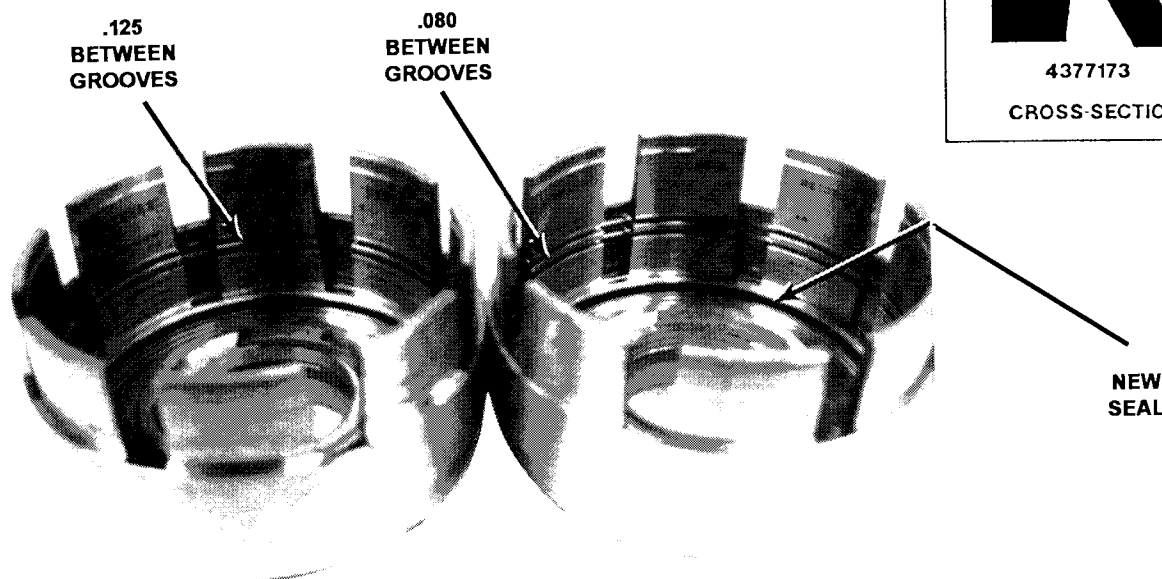


Figure 71

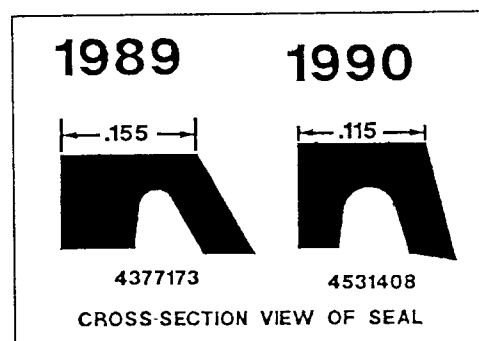


Figure 72

A-604

1990 - 1990 1/4 Update

In 1990 1/4 the A-604 input assembly was again updated. The changes involved the input clutch hub and o-rings, the overdrive/reverse piston, the overdrive/reverse pressure plate and the input clutch retainer.

1. **INPUT CLUTCH HUB** -- The grooves are wider to accept larger o-rings. The cross section of the o-rings that fit in these grooves is larger. Figure 73.
2. The overdrive/reverse piston now has 4 slots instead of 8 slots to make it stronger. Figure 74.
3. The overdrive/reverse pressure plate now has 4 lugs instead of 8 lugs to fit the new 4 slot piston. Figure 75.
4. The input clutch retainer has had the radius changed on the outer diameter to prevent lip seal damage during assembly. Figure 76.

#6502271 - .103 THICK BLUE O-RING

#6502269 - .103 THICK RED O-RING

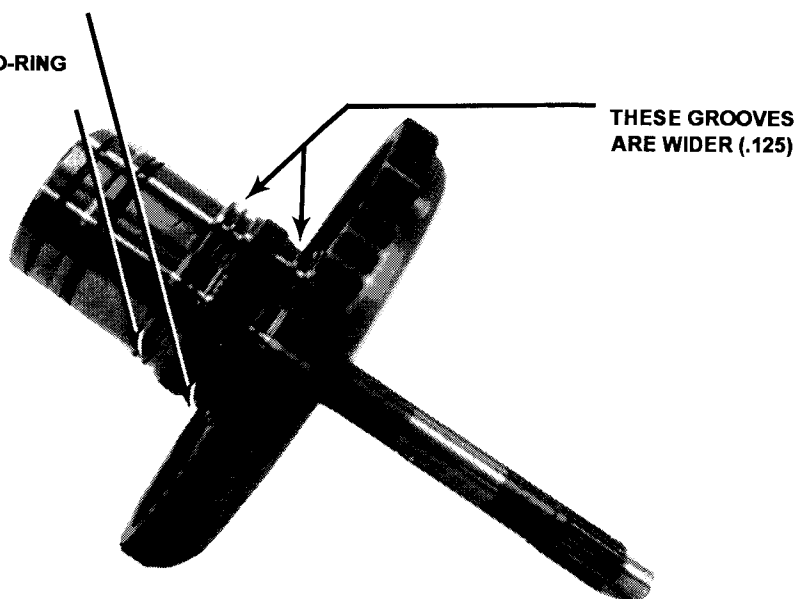
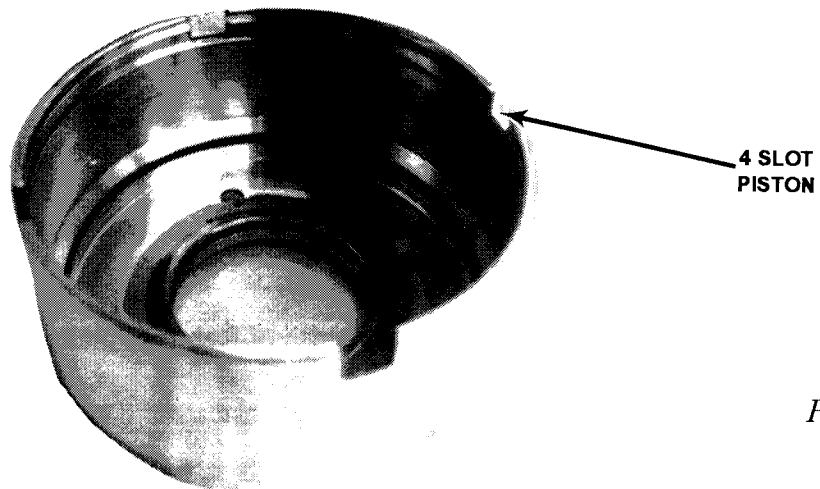
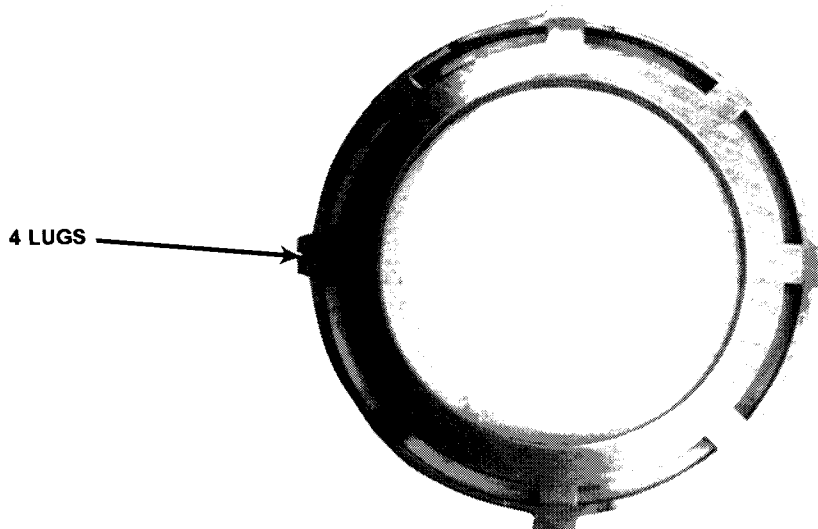
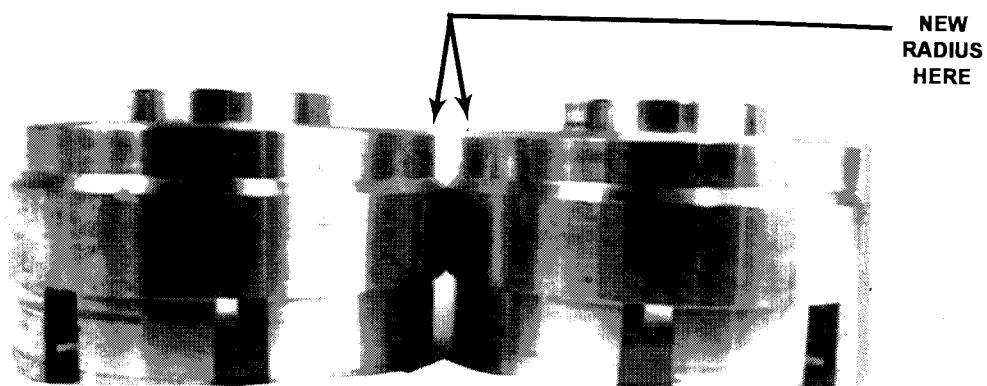


Figure 73

1990 - 1990 1/4 Update (Continued)*Figure 74**Figure 75**Figure 76*

A-604

Broken Tapered Snap Ring

A very common problem on 1990 and later A-604's is to find the tapered snap ring (in the input assembly) broken on teardown. At times you may experience a repeat failure due to snap ring breaking. An updated snap ring and underdrive/overdrive reaction plate is available to help prevent repeat breakage.

NOTES:

1. The new snap ring and reaction plate come packaged together.
2. The new snap ring and reaction plate can ONLY be installed in the late input retainer, with the "thin" area between the snap ring grooves. (See page 56 for input retainer information.)
3. The new reaction plate and snap ring must be used together.

The underdrive/overdrive reaction plate is selective to adjust underdrive clutch clearance.

Chrysler

SIZE

.215 - .219.....#4723684
.234 - .238.....#4723683
.253 - .257.....#4723682
.273 - .277.....#4723681

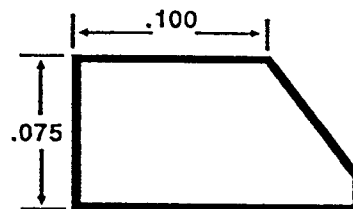
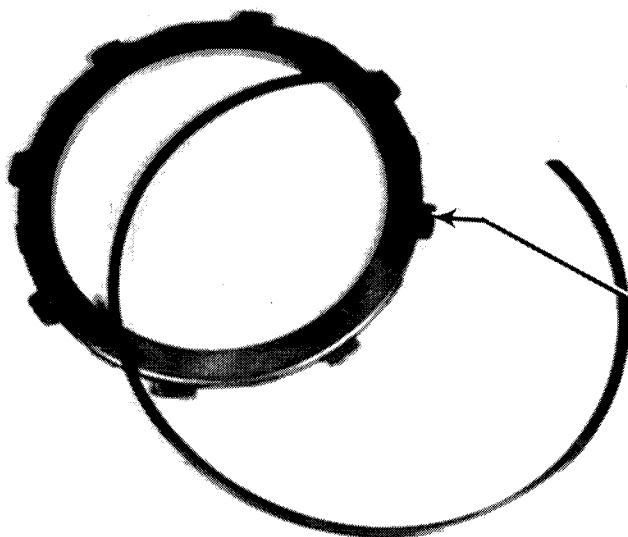


Figure 78



CROSS-SECTION VIEW OF NEW UNDERDRIVE/OVERDRIVE TAPERED SNAP RING

The new design tapered snap ring is slightly thicker (.015") than the previous 1990 design. The amount of taper has also been reduced to provide a sturdier ring.

The thickness of the lugs has been reduced to approximately .137" to make room for the new design snap ring.

Figure 77

A-604

Assorted Assembly Tips and Information

CLUTCH CLEARANCES

UNDERDRIVE CLUTCH CLEARANCE - .036-.058 Adjust with selective plate

O/D CLUTCH CLEARANCE - .042-.096 - No adjustment

REVERSE CLUTCH CLEARANCE - .042-.096 - Adjust with selective snap ring

L/R CLUTCH CLEARANCE - .042-.065 - Adjust with selective plate

2/4 CLUTCH CLEARANCE - .035-.050 - No adjustment

2/4/L/R ASSEMBLY INFORMATION

2/4 and L/R plates look the same but:

2/4 clutches are .085 thick

2/4 steels are .100 thick

L/R clutches are .070 thick

L/R steels are .070 thick

The Low/Reverse reaction plate goes "step down" on assembly.

TRANSAXLE END PLAY

Transaxle end play - .005-.015 #4 washer is selective

TURBINE SHAFT

There are 2 different turbine shaft spline counts - 22 spline - 2.5L engines
24 spline - 3.0 & 3.3 engines

AVAILABLE GEAR RATIOS

OUTPUT SHAFT GEAR	TRANSFER SHAFT GEAR	TRANSFER SHAFT	RING GEAR	OVERALL GEAR RATIO
55 Teeth	58 Teeth	17 Teeth	59 Teeth	2.52
55 Teeth	58 Teeth	16 Teeth	60 Teeth	2.72
59 Teeth	54 Teeth	16 Teeth	60 Teeth	2.36

A-604

Part Numbers

1989 PART NUMBERS

5241088 - EARLY 1989 UPDATE KIT
4431609 - LATE 1989 INPUT RETAINER
6502272 - LATE 1989 INPUT HUB ORANGE O-RING - .070
6502270 - LATE 1989 INPUT HUB GREEN O-RING - .070
4412875 - NEW INPUT HUB AND OVERDRIVE/REVERSE PISTON SEAL (FF CODE)

1990 PART NUMBERS

4505629 - O/D CLUTCH PLATES
4377183 - O/D STEEL PLATES
4505623 - 1990 INPUT CLUTCH RETAINER
4531408 - UNDERDRIVE CLUTCH OUTER SEAL (.115 BASE)

1990 MODEL OVERDRIVE/UNDERDRIVE REACTION PLATES - 2nd DESIGN

.215-.219 - THICK	4723684*
.234-.238 - THICK	4723683*
.253-.257 - THICK	4723682*
.273-.277 - THICK	4723681*

* These are 2nd design 1990 plates. See page 59 for details.

1990 1/4 PART NUMBERS

4566310 - 4 SLOT PISTON & PRESSURE PLATE
6502271 - 1990 1/4 BLUE .103 O-RING
6502269 - 1990 1/4 RED .103 O-RING
4531637 - 1990 1/4 INPUT CLUTCH HUB

MISCELLANEOUS

4531903 - OVERDRIVE/REVERSE PISTON SCREENED ORIFICE
4505579 - 22 SPLINE INPUT SHAFT
4412210 - 24 SPLINE INPUT SHAFT

A-500/A-518

Unit Overview/Component Application Chart

The A-500 is basically a TF6 with an overdrive section built into the extension housing. Overdrive and lock-up are controlled by solenoids which are actuated by the computer. An electrical connector has been added to the left rear area of the case as well as an overdrive pressure tap. (Figure 80) The TF6 3-speed valve body was modified to accept a new additional auxiliary valve body which contains the 3-4 shift control valves, lock-up valves and solenoids.

The A-518 is an overdrive version of the TF8. The A-518 is basically the same as described above except it was not available with a converter clutch until the 1992 model year. The A-518 overdrive section contains more overdrive and direct clutches than the A-500.

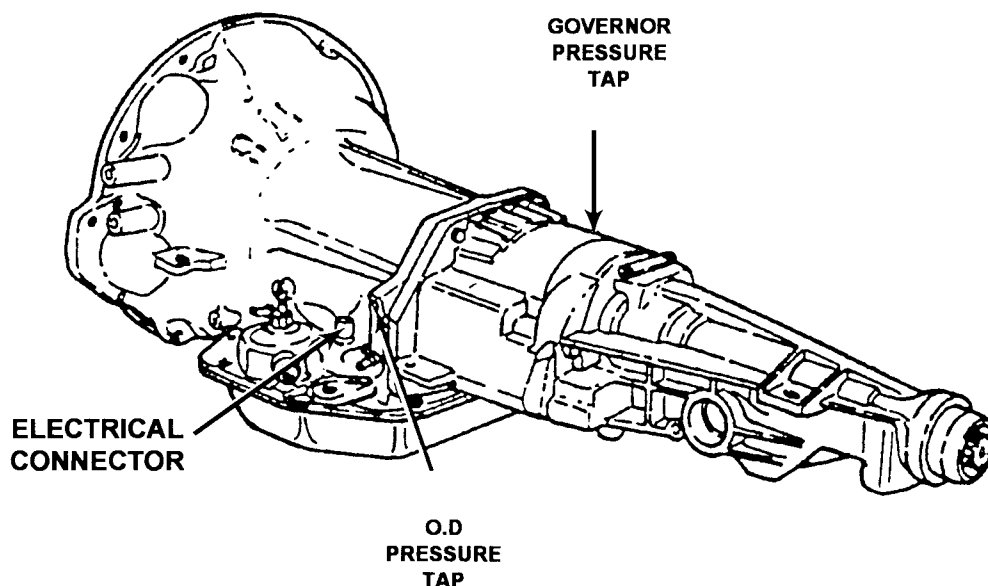


Figure 80

COMPONENT APPLICATION CHART

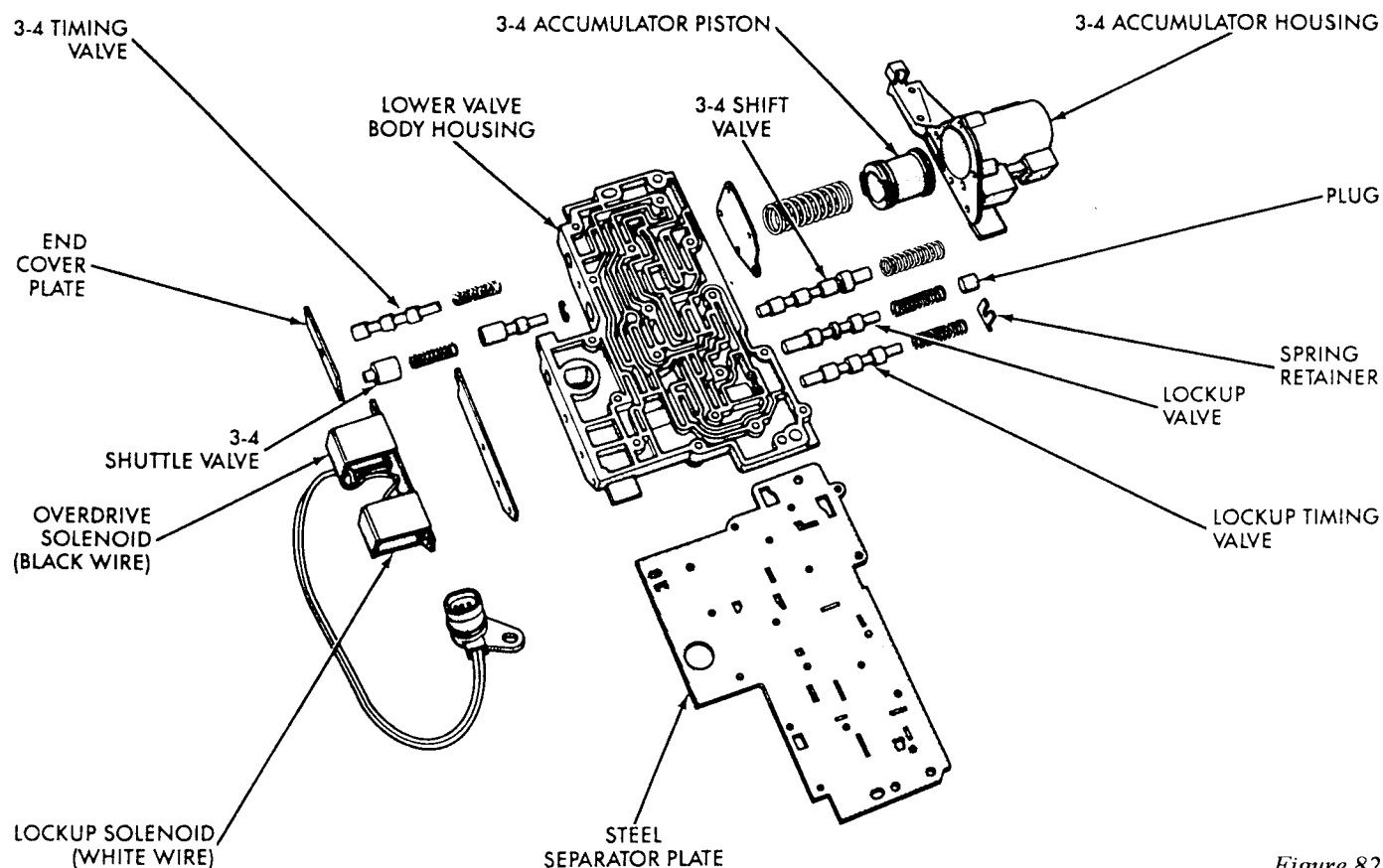
LEVER POSITION	GEAR RATIO	TRANSMISSION						OVERDRIVE		
		CLUTCHES				BANDS		CLUTCHES		
		FRONT	REAR	O'RUNNING	LOCKUP	K/D FRONT	REVERSE/REAR	O/D	O'RUNNING	DIRECT
P-Park										
R-Reverse	2.21	X					X			X
O-Drive										
First	2.74		X	X					X	X
Second	1.54		X			X			X	X
Third	1.00	X	X		X				X	X
O/D	.69	X	X		X			X		
2-Second										
First	2.74		X	X					X	X
Second	1.54		X			X			X	X
1-Low	2.74		X	X			X		X	X

Figure 81

A-500/A-518

Overdrive Hydraulic/Electronics

The new lower valve body is attached to a modified three speed valve body. Be aware that many valve body illustrations show the 3-4 timing valve backwards. The picture below shows the proper position.



Chrysler

Figure 82

The case connector as viewed from the top:

1. "Black", O.D., solenoid wire faces case front
2. "Red", +, common to both solenoids
3. "White", TCC, solenoid wire faces rear

RESISTANCE TEST:

Pins 1 to 2 = 30-32 Ω

Pins 2 to 3 = 30-32 Ω

ground to any pin = infinity

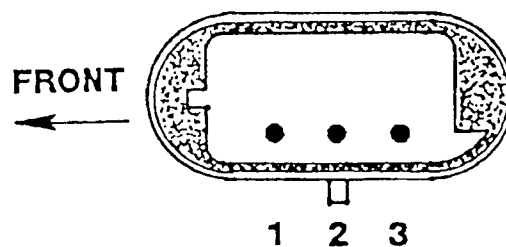


Figure 83

A500/A-518

Burnt Overdrive Clutches

Burnt overdrive clutches may be caused by a missing screened orifice located in the intermediate shaft support.

A new orifice is available from Chrysler under part #4412583.

When installing the orifice be sure to stake it in place. Early 1989 units did not have the orifice staked in place from the factory. Beginning in mid-1989 the factory started staking the orifice and as a result they are less likely to blow out.

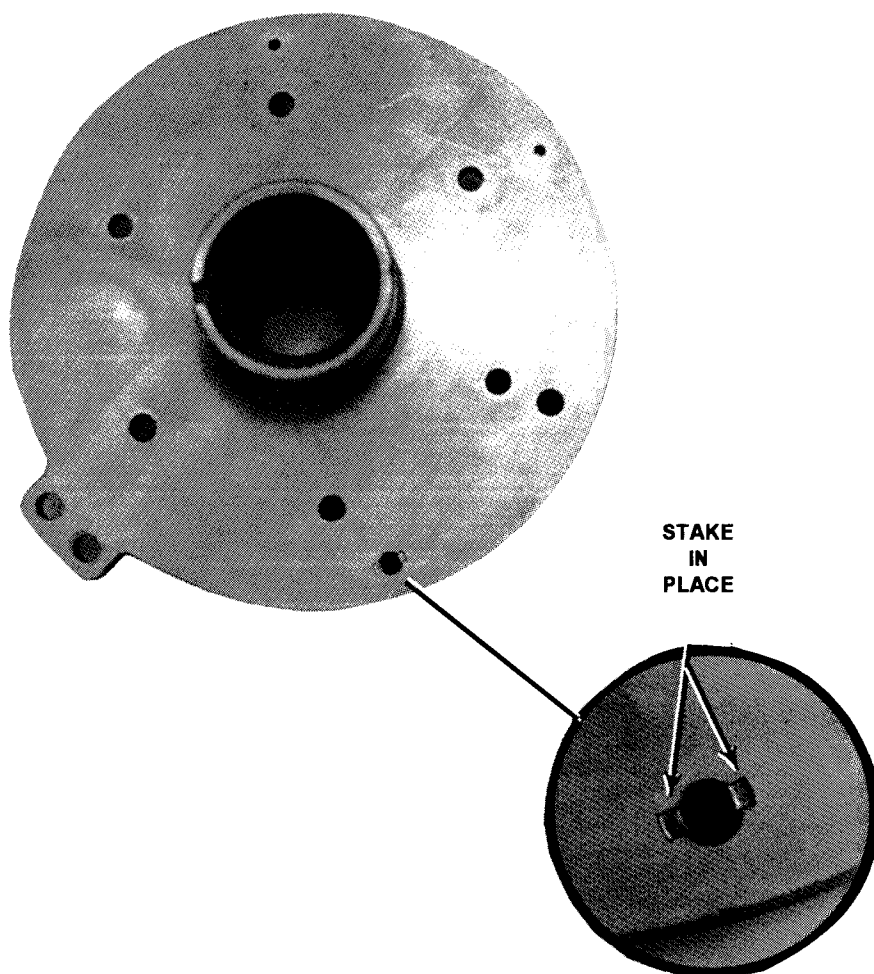


Figure 84

A500/A-518

Overdrive Planetary and Bearing Failure

To help prevent overdrive planetary and bearing failure, file a 45 degree chamfer on the inside edge of the planetary. The factory began chamfering all planetaries in late 89. Most replacements are chamfered but check all of them to be sure. Figure 85. Replace the bearing and thrust plate. See page 66.

**FILE 45 DEGREE
CHAMFER .050 WIDE**

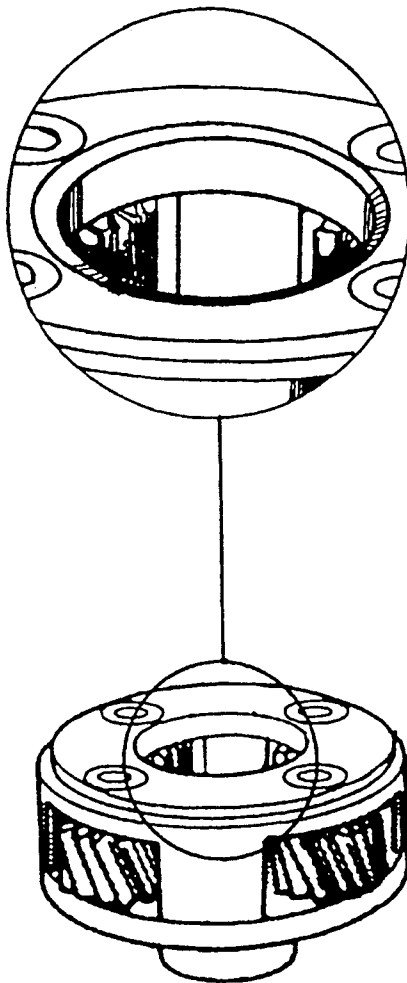
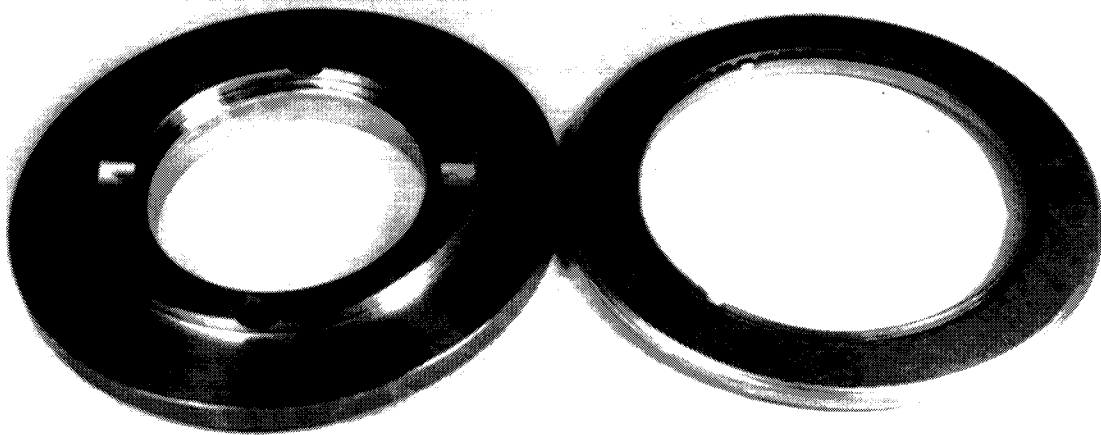


Figure 85

Overdrive Planetary and Bearing Failure (Continued)

There is a 3rd design thrust plate and bearing which is much more durable than the previous designs. The bearing is much larger, and the thrust plate has a step machined into it to locate the bearing. It is highly recommended that you update to the new bearing and thrust plate for the vastly increased durability it provides.

NEW BEARING AND THRUST PLATE ————— PART #4740774



**NEW DESIGN THRUST
PLATE AND BEARING**

A-500/A-518

Overdrive Assembly Tips

DIRECT CLUTCH ASSEMBLY

There are three different direct clutch combinations possible for the A-500/A-518. The only reliable way to determine direct clutch count is the snap ring groove height.

Attempting to determine direct clutch count based on year, application, engine size, etc., will not be successful!

Measure the distance from the snap ring groove to the top edge of the drum (as shown below) to determine direct clutch count.

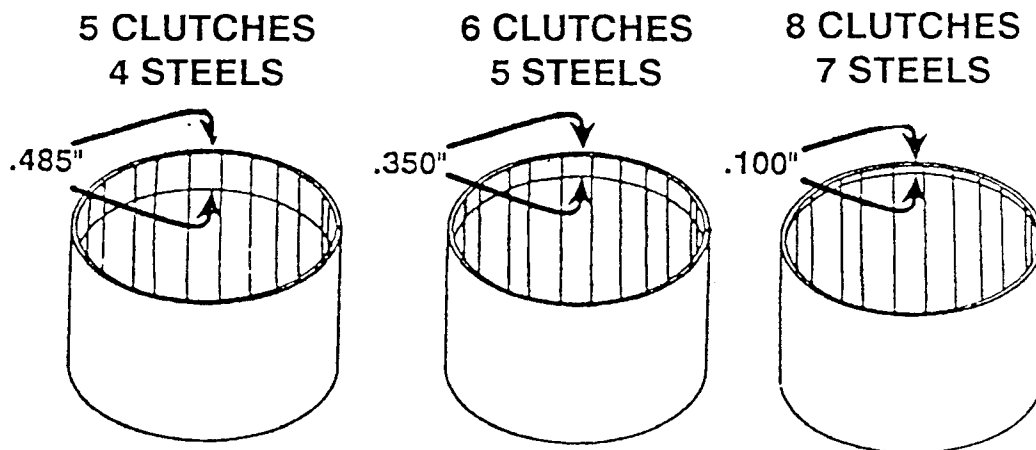


Figure 87

The 5 clutch direct pack was used for early production on A-500's only. All A-500's were updated to the 6 clutch direct pack. If you have an early A-500 with a 5 clutch pack, it is advisable to update to a 6 clutch pack drum (part #4461040).

All A-518 units come with an 8 clutch direct pack.

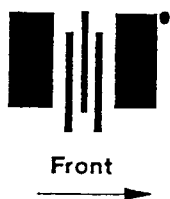
If you want to beef-up an A-500 for a heavy duty application, you can upgrade to an A-518, 8 clutch drum (part #4461089).

Overdrive Assembly Tips (Continued)

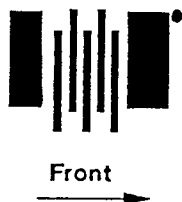
Overdrive Clutch Assembly

There are four different overdrive clutch combinations available. The first version, with only two clutch discs was up-dated to a three clutch version shortly after production began.

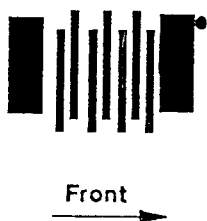
NOTE: It is advisable to update a two clutch version to three clutches whenever you encounter one.



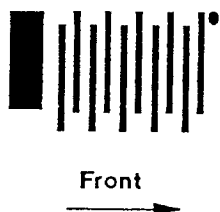
A500: Thick reaction plate
2 clutches, 1 steel
Thick apply plate
Round wire snap ring



A500: Thin reaction plate goes first
3 clutches, 2 steels
Thick apply plate
Round wire snap ring



A518: Except 1992 and later Diesel:
Thin reaction plate goes first
4 clutches, 3 steels
Thin apply plate, (Same as thin reaction plate.)
Round wire snap ring



A518: 1992 and later diesel:
Thin reaction plate goes first
5 clutches, 5 steels
Round wire snap ring
(The last steel acts as the apply plate.)

Overdrive Assembly Tips (Continued)

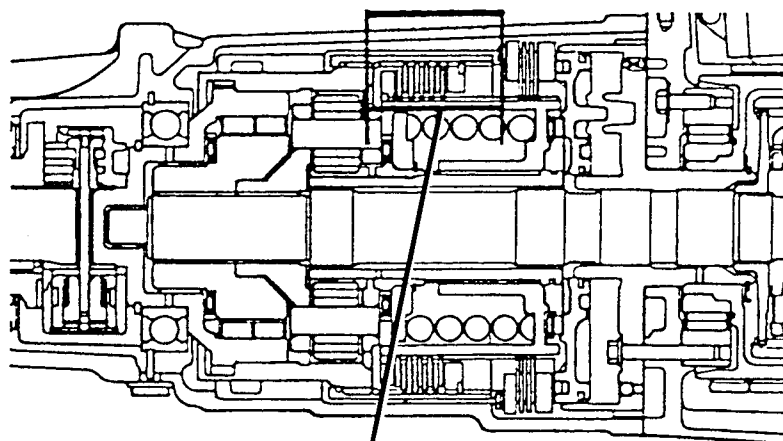
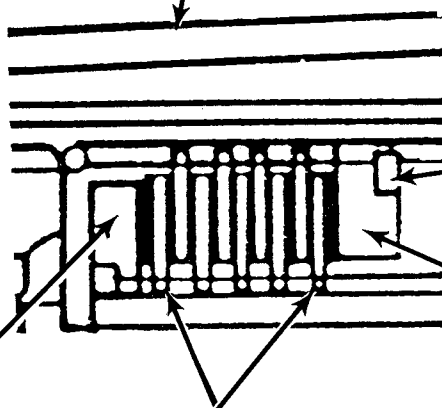


Figure 89

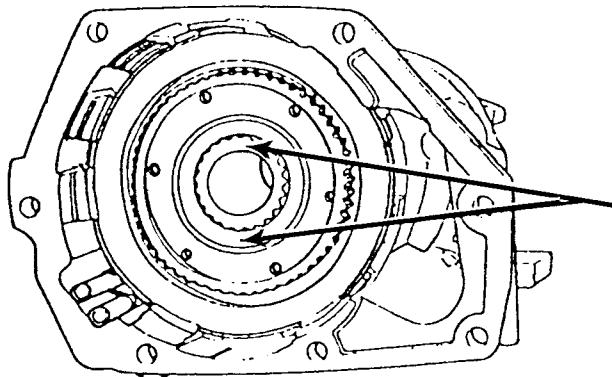
This is the bottom pressure plate. It has a step on the INNER edge. This step goes down during assembly, and stops against the teeth on the end of the sliding hub.



This waved snap ring holds the pack in the drum. The location of this groove determines how many plates in the pack.

This is the top pressure plate. It has a step on the OUTER edge. This step goes up during assembly, to make room for the snap ring.

Make certain that a clutch, not a steel, rides against both pressure plates.



SUN GEAR should be within 1/16" - 1/8" flush with sliding hub hole after assembly of direct clutch.

Figure 90

To make certain you've matched up your direct clutch count correctly with your direct drum, just be sure that after you install the top snap ring in the direct drum and release the clutch from the press that the top end of the sun gear is within 1/16" - 1/8" flush with the top of the sliding hub hole.

A-500/A-518

3-4 Flare/4-3 Flare

Rattle Noise On 3-4/4-3 Shift

A 3-4 and/or a 4-3 flare may be caused by a defective overdrive roller clutch. The same symptoms can occur after overhaul if the roller clutch is installed backwards.

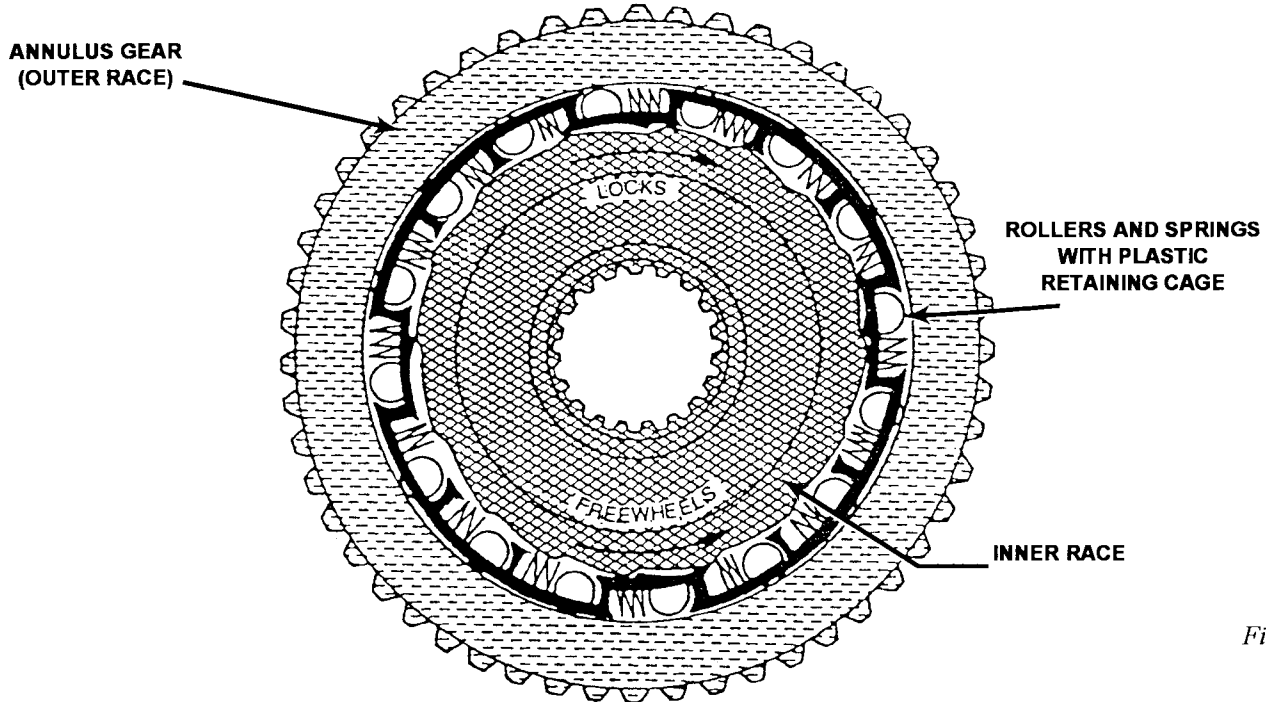


Figure 91

RATTLE NOISE ON 3-4 SHIFT

A rattle noise during the 3-4 upshift or 4-3 downshift may be caused by the overdrive friction plates rattling the steels against the case. Chrysler has made available smooth overdrive friction plates to address this concern.

SMOOTH OVERDRIVE CLUTCHES ——— 1 PER PACKAGE.....PART #4461162

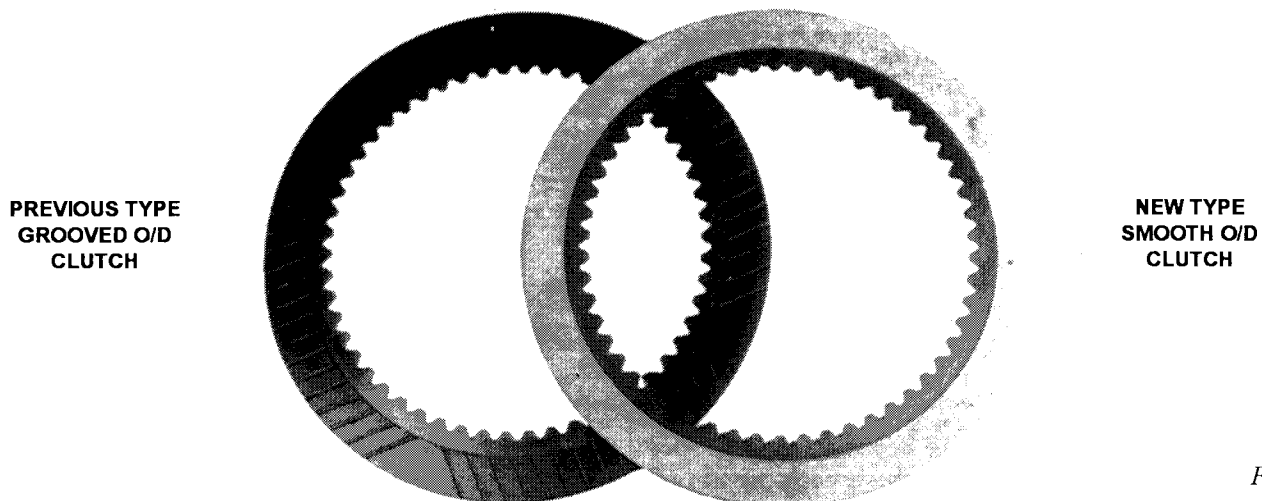


Figure 92

A-500/A-518

No 4th Gear

No 4th gear in an A-500/A-518 may be caused by improper snap ring installation. If either the "flat" snap ring or "waved" snap ring is installed in front (on top) of the overdrive clutch pack the overdrive piston will bottom on the snap ring, instead of applying the overdrive clutches.

Refer to the following figures for proper assembly.

1. Install flat snap ring first.
2. Install the waved snap ring on top of the flat ring in the same groove.
Figure 93.

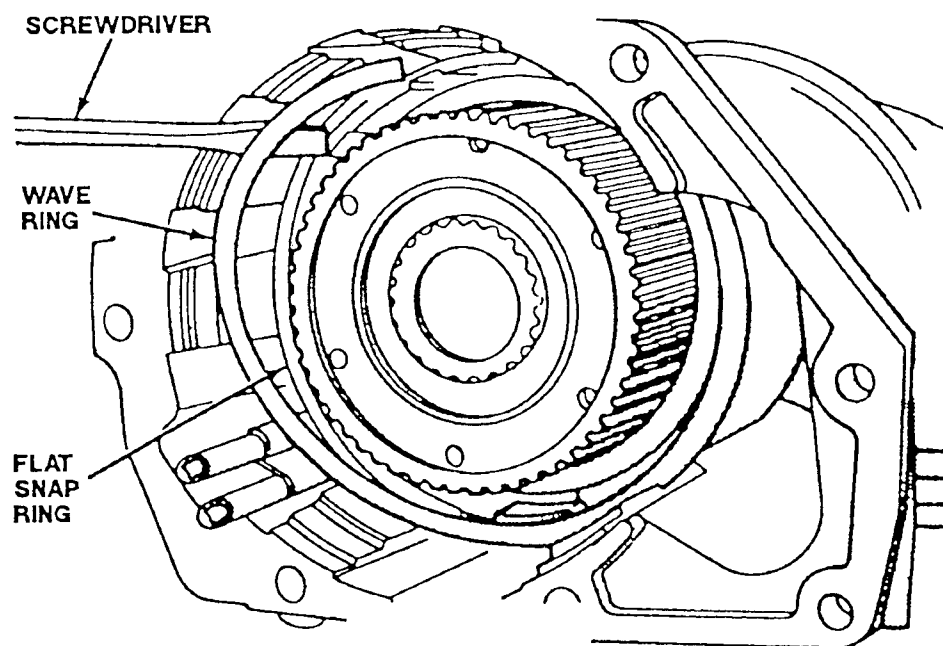


Figure 93

No 4th Gear (Continued)

3. Install the overdrive clutch pack. See pages 69 and 70 for overdrive clutch information.
4. Install the "wire" snap ring on top of the overdrive clutch pack. Figure 95.
5. Make sure to measure for proper thrust plate selection. See next page.

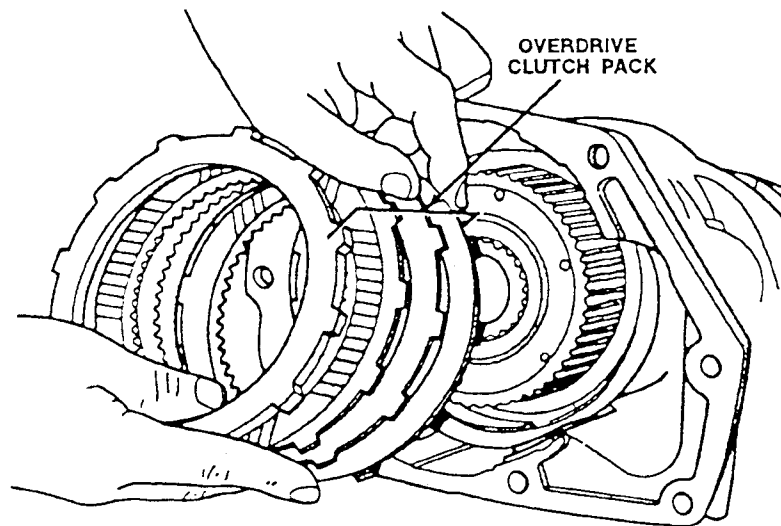


Figure 94

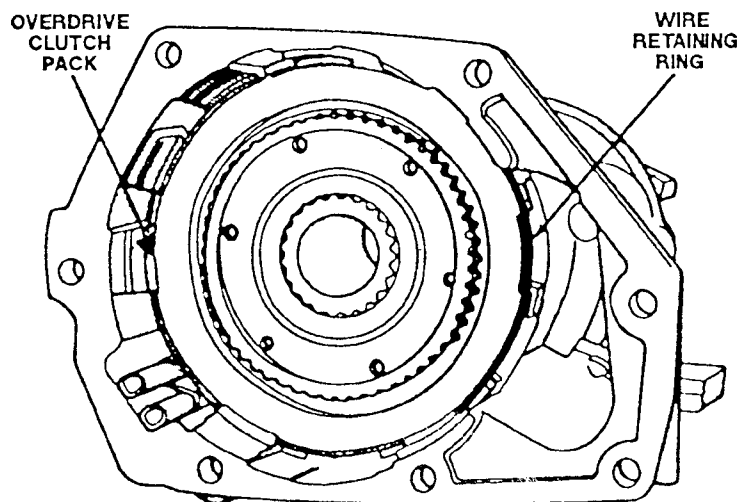


Figure 95

A-500/A-518

Thrust Plate Selection Procedure

Proper thrust plate selection is very important to prevent 3-4 bind-up, slipping in reverse, and no "engine braking". Use this method to choose the proper thrust plate thickness.

- STEP 1** Assemble entire overdrive section.
- STEP 2** Support extension housing upright in a vise or holding fixture.
- STEP 3** Lay a suitable straight-edge across the extension housing gasket surface.
- STEP 4** Using a depth micrometer or a vernier caliper, measure the distance to the sliding hub bearing seat, **WITH THE BEARING REMOVED**. Figure 96.
- STEP 5** Measure in 4 places, 90 degrees apart.
- STEP 6** Add all 4 measurements together, then divide this number by 4. This is the **AVERAGE MEASUREMENT**.
- STEP 7** Measure the thickness of the straight-edge, and subtract this amount from the **AVERAGE MEASUREMENT**.
- STEP 8** Refer to the chart for selection. Figure 97.

EXAMPLE

<i>Measurement</i>	1	1.491	
	2	1.488	
	3	1.492	
	4	<u>1.489</u>	
	Total = 5.960		
	Divide by <u>4</u>		
	= 1.490	→	(AVERAGE MEASUREMENT)
	Minus - <u>.158</u>	→	(STRAIGHT-EDGE THICKNESS)
	<u>1.332</u>	→	Compare this number to the chart for proper thrust plate selection.

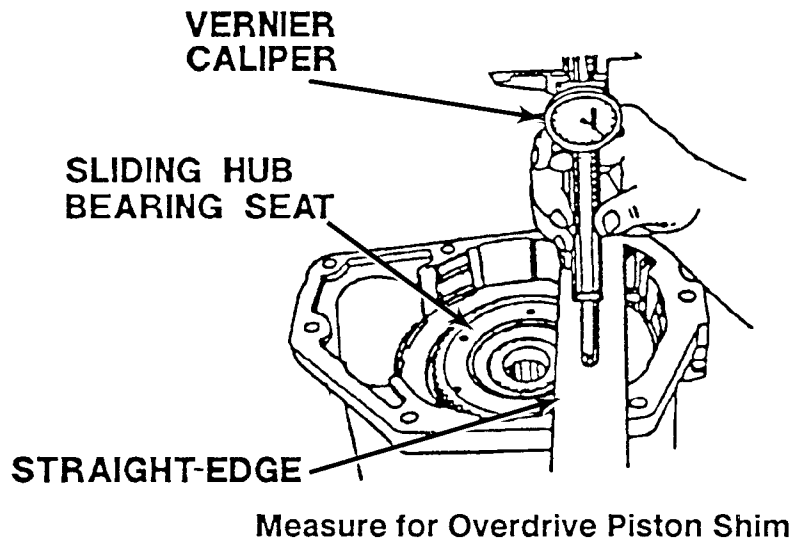
Thrust Plate Selection Procedure (Continued)

Figure 96

MEASUREMENT (INCHES)	SPACER PART NUMBER	SPACER THICKNESS (INCHES)
1.250 - 1.264	4431730	.108-.110
1.265 - 1.279	4431585	.123-.125
1.280 - 1.294	4431731	.138-.140
1.295 - 1.309	4431586	.153-.155
1.310 - 1.324	4431732	.168-.170
1.325 - 1.339	4431587	.183-.185
1.340 - 1.354	4431733	.198-.200
1.355 - 1.369	4431588	.213-.215
1.370 - 1.384	4431734	.228-.230
1.385 - 1.399	4431590	.243-.245

In this example our thrust plate selection would be part #4431587, which is .183-.185 thick.

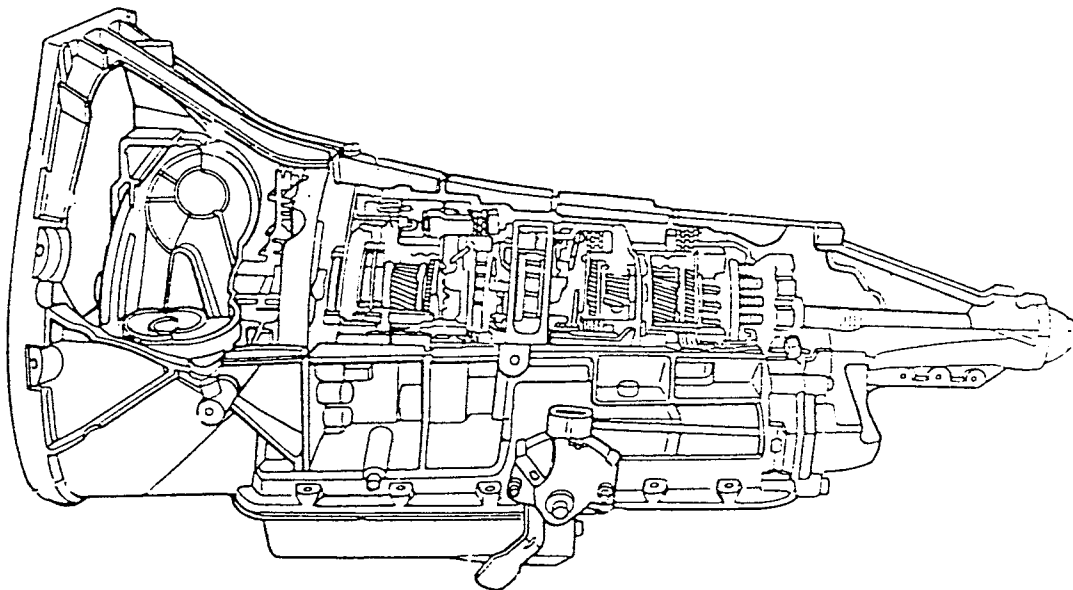
Figure 97

Notes

Notes

Ford

Ford



A4LD

No 4th Gear

Two Solenoid Models

There are several conditions which may create no 4th gear. Use the following step by step procedure to isolate the problem.

SECTION 1

MECHANICAL:

Drive the vehicle on a lift at a speed which should make the transmission shift to 4th (at least 45 mph). Loosen the overdrive band lock-nut and try to turn the band adjustment bolt.

The band adjustment bolt won't turn:

The overdrive band is applied. You have a mechanical problem. e.g., broken O.D. planet, stripped sun gear splines etc.

The band adjustment bolt turns easily:

The overdrive band is not applied. Tighten the overdrive band, this should cause the drive wheels to increase in speed. This will confirm that mechanically, the overdrive section of the transmission works.

SECTION 2

ELECTRICAL:

Using a high impedance test light, probe the wire harness going to pin #2, (the center wire) for 12V. (See Figure 98) If there's no power, you have an external electrical problem. Make sure the trans works by peeling some insulation from the wire, and using a 10 amp fused jumper wire supply 12V to the center wire, and check for 4th gear.

If you have 12V at the center wire, probe the front wire at an idle in drive. The test light should light. If not, the solenoid is bad or miswired. If the light comes on, accelerate on the lift to 60 MPH with the engine at operating temperature. Light should go out. If your test light goes out, your problem is inside the unit. If your test light doesn't go out, the computer is not grounding the solenoid. Try jumping the front wire to ground with the gear shift in O/D and vehicle speed approximately 60 MPH. If an upshift to 4th occurs when you jump #1 terminal to ground, and external vehicle electronic problem exists.

VIEW LOOKING INTO CASE CONNECTOR

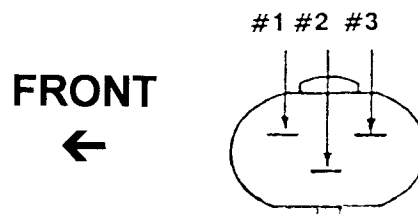


Figure 98

No 4th Gear (Continued) Two Solenoid Models

SECTION 3

VALVE BODY AND SOLENOIDS:

1. Replace the 3-4 shift solenoid with the new design Part #E8TZ-7M107A.
2. Verify that there is no checkball installed in the bathtub in the valve body (Figure 99.)
3. Flat file the case and valve body to eliminate warpage.
4. Torque the valve body to a maximum of 70 in. lbs.

NOTE: If for some reason you are forced to use an early design 3-4 solenoid, at least remove the screen from the aluminum sleeve.

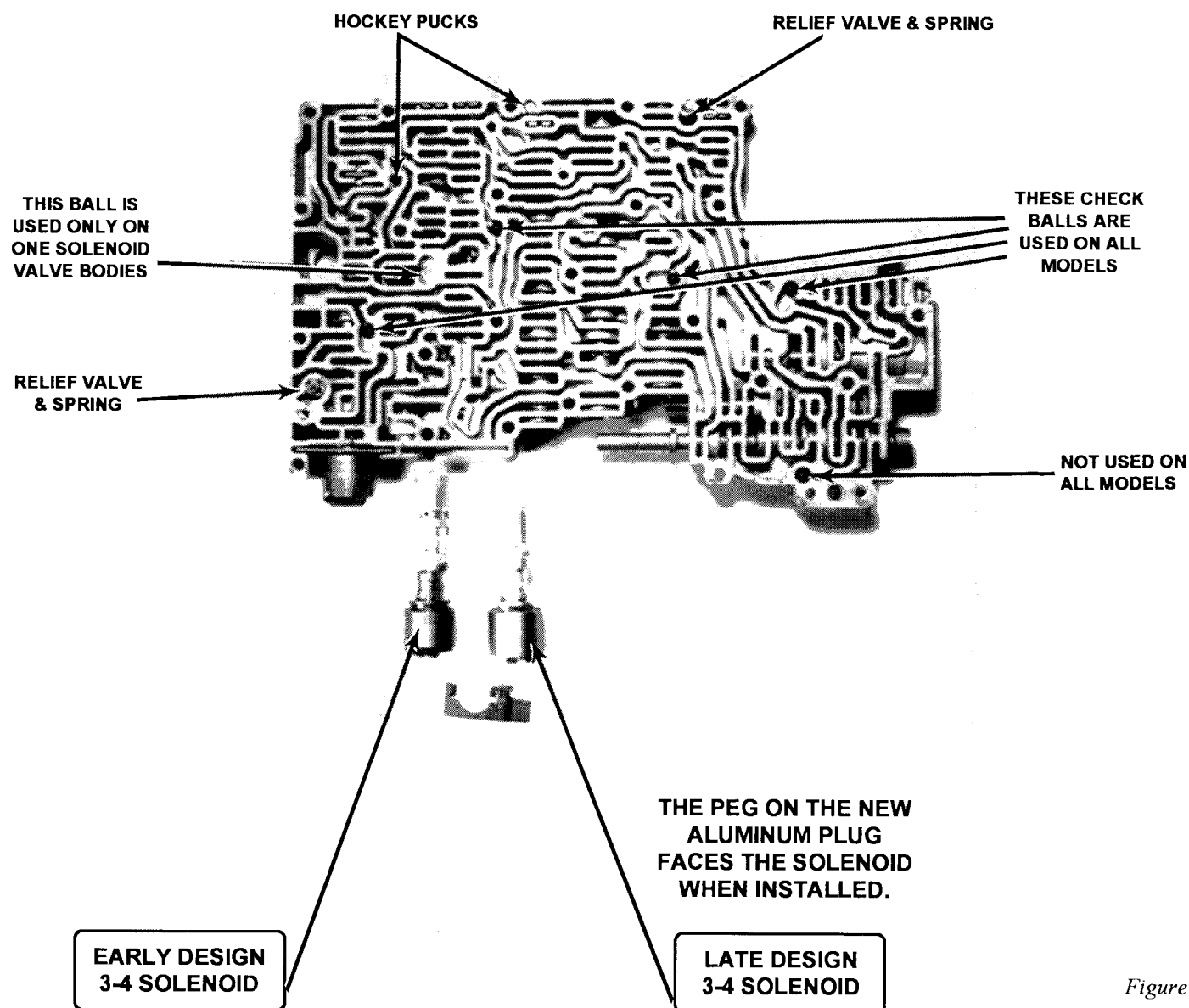


Figure 99

A4LD

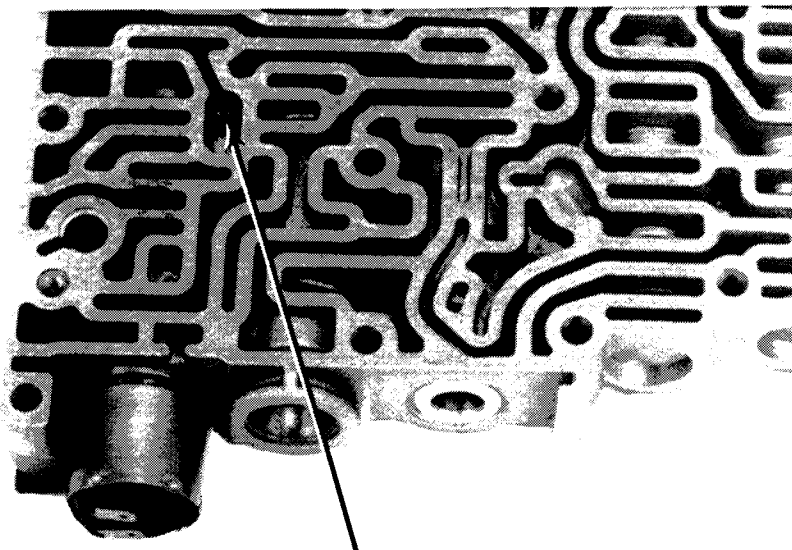
Lugs The Engine When Coming To A Stop (The Torque Converter Clutch Won't Release)

If you have an A4LD that lugs the engine when coming to a stop, you may have a TCC release problem. Use the following steps to correct it.

STEP 1 Disconnect the lock-up cancel solenoid wires.

The converter clutch should not apply with the wires disconnected. If it does apply, go to Step 2. If it does not apply, check for a shorted ground wire or a computer malfunction.

STEP 2 Make sure the check ball in Figure 100 is installed.



MAKE SURE THIS CHECK BALL IS INSTALLED.

Figure 100

Lugs The Engine When Coming To A Stop (Continued)

STEP 3

Make sure the solenoid isn't stuck.

With the solenoid de-energized, apply air in the end, (Figure 101) air should come out of hole "B". With the solenoid energized, air should come out of hole "A".

NOTE: It is best to replace the solenoid. The new high flow solenoid part number is E5TZ-7F037A.

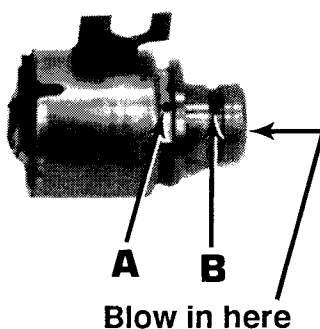


Figure 101

STEP 4

Enlarge the solenoid feed hole in the separator plate.

Enlarge the solenoid feed to 1/16" (Figure 102). If you have a separator plate with a screen in the feed hole, leave the hole alone, just make sure the screen is clean.

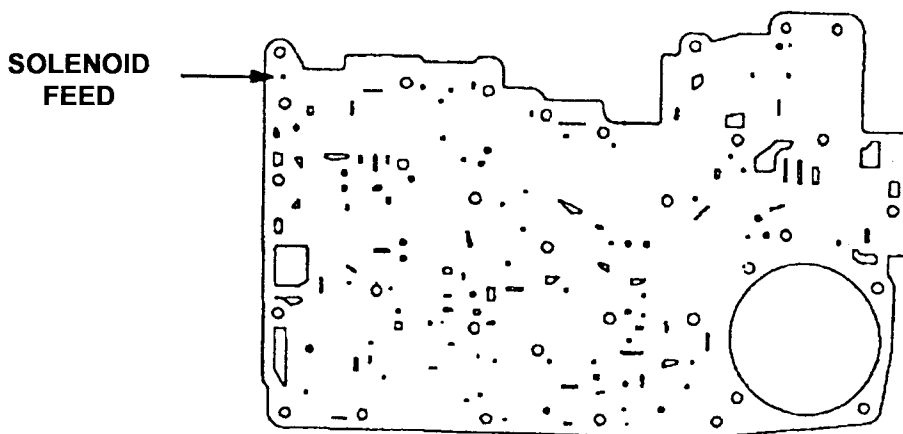


Figure 102

Lugs The Engine When Coming To A Stop (Continued)

STEP 5 Make sure the valve body is flat. This is an extremely common problem.

Flat file the valve body to get rid of any high spots.

STEP 6 Replace the shuttle valve spring.

Replace the shuttle valve spring with a spring that weighs 6 pounds at .500". Figure 103.

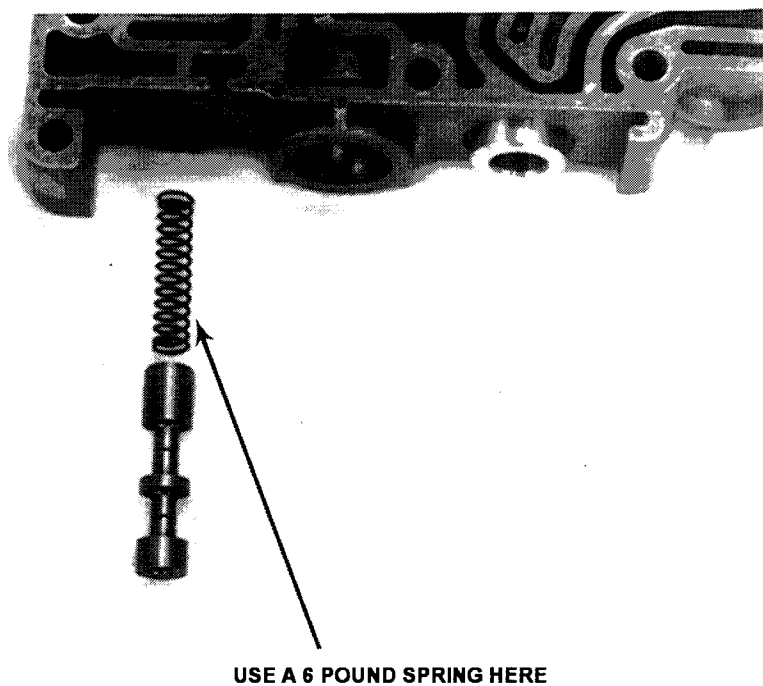


Figure 103

AXODE

Electrical Information

The AXODE is a fully electronically controlled transaxle. All automatic upshifts, downshifts, converter clutch applications, and line pressure control are achieved by activating solenoids. The following pages show the procedures and specifications for internal transaxle electrical component testing.

TOP CASE CONNECTOR PIN IDENTIFICATION

1. EPC solenoid power
2. EPC solenoid ground
3. TOT sensor
4. TOT sensor
5. LU solenoid power
6. LU solenoid ground

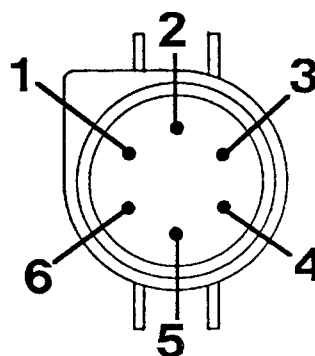


Figure 104

COMPONENT	OHMMETER LEADS BETWEEN TERMINALS	RESISTANCE SHOULD BE	
EPC SOLENOID	1 & 2	3.25 - 5.5 ohms	
LOCK-UP SOLENOID	5 & 6	91 CONTINENTAL AND ALL 92 MODELS .75 - 2 ohms 91 TAURUS & SABLE 21 - 36 ohms	
TOT SENSOR	3 & 4	TRANSMISSION FLUID TEMPERATURE	
		°F	RESISTANCE
		32-58	100K-37K
		59-104	37K-16K
		105-158	16K-5K
		159-194	5K-2.7K
		195-230	2.7K-1.5K
		231-266	1.5K-0.8K

Figure 105

Electrical Information (Continued)**SIDE CASE CONNECTOR PIN IDENTIFICATION**

1. Power to Solenoid #1
2. Ground to Solenoid #1
3. Power to Solenoid #2
4. Ground to Solenoid #2
5. Power to Solenoid #3
6. Ground to Solenoid #3

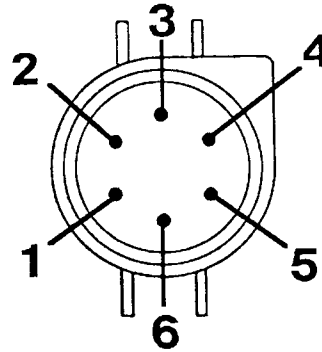


Figure 106

COMPONENT	OHMMETER LEADS BETWEEN TERMINALS	RESISTANCE
Solenoid #1	1 & 2	15 - 25 ohms
Solenoid #2	3 & 4	15 - 25 ohms
Solenoid #3	5 & 6	15 - 25 ohms

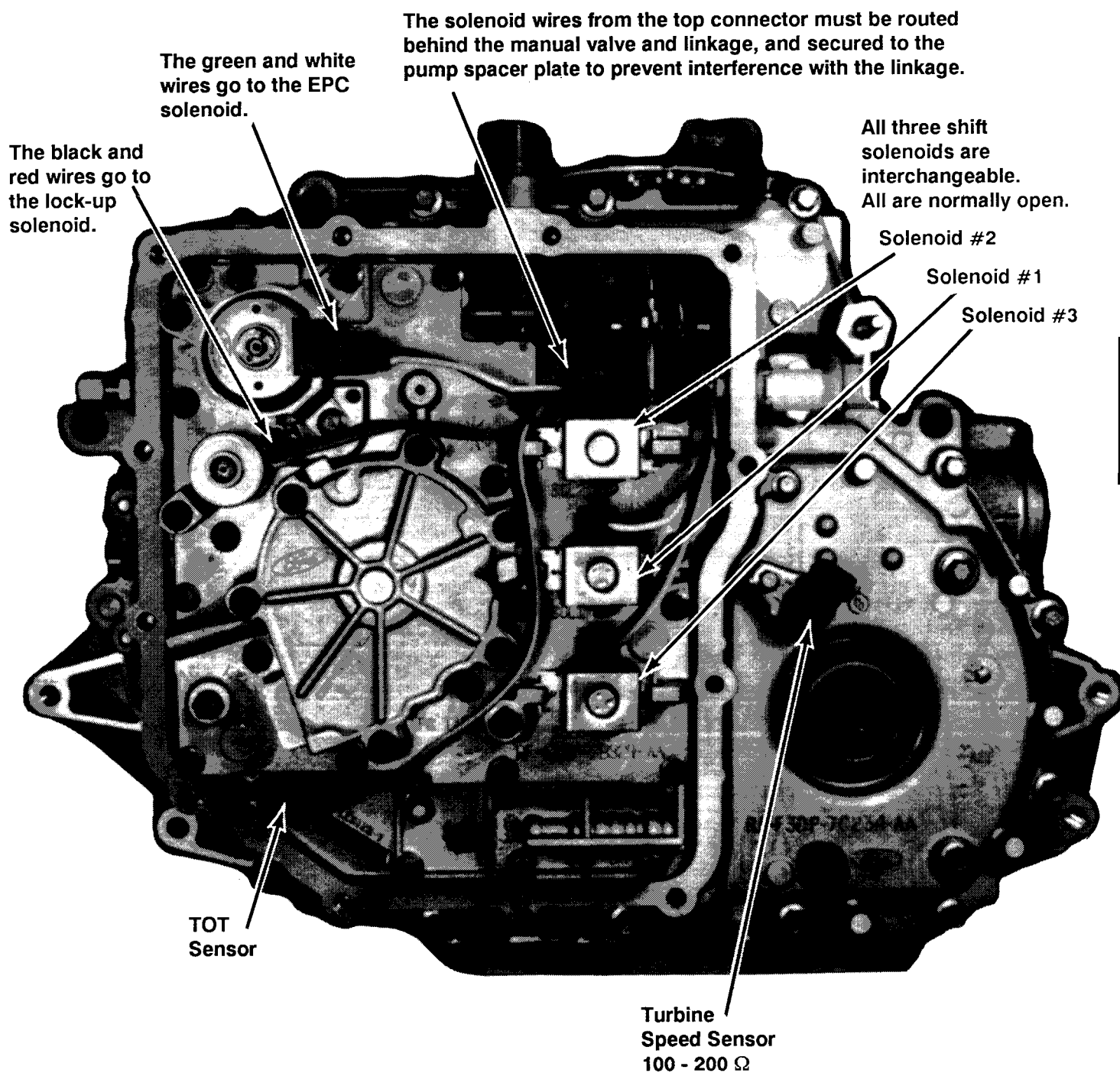
Figure 107

SOLENOID APPLICATION CHART

PRNDL	GEAR	SS1	SS2	SS3
D	1	OFF	ON	OFF
	2	ON	ON	OFF
	3	OFF	OFF	ON
	4	ON	OFF	ON

Figure 108

Electrical Information (Continued)



Ford

Figure 109

AXODE

Checkball Locations

1991 AXODE's were made with either 4 or 5 checkballs in the pump. All 1992 and 1993 models have 4 checkballs in the pump. All 1991 and 1992 valve bodies have 7 checkballs. All 1993 valve bodies have 6 checkballs.

To determine if a 1991 model should use 4 or 5 checkballs, look at the spacer plate. Figure 110. If you have 2 holes in the bathtub shown below, then use the 5 checkball arrangement shown in Figure 111. If there is only one hole in the bathtub, use the 4 checkball arrangement in Figure 112.

All 1992 and 1993 models use 4 checkballs as shown in Figure 113.

CAUTION: Even though late 1991's and 1992's both have 4 balls, the placement is different between the years. Be sure to install the balls in the proper locations for the model year you are working on. If dimension "A" is 4.085" install the balls as shown in Figure 112. If it is 3.995" install the balls as shown in Figure 113.

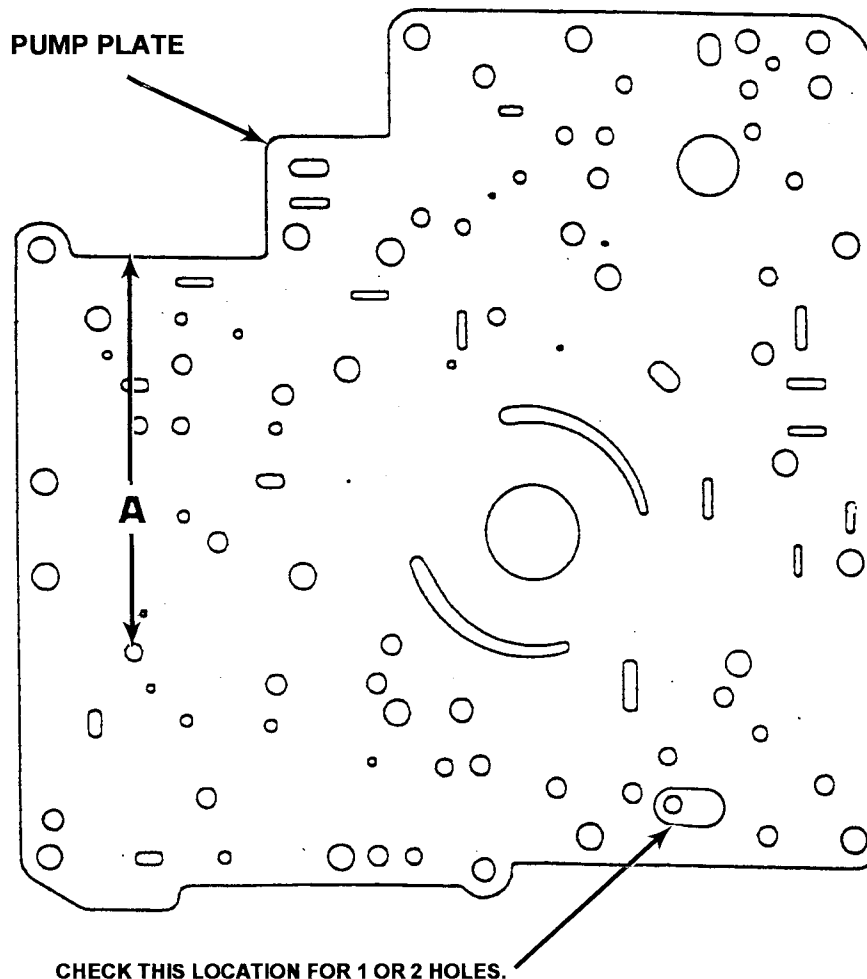


Figure 110

Checkball Locations (Continued)

EARLY 1991 -- 5 CHECKBALLS

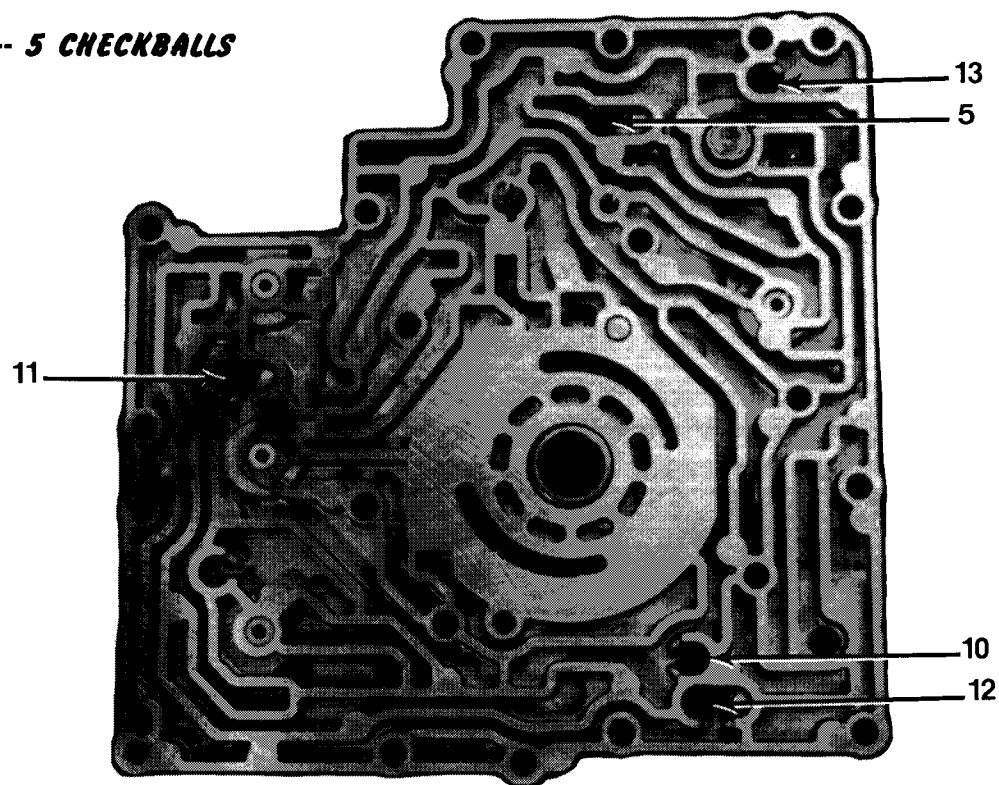


Figure 111

Ford

LATE 1991 -- 4 CHECKBALLS

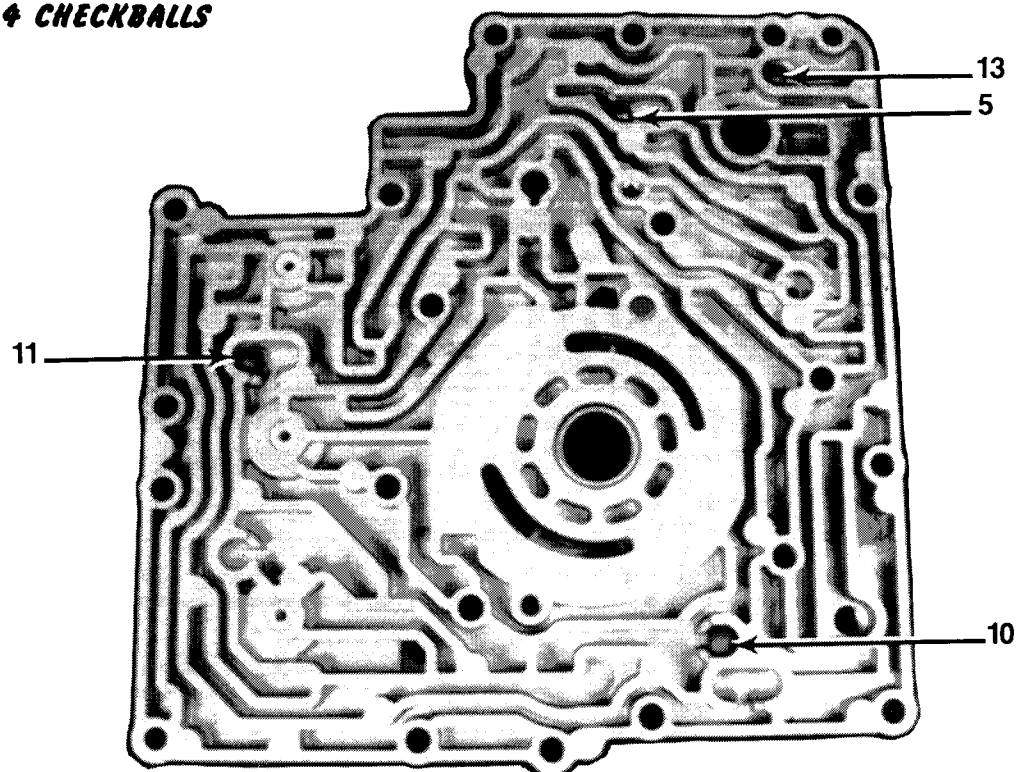
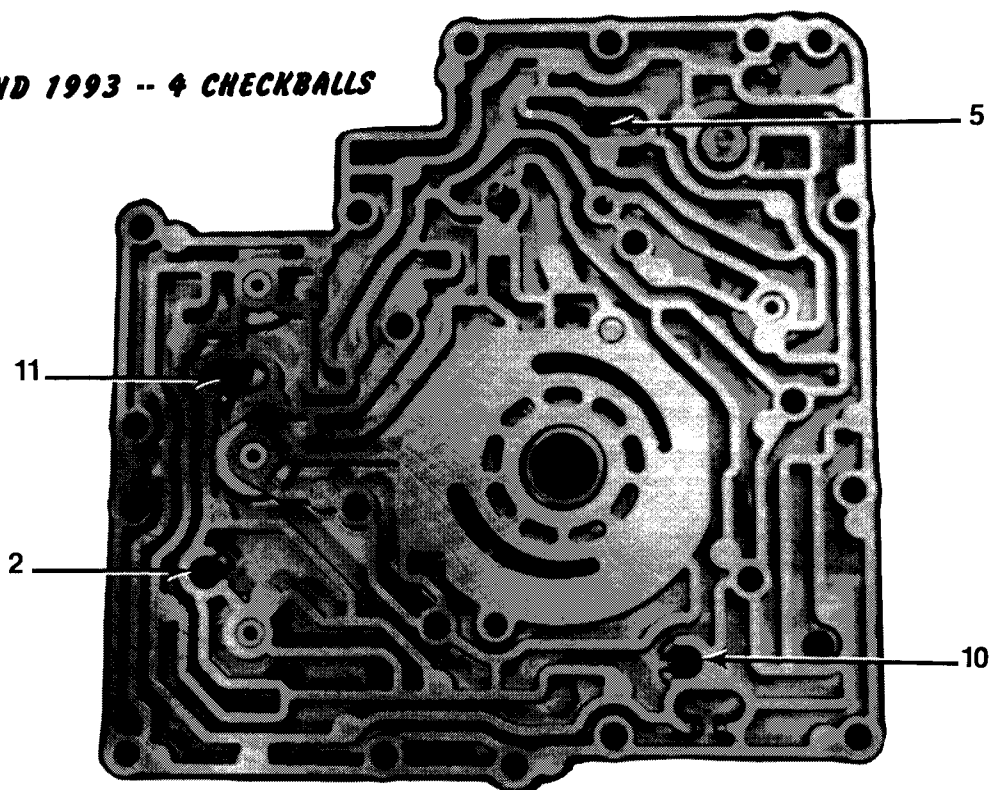
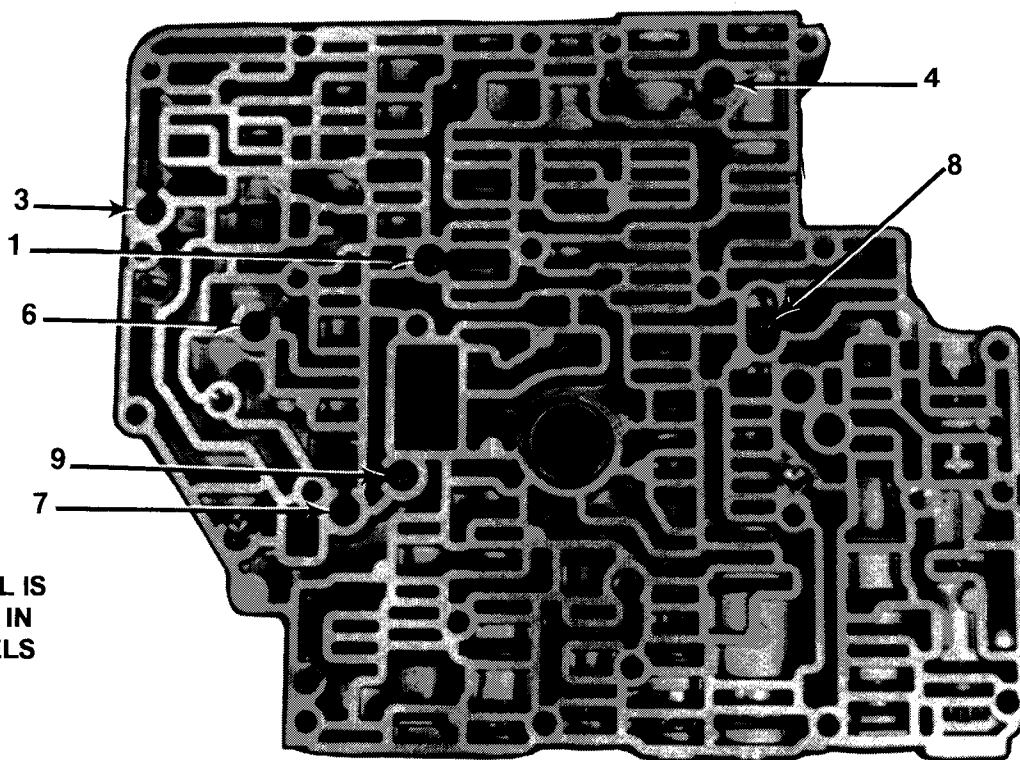


Figure 112

AXODE Checkball Locations (Continued)**1992 AND 1993 -- 4 CHECKBALLS***Figure 113***1991 AND 1992 VALVE BODIES USE 7 CHECKBALLS
1993 VALVE BODIES USE 6 CHECKBALLS***Figure 114***THE #7 BALL IS
NOT USED IN
1993 MODELS**

Checkball Locations (Continued)**NUMBER**

- 1 Reverse clutch orifice.
- 2 Forward clutch orifice.
- 3 1-2 Servo check, (Causes drive oil to go through the 2-3 servo regulator and engagement control valve before it gets to the servo).
- 4 Overdrive servo orifice.
- 5 Forward clutch control shuttle (shuttles 1st-2nd gear oil, and reverse oil, to move the forward clutch control valve).
- 6 1-2 servo release check (causes servo release oil to go thru the 3-2 control valve during a 3-2 downshift).
- 7 Direct clutch exhaust check (causes the direct clutch oil to exhaust thru the #9 checkball during the 3-2 downshift).
- 8 Direct clutch shuttle (shuttles direct clutch oil and manual low oil to feed the direct clutch).
- 9 Direct clutch orifice.
- 10 Servo release check (provides an exhaust for servo release oil in 1st and reverse).
- 11 Direct clutch oil shuttle (shuttles between 3rd gear oil & 4th gear oil to feed the direct clutch).
- 12 Engagement control valve shuttle (shuttles T.V. oil & 2nd gear oil to control the engagement control valve).

NOTE: 4 checkball configurations only use 2nd gear oil.

- 13 Forward clutch control valve feed orifice.

AXOD/AXODE

No Forward Or Slips Forward

A condition of no forward, slips in forward, or delayed engagement may be caused by a cracked forward clutch piston. These complaints are usually worse when hot.

To check for a crack, remove the outer lip seal, and insert a screwdriver into the lip seal groove. Now, twist the screwdriver and check for a crack in the bottom of the groove. Check all the way around the piston using this procedure.

NOTE: *A cracked piston may air check good. DON'T TRUST AN AIR CHECK. It is highly recommended that you install the 3rd design piston on all rebuilds*

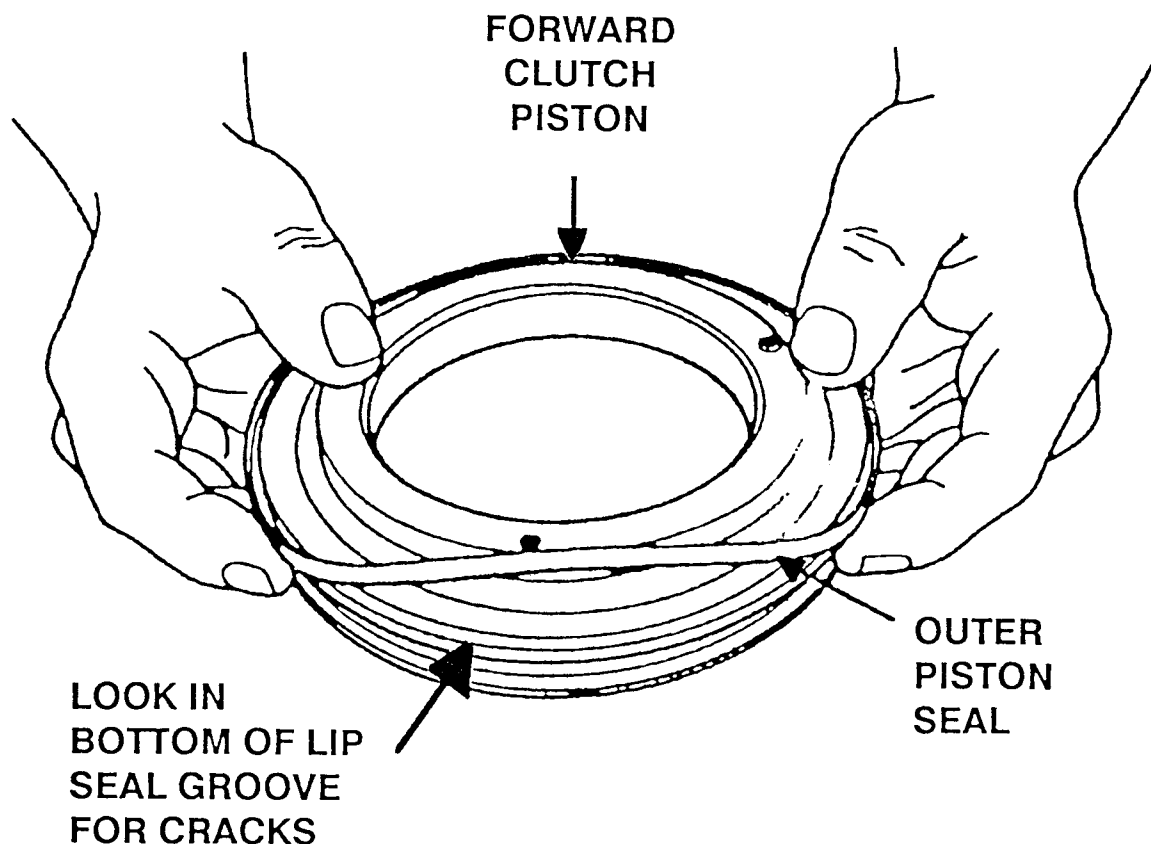


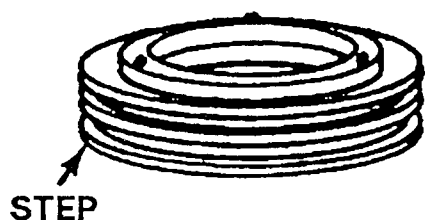
Figure 116

No Forward Or Slips Forward (Continued)

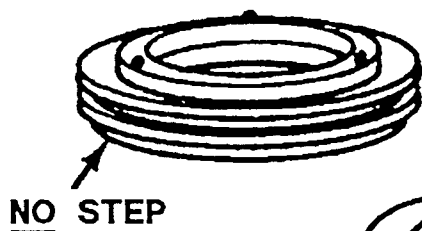
If the forward piston is cracked replace it with the 3rd design.

3rd DESIGN PISTON.....F1DZ-7A262A.

AXOD/AXODE FORWARD CLUTCH PISTON



1st DESIGN HAS A STEP

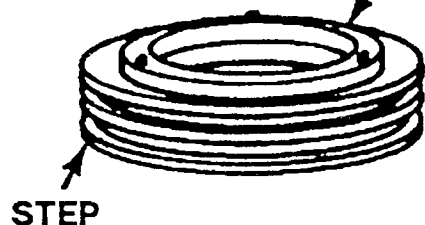


2nd DESIGN HAS NO STEP

NO STEP



**IDENTIFICATION
SYMBOL**



**3rd DESIGN HAS A STEP AND AN
IDENTIFICATION SYMBOL**

Figure 117

AXODE

Lube Oil Modification

Ford has recently made available a new set of pipes for the AXODE which will allow for a larger volume of uninterrupted lube oil to the planetaries.

The new design pipes were incorporated into production in mid-92 for all AXODE's.

It is recommended that you install the new lube delivery pipes on all AXODE's built before mid-92.

PART NUMBER	PART NAME
F2DZ-7G084-A	Rear Lube Tube
F2DZ-7G086-A	Differential/Speedometer Lube Tube

CAUTION: The new tubes WILL NOT fit the AXOD.

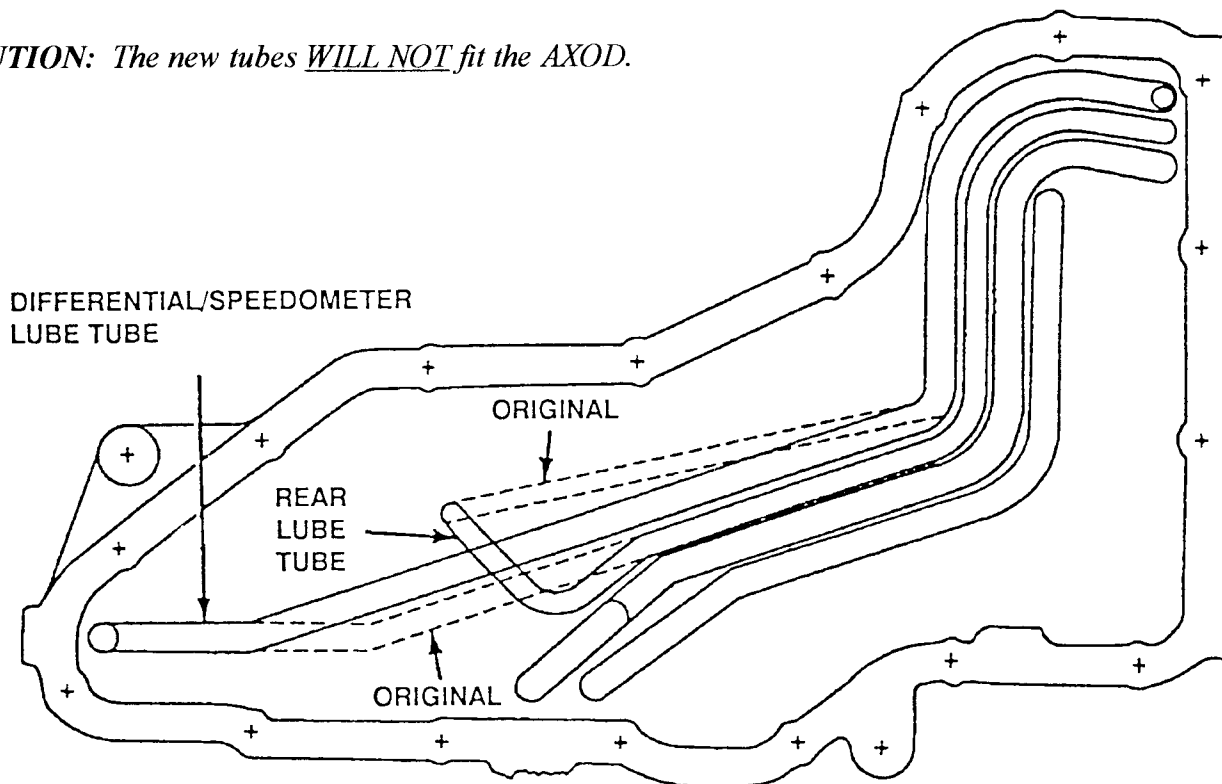


Figure 118

AXODE

Unit Interchange/Parts Matching

Many complaints may occur as a result of installing an incorrect exchange unit (or components) into the vehicle. There are 2 different lock-up systems used on AXODE transaxles. One is a normal Lock-Up Solenoid (LUS) system and the other is a Modulated Lock-Up Solenoid (MLUS) system. These systems and/or components ARE NOT interchangeable.

LUS systems were used only on 1991 Taurus and Sable vehicles. MLUS systems are used on 1991 Continentals and ALL 1992 and later vehicles. Processor design and operation is different depending on which Lock-Up apply system is used on the vehicle.

Installing an MLUS unit into a vehicle designed for an LUS system is likely to cause processor failure.

Refer to the following information to identify the different systems used on 1991 and 1992 transaxles.

1. The top wiring connector used on transaxles equipped with LUS systems are black, and MLUS systems are gray. The wires for the lock-up solenoid are longer on the black connector to accommodate the different lock-up solenoid connection position. However, it is possible to install either harness with either solenoid. If anyone has ever tampered with the unit it is possible for this method of external identification to be misleading.
2. A more positive external identification is to check the resistance of the lock-up solenoid circuit with an ohmmeter. Check the resistance between the pins shown below.

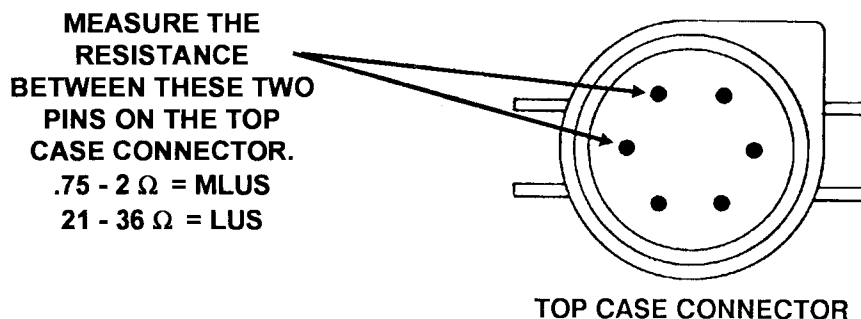


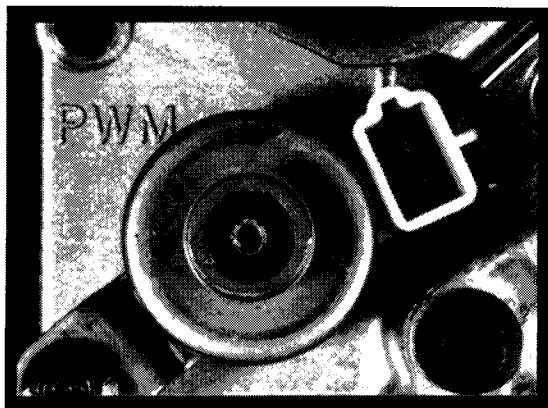
Figure 119

Unit Interchange/Parts Matching (Continued)

3. There is also a physical difference in the appearance of the solenoids.

ROUND = MLUS

SQUARE = LUS



If the solenoid is round you have a Modulated Lock-Up Solenoid (MLUS)



If the solenoid is square you have a Lock-Up Solenoid (LUS) System.

TOP CONNECTOR

GRAY = MLUS Part#F10Y-7G276A

BLACK = LUS Part#F1DZ-7G276B

SIDE CONNECTOR

1991-92 ALL THE SAME

PART#F1DZ7F276A

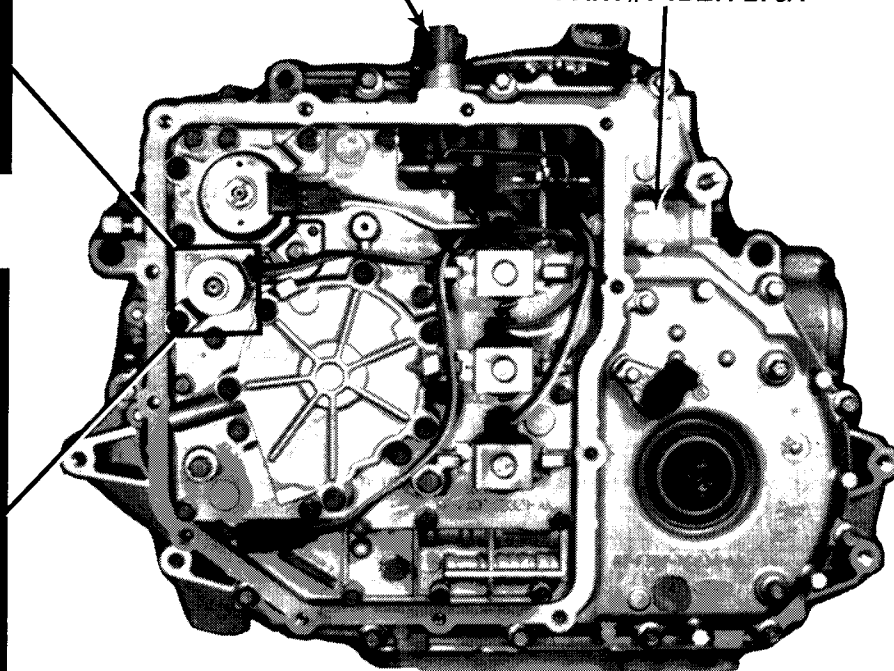


Figure 120

MIS-MATCHES OF COMPONENTS MAY CAUSE THE FOLLOWING COMPLAINTS:

- | | |
|---------------------------------|---------------------|
| 1. TCC APPLIES WITH 1-2 SHIFT | 5. ROUGH TCC APPLY |
| 2. CHUGS ON COAST DOWN | 6. NO TCC APPLY |
| 3. TCC WON'T RELEASE WITH BRAKE | 7. FAILED PROCESSOR |
| 4. SOFT TCC APPLY | |

Unit Interchange/Parts Matching (Continued)

4. The pump plate is different, depending on the type of lock-up solenoid.

If hole "A" is approximately .030" in diameter, the plate matches the square (LUS) type solenoid.

If the hole is approximately .215" in diameter, then it matches the round (MLUS) type solenoid.

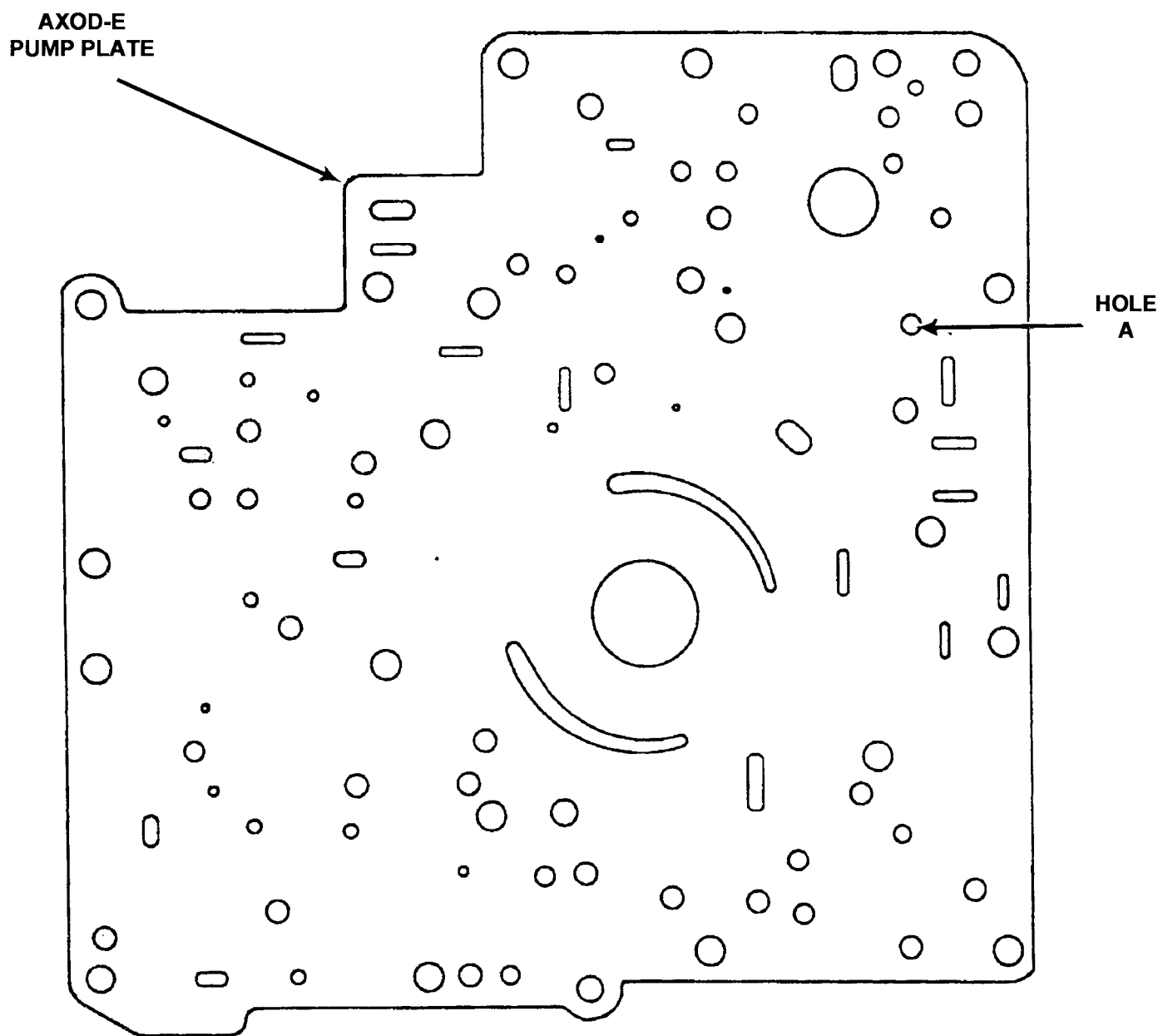


Figure 121

Unit Interchange/Parts Matching (Continued)

5. The valve body plate is also different, depending on which lock-up system is used.

If hole "B" is approximately .041" in diameter, the plate matches the square (LUS) type solenoid.

If the hole is approximately .152" in diameter, then it matches the round (MLUS) type solenoid.

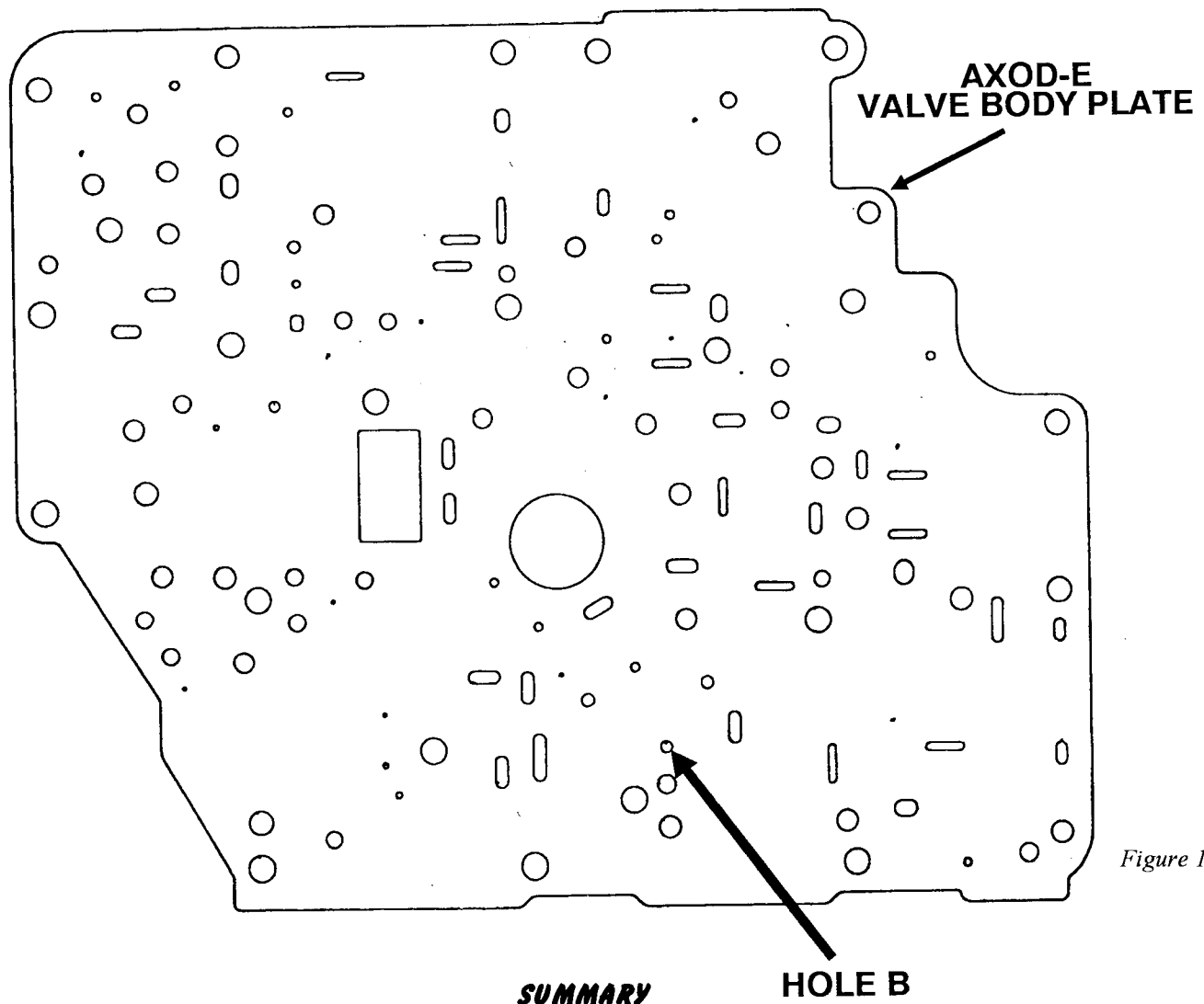


Figure 122

SUMMARY

91 TAURUS/SABLE
 LUS System
 Black top connector
 Square shaped LU solenoid 21 - 36 Ω
 Small hole in pump plate
 Small hole in valve body plate

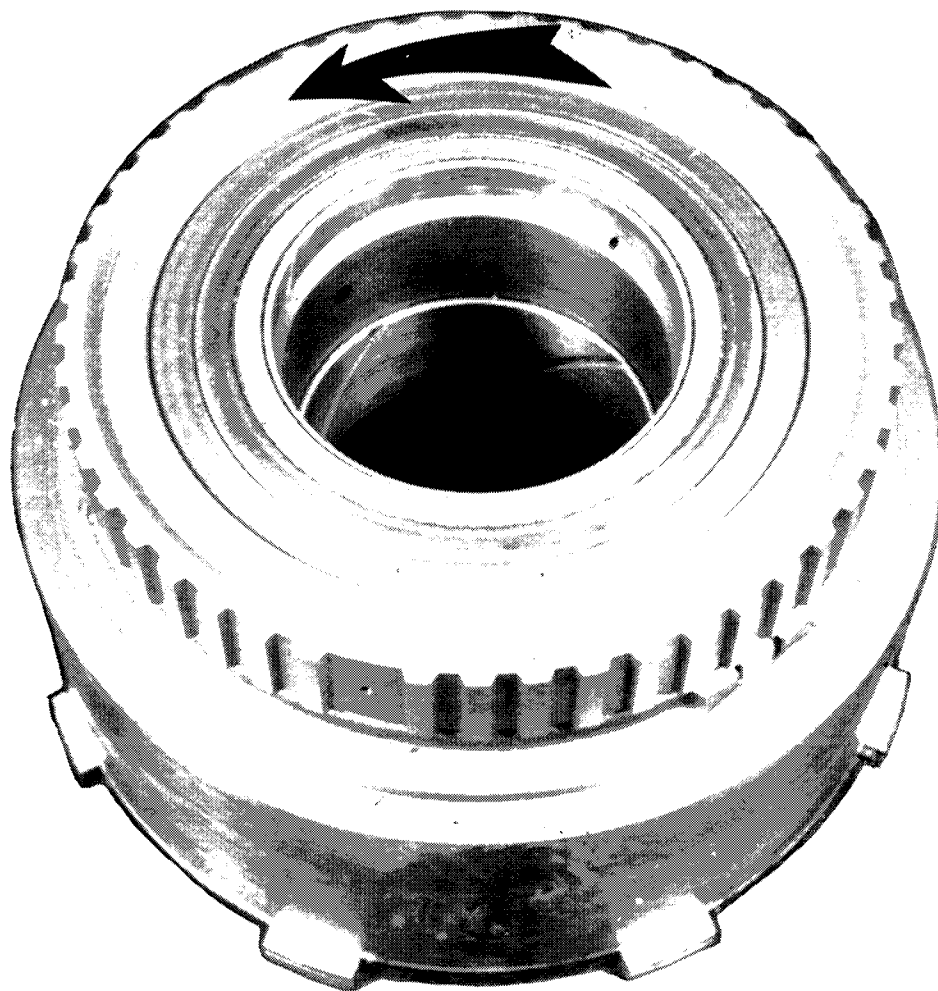
91 CONTINENTAL/ALL 92 MODELS
 MLUS System
 Gray top connector
 Round shaped solenoid .75 - 2 Ω
 Large hole in pump plate
 Large hole in valve body plate

E4OD

Intermediate Sprag Rotation

A bind-up on the first shift in the "D" position, may be caused by improper intermediate sprag rotation.

NOTE: If the transmission is manually shifted, it will bind-up on the 2-3 shift.



Ford

Figure 123

**WHEN PROPERLY ASSEMBLED THE OUTER RACE
WILL ROTATE COUNTER CLOCKWISE.**

E4OD

OD Sprag Rotation

The E4OD overdrive one way clutch end caps must be installed as shown to achieve durability. The end cap with scallops on the inner diameter must be toward the front of the transmission for proper lubrication.

- Place top (thick) end cap onto one-way clutch
- Place thin end cap onto bottom of one-way clutch
- Install one-way clutch

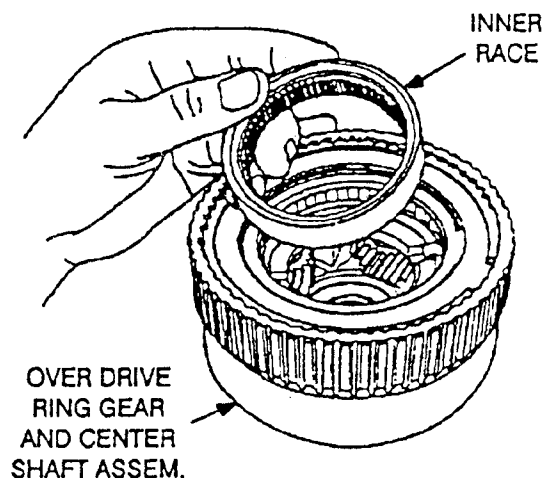
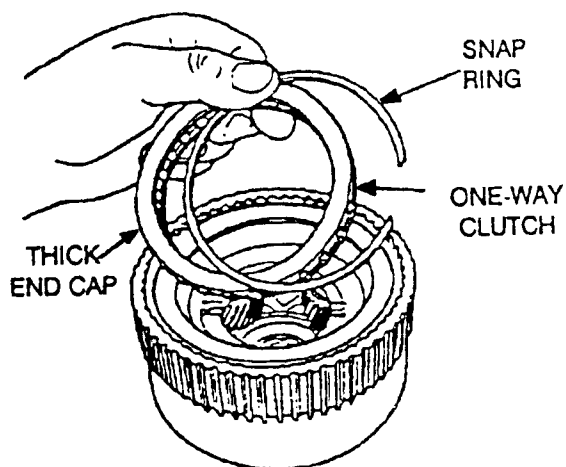
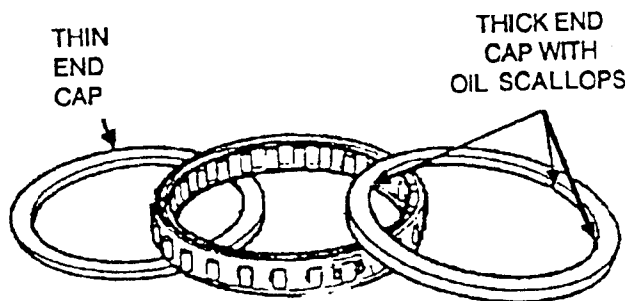


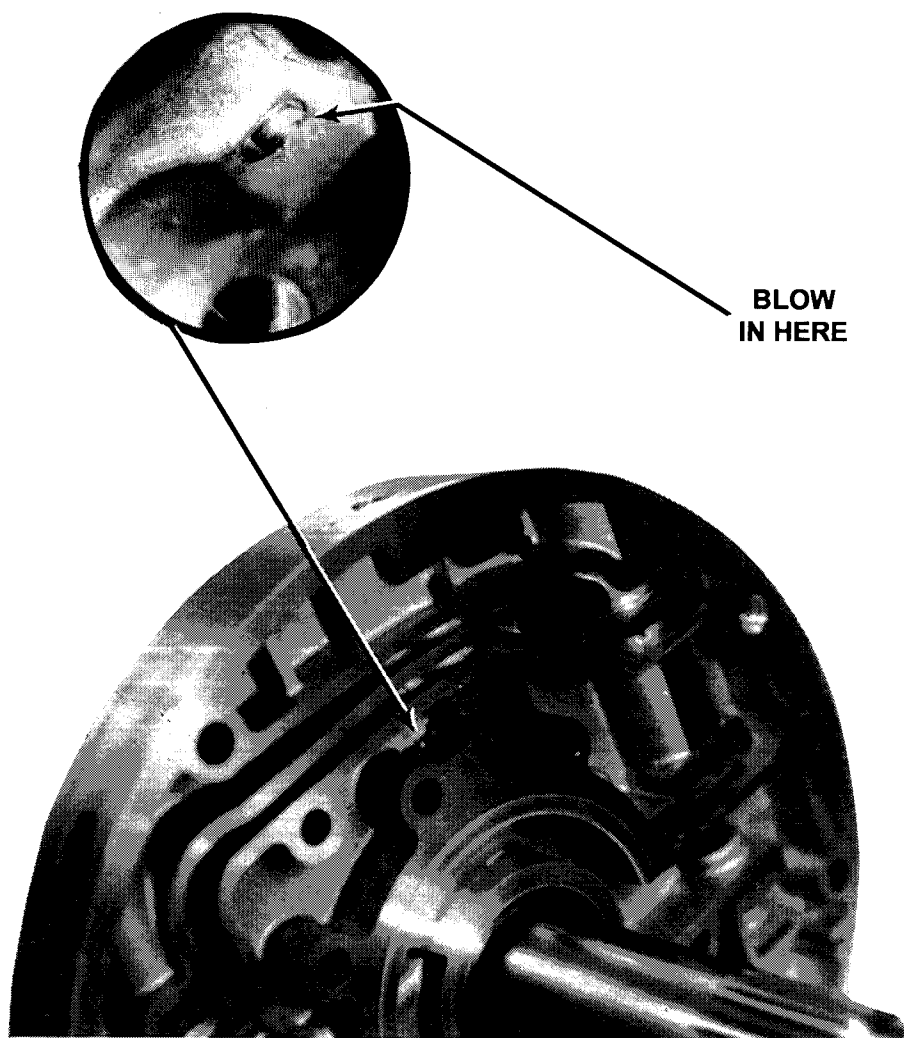
Figure 124

**WHEN PROPERLY ASSEMBLED THE INNER RACE
WILL ROTATE COUNTER CLOCKWISE**

E4OD

Burned Overdrive Section

A burned E4OD overdrive planetary may be caused by restricted lube oil feed in the stator. To check for a restriction, blow into the hole shown.



Ford

Figure 125

Burned Overdrive Section (Continued)

Air should come out of the orificed cup plug in the rear of the stator support shaft as shown below.

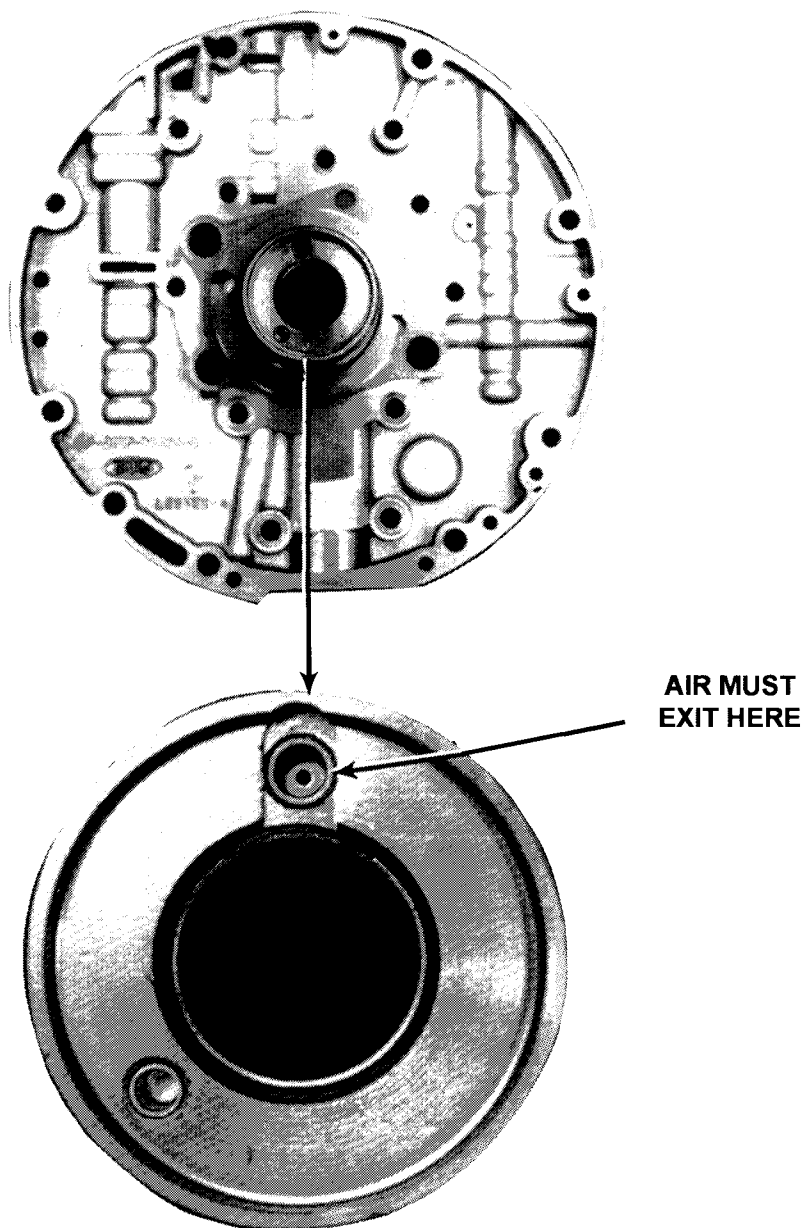


Figure 126

Burned Overdrive Section (Continued)

There is drain back valve assembly under the orificed cup plug in the stator shaft. The valve assembly may have melted if it was subjected to severe heat.

Thread a tap into the orificed cup plug, grab it with pliers and while wiggling it, pull it out. Underneath the orificed cup plug is the drainback valve. Remove it and inspect the end for possible damage.

**THIS END
GOES INTO
STATOR FIRST**

**THIS END GOES
AGAINST CUP PLUG**

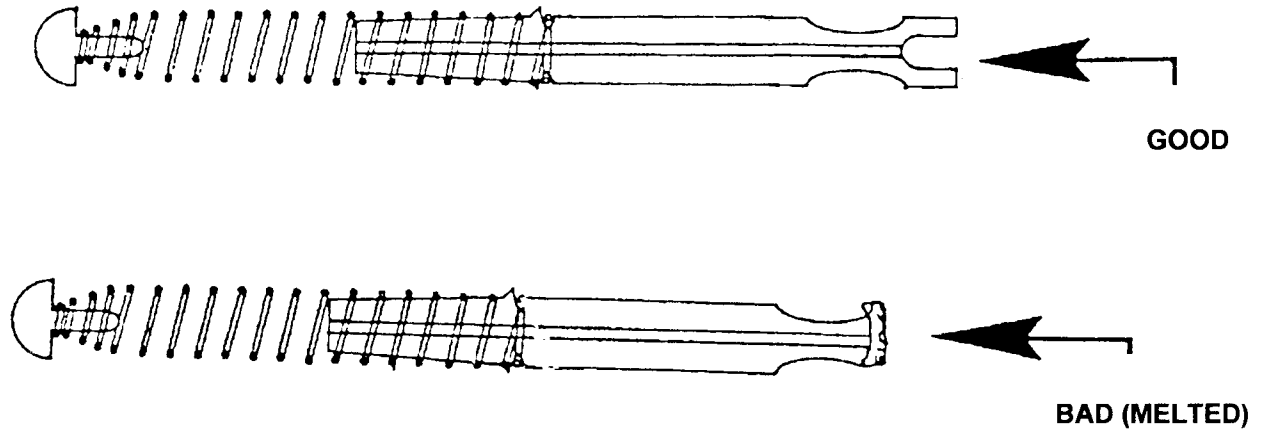


Figure 127

NOTE: *If the valve assembly is damaged, stator replacement is required. A new valve assembly is available from Ford, under part #E9TZ-7H132-A. This part number is for the valve assembly only. The orificed cup plug must be re-used.*

E40D

Pump Modifications

1. Enlarge orificed cup plug "A" to .075 for TCC exhaust.
2. Enlarge orificed cup plug "B" to .090 for cooler feed.

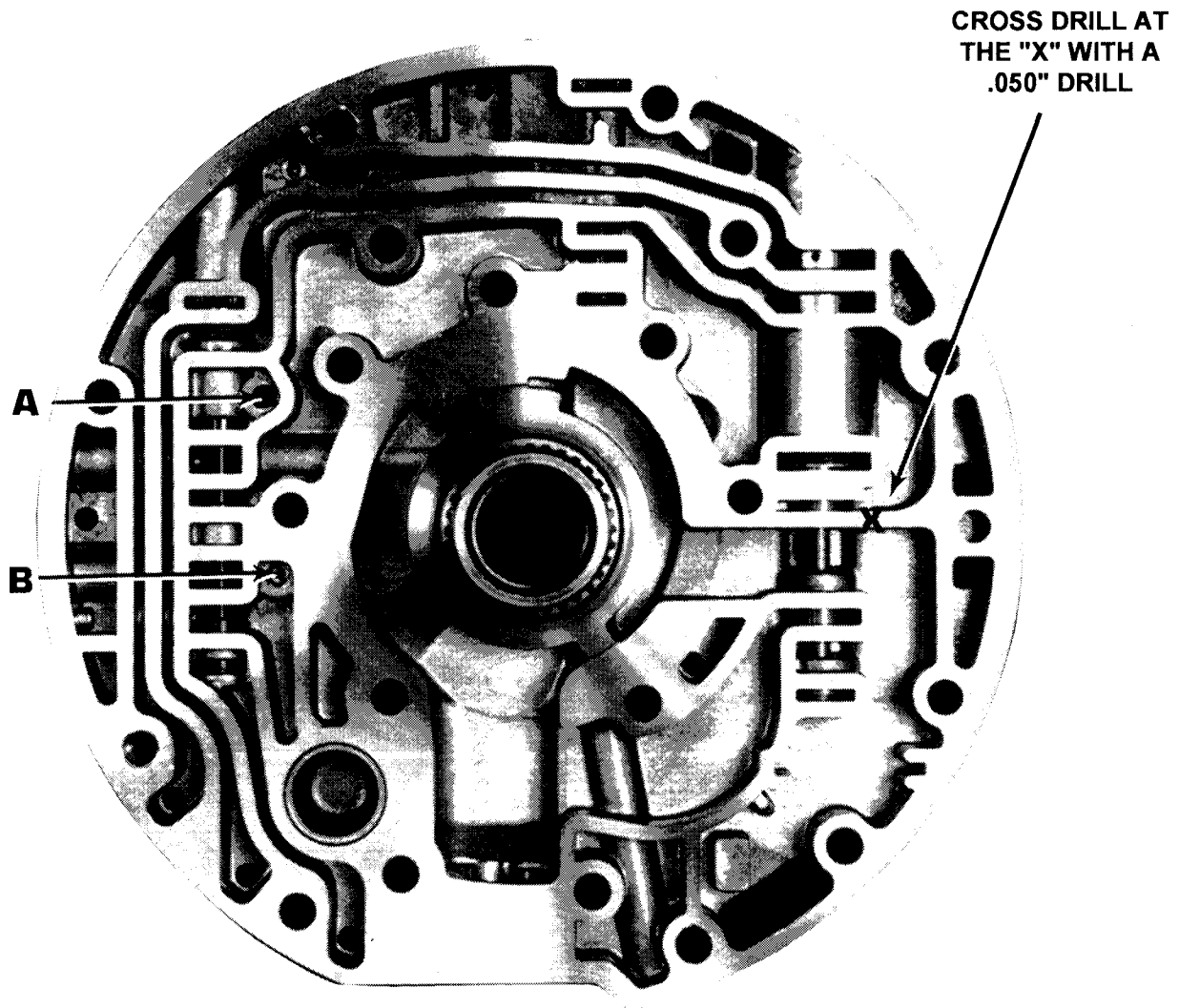


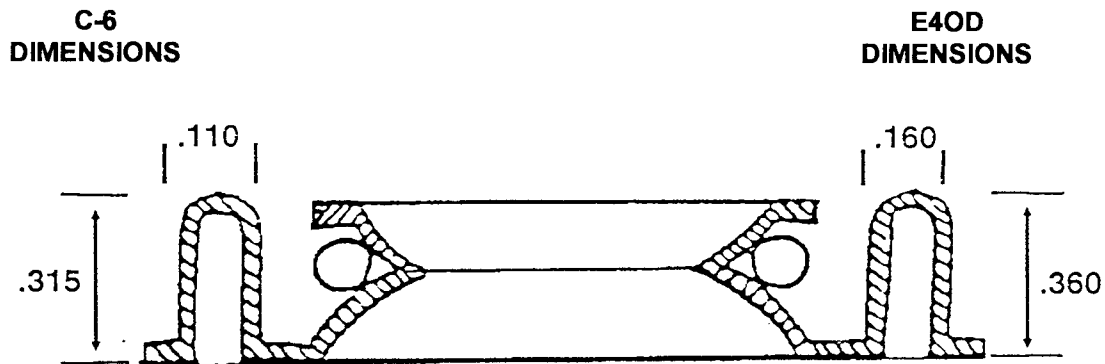
Figure 128

E4OD

Front Seal Blow-Out

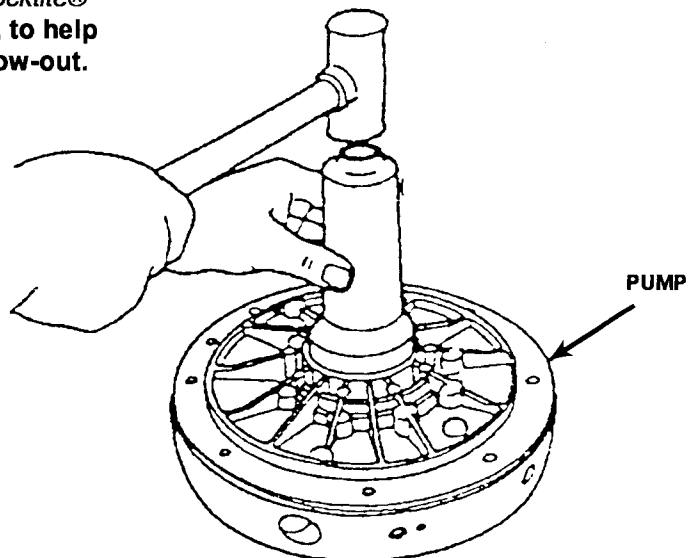
Front seal blow-out on an E4OD may be caused by using a C-6 front seal instead of a genuine E4OD front seal. The E4OD seal has a different profile which results in more contact area to hold the seal in the bore, and the lip is positioned differently within the seal itself.

CROSS-SECTIONAL VIEW OF FRONT SEAL



For added safety, wire brush the paint off the outside diameter of the seal and use *Locktite®* around the seal, to help prevent seal blow-out.

Figure 129



E40D

Case Damage

Slide hammers are the recommended tools for removing the pump on an E40D. Using a large screwdriver to pry the pump out may cause breaking or bending of the case, which may result in a serious mainline pressure leak.

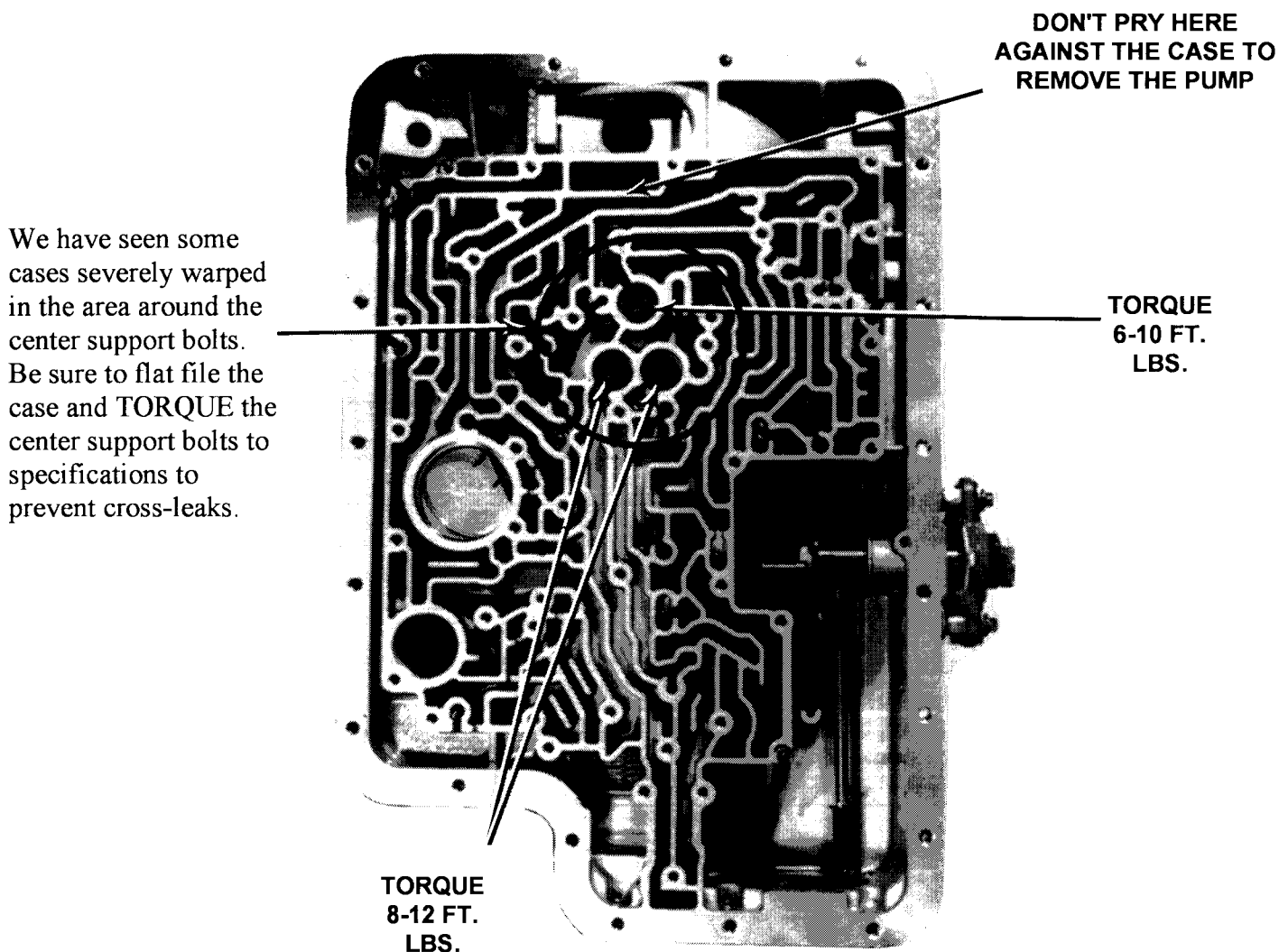


Figure 130

E4OD

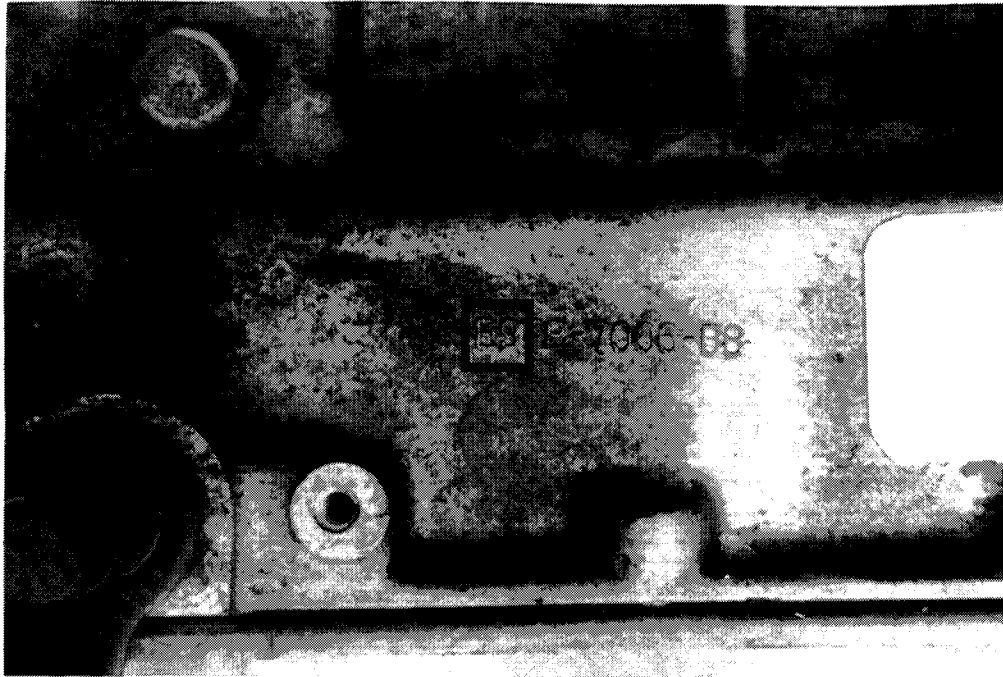
Case, Separator Plate and Valve Body Identification

The E4OD was introduced in 1989. In 1990, the case, separator plate (including gaskets) and two of the three valve body castings were changed. A mismatch of these parts can cause wrong gear starts and slips in 3rd just to name a few.

Use the following information to I.D. your parts.

STEP 1**CASE IDENTIFICATION**

The easiest way to I.D. the case is to look at the "rough forge" number. The "rough forge" number is located behind the manual control lever.



Ford

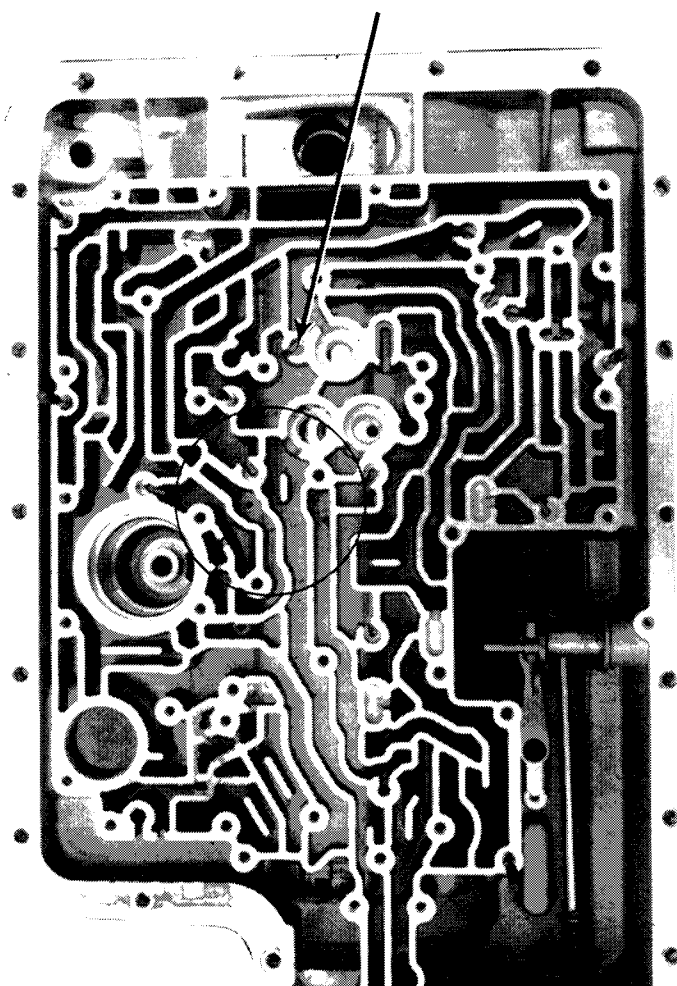
A "rough forge" number of E9 would indicate the case was a 1989 type, F0 is for a 1990 type.

Figure 131

Case, Separator Plate and Valve Body Identification (Continued)**CASE IDENTIFICATION: (Continued)**

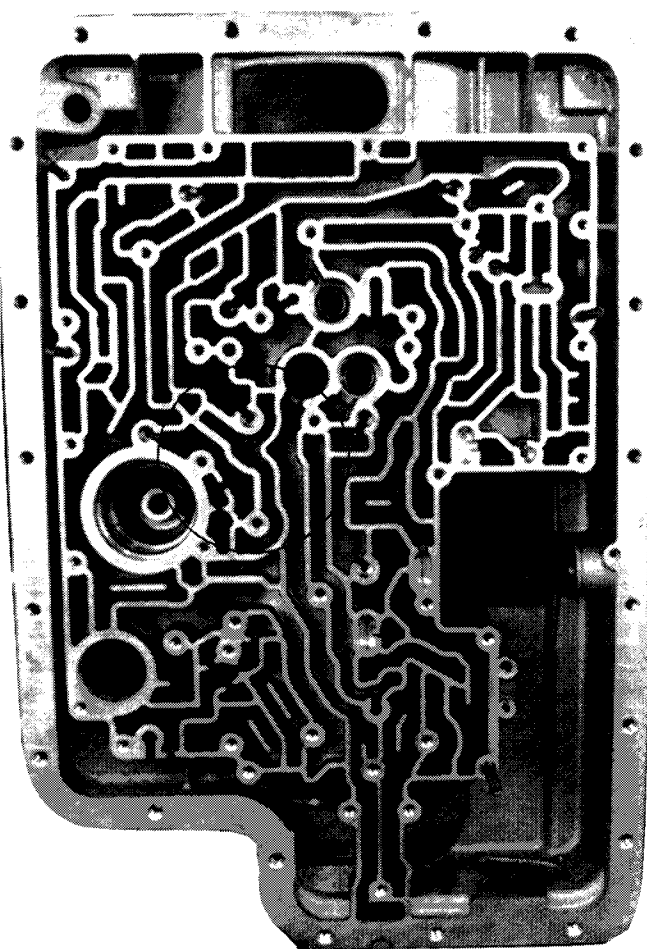
Another way to identify the case is by the change circled in the figure below.

CHECKBALL #11
WAS OMITTED IN 1990



1989

Figure 132



1990 & LATER

Figure 133

Case, Separator Plate and Valve Body Identification (Continued)

STEP 2

E4OD CHECK BALL LOCATIONS

EARLY 1989 UNITS

Place balls in locations #1-#14. All balls are 5/16 diameter rubber.

LATE 1989 UNITS

Place balls in locations #1-#11. All balls are 5/16 diameter rubber except #10 which is 5/16 diameter steel.

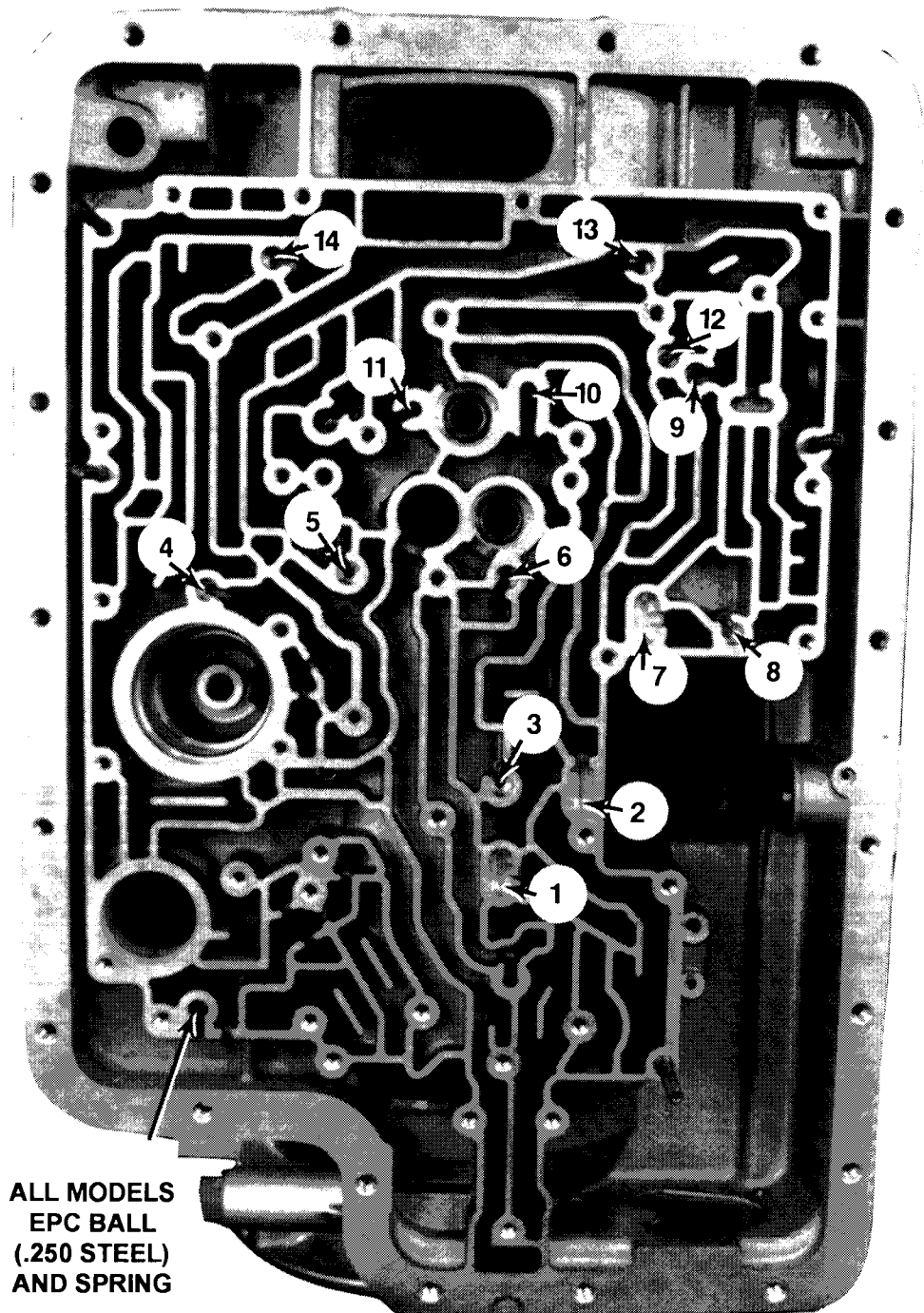
1990 - 1991

Place balls in locations #1-#9. All balls are 5/16 diameter rubber.

To determine if you have a late 89 or early 89 look for holes (ball seats) in the spacer plate above ball locations #12, #13 and #14. Late 89 does not have holes above balls #12, #13 and #14.

Late 89 does not have holes above balls #12, #13 and #14.

There are 2 balls located in the main valve body but since they have not changed locations or size since the E4OD's introduction their locations will not be included in this handout.



ALL MODELS
EPC BALL
(.250 STEEL)
AND SPRING

(The EPC spring weighs 3.5 lbs @ .750)

Figure 134

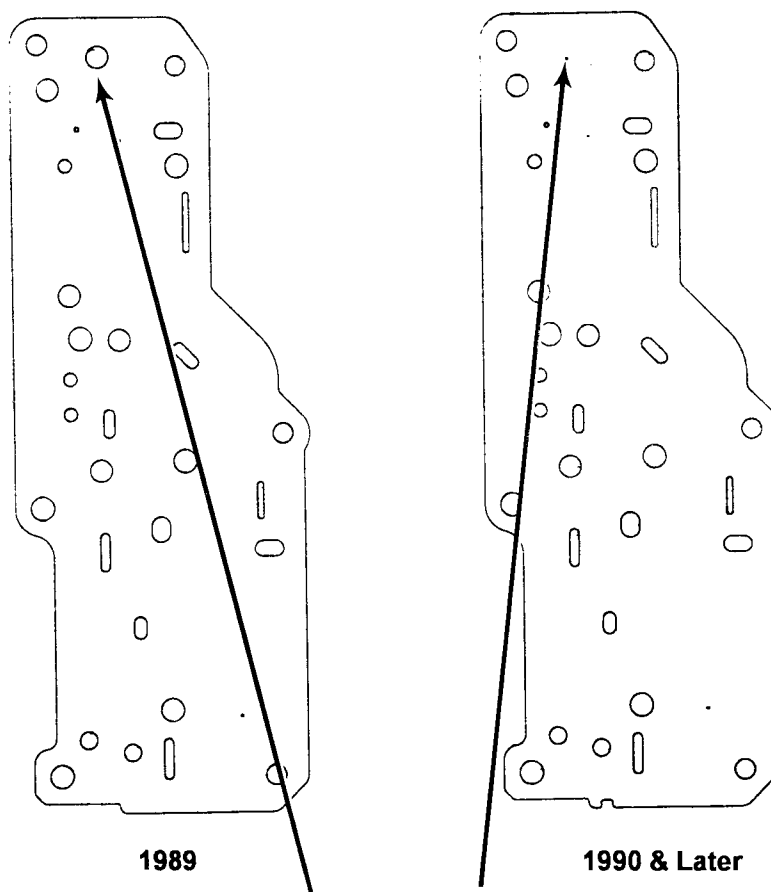
Case, Separator Plate and Valve Body Identification (Continued)

STEP 3**SEPARATOR PLATE AND GASKET IDENTIFICATION**

When checkball #11 was removed from the case in 1990, so was the hole in the separator plate that covers it. If you have a hole in the separator plate for the #11 checkball you have a 1989 plate.

The gaskets are easy. Do they cover any holes in the separator plate? If so, they're the wrong ones.

The separator plate between the upper and lower valve body sections was also changed in 1990. The figures below show the difference.



This hole size was reduced in 1990.

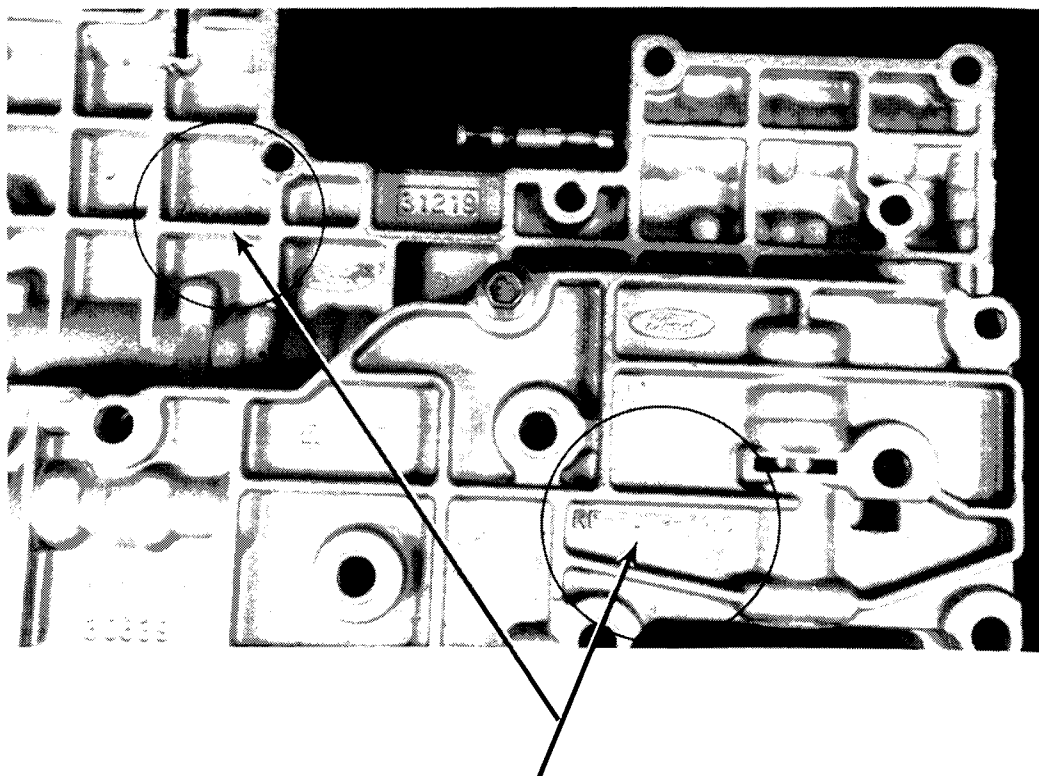
Figure 135

Case, Separator Plate and Valve Body Identification (Continued)

STEP 1**VALVE BODY IDENTIFICATION**

The upper and lower valve bodies were changed in 1990. Check the Rough Forge numbers as show below. This is the same as identifying the case, E9 = 1989, FO = 1990.

NOTE: The accumulator body casting didn't change in 1990. All E4OD's to date use E9 accumulator body.



The Rough Forge numbers are located here.

Figure 136

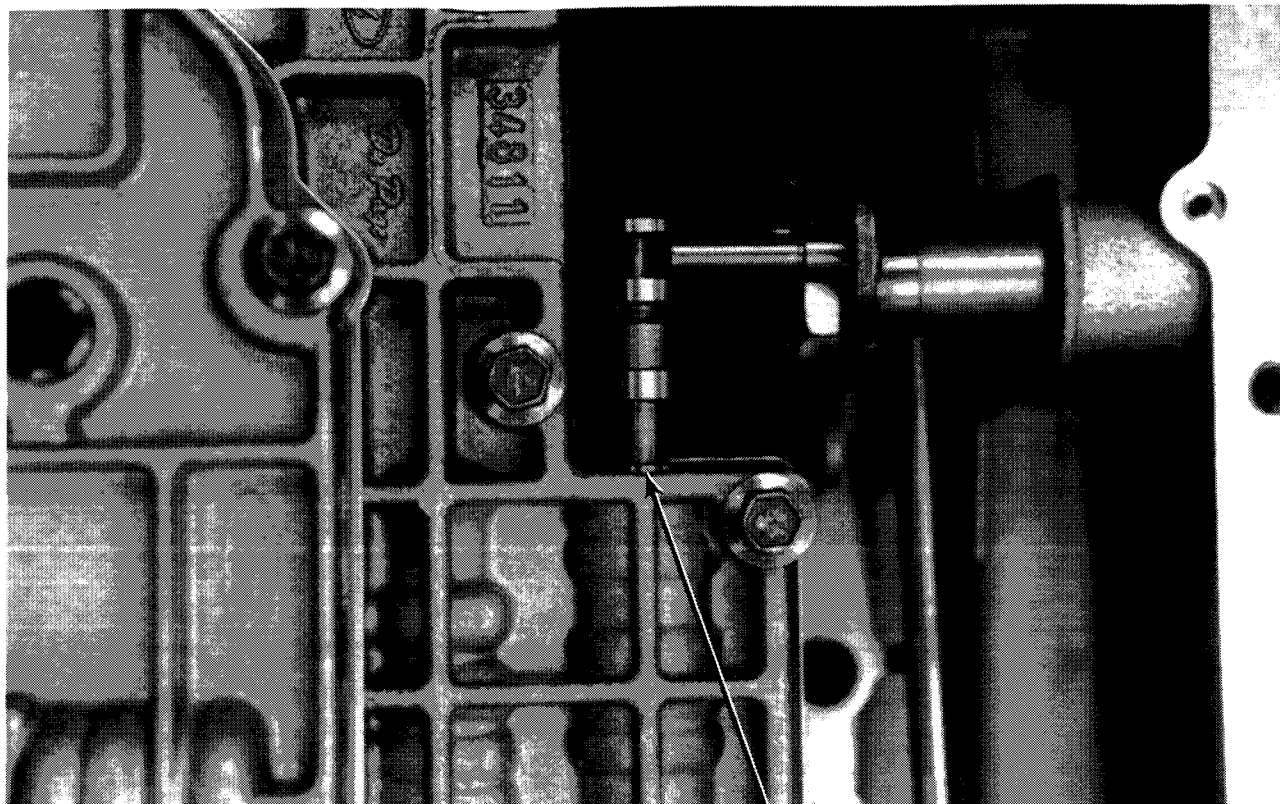
E40D

Manual Valve Indexing

After overhaul, complaints such as no reverse, delayed reverse engagement and delayed drive engagement may be caused by mis-alignment of the manual valve.

To index the manual valve, install the valve body and all linkage including the detent spring. Place the selector linkage in neutral and check the position of the manual valve. The front edge of the 2nd land should be within .030 of flush with the front edge of the valve body casting.

Replacement of the detent spring may be required to achieve proper alignment of the valve.

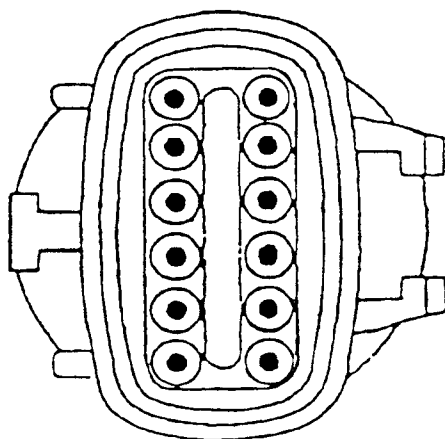


**ALIGN THE VALVE SO THE 2nd LAND IS
WITHIN .030 OF FLUSH WITH THE V.B.
CASTING WHEN IN NEUTRAL**

Figure 137

E40D**Transmission Solenoid Body Terminal Identification**

#6 -- Not Used
 #5 -- CC Solenoid
 #4 -- TCC Solenoid
 #3-- #1 Solenoid
 #2-- #2 Solenoid
 #1 -- Solenoid Power



#7 -- T.O.T. Sensor
 #8 -- T.O.T. Return
 #9 -- Not Used
 #10 -- Not Used
 #11 -- EPC Ground
 #12 -- EPC Power

**THE RESISTANCE
 BETWEEN TERMINALS**

SHOULD BE

1 & 2	20-30 Ω
1 & 3	20-30 Ω
1 & 4	20-30 Ω
1 & 5	20-30 Ω
1 & GROUND	NO CONTINUITY
2 & GROUND	NO CONTINUITY
3 & GROUND	NO CONTINUITY
4 & GROUND	NO CONTINUITY
5 & GROUND	NO CONTINUITY
11 & 12	4.25 - 6.5 Ω
11 & GROUND	NO CONTINUITY
12 & GROUND	NO CONTINUITY

	DEGREES F	RESISTANCE
7 & 8	32-58	37K - 100K
	59-104	16K - 37K
	105-158	5K - 16K
	159-194	2.7K - 5K
	195-230	1.5K - 2.7K
	231-266	.8K - 1.5K

Figure 138

Computer Signal Monitor

This computer signal monitor will save you hundreds of hours troubleshooting electronically shifted transmission complaints. Easy to build, easy to hook-up, and fairly inexpensive, this tool is sure to pay for itself many times over. Best of all, since current draw is only .025 amps, it won't damage sensitive computer circuits the way old fashion test lights can. Make one TODAY, you'll probably need it tomorrow!

PARTS LIST

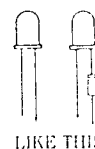
QTY	DESCRIPTION	RADIO SHACK#
3	Jumbo LED	276-086
2 (2 per pack)	470 Ω Resistor	271-019
1 (10 per pack)	Alligator Clips	270-378
1	25', 6 Conductor Phone Cord	279-422
1	Radar Detector Mount Plate	270-034
1	Shrink Tubing	278-1627
1	Small Wire Tie Strap	
	Solder	

TOOLS REQUIRED

SOLDERING IRON
WIRE CUTTER/STRIPPER
DRILL
25/64" DRILL BIT & 3/16" DRILL BIT

INSTRUCTIONS

1. Drill three 25/64" holes in mount plate for LED's (Location A). Drill two 3/16" holes for tie strap (Location B).
2. Trim long leg (+) of LED's to 1/2" and solder resistors to each of the cut legs.

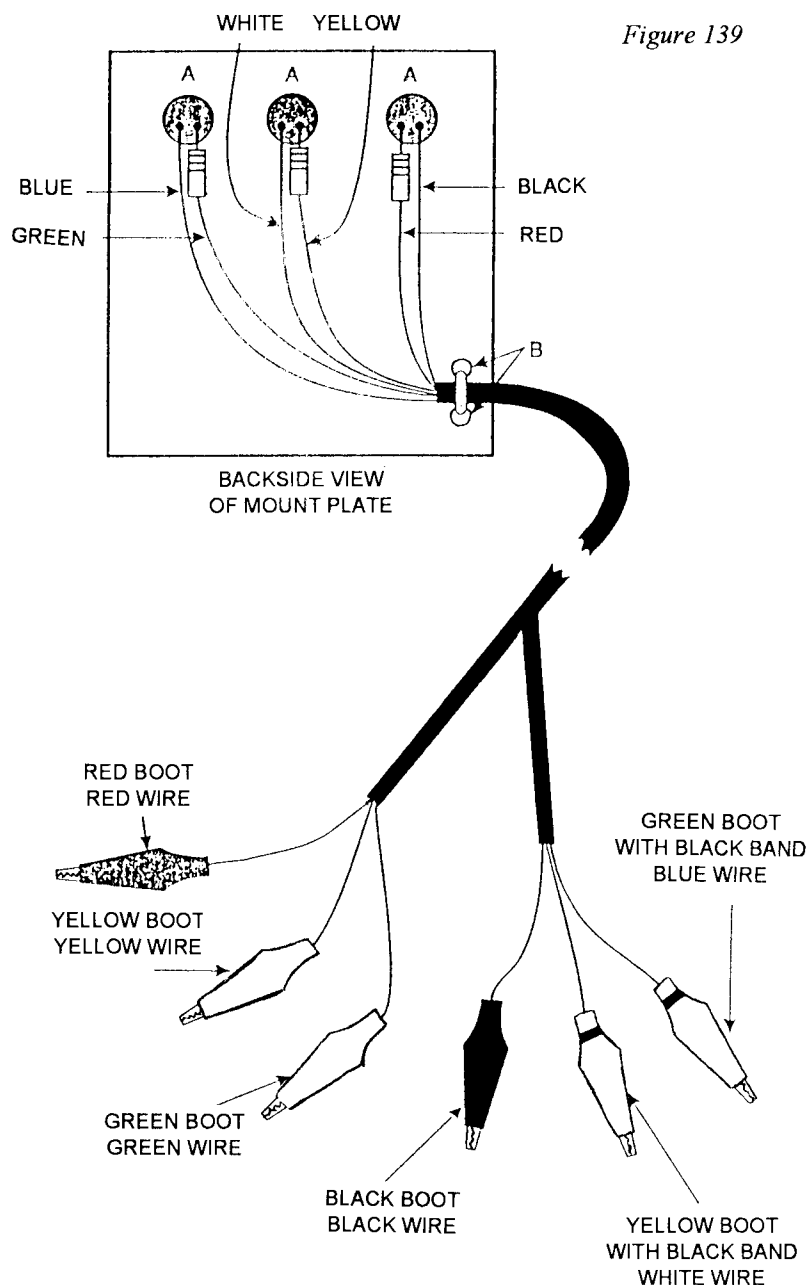


3. Cut end off phone cord and strip grey jacket back 2". Strip colored insulation back 3/8".
4. Snap LED's into holes and solder wire as shown in diagram. Cut 1" long pieces of 1/16" shrink tubing and put over wires before you solder them. After soldering, slip tubing over bare wires.
5. Cut harness length to approximately 12'.
6. Strip grey jacket back 2' from end. Place the Red, Green & Yellow wires in one length of 1/8" shrink tube; and Blue, Black and White wires in the other piece.
7. Cut two 1/4" long pieces of 1/4" shrink tube, and place on one Yellow boot and one Green boot. These Black bands will be wire identification markers.
8. Place boots over wires as shown and solder clips onto wires. Be sure to put the boots over wires before you solder clips on.
9. Paint the backside of the LED's Black to prevent sunlight from shining through them.

HOOK

Hook-up instructions are on the next page.

Figure 139



Computer Signal Monitor (Continued)

WHEN THE COMPUTER SENDS VOLTAGE TO THE SOLENOIDS, IT WILL ALSO BE SENDING VOLTAGE TO THE MONITOR LIGHTS.

1. RED BOOT (+) TO LED #1
2. YELLOW BOOT (+) TO LED #2
3. GREEN BOOT (+) TO LED #3
4. BLACK BOOT (-) TO LED #1
5. YELLOW BOOT W/BAND (-) TO LED #2
6. GREEN BOOT W/BAND (-) TO LED #3

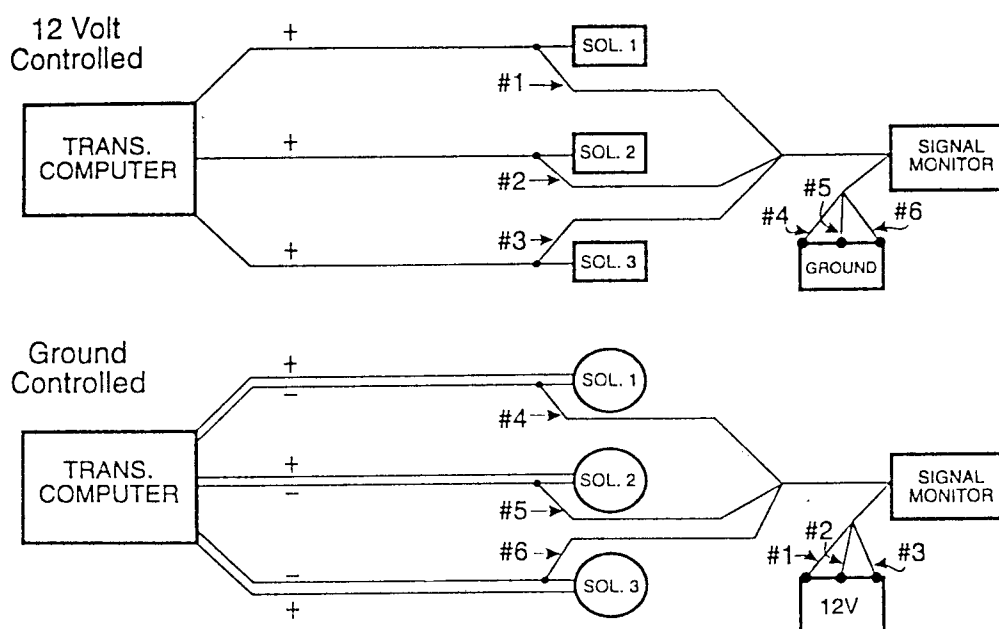


Figure 140

WHEN THE COMPUTER SUPPLIES A GROUND FOR THE SOLENOIDS, IT WILL ALSO BE SUPPLYING A GROUND FOR THE MONITOR LIGHTS.

NOTE: Remember, the positive (+) LED lead must be attached to a voltage source. The negative (-) must be attached to a ground source.

Intermittent Electrical Problems

Wrong gear starts, no upshift, no downshift, falling out of 4th gear, etc may be caused by poor grounds. This applies to any electronically shifted unit, import or domestic.

To test for a poor ground, connect the black lead of your digital voltmeter directly to the negative battery post and probe the suspect ground wire with the positive lead. A good ground will read .1 volts or less. More than .1 volts is a poor ground. Keep in mind the circuit must be operating to accurately check the ground.

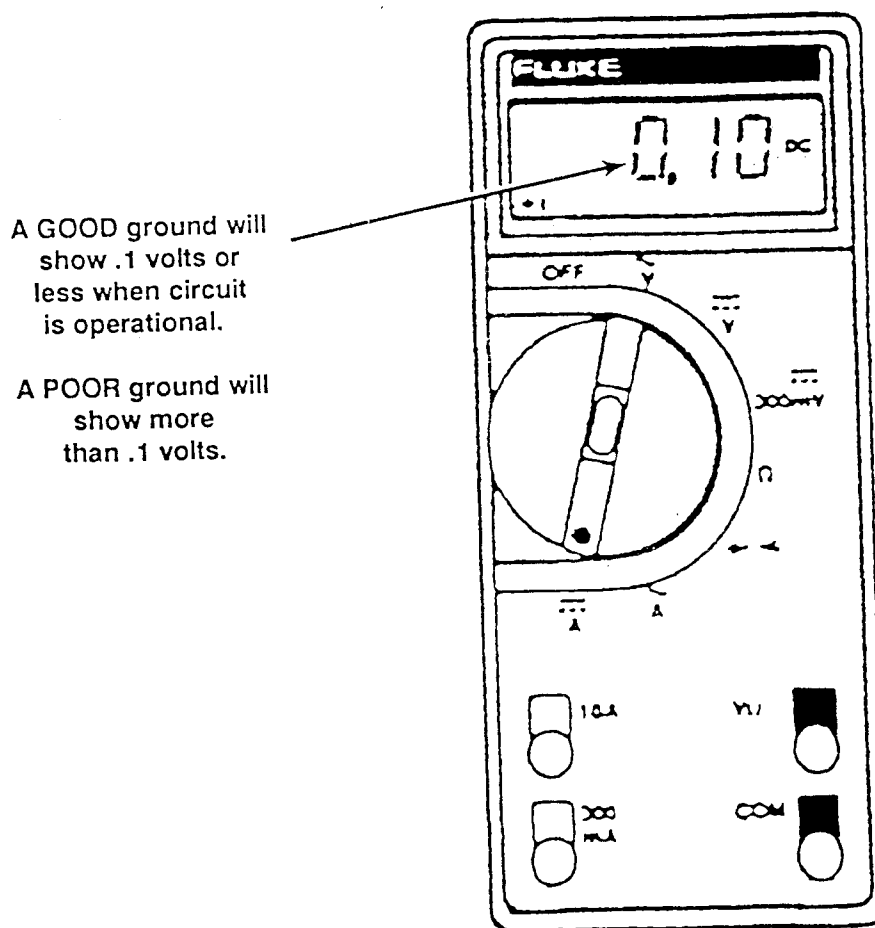
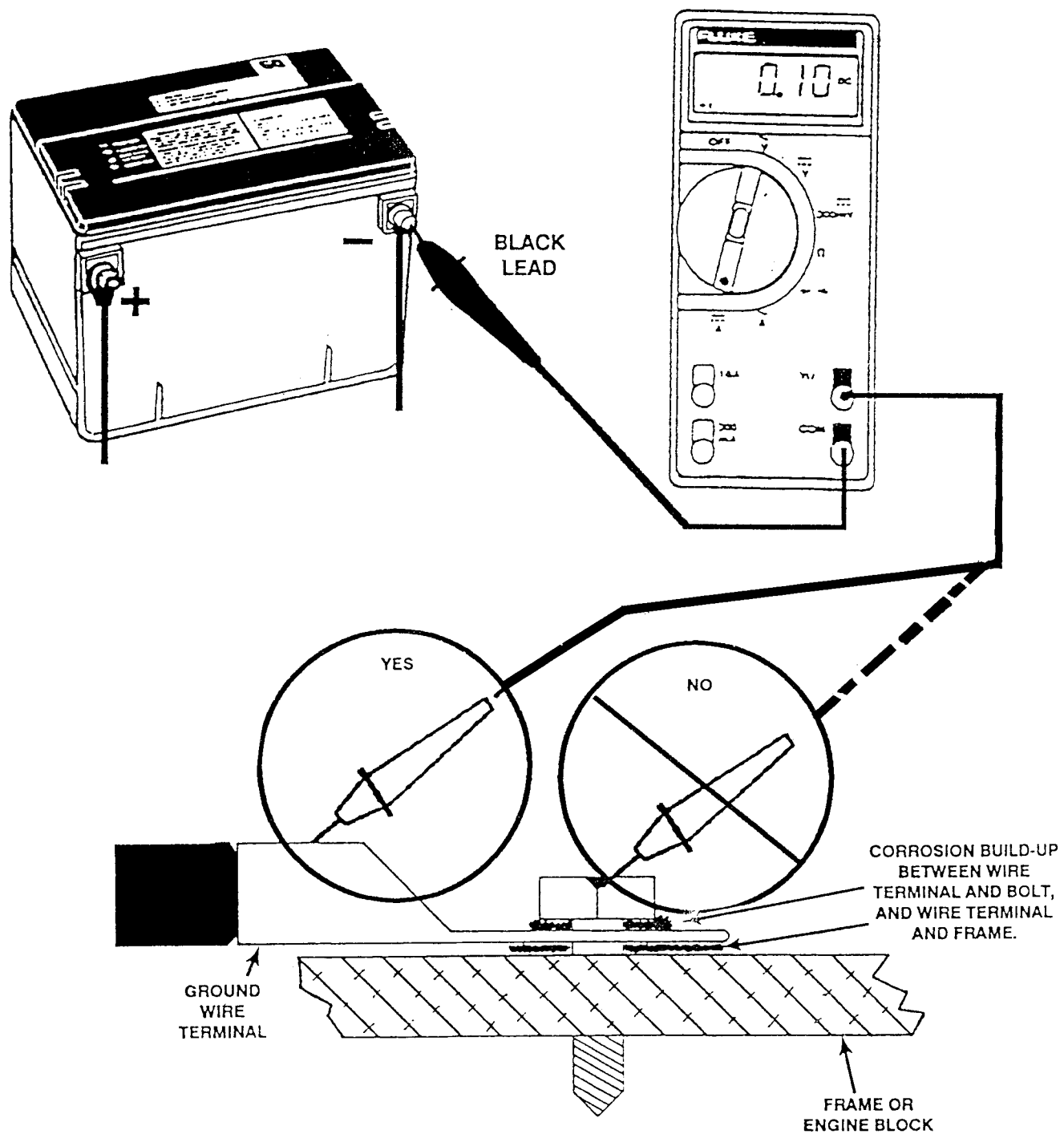


Figure 141

Intermittent Electrical Problems (Continued)

When checking a suspect poor ground always probe the wire terminal itself and not the bolt, since corrosion may insulate the wire yet the bolt is grounded.



Ford

Figure 142

Intermittent Electrical Problems (Continued)

It will be to your advantage to add an additional ground strip to insure a good ground is supplied to the transmission control unit.

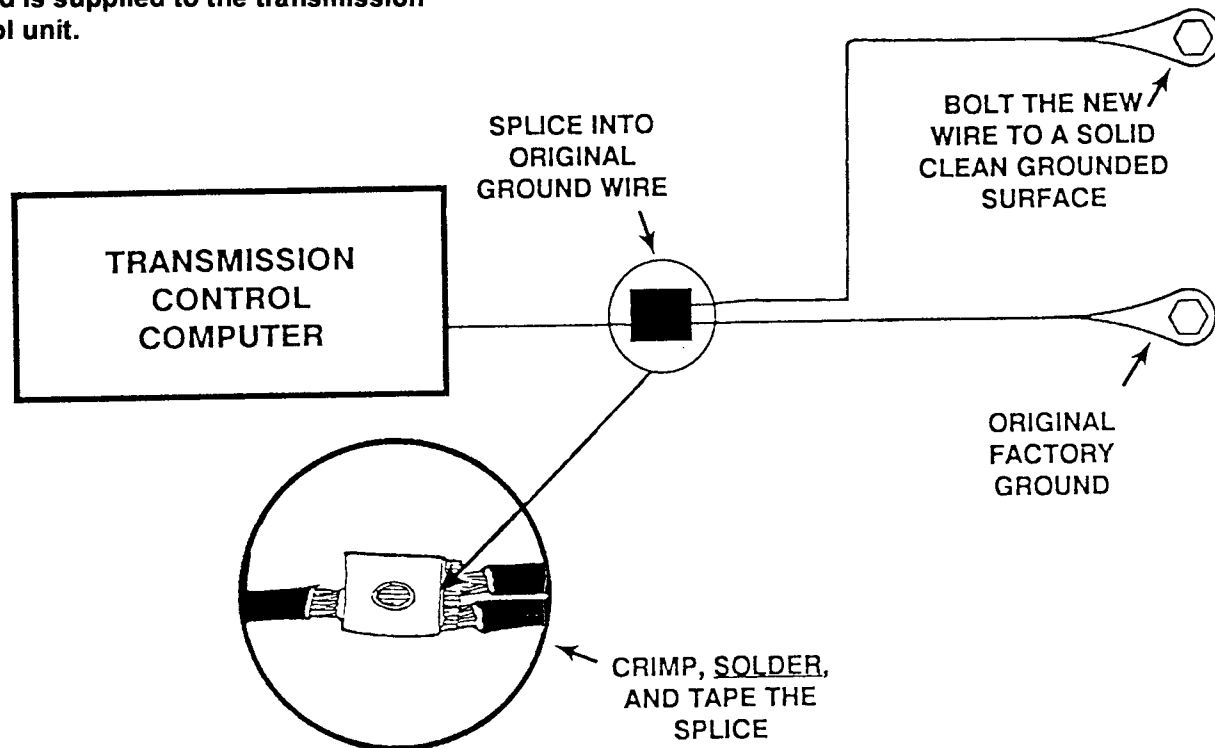
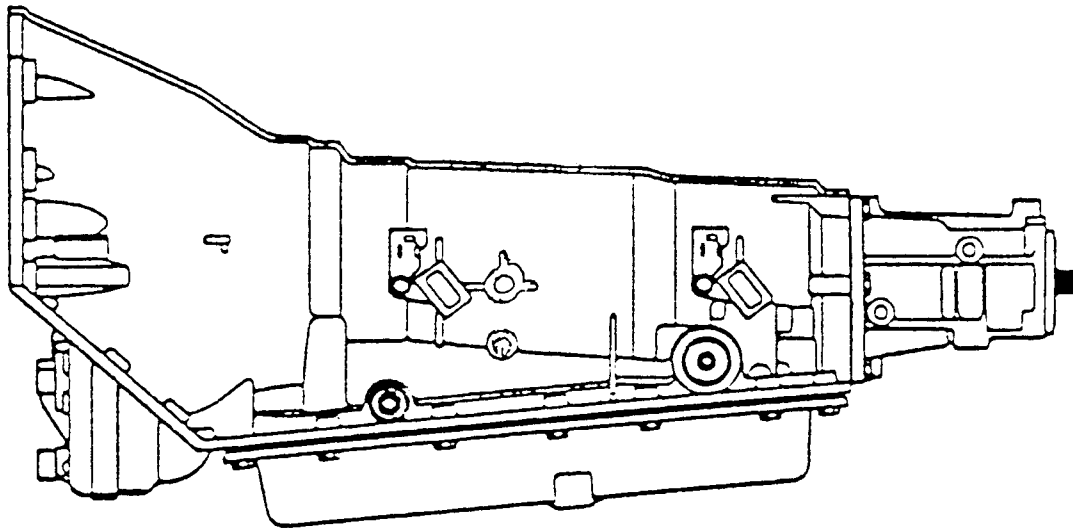


Figure 143

Notes

Notes

General Motors

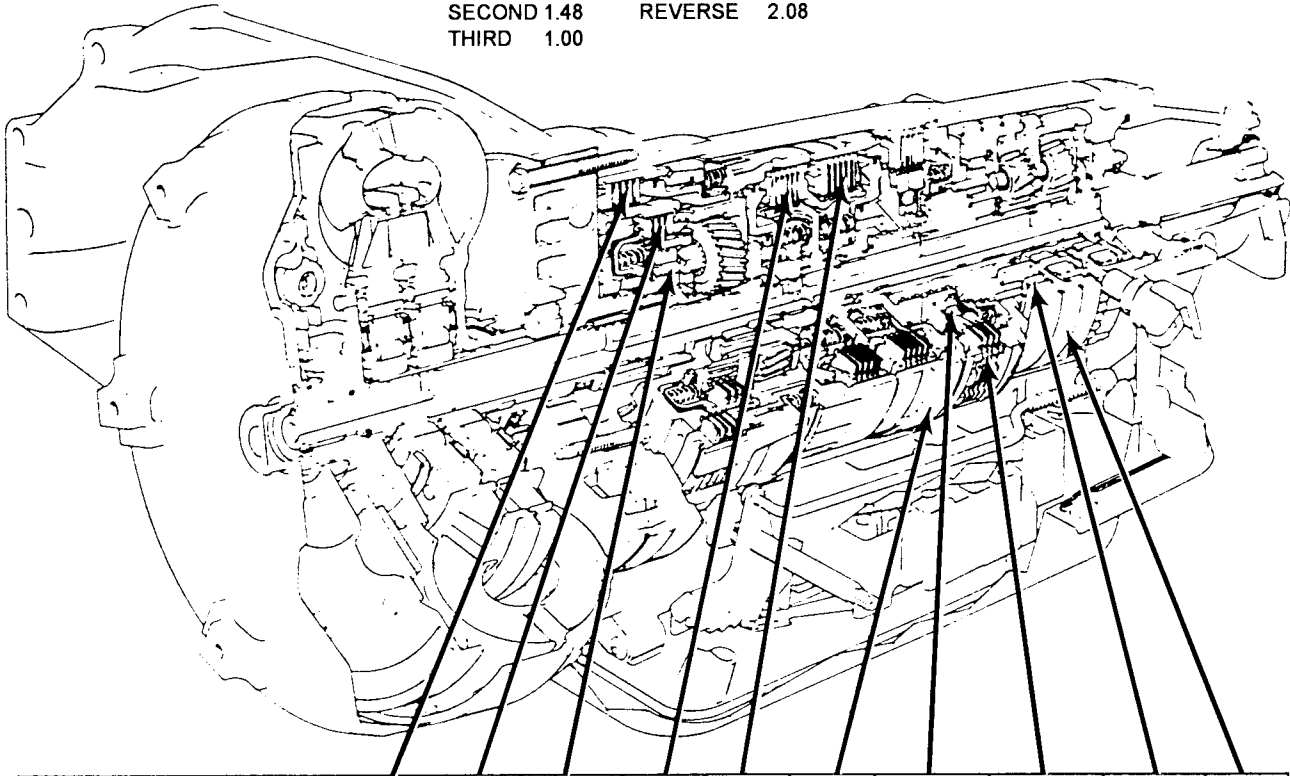


General
Motors

4L80E

HYDRA-MATIC 4L80-E - GEAR RATIOS

FIRST 2.48 FOURTH .75
SECOND 1.48 REVERSE 2.08
THIRD 1.00



RANGE	GEAR	SOLENOID @A	SOLENOID @B	FOURTH CLUTCH	OVERRUN CLUTCH	OVERDRIVE ROLLER CLUTCH	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INTERMEDIATE SPRAG CLUTCH	INTERMEDIATE CLUTCH	LD ROLLER CLUTCH	REAR BAND
P-N		ON	OFF			HOLDING							
R	REVERSE	ON	OFF			HOLDING		APPLIED					APPLIED
D	1st	ON	OFF			HOLDING	APPLIED			*		HOLDING	
	2nd	OFF	OFF			HOLDING	APPLIED			HOLDING	APPLIED	OVERRUNNING	
	3rd	OFF	ON			HOLDING	APPLIED	APPLIED		OVERRUNNING	APPLIED	OVERRUNNING	
	4th	ON	ON	APPLIED		OVERRUNNING	APPLIED	APPLIED		OVERRUNNING	APPLIED	OVERRUNNING	
D	1st	ON	OFF		APPLIED	HOLDING	APPLIED			*		HOLDING	
	2nd	OFF	OFF		APPLIED	HOLDING	APPLIED			HOLDING	APPLIED	OVERRUNNING	
	3rd	OFF	ON		APPLIED	HOLDING	APPLIED	APPLIED		OVERRUNNING	APPLIED	OVERRUNNING	
2	1st	ON	OFF		APPLIED	HOLDING	APPLIED			*		HOLDING	
	2nd	OFF	OFF		APPLIED	HOLDING	APPLIED		APPLIED	HOLDING	APPLIED	OVERRUNNING	
1	1st	ON	OFF		APPLIED	HOLDING	APPLIED			*		HOLDING	APPLIED
	2nd	OFF	OFF		APPLIED	HOLDING	APPLIED		APPLIED	HOLDING	APPLIED	OVERRUNNING	

*HOLDING BUT NOT EFFECTIVE
ON = SOLENOID ENERGIZED
OFF = SOLENOID DE-ENERGIZED

@ THE SOLENOID'S STATE FOLLOWS A SHIFT PATTERN WHICH DEPENDS UPON VEHICLE SPEED AND THROTTLE POSITION. IT DOES NOT DEPEND UPON THE SELECTED GEAR.

NOTE: DESCRIPTIONS ABOVE EXPLAIN COMPONENT FUNCTION DURING ACCELERATION.

Figure 144

4L80E

Electrical Diagnosis Information

The 4L80E is a fully electronically controlled transmission. All upshifts, downshifts, converter clutch applications and line pressure are controlled by activating solenoids. The following pages show the procedures and specifications for internal transmission electrical component testing including solenoids, temperature sensor & pressure switch manifold.

TEMPERATURE SENSOR TESTING

Using a digital ohmmeter check the resistance between terminals G and H (see Figure 146) and compare the reading to the chart below.

TRANSMISSION SENSOR - TEMP TO RESISTANCE (APPROXIMATE)

TEMPERATURE		MINIMUM RESISTANCE Ω	NORMAL RESISTANCE Ω	MAXIMUM RESISTANCE Ω
C°	F°			
-40	-40	80965	100544	120123
-30	-20	42701	52426	62151
-20	-04	23458	28491	33524
-10	14	13366	16068	18770
0	32	7871	9379	10869
10	50	4771	5640	6508
20	68	2981	3500	4018
30	86	1915	2232	2550
40	104	1260	1460	1660
50	122	848.8	977.1	1105
60	140	584.1	668.1	753.4
70	158	410.3	467.2	524.2
80	176	293.7	332.7	371.7
90	194	213.9	241.0	268.2
100	212	158.1	177.4	196.8
110	230	118.8	132.6	146.5
120	248	90.40	100.6	110.8
130	266	69.48	77.29	85.11
140	284	53.96	60.13	66.29
150	302	42.43	47.31	52.20
160	320	32.51	36.13	39.73
170	338	25.13	27.92	30.71
180	356	19.42	21.58	23.74
190	374	15.01	16.68	18.35
200	392	11.60	12.89	14.18

Figure 145

4L80E

Internal Wiring Diagram

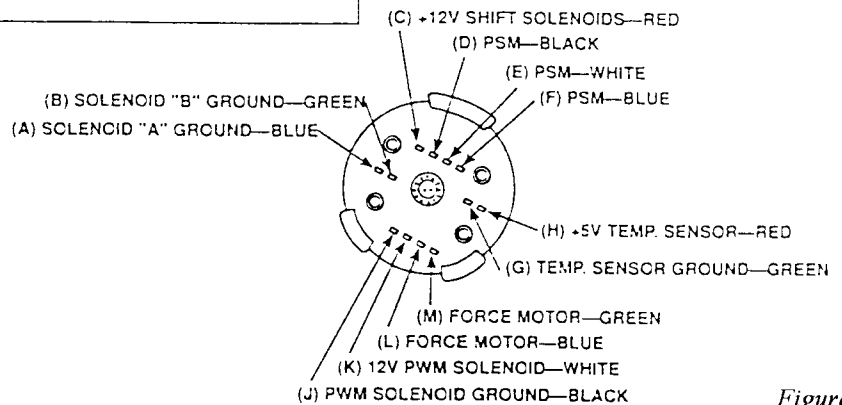
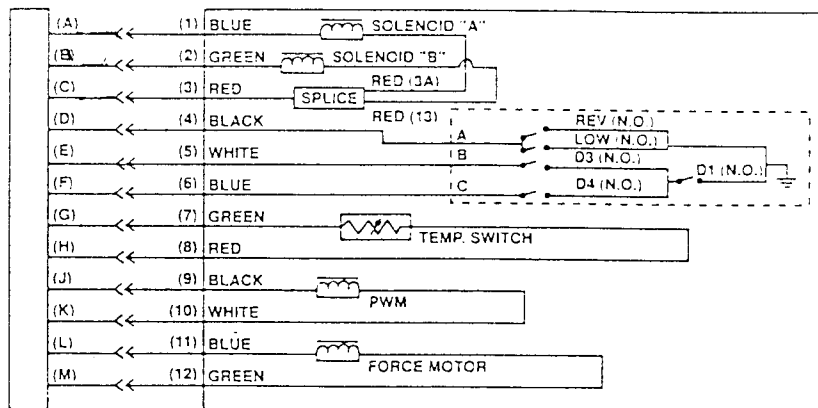
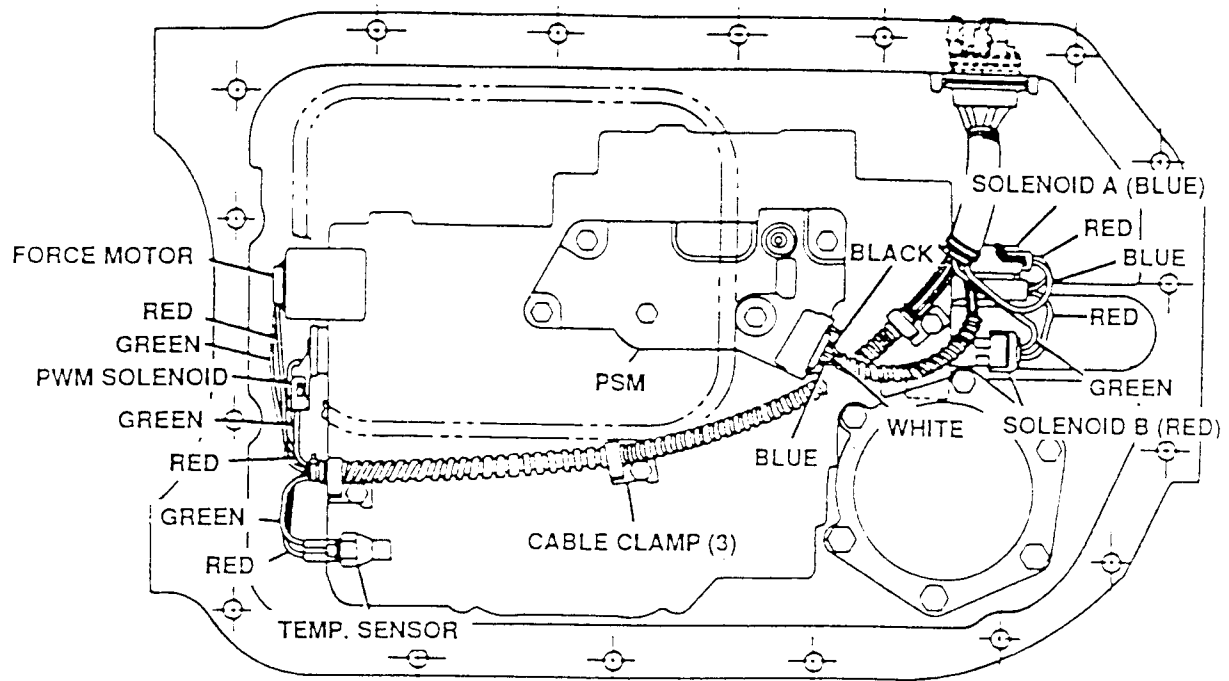


Figure 146

4L80E**Quick Testing****Solenoid Pattern**

D4 RANGE	SOLENOID A	SOLENOID B
1st GEAR	ON	OFF
2nd GEAR	OFF	OFF
3rd GEAR	OFF	ON
4th GEAR	ON	ON

Figure 147

1. Disconnect the case connector.
2. Place gear selector in the OD position.
3. Supply a fused (10 amp) 12 volt supply to terminal C of the case connector.
4. Ground terminal A for 1st gear.
5. Remove the ground from terminal A to shift to 2nd gear.
6. Ground terminal B to shift to 3rd.
7. Ground terminal A and B to shift to 4th.

NOTE: FAILURE OF THE TRANSMISSION TO RESPOND TO "QUICK CHECK" INDICATES A POSSIBLE SOLENOID OR INTERNAL MALFUNCTION. REFER TO FIGURE 149 FOR SOLENOID MECHANICAL FAILURES.

RESISTANCE VALUES

COMPONENT	OHMMETER LEADS BETWEEN TERMINALS	RESISTANCE VALUE
FORCE MOTOR	L&M	3-5 Ω
SHIFT SOLENOID A	A&C	20-50 Ω
SHIFT SOLENOID B	C&B	20-50 Ω
PWM SOLENOID	J&K	10-15 Ω
TEMPERATURE SENSOR	SEE PAGE 121	
PRESSURE SWITCH MANIFOLD	SEE PAGE 125	

Figure 148

4L80E**Solenoid A & B Mechanical Failure Diagnosis**

*(Assumes OD Range Is Selected)
(And No Defaults Present)*

COMMANDED GEAR	SOLENOID A MECHANICAL FAULT	SOLENOID B NORMAL	ACTUAL GEAR
1st	OFF	OFF	2nd
2nd	OFF	OFF	2nd
3rd	OFF	ON	3rd
4th	OFF	ON	3rd
1st	ON	OFF	1st
2nd	ON	OFF	1st
3rd	ON	ON	4th
4th	ON	ON	4th
COMMANDED GEAR	SOLENOID A NORMAL	SOLENOID B MECHANICAL FAULT	ACTUAL GEAR
1st	ON	OFF	1st
2nd	OFF	OFF	2nd
3rd	OFF	OFF	2nd
4th	ON	OFF	1st
1st	ON	ON	4th
2nd	OFF	ON	3rd
3rd	OFF	ON	3rd
4th	ON	ON	4th

Figure 149

4L80E

Pressure Switch Manifold Check (PSM)

The PSM contains 5 normally open pressure switches which are used to indicate the manual control valve position to the PCM. Use the chart below to check the PSM. Figure 150.

IMPORTANT: Since these switches are activated by hydraulic pressure, the engine must be running and the transmission must be capable of producing line pressure.

SHIFTER POSITION	PIN D	PIN E	PIN F
PARK	O	*	O
REVERSE	*	*	O
NEUTRAL	O	*	O
OD	O	*	*
D	O	O	*
2	O	O	O
1	*	O	O

* = Continuity to ground O = No Continuity to ground

Figure 150

FORCE MOTOR/PRESSURE COMPARISON

FORCE MOTOR CURRENT (AMP)	LINE PRESSURE (PSI)
0.02	157-177
0.10	151-176
0.20	140-172
0.30	137-167
0.40	121-147
0.50	102-131
0.60	88-113
0.70	63-93
0.80	43-73
0.90	37-61
0.98	35-55

Figure 151

4L80E

Internal Electrical Component Changes

New Design Temperature Sensor.

Early production 4L80-E's used a temperature sensor that screwed into the valve body. Late style 4L80-E's used a temperature sensor that was integral (built into the harness). The only new harness that is available has the integral type harness. Therefore there are 3 possible arrangements you may encounter:

1. Early design has screw in sensor with wires attached.
2. Late design with no screw in sensor in the valve body, and no wires to attach to it. This design will have the integral sensor harness.
3. Early design that has had a new (integral sensor) harness installed. This arrangement will have the screw in sensor still in the valve body but will have no wires attached to it.

NOTE: 1. All 4L80-E's must have either the screw-in type or integral type fluid temperature sensor.
2. If you install the new design harness on an early unit, the screw-in sensor must not be removed leaving an open hole in the valve body. The hole in the valve body must be plugged, or a large mainline pressure leak will result.

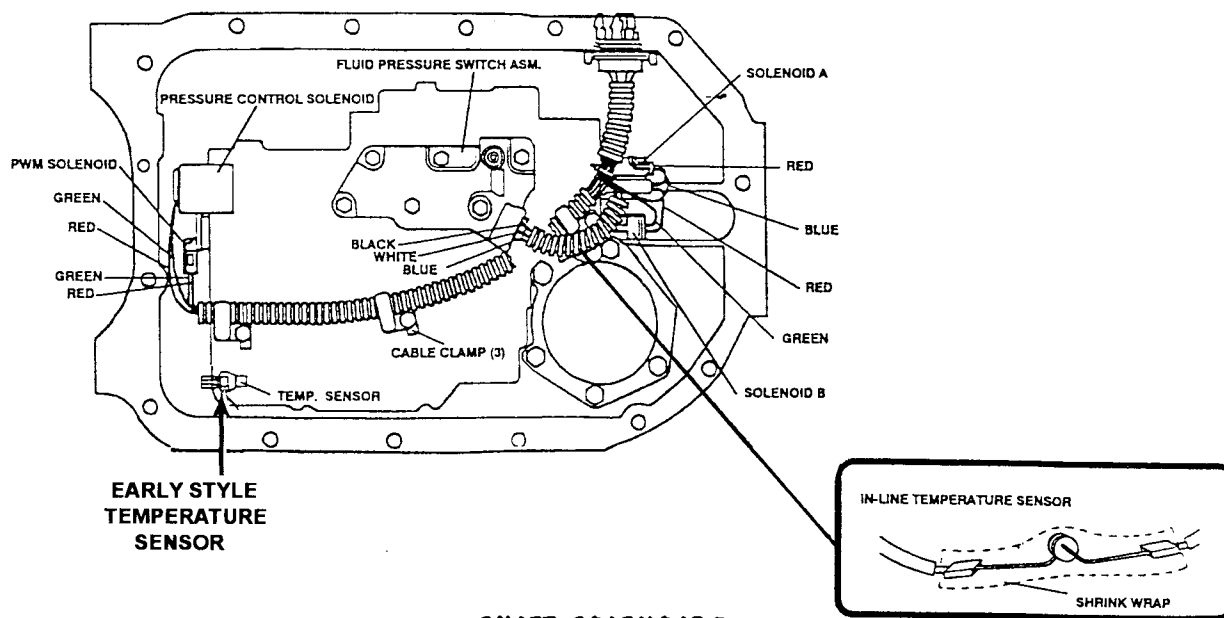


Figure 152

SHIFT SOLENOIDS

Both shift solenoids for the 4L80-E were updated for increased durability. The early design solenoids were Blue (solenoid A) and Red (solenoid B). The new solenoids are gray (solenoid A) and green (solenoid B). It is recommended to update to the new shift solenoids whenever you encounter the early design solenoids.

New Design Solenoids

Solenoid A (Gray) Part #8683081

Solenoid B (Green) Part #8683082

4L80E

Multiple/Intermittent Trouble Codes

A condition of intermittent shift complaints and multiple trouble codes may be caused by the case connector connection. Remove the main connector on the left side of the transmission and look for signs of transmission fluid. Any fluid present in the connector can cause problems.

If the connector is leaking fluid, remove the internal harness. Peel the rubber boot back from the inside of the pass thru connector and clean off all oil residue. Seal the wire holes in the connector with silicone as shown below.

Although this may seem to be an unconventional repair, it has been quite successful.

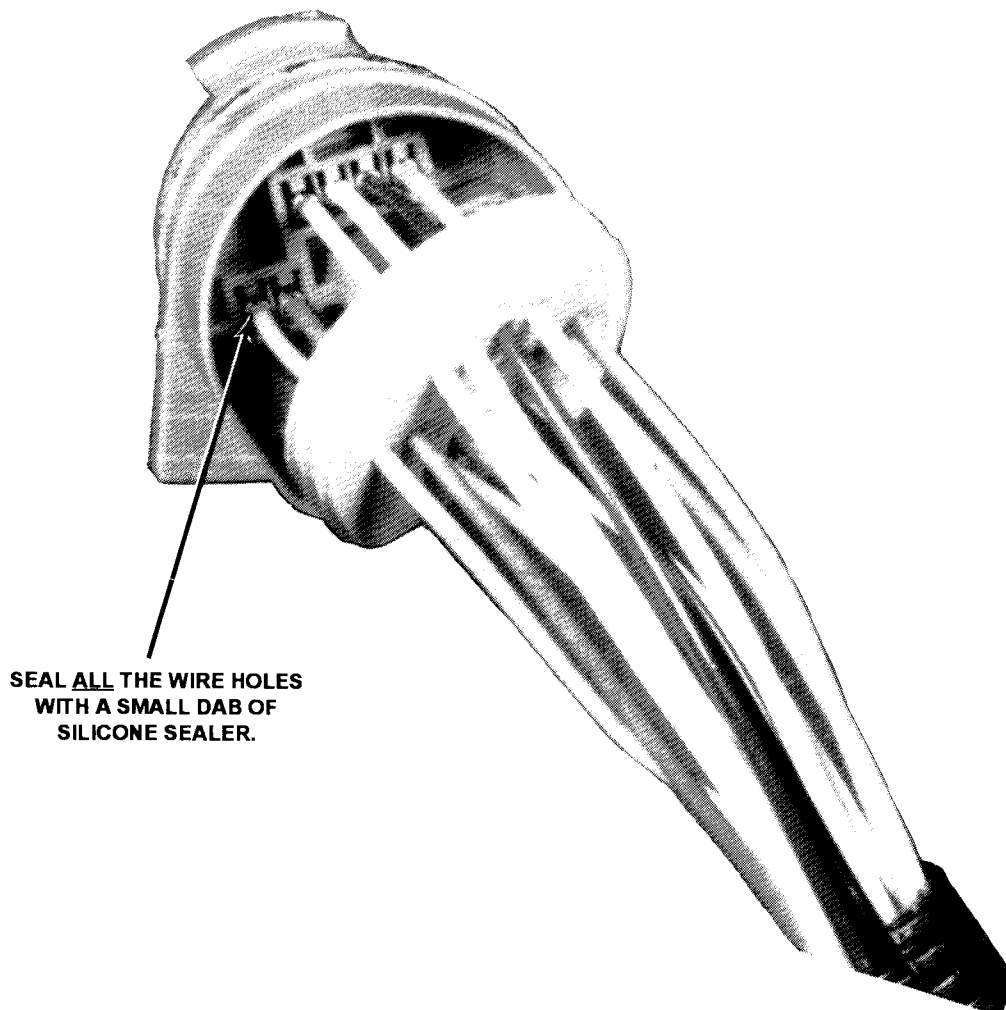
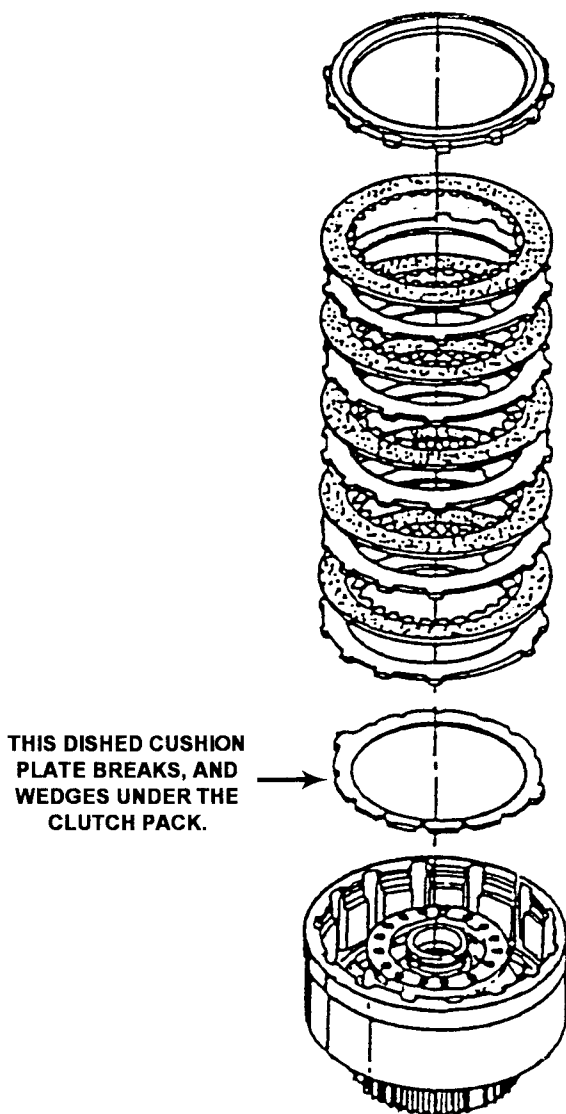


Figure 153

4L80E

Bind in Low/3rd Gear Starts

A 4L80E with a complaint of 3rd gear starts (regardless of electrical commands) accompanied by a bind-up in manual low may be caused by a broken dished cushion plate in the direct clutch. A broken cushion plate will mechanically apply the clutch which causes the complaints. This can give a false code for solenoid B.



NOTE: The part number for the cushion plate is 8680816.

Figure 154

4L80E

Buzzing Noise

A complaint of a buzzing noise on a 4L80E may be caused by pressure instability in the pressure regulator line-up. A service package (Part #8682998) is available to correct this condition. Starting March 15, 1991 (Julian Date 074) all units were built with the new Pressure Regulator Assembly.

Mismatching certain 1st and 2nd design components will cause uncontrollable line pressure. Use all 1st design components together, or preferably, all 2nd design components.

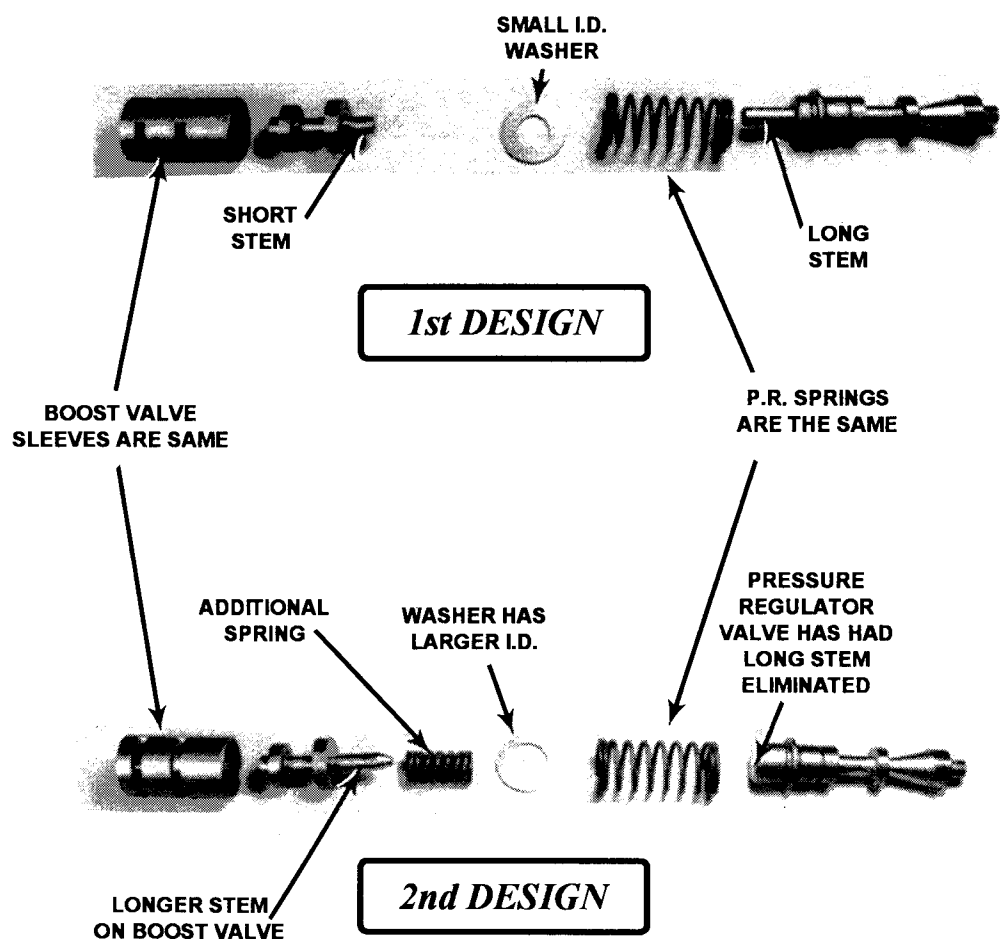


Figure 155

4L80E

No Line Pressure Rise

A complaint of no line pressure increase may be caused by using early valve body gaskets on late units. The wrong gaskets will cover a hole in the plate which feeds the boost valve. The late gaskets fit both the late and early spacer plates.

Late model case gasket..... 8680593

Late model valve body gasket..... 8680583

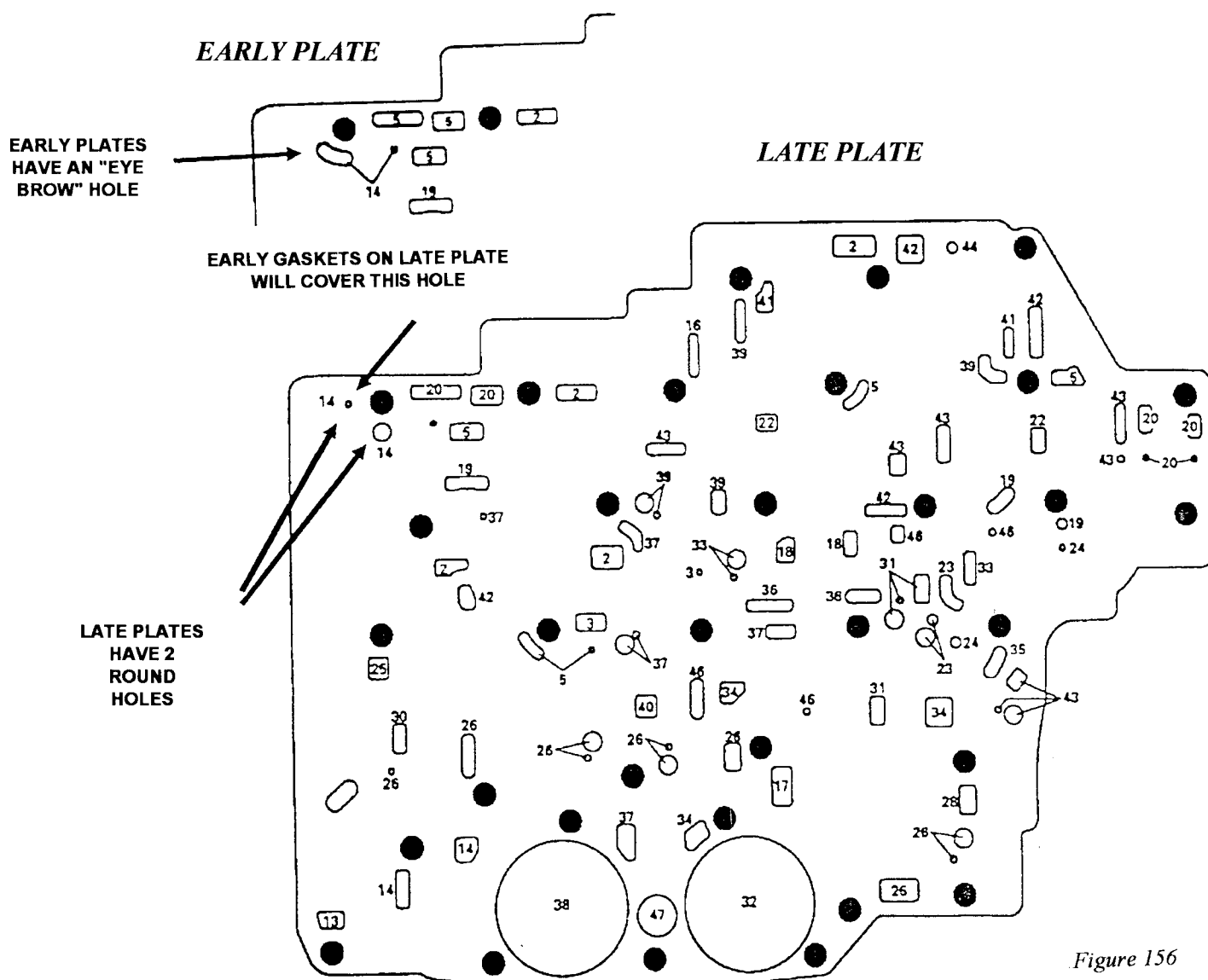


Figure 156

700R4

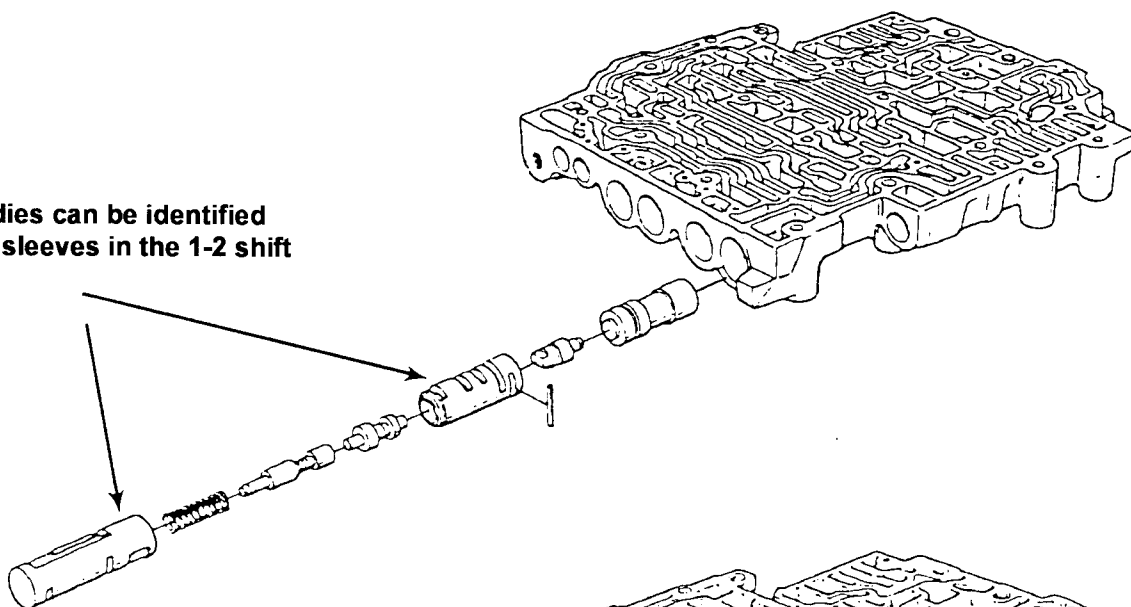
Valve Body Interchange

Late model 700R4 valve bodies can be exchanged if the spacer plate and checkball locations are matched to valve body. To determine proper interchange refer to the four steps on the following pages.

STEP 1

Identify the year of the valve body.

82-87 valve bodies can be identified by 2 aluminum sleeves in the 1-2 shift valve line-up.



All 1988 or later valve bodies have only one very long aluminum sleeve.

Beginning in 1989 the converter clutch throttle valve bore was eliminated and a notch was machined in the worm tracks.

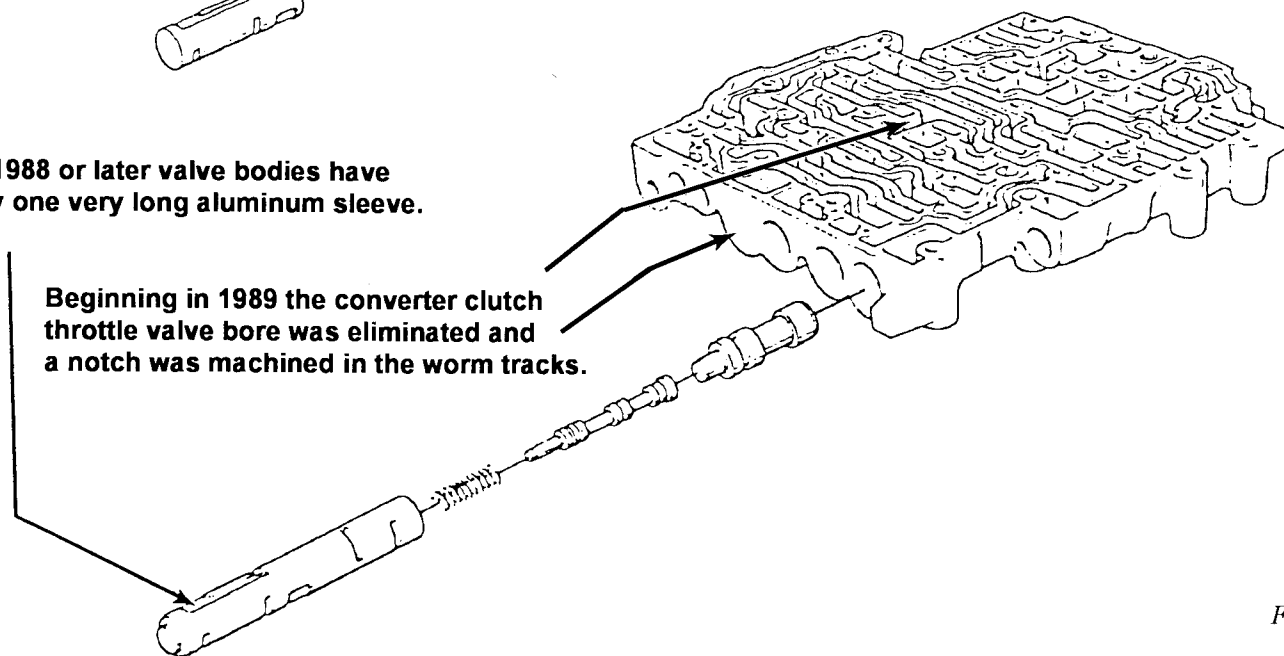


Figure 158

Valve Body Interchange (Continued)**STEP 2**

Identify the valve body type. This is necessary to match the valve body to the spacer plate. There are two types for each year (87 and later) determined by the design of the line bias valve.

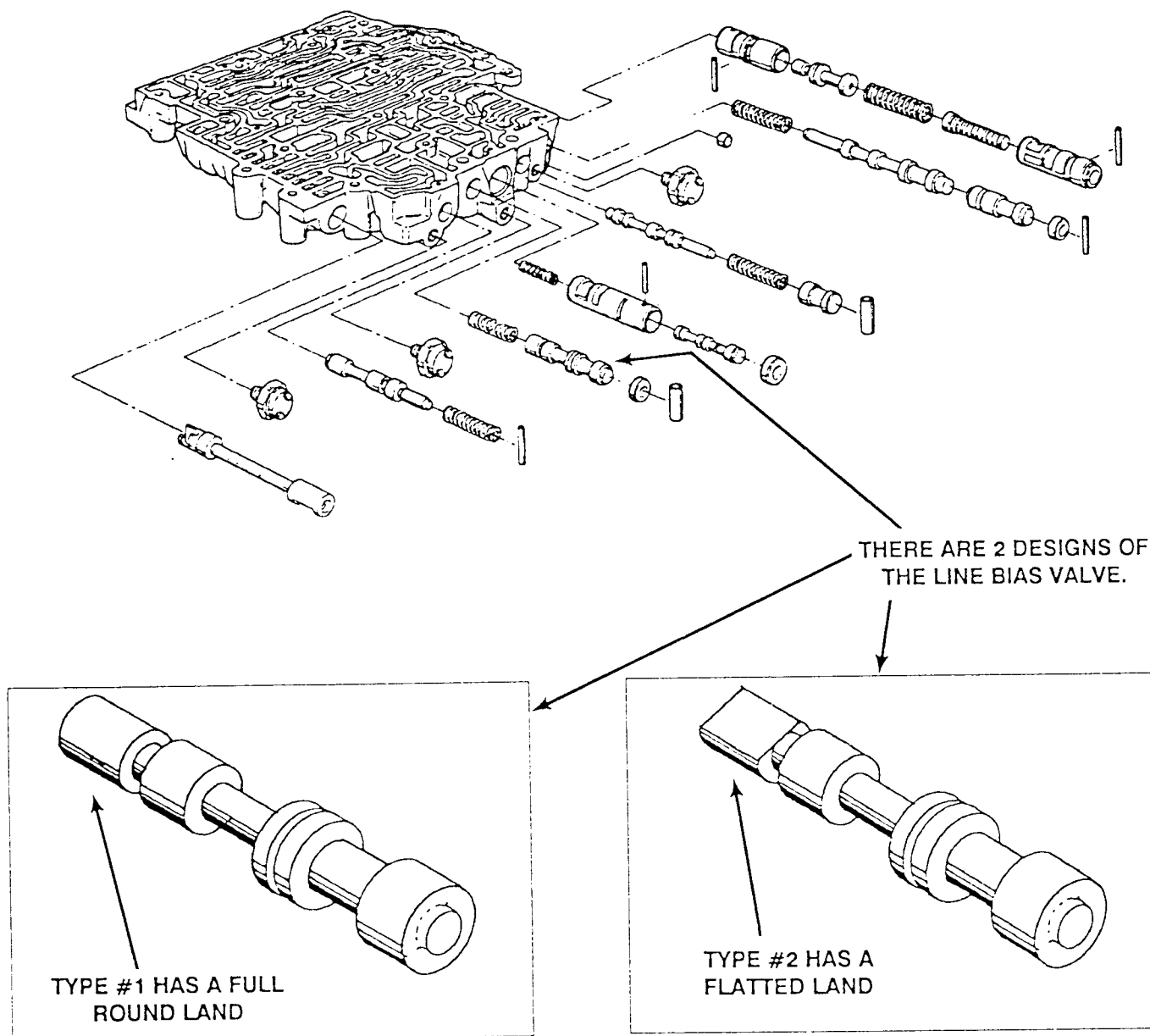
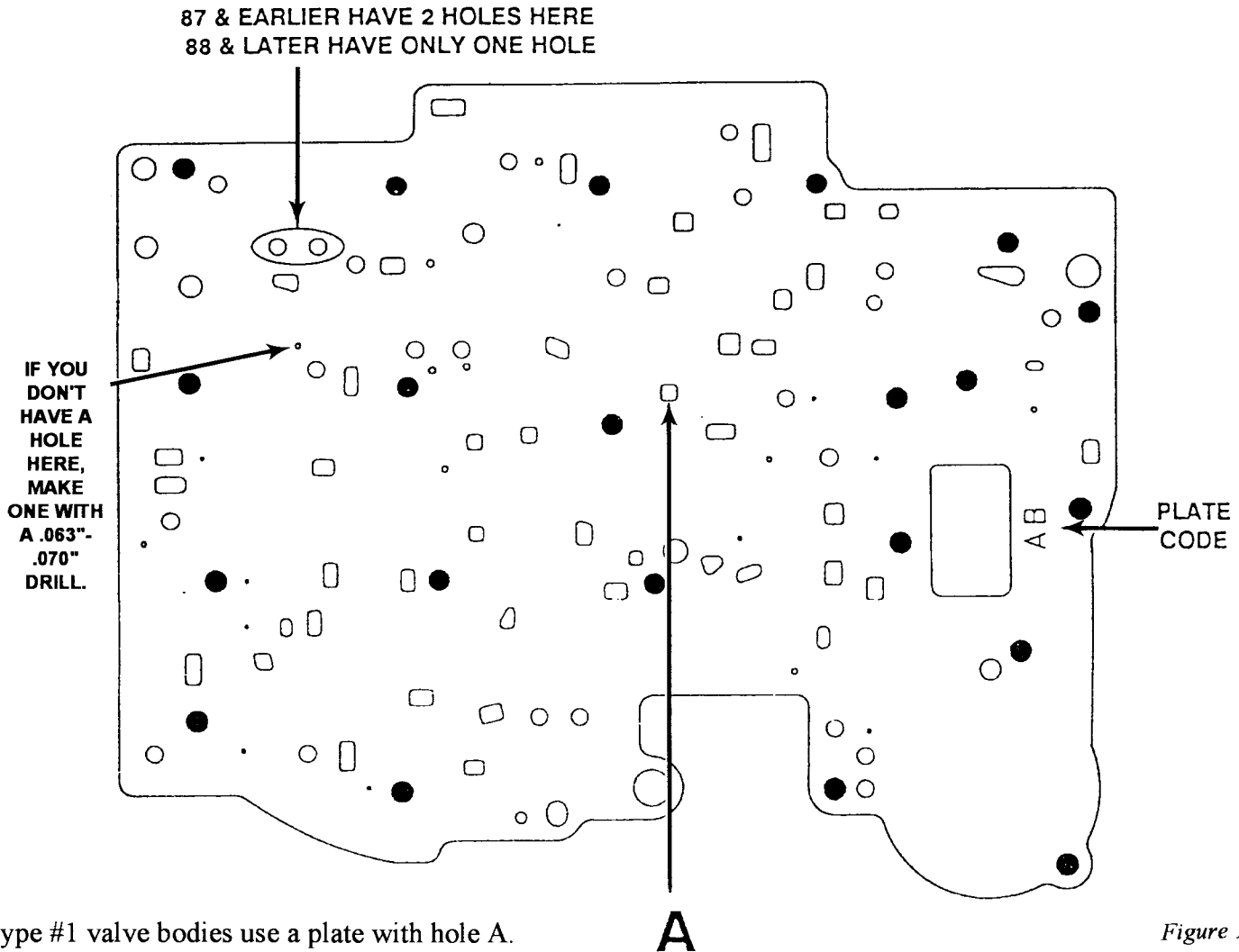


Figure 159

Valve Body Interchange (Continued)**STEP 3**

Identify the spacer plate. The spacer plate must be matched to the year and type of the valve body.



Type #1 valve bodies use a plate with hole A.
Type #2 valve bodies use a plate without hole A.

Figure 160

PLATE CODES

Beginning in 1987 GM started using 2 letter codes to identify the spacer plates. The first letter of the code is used to determine the year of the plate.

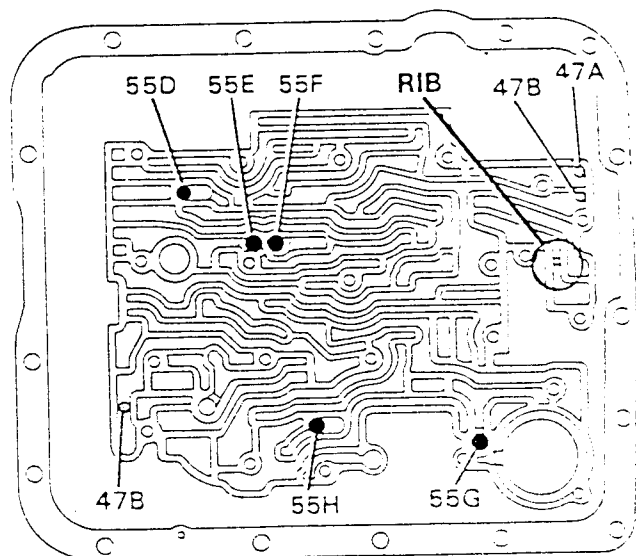
If the first letter is:

- A = 1987 cars and trucks
- B = 1988 cars and 1988, 1989, 1990 trucks
- C = 1989, 1990 (cars only)
- D = 1990 and later diesels

Valve Body Interchange (Continued)

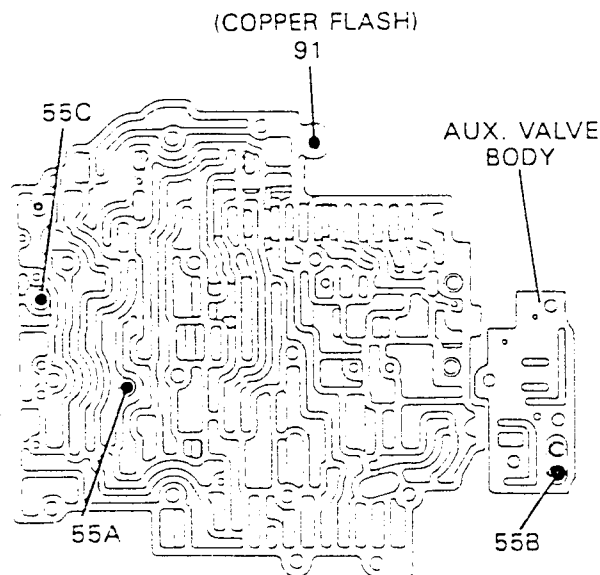
STEP 4

Identify the proper check ball location according to the year of the valve body and plate.



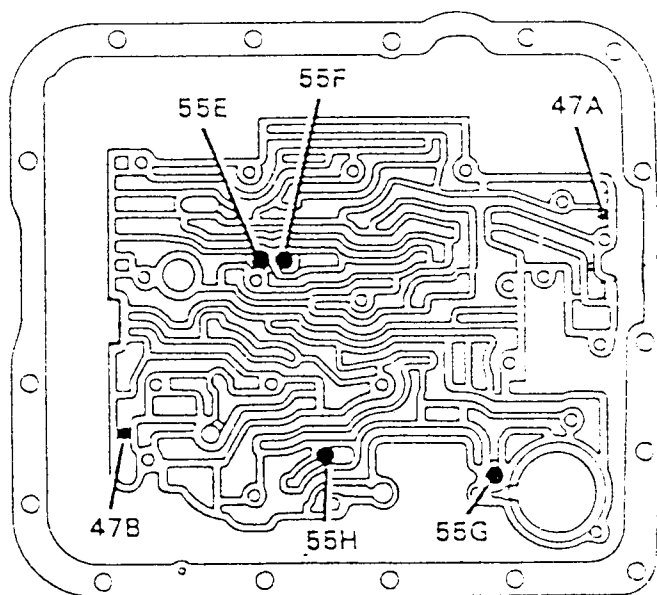
CASE CHECKBALL LOCATIONS WITH
AUXILLARY VALVE BODY - 1987 ONLY

Figure 161



VALVE BODY CHECKBALL LOCATIONS FOR
1987-1992 MODELS WITH AUXILLARY VALVE BODY

Figure 163



CASE CHECKBALL LOCATIONS FOR ALL
1988 AND LATER MODELS

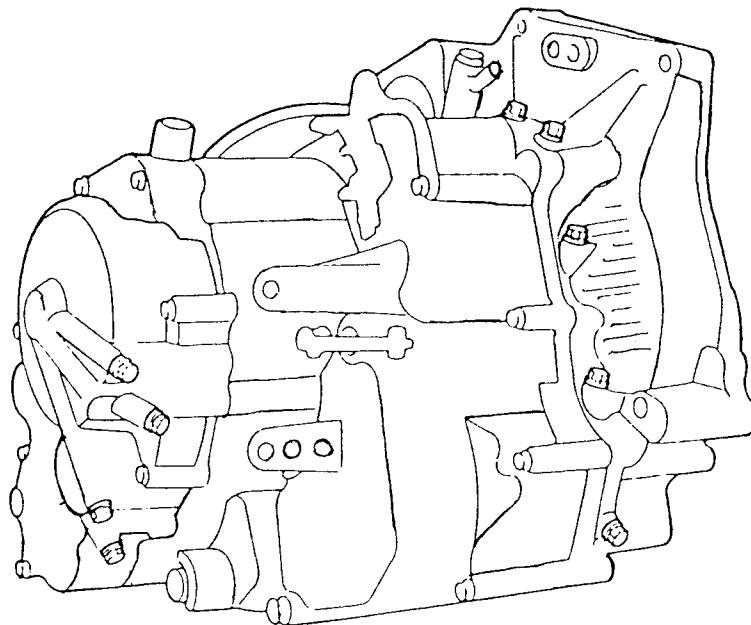
Figure 162

1. The worm tracks in the auxillary valve body cases are the same from 87-92 model years so the valve bodies & plates will interchange from year to year.
2. The type #1 valve bodies and plates are preferred in severe duty vehicles.
3. If you have an 89 or later and you want to use a TCC valve, use an 87 or 88 valve body and plate.
4. Keep in mind there are also calibration differences between valve bodies that will not allow acceptable driveability characteristics. (i.e. Using a diesel valve body on an S-10 etc.)

Notes

Notes

Honda-Acura



Honda/Acura 4-Speeds

Noise going into and/or out of reverse

To fix a Honda that grinds in Reverse and/or out of reverse you first need to understand how it works. The normal position (i.e. park, neutral, drive, 3rd and 2nd) of the reverse/4th gear set is shown in the figure below. When the manual control valve is moved to the reverse position, oil charges the bottom of the reverse position, oil charges the bottom of the reverse servo including port E located on the servo including port E located on the servo. As the servo moves up, port C & B will be connected. At this point, the reverse gear selector will be engaged to the reverse gear and the reverse servo oil can now flow out port B to apply the 4th clutch. When the manual control valve is moved out of reverse, pressure at port D will move the servo down to engage the 4th gear. As the servo approaches the gear position 4th clutch oil will exhaust thru port A.

The grinding occurs when the reverse gear selector is between the two gears. During this time the gear set is momentarily in neutral. If the gears start turning, you'll get a grind.

NEVER shift a Honda into or out of Reverse while the car is moving.

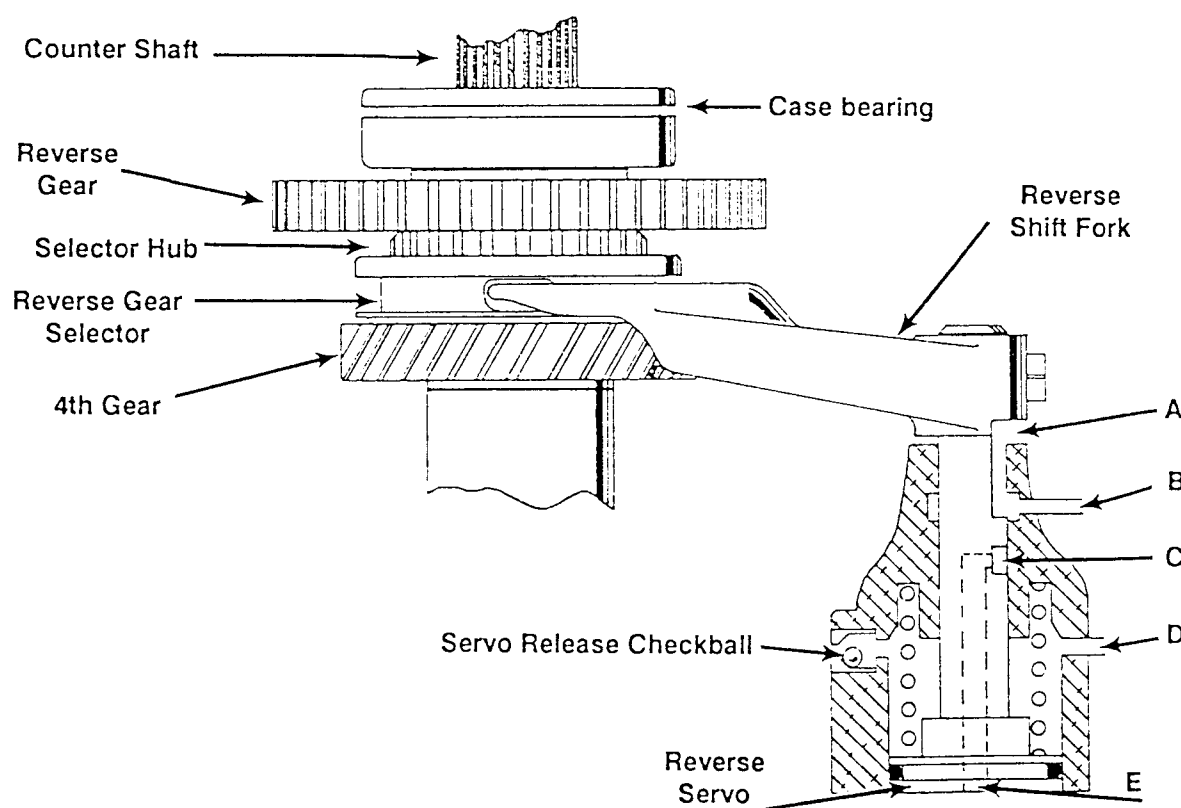


Figure 164

NOTE: Keep in mind, all Honda's with this type of gear set will chunk going into and out of reverse.

Noise going into and/or out of reverse (Continued)

THINGS TO CHECK BEFORE A REBUILD

LINE PRESSURE

Low line pressure will slow the rate that the servo will move. The longer it takes to move the shift fork from one range to another, the greater the opportunity for the gears to grind.

WHAT TYPE OF OIL IS IN THE TRANSAXLE?

See if the transaxle has been serviced recently. Some oils like "F" can cause the 4th clutch to drag. Honda oil works best.

CHECK TO MAKE SURE THE MAINSHAFT AND COUNTER SHAFT AREN'T BENT

If you can get the end cover off, rotate the two shafts and make sure they're not bent. This can cause a mechanical bind.

THINGS TO CHECK DURING A REBUILD

1. CHECK THE REVERSE/4TH GEAR SET FOR WORN TEETH

Worn teeth on these parts are not normally the cause of the noise but the result of these gears grinding. It is important for the smooth operation of this transaxle that these parts not be worn. If they are worn replace the gear set.



Figure 165

Noise going into and/or out of reverse (Continued)

2. 4th CLUTCH CLEARANCE

A Tight 4th clutch pak will cause excessive drag. The clearance in the 4th clutch should be .016"-.024" on all models except AK: .016"-.028" and AS: .016"-.023". It may be to your advantage to favor clearances to the loose end of the specs.

3. FRICTION MATERIAL

The type of friction material used will influence how the 4th clutch releases out of reverse. If the clutch doesn't break loose or if it drags, the transaxle will grind. Always use top quality frictions. When in doubt, use factory frictions. It is important to check the clutch plates for flatness.

4. CHECK THE 4th/REVERSE HUB CLEARANCE

Assemble the mainshaft (including the case bearing) and tighten the nut to 25lb ft. The Reverse/4th hub should have .003"-.006" endplay. If you don't have any clearance, you have a misassembly or a worn Reverse/4th bearing collar.

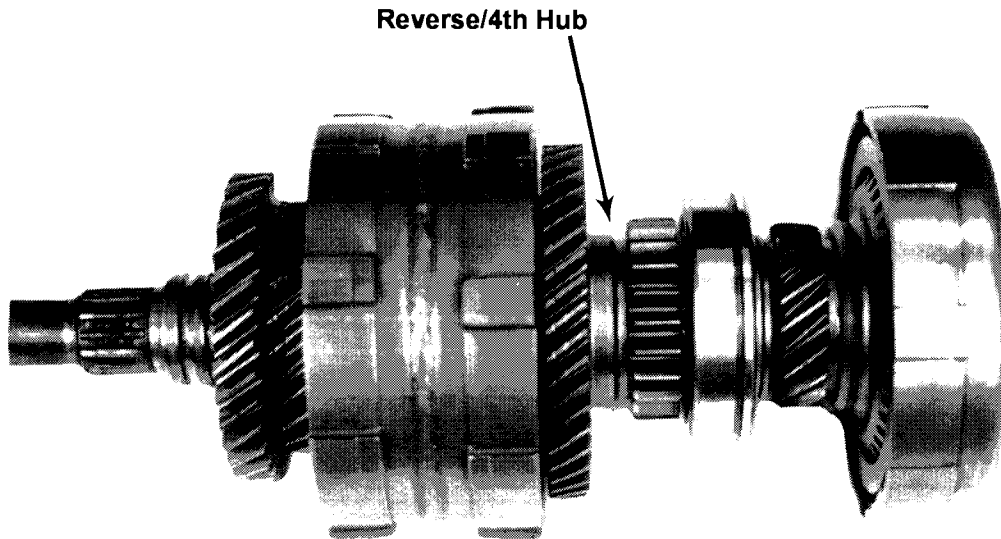


Figure 166

NOTE: The Reverse/4th bearing collar is the part that the needle bearing rides on.

Noise going into and/or out of reverse (Continued)

5. SERVO SHAFT & BORE

Make sure the servo shaft and bore are not scored. A damaged shaft or bore can bind the servo. The servo must be allowed to move quickly from one gear to another.

6. SERVO SHAFT BOLT

Make sure the servo has a shouldered bolt. Using a shouldered bolt on the servo will prevent you from bolting the servo shaft in backwards. Bolting the servo in backwards will restrict port "A" (Page 138) which is the 4th clutch exhaust out of reverse.

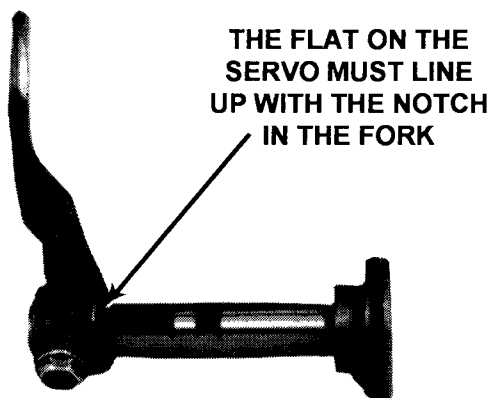


Figure 167

7. MAKE SURE THE SERVO CONTROL VALVE ISN'T STUCK

Some models have a servo control valve. This valve controls the rate of the servo apply & release.

NOTE: Models without a servo control valve use an orificing checkball.

8. SERVO RELEASE CHECKBALL

Make sure this checkball does not leak. If it does, the servo will not release fast enough. (See the illustration on Page 138.) This will cause a grinding noise when you shift out of reverse.

9. 1st CLUTCH FEED PIPE BUSHING

Noise from Drive to Reverse can be caused by a worn 1st clutch feed pipe bushing. If this is so, there will be a small amount of oil pressure at the 4th gear tap in drive. (Check it with the wheels stationary.) This may also cause 4th clutch failure.

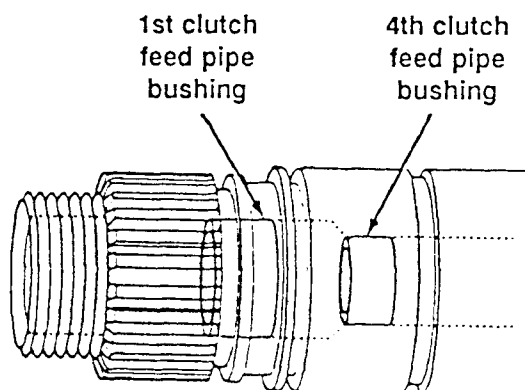


Figure 168

Honda/Acura 4-Speeds

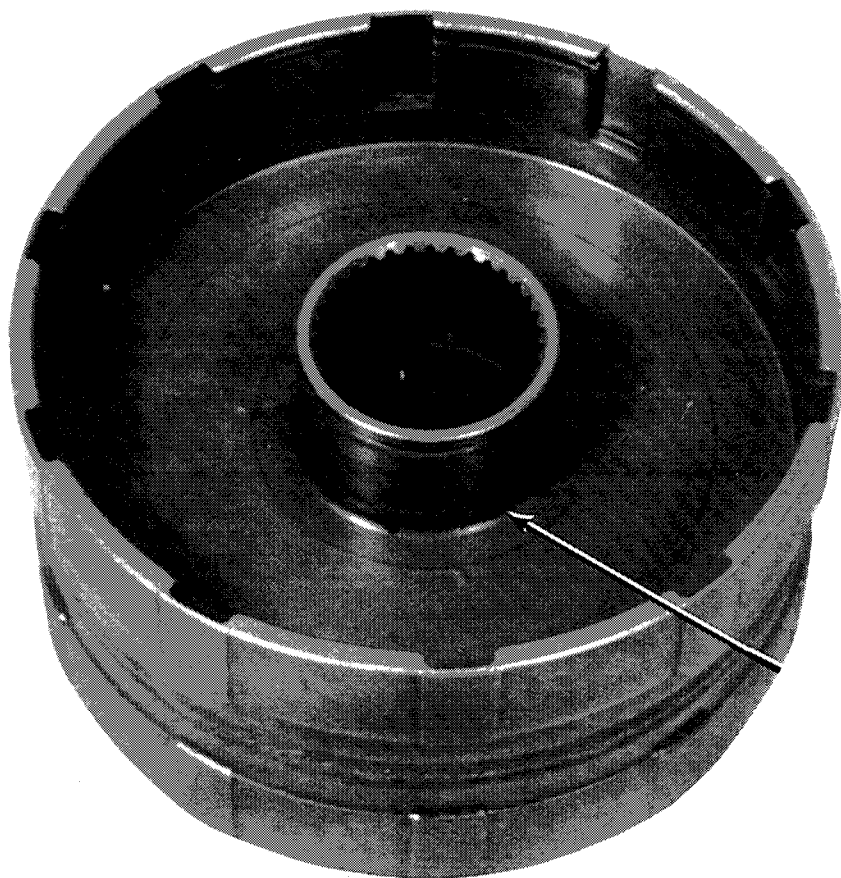
Bind in 4th, Burnt 2nd and/or 4th Clutches

A bind-up in 4th, and burnt 2nd and/or 4th clutches may be caused by a cracked 2/4 drum. Inspect the area around the hub, **VERY CLOSELY**, for cracks.

DIAGNOSTIC HINT: If a pressure gauge on the 2nd clutch tap shows pressure when in 4th gear, it indicates the possibility of a cracked drum.

Keep in mind that because of the valve body circuitry, no pressure should be present in the 4th gear circuit when in 2nd gear.

**This information
applies only to units
equipped with a 2/4
drum assembly.**



**LOOK
FOR
CRACKS
HERE**

Figure 169

Honda/Acura 4-Speeds
Bind In Reverse

After overhaul, complaints of bind up in reverse, and/or drives forward in neutral may be caused by either a hydraulic or mechanical problem. The first diagnostic step is to determine if the root cause is mechanical or hydraulic.

Check pressure on the first, second, and third clutch taps with the engine running and the gearshift in reverse.

If there is pressure in any of these circuits a hydraulic malfunction exists, such as missing or undersized accumulator rings, crossleaks, etc.

No pressure in any of these circuits indicates a mechanical problem such as improper geartrain clearance (most common), mis-assembled first clutch, or insufficient clutch clearances. It is extremely important to check and adjust the clearances, even if no hard parts are changed. The following pages show the factory recommended procedures on checking and adjusting clearances for the most common models.

CHECKING AND ADJUSTING GEARTRAIN END-CLEARANCES

COUNTERSHAFT ASSEMBLY

- STEP 1
- Assemble the entire countershaft with the case bearing on the shaft and torque the nut to the specifications shown in figure 170.

MODELS	TORQUE
CA, AK, AS, F4 CA, G4	25 ft. lbs.
L4, S5, K4, P1, L5 ML4A, MPSA	22 ft. lbs.

Figure 170

Bind In Reverse (Continued)

COUNTERSHAFT ASSEMBLY (Continued)

STEP 2

A. Measure the clearance between the shoulder on the selector hub and the shoulder on 4th gear.

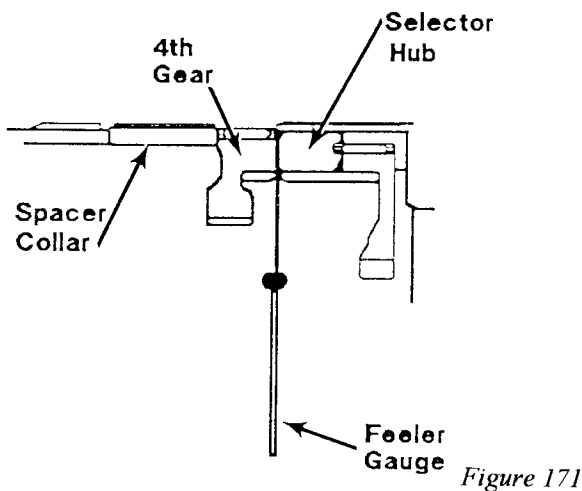
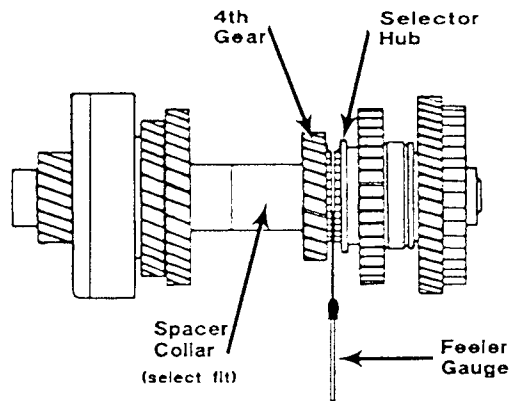


Figure 171

B. If clearance exceeds the service limit, replace the spacer collar with one that gives the correct clearance.

Countershaft 4th Gear Clearance: .003-.006 in.

STEP 3

A. Slide the 3rd gear towards the 3rd clutch. Measure and record the clearance between the 2nd and 3rd gears with a feeler gauge.

NOTE: Leave feeler gauge in place (4th gear) while measuring 2nd gear clearance.

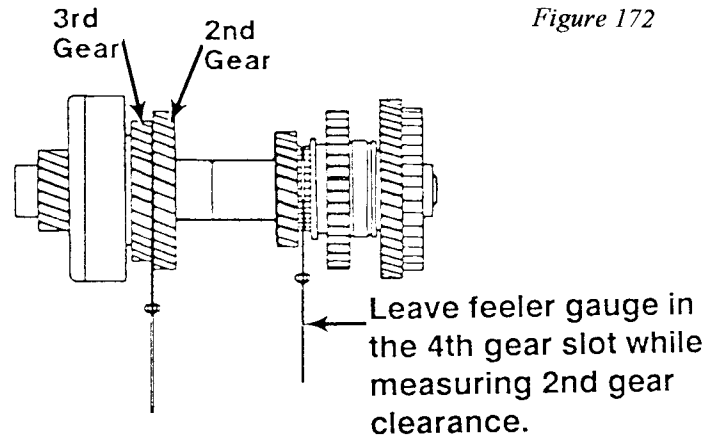
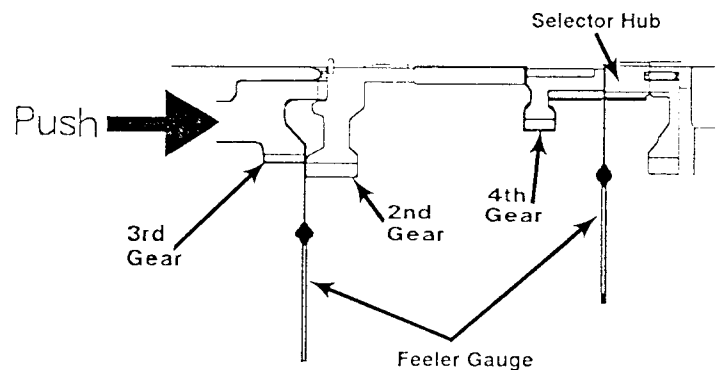


Figure 172

B. Now slide the 3rd gear towards the 2nd gear and measure the clearance between the 2nd and 3rd gears with a feeler gauge.



C. Calculate the difference between the two readings to determine the actual clearance between the two gears.

D. If clearance exceeds service limit, measure the thickness of the splined thrust washer and replace it with one which gives the proper clearance.

Countershaft 2nd Gear Clearance: .003-.006 in.

Bind In Reverse (Continued)

MAINSHAFT ASSEMBLY

STEP 1

Assemble the entire mainshaft including the case bearing and torque the nut to the specifications shown in table 1.

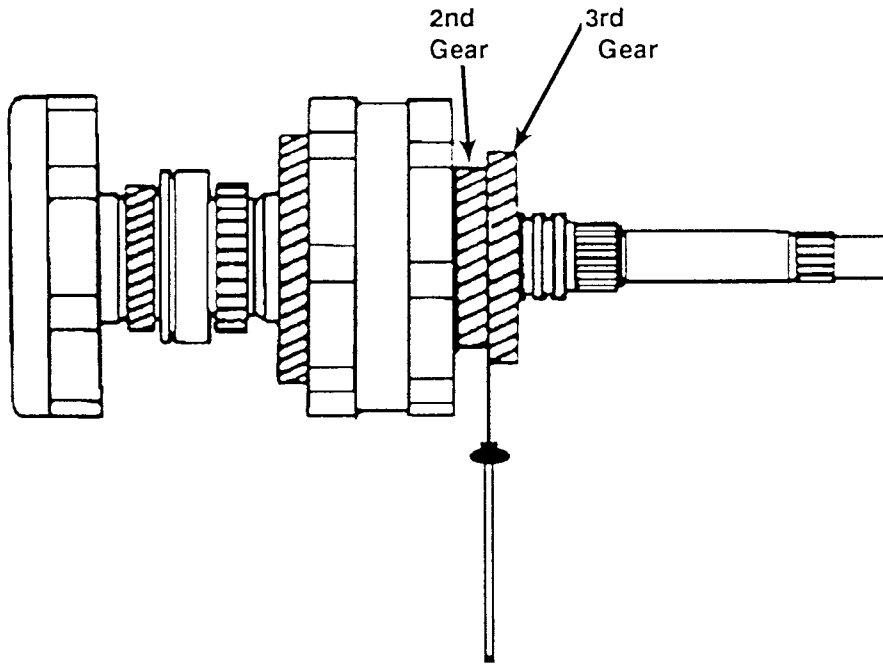


Figure 173

STEP 2

A. Measure the clearance between the shoulder of 2nd gear and main 3rd gear, the same way you did on the countershaft.

Mainshaft 2nd Gear Clearance: .003-.006 in.

B. If the clearance exceeds the service limit, measure the thickness of the 2nd clutch thrust washer and replace it with one that gives the correct clearance.

NOTE: The 2nd clutch thrust washer is between the 2/4 drum assembly and the 2nd gear bearing.

Mainshaft and Countershaft clearance adjustment procedures for some models are too lengthy and involved to be included in this handout. Refer to the appropriate service manual for complete clearance adjustment procedures on the models listed below.

RO, PX4B, APX4, MPRA, PL5X, MPYA

Bind In Reverse (Continued)

FINAL ASSEMBLY

STEP 1

Torque the countershaft nut to the specifications listed below.

MODEL	TORQUE
CA, AS, G4	70 ft. lbs.
L4, S5, F4, K4, P1, L5 ML4A, MPSA, MY8A	102 ft. lbs.

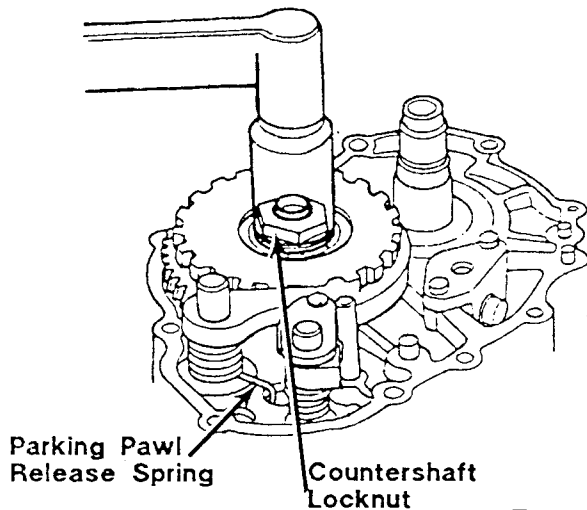


Figure 174

STEP 2

Torque the mainshaft nut to 70 ft. lbs.

CAUTION: Locknut has left-hand threads.

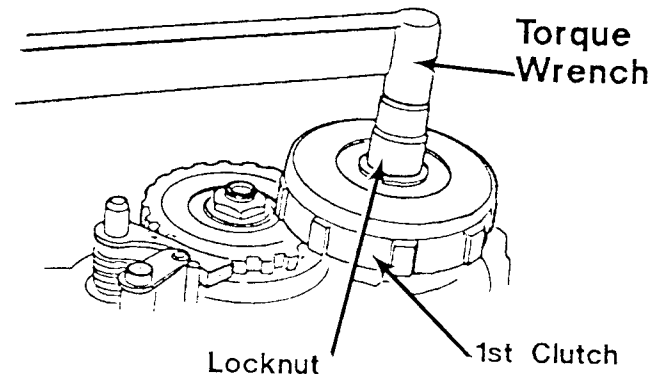


Figure 175

STEP 3

Once the nuts are torqued, hold the 1st gear stationary and make sure the 1st clutch drum will rotate in both directions.

If the drum does not rotate back & forth, clearance is incorrect, or a clutch may be misassembled.

If the drum will rotate back & forth then stake the nuts in place, and finish assembly the unit.

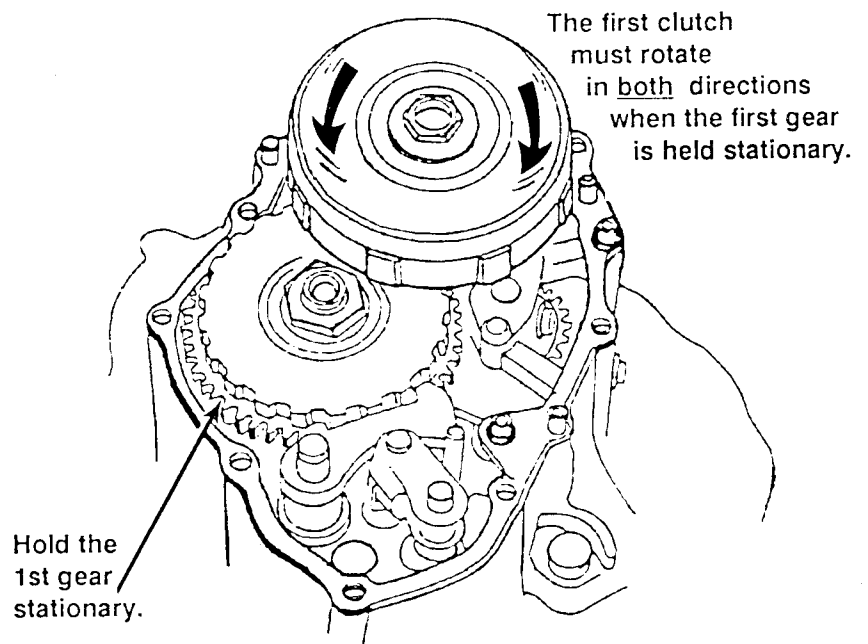


Figure 176

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Visual aids (slides, etc.)	1	2	3	4	5	6	7	8	9	10
Lunch	1	2	3	4	5	6	7	8	9	10
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TECHNICAL SEMINAR

Technical Seminar



Technical Seminar

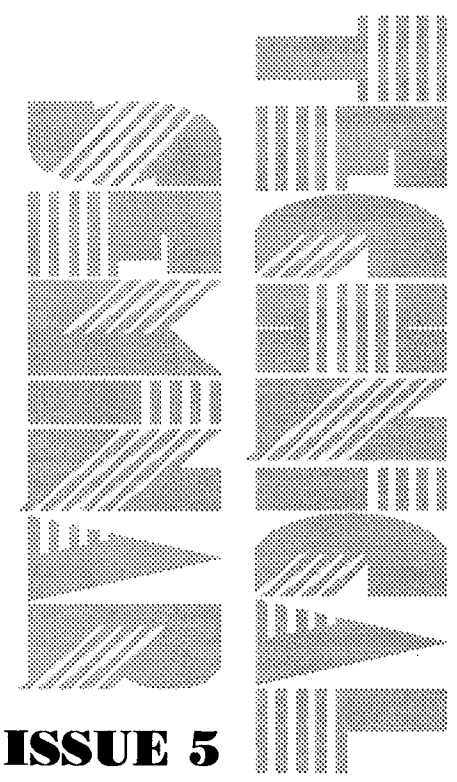
TECHNICAL SEMINAR



Technical Seminar

Technical Seminar

ISSUE 5





Technical Seminar

Automatic Transmission Rebuilders Association

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Electronics

Hydraulics

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General
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Glossary

ELECTRONICS

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Notes

Inside or Outside

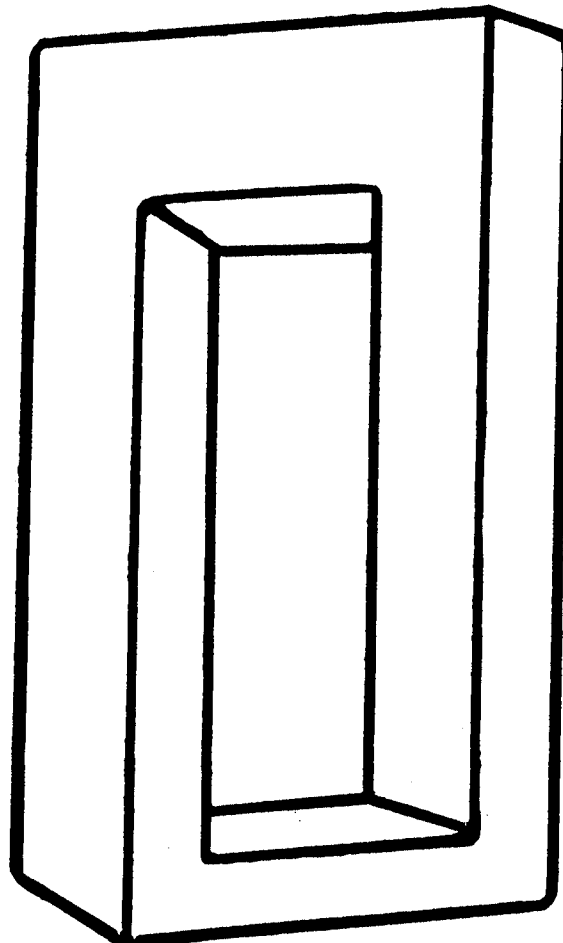
That Is The Question

The purpose of the following section is to help you pinpoint the answer to the question of, "Is the problem you're trying to figure out being caused by something inside the transmission? Or is the cause of the problem in the external control system?" This question **MUST** be accurately answered before going any further in your diagnosis.

There are many diagnostic testers and scan tools available to you today. The aftermarket manufacturers have done an excellent job providing you with ways to 'look into' a control system to see what's happening. And, of course, the auto manufacturers all have their own dedicated diagnostic equipment designed for their specific make.

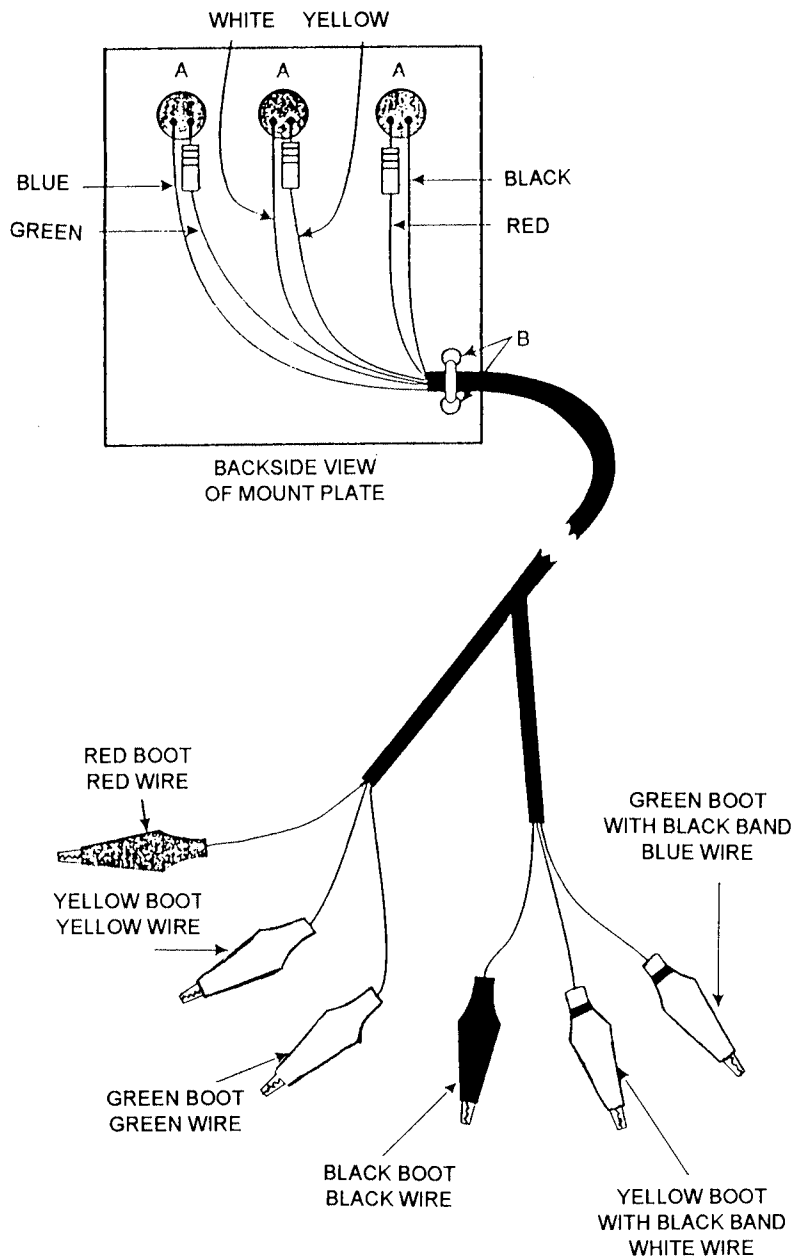
But what if you don't have the scan tools yet? Or maybe you want a 'second opinion' of your scan tool results?

That's what this section is about. A method of answering that all important 'Inside or Outside' question.



Computer Signal Monitor

This computer signal monitor will save you hundreds of hours troubleshooting electronically shifted transmission complaints. Easy to build, easy to hook-up, and fairly inexpensive, this tool is sure to pay for itself many times over. Best of all, since current draw is only .025 amps, it won't damage sensitive computer circuits the way old fashion test lights can. Make one TODAY, you'll probably need it tomorrow!



PARTS LIST

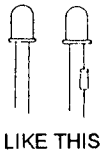
QTY	DESCRIPTION	RADIO SHACK#
3	Jumbo LED	276-086
2 (2 per pack)	470 Ω Resistor	271-019
1 (10 per pack)	Alligator Clips or Bed of Nails Clips (See below)	270-378
1	25', 6 Conductor Phone Cord	279-422
1	Radar Detector Mount Plate	270-034
1	Shrink Tubing	278-1627
1	Small Wire Tie Strap	
	Solder	

TOOLS REQUIRED

SOLDERING IRON
WIRE CUTTER/STRIPPER
DRILL
25/64" DRILL BIT & 3/16" DRILL BIT

INSTRUCTIONS

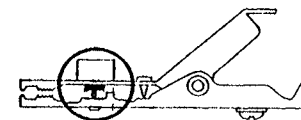
1. Drill three 25/64" holes in mount plate for LED's (Location A). Drill two 3/16" holes for tie strap (Location B).
2. Trim long leg (+) of LED's to 1/2" and solder resistors to each of the cut legs.



3. Cut end off phone cord and strip grey jacket back 2". Strip colored insulation back 3/8".
4. Snap LED's into holes and solder wire as shown in diagram. Cut 1" long pieces of 1/16" shrink tubing and put over wires before you solder them. After soldering, slip tubing over bare wires.
5. Cut harness length to approximately 12'.
6. Strip grey jacket back 2' from end. Place the Red, Green & Yellow wires in one length of 1/8" shrink tube; and Blue, Black and White wires in the other piece.
7. Cut two 1/4" long pieces of 1/4" shrink tube, and place on one Yellow boot and one Green boot. These Black bands will be wire identification markers.
8. Place boots over wires as shown and solder clips onto wires. Be sure to put the boots over wires before you solder clips on.
9. Paint the backside of the LED's Black to prevent sunlight from shining through them.

HOOK

Hook-up instructions are on the next page.

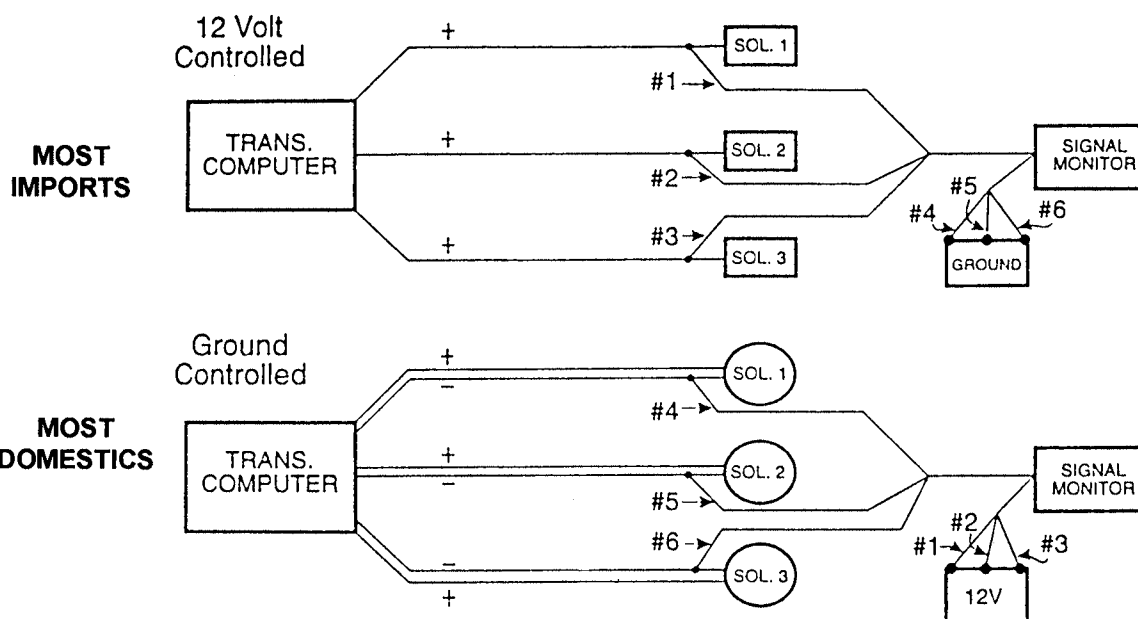


Bed of Nails clips
Manufactured by
J.S. POPPER, INC.
P.O. Box 412
200 Liberty Street
Little Ferry, NJ 07643
(201) 641-3252 -- FAX (201) 440-4283

Computer Signal Monitor (Continued)

WHEN THE COMPUTER SENDS VOLTAGE TO THE SOLENOIDS, IT WILL ALSO BE SENDING VOLTAGE TO THE MONITOR LIGHTS.

1. RED BOOT (+) TO LED #1
2. YELLOW BOOT (+) TO LED #2
3. GREEN BOOT (+) TO LED #3
4. BLACK BOOT (-) TO LED #1
5. YELLOW BOOT W/BAND (-) TO LED #2
6. GREEN BOOT W/BAND (-) TO LED #3



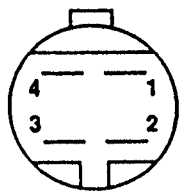
WHEN THE COMPUTER SUPPLIES A GROUND FOR THE SOLENOIDS, IT WILL ALSO BE SUPPLYING A GROUND FOR THE MONITOR LIGHTS.

NOTE: Remember, the positive (+) LED lead must be attached to a voltage source. The negative (-) must be attached to a ground source.

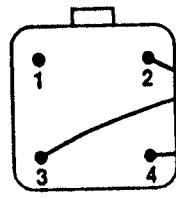
Mitsubishi KM175/6/7

The KM Series solenoids have a full time GROUND at the valve body, and the computer switches 12V POWER signals to the solenoids to activate them.

Watching the Shifts



Early



Late

RED BOOT
RED WIRE

YELLOW BOOT
YELLOW WIRE

GREEN BOOT
GREEN WIRE

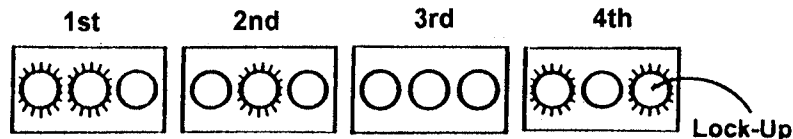
BLACK BOOT
BLACK WIRE

GREEN BOOT
WITH BLACK BAND
BLUE WIRE

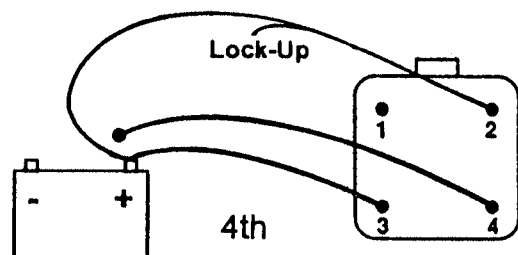
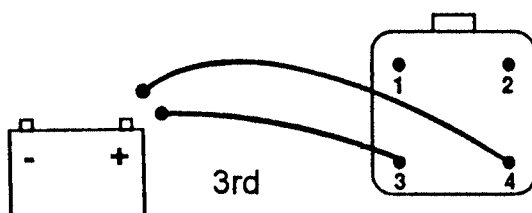
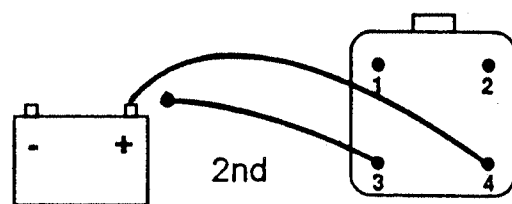
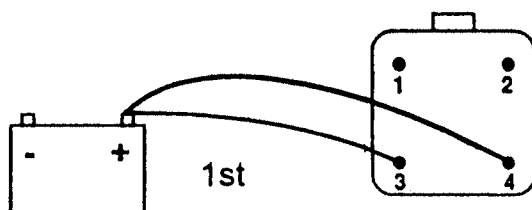
YELLOW BOOT
WITH BLACK BAND
WHITE WIRE

- 1 = PCSV
- 2 = DCSV
- 3 = SOL B
- 4 = SOL A

SOLENOID PATTERN	
GEAR	SOL 'ON'
1st	Sol. A & B
2nd	Sol. B
3rd	None
4th	Sol. A
Lock-Up	L/U Sol. - PWM



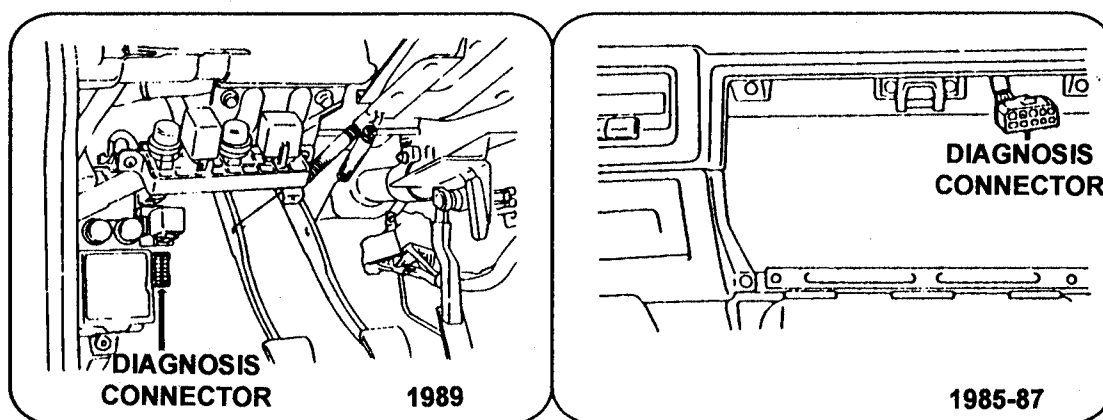
Making the Shifts



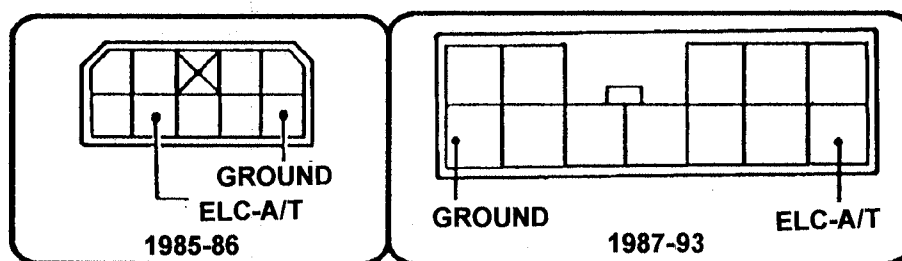
Mitsubishi Trouble Codes

When an analog voltmeter is connected to the ELC-A/T terminal, the needle will swing from 0 volts to 12 volts. The timing of these pulses from the TCU (seconds on) (seconds off) determines the trouble code.

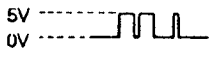
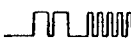
CONNECTOR LOCATION



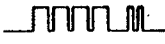
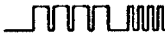
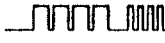
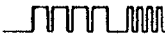
CONNECTOR TYPE



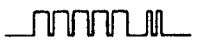
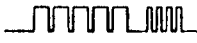
1989 Codes

Fault code	Fault code (for voltmeter)	Cause	Remedy
21		Abnormal increase of TPS output	• Check the throttle position sensor connector. • Check the throttle position sensor itself. • Adjust the throttle position sensor. • Check the accelerator switch (No. 28: output or not). • Check the throttle position sensor output circuit harness.
22		Abnormal decrease of TPS output	
23		Incorrect adjustment of the throttle-position sensor system	
24		Damaged or disconnected wiring of the oil temperature sensor system	• Check the oil temperature sensor circuit harness. • Check the oil temperature sensor connector. • Check the oil temperature sensor itself.
25		Damaged or disconnected wiring of the kickdown servo switch system, or improper contact	• Check the kickdown servo switch output circuit harness. • Check the kickdown servo switch connector. • Check the kickdown servo switch itself.
26		Short circuit of the kickdown servo switch system	
27		Damaged or disconnected wiring of the ignition pulse pick-up cable system	• Check the ignition pulse signal line.
28		Short circuit of the accelerator switch system or improper adjustment	• Check the accelerator switch output circuit harness. • Check the accelerator switch connector. • Check the accelerator switch itself. • Adjust the accelerator switch.
31		Malfunction of the microprocessor	• Replace the control unit.
32		First gear command during high-speed driving	• Replace the control unit.
33		Damaged or disconnected wiring of the pulse generator B system	• Check the pulse generator B output circuit harness. • Check pulse generator B itself. • Check the vehicle speed reed switch (for chattering).

1989 Codes (Continued)

Fault code	Fault code (for voltmeter)	Cause	Remedy
41		Damaged or disconnected wiring of the shift control solenoid valve A system	• Check the solenoid valve connector. • Check shift control solenoid valve A itself. • Check the shift control solenoid valve A drive circuit harness
42		Short circuit of the shift-control solenoid valve A system	
43		Damaged or disconnected wiring of the shift control solenoid valve B system	• Check the solenoid valve connector. • Check shift control solenoid valve B itself. • Check the shift control solenoid valve B drive circuit harness.
44		Short circuit of the shift control solenoid valve B system	
45		Damaged or disconnected wiring of the pressure control solenoid valve system	• Check the solenoid valve connector. • Check the pressure control solenoid valve itself. • Check the pressure control solenoid valve drive circuit harness.
46		Short circuit of the pressure control solenoid valve system	
47		Damaged or disconnected wiring of the damper clutch control solenoid valve system	• Check the solenoid valve connector. • Check the damper clutch control solenoid valve itself. • Check the damper clutch control solenoid valve drive circuit harness.
48		Short circuit of the damper clutch control solenoid valve system	
49		Malfunction of the damper clutch system	• Check the damper clutch control solenoid valve drive circuit harness. • Check the damper clutch hydraulic pressure system. • Check the damper clutch control solenoid valve itself. • Replace the control unit
51		First gear non-synchronous	• Check the pulse generator output circuit harness. • Check the pulse generator connector. • Check pulse generator A and pulse generator B themselves. • Kickdown brake slippage.

1989 Codes (Continued)

Fault code	Fault code (for voltmeter)	Cause	Remedy
52		Second gear non-synchronous	• Check the pulse generator A output circuit harness. • Check the pulse generator A connector. • Check pulse generator A itself. • Kickdown brake slippage.
53		Third gear non-synchronous	• Check the pulse generator A output circuit harness. • Check the pulse generator connector. • Check pulse generator A and pulse generator B themselves. • Front clutch slippage. • Rear clutch slippage.
54		Fourth gear non-synchronous	• Check the pulse generator A output circuit harness. • Check the pulse generator A connector. • Check pulse generator A itself. • Kickdown brake slippage.

1989 Codes (Continued)

FAIL-SAFE ITEM

Output code		Description	Fail-safe	Note (relation to fault code)
Code No.	Output pattern (for voltmeter)			
11		Malfunction of the microprocessor	3rd gear hold	When code No. 31 is generated 4th time.
12		First gear command during high speed driving	3rd gear (D) or 2nd gear (2, L) hold	When code No. 32 is generated 4th time.
13		Damaged or disconnected wiring of the pulse generator B system	3rd gear (D) or 2nd gear (2, L) hold	When code No. 33 is generated 4th time.
14		Damaged or disconnected wiring, or short circuit, of shift control solenoid valve A	3rd gear hold	When code No. 41 or 42 is generated 4th time.
15		Damaged or disconnected wiring, or short circuit, of shift control solenoid valve B	3rd gear hold	When code No. 43 or 44 is generated 4th time.
16		Damaged or disconnected wiring, or short circuit, of the pressure control solenoid valve	3rd gear (D) or 2nd gear (2, L) hold	When code No. 45 or 46 is generated 4th time.
17		Shift steps non-synchronous	3rd gear (D) or 2nd gear (2, L) hold	When either code No. 51, 52 53 or 54 is generated 4th time.

Component Testing & Behavior

If trouble codes were present during the last step of preliminary testing, you would then go directly to that component for verification of the fault. Keep in mind that a trouble code does not mean, "replace that component", it means "check" that component.

If no trouble codes were present, you may have to check several components to find the malfunction. Either way, checking components is easy if you have the right tools. To really test well you should have two tools, a scan tool and a digital multimeter such as a Fluke 87. By comparing the scanner reading with the Digital Multimeter (DMM) reading, you are checking the computers capability of processing the sensor signal. This is one of the few ways of actually checking the computer.

Electrical Input Component Behavior

Most Electrical Input Components can be put into three basic categories. Voltage generators, switches, and variable resistors. These categories can be broken down even further. We'll do this by referring to the number of wires they have. 90% of the sensors/switches you encounter will fall into one of these categories.

voltage generators	2 wire
switches	1 wire 2 wire
variable resistors	1 wire 2 wire 3 wire

The key to diagnosing electrical input components is understanding their behavior. Once this is done, a simple wiring schematic will usually be all that is needed to diagnose the input components used in todays computer controlled transmissions.

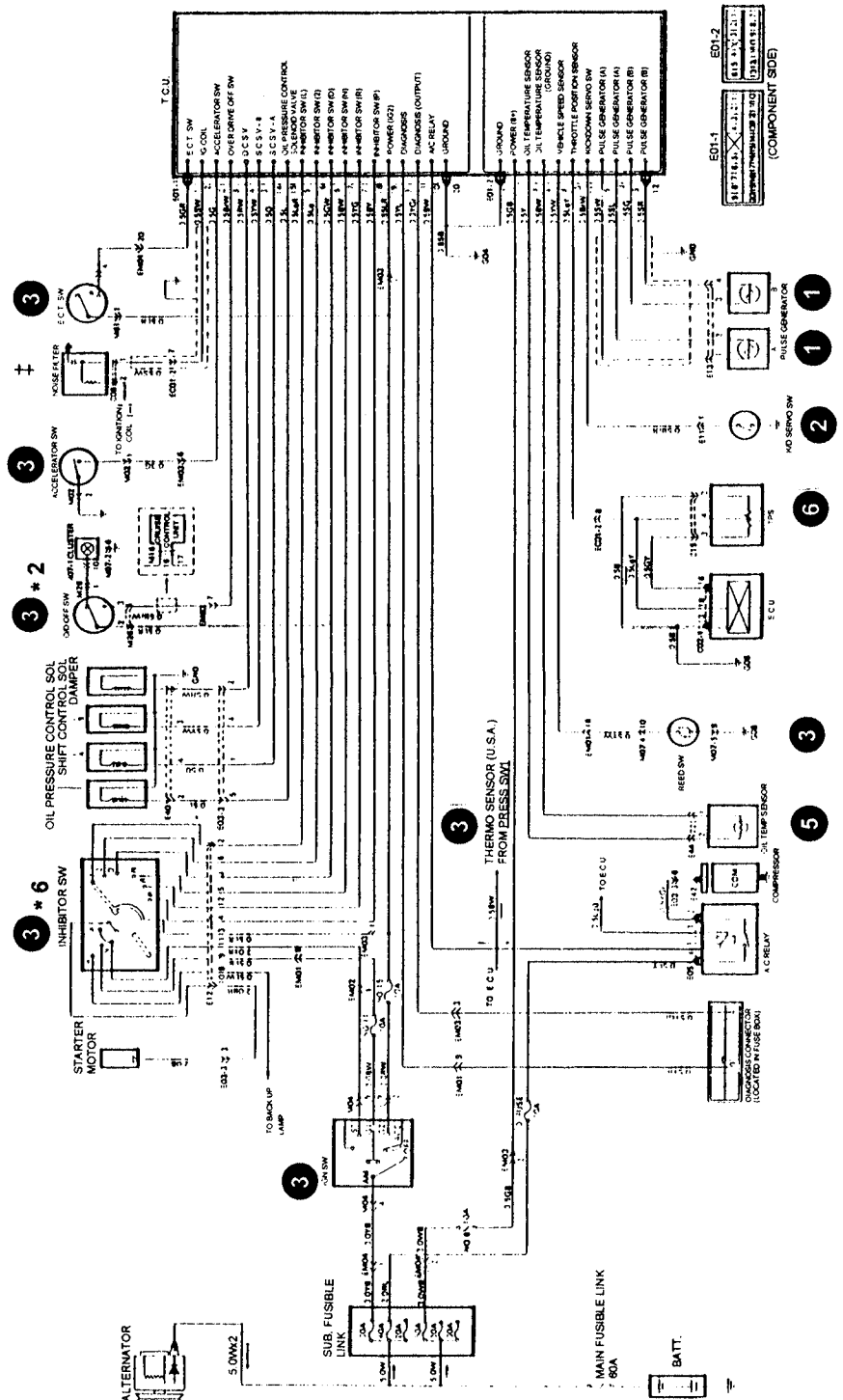
Some input components have more than three wires. In these cases, you'll find one or more components built into one housing. This is usually the case with throttle position switches, manual lever (neutral safety) switches and temperature sensors.

NOTE: The test and behaviorial observations made in this section are with the switch/sensor still connected to the circuit and operating normally. To check the operation of the circuit you'll want to backprobe the computer harness connector or use a break-out box. Most computer systems use five volts or battery voltage to operate the switches/sensors. We'll refer to this as source voltage or reference voltage.

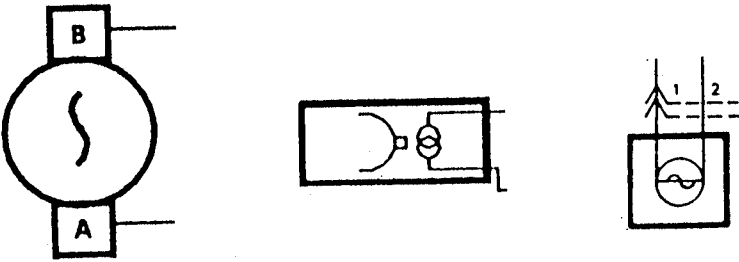
Component Testing & Behavior (Continued)

EXAMPLE: Below is a wire schematic of a 1990 Hyundai Sonata with a KM175 transaxle, the computer system uses 18 input sensors/switches. All of these (with the exception of the tach signal) inputs fall into one of the three categories of electrical input components.

- 1 Voltage Generator
 - 2 One wire switch
 - 3 Two wire switch
 - 4 One wire variable resistor
 - 5 Two wire variable resistor
 - 6 Three wire variable resistor
- * Compound switch
(The number to the right of the asterisk denotes how many switches.)
- † Tach signal



Voltage Generators - Two Wire

Description	Two wire voltage generators are nothing more than a magnetic rod with wire wrapped around it. When ferrous metal (something that will attract a magnet) is passed by the end, it produces an AC electrical signal. The most common application for this is a VSS or turbine shaft sensor.
Commonly Used Symbols	
Test/Behavior	This sensor produces an AC (alternating current) signal when the shaft it monitors is rotating. This can be measured with a voltmeter. The voltage will increase as the shaft speed increases. The range will usually be 0-10 volts AC. In some cases it will go higher. Because some sensors will peak before maximum shaft RPM is obtained (e.g. 1992 Ford truck with VSS on the differential), it is often more accurate to check the sensors frequency (Hz).
Common Applications	4L80-E input and output sensors Ford 7.3L Diesel RPM Sensor A604 turbine shaft and output sensors KM175 pulse generators A and B AXOD-E turbine sensors AOD-E output sensor 4T60-E VSS G4A-EL turbine sensor

GM Voltage Generator

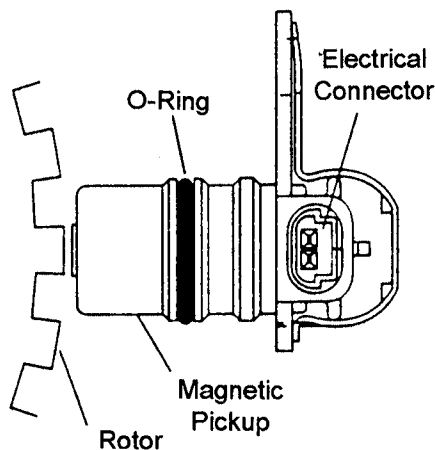
Vehicle Speed Sensors (VSS)

ADDITIONAL INFORMATION

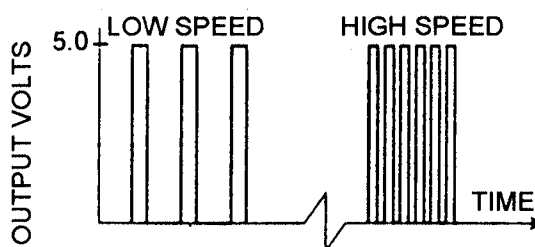
The main job of the Vehicle Speed Sensor (VSS) is to tell the computer how fast the vehicle is going. There are two main types of VSS systems. The early type used an L.E.D. and a photocell. Simply put, the speedometer cable would spin a reflective blade and light from the LED would be reflected to the photocell. The photocell would pulse a transistor on and off each time the blade passed by. The computer would simply count the pulses and compare them to an internal clock to calculate vehicle speed. The later type doesn't have a speedometer cable. A permanent magnet generator (kind of a little alternator) is mounted to the transmission. This PM generator produced AC voltage as the vehicle started to move. The voltage would rise as vehicle speed increased but the computer doesn't look at the voltage. AC voltage switches between positive and negative forming a wave called a sine wave. The number of times (cycles) per second that it switches is called its frequency. Frequency is measured in hertz (Hz) which means cycles per second. As vehicle speed increased the frequency would also increase. The computer would simply compare frequency to a clock and get vehicle speed much like the photocell pulses.

The easiest way to check a VSS is to compare your scanner MPH reading to the dashboard speedometer. They need to be the same. The next way, which is not as accurate is to measure the frequency at the VSS. You would either need a scope to do this or a DMM that had frequency capability like the Fluke 87 or 88. Set the meter to AC volts then push the Hz button. Put the two leads of your meter to the two wires of the PM generator. Now as vehicle speed goes up, you'll see a rising frequency on your meter. Up until 1987, GM used 1.112 Hz per MPH which means MPH times 1.112 should equal your meter reading. Beginning in 1987 GM now has PM generators operating at about 10 times higher frequency.

The least effective method of testing a VSS (But better than nothing) is to measure the AC voltage and expect it to rise as you go faster. At some point it will stop rising and there is no direct comparison of voltage to MPH.

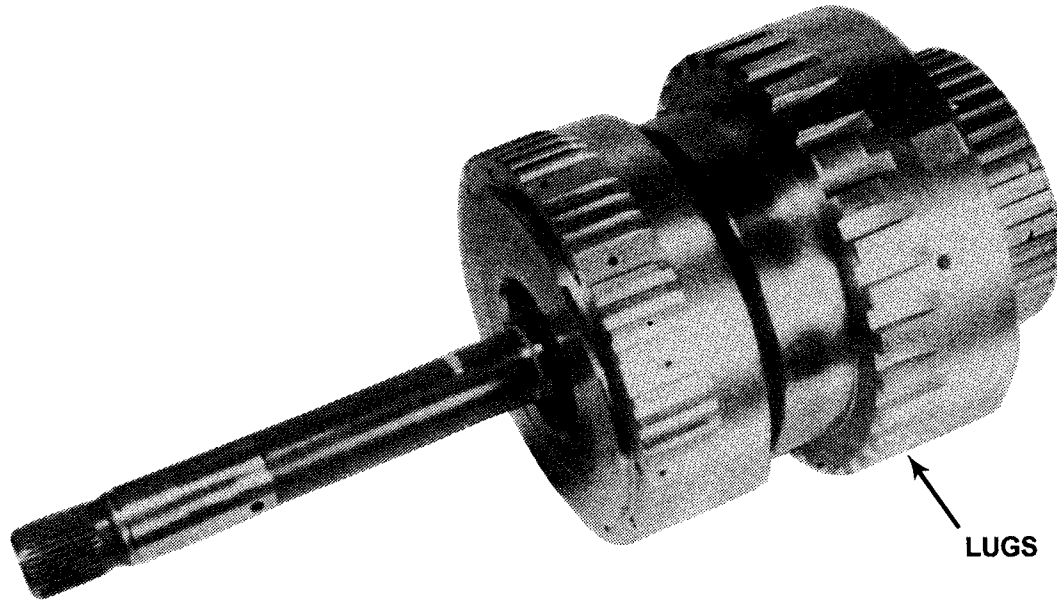


SPEED SENSOR



Converting Hz into RPM

- ① Count the tabs (or holes in cases like a sun gear shell of a KM transaxle) on the rotating shaft.



- ② Measure the frequency (Hz) of the rotating shaft.

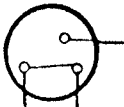
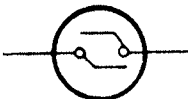
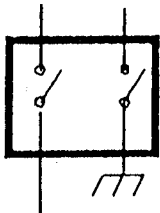
- ③ $(\text{Hz} \div \text{Number of tabs}) \times 60 = \text{RPM}$

EXAMPLE: A 4L80-E has 31 lugs on the forward clutch drum. If the frequency was measured at 819.2 Hz, the drum RPM would be $(819.2 \div 31) \times 60 = 1585.5$.

Switches - One Wire

Description	This switch is a normally open (N.O.) or normally closed (N.C.) grounding switch and changes states when certain conditions are met. This switch can be used to monitor pressure, temperature or mechanical position (e.g. neutral safety, KM servo switch).
Commonly Used Symbols	COMPOUND SWITCH
Test/Behavior	Temperature: Check the signal wire for source voltage when the engine is cold. It should change states when the engine warms up. Pressure: Check the signal wire for source voltage with the engine off, ignition on. Start the engine, run the transmission through the ranges or gears that are required to pressurize the switch (i.e. if it's a fourth gear switch, let the transmission upshift to fourth), it should then change states. Mechanical: This can be somewhat confusing because the test will be unit specific. In this example we'll use the servo switch on a KM175. This switch changes states when the servo is pressurized (second and fourth). Check the signal wire for source voltage while shifting from first to second. It should change states when it shifts.
Common Applications	Temperature: Mitsubishi - coolant temperature switch (compound switch). Toyota - coolant temperature switch. Pressure: 2004R - fourth gear switch. AXOD - N - D - switch 4L80-E PSM switch (compound switch). Mechanical: KM175 - servo switch

Switches - Two Wire

Description	This switch operates in the same manner as the single wire switch. The difference is, the switch is not self-grounding. This being the case it can be used to provide a ground signal or a voltage signal. This switch is most commonly used as a pressure switch or a mechanical switch.								
Commonly Used Symbols	 COMPOUND SWITCH   COMPOUND SWITCH								
Test/Behavior	Before the behavior of this switch can be checked, the signal to the switch must be checked first. It's important to know whether the switch is used to provide a ground or voltage signal. This is where understanding the wire schematic comes in handy.								
Common Applications	<table border="0"> <tr> <td>700R4</td> <td>3rd gear switch</td> </tr> <tr> <td>440T4</td> <td>Temperature switch</td> </tr> <tr> <td>A604</td> <td>PRNDL switch (compound switch)</td> </tr> <tr> <td>G4A-EL</td> <td>Manual lever switch (compound switch)</td> </tr> </table>	700R4	3rd gear switch	440T4	Temperature switch	A604	PRNDL switch (compound switch)	G4A-EL	Manual lever switch (compound switch)
700R4	3rd gear switch								
440T4	Temperature switch								
A604	PRNDL switch (compound switch)								
G4A-EL	Manual lever switch (compound switch)								

Variable Resistor - One Wire

Description	The switch is currently used only as a temperature sensor. It provides a varying ground signal.
Commonly Used Symbols	
Test/Behavior	Check the voltage on the signal wire. The voltage should vary between .5v - 4v (approximately).
Common Applications	Nissan 440T4 ATF temperature sensor Thermistor

Variable Resistor - Two Wire

Description	In most cases, this sensor works just like the one wire sensor. In most cases the 'extra' wire is connected to ground. This is usually used as a temperature sensor. Ford also uses a 'ganged' resistor as manual lever position sensor.
Commonly Used Symbols	
Test/Behavior	Temperature: Check the voltage on the signal wire. It should vary with temperature (.5v - 4v approximately).
Common Applications	ATF temperature sensor Coolant temperature sensor

GM 2 Wire Variable Resistors

Coolant Temperature Sensor (CTS)

ADDITIONAL INFORMATION

The coolant temperature sensor (CTS) is also a variable resistor but it only has 2 wires. The wires on every GM vehicle I've ever seen are yellow and black. The CTS has a negative temperature coefficient which is a fancy way of saying as temperature goes up, resistance goes down. The following chart will compare temperature with resistance.

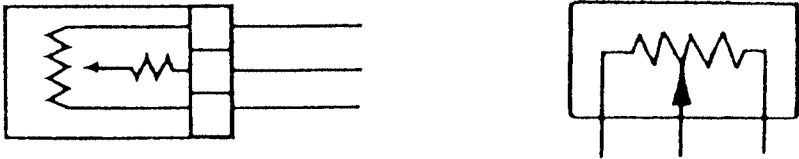
RESISTANCE	TEMP. - F	TEMP. - C
100,000Ω	-40	-40
25,000Ω	0	-18
13,500Ω	20	-7
7,500Ω	40	4
3,500Ω	70	20
1,800Ω	100	38
450Ω	160	70
185Ω	212	100
(Boiling Point of water)		

The computer supplies 5 volts on the yellow wire, which is trying to go to ground on the black wire. If the CTS resistance is high, the 5 volts can't go to ground and the computer reads high voltage on the yellow wire which means the motor is cold. As the CTS warms up it's resistance goes down and more of the 5 volts can go to ground. The computer sees the drop in voltage on the yellow wire as an increase in temperature.

The easiest way to test this sensor is with your scanner. If the car has sat all day (or night) without running then call up the CTS on your scanner. The temperature on the scanner should be the same as the ambient temperature (air temp.). When you start the vehicle the temperature on the scanner should begin going up. To be really precise you could also compare the scanner reading to the reading of a thermometer inserted in the radiator.

If the readings are wrong, first check for 5 volts on the yellow wire. If you don't have 5 volts then suspect the computer or the wire. If you get 5 volts then unplug the CTS. With the CTS unplugged none of the 5 volts can go to ground so the computer thinks the engine is very cold. Expect a scanner reading around -40. Next use a jumper to connect the yellow and black wires together which sends all 5 volts to ground. Expect a scanner reading around 150°C. Those two tests would show that the computer is capable of interpreting the CTS correctly so suspect the CTS as faulty. It could then be checked with an ohmmeter and a thermometer.

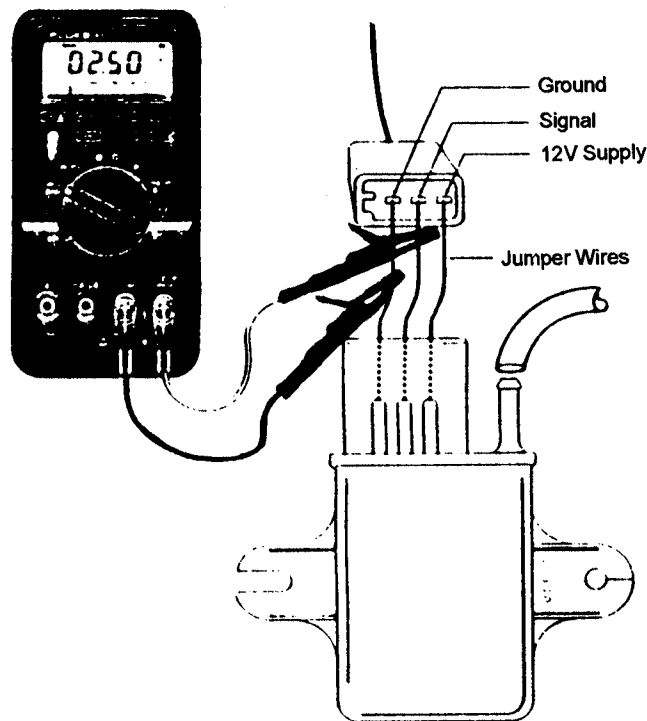
Variable Resistor - Three Wire

Description	This is one of the most common 'types' of sensors used in today's computer controlled systems. It consists of: A voltage reference signal (usually five volts), a ground signal, and a return signal. The return signal is varied by way of some 'outside force'. This can be mechanical (TPS), Vacuum (MAP), or Atmospheric pressure (BARO). Just to name a few.
Commonly Used Symbols	
Test/Behavior	If there was ever a sensor that needed a good ground this is it. This sensor is more often than not, used to sense engine 'load'. In most cases voltage will increase as load increases. What is important to recognize, however, is voltage will vary with load. In some cases (Jeep w/AW4), voltage will decrease with increased throttle angle (load). Do not be too concerned with voltage specifications. Be aware that voltage will normally vary from .5v - 4.5v. NOTE: A bad ground will cause a high voltage return signal.
Common Applications	TPS, MAP, BARO, MAF

GM 3 Wire Variable Resistors

ADDITIONAL INFORMATION

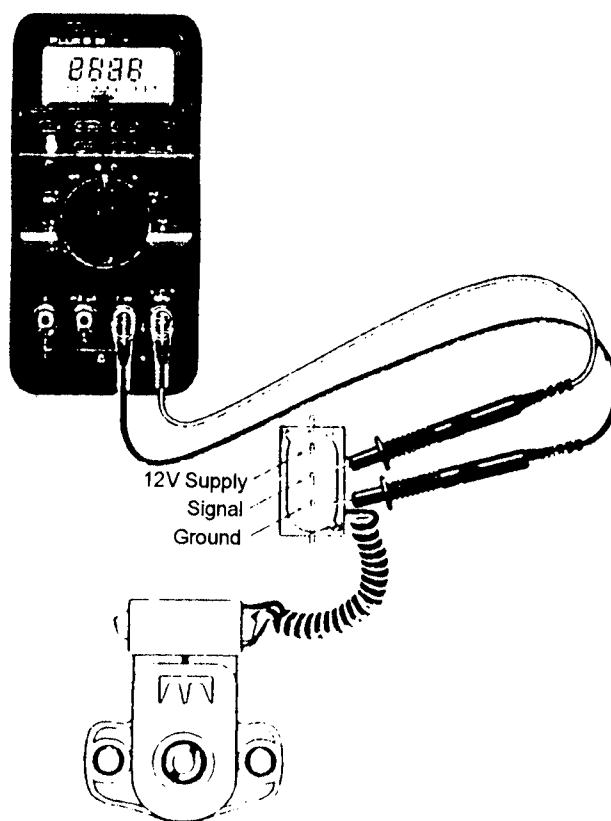
There are many types of 3 wire sensors such as: Throttle Position Sensor, Manifold Absolute Pressure, Vacuum Sensor and Barometric Pressure. Luckily they all test the same way. All the above 3 wire sensors are really just variable resistors or potentiometers. When voltage is applied to one end of a resistor, less voltage will come out the other end. This is called a voltage drop. If the resistor is variable then the voltage drop will be variable. This variable voltage is sent back to the computer on a wire called signal return. The computer reads this variable voltage as variable sensor positions and now knows exactly what the sensor is doing.



These sensors have 3 wires. One wire is signal return as already discussed. Signal return on a GM vehicle (our example vehicle) is usually the center wire of the three. Of the other two wires, one is voltage feed and the other is ground. A ground wire eventually goes to the battery negative post which is zero volts so in a perfect condition the sensor ground wire will read zero volts. Perfection is hard to achieve so in an actual system we will allow no more than 0.1 volts. The ground wire on a sensor, grounds in the computer and is called sensor return. Don't confuse this with signal return which is the center wire. The last wire is the voltage feed wire. On a GM vehicle, it is fed five volts from the computer and is called VRef (Voltage Reference).

3 Wire Sensors (Continued)

If you understand everything just discussed then testing the 3 wire sensor will be very simple. Get your DMM and set it to DC volts. On many meters, that will be a V with a straight line above it. (The wavy line is AC) Place the negative lead of your meter on the negative post of the battery. Place the positive lead of your meter to one of the outside (not center) wires of the sensor. This will be done with the sensor still plugged in so you will be back probing or you will have to scrape some insulation off the wires. Turn the key on but don't start the engine. You will either be on VRef or sensor return. Let's suppose your on VRef, your meter should read 5 volts. If it doesn't then either the computer or the wire to the computer is at fault. Now place your lead to the other outside wire, your meter must read no more than 0.1 volts. If you have more than .1 then you have a bad ground, probably in the computer or the wire to the computer. If the problem ground was elsewhere it should have been caught during the Preliminary Checks.



Now you can check the signal return wire which is the center wire.

IMPORTANT! If either of the outside wires, VRef or sensor return is bad, there is no way the center wire, signal return, can be correct. You must correct the VRef or ground problem before the center wire can give an accurate and usable reading.

As you already know, the signal return will be variable, so what should the reading be?

3 Wire Sensors (Continued)

The reading will vary between approximately .5 volts and 4.8 volts. The actual reading will be based on what the sensor is doing. When a scan tool is plugged into the diagnostic connector, then any sensor voltage reading it gives you should be the same as the center wire. At this point I usually plug in a scan tool AND put my DMM on the center wire. As long as the readings are the same, then the computer is properly reading the signal. If the readings are different by more than a few hundredths of a volt then the computer has a problem. But what should the reading be?

TPS - The Throttle Position Sensor reading will be approximately .5 volts at closed throttle and 4.5 volts at wide open throttle. It is VERY important to move the throttle from the closed position to the wide open position S-L-O-W-L-Y to make sure the voltage rises smoothly. Any spikes or dips in the voltage reading is a short or open in the sensor, meaning the sensor must be replaced.

MAP - The Manifold Absolute Pressure Sensor will have a Red (Carburated), Green (Fuel injected), or White (Cadillac) connector. The signal return reading should be approximately 4.8 volts at zero vacuum and drop to about 1.0 - 1.5 volts at high vacuum.

Turbo MAP - identified by an orange connector will have about 2.5 volts at zero vacuum. Applying vacuum will drop the reading to as low as approximately 1.0 volts. Apply pressure (like turbo boost) will raise the reading to nearly 5 volts.

Vacuum Sensor identified by a gray connector will be exactly opposite of a regular MAP sensor. Approximately 1 volt at zero vacuum and increasing to 4.5 to 5.0 at high vacuum.

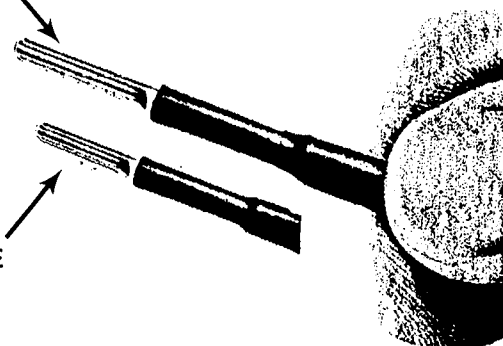
BARO Sensor - The Barometric Pressure Sensor has a blue connector and is used to tell the computer the altitude the vehicle is at. At Sea Level the reading should be at least 4.6 volts and decrease as altitude increases.

NOTE: Fuel injected cars (other than early Cadillac) don't use BARO sensors. When the key is first turned on but before the engine cranks the computer takes a quick look at the MAP reading. If the engine isn't cranking or running the Manifold Pressure will be barometric pressure.

Do You BACK-PROBE? Use The Tool Designed For The Job

JP-29591 TEST PROBE

JP-29491 TEST PROBE



Manufactured by
J.S. POPPER, INC.
P.O. Box 412
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(201) 641-3252 - FAX (201) 440-4283

HYDRAULICS

Hydraulics

Hydraulics

Hydraulics

Hydraulics

Hydraulics

Hydraulics

Hydraulics

Hydraulics

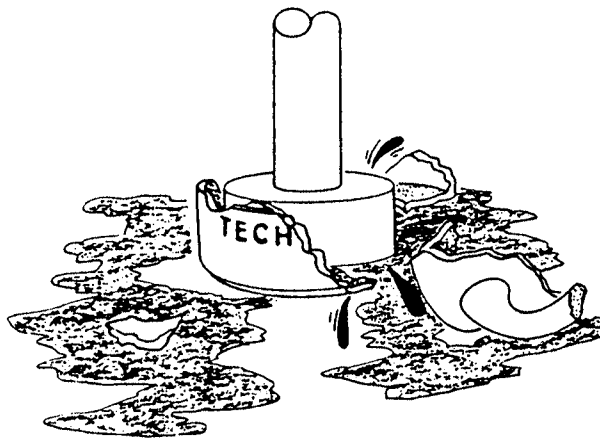
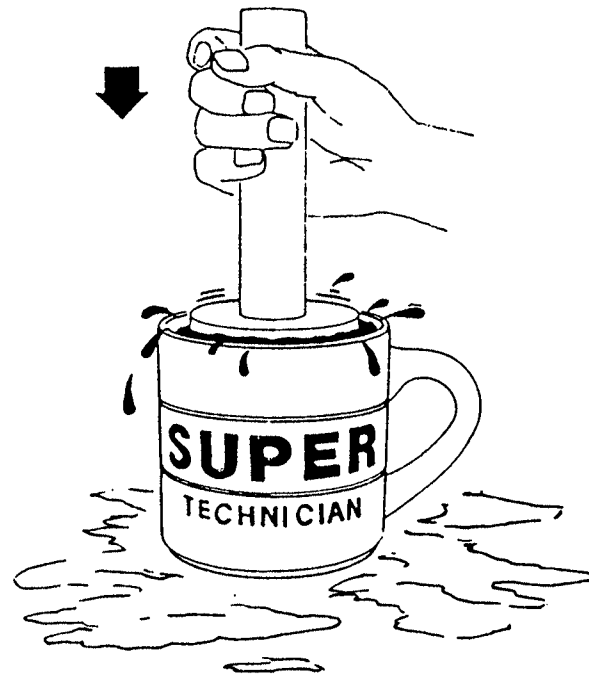
Hydraulics



Notes

Hydraulic Principles

Before we look at each hydraulic control component, you will need a basic understanding of the principles of hydraulics. The first principle is that liquids resist compression. To put it another way, if you were to try to compress a liquid, the container would leak around any seals, and if enough pressure were applied the container could break.



FLUIDS DO NOT COMPRESS

Hydraulic Principles (Continued)

When you think of pressure, think of a fluid filled cylinder with a piston at one end. When you apply a force or weight to the outside of the piston, there is a pressure on the liquid inside the container.

Pressure is usually measured in pounds per square inch (PSI). Pounds per square inch tells you that the piston is pushing on every square inch of fluid with the same in every direction.

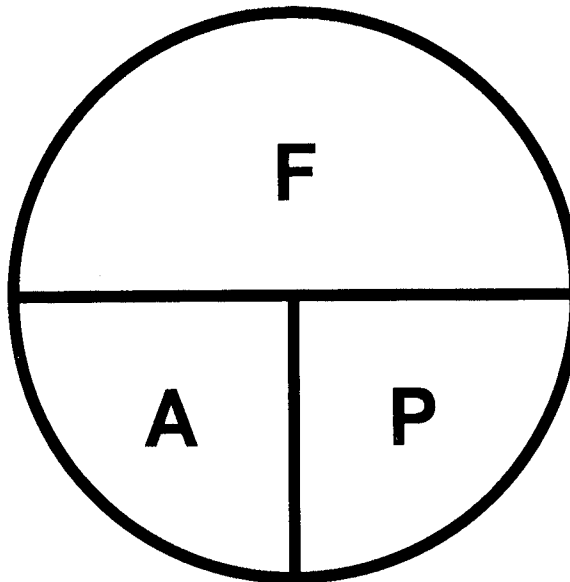
If the apply force on a one square inch piston is 100 PSI, the pressure on the walls and opposite end of the cylinder will also be 100 PSI. The pressure is the same throughout the cylinder because of the first law of hydraulics.

Pascal's Law, the first law of hydraulics, states: Pressure on a confined fluid is transmitted equally in all directions.

F = Force

A = Area

P = Pressure



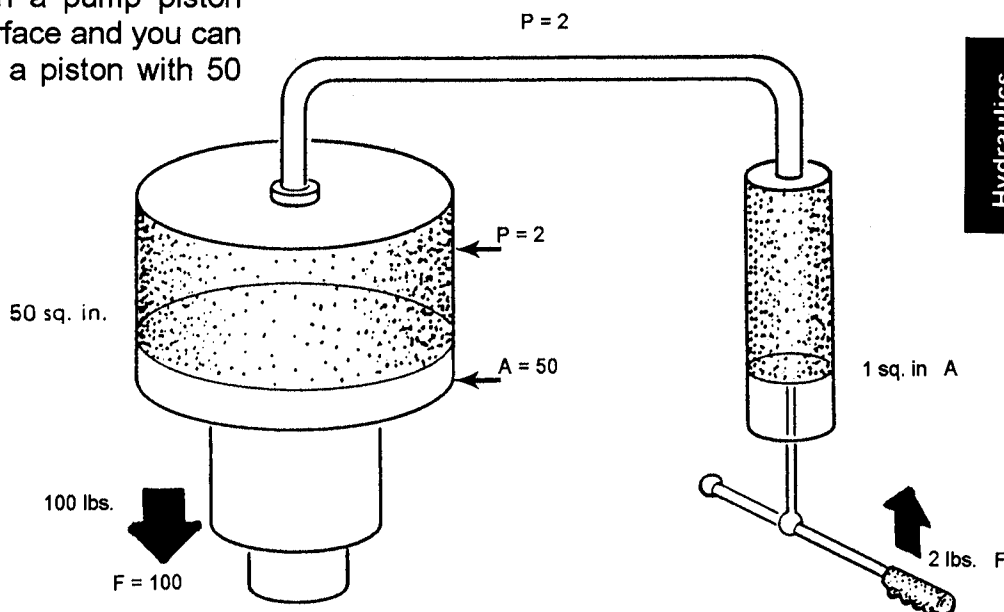
$$F \div A = P$$

$$F \div P = A$$

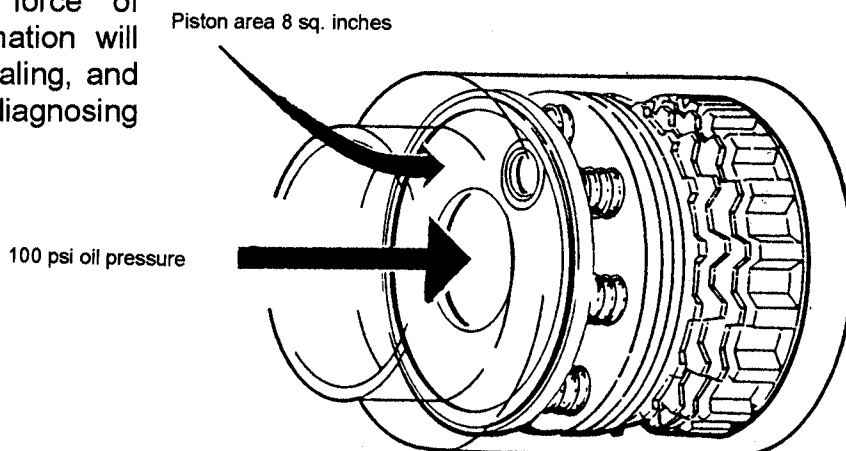
$$P \times A = F$$

Hydraulic Principles (Continued)

The formula to get leverage works like this. Apply two pounds of force on a pump piston that has one square inch of surface and you can get 100 pounds of force from a piston with 50 square inches of surface.



Since the average oil pressure of an automatic transmission is only 75-100 lbs. per square inch, we will have to use a large apply piston in order to increase the apply force against the clutch plates. In other words, if we have a clutch piston with 100 lbs. per square inch, and we have 8 square inches of piston area, then we would have a clutch apply force of approximately 800 lbs. This information will show you the importance of good sealing, and will be of value to you when you are diagnosing slippage conditions.

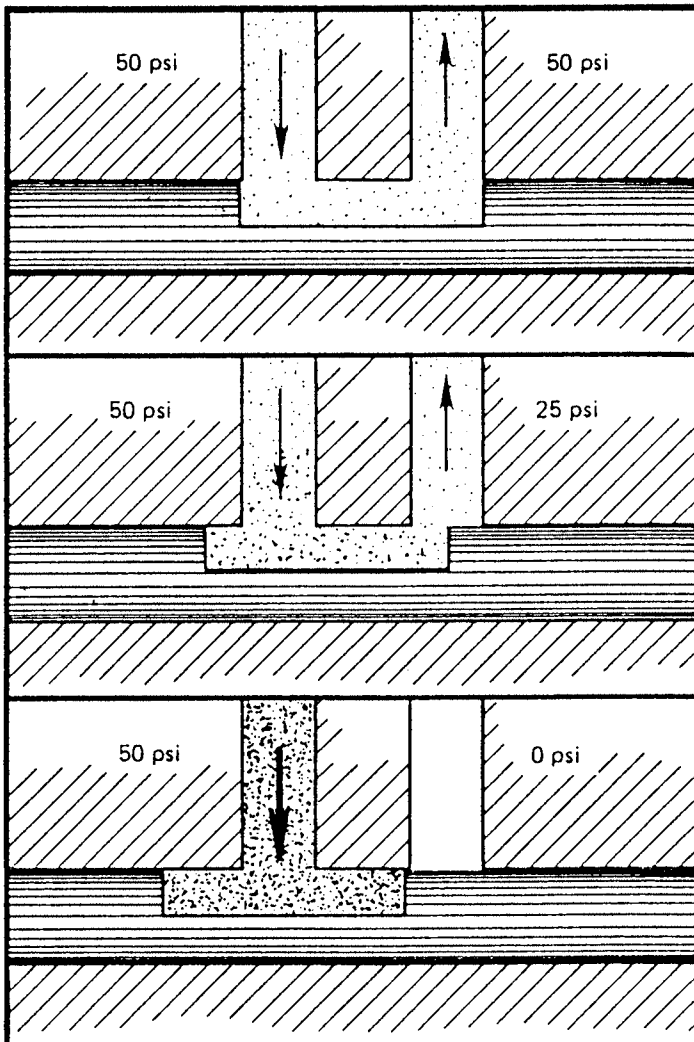


or, 8 sq. inches x 100 psi = 800 lbs. apply force

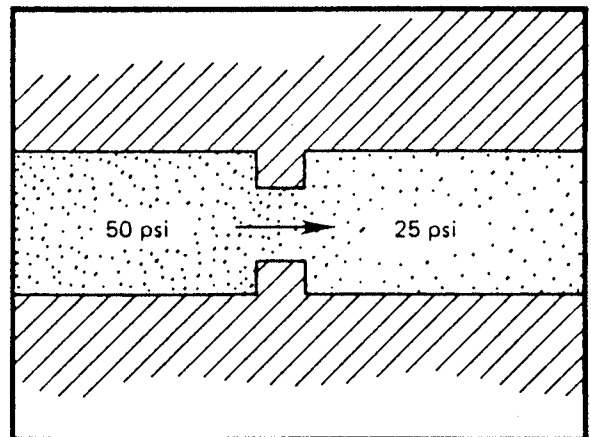
Hydraulic Principles (Continued)

To get an automatic transmission to shift gears, we must have fluid flow. To get any flow we must have a pressure difference within the system. To get pressure differences we use a system of valves and orifices. With a valve we can start, stop, or regulate the flow of oil. With an orifice we may only create a fixed pressure differential.

VALVE



ORIFICE



Valve Types

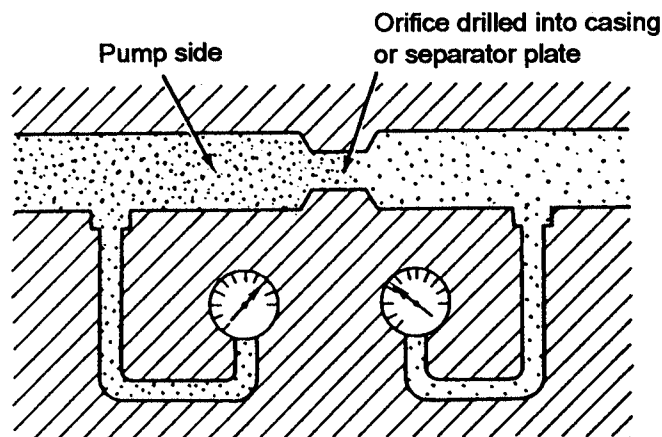
Valves used in automatic transmissions will fall into one of three categories, servo, switch or regulator. Some valves will serve more than one function.

- | | |
|------------------|--|
| <i>Servo</i> | This valve is used to move other valves. The most common use for these are pressure regulator boost valves. |
| <i>Switch</i> | This valve is used to direct oil to shifting elements or other valves. The most common use for these are shift valves. |
| <i>Regulator</i> | This valve is used to control how much pressure is used in a given circuit. The most common use for these are pressure regulator valves. |

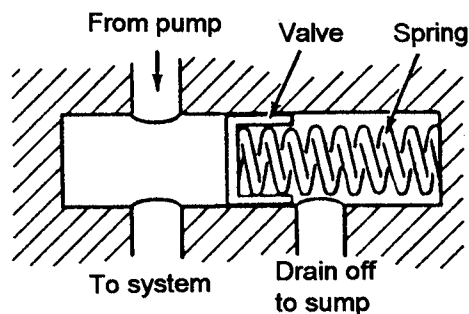
Valves

Let's take a look at the valves used in most automatic transmissions. These valves all work on the basic hydraulic principles that we covered earlier in this book. In general there are two types of control valves used in automatics. The first is a valve that regulates oil pressure and flow. The other is a type that directs flow.

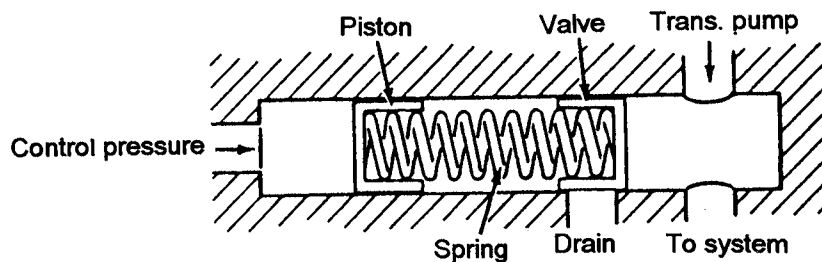
A valve that regulates oil pressure and flow can be as simple as an orifice. An orifice creates a back pressure on the pump side of the system. On the other side of the orifice the pressure drops to lower amount, depending on the size of the line.



Pressure regulator valves are used in all automatic transmissions. There are two types, one being a straight forward regulator. Line pressure is regulated by a fixed rate spring.

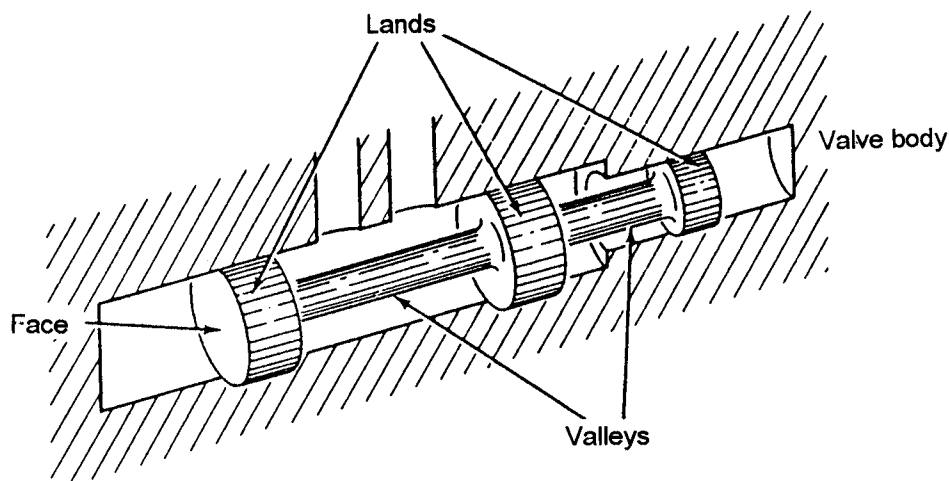


A variation on this valve is a variable regulator. This system allows a second oil pressure to control the primary pressure.



Valves (Continued)

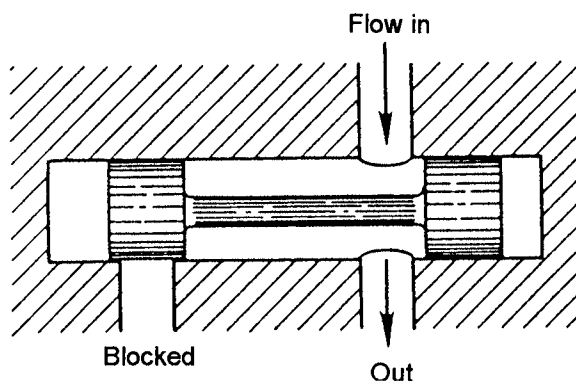
A system of valves is used to direct the oil flow to the various clutches, brakes, servos, and lock-up units. These valves are cylindrical and usually have at least two lands. Between the lands there is a groove or valley.



SPOOL VALVE

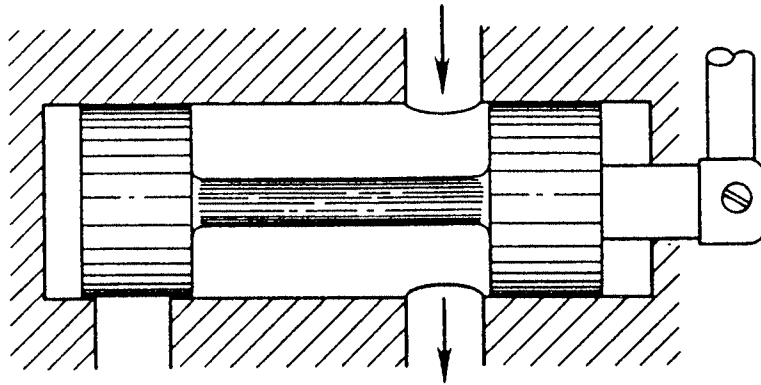
In automatic transmissions most of the valves are located in the valve body assembly. They are fitted in their bores to very close tolerances, so care must be taken when handling them.

The valves can be positioned to block flow to one port, thus diverting the flow to another port.

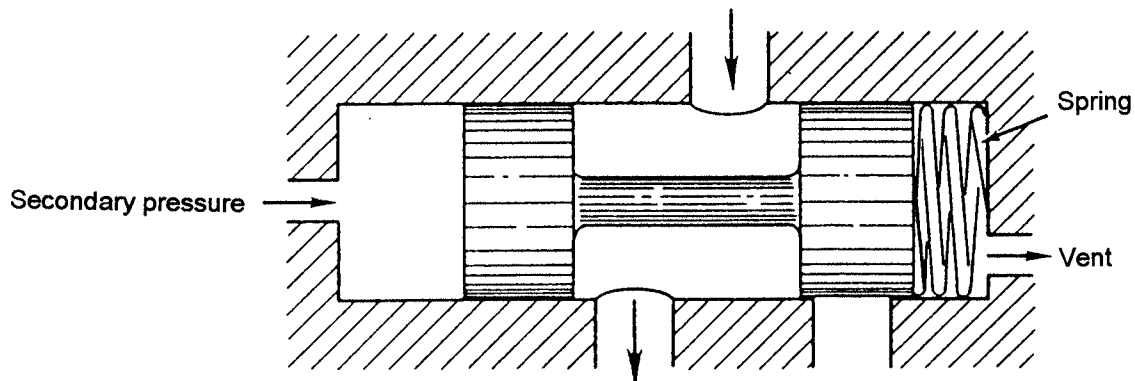


Valves (Continued)

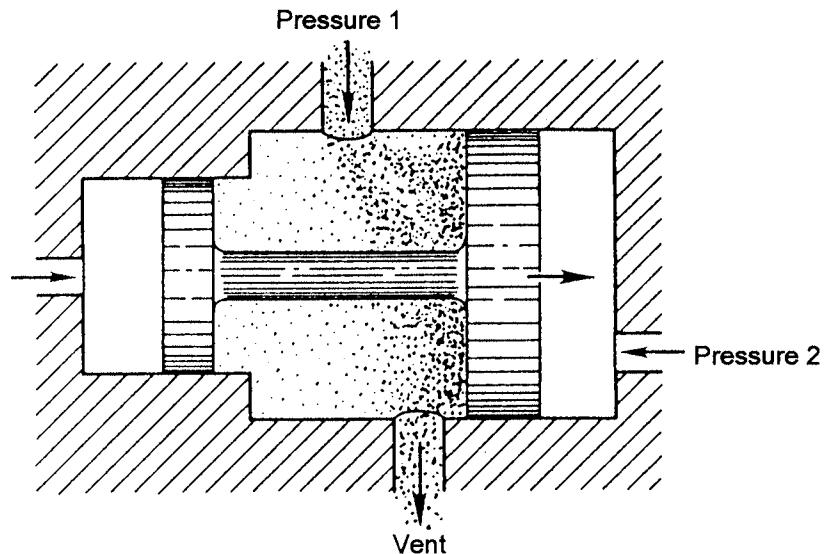
If we move the valve to the left, it would block the one port and open the other. Now how do we move the spool valve? We could use some sort of mechanical linkage.



We could also have a second oil pressure source push on the face of the spool valve. A spring at the other end of the valve would push it back when the second pressure was released.

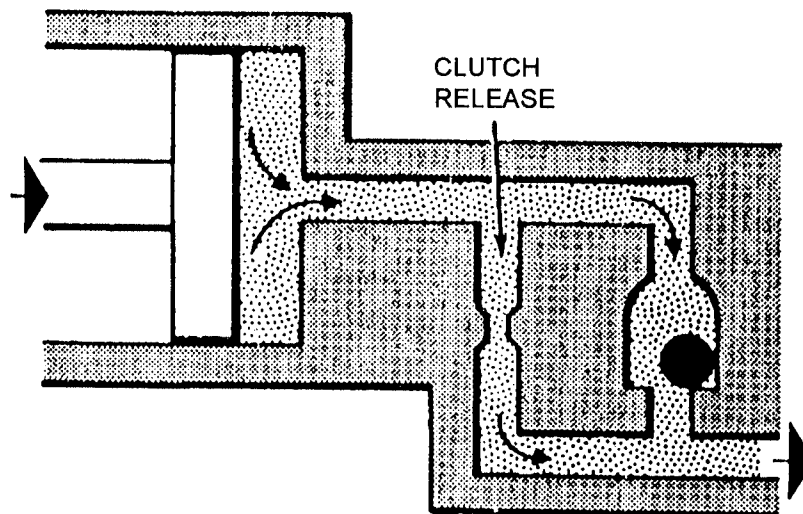
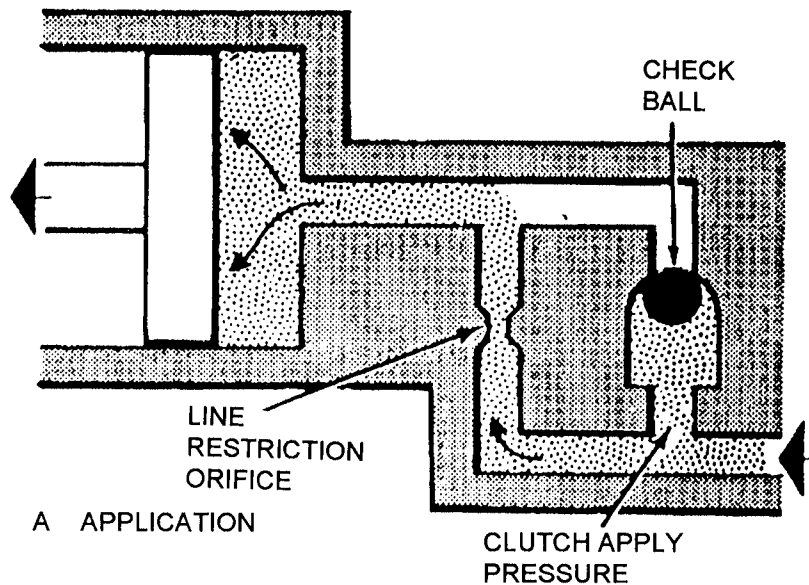


Some spool valves have lands with different diameters. The pressure is applied between the lands to position the valve. The larger land gets the harder push, thus moving to that side to open the port.



Check Balls

Check balls are small steel or rubber balls that allow fluid to flow in only one direction. When fluid is flowing in one direction, it pushes the check ball out of the way and into the open position. The fluid then flows around the ball. If the fluid begins to go in the opposite direction, it pushes the ball into its seat blocking the flow of fluid.



Governors

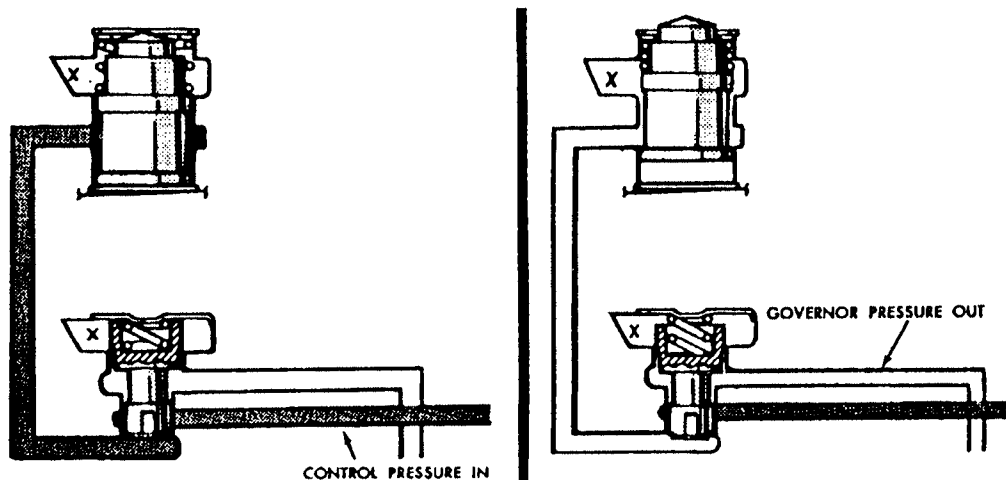
The governor is a hydraulic speedometer which uses centrifugal force to change mainline pressure to governor pressure according to vehicle speed. Governor pressure usually matches road speed. In other words, governor pressure is about 20 PSI when the vehicle is traveling at 20 MPH and about 30 PSI at 30 MPH. Governor pressure will eventually equal mainline at high speeds.

Governor pressure works against TV pressure. The two pressures work on opposite ends of the shift valves to control upshift and downshift timing.

There are three basic styles of governors. Ford, Chrysler and some imports attach the governor to the output shaft. Oil feed is through the governor support and into the governor housing through one hole. Then, depending on the speed of the vehicle, oil metered by the governor feeds into another hole called the governor oil return circuit. This oil is governor pressure which feeds the large end of each shift valve.

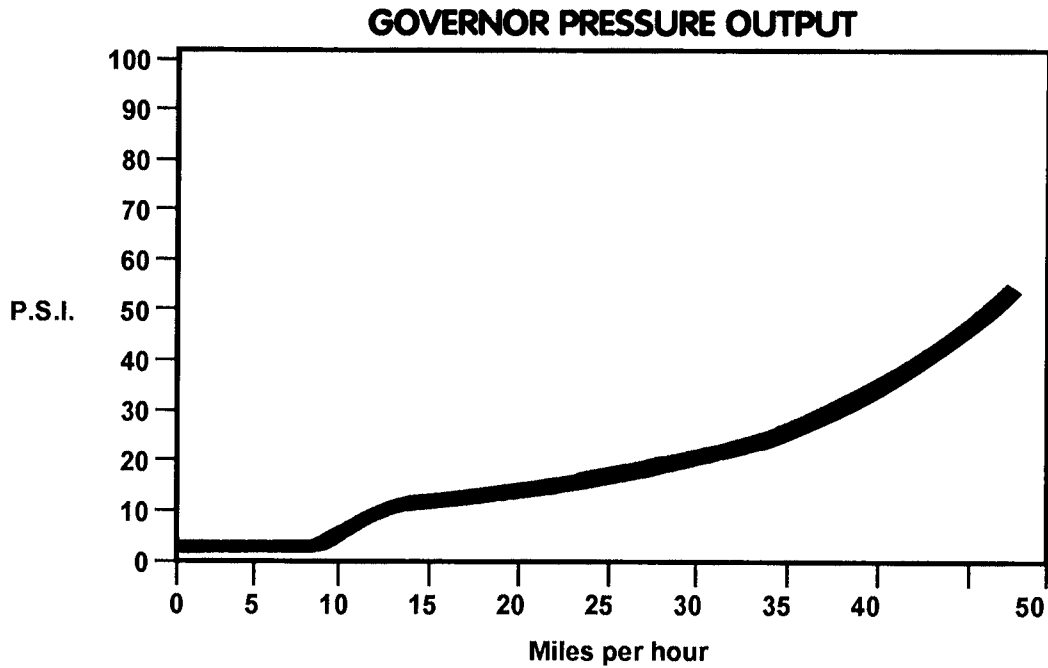
Many manufacturers use two different size valves inside the governor housing. The heavier valve is the primary valve. The primary valve moves when the vehicle's speed is below 10 MPH.

The lighter valve inside the governor is the secondary valve. This valve moves after the primary valve has opened. The secondary valve is an orificing valve which increases governor pressure as road speed increases. Centrifugal force and a spring control the secondary valve.



Governors (Continued)

The vehicle's governor pressure should show an even, smooth increase in pressure as road speed increases. The chart shows normal governor output pressure. If the governor pressure does not rise with road speed the transmission will shift very irregularly.



Throttle Valve

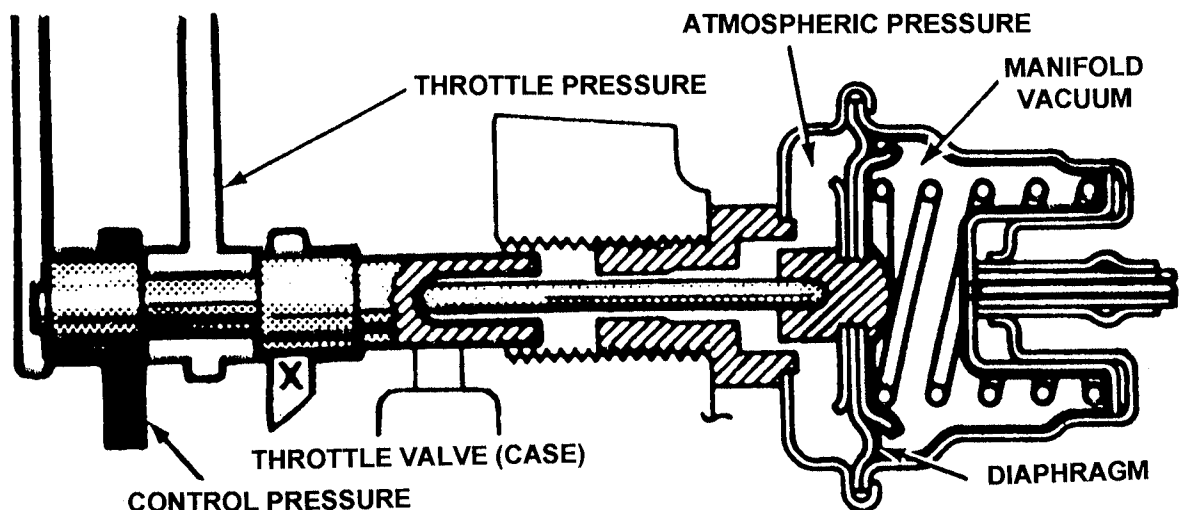
When a driver steps on the accelerator, engine torque increases. This means that the engine is under load.

Transmission pressure should change with engine load, so the transmission can handle the increased torque. To do this the transmission must know the position of the accelerator pedal. To send this information to the transmission, the car manufacturer uses either a vacuum line and modulator or linkage. The modulator or linkage moves a valve in the valve body. We call this valve a modulator or throttle valve and it controls TV pressure. This valve acts as a regulator valve which changes line pressure into TV pressure according to throttle opening.

Vacuum operated transmissions use a modulator. A modulator changes vacuum signal into a mechanical force. This force moves the throttle valve. The diagram shows the modulator, pin and modulator valve. When the engine is idling, vacuum is high. The high vacuum pulls back the diaphragm inside the modulator. When the valve is in this position, it reduces pressure within the TV circuit.

When you depress the accelerator pedal, vacuum decreases. Reduced vacuum allows the spring inside the modulator to push the pin and valve back to their original position. When the valve moves back, TV pressure increases. Passages direct the TV pressure to the pressure regulator and shift valves.

When you open the throttle, the throttle valve plunger pushes the throttle valve into the bore. Then, depending on how far you depress the pedal, main line pressure bleeds into the TV circuit. TV oil works on several valves including the backside of the TV plunger, the pressure regulator valve and the shift valves.



Shift Valves

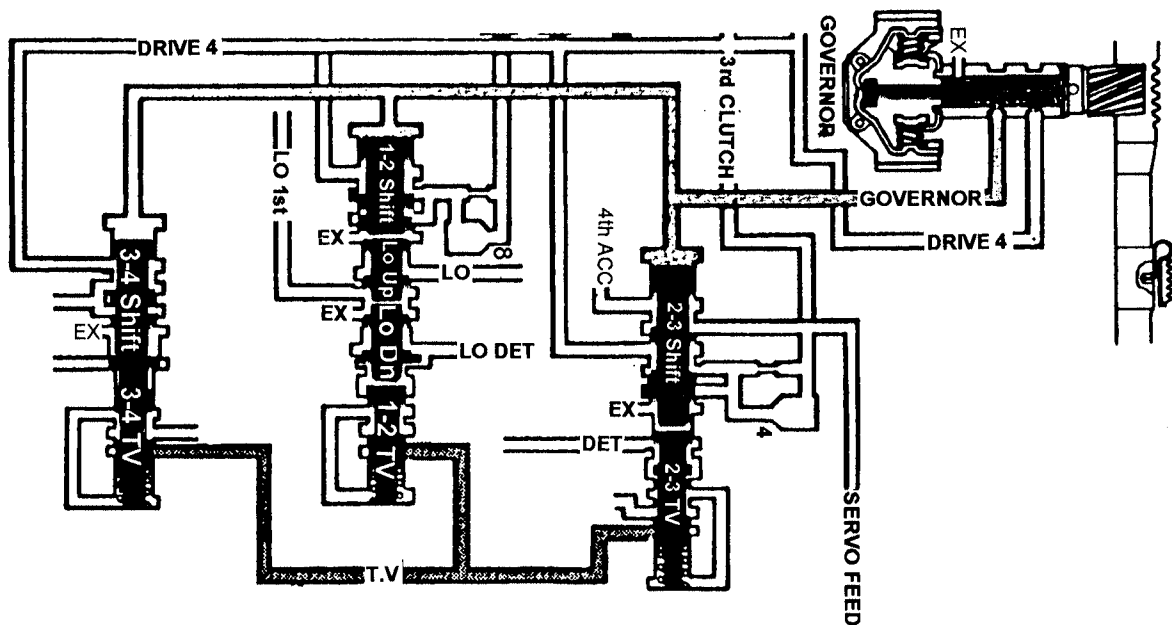
A shift valve is a hydraulic on-off switch that is either open or closed. TV pressure and governor pressure control most shift valves. TV pressure acts on one end of the valve while governor pressure acts on the other end of the valve. These pressures work against each other to move the valve. Governor pressure moves the valve to the upshift position while TV pressure moves the valve to the downshift position.

There is also a spring on the TV end of the shift valve. This spring works against governor pressure to return the valve to its downshift position.

When governor pressure is working against the 1-2, 2-3 and 3-4 shift valves, the 1-2 shift valve will always move first. The reason is simple.

Shift valves have different diameter faces. A 1-2 shift valve usually has a larger diameter face than the 3-4 shift valve. This means that more force is working against the 1-2 shift valve than there is against the 3-4. Also, the spring behind the 1-2 shift valve may have less tension than the spring behind the 3-4 shift valve.

The diameter of the face combined with the tension of the spring, makes the 1-2 shift valve easier to move than the 3-4 shift valve.



Hydraulic vs. Computer Shifted Systems

The following is a comparison of hydraulic vs. computer shifted systems.

HYDRAULIC	COMPUTER
Governor Pressure = road speed pushes the valve against TV & spring Tries to upshift	VSS = road speed
TV Pressure = engine load Opposes upshift	TPS, MAP = engine load * EXAMPLE: ECM calculates VSS & TPS then sends a signal to the solenoid which pressurizes the governor side of the shift valve overcoming spring pressure.

- * Some units use TV pressure but only for shift feel. It is not used to control shift timing.

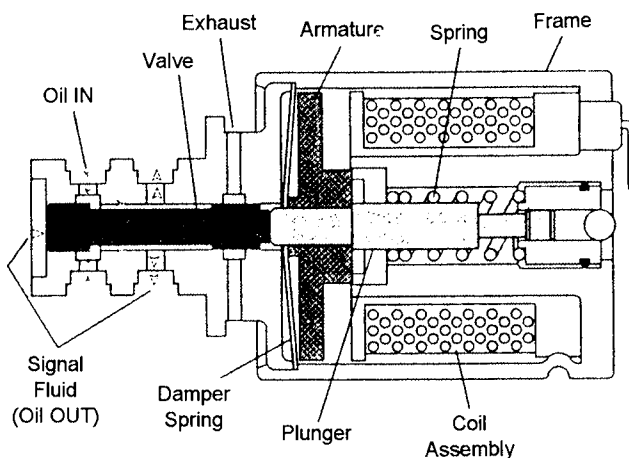
Electronic Pressure Control

There are two main types of electronic pressure control systems currently in use.

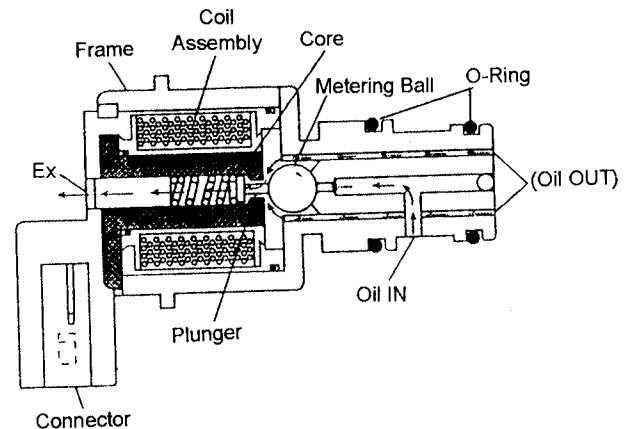
1. Variable force solenoids also known as force motors, and
2. Pulse width modulation also known as duty cycle.

Think of variable force solenoids as electronic modulators. A modulator puts a variable force on a valve to control the valve's position which in turn controls pressure. The variable force solenoid does exactly the same thing. The computer sends a variable current to the solenoid. Since the current varies, the electromagnetic field in the solenoid also varies. It's this varying magnetic field that allows the solenoid to exert a variable force on a valve.

Pulse Width Modulation (PWM) usually doesn't operate a valve. It just opens or closes a passage to either bleed off pressure or let pressure into a circuit. A PWM solenoid usually operates at a fixed frequency while controlling pressure. In other words it pulses the same number of times per second whether it's raising or lowering pressure. Each pulse consists of an "ON" time and an "OFF" time. If the ON/OFF times are equal of 50/50 then the solenoid is operating at a 50% duty cycle. If the ON time is more than the OFF time then the percentage of duty cycle is higher like 70%. By changing the duty cycle or pulse width it will change how often the solenoid opens the passage to control pressure.



FORCE MOTOR



PULSE WIDTH MODULATION

Imports

IMPORTS

Imports

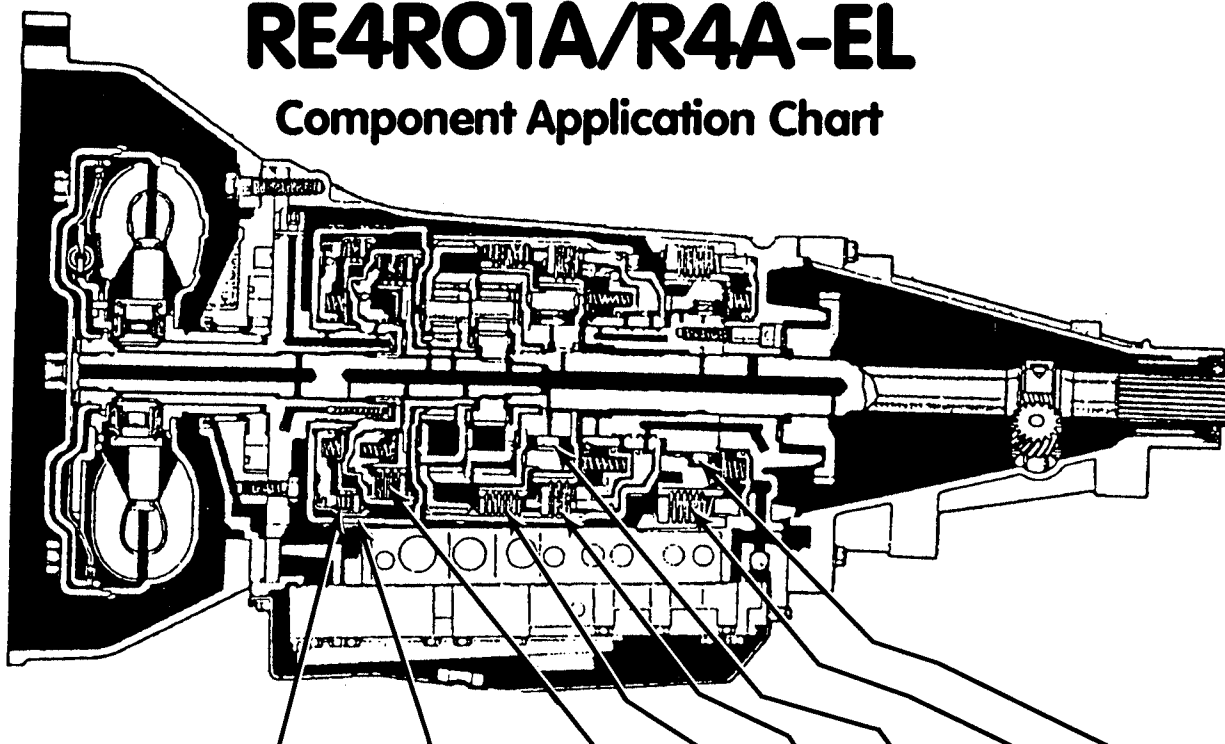
Imports



Notes

RE4R01A/R4A-EL

Component Application Chart



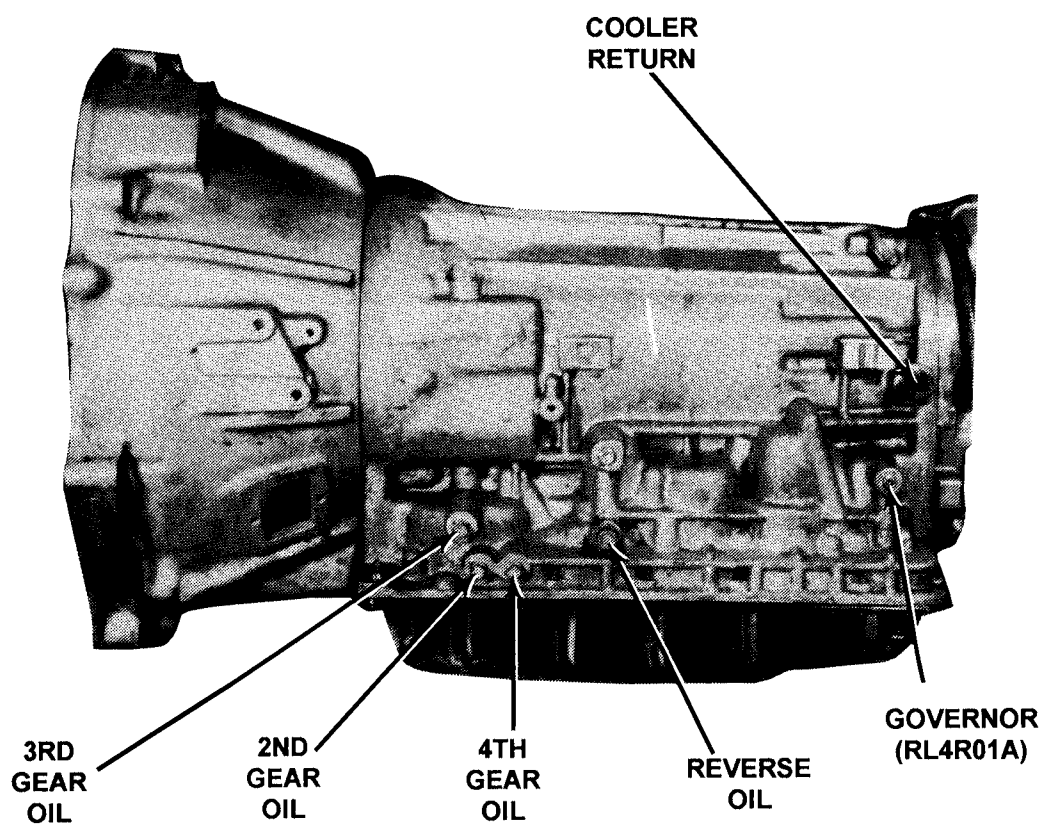
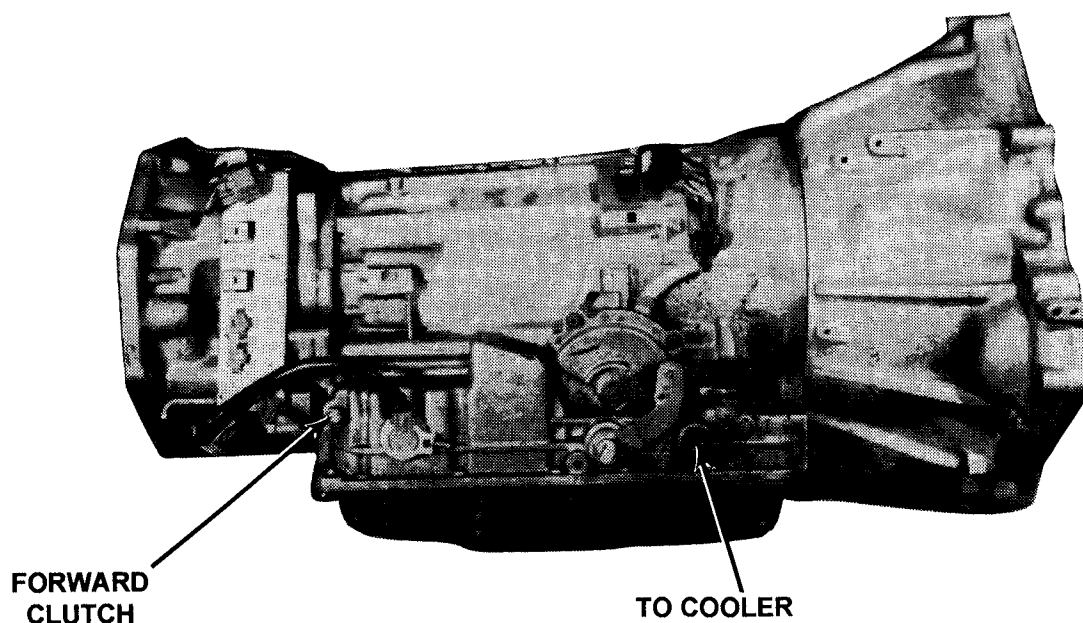
Imports

Selector Position	Gear	REV Clutch	BRAKE BAND			High Clutch	FWD Clutch	Over-Running Clutch	FWD One-way Clutch	LOW and Rev Brake	LOW One-way Clutch
			2nd Applied	3rd Release	OD Applied						
R	Rev	○								○	
D	1st						○	■	●		●
	2nd		○				○	□	●		
	3rd		⊗*1	⊗		○	○	□	●		
	OD		⊗*2	⊗	○	○	⊗				
S	1st						○	★	●		●
	2nd		○				○	⊙	●		
	3rd		⊗*1	⊗		○	○	⊙	●		
L	1st						○	○	●	○	
	2nd		○				○	○	●		

- *1 Hydraulic pressure is applied to both 2nd applied side and 3rd released side of band servo piston. However, because the area of the 3rd released side is larger than the 2nd applied side, the brake band does not operate.
- *2 Hydraulic pressure is applied to OD applied side, plus condition *1 above. Brake band is applied.
- Operates.
- ⊙ Operates when throttle opening is less than 1/8. Engine braking effect available.
- ★ Operates when throttle opening is less than 1/8. Engine braking effect not available.
- Operates when the EC-AT control unit receive OD inhibit signal from the cruise control unit and throttle opening less than 1/8. Engine braking effect available.
- Operates when the EC-AT control unit receive OD inhibit signal from the cruise control unit and throttle opening less than 1/8. Engine braking effect not available.
- ⊗ Operates but does not transmit power.
- Operates during acceleration and cruising.

RE4R01A/R4A-EL

Pressure Tap Identification



RE4R01A/R4A-EL

Pressure Specifications

Line pressure specs vary from model to model. Below are 4 charts to represent the different models and manufacturers specifications.

MAZDA MPV-2WD

	IDLE	STALL
DSL	68-74	175-186
REVERSE	88-94	219-230

MAZDA MPV-4WD

	IDLE	STALL
DSL	57-74	148-159
REVERSE	102-108	206-218

NISSAN 240SX

	IDLE	STALL
DSL	68-74	148-159
REVERSE	95-101	206-218

NISSAN PATHFINDER

	IDLE	STALL
DSL	63-68	175-186
REVERSE	97-102	219-230

RE4R01A/R4A-EL

Valve Body Removal and Installation

Use this picture as a guide for placement of sensors, clamps, etc.

S = Short Bolt
L = Long Bolt

TO REMOVE
VALVE BODY --
REMOVE ONLY
BOLTS MARKED
S AND L

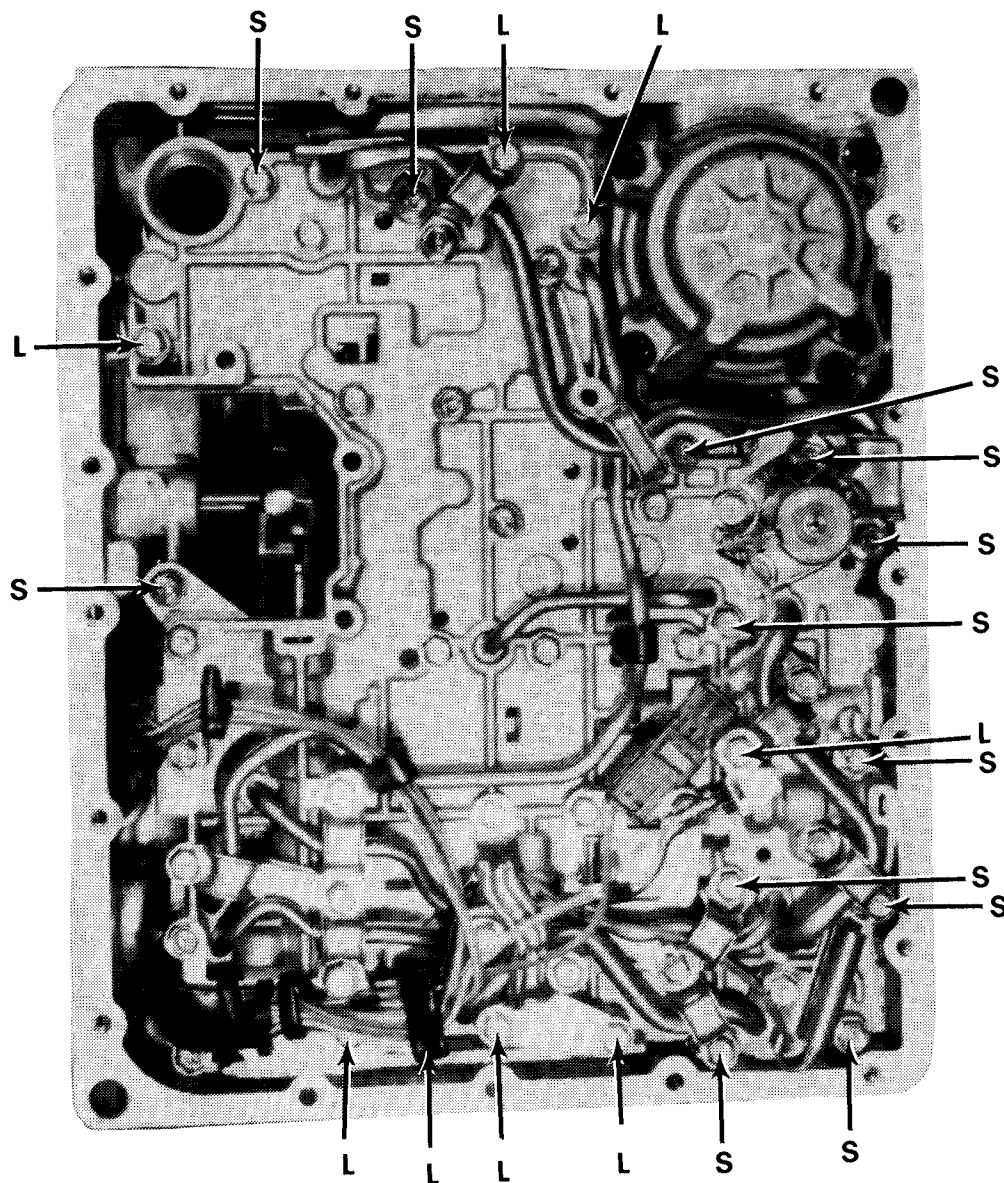


PHOTO SHOWN
WITH FILTER
REMOVED FOR
CLARITY

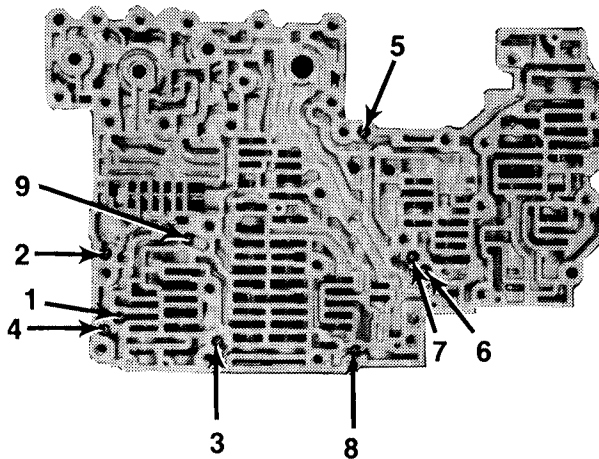
NOTE: No pipes need to be removed for valve body removal.

RE4R01A/R4A-EL

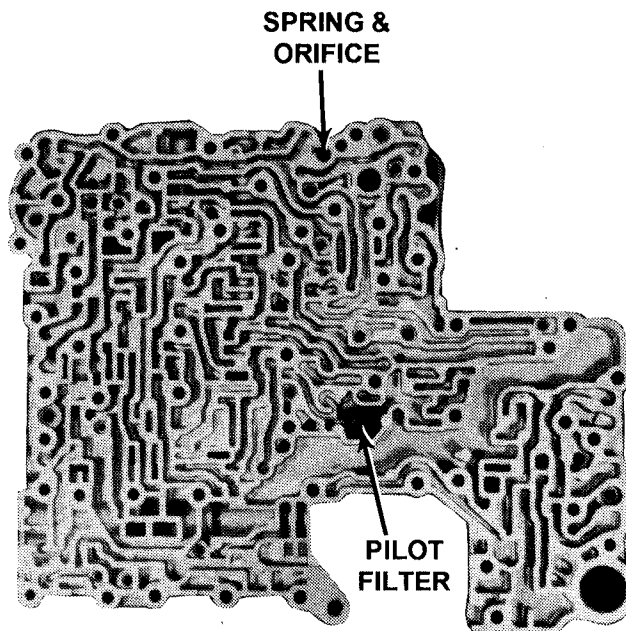
Checkball Functions and Locations

VALVE BODY CHECK BALLS

1. Overrun Clutch
2. Forward Clutch
3. Band Apply (2nd)
4. Band Apply (4th)
5. Reverse Apply
6. 3rd Apply
7. 3rd Exhaust
8. 3-2 Control
9. Low & Reverse Shuttle

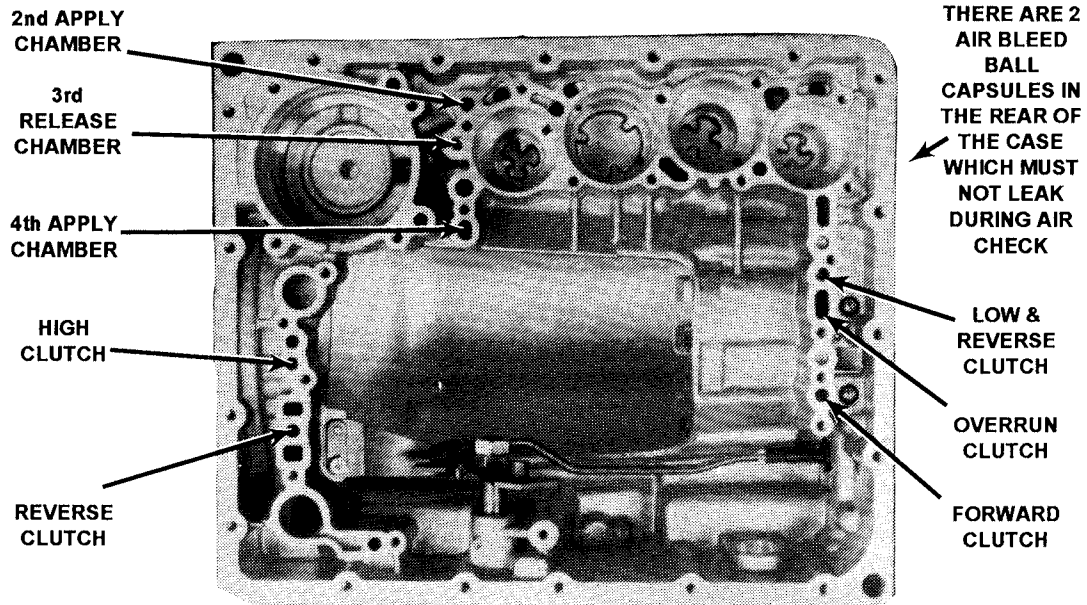


ALL BALLS ARE STEEL AND .218 DIAMETER



RE4R01A/R4A-EL

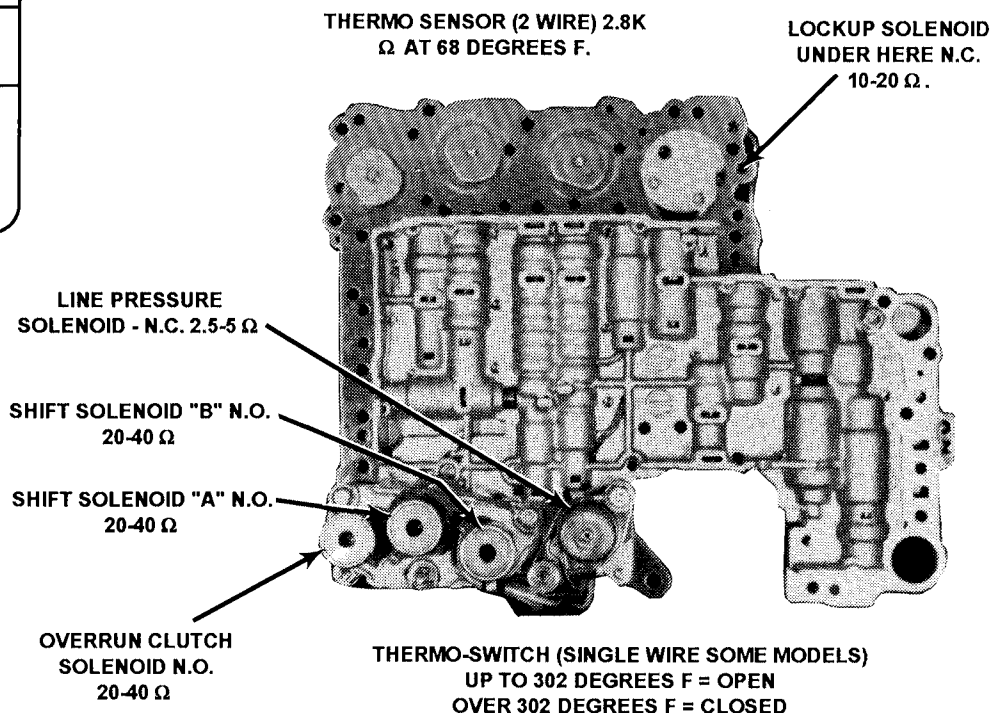
Air Check Points/Solenoid Information



SOLENOID APPLICATION

GEAR IN DRIVE	SOL A	SOL B
1	ON	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

N.C. = Normally Closed
N.O. = Normally Open

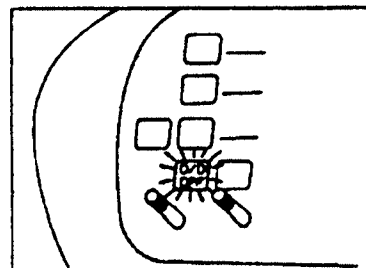
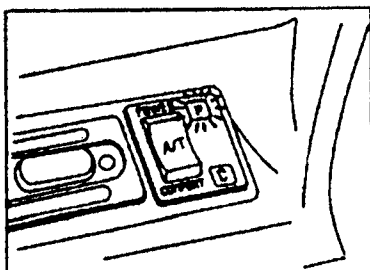
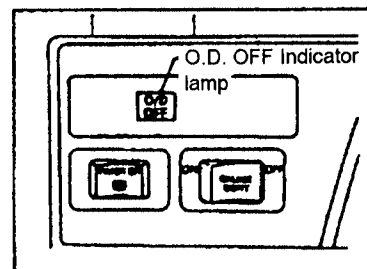
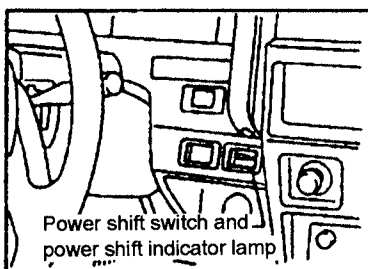


Nissan Trouble Codes

Transmission trouble code retrieval on Nissan computer shifted transmissions and transaxles is easy and uniform. Simply have a seat, turn the key on, *and move the shifter and the 'O/D OFF' switch around and an instrument panel light will flash codes to you.* Just be sure that the appropriate light comes on for a moment when you turn the key on in Park before you enter diagnostics.

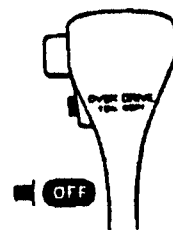
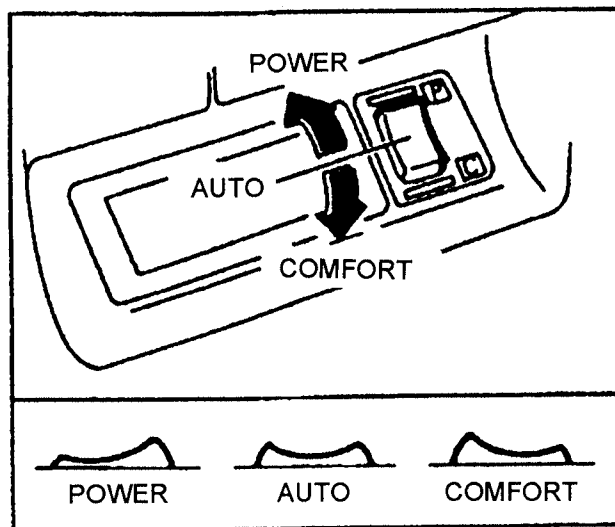
The following chart shows you which light to watch for:

Pathfinder	- All	Watch the 'POWER' or 'POWER SHIFT' light
Pick-up	- All	
Van	- All	
Stanza	- All (except '93 Altima)	
Maxima	- All (except '93 DOHC)	
240SX	- All	Watch the 'O/D OFF' light
Quest	- All	
'93 Stanza Altima		
'93 Maxima DOHC		
300ZX	- All	Watch the 'A/T CHECK' light



Nissan Trouble Codes (Continued)

On all vehicles except the '88-'89 Pathfinder and pick-up models, make sure that the transmission 'MODE' switch, (Power, Auto, Econ,) stays in the 'AUTO' position throughout the procedure. The '88-'89 Pathfinder and pick-up (PF & PU) use this switch during the code retrieval procedure.



GETTING CODES - ALL MODELS EXCEPT QUEST

1. Get the engine to operating temperature.
2. Turn the key off.
3. Set parking brake. From this point on, do not touch the throttle or brake pedal unless instructed to.
4. Move shifter to 'D'. (Push the shift lock button, if equipped, to release the shifter with the key off.)
5. Turn O/D switch 'OFF'. '88-'89 PF & PU set power shift switch to 'POWER'.
6. Turn the key 'ON'.
7. Wait at least two seconds.
8. Move shifter to '2'.
9. Turn the O/D switch 'ON'. '88-'89 PF & PU set the power shift switch to 'AUTO'.
10. Move shifter to '1'.
11. Turn the O/D Switch 'OFF'. '88-'89 PF & PU set the power shift switch to 'POWER'.
12. Slowly push the throttle to the floor.
13. Slowly release the throttle.
14. 240SX and Van only. Turn the O/D switch 'ON'.

Watch the appropriate instrument panel light for codes.

Nissan Trouble Codes (Continued)

GETTING THE CODES - QUEST

The Quest RE4F04A control system uses a sliding, spring loaded, momentary 'O/D OFF' switch on the column shift lever.

1. Get the engine to operating temperature.
2. Turn the key off.
3. Set the parking brake. From this point on, do not touch the throttle or brake pedals unless instructed to.
4. Move the shifter to 'D'.
5. Slide the 'O/D OFF' switch to the left and hold it there all the way through steps 6 and 7. Do not let it slip.
6. Turn the key 'ON'.
7. Move the shifter to '2'.
8. Release the 'O/D OFF' switch.
9. Slide the 'O/D OFF' switch to the left again.
10. Release the 'O/D OFF' switch.
11. Move the shifter to '1'.
12. Slide the 'O/D OFF' switch to the left once more.
13. Release the 'O/D OFF' switch.
14. Push the throttle slowly to the floor. hard.
15. Release the throttle slowly.

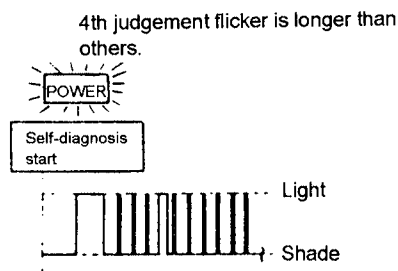
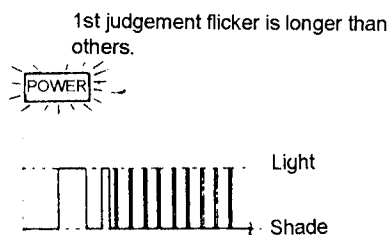
Watch the 'O/D OFF' light for codes.

CODE FORMAT

The appropriate light, previously listed, will give you the codes using an 11 flash sequence. This sequence ALWAYS begins with a long (2.0 second) starter flash, followed by ten shorter flashes. If no problem exists, all ten short flashes will be REALLY short flashes (0.2 seconds). If a problem exists, one of the ten short flashes will be a little longer (0.8 seconds) than the rest in that sequence. Your job is to count which shorter flash after the long starter flash was the 0.8 second flash, i.e. 1st, 3rd, 7th, etc.

If the 1st short flash was the slightly longer one, we'll call that a code '1'.

If the 4th short flash was the slightly longer one, we'll call that a code '4'. You get the idea.



Nissan Trouble Codes (Continued)

CODE FORMAT (Continued)

After each sequence of 11 flashes, there is a 2.5 second 'OFF' pause. Then, either the code will repeat, or the next code in line will be displayed.

If all your light gives you for a code is one second 'ON', one second 'OFF', over and over, it's telling you that the battery is either low, or hooked up backwards.

If your light worked before you entered Diagnostics, but doesn't do anything now, you've got a problem with the shift lever position (Inhibitor) switch, overdrive switch, throttle valve switch or computer.

CLEARING THE CODES

Any codes given will clear themselves after you fix the problem and then start the engine twice.

CODE LIST

1. Vehicle Speed Sensor - Transmission circuit open or shorted.
2. Vehicle Speed Sensor - Speedometer circuit open or shorted.
3. Throttle Position Sensor circuit open or shorted.
4. Shift Solenoid 'A' circuit open or shorted.
5. Shift Solenoid 'B' circuit open or shorted.
6. Timing Solenoid, or overrun clutch solenoid circuit open or shorted.
7. Lock-up Solenoid circuit open or shorted.
8. ATF Temperature Sensor circuit is open, or computer power source is insufficient.
9. Engine RPM signal circuit open or shorted.
10. Line Pressure Solenoid circuit open or shorted.

Mazda Trouble Codes

All Except '87 626

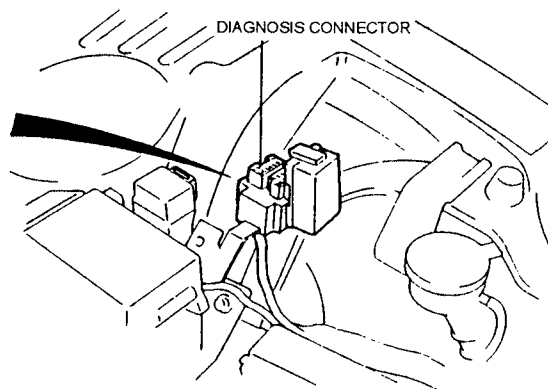
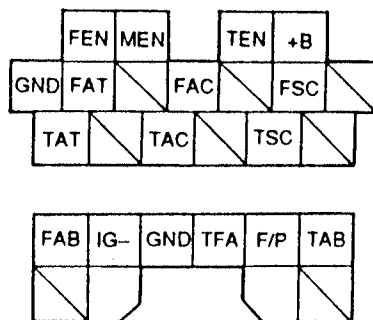
Trouble codes will be displayed by either the 'HOLD' light, or in some cases, the 'MIL' (check engine) light. If no problem exists, the 'HOLD' or 'Check Engine' light will come on for three (3) seconds after turning the key on, then it will go out. If a problem develops, the 'HOLD' or 'Mil' light will flash in a regular pattern as long as the problem persists. This is not a trouble code, just an indication to look for them. Make certain that either this, or the 'no problem' flash occurs. Trouble codes will be retained in memory for later retrieval.

GETTING CODES

In order to get the codes, you have to locate the 'Diagnostic Request' lead, and using a jumper wire hook it to a good ground.

The 'Diagnostic Request' lead comes in several forms.

1. A single pin, single wire Blue connector.
2. A single pin, single wire Green connector.
3. One of the pins in an integrated 'Diagnostic Connector'.



Use the following chart to find out which connector you need and where it is.

323 90-91

The integrated 'Diagnostic Connector' located behind the battery. Ground the TAT pin. The 'HOLD' light flashes your codes.

92-93

The integrated 'Diagnostic Connector' located behind the battery. May not have a TAT pin. If not, ground TEN pin. The 'Check Engine' light flashes your codes.

Mazda Trouble Codes All Except '87 626 (Continued)

626/MX6 88-89 ALL, 90-92 Turbo

Blue single pin connector. Behind dashboard to the left of the steering column, coming out of transmission computer harness. 'HOLD' light flashes your codes.

90-92 Non Turbo

Green single pin connector. Behind the left front shock tower. The 'Check Engine' light flashes your codes.

93 ALL

The integrated 'Diagnostic Connector' in front of the left front shock tower. Ground the TAT pin. The 'HOLD' light will flash your codes.

929 88-91

Blue single pin connector. Next to right side hood strut. The 'HOLD' light flashes your codes.

92-93

Integrated 'Diagnostic Connector'. Near left front shock tower by air filter box. Ground TAT pin. 'HOLD' light flashes your codes.

RX7 89-91

Blue single pin connector. In front of left front shock tower. 'HOLD' light flashes your codes.

92-93

Integrated 'Diagnostic Connector'. Near left front shock tower. Ground TAT pin. 'HOLD' light flashes your codes.

MPV Van - All

Blue single pin connector. Under dash to the left of the steering column, coming out of transmission computer harness. 'HOLD' light flashes your codes.

CODE FORMAT

When the 'Diagnostic Request' pin is grounded, the appropriate light, ('HOLD' or 'Check Engine') will give you your trouble codes in long and short flashes. Long flashes (1.2 seconds) are the 'tens' digit of a two digit code, short flashes are the 'ones' digit of a one or two digit code. The lowest number codes will be shown first, then the higher number codes will be shown in order. There is a four second 'OFF' period between codes. The series of codes will repeat as long as the 'Diagnostic Request' pin is grounded. If no codes are present when you ground this pin, the 'HOLD' or 'Check Engine' light will remain dark.

Mazda Trouble Codes All Except '87 626 (Continued)

CLEARING CODES

Disconnect the battery negative post for at least 60 seconds. All codes will be cleared.

CODE LIST

1. No Engine RPM signal from ECM.
6. No vehicle speed signal from the transmission VSS.
7. No vehicle speed signal from the speedometer VSS.
12. Throttle position sensor signal open or shorted.
55. No signal from 'Drum Speed' pulse generator on trans.
56. No signal from ATF temperature sensor.
57. No 'Shift Signal' from transmission controller. Bad controller.
60. '1-2' or 'A' shift solenoid circuit open or shorted.
61. '2-3' or 'B' shift solenoid circuit open or shorted.
62. '3-4' or 'Overrun Clutch' solenoid circuit open or shorted.
63. Lock-up solenoid circuit open or shorted.
64. Line pressure control solenoid circuit open or shorted.
65. Lock-up engagement control solenoid circuit open or shorted.

Mazda R4AEL

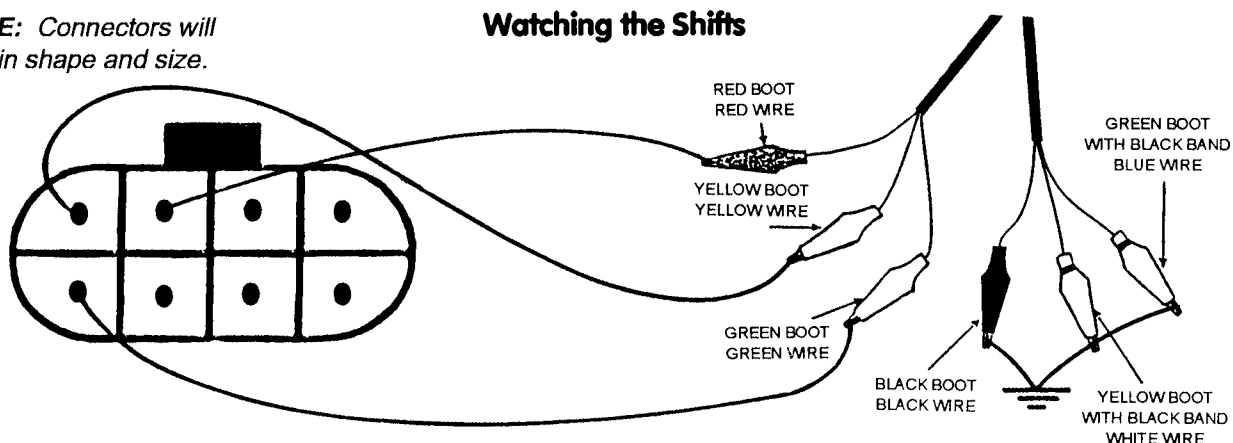
Nissan RE4R01A

Nissan RE4F02A

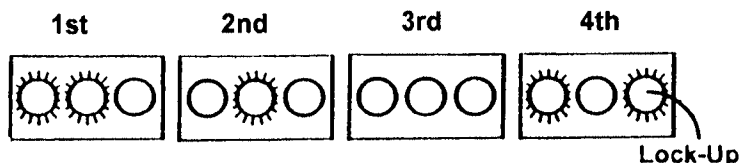
The solenoids have a full time GROUND at the valve body, and the computer switches 12V POWER signals to the solenoids to activate them.

NOTE: Connectors will vary in shape and size.

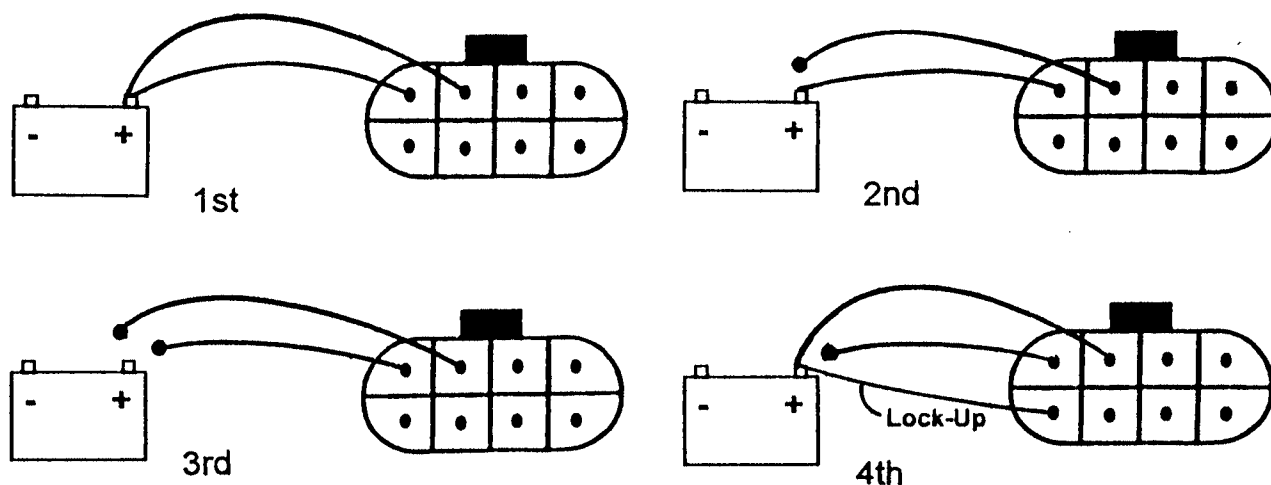
Watching the Shifts



SOLENOID PATTERN	
GEAR	SOL 'ON'
1st	Sol. A & B
2nd	Sol. B
3rd	None
4th	Sol. A
Lock-up	TCC Sol.



Making the Shifts

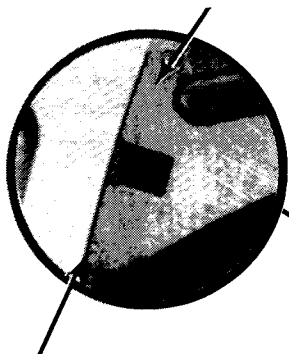


RE4R01A/R4A-EL

Burnt High Clutches/2-4 Band

Burnt high clutches and/or 2-4 band may be caused by no line pressure rise. One cause may be the slide lever binding on the edge of the pump pocket. The solution is to either purchase a NEW pump, or modify the slide lever in your pump, as shown below.

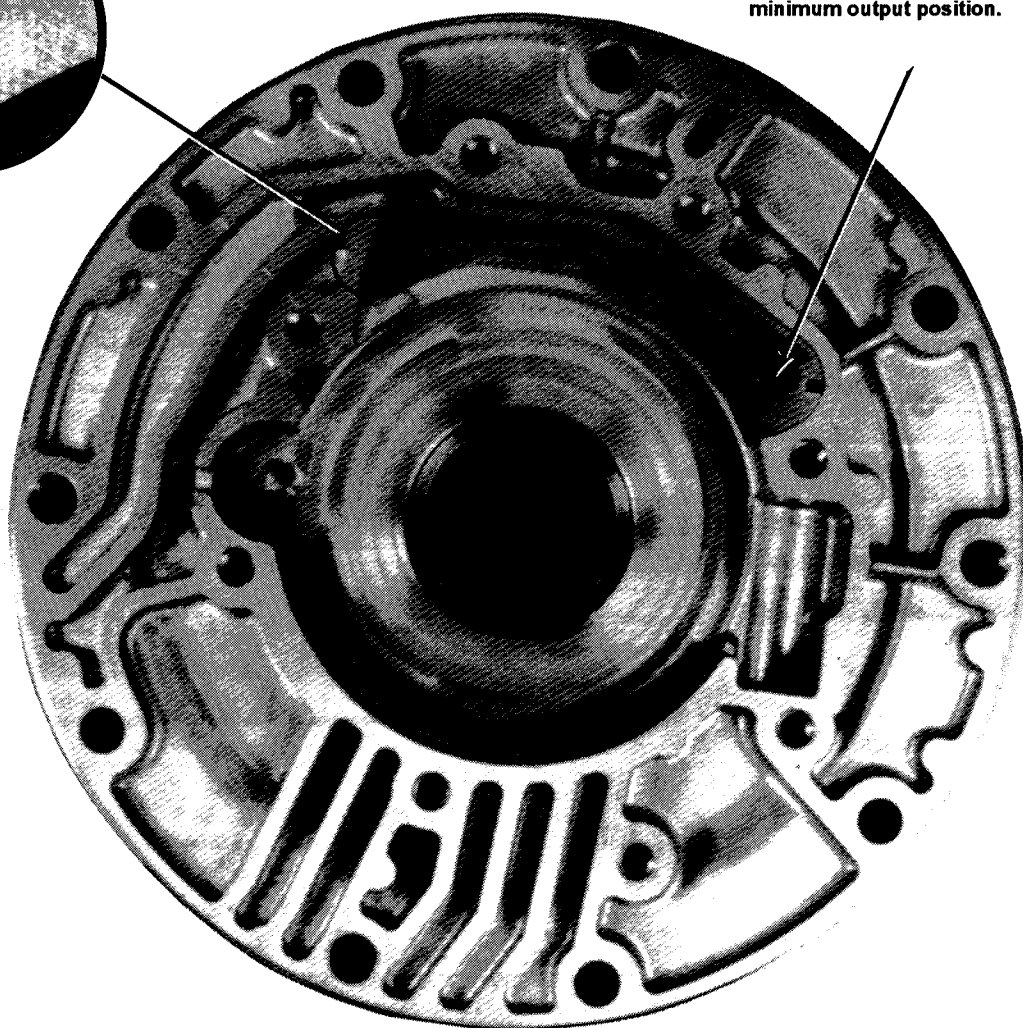
FILE -- .006 - .009 from the end of the slide lever. Don't grind it on the bench grinder since that will leave a burr on the tip seal groove, which may wear out the tip seal.



Try to achieve
.005 - .008
clearance
between the slide
lever and the
pump body

IMPORTANT: Push the
lever to the left while
measuring the clearance.

Wear of the slide lever, pivot pin and the hole in
the pump pocket, allow the lever to contact the
wall in the pump, which binds the lever in the
minimum output position.



RE4R01A, R4A-EL

Premature Planetary Failure

Several areas require extra attention when addressing a complaint of repeat or premature planetary failure on this unit:

- #1 Clogged or Restricted Coolers
- #2 Mislocated Case Bushings
- #3 Geartrain Set-Up
- #4 Lube-Relief Valve
- #5 Filter Restrictions

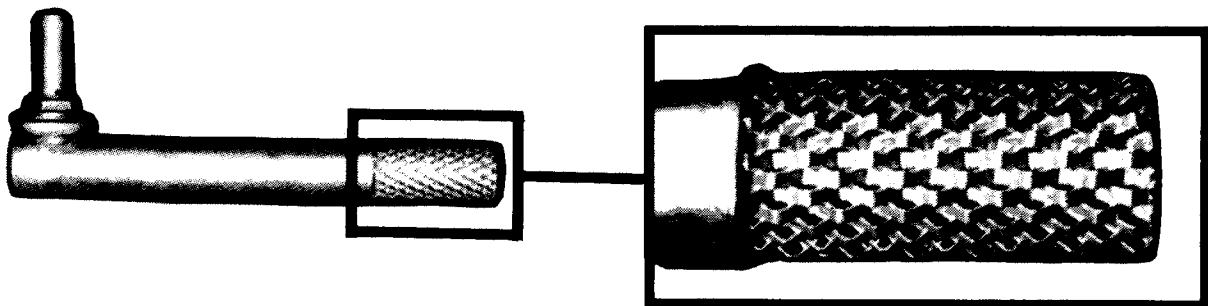
COOLERS

The transmission coolers in the vehicles listed below are of the "Fin" Type design. These fin type coolers will trap any contaminants in the fluid. Once the cooler is plugged or restricted with these contaminants, lube oil to the transmission will be reduced. The fin type coolers cannot be properly cleaned using conventional methods. Cooler replacement will be required if the cooler is clogged or restricted. Acceptable cooler flow is 1 quart in 20 seconds returning to the transmission.

These Nissan vehicles are originally equipped with fin type coolers:

MODEL	YEAR
<i>300ZX</i>	<i>1990-1992</i>
<i>Truck</i>	<i>1988-1992</i>
<i>Pathfinder</i>	<i>1988-1992</i>

Mazda vehicles equipped with this transmission have not had any widespread cooler concerns.



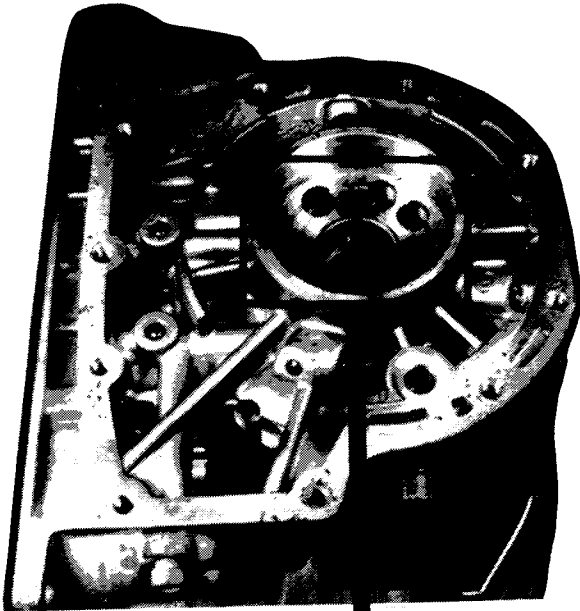
CUT-AWAY VIEW OF TRANSMISSION COOLER

RE4R01A, R4A-EL

Premature Planetary Failure (Continued)

CASE BUSHINGS

Mislocated case bushing will also cause planetary failure due to lack of lube. Lube oil is fed through the hole between the case bushings, and into the mainshaft. Make sure the bushings have not moved together, covering the hole.

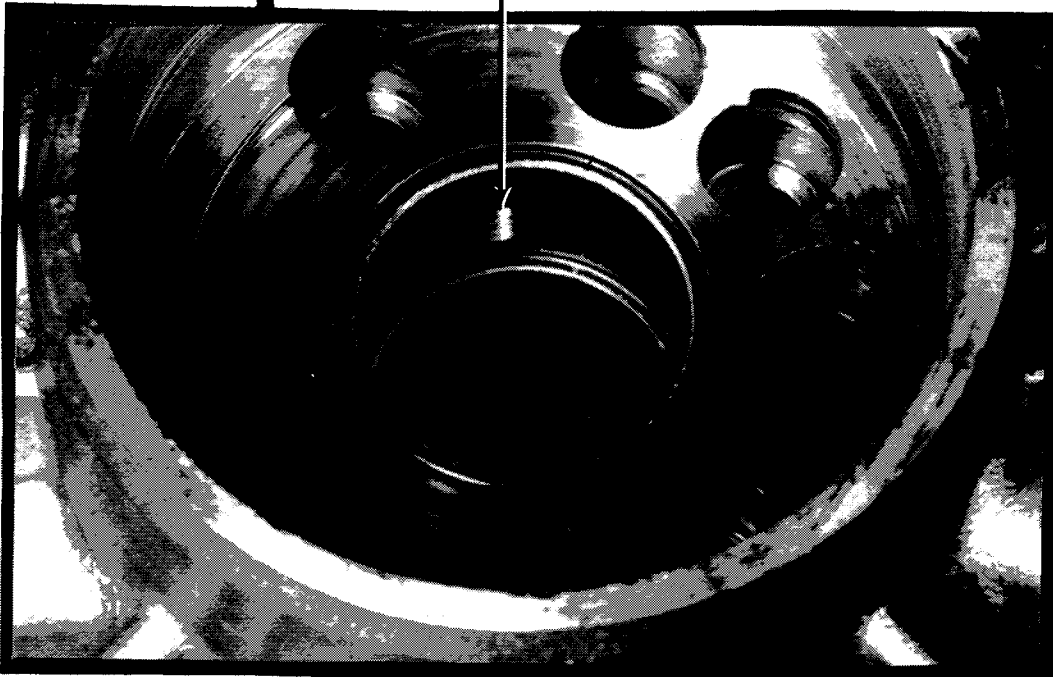


NOTE: The rear case bushing should be flush with the rear edge of the bore.

The front case bushing should be approximately .150" below the front edge of the bore.

Imports

This hole must not be covered by the bushings.



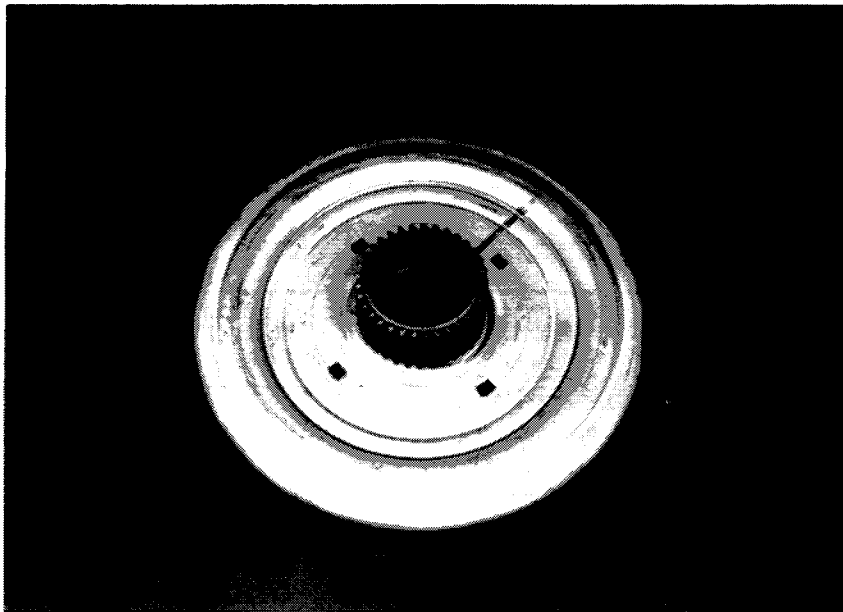
RE4R01A, R4A-EL

Premature Planetary Failure (Continued)

GEARTRAIN SET-UP

To help the lube reach the front planet, remove the sun shell bushing. This allows lube oil to flow freely out the end of the sun gear into the front planet. NEW replacement shells DO NOT have a bushing installed from the factory.

Remove the bushing from the front sun gear.



To prevent a potential loss of lube through clearance in the geartrain, limit end play to the minimum side of factory specifications. Listed below are the Nissan part numbers for the selective washers available. Factory specifications on end play are:

Total end play: .010 - .020

Reverse drum end play: .021 - .035

**Selective Bearing
Races**

**Pump cover to Reverse Drum
Selective Washer**

Thickness mm (in)	Part Number	Thickness mm (in)	Part Number
0.8 (0.031)	31429-21X00	0.7 (0.028)	31528-21X00
1.0 (0.039)	31429-21X01	0.9 (0.035)	31528-21X01
1.2 (0.047)	31429-21X02	1.1 (0.043)	31528-21X02
1.4 (0.055)	31429-21X03	1.3 (0.051)	31528-21X03
1.6 (0.063)	31429-21X04	1.5 (0.059)	31528-21X04
1.8 (0.071)	31429-21X05	1.7 (0.067)	31528-21X05
2.0 (0.079)	31429-21X06	1.9 (0.075)	31528-21X06

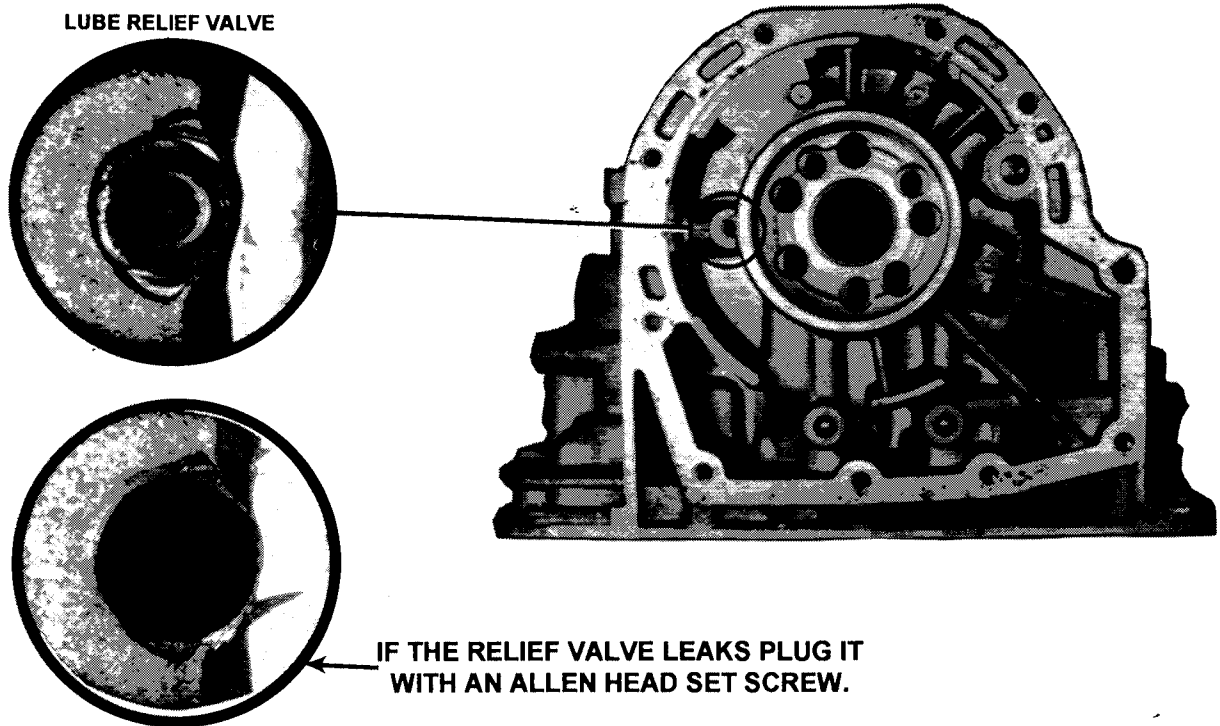
RE4R01A, R4A-EL

Premature Planetary Failure (Continued)

LUBE RELIEF VALVE AND FILTER RESTRICTIONS

Lube Relief Valve

There is a lube blow-off ball & spring in the rear of the case that vents the lube circuit at approximately 17 psi. Remove the ball, spring and orificed cup plug. Thread the hole and install an allen head set screw to plug the hole. Be sure to apply *Locktite®* to the threads of the set-screw during installation.



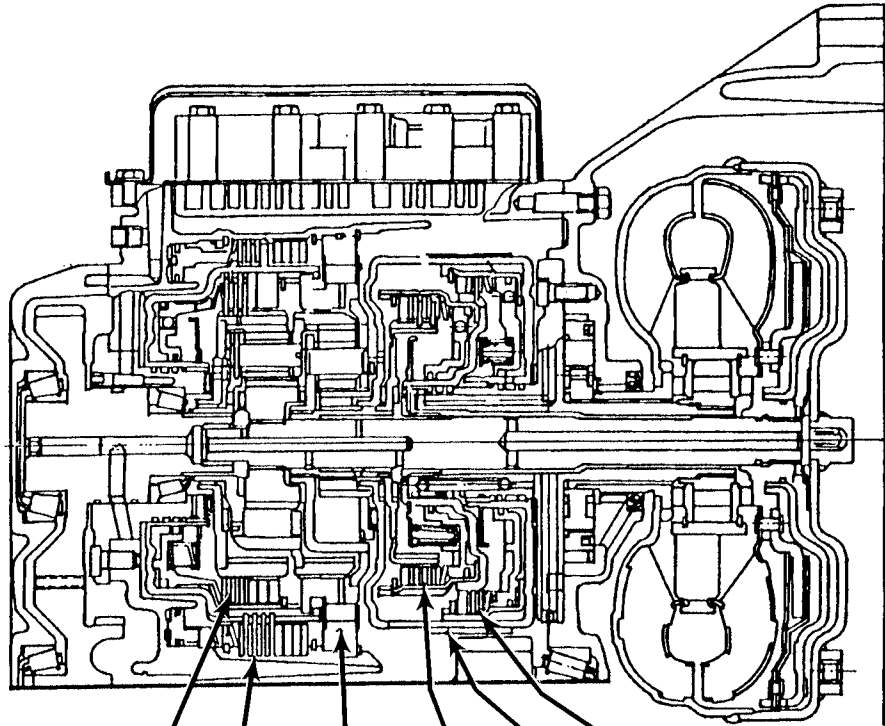
Filter

The life of the planetary in this unit depends on a free flowing filter to supply the lube circuit with an adequate volume of oil. A restricted filter will cause the pump to suck air which is eventually fed into the lube circuit. The filter can be restricted to the point that the unit doesn't exhibit any operational complaints but still not flow enough volume to supply the lube circuit sufficiently.

Take the extra time to thoroughly clean the valve body, and blow dust and stray fibers off new friction material. It may also be worthwhile to remove the pan and clean the filter after the vehicle has been in service for a week or two after overhaul. This will clean out any loose material that may have collected in the sump and on the filter during "break-in".

RE4F02A

Component Application Chart



GEAR RATIOS	
1st gear	2.785:1
2nd gear	1.545:1
3rd gear	1.000:1
4th gear	0.694:1
Reverse	2.272:1

SELECTOR POSITION	GEAR ENGAGES	LOW CLUTCH	LOW REVERSE CLUTCH	SPRAG	HIGH CLUTCH	2-4 BAND	REVERSE CLUTCH
R	Reverse						
D	1st gear						
	2nd gear						
	3rd gear						
	4th gear						
2	1st gear						
	2nd gear						
1	1st gear						
	2nd gear						



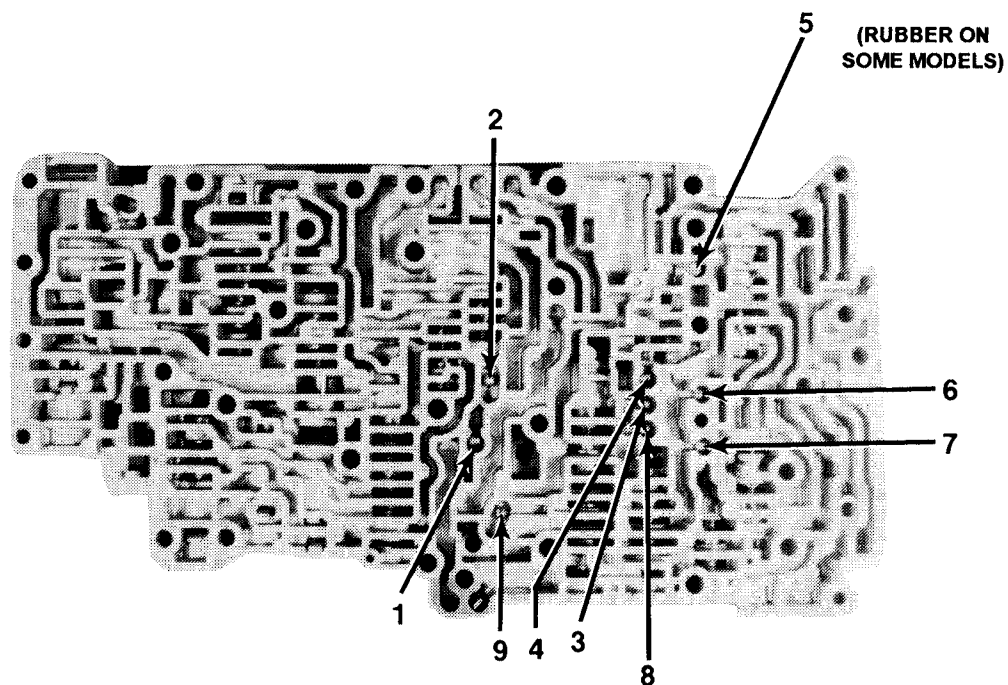
= APPLIED OR HOLDING

RE4F02A

Shifts 1-2-Neutral

A shift from 2nd to neutral can be caused by checkball misplacement. The #9 checkball is **NOT** used in all models. Using the #9 checkball on models not designed for it can cause a shift from 2nd to 1st which feels like a shift to neutral.

To see if you need the #9 checkball look at the separator plate. If it has one hole over the #9 bathtub it doesn't use a ball, if it has two holes it does use a ball.



CHECKBALL FUNCTION

- | | |
|----------------------------------|-----------------------------------|
| #1 Low/Rev brake orifice | #6 Low clutch timing valve bypass |
| #2 Low/Rev brake shuttle | #7 Low clutch feed orifice |
| #3 High clutch feed orifice | #8 High clutch exhaust orifice |
| #4 Servo release exhaust orifice | #9 2-3 shift valve shuttle |
| #5 Servo apply orifice | |

NOTE: The checkball numbers shown here are ATRA numbers not factory numbers.

RE4F02A

Soft Shifts/Slips

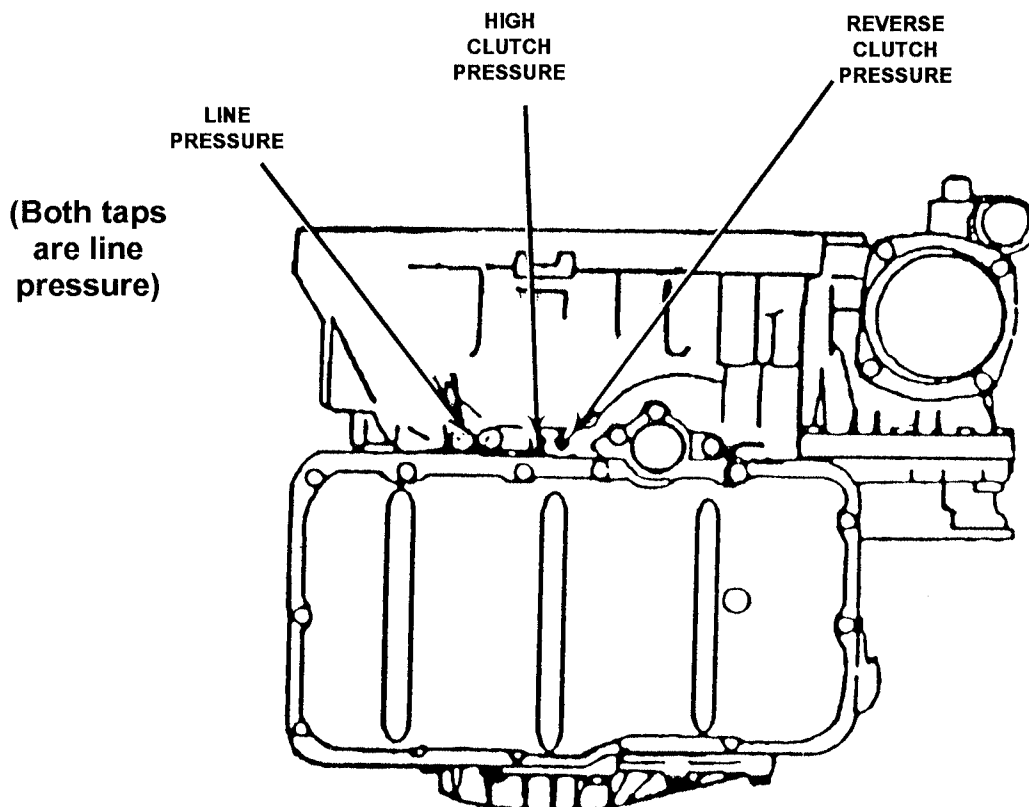
A soft shift or slip complaint on an RE4F02A is usually caused by a worn out pressure control solenoid. Use the following steps to isolate the problem.

- 1 Check mainline pressure in drive.
It should be 55-66 PSI at an idle, 186-198 PSI at a stall.

If line doesn't rise (or rises very little) try the stall test again with the solenoid wires disconnected.

If the pressure rises to maximum, go to STEP 2.

If line pressure is still low you may have a stuck slide, valve body problem, a leaking pressure control solenoid or "O" ring, control cylinder, etc.



RE4F02A

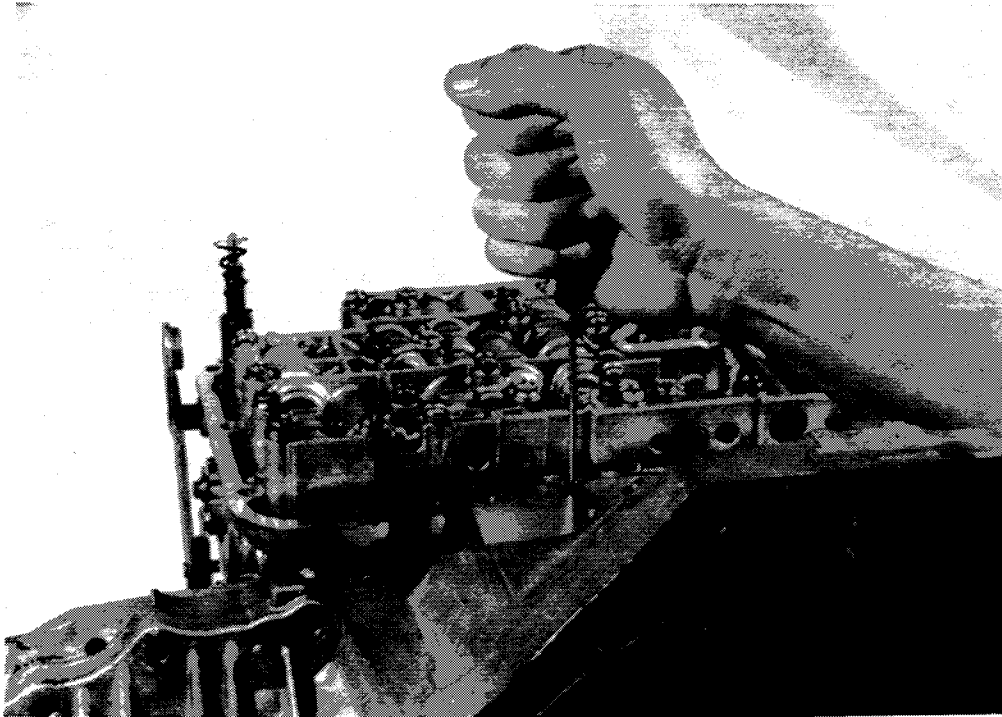
Soft Shifts/Slips (Continued)

To check for a stuck slide, remove the control cylinder and stick a long screwdriver down the control cylinder rod hole.

When you push on the screwdriver you should feel the slide move and the spring compress.

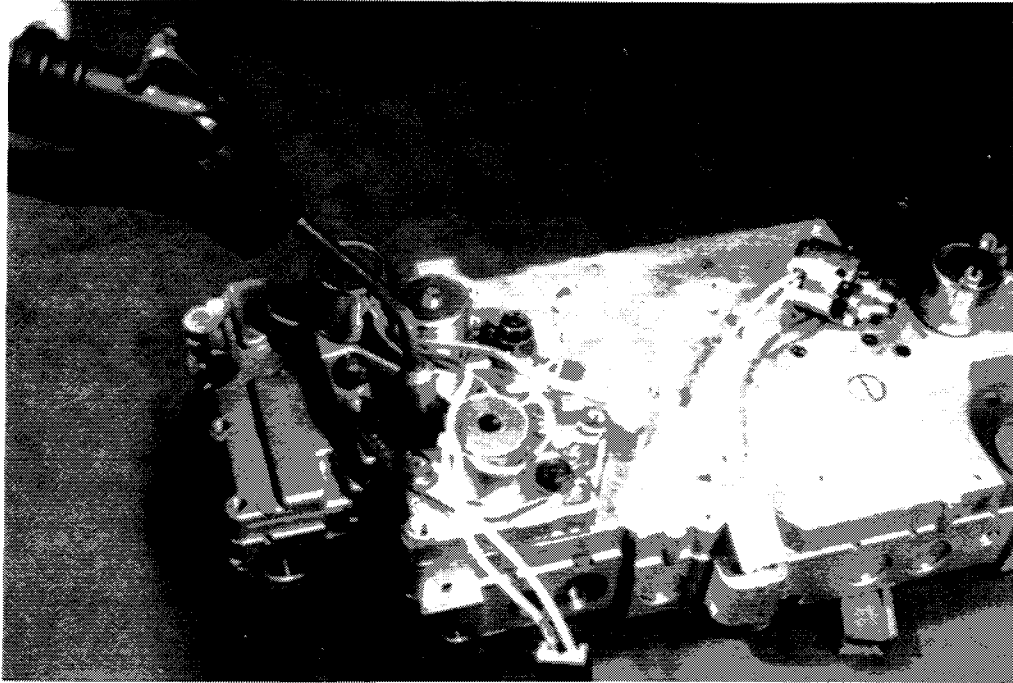
To check the solenoid, pour solvent down the neck. It shouldn't leak, if it does, replace it.

While you have the solenoid off, blow air into the valve body where the solenoid fits. You should be able to hear the Pressure Regulator boost valve stroke.



RE4F02A

Soft Shifts/Slips (Continued)



- ② Check the voltage to the pressure control solenoid, (with the solenoid connected).

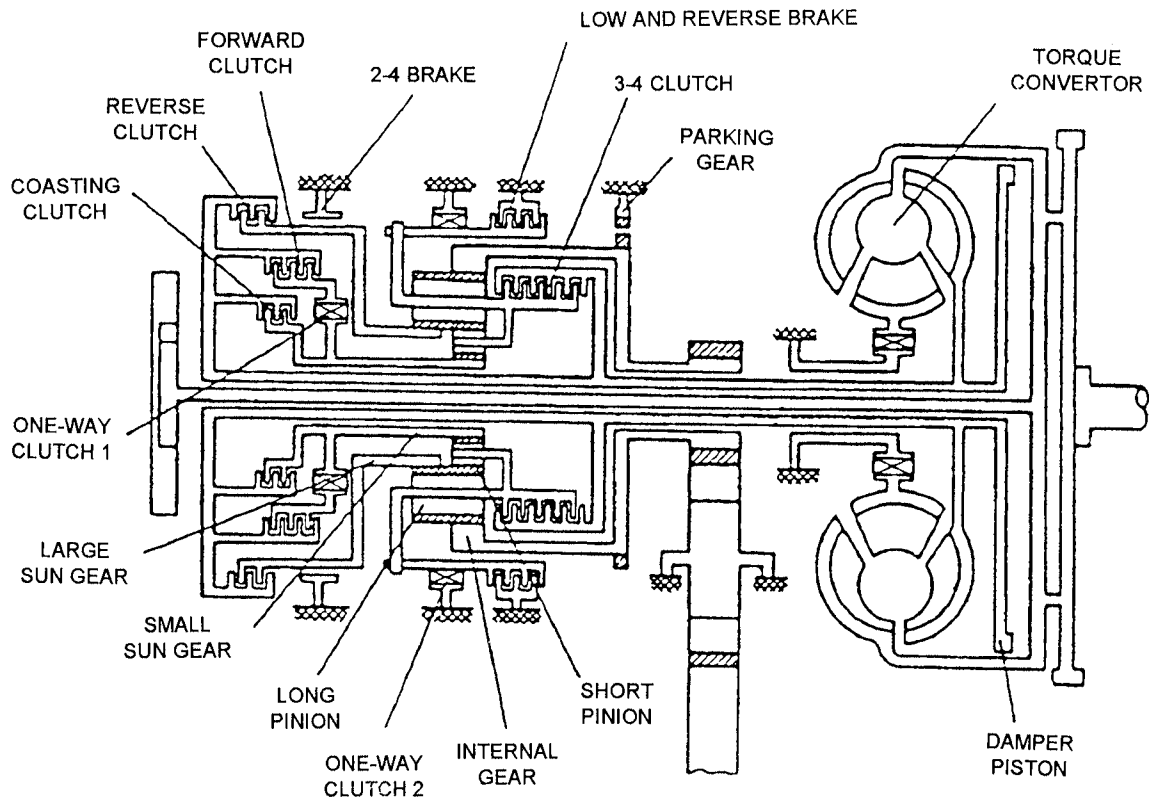
The voltage should be 1.5-2.5V at closed throttle and drop to .5V at WOT. If it does, replace the solenoid pack. The part number is 31940-27X66.

If the voltage does not drop, the problem is computer related (TPS, bad ground, etc.).

NOTE: Most line rise problems are solenoid related. If the unit has more than 50,000 miles, the solenoids should be replaced during rebuild.

F4EAT

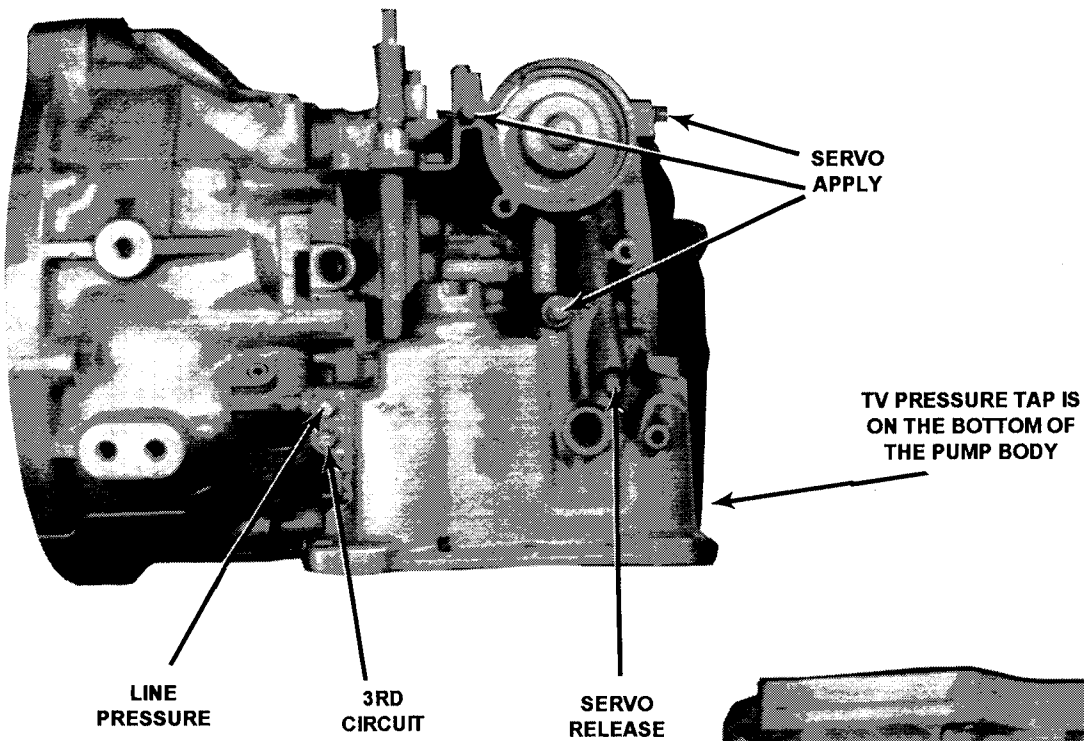
Component Application Chart



RANGE	GEAR	FORWARD CLUTCH	COASTING CLUTCH	3-4 CLUTCH	REVERSE CLUTCH	2-4 BRAKE		LOW & REVERSE BRAKE	ONE-WAY CLUTCH 1	ONE-WAY CLUTCH 2
						APPLIED	RELEASED			
P	--									
R	--									
N	--									
D	1ST									
	2ND									
	3RD									
	4TH									
2	2ND									
	3RD									
1	1ST									
	2ND									

F4EAT

Pressure Tap Identification and Specifications

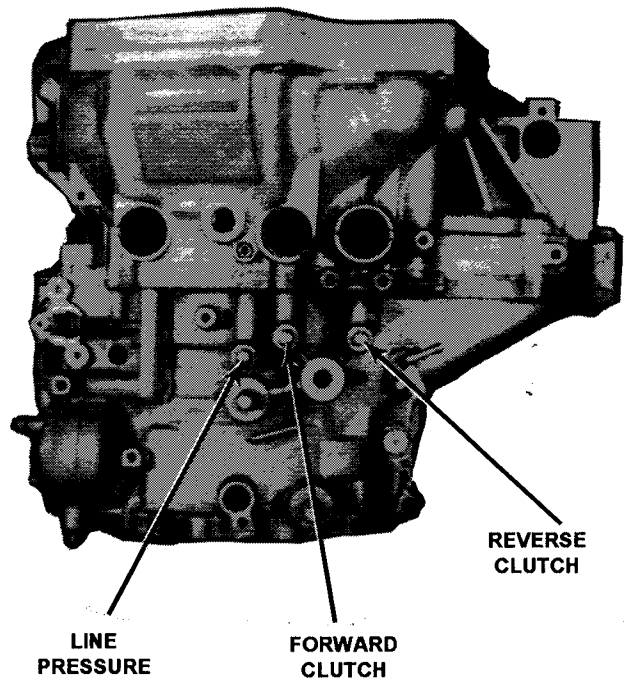


Mainline Pressure Specifications

RANGE	IDLE	STALL
D, S, L	53-65	135-155
R	85-107	220-253

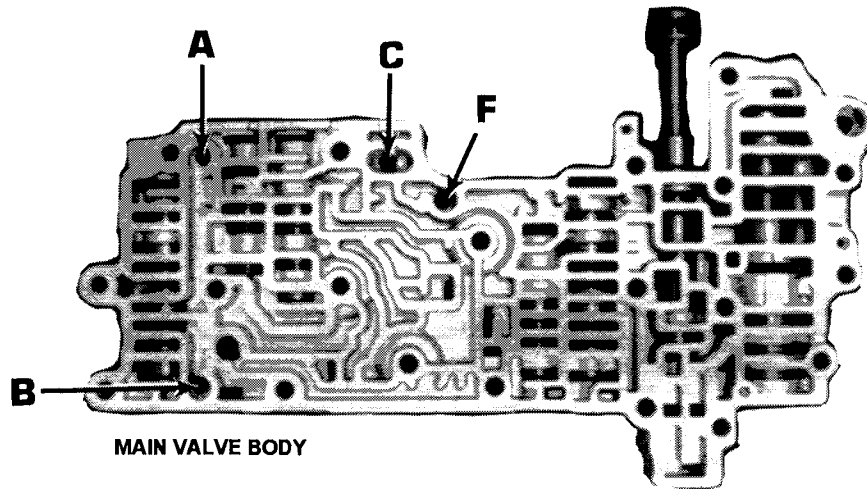
TV Pressure Specification

RANGE	IDLE	STALL
D	5-15	78-96

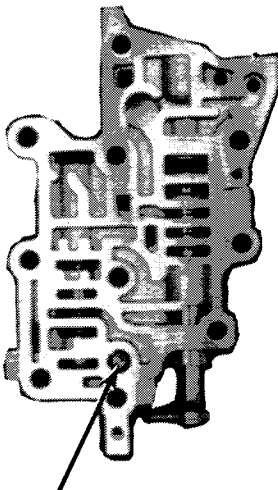


F4EAT

Checkball Locations & Functions

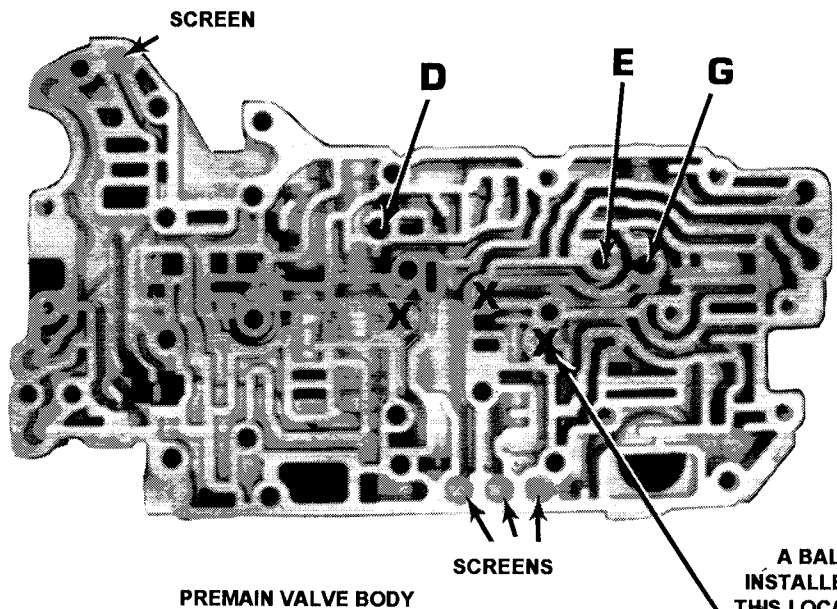


MAIN VALVE BODY



TV LIMIT BALL & SPRING

TV LIMIT SPRING WEIGHS 2lbs 6oz @ .620



PREMAIN VALVE BODY

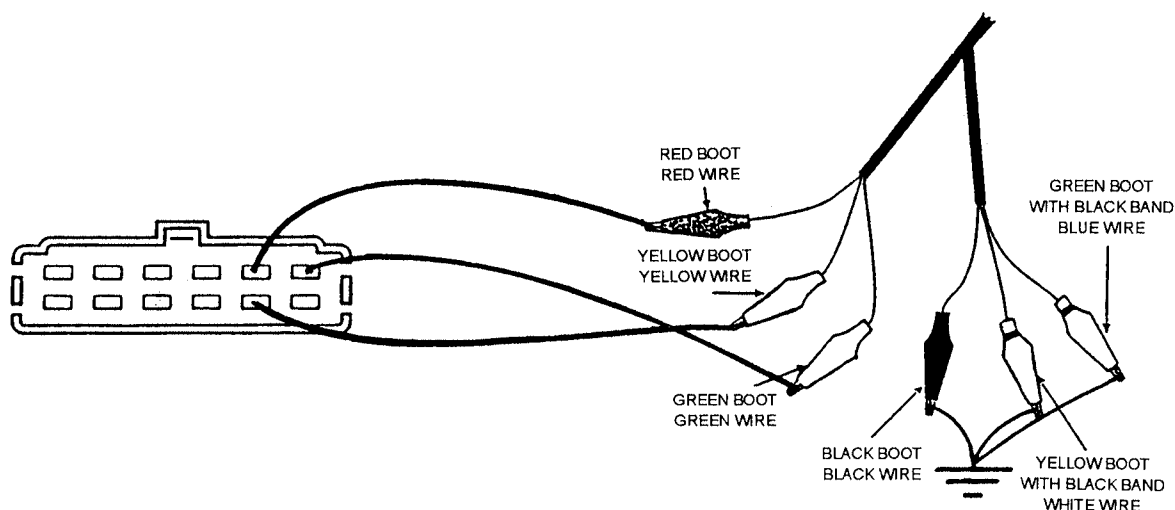
CHECKBALL FUNCTIONS

- A = Forward clutch feed
- B = Coast clutch feed
- C = Low reverse shuttle
- D = Reverse clutch feed
- E = 3rd circuit feed
- F = Low reverse exhaust (Not used on all models)
- G = 3-2 control to 3-2 timing valve (Not used on all models)

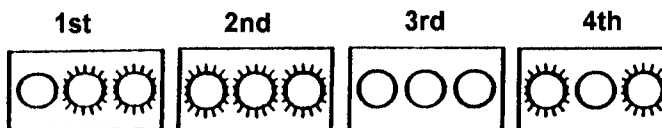
Mazda F4A-EL/Ford F4EAT

The solenoids have a full time GROUND at the valve body, and the computer switches 12V POWER signals to the solenoids to activate them.

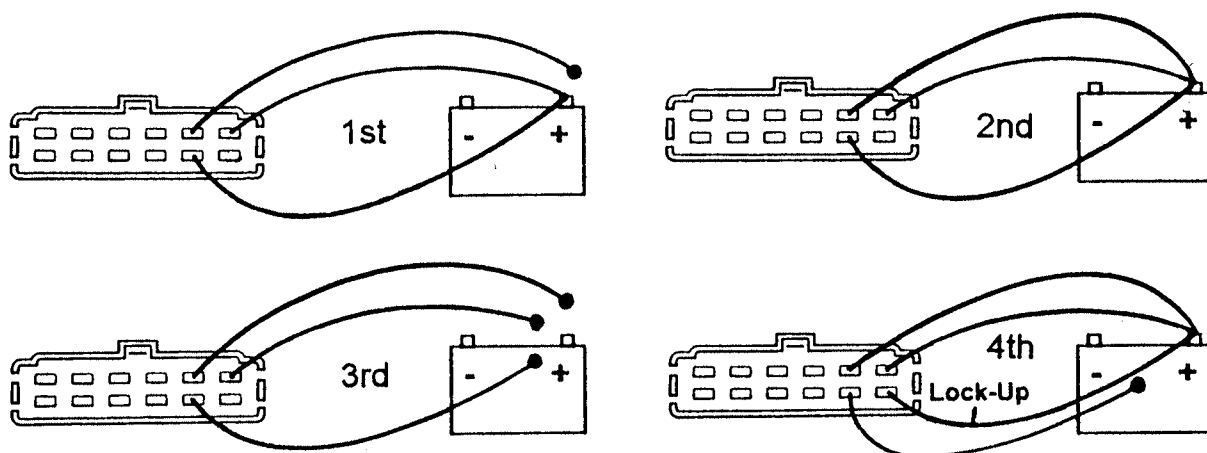
Watching the Shifts



SOLENOID PATTERN	
GEAR	SOL 'ON'
1st	2-3 & 3-4
2nd	All three
3rd	None
4th	1-2 & 3-4

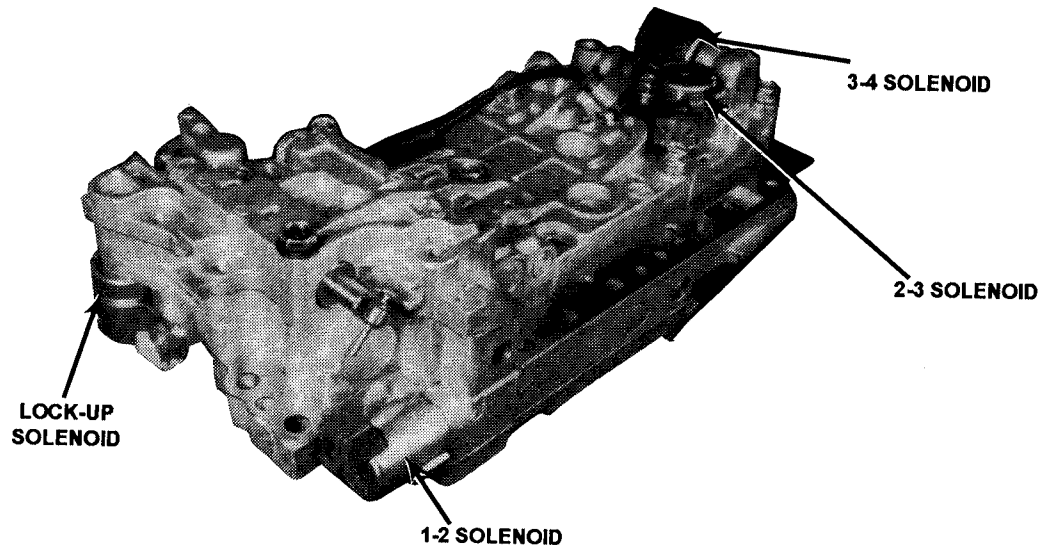


Making the Shifts



F4EAT

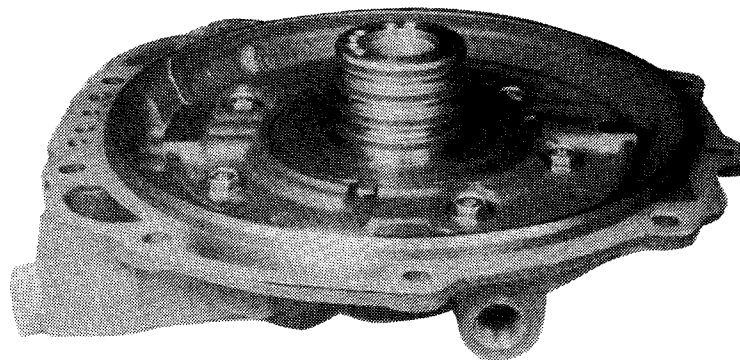
Valve Body Solenoid Identification



Imports

All solenoids are normally closed and measure approximately 13-27 Ω resistance.

All solenoids have feed screens in the valve body over the snout of the solenoids. Clean and re-install them to protect the solenoids from clogging with debris.

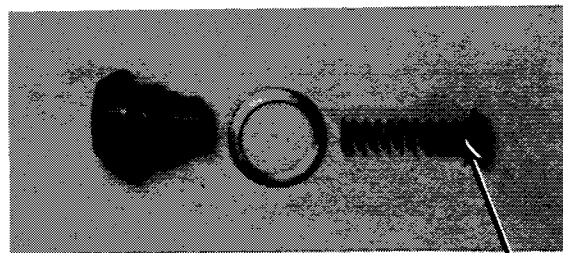
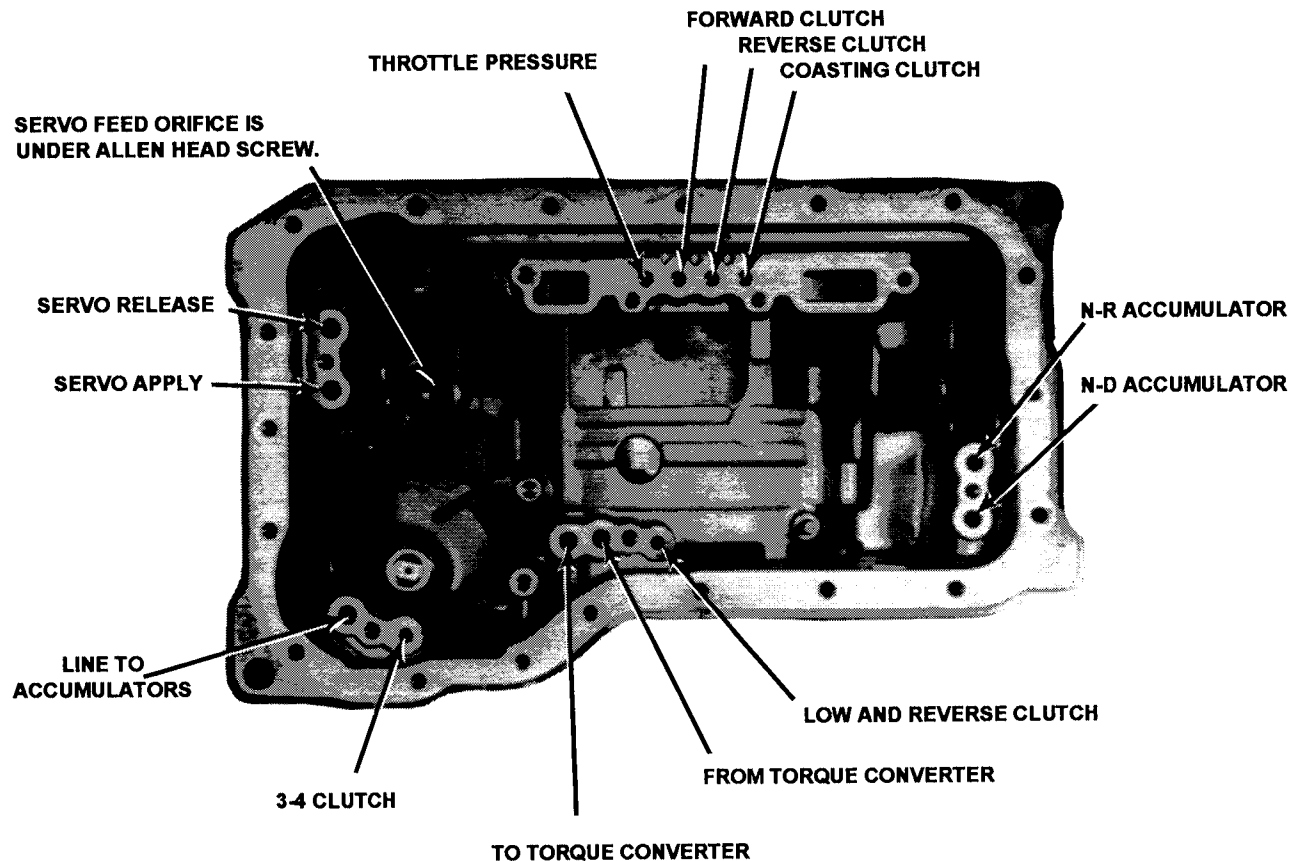


The 4 oil sealing rings on the pump tower are very critical.

Factory seal rings are available separately from Ford under Part #FICZ-7D019-A.

F4EAT

Air Check Points

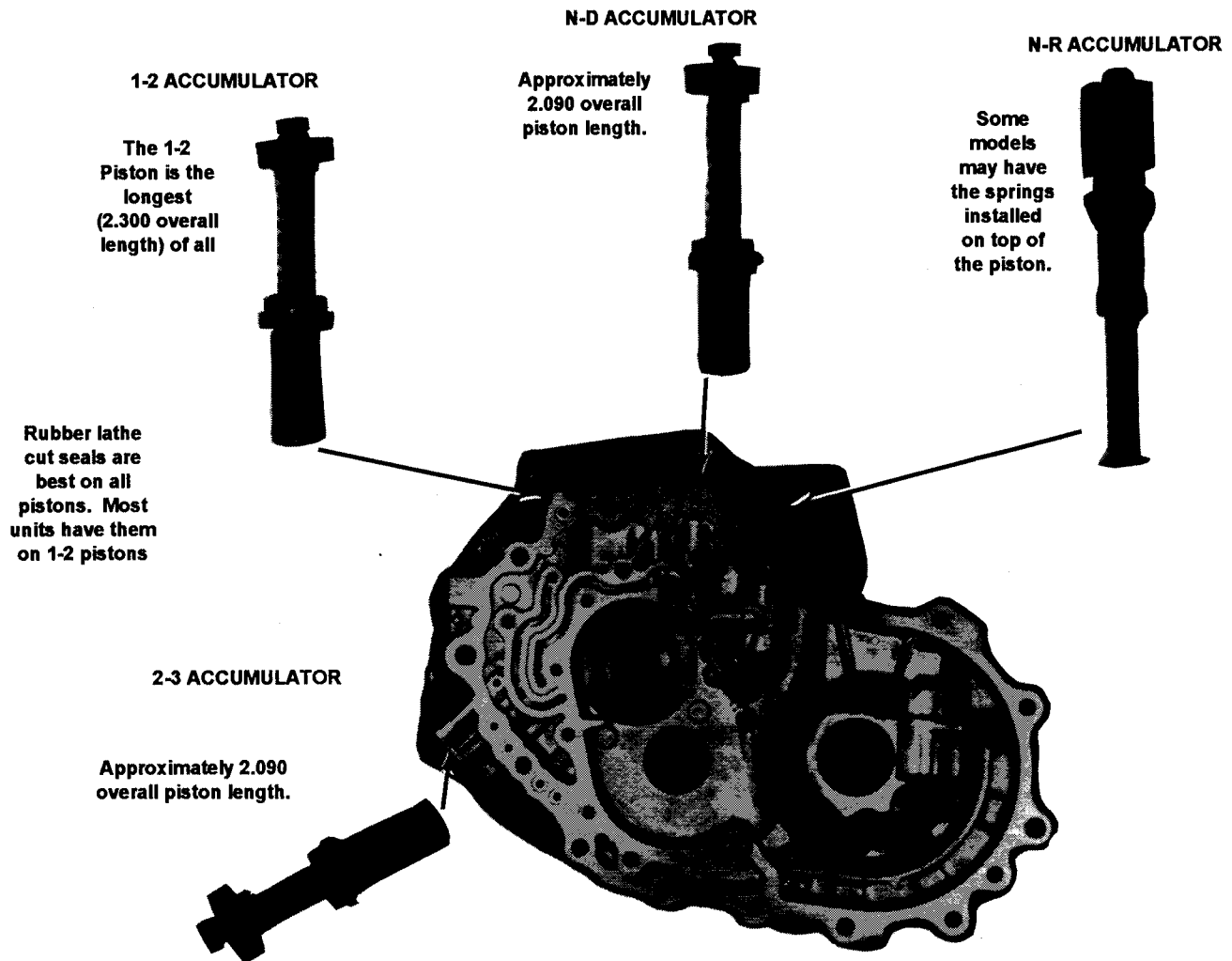


SERVO FEED ORIFICE

There is a servo feed orifice located under the big allen head screw, by the linkage. It would be a good idea to remove it for cleaning. Soap residue from hot water washing machines (or other debris) is likely to interfere with its operation.

F4EAT

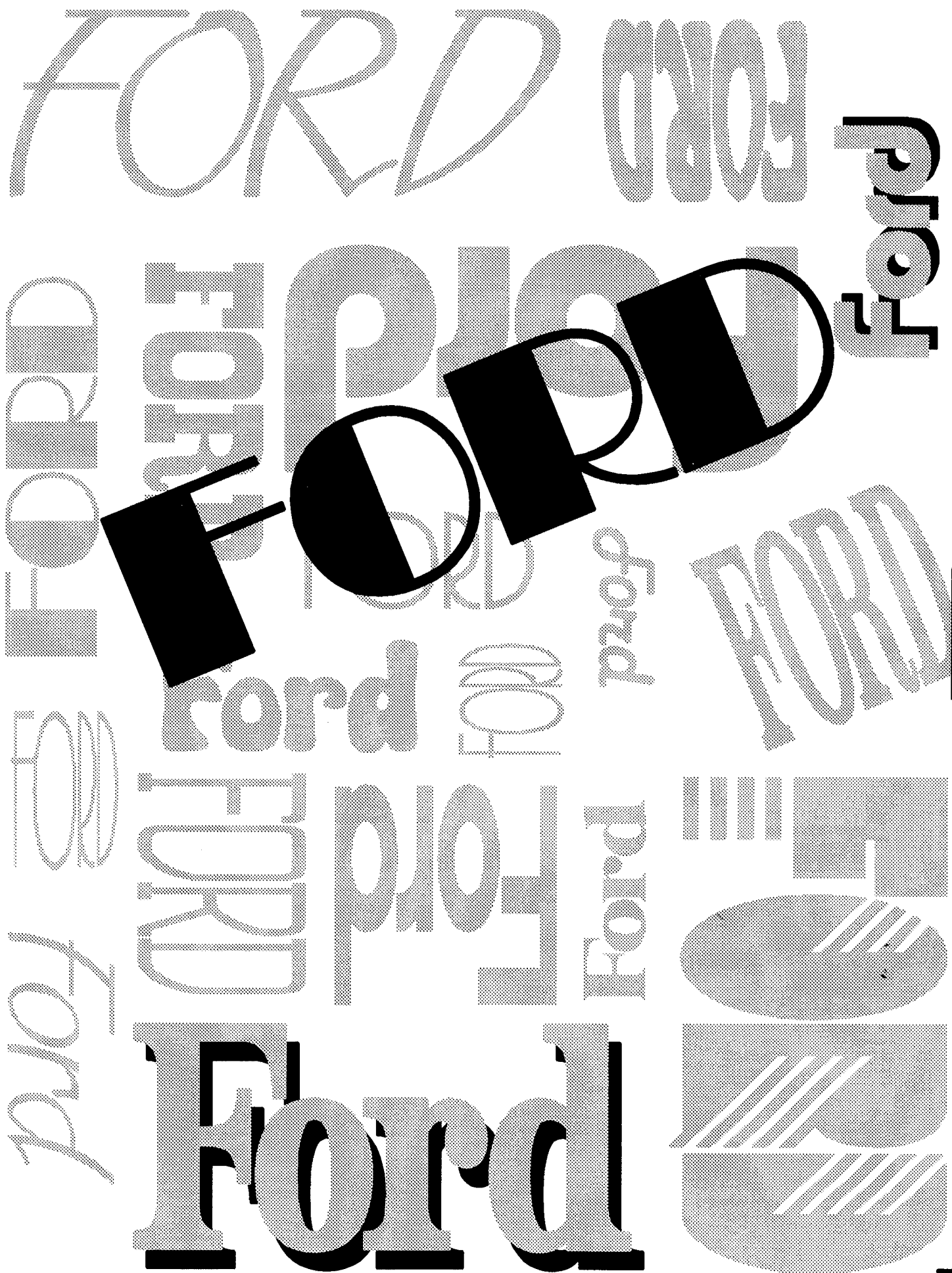
Accumulator Installation



Imports

Pistons installed in wrong locations can cause bind-ups and wrong gear starts.

CAUTION: There are several different arrangements of springs used in the accumulators depending on the model. Tag all springs during disassembly to eliminate confusion.



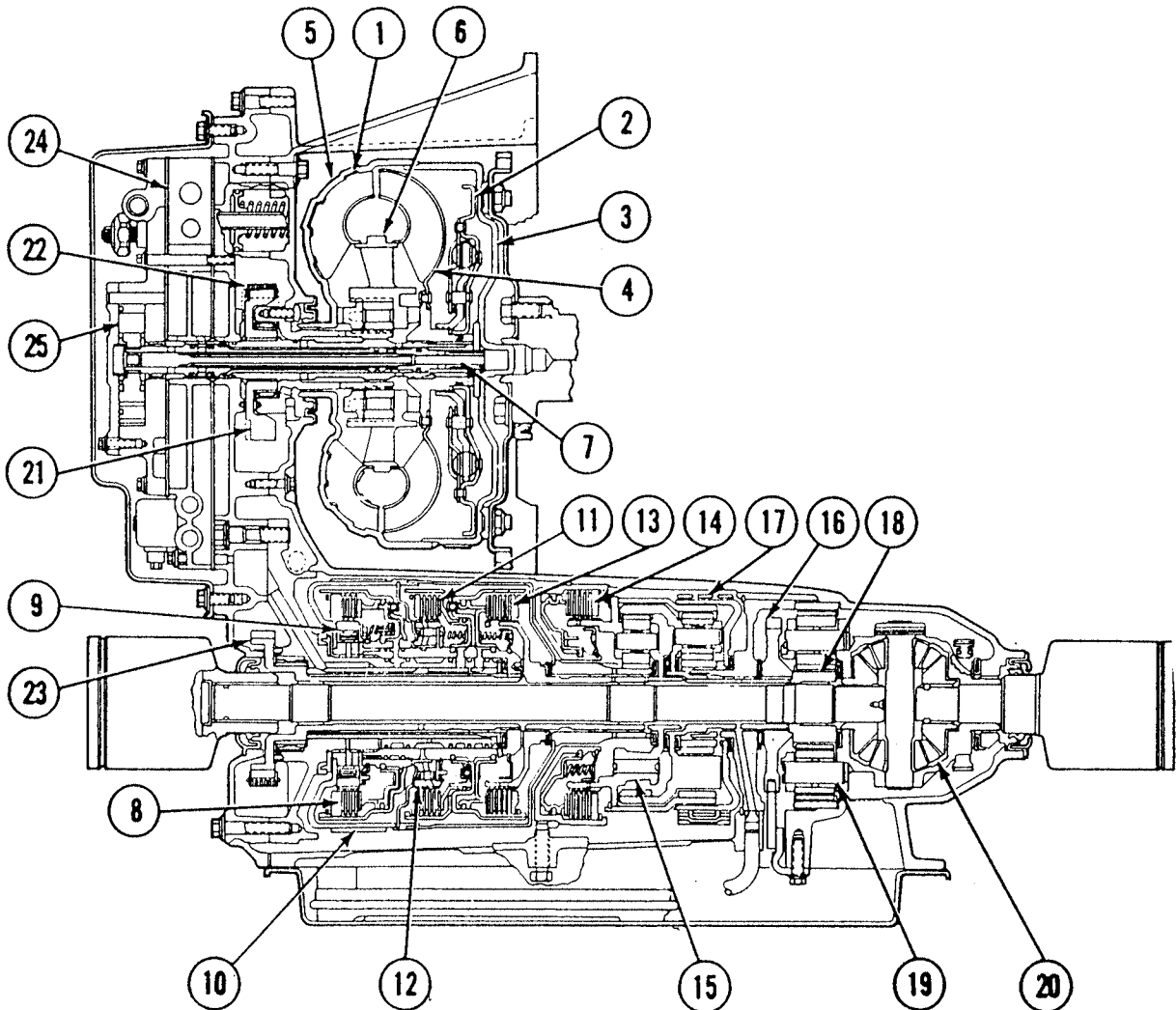
Ford



Notes

AXOD-E

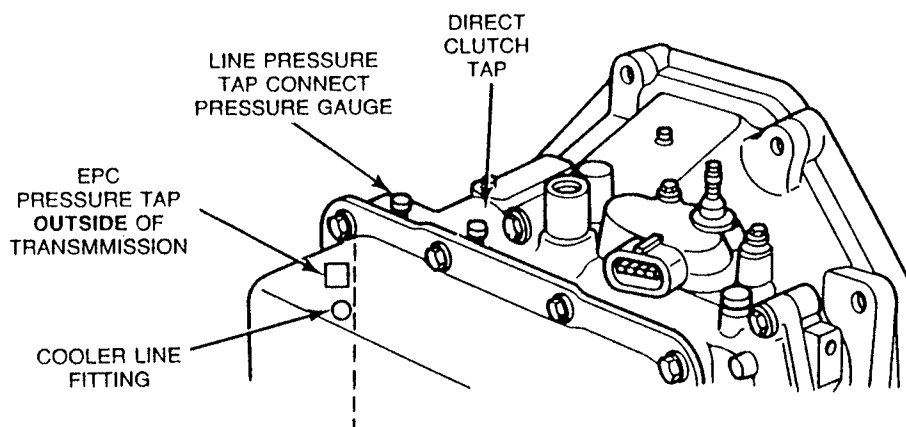
Component Application Chart



GEAR	OVER DRIVE BAND	FORWARD CLUTCH	LOW ONE-WAY CLUTCH	DIRECT CLUTCH	DIRECT ONE-WAY CLUTCH	INTER- MEDIATE CLUTCH	REVERSE CLUTCH	LOW INTER. BAND	RATIO
Manual Low									2.77:1
Drive 1st Gear									2.77:1
Drive 2nd Gear									1.543:1
Drive 3rd Gear									1.000:1
Drive 4th Gear									.694:1
Reverse									2.263:1

AXOD-E

Pressure Tap Identification & Specifications



DIAGNOSTIC PRESSURE CHART		
Pressures at Idle		
Gear	EPC	LINE
P##	40-60##	130-150##
P	10-20	48-77
R	10-20	61-99
N	10-20	48-77
OD	10-20	48-77
D or 3rd	10-20	48-77
1	10-20	48-77
Pressures at Wide Open Throttle (WOT) stall		
Gear	EPC	LINE
P	-----	-----
R	70-90	252-316
N	-----	-----
OD	70-90	168-217
D or 3rd	70-90	168-217
1	70-90	198-247
## Special Note: This condition will occur when the TRANSMISSION OIL TEMPERATURE is below 150°F AND PRIOR to the INITIAL engagement.		

AXOD-E

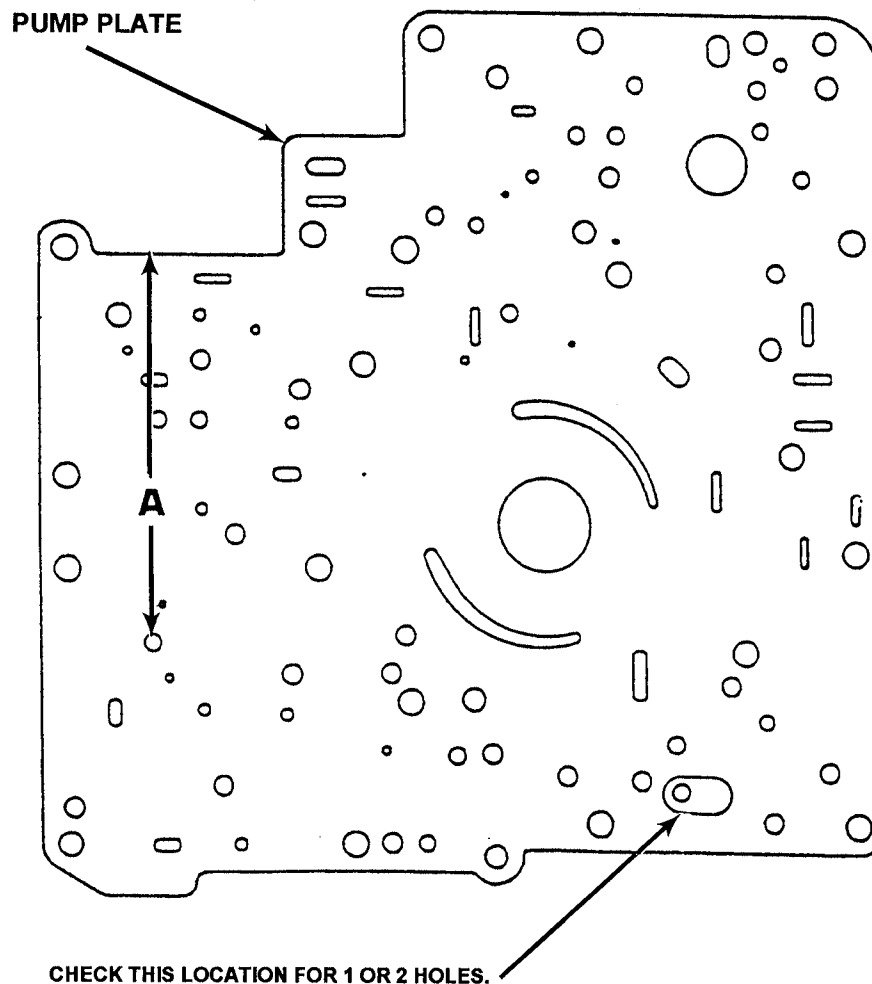
Checkball Functions & Locations

1991 AXOD-E's were made with either 4 or 5 checkballs in the pump. All 1992 and 1993 models have 4 checkballs in the pump. All 1991 and 1992 valve bodies have 7 checkballs. All 1993 valve bodies have 6 checkballs.

To determine if a 1991 model should use 4 or 5 checkballs, look at the spacer plate. If you have 2 holes in the bathtub shown below, then use the 5 checkball arrangement shown. If there is only one hole in the bathtub, use the 4 checkball arrangement.

All 1992 and 1993 models use 4 checkballs as shown on page 83.

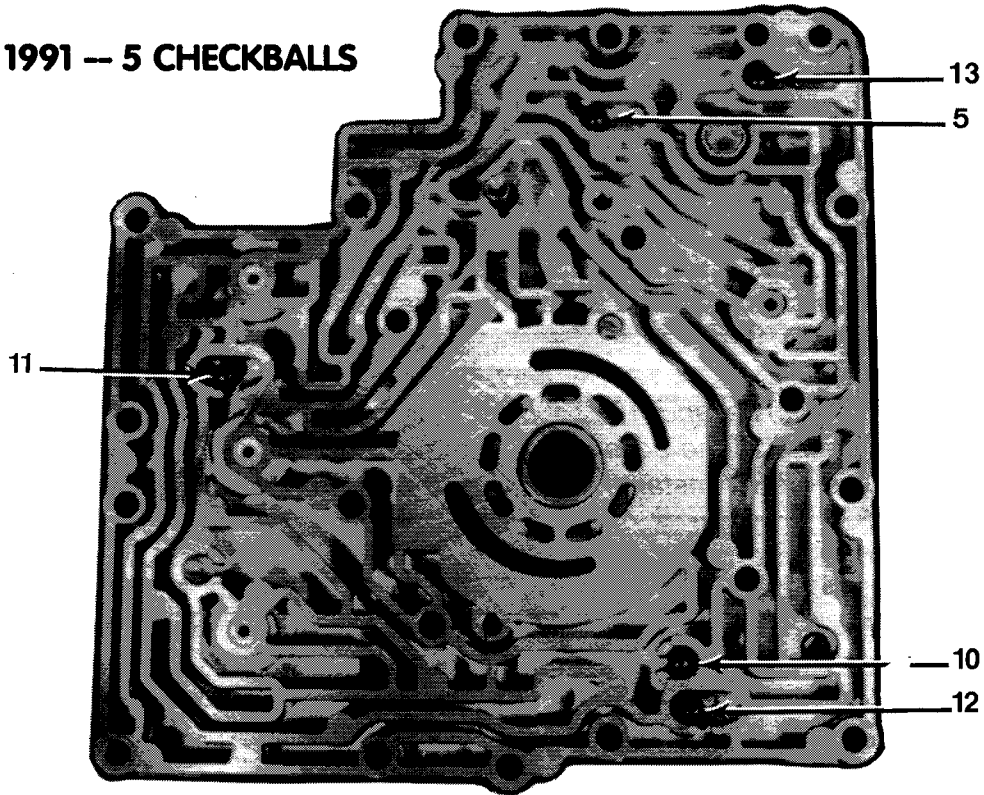
CAUTION: Even though late 1991's and 1992's both have 4 balls, the placement is different between the years. Be sure to install the balls in the proper locations for the model year you are working on. If dimension "A" is 4.085" install the balls as shown on page 82. If it is 3.995" install the balls as shown on page 83.



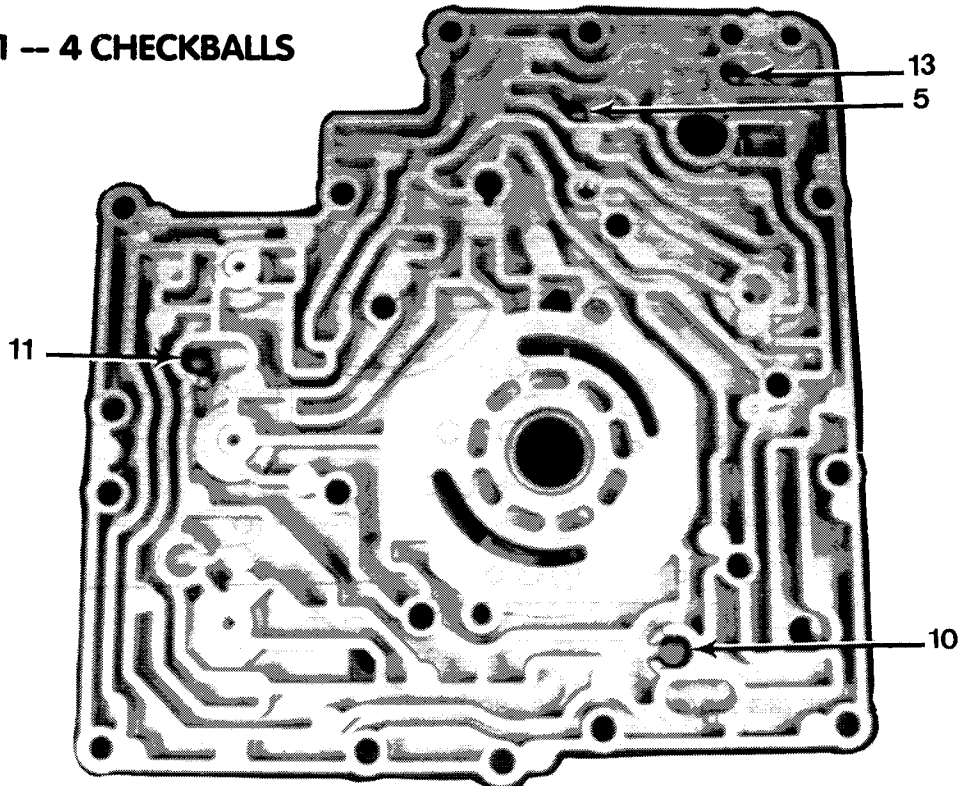
AXOD-E

Checkball Functions & Locations (Continued)

EARLY 1991 -- 5 CHECKBALLS



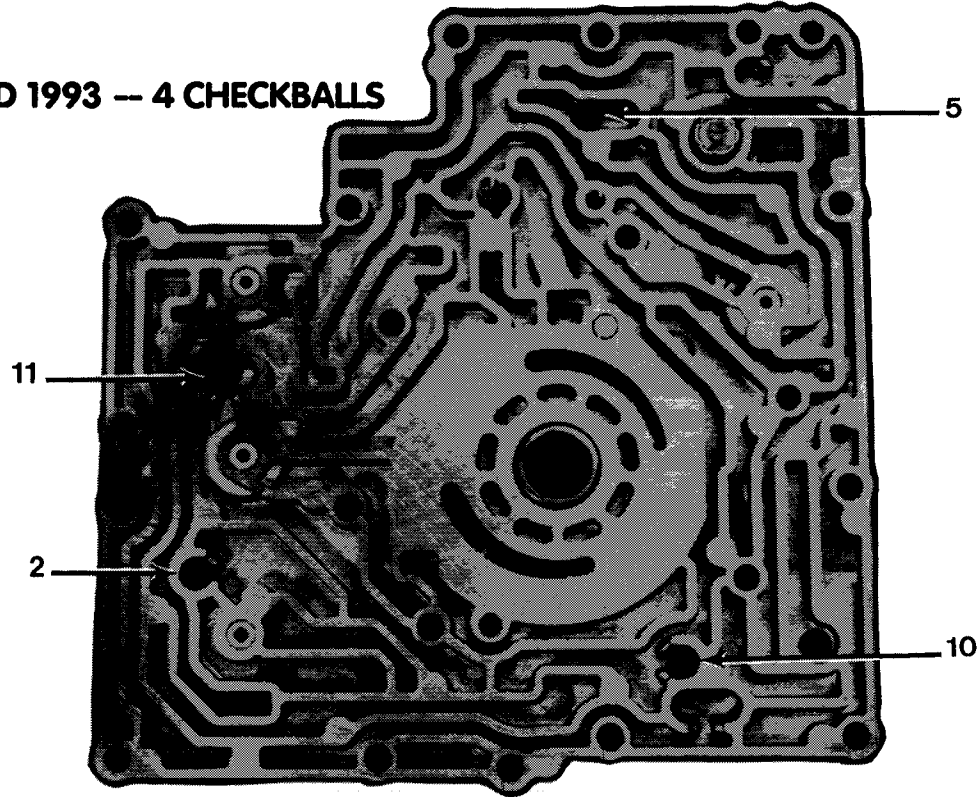
LATE 1991 -- 4 CHECKBALLS



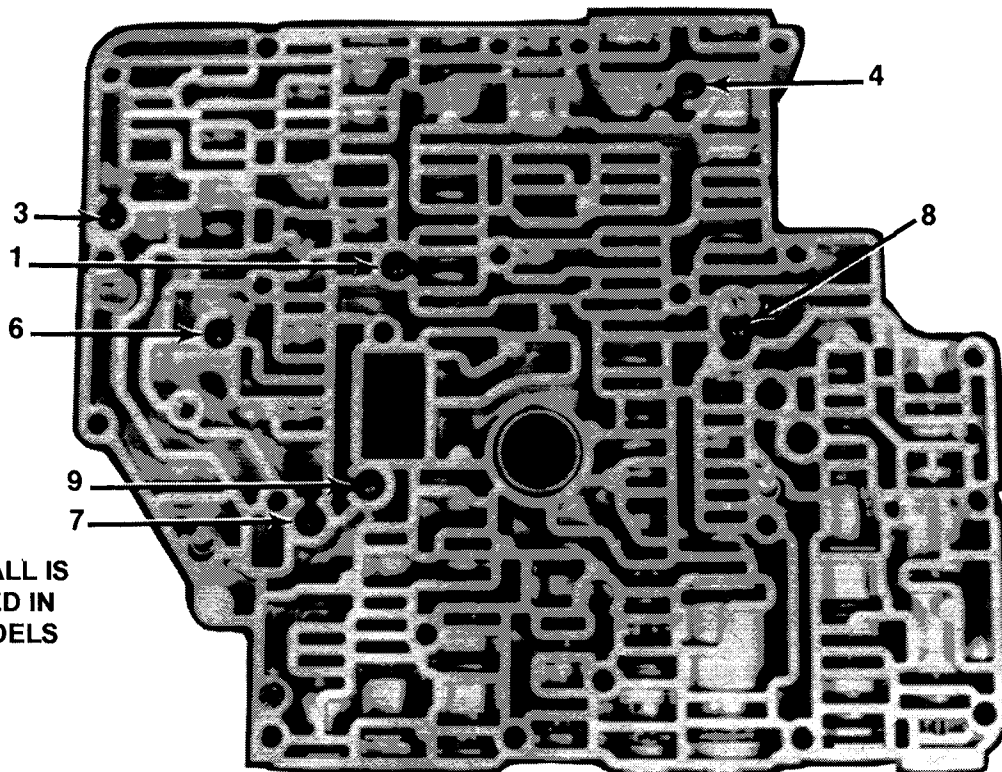
AXODE

Checkball Functions & Locations (Continued)

1992 AND 1993 -- 4 CHECKBALLS



1991 AND 1992 VALVE BODIES USE 7 CHECKBALLS
1993 VALVE BODIES USE 6 CHECKBALLS



THE #7 BALL IS
NOT USED IN
1993 MODELS

AXOD-E

Checkball Locations (Continued)

NUMBER

- 1 Reverse clutch orifice.
- 2 Forward clutch orifice.
- 3 1-2 Servo check, (Causes drive oil to go through the 2-3 servo regulator and engagement control valve before it gets to the servo).
- 4 Overdrive servo orifice.
- 5 Forward clutch control shuttle (shuttles 1st-2nd gear oil, and reverse oil, to move the forward clutch control valve).
- 6 1-2 servo release check (causes servo release oil to go thru the 3-2 control valve during a 3-2 downshift).
- 7 Direct clutch exhaust check (causes the direct clutch oil to exhaust thru the #9 checkball during the 3-2 downshift).
- 8 Direct clutch shuttle (shuttles direct clutch oil and manual low oil to feed the direct clutch).
- 9 Direct clutch orifice.
- 10 Servo release check (provides an exhaust for servo release oil in 1st and reverse).
- 11 Direct clutch oil shuttle (shuttles between 3rd gear oil & 4th gear oil to feed the direct clutch).
- 12 Engagement control valve shuttle (shuttles T.V. oil & 2nd gear oil to control the engagement control valve).

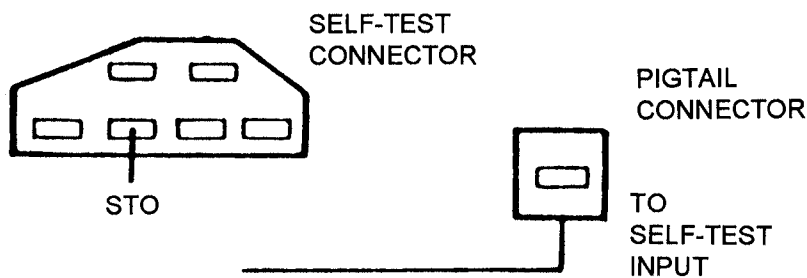
NOTE: 4 checkball configurations only use 2nd gear oil.

- 13 Forward clutch control valve feed orifice.

Ford Trouble Codes

Getting the Codes

To get the Ford ECA to start sending out trouble codes, use a jumper wire and connect the 'STI' connector, which is the single pin diagnostic connector, to a good chassis ground or the negative battery terminal. Turn the key on, but don't start the engine. The computer goes through a test routine, (you may hear stuff go on and off for about 15 seconds) and will then send codes out as ground pulses on the 'STO' wire that you can read with a voltmeter. However, most late model Ford vehicles will also start to flash a 'Check Engine' light or an 'Overdrive Cancel' light. If you have a dash light flashing codes, you won't need a meter. If not, just hook your negative VOM lead to the 'STO' wire on the 6 hole diagnostic connector as shown and hook the positive VOM lead to the battery positive terminal.



Your volt meter will now show on and off 'pulses', when the computer is sending out codes. Think of these pulses as a light flashing on and off, just like a 'Check Engine' light. If you have an 'Overdrive Cancel' light, make sure that you don't turn the cancel button on.

Code Format

For these codes to make any sense, you have to be able to tell how long the 'off' time is between the flashes. For each code digit, there is a half second 'off' between each 'on'.

EXAMPLE: ON-OFF 1/2 sec. -- ON-OFF 1/2 sec. -- ON=3.

Between each digit of a code there is 2 seconds 'off'.

EXAMPLE: ON-OFF 1/2 sec. -- ON-OFF 1/2 sec. -- ON-OFF 2 sec. -- ON-OFF 1/2 sec. -- ON=32.
Some codes will have two digits and some will have three.

Each code is separated by a four second 'OFF' period.

Ford Trouble Codes (Continued)

Code Format (Continued)

The first group of codes you get will be key on engine off or KOEO codes. These tell you what is wrong NOW. An intermittent problem, or one that has been corrected will not show up here. These codes will be repeated once. After the second display of the KOEO codes, there is a 6 to 9 second pause. Then a single flash, or pulse, followed by another 6-9 second pause. Then you get the continuous memory codes. These are codes that, once set, stay in memory until the problem is fixed or goes away, and the engine has heated and cooled either 40 or 80 times, depending on the model.

Clearing Codes

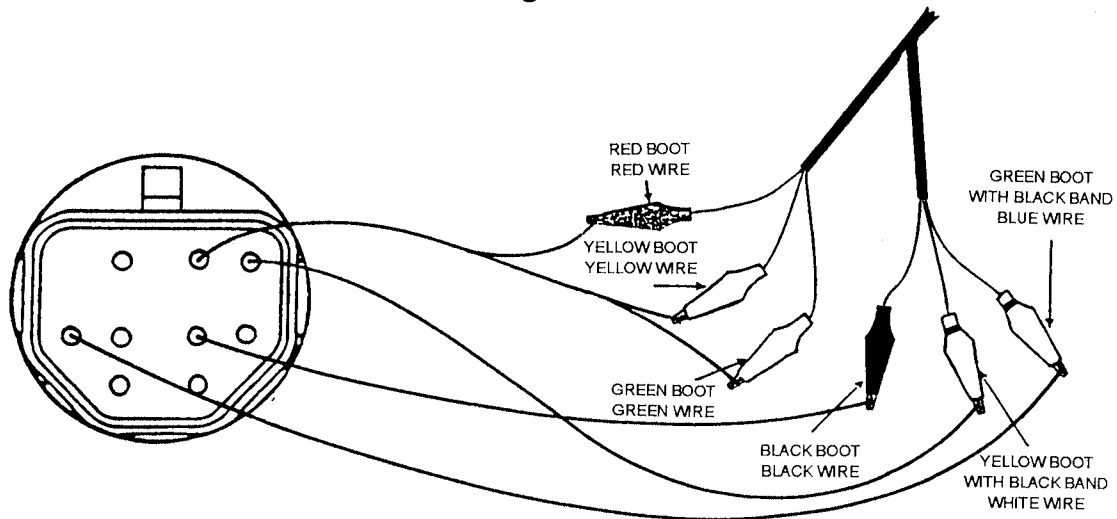
KOEO codes will clear immediately when the problem is fixed. Continuous memory codes are cleared by disconnecting your STI jumper wire from ground while the codes are being displayed.

Because of the wide variety of trouble code listings, consult ATRA Technical Bulletin #089, January, 1992.

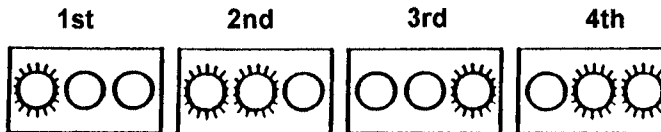
AXOD-E -- 93/On

The AXOD-E shift solenoids have a full time 12V POWER source, and the computer switches GROUND signals to the solenoids to activate them.

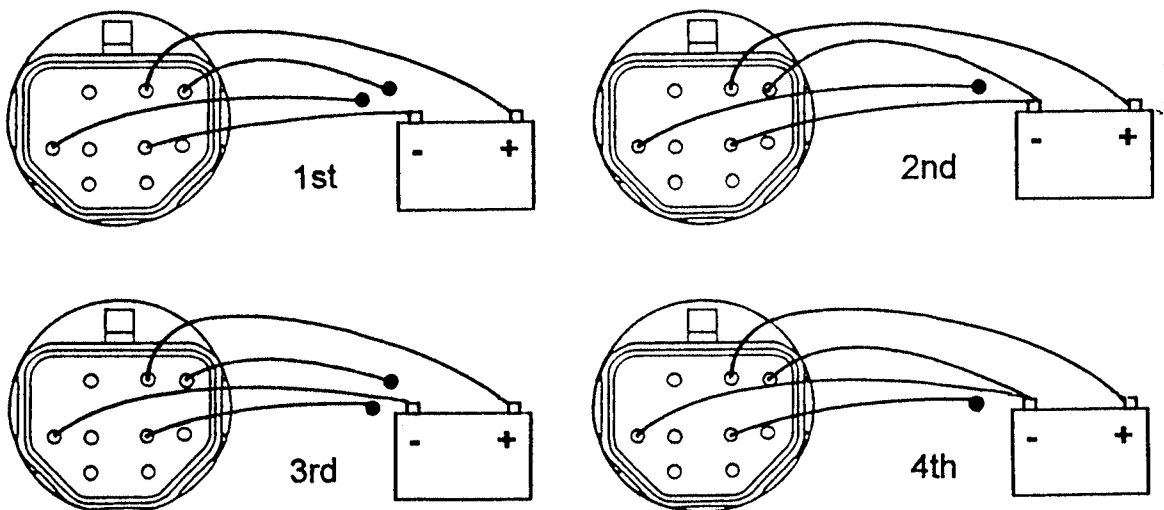
Watching the Shifts



SOLENOID PATTERN	
GEAR	SOL 'ON'
1st	Sol. 2
2nd	Sol. 1 & 2
3rd	Sol. 3
4th	Sol. 1 & 3



Making the Shifts



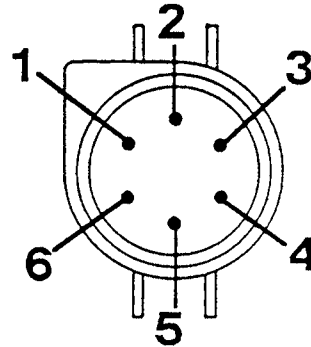
AXOD-E

Electrical Information

The AXOD-E is a fully electronically controlled transaxle. All automatic upshifts, downshifts, converter clutch applications, and line pressure control are achieved by activating solenoids. The following pages show the procedures and specifications for internal transaxle electrical component testing.

TOP CASE CONNECTOR PIN IDENTIFICATION

1. EPC solenoid ground
2. EPC solenoid power
3. TOT sensor
4. TOT sensor
5. LU solenoid power
6. LU solenoid ground



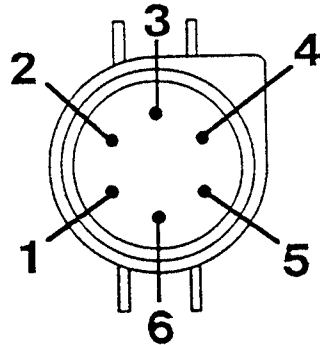
COMPONENT	OHMMETER LEADS BETWEEN TERMINALS	RESISTANCE SHOULD BE	
EPC SOLENOID	1 & 2	3.25 - 5.5 ohms	
LOCK-UP SOLENOID	5 & 6	91 CONTINENTAL AND ALL 92 MODELS .72 - 2 ohms 91 TAURUS & SABLE 21 - 36 ohms	
TOT SENSOR	3 & 4	TRANSMISSION FLUID TEMPERATURE	
		°F	RESISTANCE
		32-58	100K-37K
		59-104	37K-16K
		105-158	16K-5K
		159-194	5K-2.7K
		195-230	2.7K-1.5K
		231-266	1.5K-0.8K

AXOD-E

Electrical Information (Continued)

SIDE CASE CONNECTOR PIN IDENTIFICATION

1. Power to Solenoid #1
2. Ground to Solenoid #1
3. Power to Solenoid #2
4. Ground to Solenoid #2
5. Ground to Solenoid #3
6. Power to Solenoid #3



COMPONENT	OHMMETER LEADS BETWEEN TERMINALS	RESISTANCE
Solenoid #1	1 & 2	15 - 25 ohms
Solenoid #2	3 & 4	15 - 25 ohms
Solenoid #3	5 & 6	15 - 25 ohms

Ford

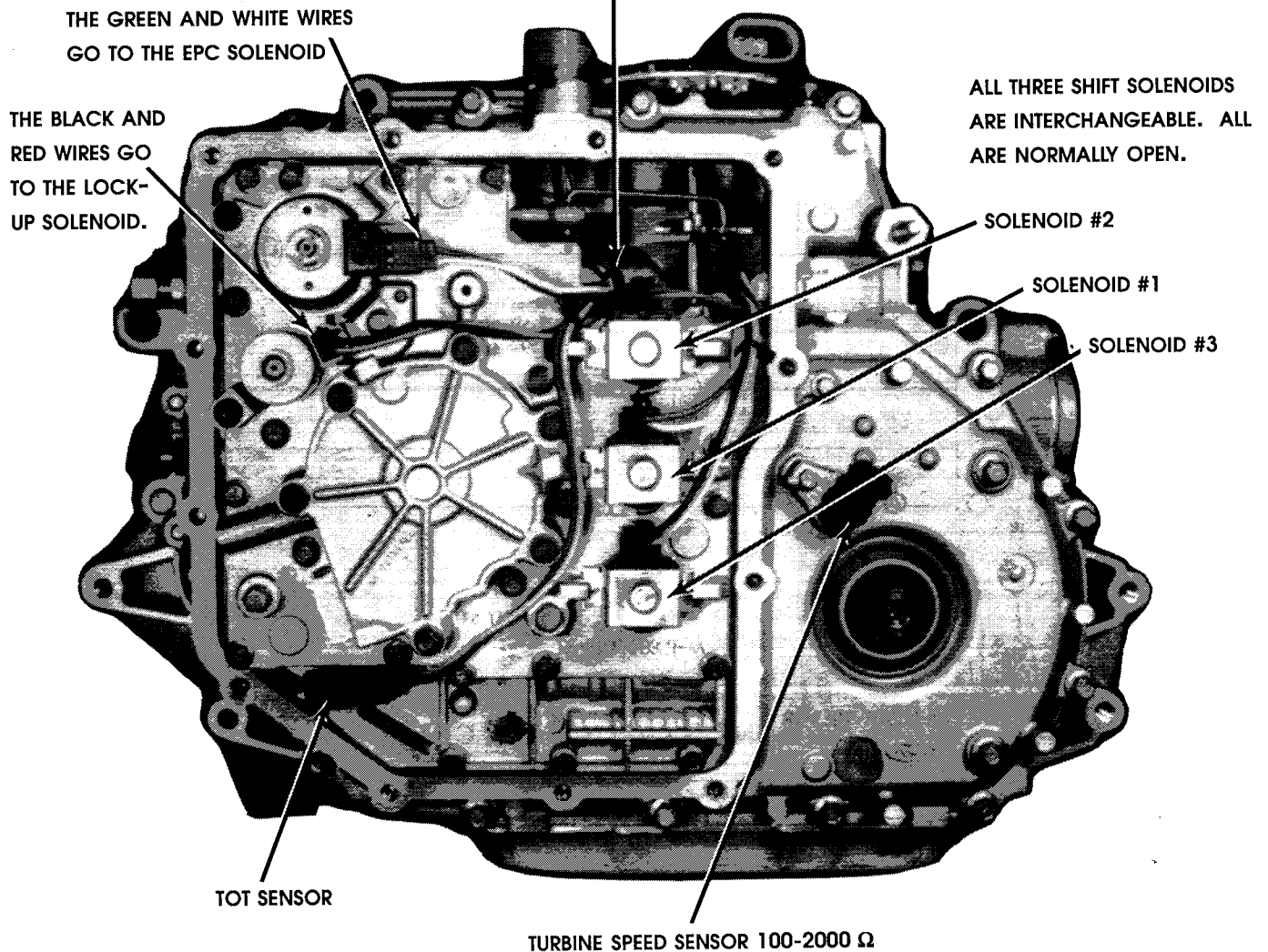
SOLENOID APPLICATION CHART

PRNDL	GEAR	SS1	SS2	SS3
D	1	OFF	ON	OFF
	2	ON	ON	OFF
	3	OFF	OFF	ON
	4	ON	OFF	ON

AXOD-E

Electrical Information (Continued)

THE SOLENOID WIRES FROM THE TOP CONNECTOR MUST BE ROUTED BEHIND THE MANUAL VALVE AND LINKAGE, AND SECURED TO THE PUMP SPACER PLATE TO PREVENT INTERFERENCE WITH THE LINKAGE.



AXOD-E

Unit Interchange/Parts Matching

Many complaints may occur as a result of installing an incorrect exchange unit (or components) into the vehicle. There are 2 different lock-up systems used on AXOD-E transaxles. One is a normal Lock-Up Solenoid (LUS) system and the other is a Modulated Lock-Up Solenoid (MLUS) system. These systems and/or components ARE NOT interchangeable.

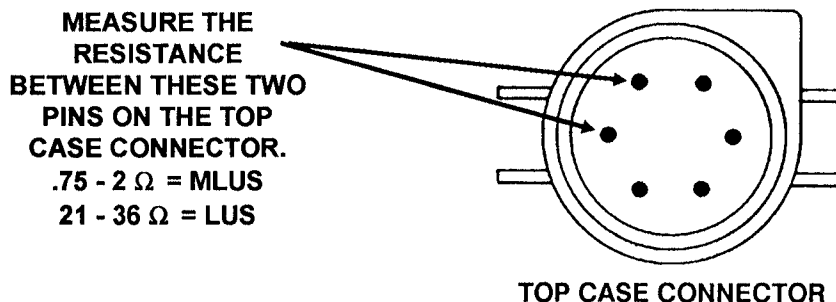
LUS systems were used only on 1991 Taurus and Sable vehicles. MLUS systems are used on 1991 Continentals and ALL 1992 and later vehicles. Processor design and operation is different depending on which Lock-Up apply system is used on the vehicle.

Installing an MLUS unit into a vehicle designed for an LUS system is likely to cause processor failure.

Refer to the following information to identify the different systems used on 1991 and 1992 transaxles.

1. The top wiring connector used on transaxles equipped with LUS systems are black, and MLUS systems are gray. The wires for the lock-up solenoid are longer on the black connector to accommodate the different lock-up solenoid connection position. However, it is possible to install either harness with either solenoid. If anyone has ever tampered with the unit it is possible for this method of external identification to be misleading.

2. A more positive external identification is to check the resistance of the lock-up solenoid circuit with an ohmmeter. Check the resistance between the pins shown below.

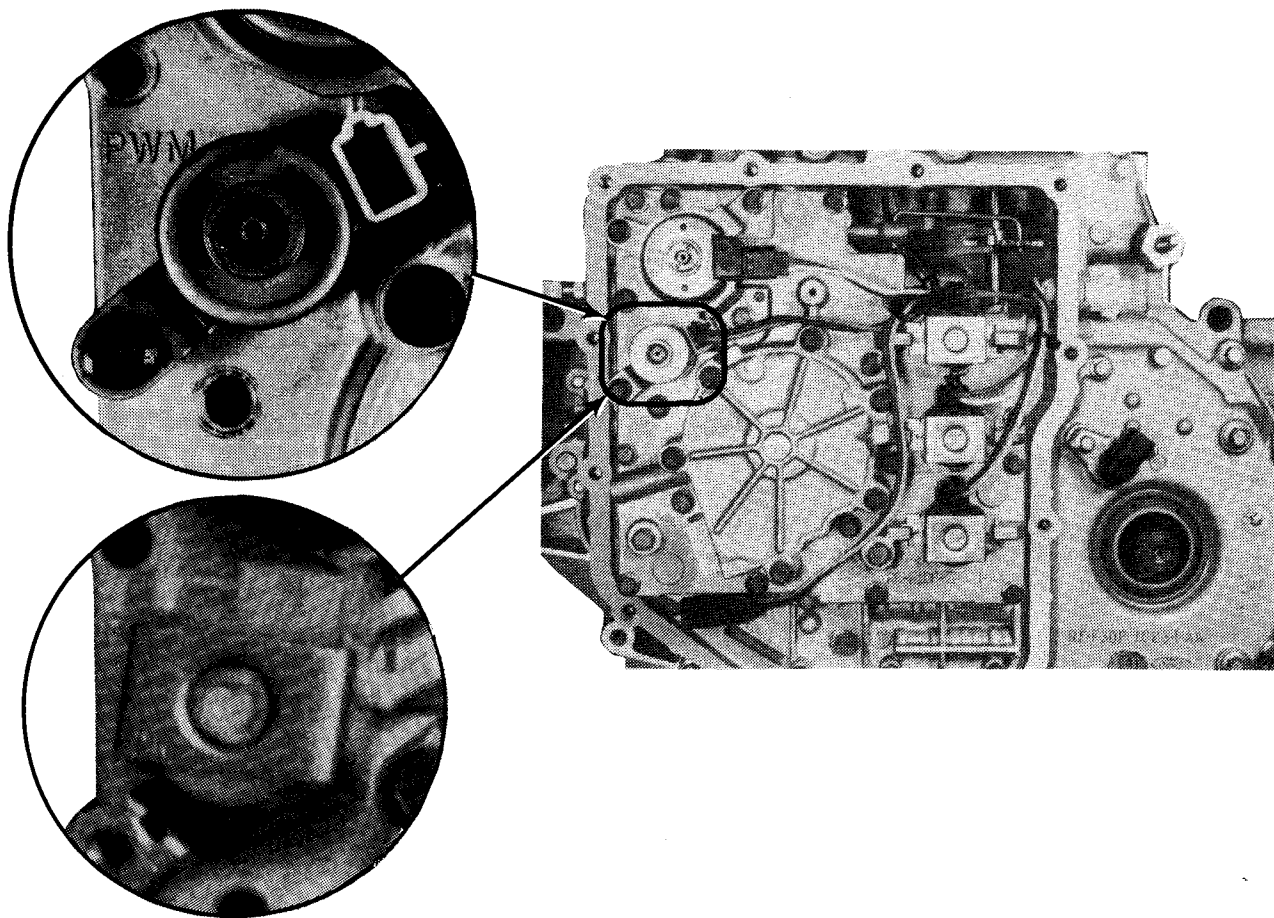


AXOD-E

Unit Interchange/Parts Matching (Continued)

3. There is also a physical difference in the appearance of the solenoids.

ROUND = MLUS
SQUARE = LUS



MIS-MATCHES OF COMPONENTS MAY CAUSE THE FOLLOWING COMPLAINTS:

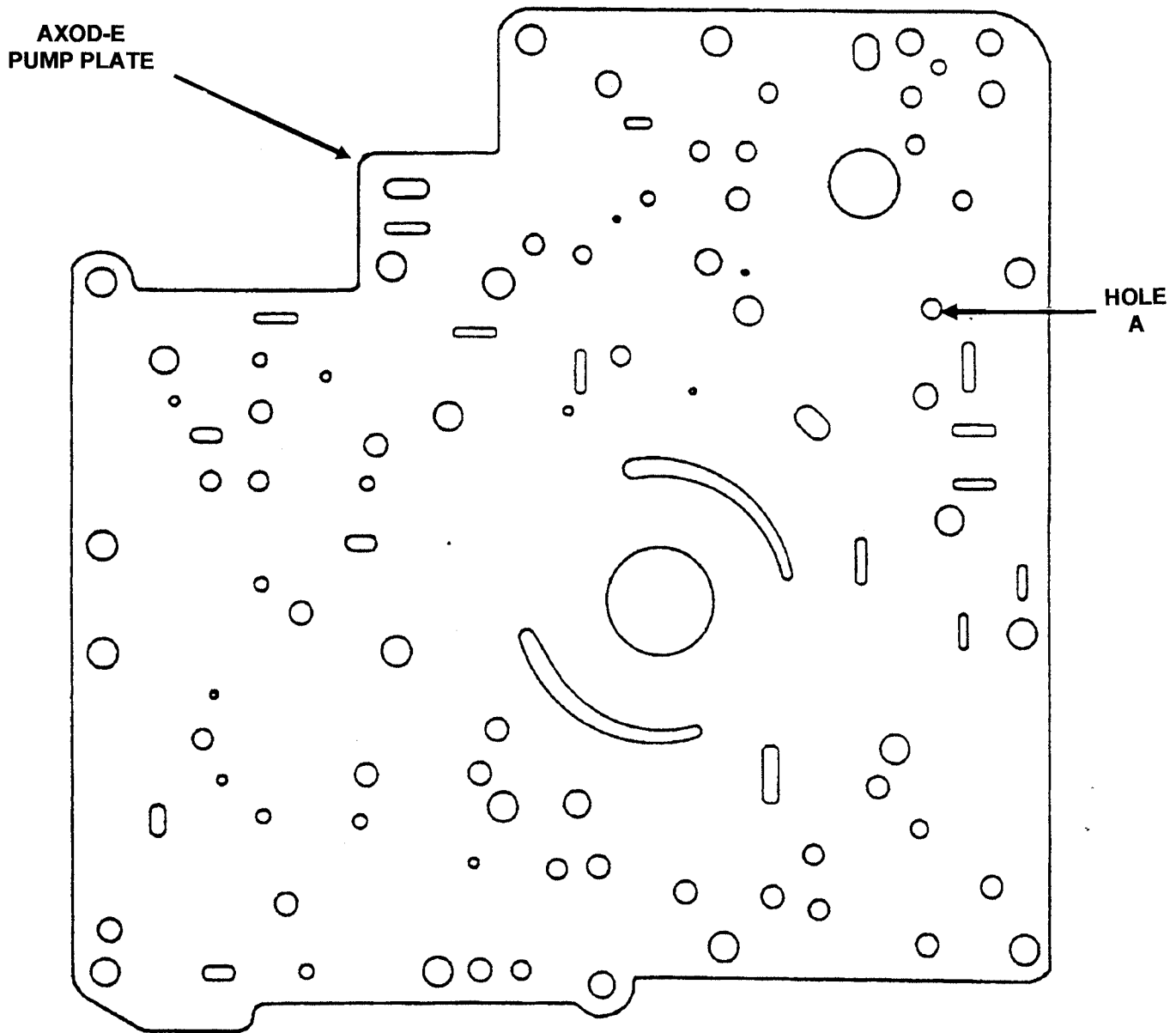
- | | |
|---------------------------------|---------------------|
| 1. TCC APPLIES WITH 1-2 SHIFT | 5. ROUGH TCC APPLY |
| 2. CHUGS ON COAST DOWN | 6. NO TCC APPLY |
| 3. TCC WON'T RELEASE WITH BRAKE | 7. FAILED PROCESSOR |
| 4. SOFT TCC APPLY | |

AXOD-E

Unit Interchange/Parts Matching (Continued)

4. The pump plate is different, depending on the type of lock-up solenoid.

If hole "A" is approximately .030" in diameter, the plate matches the square (LUS) type solenoid. If the hole is approximately .215" in diameter, then it matches the round (MLUS) type solenoid.

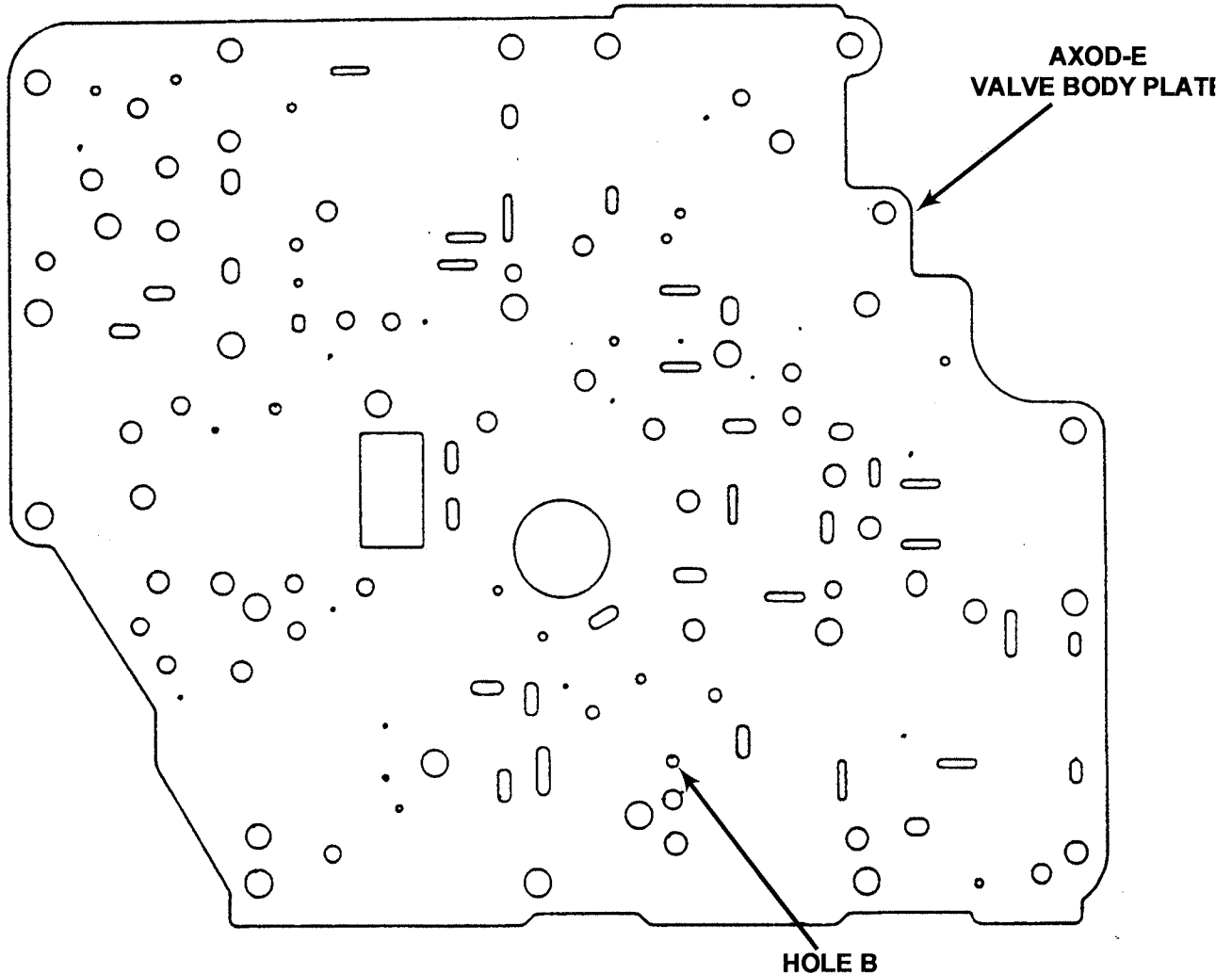


AXOD-E

Unit Interchange/Parts Matching (Continued)

5. The valve body plate is also different, depending on which lock-up system is used.

If hole "B" is approximately .041" in diameter, the plate matches the square (LUS) type solenoid.
If the hole is approximately .152" in diameter, then it matches the round (MLUS) type solenoid.



SUMMARY

91 TAURUS/SABLE

LUS System

Black top connector

Square shaped LU solenoid 21 - 36 Ω

Small hole in pump plate

Small hole in valve body plate

91 CONTINENTAL/ALL 92 MODELS

MLUS System

Gray top connector

Round shaped solenoid .75 - 2 Ω

Large hole in pump plate

Large hole in valve body plate

AXOD-E

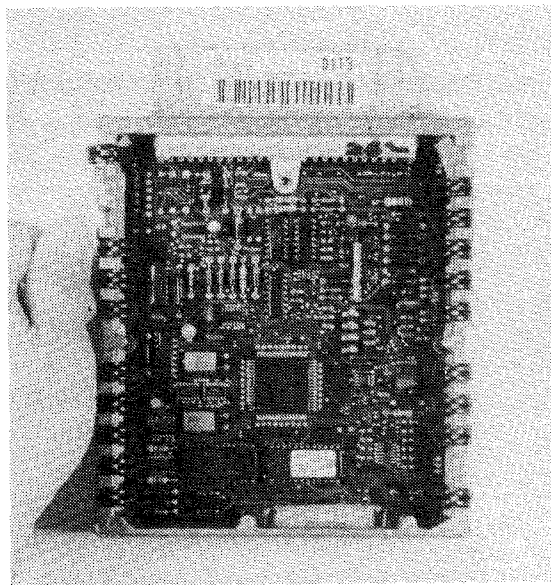
1991 Computer Repair

Rather than throwing away your 1991 Taurus or Sable computer, you can use the procedure below to repair it. This procedure is for repair of the LUS driver for 1991 Taurus and Sables only.

NOTE: *This delicate repair should be made only by persons who have soldering experience.*

PARTS AND TOOLS REQUIRED	RADIO SHACK PART #
30w or lower soldering iron	64-2067B
Desoldering iron	64-2060
60/40 light duty rosin core solder	64-005
Heat sink (optional but recommended)	276-1567A
NPN Transistor	276-2020

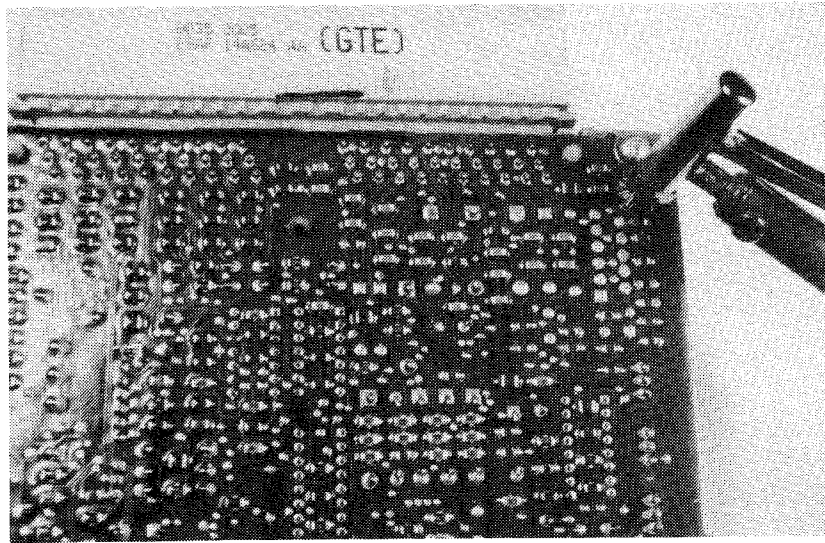
- 1 Remove the two computer covers and the transistor hold-down clip.



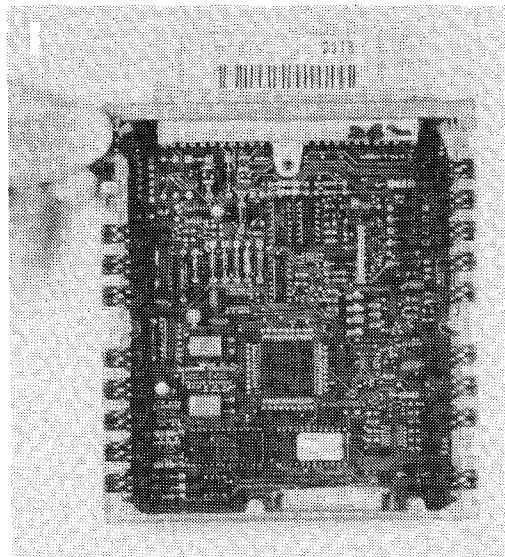
AXOD-E -- 1991 Computer Repair (Continued)

- ② Use the desoldering iron to remove the solder from the old transistor. You may want to practice on an old printed circuit (P.C.) board if you have not done this before.

NOTE: Some P.C. boards may have a protective plastic coating on the solder joints. This should be carefully removed before desoldering. This is easy to do with a small screwdriver or pick.

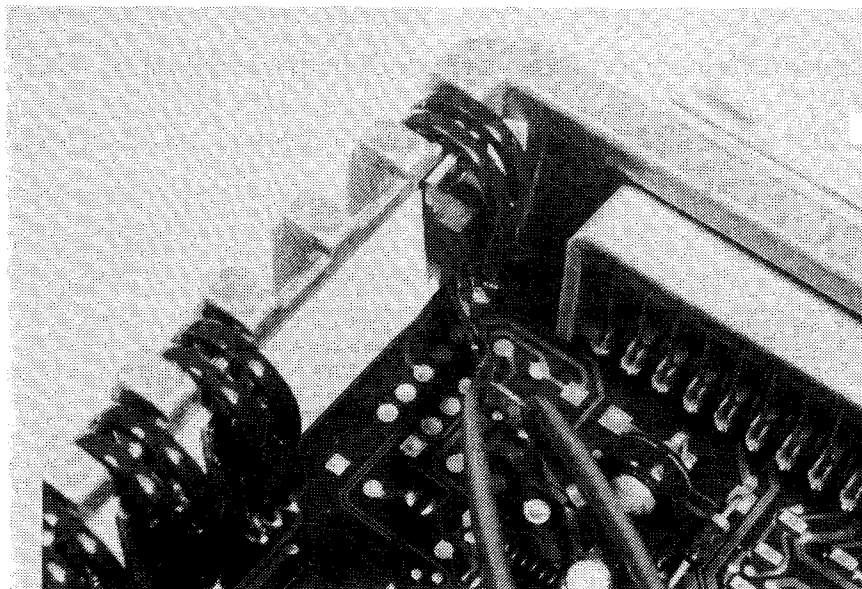


- ③ Carefully remove the old transistor. Put the replacement transistor in place. Secure the transistor with the hold-down clip. You are now ready to solder the three legs of the transistor in place.

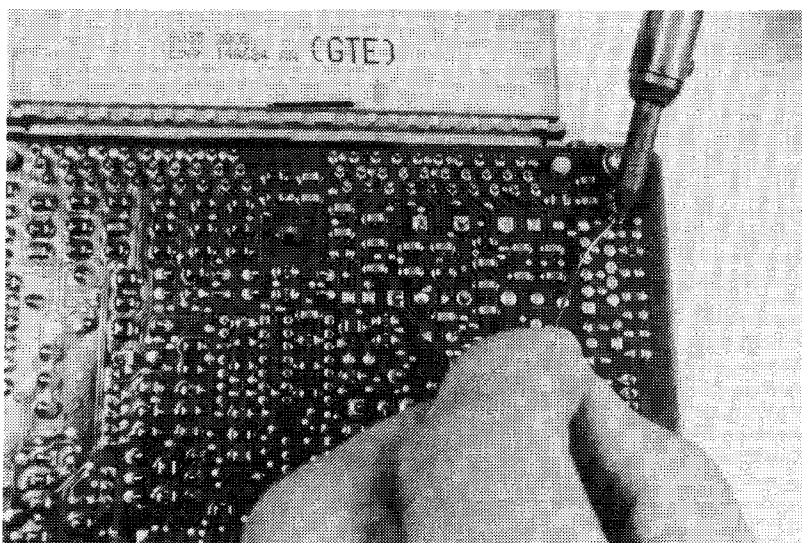


AXOD-E -- 1991 Computer Repair (Continued)

- ④ Attach a heat sink to each leg of the transistor before soldering it. This is used to protect the transistor from heat while you're soldering.



- ⑤ Carefully solder the three legs of the transistor. Trim the transistor legs down to 1/16". Put the covers back on and you're done.



AXOD-E

Lube Oil Modification

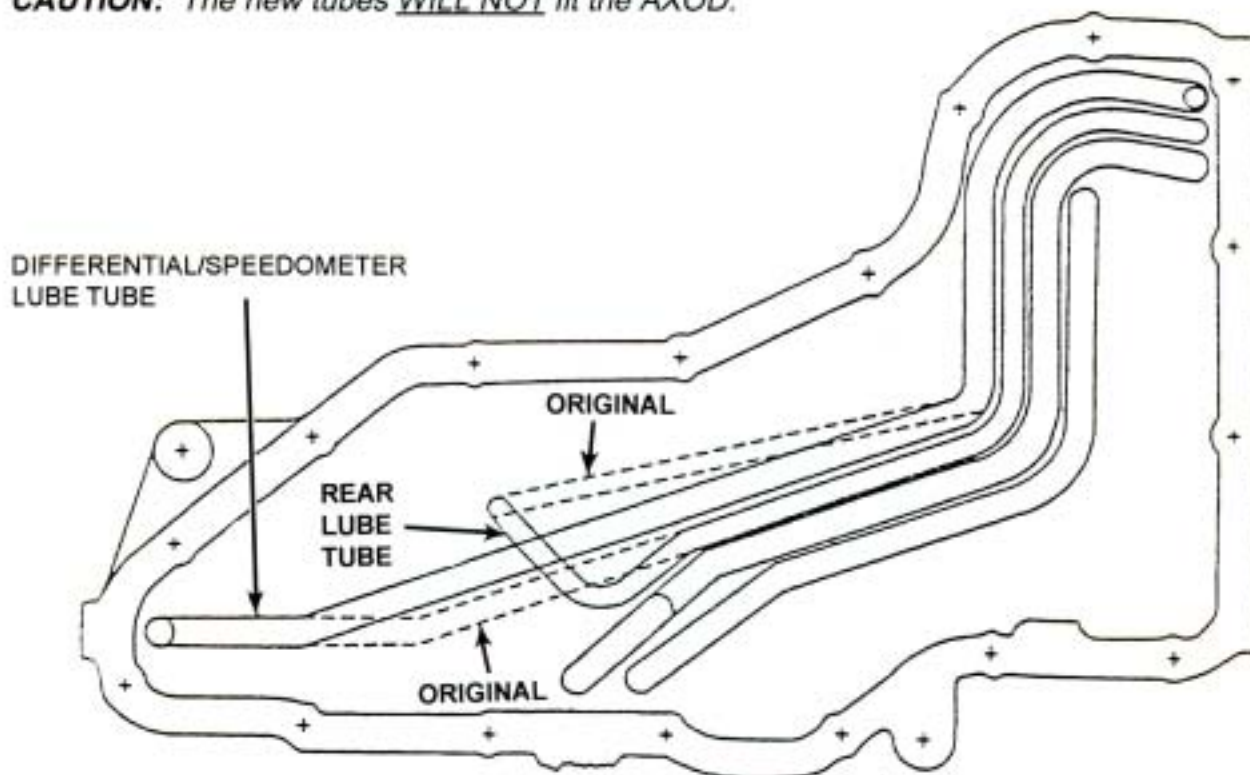
Ford has made available a new set of pipes for the AXOD-E which will allow for a larger volume of uninterrupted lube oil to the planetaries.

The new design pipes were incorporated into production in mid-92 for all AXOD-E's.

It is recommended that you install the new lube delivery pipes on all AXOD-E's built before mid-92.

PART NUMBER	PART NAME
F2DZ-7G084-A	Rear Lube Tube
F2DZ-7G086-A	Differential/Speedometer Lube Tube

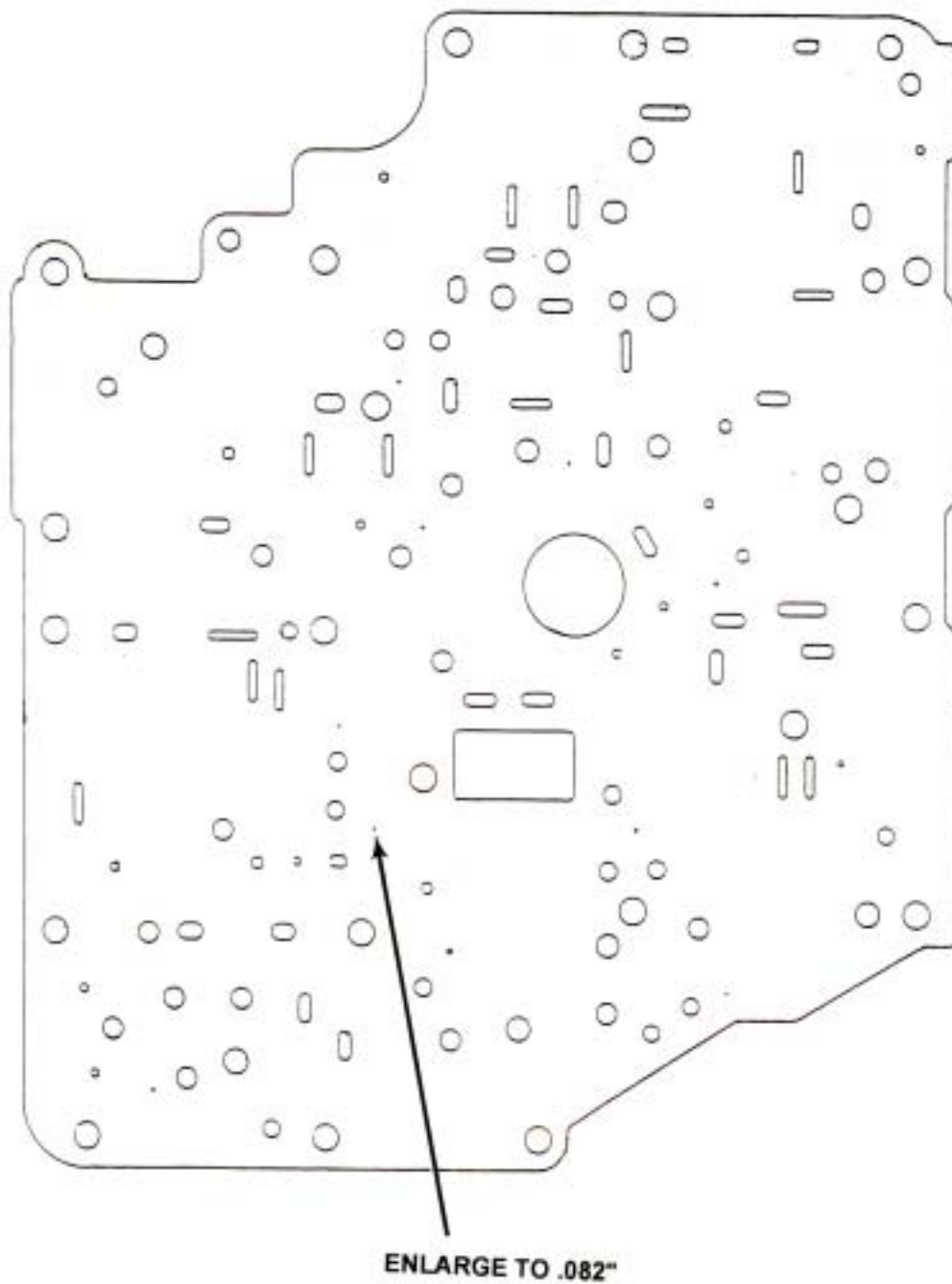
CAUTION: The new tubes WILL NOT fit the AXOD.



AXOD-E

Lube Oil Modification (Continued)

Main Valve Body Separator Plate



GENERAL MOTORS

General
Motors

WG

General Motors

GENERAL
MOTORS

General
Motors

GENERAL
MOTORS

GENERAL
MOTORS

GM

GM

General
GM
Motors

GENERAL
MOTORS

WG

General Motors

General
Motors

GENERAL
MOTORS

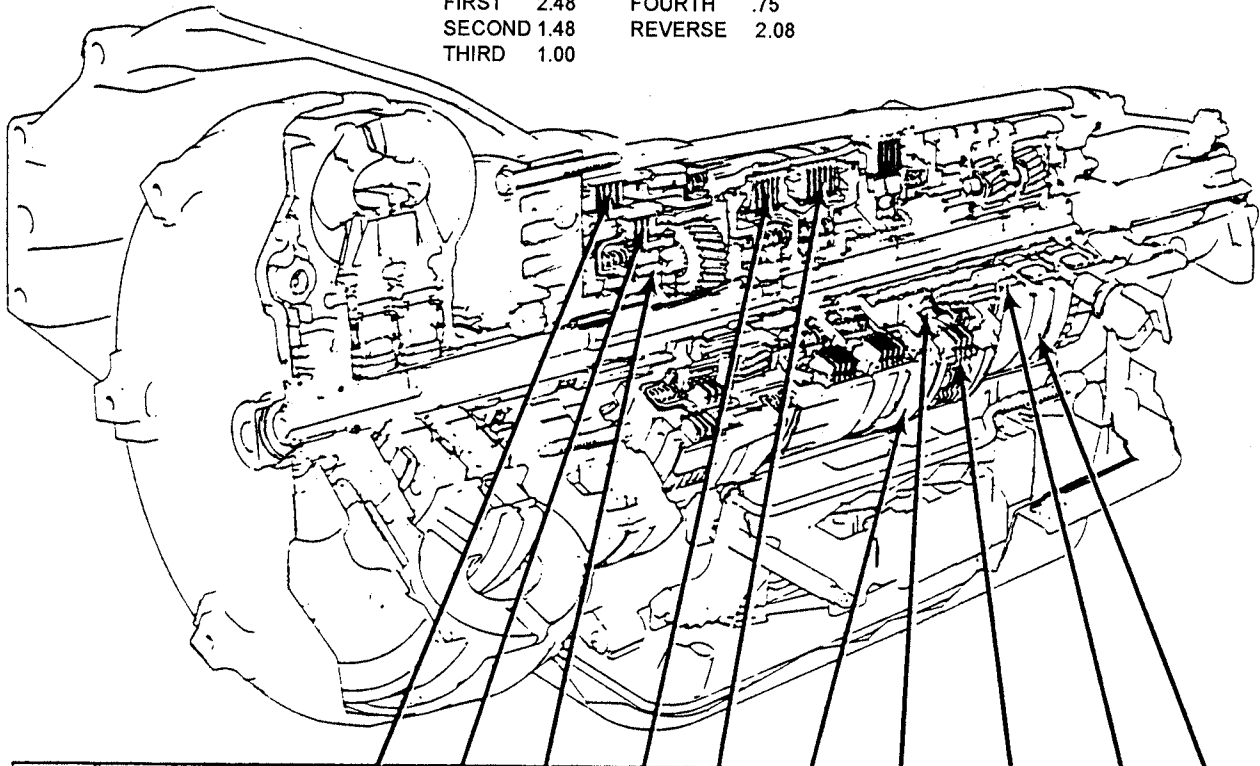
General
Motors

4L80E

Component Application Chart

HYDRA-MATIC 4L80-E - GEAR RATIOS

FIRST	2.48	FOURTH	.75
SECOND	1.48	REVERSE	2.08
THIRD	1.00		



RANGE	GEAR	SOLENOID @ A	SOLENOID @ B	FOURTH CLUTCH	OVERRUN CLUTCH	OVERDRIVE ROLLER CLUTCH	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INTERMEDIATE SPRAG CLUTCH	INTERMEDIATE CLUTCH	LO ROLLER CLUTCH	REAR BAND
P-N		ON	OFF			HOLDING							
R	REVERSE	ON	OFF			HOLDING		APPLIED					APPLIED
D	1st	ON	OFF			HOLDING	APPLIED			*		HOLDING	
	2nd	OFF	OFF			HOLDING	APPLIED			HOLDING	APPLIED	OVERRUNNING	
	3rd	OFF	ON			HOLDING	APPLIED	APPLIED		OVERRUNNING	APPLIED	OVERRUNNING	
	4th	ON	ON	APPLIED		OVERRUNNING	APPLIED	APPLIED		OVERRUNNING	APPLIED	OVERRUNNING	
D	1st	ON	OFF		APPLIED	HOLDING	APPLIED			*		HOLDING	
	2nd	OFF	OFF		APPLIED	HOLDING	APPLIED			HOLDING	APPLIED	OVERRUNNING	
	3rd	OFF	ON		APPLIED	HOLDING	APPLIED	APPLIED		OVERRUNNING	APPLIED	OVERRUNNING	
2	1st	ON	OFF		APPLIED	HOLDING	APPLIED			*		HOLDING	
	2nd	OFF	OFF		APPLIED	HOLDING	APPLIED		APPLIED	HOLDING	APPLIED	OVERRUNNING	
1	1st	ON	OFF		APPLIED	HOLDING	APPLIED			*		HOLDING	APPLIED
	2nd	OFF	OFF		APPLIED	HOLDING	APPLIED		APPLIED	HOLDING	APPLIED	OVERRUNNING	

* HOLDING BUT NOT EFFECTIVE
ON - SOLENOID ENERGIZED
OFF - SOLENOID DE-ENERGIZED

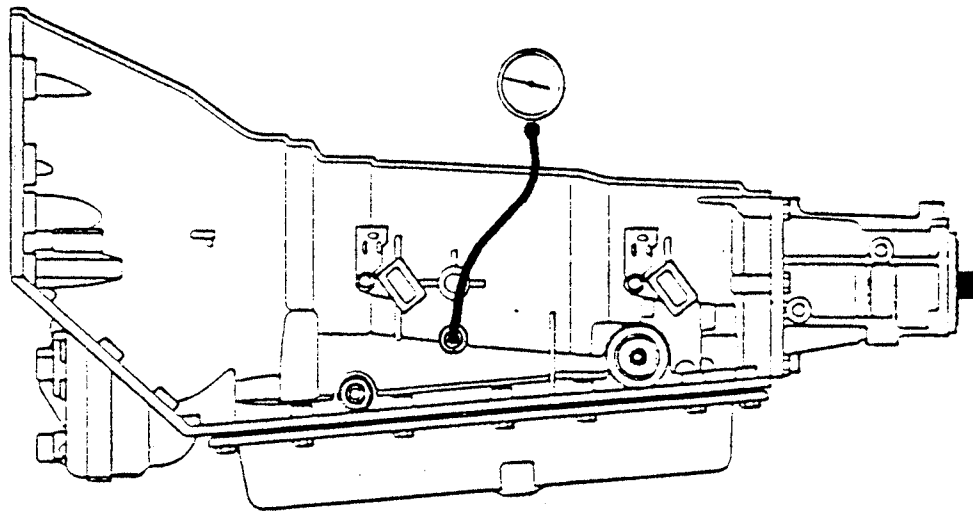
@ THE SOLENOID'S STATE FOLLOWS A SHIFT PATTERN WHICH DEPENDS UPON VEHICLE SPEED AND THROTTLE POSITION IT DOES NOT DEPEND UPON THE SELECTED GEAR.

NOTE: DESCRIPTIONS ABOVE EXPLAIN COMPONENT FUNCTION DURING ACCELERATION.

Pressure Tap Identification & Specifications

GEAR RANGE
Drive, Park or Neutral
Reverse

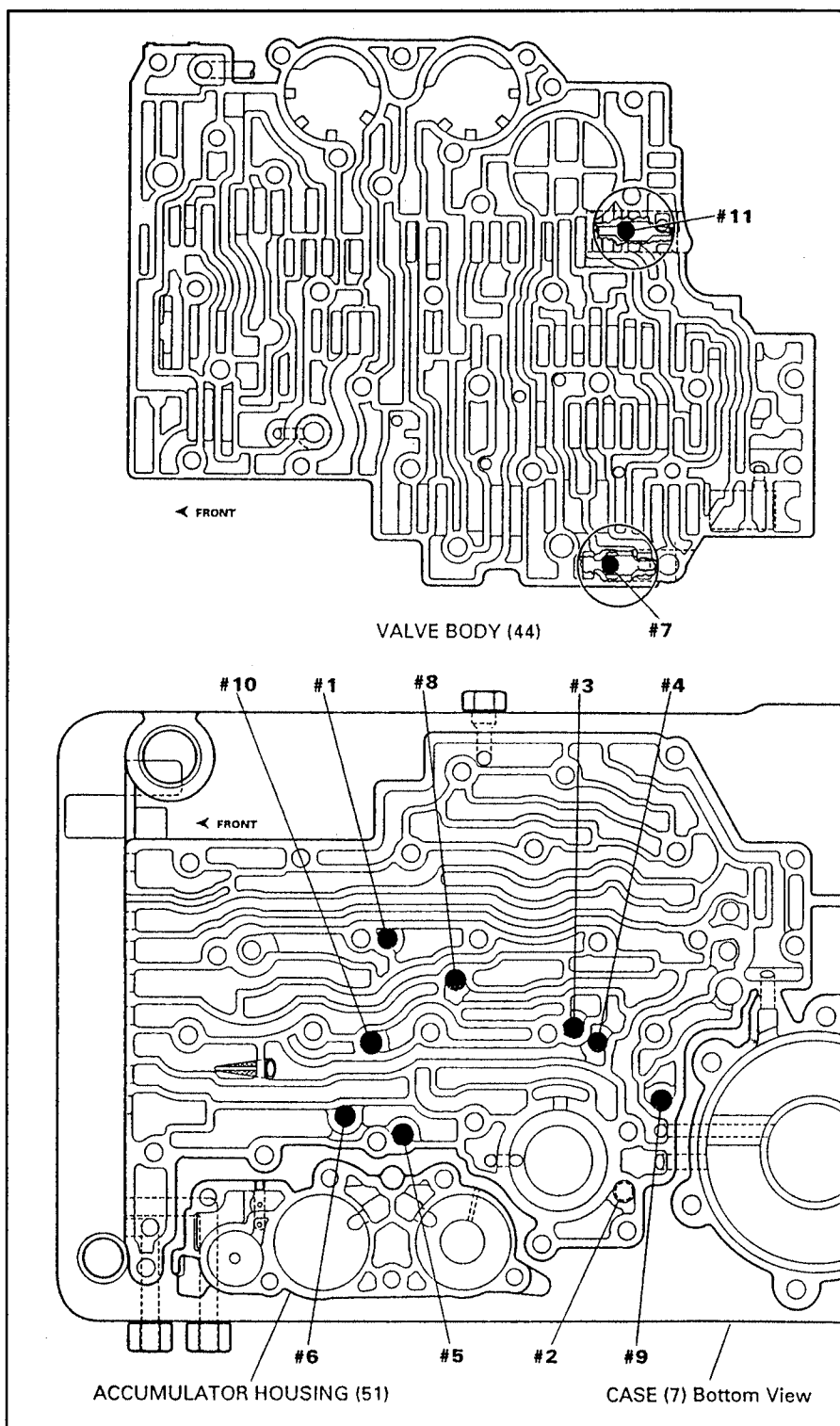
LINE PRESSURE RANGE
35 - 171 PSI
67 - 324 PSI



Force Motor Current (AMP)	Line Pressure (PSI)
0.02	157-177
0.10	151-176
0.20	140-172
0.30	137-162
0.40	121-147
0.50	102-131
0.60	88-113
0.70	63-93
0.80	43-73
0.90	37-61
0.98	35-55

Checkball Functions and Locations

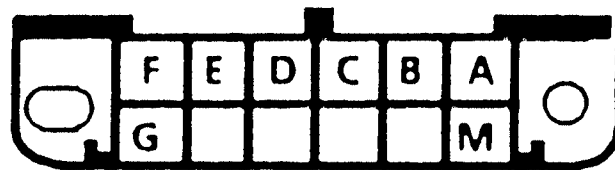
- #1 Overrun Clutch
- #2 2nd Accumulator
(Used only on some models)
- #3 Front Band Apply
- #4 2nd Clutch
- #5 3rd Accumulator
- #6 4th Accumulator
- #7 Low/Reverse
- #8 3rd Clutch
- #9 Reverse
- #10 4th Clutch
- #11 3rd Clutch/Reverse



GM Trouble Codes

Getting Codes

Locate the ALDL - it's usually under the dash right in front of one of the driver's knees. (If not, consult a component locator chart to find it.) Locate pins 'a' and 'b' (the connector has little letters around the edge). Bridge them together with a paper clip. Turn the key on and watch the 'Check Engine' light. It will flash any trouble codes to you.



Code Format

First, code 12 flashes. That's one blink, a short pause, then 2 blinks. Then there's a long pause and the code 12 repeats. This happens one more time, because all codes display three times before moving on to the next one. All codes in memory will be displayed three times each, and when all codes have been flashed it starts all over.

Clearing Codes

You can clear codes by disconnecting the battery for at least a minute.

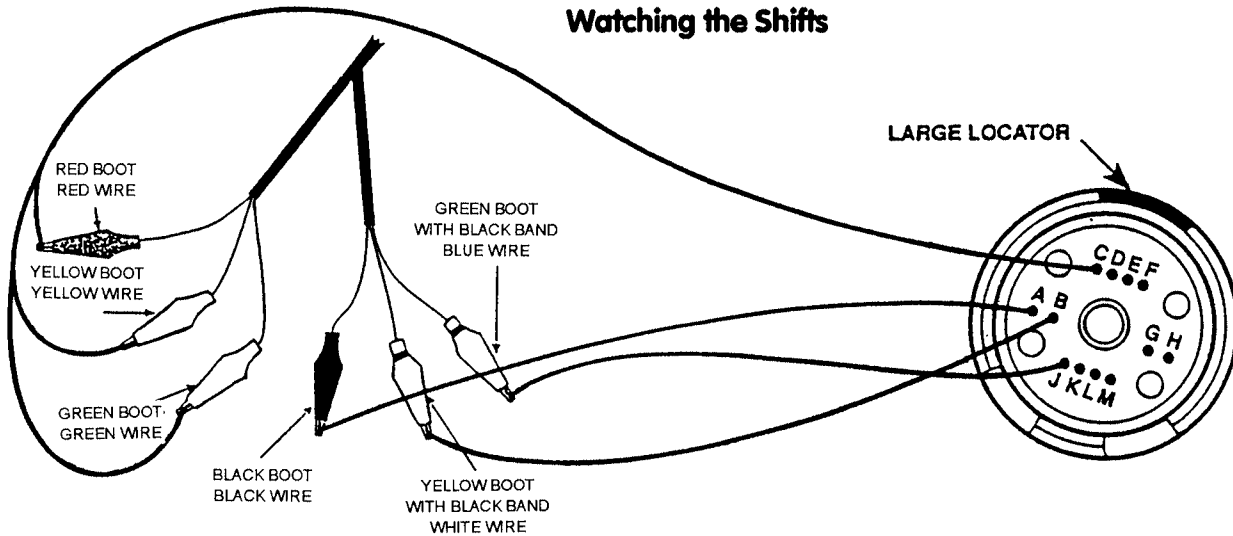
Because of the wide variety of trouble code listings, consult ATRA Technical Bulletin #159, March 1993.

Cadillac DFI trouble code retrieval is covered in detail in ATRA Technical Bulletin #025, September 1990.

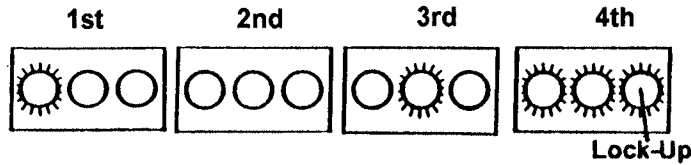
GM 4L80E

The 4L80E shift solenoids have a full time 12V POWER source and the computer switches GROUND signals to the solenoids to activate them.

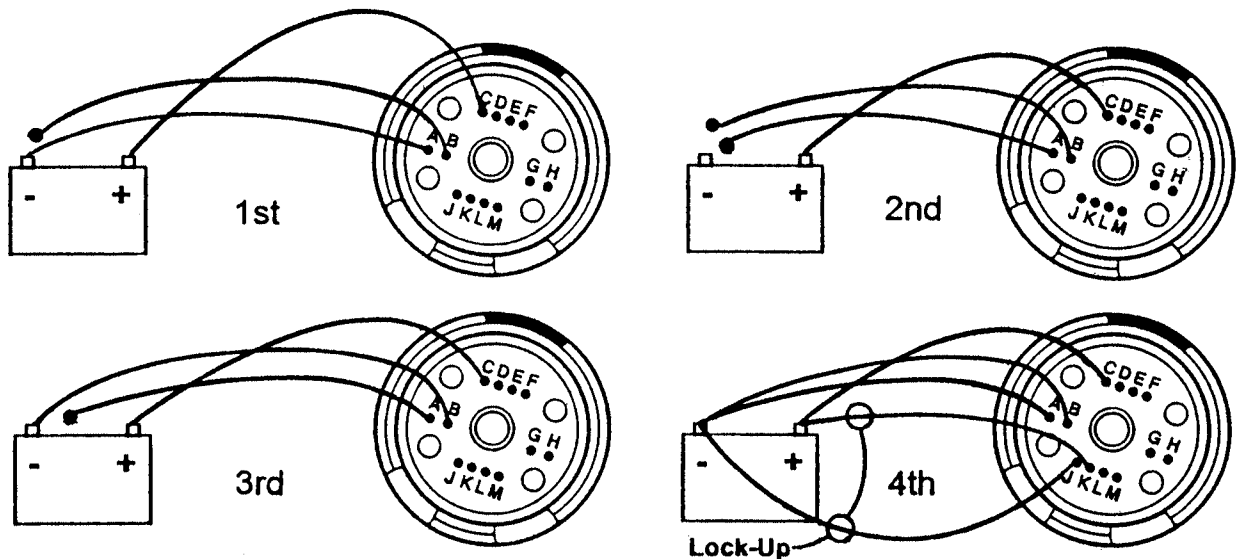
Watching the Shifts



SOLENOID PATTERN	
GEAR	SOL 'ON'
1st	Sol. A
2nd	None
3rd	Sol. B
4th	Sol. A & B
Lock-Up	TCC sol.
PWM	(light 3)

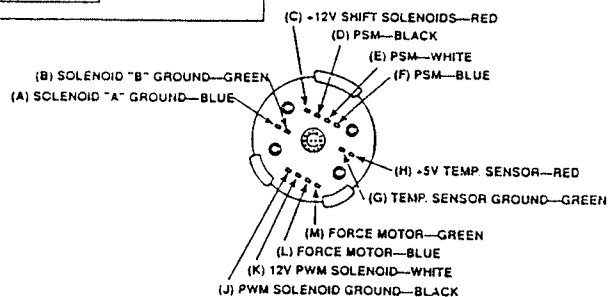
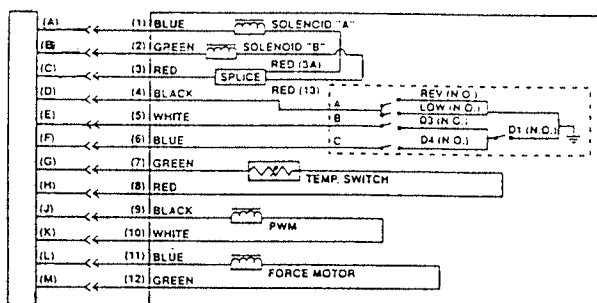
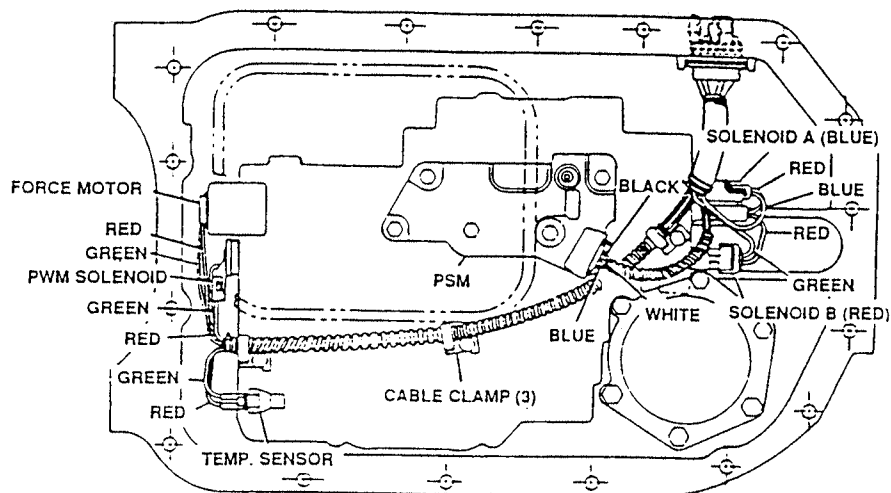


Making the Shifts



4L80E

Internal Wiring Diagram



RESISTANCE VALUES

COMPONENT	OHMMETER LEADS BETWEEN TERMINALS	RESISTANCE VALUE
FORCE MOTOR	L & M	3-5 Ω
SHIFT SOLENOID A	A & C	20-50 Ω
SHIFT SOLENOID B	C & B	20-50 Ω
PWM SOLENOID	J & K	10-15 Ω
TEMPERATURE SENSOR	SEE PAGE 109	
PRESSURE SWITCH MANIFOLD	SEE PAGE 110	

4L80E

Electrical Diagnosis Information

The 4L80E is a fully electronically controlled transmission. All upshifts, downshifts, converter clutch applications and line pressure are controlled by activating solenoids. The following pages show the procedures and specifications for internal transmission electrical component testing including solenoids, temperature sensor & pressure switch manifold.

TEMPERATURE SENSOR TESTING

Using a digital ohmmeter check the resistance between terminals G and H and compare the reading to the chart below.

TRANSMISSION SENSOR - TEMP TO RESISTANCE (APPROXIMATE)

TEMPERATURE		MINIMUM RESISTANCE Ω	NORMAL RESISTANCE Ω	MAXIMUM RESISTANCE Ω
C°	F°			
-40	-40	80965	100544	120123
-30	-20	42701	52426	62151
-20	-04	23458	28491	33524
-10	14	13366	16068	18770
0	32	7871	9379	10869
10	50	4771	5640	6508
20	68	2981	3500	4018
30	86	1915	2232	2550
40	104	1260	1460	1660
50	122	848.8	977.1	1105
60	140	584.1	668.1	753.4
70	158	410.3	467.2	524.2
80	176	293.7	332.7	371.7
90	194	213.9	241.0	268.2
100	212	158.1	177.4	196.8
110	230	118.8	132.6	146.5
120	248	90.40	100.6	110.8
130	266	69.48	77.29	85.11
140	284	53.96	60.13	66.29
150	302	42.43	47.31	52.20
160	320	32.51	36.13	39.73
170	338	25.13	27.92	30.71
180	356	19.42	21.58	23.74
190	374	15.01	16.68	18.35
200	392	11.60	12.89	14.18

4L80E

Pressure Switch Manifold Check (PSM)

The PSM contains 5 normally open pressure switches which are used to indicate the manual control valve position to the PCM. Use the chart below to check the PSM.

IMPORTANT: Since these switches are activated by hydraulic pressure, the engine must be running and the transmission must be capable of producing line pressure.

SHIFTER POSITION	PIN D	PIN E	PIN F
PARK	O	*	O
REVERSE	*	*	O
NEUTRAL	O	*	O
OD	O	*	*
D	O	O	*
2	O	O	O
1	*	O	O

* = Continuity to ground O = No Continuity to ground

FORCE MOTOR/PRESSURE COMPARISON

FORCE MOTOR CURRENT (AMP)	LINE PRESSURE (PSI)
0.02	157-177
0.10	151-176
0.20	140-172
0.30	137-167
0.40	121-147
0.50	102-131
0.60	88-113
0.70	63-93
0.80	43-73
0.90	37-61
0.98	35-55

4L80E

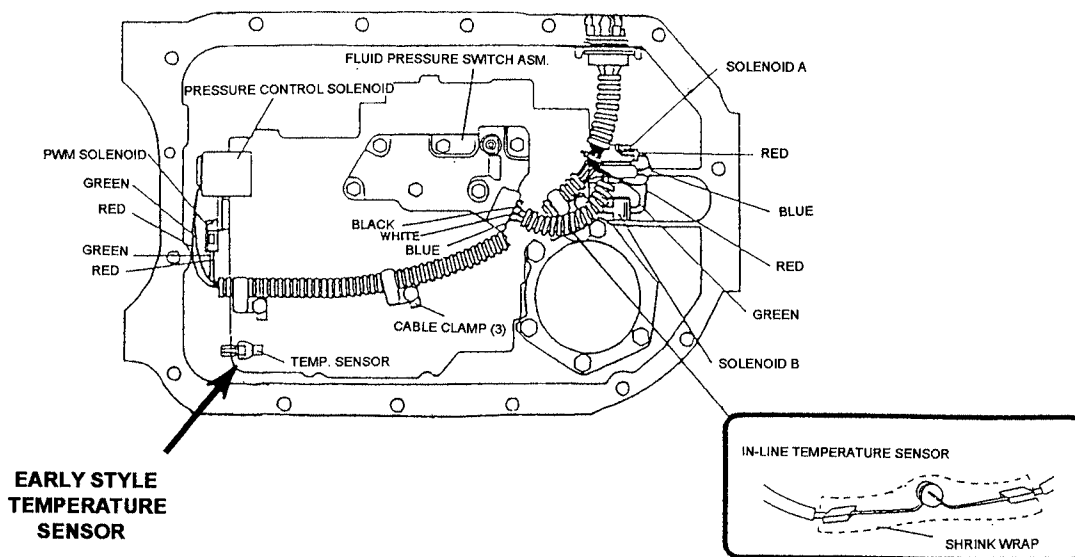
Internal Electrical Component Changes

1. New Design Temperature Sensor.

Early production 4L80-E's used a temperature sensor that screwed into the valve body. Late style 4L80-E's used a temperature sensor that was integral (built into the harness). The only new harness that is available has the integral type harness. Therefore there are 3 possible arrangements you may encounter:

1. Early design has screw in sensor with wires attached.
2. Late design with no screw in sensor in the valve body, and no wires to attach to it. This design will have the integral sensor harness.
3. Early design that has had a new (integral sensor) harness installed. This arrangement will have the screw in sensor still in the valve body but will have no wires attached to it.

NOTE: 1. All 4L80-E's must have either the screw-in type or integral type fluid temperature sensor.
2. If you install the new design harness on an early unit, the screw-in sensor must not be removed leaving an open hole in the valve body. The hole in the valve body must be plugged, or a large mainline pressure leak will result.



SHIFT SOLENOIDS

Both shift solenoids for the 4L80-E were updated for increased durability. The early design solenoids were Blue (solenoid A) and Red (solenoid B). The new solenoids are Purple (solenoid A) and Tan (solenoid B). It is recommended to update to the new shift solenoids whenever you encounter the early design solenoids.

New Design Solenoids

Solenoid A (Purple)	Part #24201004
Solenoid B (Tan)	Part #24201005

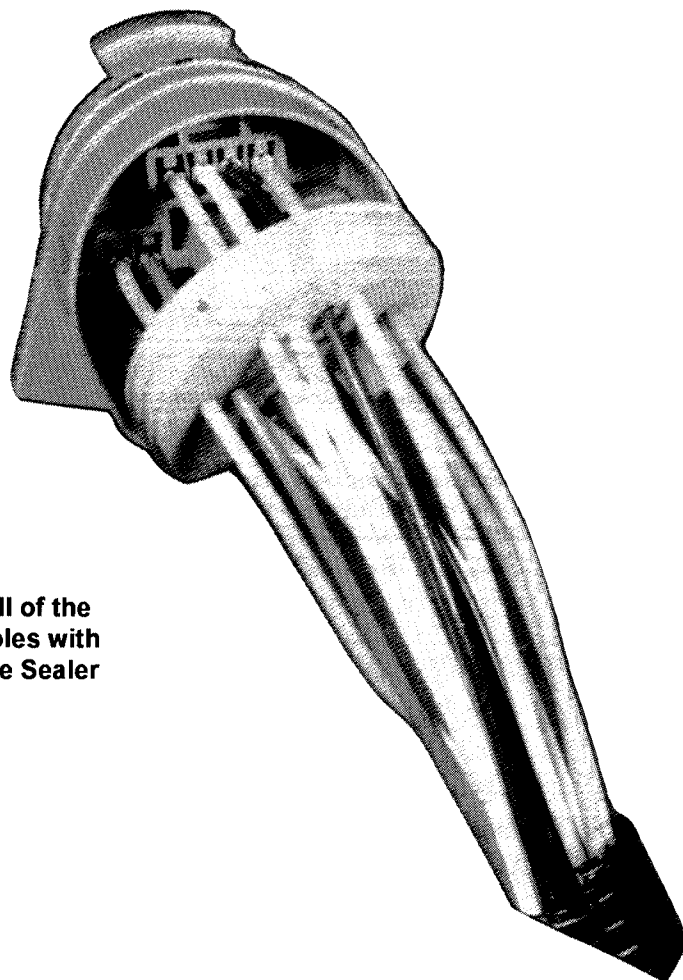
4L80E

Multiple/Intermittent Trouble Codes

A condition of intermittent shift complaints and multiple trouble codes may be caused by the case connector connection. Remove the main connector on the left side of the transmission and look for signs of transmission fluid. Any fluid present in the connector can cause problems.

If the connector is leaking fluid, remove the internal harness. Peel the rubber boot back from the inside of the pass thru connector and clean off all oil residue. Seal the wire holes in the connector with silicone as shown below.

Although this may seem to be an unconventional repair, it has been quite successful.



**Seal all of the
wire holes with
Silicone Sealer**

4L80E

Fluid Leaks at Transmission Pass-Through Connector

Some HYDRA-MATIC 4L80E/4L80-EHD transmissions may experience a fluid leak out the Transmission Pass-Through Connector causing material degradation on vehicle side connector and wiring which may lead to erratic transmission operation.

"Wicking" of fluid between wire and insulation through the pins and into the connector interface and ultimately to the vehicle side wiring.

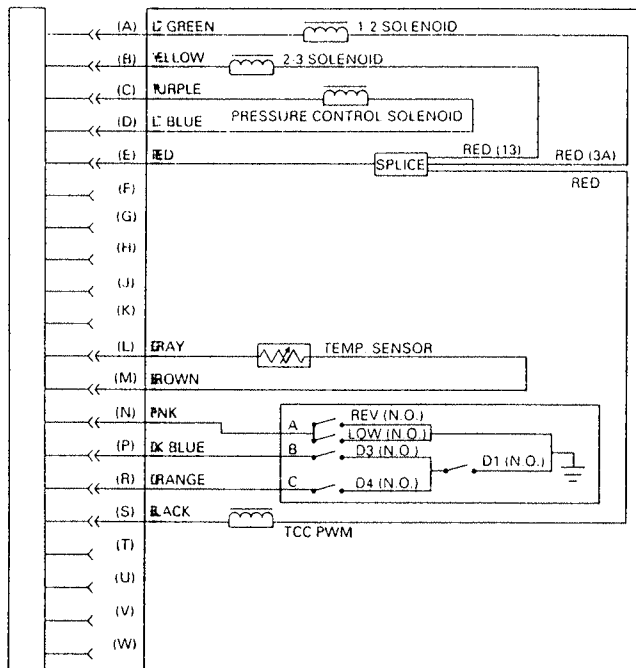
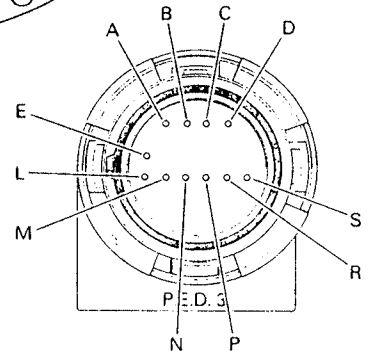
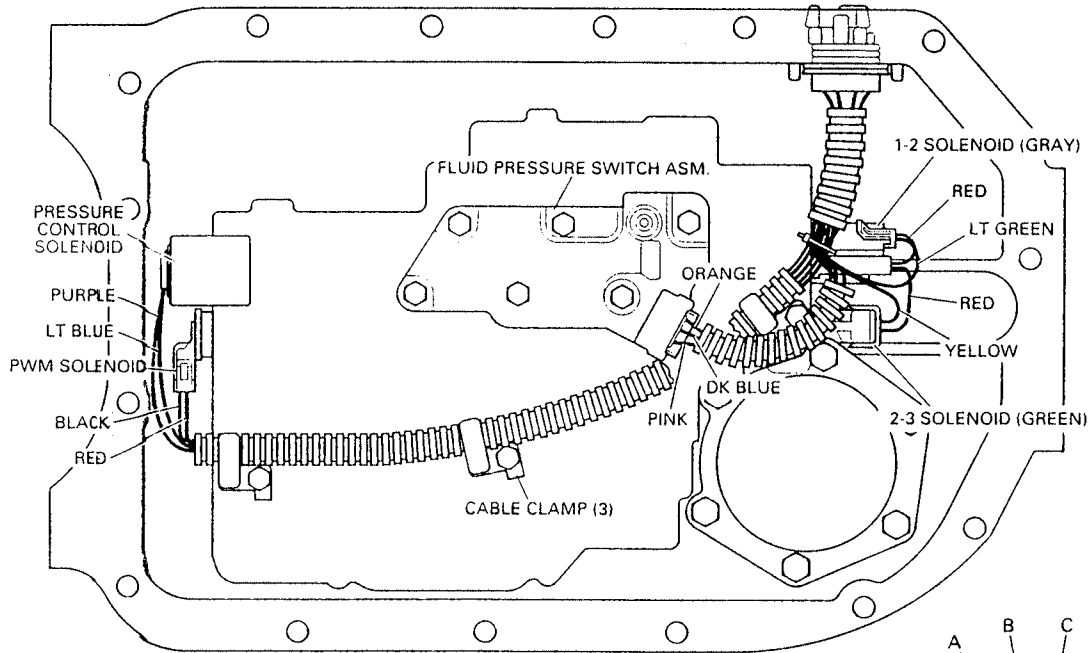
Replace the wire harness assembly per your transmission service manual and install this service package per instruction sheets.

PART NO.
24200161

NAME
*Harness Package - Automatic Transmission Wiring
Harness Asm.
Vehicle Side Harness Connector Assembly
Instruction Sheets
Misc. Accessories

4L80E

Fluid Leaks at Transmission Pass-Through Connector (Continued)

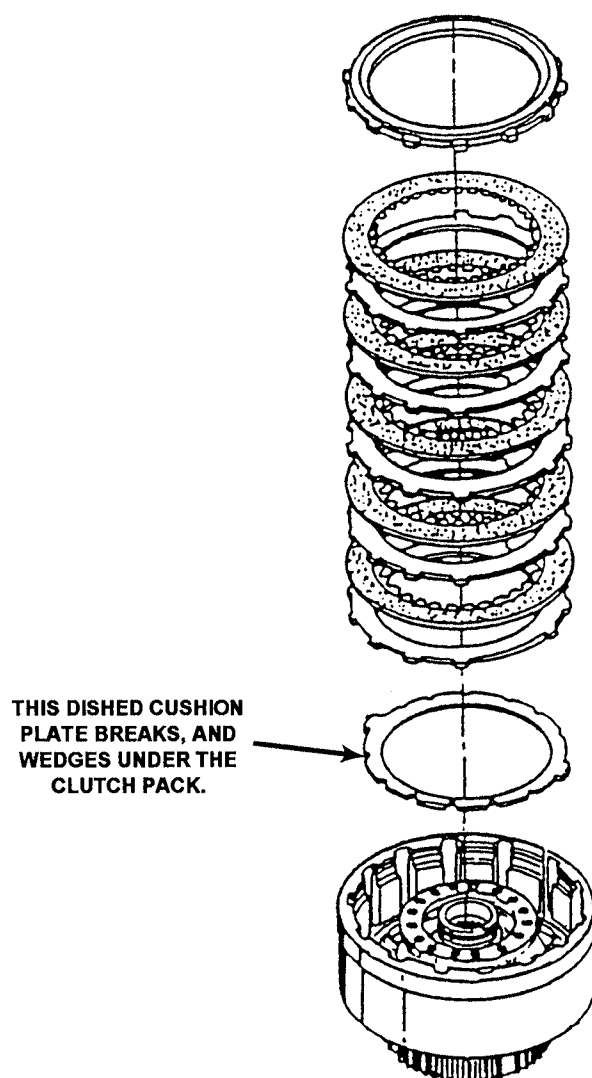


CAVITY	FUNCTION
A	PCM TO TRANS SHIFT SOL 'A'
B	PCM TO TRANS SHIFT SOL 'B'
C	PCM TO PRESSURE CONTROL SOLENOID (HIGH)
D	PCM TO PRESSURE CONTROL SOLENOID (LOW)
E	12V+, IGN 'CRANK ON'
L	PCM TO TRANS TEMP SENSOR
M	GROUND LEVEL LOW
N	PCM TO TRANS RANGE MODE A
P	PCM TO TRANS RANGE MODE C
R	PCM TO TRANS RANGE MODE B
S	TCC PWM TO ECM

4L80E

Bind in Low/3rd Gear Starts

A 4L80E with a complaint of 3rd gear starts (regardless of electrical commands) accompanied by a bind-up in manual low may be caused by a broken dish cushion plate in the direct clutch. A broken cushion plate will mechanically apply the clutch which causes the complaints. This can give a false code for solenoid B (Code 81).

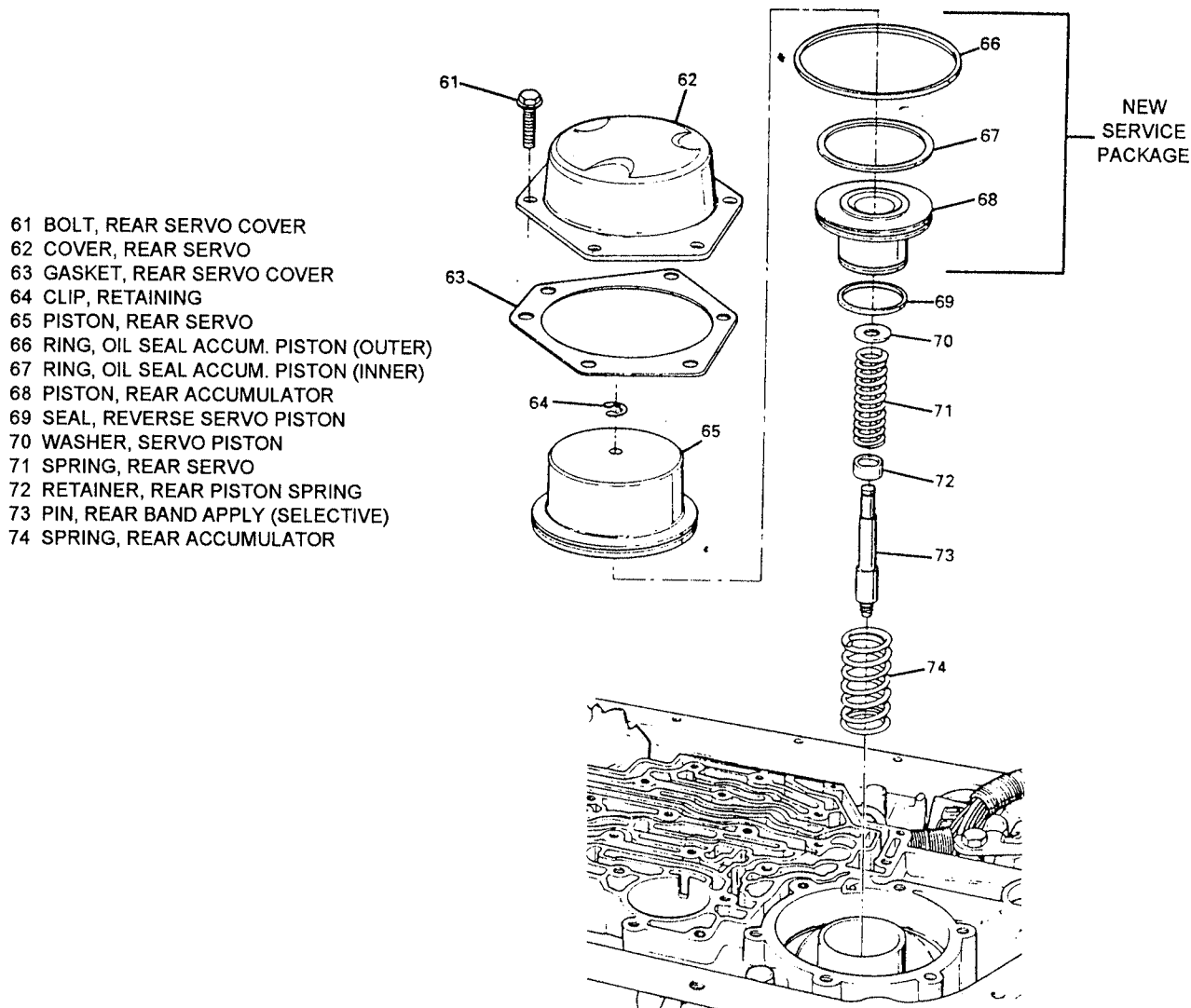


NOTE: The part number for the cushion plate is 8680816.

4L80-E

Binds In Manual Low

A Bind-up in manual low can be caused by a leaking intermediate accumulator. An upgraded accumulator is available with rubber seals instead of Teflon® seals. The GM part number is 8680929.



(ARTWORK COURTESY OF GENERAL MOTORS CORPORATION.)

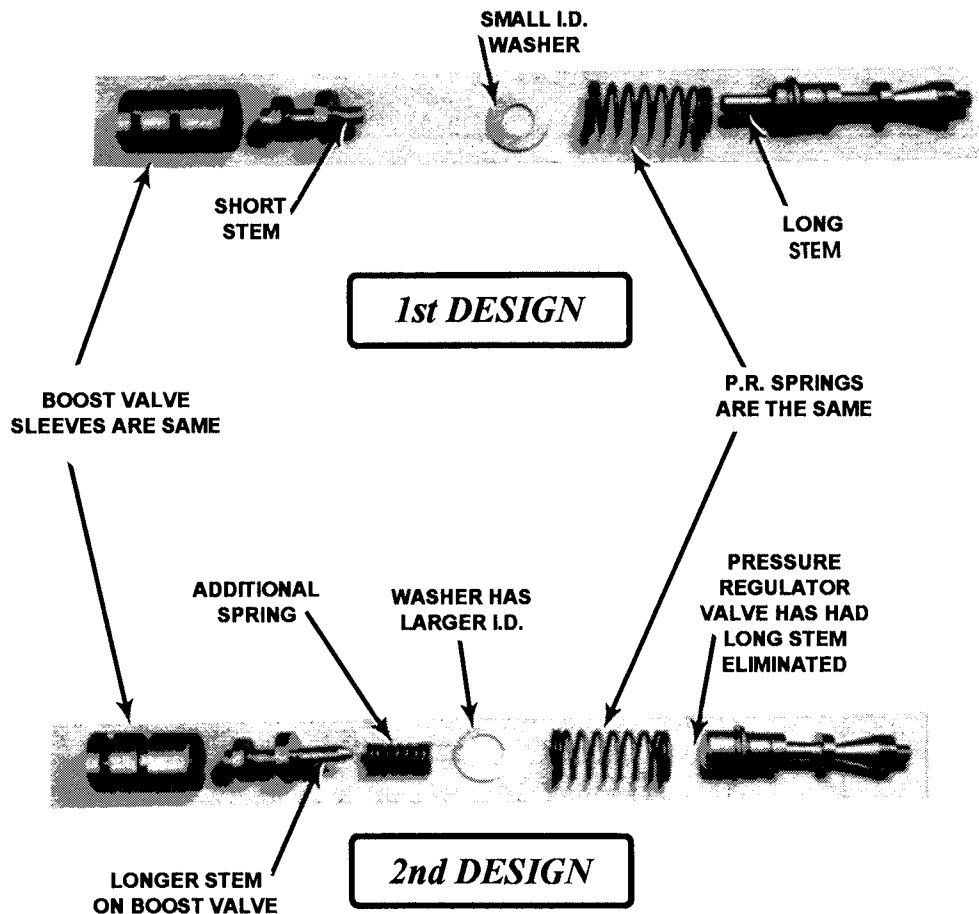
NOTE: The accumulator was upgraded for reasons other than a bind-up in manual low. However, the upgraded accumulator is the best choice for fixing this problem.

4L80E

Buzzing Noise

A complaint of a buzzing noise on a 4L80E may be caused by pressure instability in the pressure regulator line-up. A service package (Part #8682998) is available to correct this condition. Starting March 15, 1991 (Julian Date 074) all units were built with the new Pressure Regulator Assembly.

Mismatching certain 1st and 2nd design components will cause uncontrollable line pressure. Use all 1st design components together, or preferably, all 2nd design components.



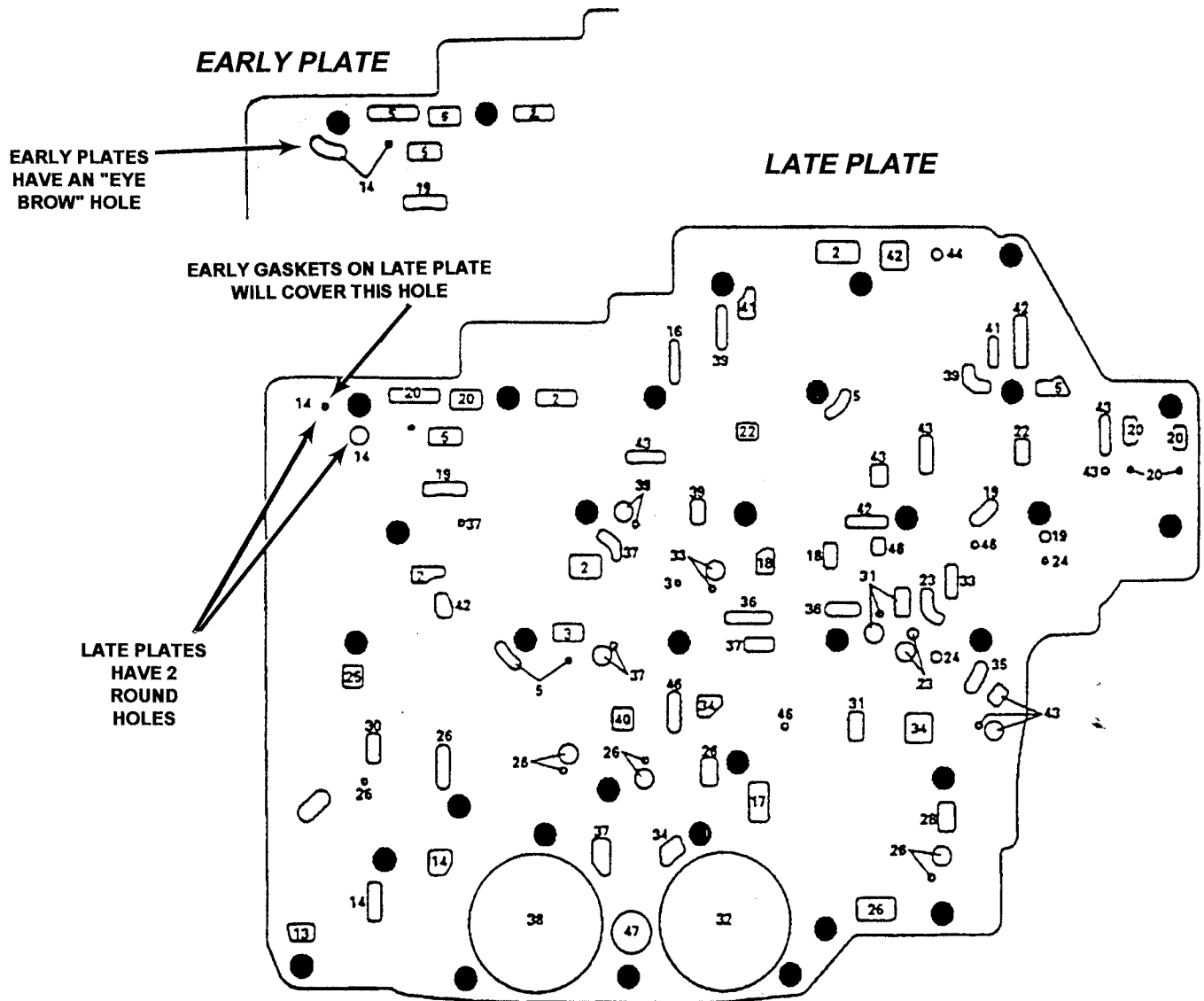
4L80E

No Line Pressure Rise

A complaint of no line pressure increase may be caused by using early valve body gaskets on late units. The wrong gaskets will cover a hole in the plate which feeds the boost valve. The late gaskets fit both the late and early spacer plates.

Late model case gasket..... 8680593

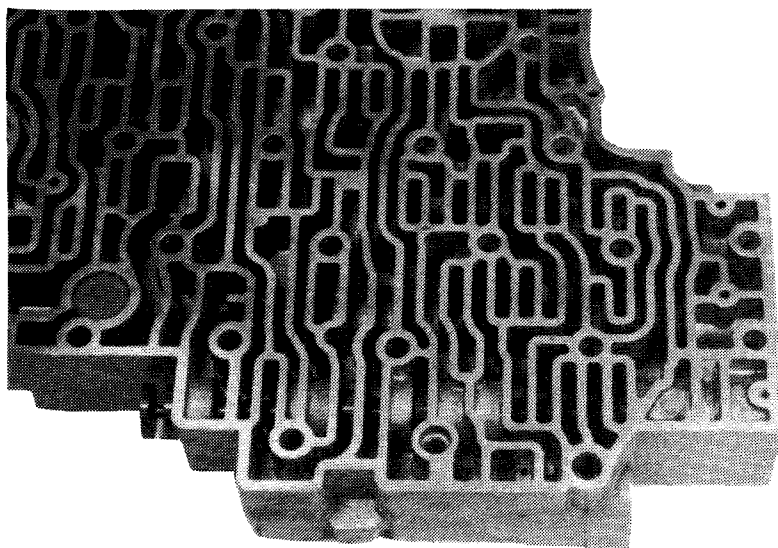
Late model valve body gasket..... 8680583



4L80-E

No or Low Line Rise

The activator feed screen used in the 4L80-E should be checked for damage and cleaned during each rebuild. It is not uncommon to find the screen cracked or broken. A broken screen will allow activator feed oil to leak causing no or low line rise. The GM part number for the screen is 8661709.



ACTIVATOR
FEED
SCREEN

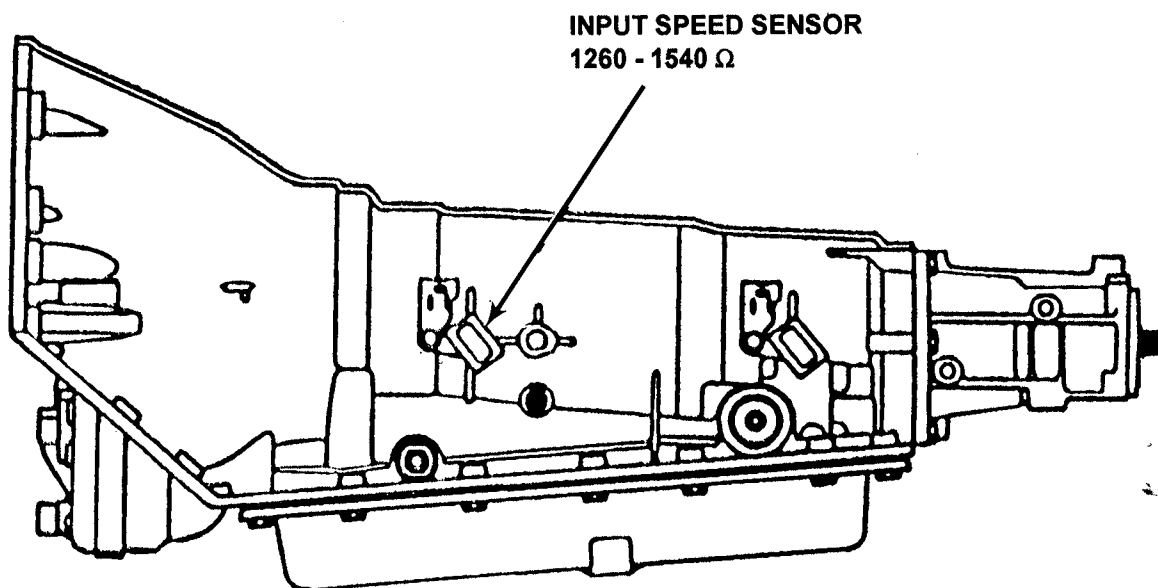
4L80-E

No Upshift

A complaint of no upshift may be caused by a bad Transmission Input Speed Sensor. Reading data with a scan tool may show no vehicle speed signal. Replacing the output speed sensor, DRAC, and even the computer may not restore normal vehicle speed signal, if the computer does not recognize a valid transmission input speed signal.

High line pressure (no Force Motor current) may also occur depending on the software strategy. This condition is most common on two-wheel drive diesel applications, but may also apply to others. The software strategy used on the different models, years, and calibrations are too widely varied to be absolutely certain which vehicles may be affected in this manner.

Verify input speed sensor operation with a scanner before replacing other components needlessly.



4L80E

Example Scanner Readings

READING #1

-8 INPUT RPM 2745
** CODES & DATA
(NO CODES PRESENT)
I/O RPM(RATIO) 1.00
TURBINE RPM 2059
TCC DUTY CYCLE 98
BRAKE REQUEST NO
TCC SLIP(RPM) 686
TPS(V) 2.09
BATTERY(V) 14.1
FORCE MOTR AMP 0.61
ENGINE RPM 2740
OVRDRIVE RATIO 1.00
CURRENT GEAR 4TH
SOLENOID A ON
RANGE A CLSD
RANGE C OPEN
1-2 SHIFT(SEC) 0.56
3-4 SHIFT(SEC) 0.03
A/C CLUTCH OFF

OUTPUT RPM 2745
OK TO DRIVE **
VEH SPEED(MPH) 56
TRANS TEMP(°F) 196
GEAR RATIO 1.00
BRAKE SW OPEN
TORQUE SIG(Psi) 37
THROTTLE(%) 34
PROM ID 3669
DES MOTOR AMP 0.61
INPUT RPM 2745
VEH SPEED (MPH) 56
PRNDL SW 4TH
SOLENOID B ON
RANGE B OPEN
POWER ENRICH YES
2-3 SHIFT(SEC) 0.47
A/C REQUEST NO

READING #2

-7 INPUT RPM 2745
** CODES & DATA
(NO CODES PRESENT)
I/O RPM(RATIO) 1.00
TURBINE RPM 2059
TCC DUTY CYCLE 98
BRAKE REQUEST NO
TCC SLIP(RPM) 686
TPS(V) 2.09
BATTERY(V) 14.1
FORCE MOTR AMP 0.51
ENGINE RPM 2758
OVRDRIVE RATIO 0.98
CURRENT GEAR 3RD
SOLENOID A OFF
RANGE A CLSD
RANGE C OPEN
1-2 SHIFT(SEC) 0.56
3-4 SHIFT(SEC) 0.03
A/C CLUTCH OFF

OUTPUT RPM 2745
OK TO DRIVE **
VEH SPEED(MPH) 56
TRANS TEMP(°F) 196
GEAR RATIO 1.00
BRAKE SW OPEN
TORQUE SIG(Psi) 37
THROTTLE(%) 34
PROM ID 3669
DES MOTOR AMP 0.55
INPUT RPM 2754
VEH SPEED (MPH) 56
PRNDL SW ????
SOLENOID B ON
RANGE B OPEN
POWER ENRICH YES
2-3 SHIFT(SEC) 0.47
A/C REQUEST NO

READING #3

-6 INPUT RPM 2754
** CODES & DATA
(NO CODES PRESENT)
I/O RPM(RATIO) 0.98
TURBINE RPM 2754
TCC DUTY CYCLE 0
BRAKE REQUEST NO
TCC SLIP(RPM) 259
TPS(V) 2.21
BATTERY(V) 14.1
FORCE MOTR AMP 0.51
ENGINE RPM 2758
OVRDRIVE RATIO 0.98
CURRENT GEAR 3RD
SOLENOID A OFF
RANGE A CLSD
RANGE C OPEN
1-2 SHIFT(SEC) 0.56
3-4 SHIFT(SEC) 0.03
A/C CLUTCH OFF

OUTPUT RPM 2759
OK TO DRIVE **
VEH SPEED(MPH) 56
TRANS TEMP(°F) 196
GEAR RATIO 0.98
BRAKE SW OPEN
TORQUE SIG(Psi) 44
THROTTLE(%) 37
PROM ID 3669
DES MOTOR AMP 0.55
INPUT RPM 2754
VEH SPEED (MPH) 56
PRNDL SW ????
SOLENOID B ON
RANGE B OPEN
POWER ENRICH YES
2-3 SHIFT(SEC) 0.47
A/C REQUEST NO

CHRYSLER

Chrysler

chrysler

CHRYSLER

CHRYSLER

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Chrysler

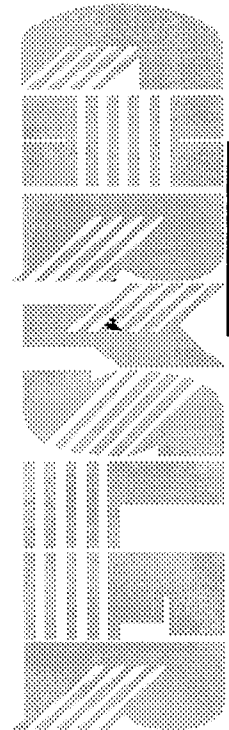
Chrysler

CHRYSLER

Chrysler

Chrysler

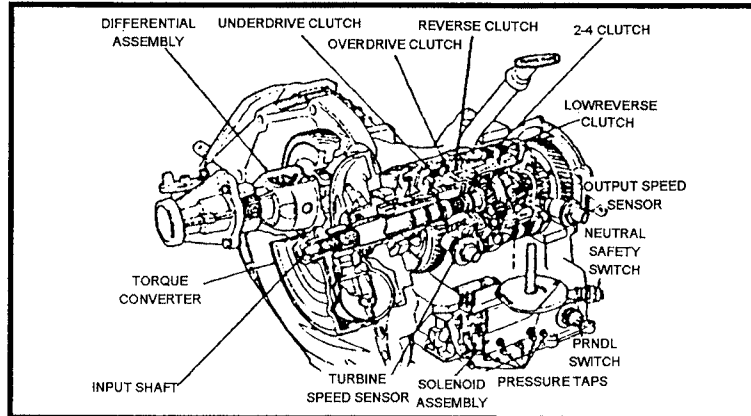
Chrysler



Chrysler

A-604

Component Application Chart



CLUTCH AND SOLENOID APPLICATION CHART

GEAR	CLUTCH					SOLENOID			
	L & R	2-4	O/D	UD	REV	LR/LU	2-4/LR	UD	OD
P									
R									
N									
4th									
3rd									
2nd									
1st									

A-604

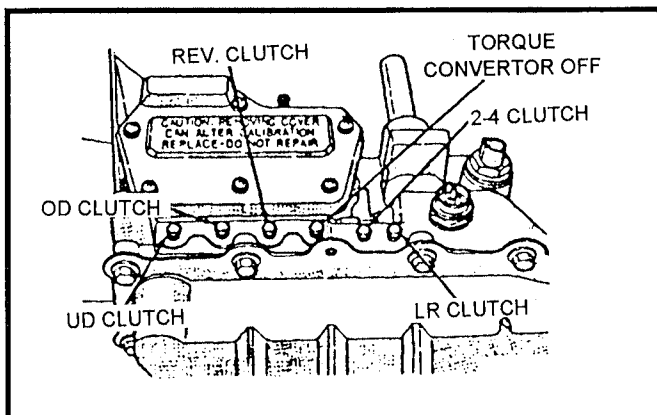
Pressure Tap Identifications & Specifications

GEAR SELECTOR POSITION	ACTUAL GEAR	PRESSURE TAPS					
		UNDER- DRIVE CLUTCH	OVER- DRIVE CLUTCH	REVERSE CLUTCH	LOCKUP OFF	2/4 CLUTCH	LOW/ REVERSE CLUTCH
Park * 0 mph	Park	0-2	0-5	0-2	60-110	0-2	115-145
Reverse * 0 mph	Reverse	0-2	0-7	165-235	50-100	0-2	165-235
Neutral * 0 mph	Neutral	0-2	0-5	0-2	60-110	0-2	115-145
L # 20 mph	1st	110-145	0-5	0-2	60-110	0-2	115-145
D # 30 mph	2nd	110-145	0-5	0-2	60-110	115-145	0-2
D # 45 mph	Direct	75-95	75-95	0-2	60-90	0-2	0-2
OD # 30 mph	Overdrive	0-2	75-95	0-2	60-90	75-95	0-2
OD # 50 mph	Overdrive Lockup	0-2	75-95	0-2	0-5	75-95	0-2

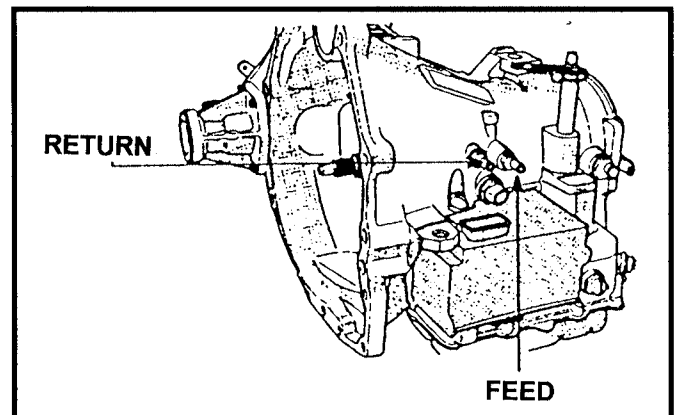
* Engine speed at 1500 rpm

CAUTION: Both front wheels must be turning at same speed.

PRESSURE TAPS

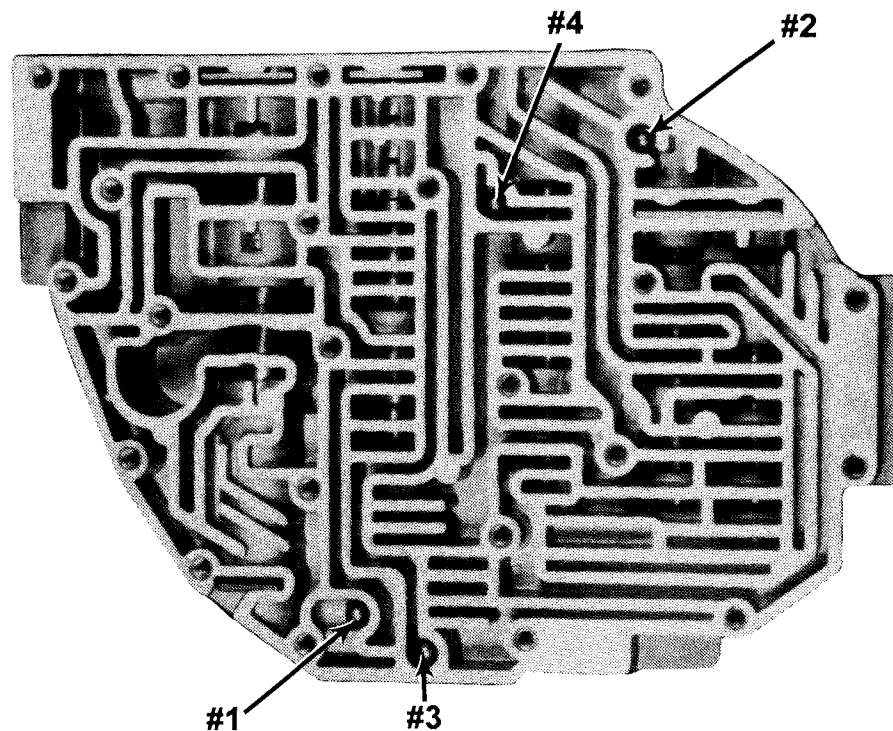


COOLER FITTINGS I.D.



A-604

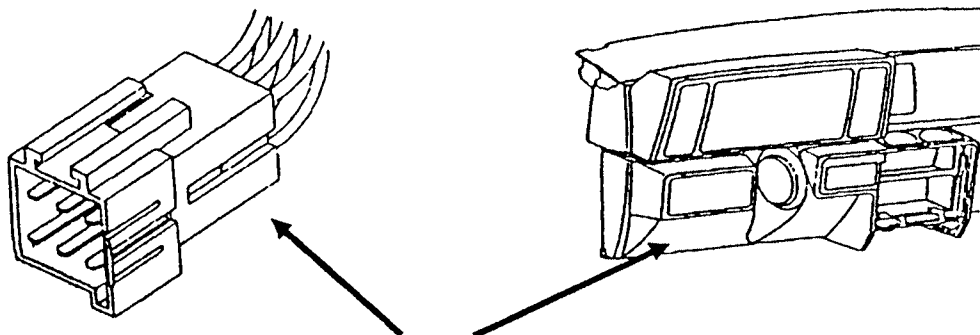
Checkball Functions & Locations



- #1 LR Shuttle
- #2 UD Feed and Bypass -- will not allow UD feed to bypass the UD solenoid. UD oil can bypass the solenoid during the release.
- #3 Keeps line oil out of the L/R circuit in 2nd, 3rd and 4th gear.
- #4 Reverse Clutch Orifice

A-604 Trouble Codes

Transmission trouble codes stored in the controller memory on an A-604 equipped Chrysler can only be retrieved with a scan tool connected to the bus (C²D) connector. Codes which are retrieved from the diagnostic connector located in the engine compartment are engine codes and do not directly relate to transmission codes.



The diagnostic connector looks like this, and is located under the left side of the dash.

Some scanners may display an unknown trouble code such as B-2. To decipher these codes, first determine the number that the letter represents as follows:

A = 20
B = 30
C = 40
D = 50
E = 60
F = 70

Now add the number displayed in the "unknown code" to the number represented by the letter, to determine the trouble code number.

EXAMPLES:

Unknown code - B2

Number value of unknown code letter B = 30
Number in unknown code..... 2
Add together = trouble code 32

Unknown code - C1

Number value of unknown code letter C = 40
Number in unknown code..... 1
Add together = trouble code 41

A-604 Trouble Codes

<i>CODE</i>	<i>FAULT</i>	<i>LIMP-IN</i>
11	Internal EATX controller failure	Yes
12	Battery was disconnected	No
13	Internal EATX controller failure	Yes
14	Relay output always on	Yes
15	Relay output always off	Yes
16	Internal EATX controller failure	Yes
17	Internal EATX controller failure	Yes
18	Engine speed sensor circuit	Yes
19	BUS communication with SBEC	No
20	Switched battery	Yes
21	OD pressure switch circuit	Yes
22	2-4 pressure switch circuit	Yes
23	2-4/OD pressure switch circuit	Yes
24	LR pressure switch circuit	Yes
25	LR/OD pressure switch circuit	Yes
26	LR/2-4 pressure switch circuit	Yes
27	All pressure switch circuits	Yes
28	Illegal shifter position data	No
29	Throttle position signal error	No
31	OD hydraulic pressure switch	Yes
32	2-4 hydraulic pressure switch	Yes
33	OD/2-4 hydraulic pressure switch	Yes
36**	Fault immediately after shift	Yes
37	Solenoid switch valve stuck in LU position	No
38	Lockup control	No
39*	Speed/Ratio error	Yes
41	LR solenoid circuit	Yes
42	2-4 solenoid circuit	Yes
43	OD solenoid circuit	Yes
44	UD solenoid circuit	Yes
45	Internal EATX controller	No
46	UD hydraulic circuit	No
47**	Solenoid switch valve stuck in LR position	Yes
50**	Speed/Ratio error in reverse	Yes
51**	Speed/Ratio error in 1st	Yes
52**	Speed/Ratio error in 2nd	Yes
53**	Speed/Ratio error in 3rd	Yes
54**	Speed/Ratio error in 4th	Yes
55**	Speed/Ratio error in neutral	Yes
56**	Turbine sensor error	Yes
57**	Output sensor error	Yes
58**	Sensor ground error	Yes
60**	Inadequate element volume in LR clutch	No
61**	Inadequate element volume in 2-4 clutch	No
62**	Inadequate element volume in OD clutch	No
63**	Inadequate element volume in UD clutch	No

* Early Controllers Only

** Late Controllers Only

A-604

How Does It Work?

This unit usually comes in with the same complaint. Stuck in second gear. This is the 'Failsafe' mode, where the transmission computer has observed something that should not have happened, recognized it as a problem, and 'Pulled the plug' on the transmission.

Sometimes this happens right away, the moment you put the unit in gear, but usually the transmission will operate okay for a bit, warm up, then SOMETHING happens and bang, second gear only.

NOW WHAT?

The biggest challenge facing you at this point is the sheer number of different things that can cause this to happen, such as:

- Electrical control system problems.

- Hydraulic apply circuit problems.

- Internal mechanical or sticky valve problems.

Where do you start? How do you know which of these areas to attack first?

There is an excellent article about this problem written by Gil Younger called 'Formula A604 - Lasting Relief'. Read this article. It contains some of the best approaches and solutions for this problem available. You'll find this article in your past issues of Gears, Fall - '92, (the one with the valve body on the front) and Winter '93, (the one with the converter turbine on the front).

Chances are it'll take you to the root of your problem in the shortest time possible.

But wait! What about all us scan tool and pressure gauge freaks? Someone said this was such a sophisticated control system. Is there another way to locate the source of that slip, slide, chatter and 'Limp-in mode'?

First, you've got to experience the complaint. No substitutes allowed. Trust no one. And, if the VERIFIED complaint is immediate Failsafe mode on start-up, go get Gil's article and fix the car. Or...

Hook up your scan tool to the blue six pin CCD connector under the dash. That's how to 'talk' to the transaxle computer. *Not the connector under the hood.* That's for motor-talk, and beneath our concern at this time.

A-604

How Does It Work? (Continued)

See what trouble codes might be lurking in the computer's memory. Write them down. Clear them. Drive the car, until the complaint occurs again. See what codes return. Write these down. For the time being, let's believe these codes to be true.

A WORD ABOUT A604 TROUBLE CODES

A complete list of codes, what sets them, and a good description of this system is available to you from the ATRA bookstore. Order the book "A604 Ultradrive Transaxle Electronic Control System, Student Reference book"

Let's classify these codes into three groups.

Component Failure Codes: These codes tell you an electronic item failed a specific test for that item.

Condition Failure Codes: These codes tell you that the transmission did not do what the computer told it to do.

Codes that defy this classification: These are component or condition codes, caused by something other than what the code tells you. Treacherous waters indeed.

Component failure codes. Most codes are component failure codes. These are: 11 through 33, 37, 41 through 45, 47, and 56 through 58. Usually, if you change the accused part, the problem will go away. Watch out for codes 21 through 27 and 31 through 33.

Condition failure codes. These include codes 36, 38, 39, 46, 50 through 54 and 60 through 63.

These codes, and the computer's ability to monitor these conditions and set these codes, rely on three speed sensors used by the transaxle computer to determine exactly how fast certain things are turning. These sensors watch engine RPM, turbine or input shaft RPM and output shaft RPM. And not only can the computer tell how fast something turns, it can tell how fast that speed *changes*, measuring these changes on the order of thousandths of a second. Super precise.

The computer needs this precision in order to police the transmission, make sure the transmission does as it's told. We'll talk more about that in a minute.

In 1989 and 1990, the A604 used only a few of these codes, 38, 39, and 46.

Code 38 means that partial lock-up was requested by the computer, but engine vs. turbine speed never reached the right ratio for partial lock-up.

Code 46 means that a 3-4 shift was commanded, but turbine speed vs. output speed never reached the right ratio, so after the third try, it quit trying.

A-604

How Does It Work? (Continued)

Code 39 means that at some point in time, while the transmission was in gear, it slipped. The ratio of input shaft speed to output shaft speed did not match the gear the computer requested.

Starting in 1991, instead of giving you code 39, the computer gives you one of codes 50 through 54, telling you which gear it slipped in. Code 50 means reverse, 51 means first, 52 means second, 53 means third and 54 means fourth. You will also probably see code 36 with one of these which means that the electrical system checked out okay during the problem. Check hydraulic or mechanical systems first.

Which takes us now to codes 60 through 63. Inadequate clutch volume, 1991 & later.

CLUTCH VOLUME INDEX (CVI)

We already know that the computer knows the input shaft and output shaft speed, and updates this information over 100 times a second.

We know that the computer knows what the observed input speed to output speed ratio should be for each gear.

The computer's programming knows how long it should take to go from one ratio to another during a shift. Too much time makes a sliding or slipping shift, and too little time makes a harsh shift.

By watching the turbine and output sensors, the computer can come up with a CVI number and can tell not only when a shift happens, but exactly when the applying clutch begins to engage, and how long the shift actually took to accomplish. It does this by looking at the rate at which Input/Output ratios change. As well as a change in the rate of change. Let's look into this computer and watch both a 1-2 upshift and a 4-3 downshift.

1-2 UPSHIFT:

The computer is about to signal for a 1-2 shift. It sees the correct first gear ratio on the I/O (Input/Output) sensors. Throttle and vehicle speed and shifter info say it's time to shift, so here goes the command . . . Now! And you hit your stop watch.

Fascinating stuff starts to happen. First, the 2/4 clutch circuit is starting to get pulsed on. The computer looked up a CVI number, and determines how long these pulses should be so the clutch would apply at a certain rate. If you had a scanner in your hand, you would notice that the I/O ratio numbers haven't changed yet. The 2/4 apply circuit is still filling with oil.

Next, the computer looks at a CVI number again, and decides when to dump the Low/Reverse clutch is off, and the 2/4 clutch is actually starting to apply, to bring the I/O ratio to the proper second gear ratio. You stop your stop watch when you see the Input speed begin to drop toward that ratio, knowing that you just counted the time required to fill the 2/4 clutch circuit. You write down the number your stop watch ended up at, *realizing that this is the CVI number that the computer was looking at to control the shift.*

A-604

How Does It Work? (Continued)

4-3 DOWNSHIFT:

The 4-3 downshift, (or any accelerating downshift for that matter), has an additional concern that you don't have to worry about on an upshift. On an accelerating downshift, the motor must be allowed to spin up to the proper RPM before the applying clutch engages. This keeps the shift smooth. The A604 computer has to keep this in mind.

Remember watching the 1-2 shift? All we were watching for on the I/O sensors was a change, or slowing, of Input speed. Well, the downshift is a bit different, because we need to account for the engine spin-up time. The computer knows how long this spin-up time should be, but how does it make sure that it controls spin-up time correctly and still control shift apply feel?

Back into the computer with a stop watch. You see that the I/O sensors show 4th gear at about 60 mph. Signals from the throttle position sensor show that the driver wants to go faster, so we need a 4-3 downshift. Here comes the command . . . Now! You hit your stop watch. The computer knows that it has to dump the 2-4 clutch and apply the Underdrive clutch with a semi-neutral state in between. First, the U/D clutch starts to get pulsed on. This begins filling the U/D circuit. After looking at a CVI number the computer knows how long it will take for that clutch to start to apply. It uses the appropriate pulse 'ON' time to make sure that time is correct.

Next, the computer looks at a CVI number to see when it should dump the 2/4 clutch. This determines what the overlap time, or time when both clutches are partially applied - partially slipping, should be.

Here comes the dump signal - Whoosh. You notice that the input speed immediately starts to rise. The computer is measuring how fast the input shaft is accelerating, otherwise known as the input speed *Rate of change*. This must be that semi-neutral state. The underdrive clutch better start coming on soon, or we'll have a real spin-up.

Now you notice the input shaft isn't accelerating as fast as it was just a moment ago. Instead of increasing 25 RPM every 1/10 second, it's only increasing 18 RPM every 1/10 of a second. A *change in the rate of change*. You stop your stop watch, knowing that the underdrive clutch is starting to apply.

Your stop watch shows you a number that corresponds to how long it took to apply the underdrive clutch in a controlled, pulsed fashion.

In reality, the computer has the stop watch. And in case you've heard otherwise, those pressure switches in the solenoid body you hear about are not involved in this process. They are used to double check solenoid operation and PRNDL/Neutral switch function only.

A-604

How Does It Work? (Continued)

What does the computer do with the stop watch, or CVI numbers? It uses the 'Clutch Volume Index' numbers to decide the proper clutch overlap times, as well as the pulsed apply oil flow rate, to make sure each shift, upshift or downshift, takes the same amount of time and feels the same way, *even if clutch apply travel distances and circuit leak amounts change, or are different unit to unit.*

These Index numbers are memorized for four of the five clutch packs in the unit. (They don't need to worry about the Reverse Input clutch.) The computer can 'update', or change these numbers. If it feels that a shift was too short, or harsh (sees a lower stop watch number than it has in memory), it will enter the lower number in memory. The computer now knows it should 'drag out' the shift a little more. If the computer feels a shift was too long, or soft, (sees a higher stop watch number than it has in memory), it will enter the higher number into its memory and appropriately tighten up the shift.

These numbers are updated through Input/Output monitoring ONLY under certain shifts, as follows. The Low/Reverse index is updated on a 2-1 or 3-1 accelerating downshift. The 2/4 index is updated on a 1-2 upshift. The Underdrive index is updated on a 4-3 or 4-2 accelerating downshift. The overdrive index is updated on a 2-3 upshift. These conditions are when these clutches are under high load, and most likely to show differences in fill volume requirements.

HOW CAN YOU USE THESE NUMBERS?

You can retrieve these numbers with a scan tool, and compare them with known ranges that these index numbers should fall within.

These ranges are:

L/R index should be between 35 and 83

2/4 index should be between 20 and 77

Underdrive index should be between 24 and 70

Overdrive index should be between 75 and 150

These numbers are not specific fractions of a second, or RPM's per 1/10 of a second. If the number is near or exceeding the top of its proper range, then that clutch either has a whole lot of room, (worn, mis-assembled) apply circuit leaks, or some other reason for extended shift time. We know it takes a long time to apply. And that MIGHT be the cause of the slip, chatter, or limp mode.

If the number is near or below the bottom of its proper range, that clutch could be mis-assembled, or partially applied by cross leaks, or it could have a broken return spring, or even valve body modifications. We know this clutch takes a very short time to apply, and that MIGHT be the cause of some clunky or bindy feeling shifts.

From 1991 on, the A604 will set codes 60 through 63 if any of these index numbers, or CVIs fall below their lower limits. If you find one of these codes, it's a pretty safe bet you're going into the transaxle.

A-604

How Does It Work? (Continued)

Now let's go back to the trouble shooting scenario and see how CVI numbers fit into the picture. Every shift in an A604 has one clutch that is already on and remains on for the gear you're shifting into, and one clutch that was off but must apply for the gear you're shifting into. You also must release a clutch for each shift.

Let's say you've got a problem with a shift. It slides, binds, slips, chatters or makes the computer pull the plug on the unit.

Use the clutch apply chart to see which clutch stays on for that gear, which clutch applies for that gear and which clutch releases for that gear. We'll call the applying clutch Suspect #1. We'll call the clutch that stays on Suspect #2. We'll call the releasing clutch Suspect #3. If the shift in question slips, slides, chatters, or limps, you've got a problem applying or holding a clutch. Something slips, either due to low apply pressure at the clutch or excessive piston travel. See if your CVI for Suspects #1 or #2 are near or above their top limits.

If the problem shift feels harsh or bindy, a clutch may not be releasing all the way. See if your CVI for Suspect #3 is near or below its bottom limit. The CVI numbers are by no means proof that a clutch circuit is bad, but consider them pretty heavy evidence.

Your CVI numbers will probably take Suspect #1, #2, or #3 up to the level of 'Prime Suspect'. Now, how do we prove it?

Use your pressure gauge. Line pressure in an A604 behaves in a wonderfully convenient fashion. It does not go up or down with the throttle. It remains fixed at a steady pressure, depending on which gear you're in, like so:

In Park, Neutral, first, or second gear, line is 120-145 p.s.i.

In Third or Fourth gear, line is 75-95 p.s.i. Expect the pressure to drop during a 2-3 shift.

In Reverse, line is 175-235 p.s.i.

Check the pressure of the Prime suspect *during the bad shift, on the road!* Now compare that reading with another reading you need to take, during the bad shift, on the road.

If your Prime Suspect is Suspect #1, compare readings with Suspect #2.

If your Prime Suspect is Suspect #2, compare readings with Suspect #1.

The lower pressure reading after the shift is complete is your culprit clutch. The circuit leaks.

If your Prime Suspect is Suspect #3 (harsh or bindy shifts) all you really need to do is see if the pressure on that clutch goes right to zero during the bad shift. If it doesn't, you are cross leaking that clutch on when it shouldn't be. Find the leak.

A-604

How Does It Work? (Continued)

ONE LAST NOTE ABOUT CVI

One last trick about using CVI for your diagnosis relies on the reset function of the computer, or what happens to the computer's memory when power is removed from the computer at any time, for any reason.

The computer forgets all learned CVI valves, and substitutes 'Middle of the Road' numbers in their place. This is a double-edged sword.

It's bad because the reset numbers are totally bogus from a diagnostic standpoint. They don't reflect your unit's actual condition, and it takes quite a few of those 'Special Update' shifts for accurate values to be learned. What if you don't know that the battery went dead or was disconnected recently? Your best defense is a real thorough road test. If the numbers shown on your scan tool are real close to the reset valves listed below, do what the next paragraph tells you.

CVI RESET VALUES

L/R = 64, 2/4 = 48, U/D = 45, O/D = 89

Reset values can be a good thing. It gives you a good starting place to see how bad a clutch might be. You now know what shifts update which clutch pack CVIs. The operating complaint on the unit you've got should lead you to a suspect clutch pack. Pick that clutch's CVI updating shift and mercilessly hammer the unit through that shift, over and over. Watch how much the CVI changes for that clutch after each update shift. Keep going until the reading doesn't change by more than two points. Now you should have an accurate CVI for that clutch.

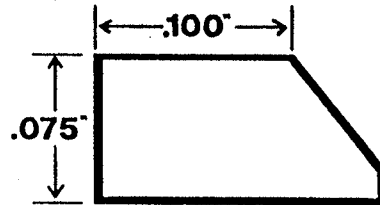
A-604

Snap Ring Breakage

Many 1990 and later A-604's may experience a complaint of a broken overdrive/underdrive reaction plate tapered snap ring. This may be the original complaint or it may be a repeat failure.

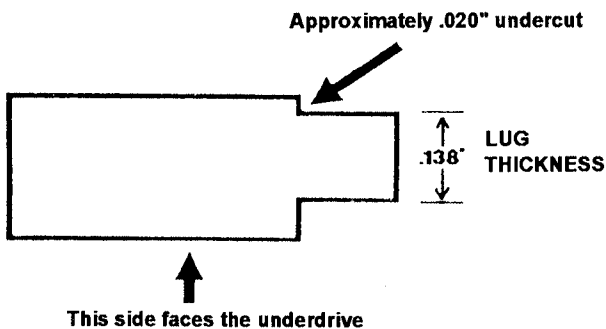
To help prevent this failure there is a new design overdrive/underdrive reaction plate and tapered snap ring available. The new tapered snap ring is thicker than the previous design. The new underdrive/overdrive reaction plate has thinner lugs to make room for the thicker snap ring. The new snap ring and reaction plate can only be installed into the late input retainer.

The new snap ring is slightly thicker than the previous design, and there is less taper. These changes provide for a much stronger ring.



A604

Snap Ring Breakage (Continued)



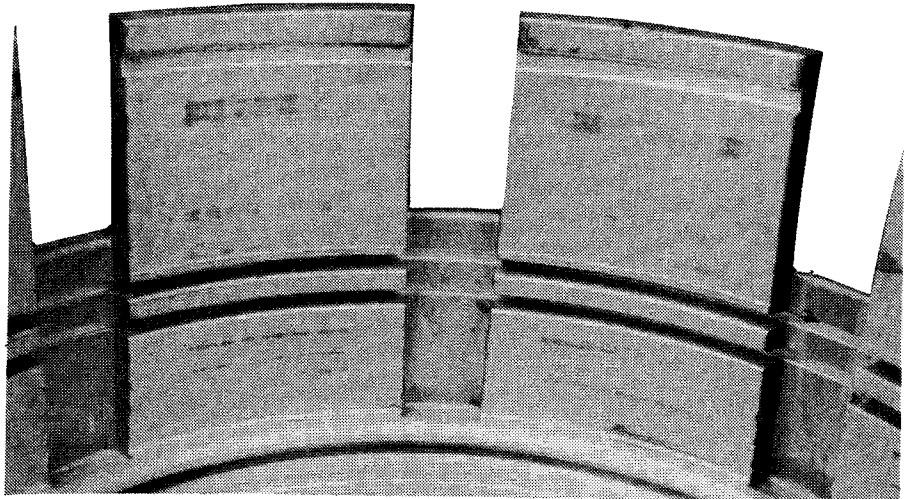
The new overdrive/underdrive reaction plate has lugs that are thinner than previous plates. The reduced lug thickness was required to make room for the new thicker snap ring. The reaction plate is selective adjust of the underdrive clutch clearance.

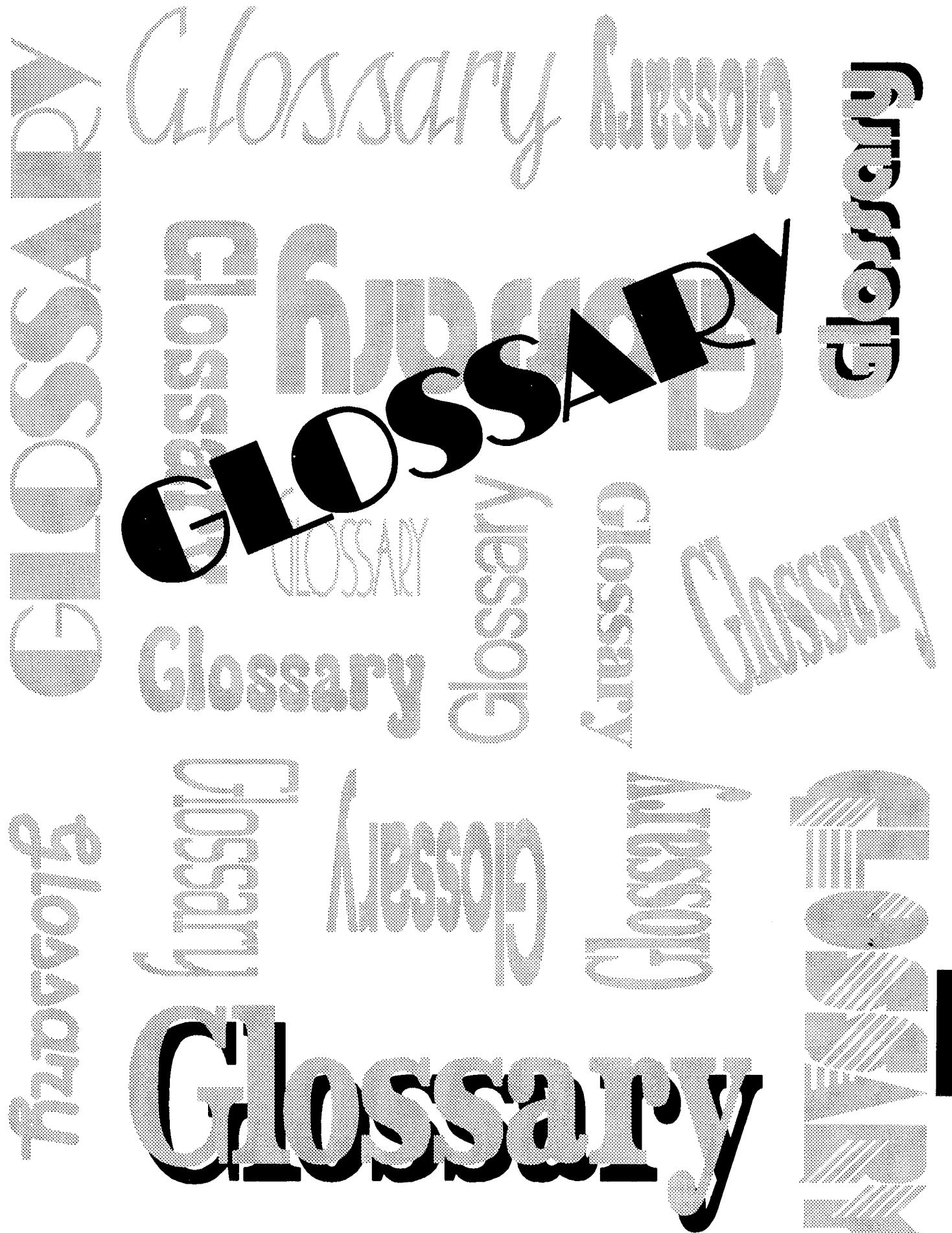
Selective overdrive/underdrive reaction plates

<u>Thickness</u>	<u>Part #</u>
.273\"-.277"	4723681
.253\"-.257"	4723682
.234\"-.238"	4723683
.215\"-.219"	4723684

The new reaction plate and snap ring will only fit the late retainer. Measure the thickness of material between the snap ring grooves to positively identify the retainer.

Approximately .125" = Early Retainer
Approximately .080" = Late Retainer





Glossary

AMMETER:

An instrument for measuring current flow. It may be constructed to measure alternating or direct current.

AMPERAGE:

The total amount of current (amperes) flowing in a circuit.

AMPERE (AMP):

The unit of measurement for the flow of electrons in a circuit. The amount of current produced by one volt acting through a resistance of one ohm.

ANALOG SIGNAL:

A signal that varies in exact proportion to a measured quantity such as pressure, temperature, speed, etc.

CHANGING STATES:

This refers to the opening and closing of a switch. If a switch is open and is then closed (by pressure, temperature, mechanical positioning etc.) is said to have 'changed states'. This is also true when a switch is closed and then becomes open.

CIRCUIT:

The complete path provided for current flow.

COMPOUND SWITCHES:

Some sensors/switches are built within the same sensor housing, but are still two or more distinct circuits. A good example of the inhibitor switch is used in the 1990 Hyundai Sonata (see page #11). These sensors/switches should be confronted as separate switches. There are times when two 'types' of switches are confined to the same housing. An example of this is the Nissan Throttle Position Sensor (TPS). It contains one variable resistor and two switches. Each of these should be considered separate sensors/switches.

COMPUTER:

Any device capable of accepting information, comparing, adding, subtracting, multiplying, dividing, and integrating this information; then supplying the results of these processes in proper form.

FREQUENCY:

Cycles Per Second. Measured in Hertz.

GANGED RESISTOR:

A group of several resistors wired in series.

HERTZ:

The unit for measuring frequency. Abbreviated 'Hz'.

Glossary (Continued)

MULTIMETER:

A test instrument with suitable switching facilities to measure voltage, current, and resistance. Also called a volt-ohm-meter.

NORMALLY CLOSED:

Refers to an item (a solenoid or switch) that when it's not activated will be in the closed position. If it's a solenoid it will not flow, if it's a switch it will form a complete electrical circuit.

NORMALLY OPEN:

An item that when not activated is in the open position. (See 'Normally Closed'.)

OHM:

The practical unit for measuring electrical resistance.

OHMMETER:

An instrument for measuring resistance.

OHM'S LAW:

"Amperage varies in direct ratio to voltage and in inverse ratio to resistance." For example: One ampere is equal to the amount of current forced by one volt through a resistance of one ohm.

OPEN CIRCUIT:

An electric installation in which the circuit is not complete (no current flow).

PARALLEL CIRCUIT:

A method or pattern of connecting units in an electrical circuit. In a parallel circuit, all the units are connected negative-to-negative and positive-to-positive.

PULSE WIDTH MODULATION (PWM):

Changing the percentage of 'ON' time of a pulsing signal to control the signal. Also called Duty Cycle.

QUAD DRIVER (QDM):

Integrated circuit used to turn certain components ON or OFF. A Quad Driver Module (QDM) has four separate outputs (switches) and can turn ON or OFF up to four circuits and/or components independently.

SERIES CIRCUIT:

A circuit in which the units are consecutively connected or wired positive-to-negative, and current must flow through all units.

Glossary (Continued)

SOLENOID:

A tubular coil containing a movable core that moves when the coil is energized.

SOURCE VOLTAGE:

The voltage that is sent by the computer to the input device (sensor/switch). Most computer system will send either 5 volts or battery voltage.

SQUARE WAVE:

An essentially square - or rectangular-shaped wave. A wave that alternately assumes two fixed values for equal lengths of time with a negligible transition time between the two values.

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1995 Technical Seminar

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Notes

Driveability Electronics Diagnosing & Testing

Misdiagnosis of electrical problems and needless transmission removal happens hundreds of times. The goal of this section is to provide the information needed to prevent these things from happening and to prepare for the electrical systems (problems) of the future.

Electrical problems are not that difficult to diagnose and fix. Mysterious maybe, but not difficult. This is because electrical behavior is constant. Electrical behavior also follows certain rules. These rules can be explained and once understood, they explain what should be expected from a circuit. Once that is known, diagnosing an electrical problem begins to become quite easy and actually fun.

BATTERY OPEN POST VOLTAGE

To diagnose an electrical problem, begin at the beginning, which means start at the battery. The first electrical check on any car should be the battery open post voltage. To do this correctly an accurate voltmeter is needed. The best choice will be a digital multi-meter. An analog meter might be okay, but a test light is definitely not the tool to use.

The engine must be off and preferably cold. Place the positive lead of the voltmeter to the positive post of the battery. Now do the same for the negative side, negative lead to negative post. Now read the meter. A fully charged battery will read between 12.45 volts and 12.66 volts. A battery that reads 12.24 volts is only 50% of full charge and 11.98 or lower is considered discharged. An analog meter may not detect a two tenths of a volt difference and a test light definitely can't.

If battery voltage is not at least 12.45 volts, then it must be corrected. Maybe the battery needs charging or maybe it needs replacement. There could be a problem with parasitic loads. In any event, the problem must be corrected before doing the next test.

Driveability Electronics (cont'd)

GROUND CIRCUIT VOLTAGE DROP

The next test will be a voltage drop test on the accessory ground circuit. To do this, leave the meter in the DC volts mode and place the negative lead to the negative post of the battery. Now place the positive lead to a body ground such as the fender well. Don't ground to the engine. That is a later test. Now get in the car and turn on the ignition and several accessories such as the radio, heater fan (on high), headlights (on high beam), and the electric defrost. With all of the items on, go back and read the meter. The reading must be less than 0.1 volts. Any reading that is higher than one tenth of a volt indicates a poor ground. Poor grounds are the most common cause of electrical problems on cars today.

There are 16 electrical tests that should be completed first when diagnosing any electrical system. ATRA's bookstore has a flip-chart available detailing the 16 tests with pictures and clear explanations. It's called First Things First. Call the International Business Office at (805) 654-1700 to order.

ATRA also has a 5 day, hands-on Electronics Training Institute (ETI) that will take the student from Ohms Law through troubleshooting Darlington pair transistor circuits. It's probably the best way to 'jump in hard and fast' on electrical troubleshooting. For further information call 1-800-428-8489.

LOADS

Electrical circuits have components called loads. A load is a device that converts electricity into some other form of energy. A headlight is a load, it converts electricity into light. Electric motors and solenoids are also loads which convert electricity to motion. A rear defroster converts electricity to heat and a speaker converts it to sound. Any electrical device that performs work is a load and all loads have electrical resistance. Resistance opposes electrical flow (current). Resistance in an electrical circuit will lower the current in that circuit.

It takes a certain amount of electrical pressure (volts) to overcome resistance, just like it takes a certain pressure or force to push a car. An electrical load (resistance) will use voltage (pressure) to perform work.

In a nutshell, electrical resistance will convert voltage into another form of energy. The amount of voltage used by a resistor or load is called its *voltage drop*.

Driveability Electronics (cont'd)

SERIES CIRCUIT

A series circuit means there is only one path for electrical flow. All loads are in series (one after another) with each other. Electric current will have to flow through the first resistor before it can get to the second. Current will flow through the first and second to get to the third. Each resistor or load will use some of the voltage and lower the current flow. Each load will have a voltage drop. There are three laws that relate to a series circuit. They are:

1. The sum of the individual resistors equals the total circuit resistance.
2. The sum of the voltage drops equals the applied voltage.
3. The current flow will be the same at any point.

The following example will help make some sense of those laws. Resistance is measured in ohms. If a series circuit had two 10 ohm loads in it, then as the first law states the total resistance would be 20 ohms. If there were three 5 ohm loads, the total would be 15 ohms. If resistance values were 6 ohms and 4 ohms, the total would be 10 ohms. In other words, add them up.

The second law is easy because it's similar to the first law. If there are 2 loads and each dropped 6 volts then that means that the circuit started with 12 volts. Once again, add them up. Now an important point. The load or loads in the circuit will use ALL of the voltage. Read that again. If applied voltage is 12 volts and there are two loads, then the two loads will use all 12 volts. If the first load had a voltage drop of 8 volts then the second load would HAVE TO BE 4 VOLTS because $8 + 4 = 12$. If there were three loads in a circuit, they would all drop a portion of the applied voltage. If a circuit operated on 12 volts and had only one load, then the voltage drop on the one load would be 12 volts.

Now for the third law. Current flow is measured in amps. If a given circuit had 2 amps of current flowing into the first load then 2 amps would flow out of it, and into the second load. Two amps would flow out of the second and so on. In other words, no matter where the measurement was taken it would read the same.

Driveability Electronics (cont'd)

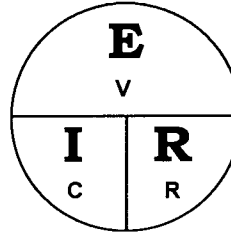
OHMS LAW

According to Ohms Law, if any two values are known the third can be figured out. Here's how it works:

$$\text{Voltage} \div \text{Current} = \text{Resistance}$$

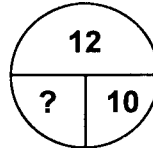
$$\text{Voltage} \div \text{Resistance} = \text{Current}$$

$$\text{Current} \times \text{Resistance} = \text{Voltage}$$



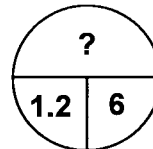
Here is an example circuit. It will have 12 volts at the source. The circuit contains a 6 ohm and a 4 ohm load. The loads are added, to offer a total circuit resistance of 10 ohms. Now use Ohms Law to find the current flow.

$$\text{Voltage (12)} \div \text{Resistance (10)} = \text{Current (1.2)}$$



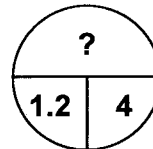
Remember, current is the same at any point, this can be used to figure the voltage drop. The first resistor is 6 ohms.

$$\text{Current (1.2)} \times \text{Resistance (6)} = \text{Voltage (7.2)}$$



The voltage drop on the first load is 7.2 volts. The second resistor is 4 ohms.

$$\text{Current (1.2)} \times \text{Resistance (4)} = \text{Voltage (4.8)}$$



The voltage drop on the second load is 4.8 volts. The sum of the voltage drops equals the applied voltage. $7.2 + 4.8 = 12$.

Driveability Electronics (cont'd)

GROUND PROBLEM

Now let's suppose there is corrosion, rust or a loose connection in the ground circuit. Any one of these problems will create resistance. Since all the resistors will use some of the voltage, this ground problem will have a voltage drop. If the ground resistance is 2 ohms, for example, the new total resistance will be:

$$6 + 4 + 2 = 12 \text{ ohms. It should be 10 ohms}$$

The new current flow is:

$$12 \text{ volts} \div 12 \text{ ohms} = 1 \text{ amp. It should be 1.2 amps}$$

The new voltage drops are:

1st Resistor 1 amp. x 6 ohms = 6 volts. It should be 7.2 Volts, 1.2 Amps

2nd Resistor 1 amp. x 4 ohms = 4 volts. It should be 4.8 Volts, 1.2 Amps

Ground Problem 1 amp. x 2 ohms = 2 volts

What this means is that the two loads have less voltage and less current to operate them causing them to work improperly. If they were lights, they would dim. If they were motors or solenoids, they would operate slowly. Either way, the problem would have been found by performing a Ground Circuit Voltage Drop test.

Component Testing & Behavior

Checking components is easy with the right tools. Proper testing will in most cases require a scan tool and digital multimeter. By comparing the scanner reading with the digital multimeter (DMM) reading, the computers capability of processing a sensor's signal can be checked. This is one of the few ways of actually testing the computer.

ELECTRICAL INPUT COMPONENT BEHAVIOR

Most electrical input components can be put into one of three basic categories. Switches, variable resistors and voltage generators. These categories can be broken down even further by referring to the number of wires they have. 90% of the sensors and switches you encounter will fall into one of these categories.

switches	1 wire 2 wire
variable resistors	1 wire 2 wire 3 wire
voltage generators	2 wire

The key to diagnosing electrical input components is understanding their behavior. Once this is done, a simple wiring schematic will usually be all that is needed to diagnose the input components used in todays computer controlled transmissions.

Some input components have more than three wires. In these cases, one or more components will be built into a single housing. This is usually the case with throttle position switches, manual lever (neutral safety) switches and temperature sensors.

NOTE: *The test and behavioral observations made in this section are with the switch/sensor still connected to the circuit and operating normally. To check the operation of the circuit, backprobe the computer harness connector or use a break-out box. Most computer systems use either five volts or battery voltage to operate the switches and sensors. This will be referred to as source voltage or reference voltage.*

Switches - One Wire GROUNDING SWITCHES

DESCRIPTION

This switch is a normally open (N.O.) or normally closed (N.C.) grounding switch and changes states when certain conditions are met. This switch can be used to monitor pressure, temperature or mechanical position (e.g. neutral safety, KM servo switch).

COMMON APPLICATIONS

Temperature:	Mitsubishi - coolant temperature switch Toyota - coolant temperature switch
Pressure:	2004R - fourth gear switch AXOD - N - D - switch
Mechanical:	KM175 - servo switch

Switches - Two Wire CONNECTING SWITCHES

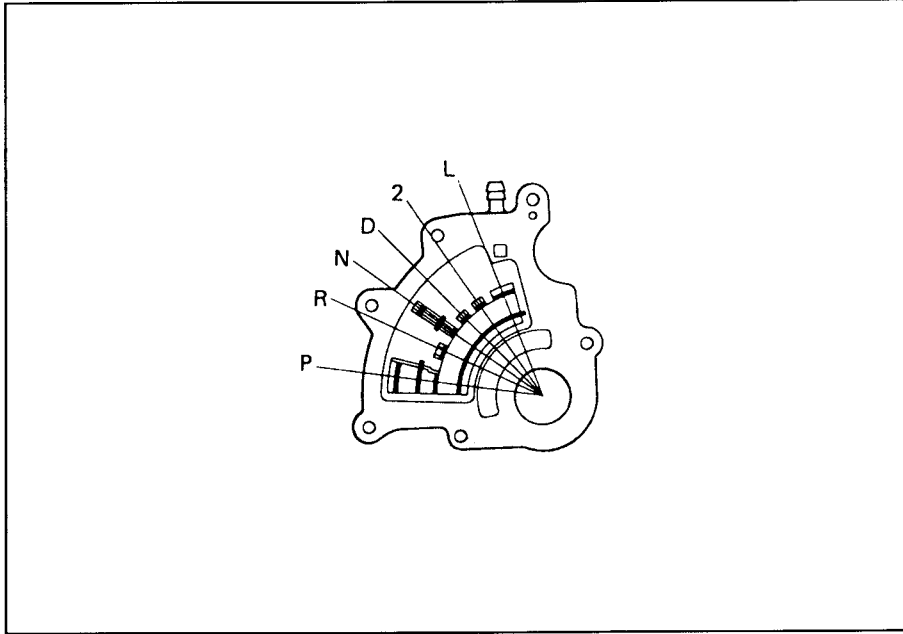
DESCRIPTION

This switch operates in the same manner as the single wire switch. The difference is, the switch is not self-grounding. This being the case it can be used to provide a ground signal or a voltage signal. This switch is most commonly used as a pressure switch or a mechanical switch.

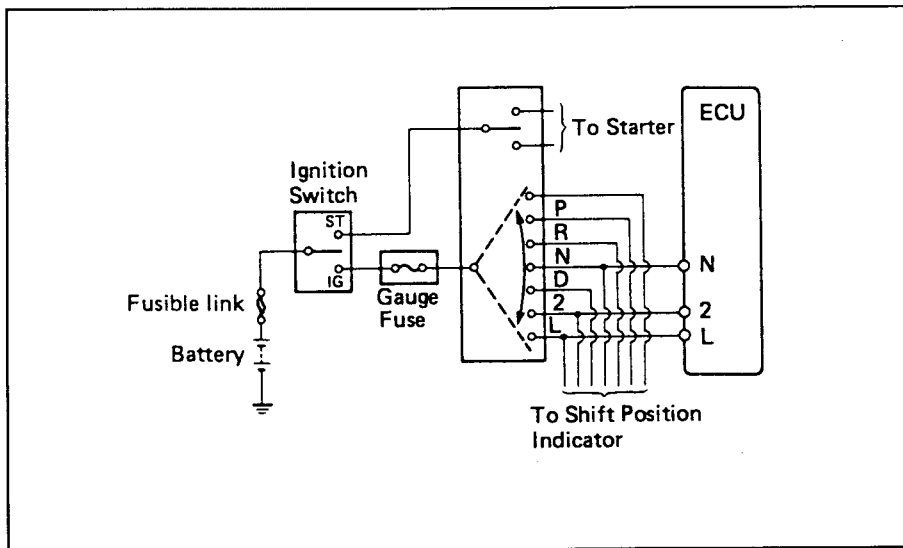
COMMON APPLICATIONS

700R4	3rd gear switch
440T4	Temperature switch
A604	PRNDL switch (compound switch)
G4A-EL	Manual lever switch (compound switch)

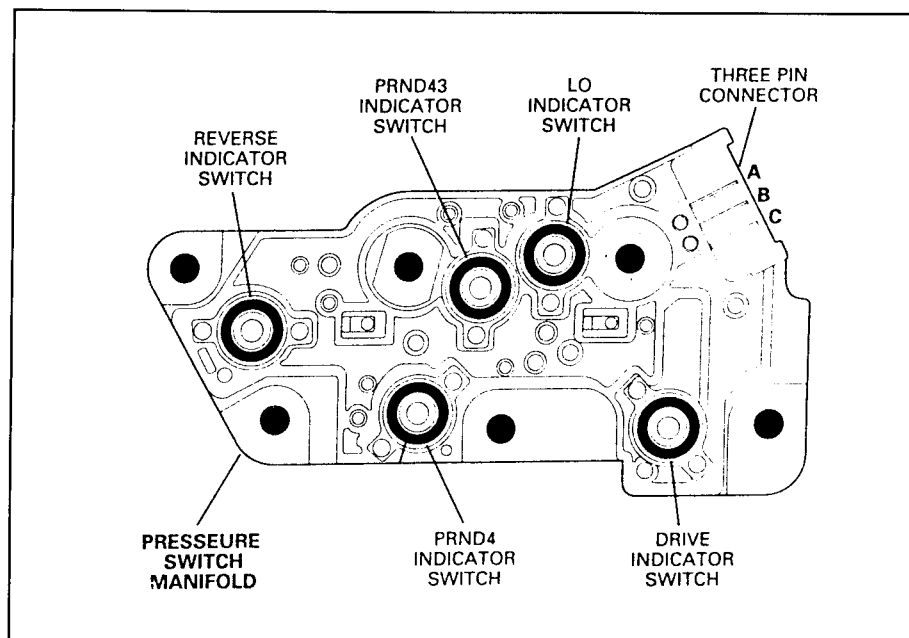
Neutral Safety Switch CONNECTING SWITCH



This is actually a simple connecting switch. It connects one lead, either voltage or ground to another lead. The other lead may have several contacts that are selected as the shift lever is moved. For example, you may have one voltage lead and six other leads. These other leads can be labeled P R N D 2 1. As the shift lever is moved, voltage is applied to ONE of the six other leads. If the computer 'sees' voltage on the first one, the shifter is in Park. If the computer 'sees' voltage on the last one, the shifter is in Low.

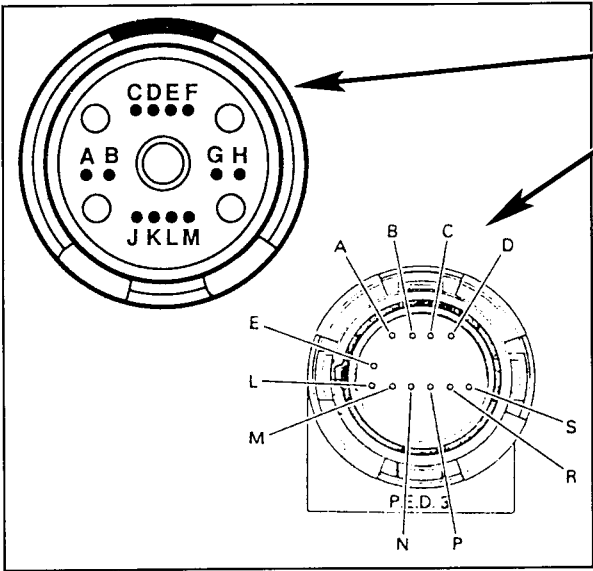
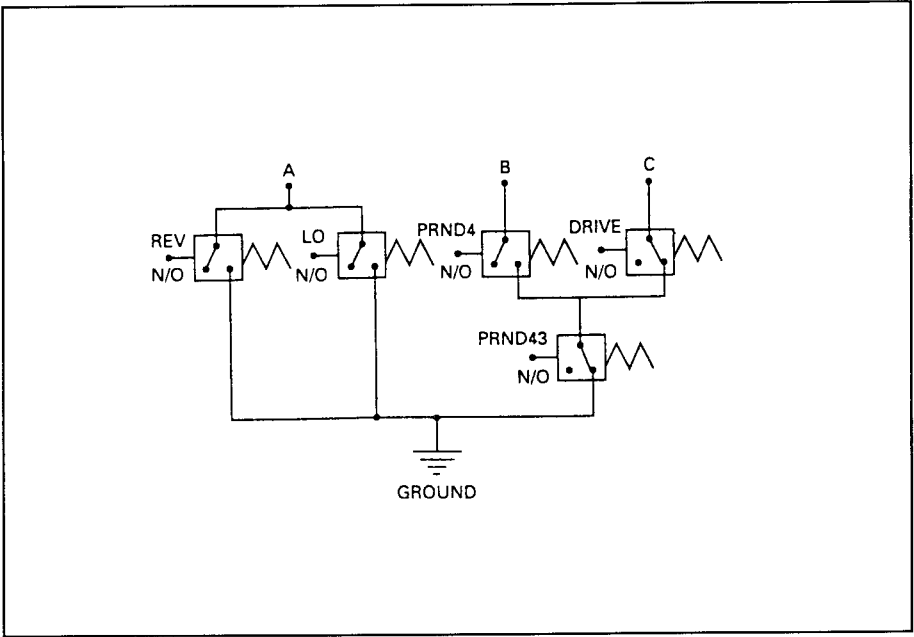


Pressure Switch Manifold GROUNDING SWITCH



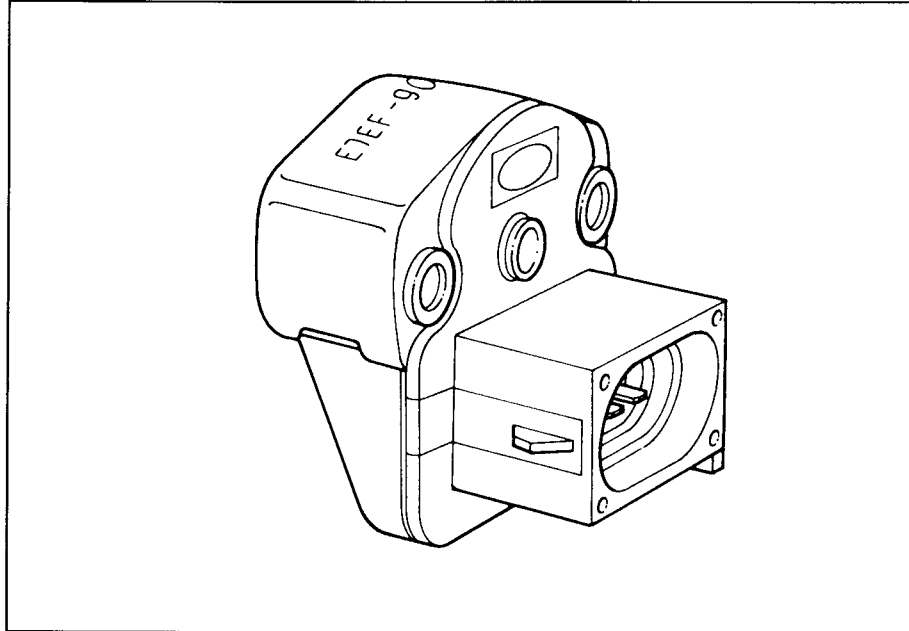
The Pressure Switch Manifold (PSM) is a multiple switch assembly containing five normally open (N.O.) pressure switches. Various fluid pressures are fed from the manual valve to the switches depending on manual valve positioning. These fluid pressures determine the digital logic at the electrical pins (A, B and C) of the PSM's three pin connector. This logic is used by the computer to determine what gear range (PRND321) the transmission is operating in. The electrical schematic and chart on the next page show the circuitry and logic used at the PSM and electrical connector to signal the computer as to which range the manual valve is in.

Pressure Switch Manifold



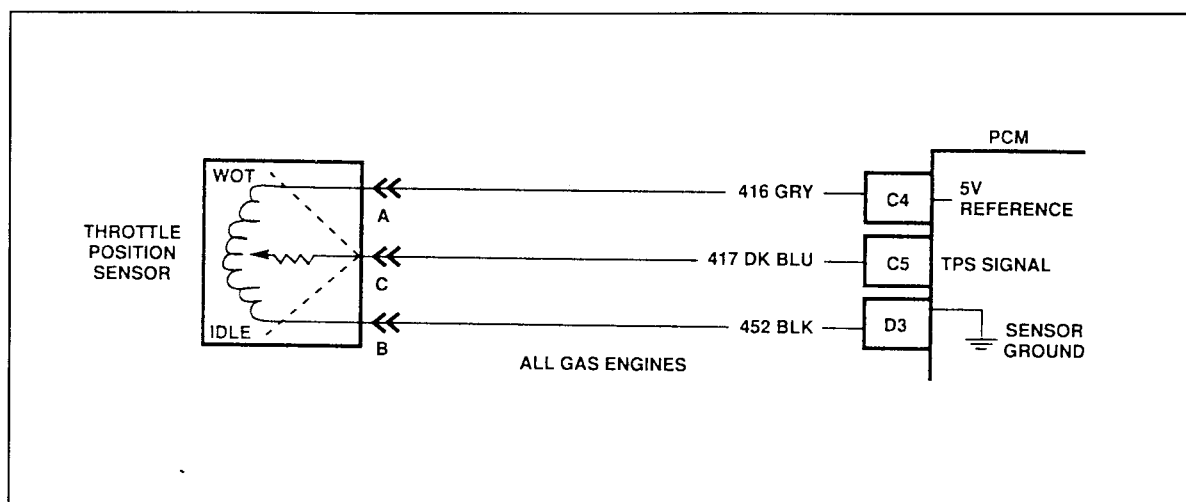
EARLY	D	E	F
LATE	N	R	P
at PSM	A	B	C
P	12	0	12
R	0	0	12
N	12	0	12
OD	12	0	0
3	12	12	0
2	12	12	12
1	0	12	12

Throttle Position Sensor THREE WIRE VARIABLE RESISTOR

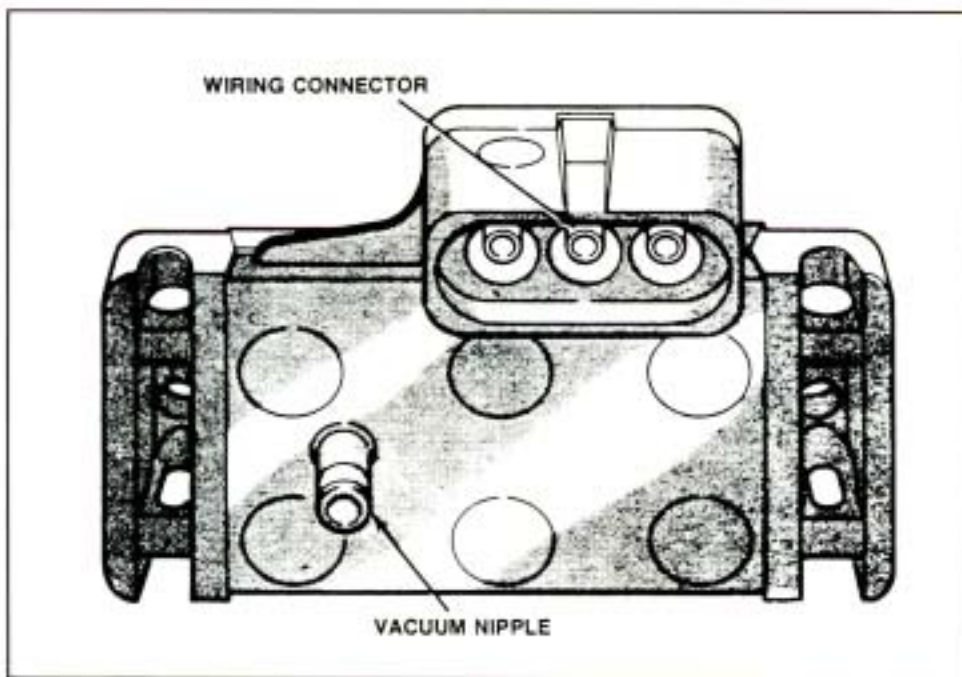


The Throttle Position Sensor (TPS) is a potentiometer mounted on the throttle body. The TPS detects the position of the throttle plate and sends this information to the computer as a varying voltage signal.

If a malfunction occurs in the TPS circuit, the computer will recognize that the TPS sensor signal is out of specification. The computer may then operate the transmission in a high capacity mode to prevent transmission damage.



Manifold Absolute Pressure Sensor THREE WIRE VARIABLE RESISTOR



The Manifold Absolute Pressure (MAP) sensor measures changes in the intake manifold pressure which result from engine load and speed changes, and converts this to a voltage output.

A closed throttle on engine coastdown would produce a relatively low MAP output, while wide open throttle would produce a high output. This high output is produced because the pressure inside the manifold is the same as outside the manifold. Manifold Absolute Pressure (MAP) is the OPPOSITE of what you would measure on a vacuum gauge. When manifold pressure is high, vacuum is low.

The computer applies a 5-volt reference signal to the MAP sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes. By monitoring the sensor's output voltage, the computer can determine the level of manifold pressure. A higher pressure, (high voltage) requires more fuel, while a lower pressure, (low voltage) requires less fuel.

The computer uses the MAP sensor to control fuel delivery and ignition timing.

Manifold Absolute Pressure Sensor

DIFFERENTIAL PRESSURE SENSOR

The Vacuum Sensor (VS) is similar in appearance to MAP and Baro sensors. However, it operates just the opposite of a MAP sensor in that it measures the difference between the manifold vacuum and atmospheric pressure. The output of the sensor increases as vacuum increases. The voltage will be low (below 2 volts), with the ignition "ON" and the engine stopped, and high (3-5 volts) with the engine idling or under a light load.

BARO SENSOR

The Barometric Pressure (BARO) sensor works like the MAP sensor, except that instead of measuring engine manifold vacuum, it is open to the outside air so it can measure barometric pressure. This allows it to give the computer information on altitude. The computer can then adjust fuel delivery and ignition timing for improved driveability at high altitudes.

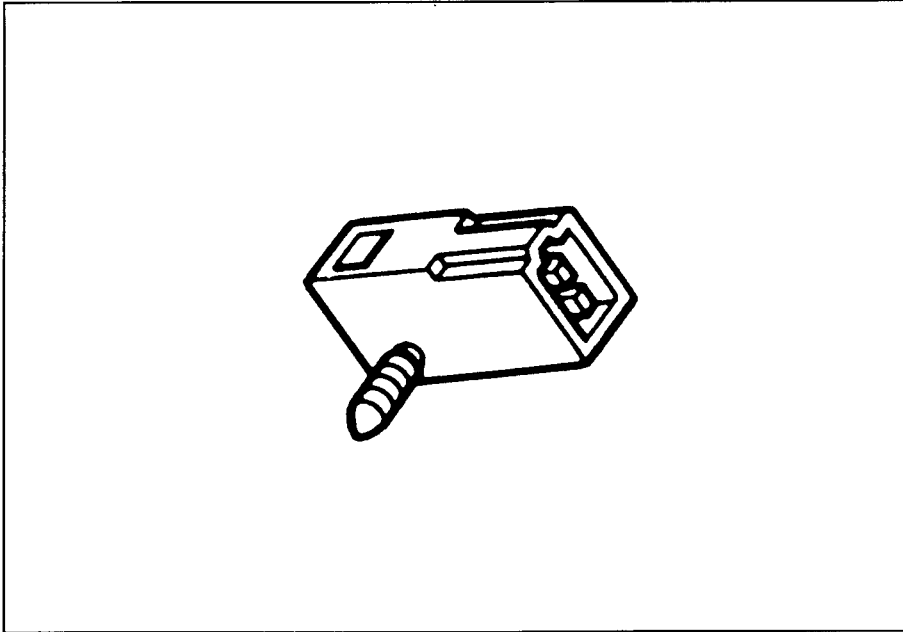
The BARO sensor looks like the MAP sensor but is usually located inside the vehicle, under the instrument panel.

FORD MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

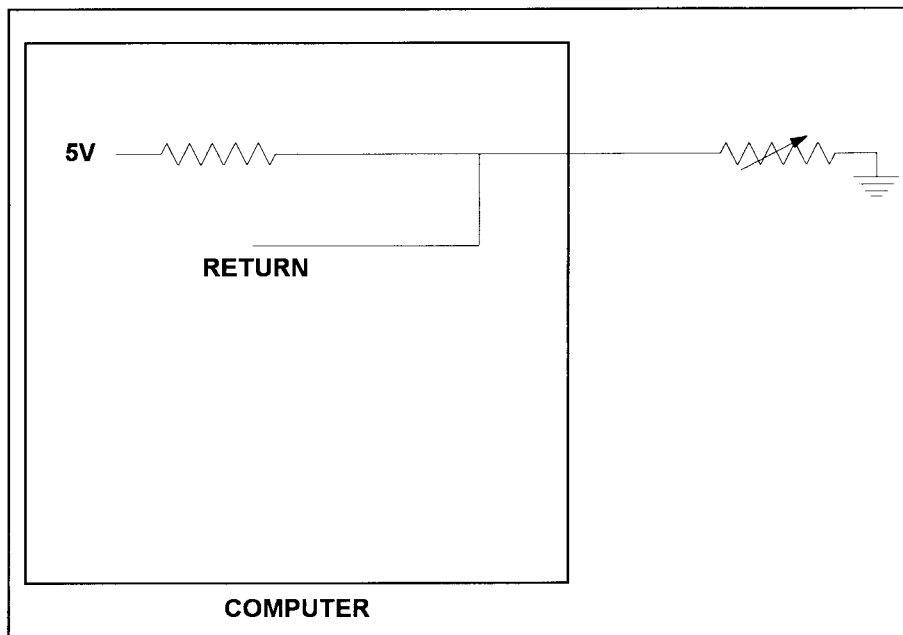
The Ford MAP sensor performs the same job as the GM MAP sensor discussed earlier. It also has 3 wires: VRef, Signal Return, and Ground. An important difference is that the signal return wire is NOT a variable voltage rather it is a variable Frequency. The following chart lists the approximate frequencies and their corresponding vacuum.

FREQUENCY IN HZ	VACUUM IN INCHES
160	0"
145	5"
130	10"
115	15"
100	20"

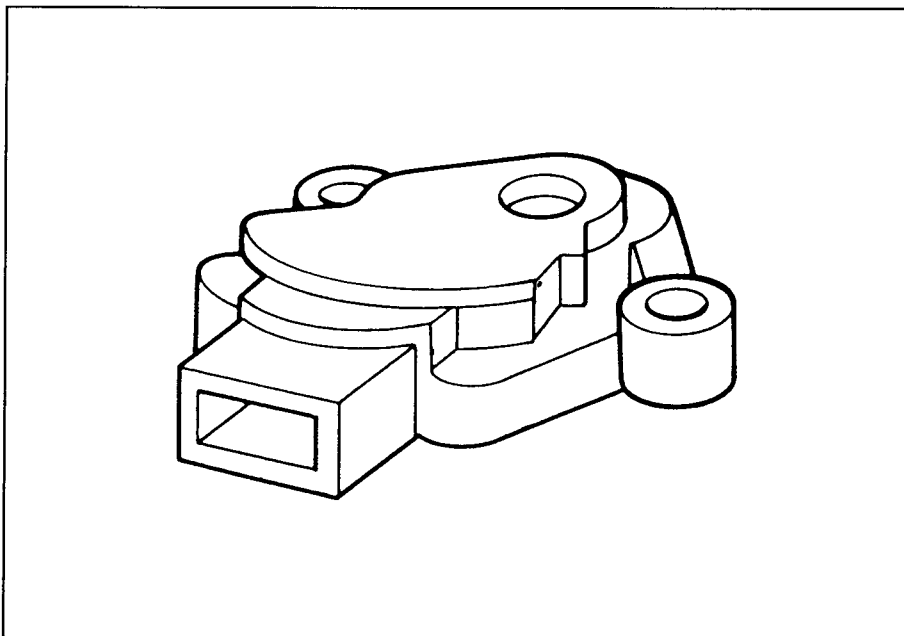
Transmission Oil Temperature Sensor TWO WIRE VARIABLE RESISTOR



The Transmission Oil Temperature (TOT) sensor is located within the transmission. It is a temperature-sensitive device called a thermistor. The resistance value of the TOT will vary with temperature change. The computer monitors the voltage across the TOT to determine the temperature of the transmission oil.

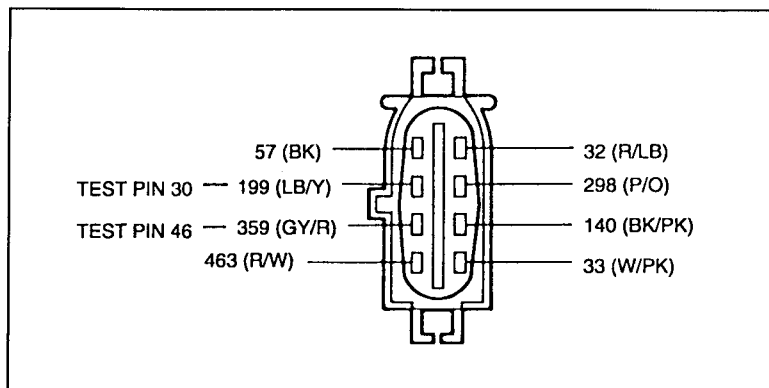


Ford Manual Lever Position Sensor SERIES RESISTORS



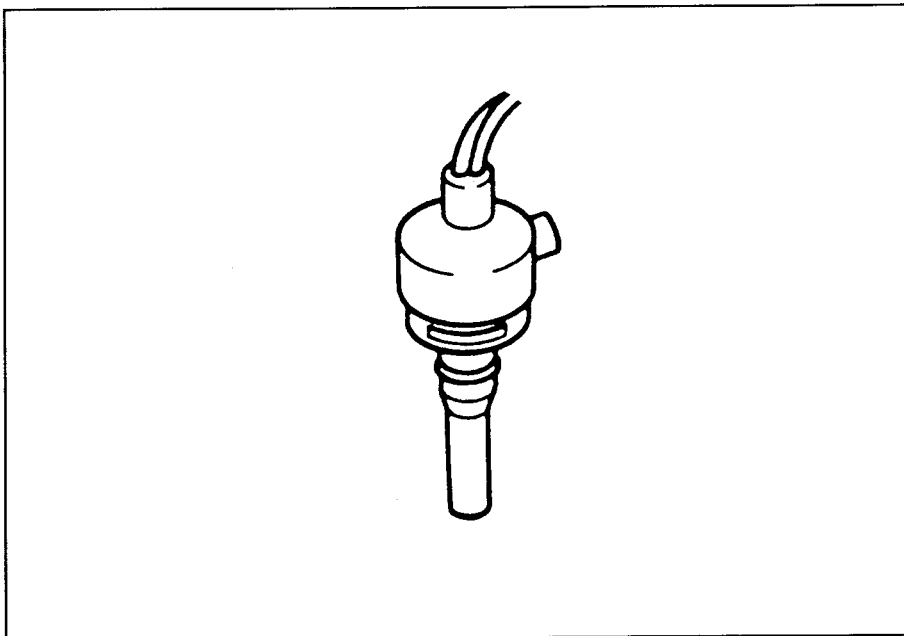
The computer sends a voltage signal to the Manual Lever Position Sensor (MLPS). The MLPS incorporates a series of step-down resistors which act as a voltage divider. The computer monitors this voltage which corresponds to the position of the manual lever (P, R, N, OD, D, 1). The MLPS is located on the outside of the transmission at the manual lever.

L	.7
* 2	1.4
* D	2.1
N	2.8
R	3.6
P	4.4

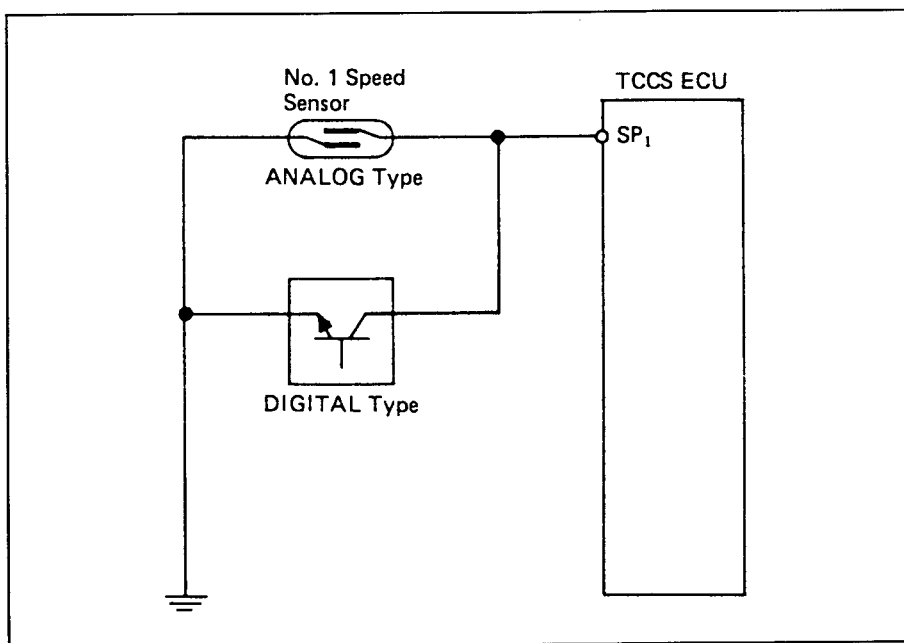


* Some models will use 'OD' and 'D', 'D' and '3' or 'D' and '2'. The voltage values for these positions are the same as those shown in the chart.

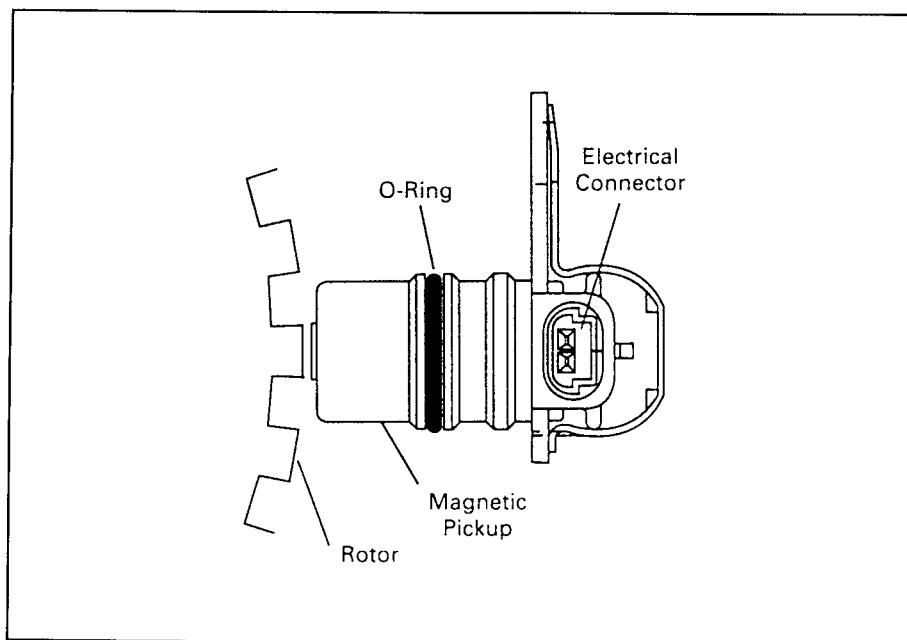
Vehicle Speed Sensor REED TYPE SWITCH



This is a simple connecting switch similar to a set of ignition points. A magnet, which is mounted on the output shaft will spin as the output shaft spins. As it passes the switch it pulls the points closed. The computer counts how many times the points open and close within a certain period of time and calculates the vehicle speed.



Voltage Generators SPEED SENSORS

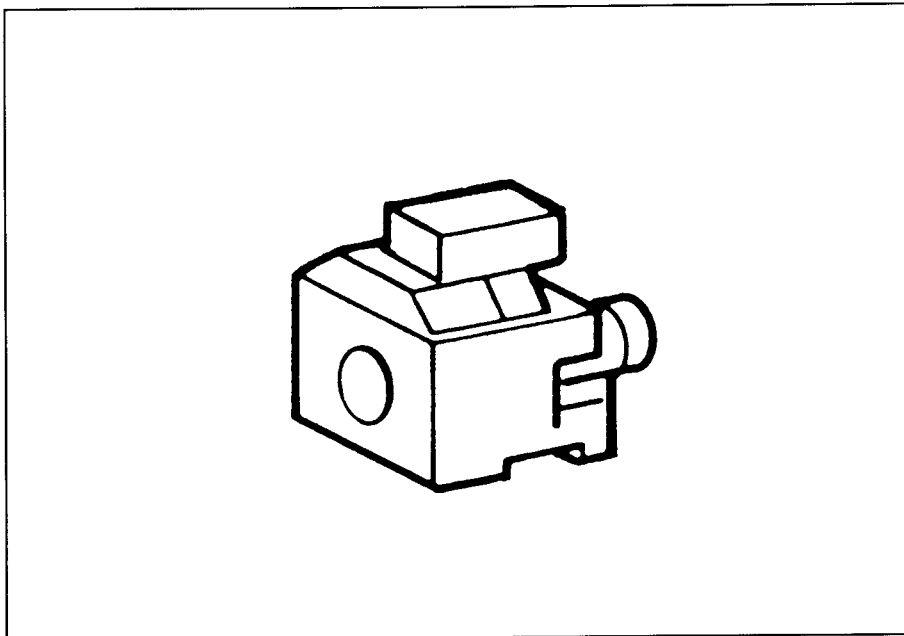


TRANSMISSION OUTPUT SPEED SENSOR

The output speed sensor is a variable reluctance magnetic pickup located in the rear of the transmission case. It consists of a permanent magnet surrounded by a coil of wire. As the speed sensor ring rotates, an alternating current (AC) is induced in the coil from the "teeth" on the sensor ring passing by the magnetic pickup. The output speed sensor produces an AC voltage signal proportional to vehicle speed. This signal is sent to the computer. At the computer, the AC signal is electronically conditioned to a 5 volt square wave form. The square wave form can then be interpreted as transmission output speed based on the number of square waves within a given time frame. The square waves can be thought of as the speed sensor ring teeth. Therefore, the more teeth (or waves) that pass by the magnetic pickup within a given time frame, the faster the vehicle is moving. The square wave form is compared to a fixed clock signal internally within the computer to determine transmission output speed.

Shift Solenoids

ON/OFF SOLENOIDS



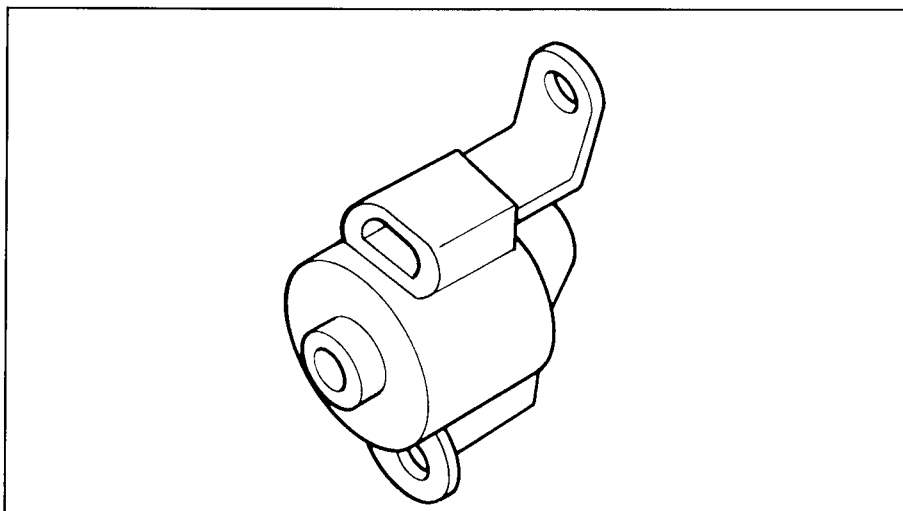
These solenoids may be normally open or normally closed. They either trap or bleed an oil pressure that is acting on a valve to make the valve move.

AXOD-E Solenoid Chart

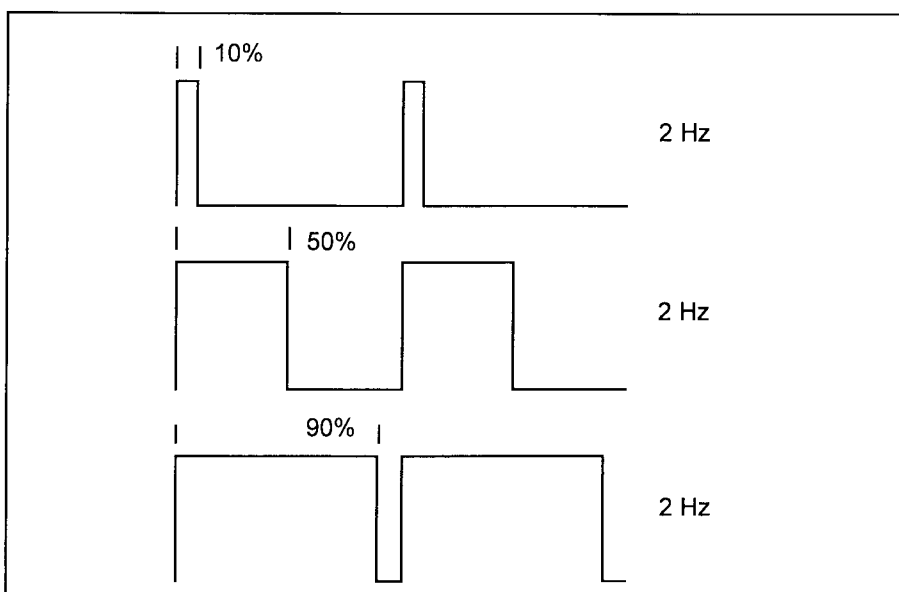
	SS1	SS2	SS3
1st		●	
2nd	●	●	*
3rd			●
4th	●		●

* Momentarily on during a 3-2 kickdown.

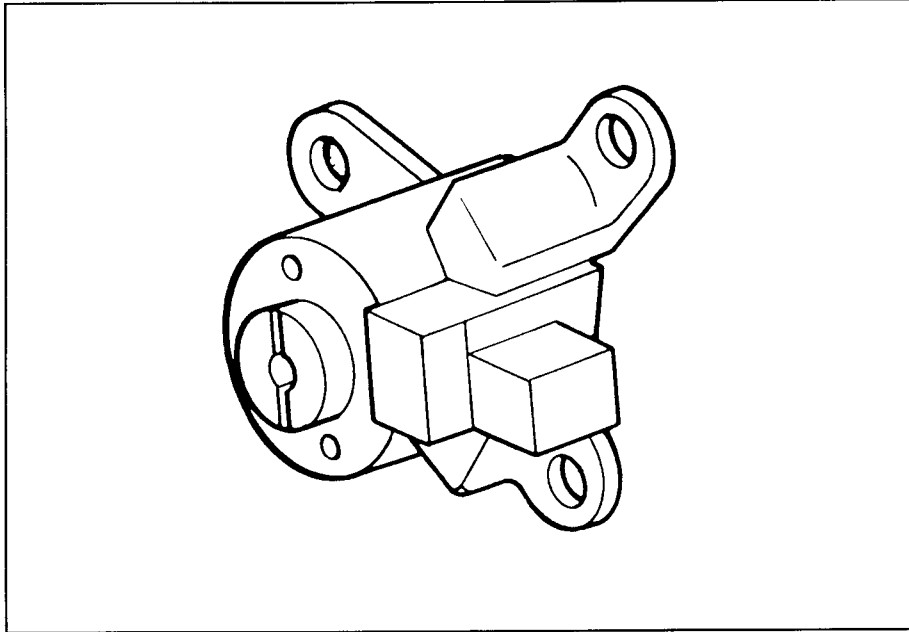
Lock-Up Solenoid PULSE WIDTH MODULATED



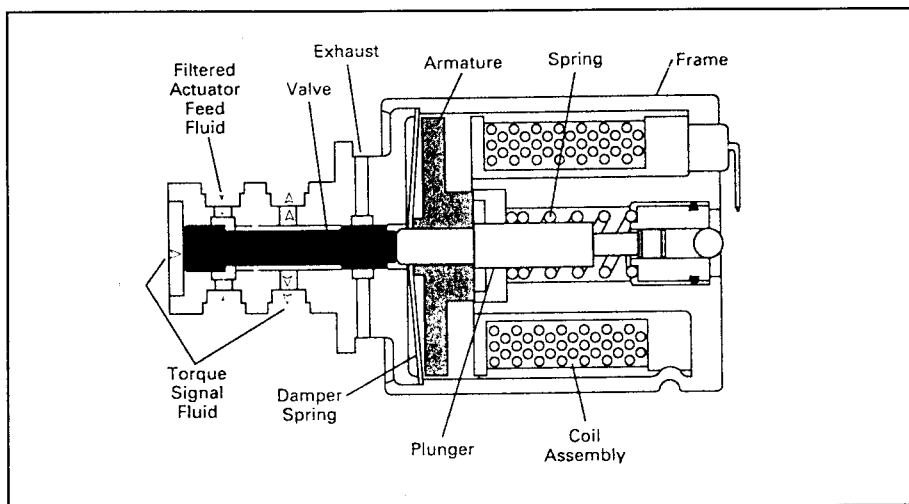
A Pulse Width Modulated Solenoid (PWM) opens or closes a passage to either exhaust or trap pressure within a given circuit. A PWM solenoid usually operates at a fixed frequency. In other words it pulses the same number of times per second whether it's raising or lowering pressure. Each pulse consists of an "ON" time and an "OFF" time. If the ON/OFF times are equal or 50/50 then the solenoid is operating at a 50% duty cycle. If the ON time is more than the OFF time then the percentage of duty cycle is higher, like 70% for example. By changing the duty cycle or pulse width it will change how often the solenoid opens the passage thereby controlling the pressure within that circuit. PWM solenoids are often used in import vehicles for main line pressure control. Domestic vehicles will usually have them to control the apply rate of the torque converter clutch.



Electronic Pressure Control Solenoid FORCE MOTOR



The Electronic Pressure Control solenoid (EPC) or force motor regulates EPC pressure. EPC pressure is used to control line pressure on many domestic vehicles. Think of a variable force solenoid as an electronic modulator. A modulator puts a variable force on a valve to control the valve's position which in turn controls pressure. The variable force solenoid does exactly the same thing. The computer sends a variable current to the solenoid. Since the current varies, the electromagnetic field in the solenoid also varies. It's this varying magnetic field that allows the solenoid to exert a variable force on a valve.



FORD FORD

Ford

FORD

FORD

FORD

Ford

Ford

Ford

FORD

Ford

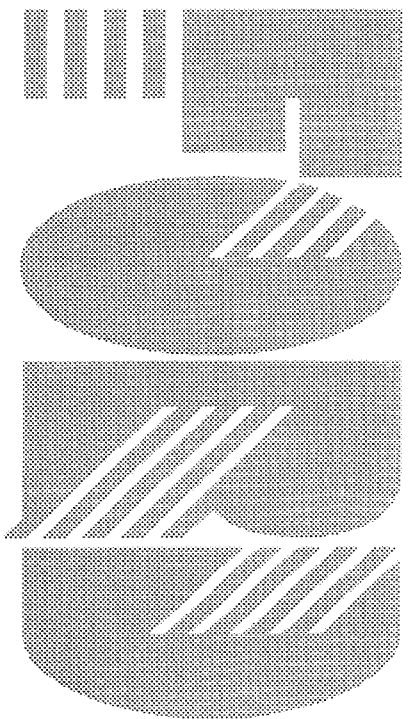
FORD

FORD

Ford

Ford

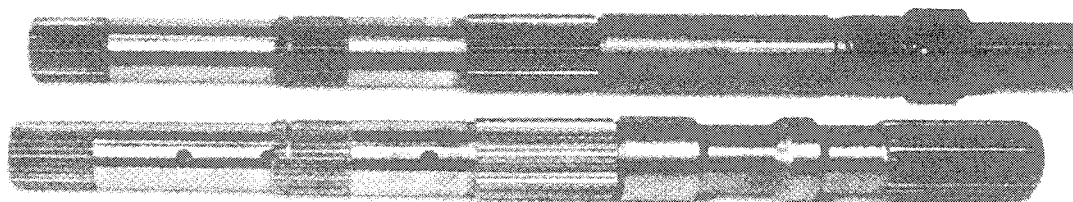
Ford



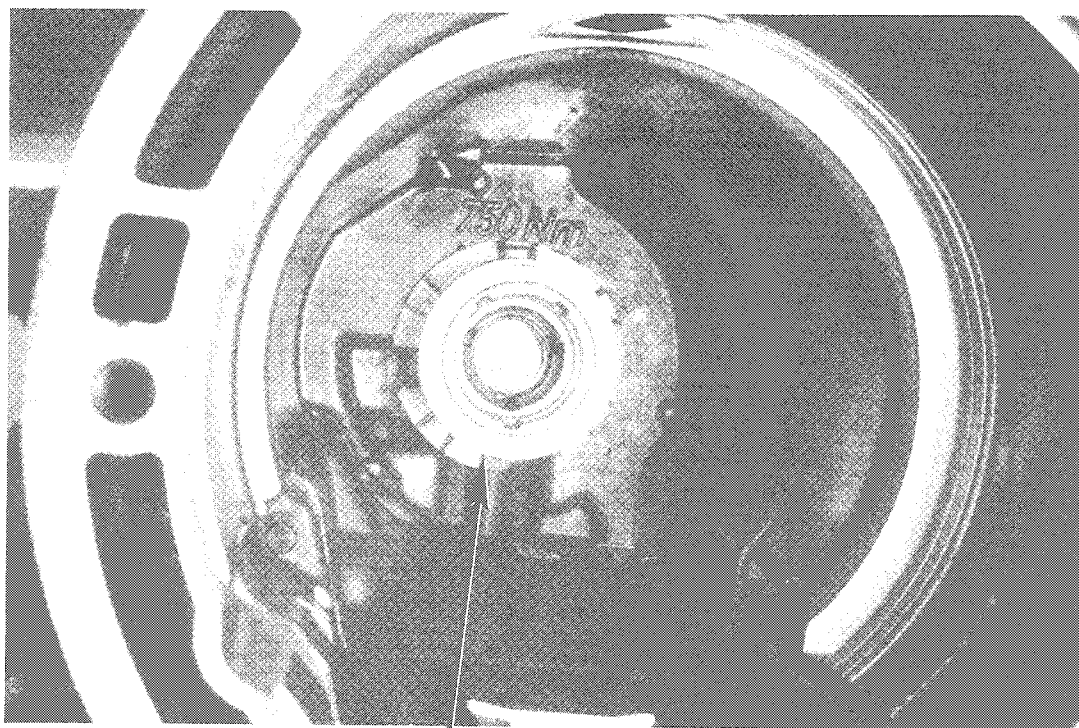
Notes

A4LD 4.0L Engine

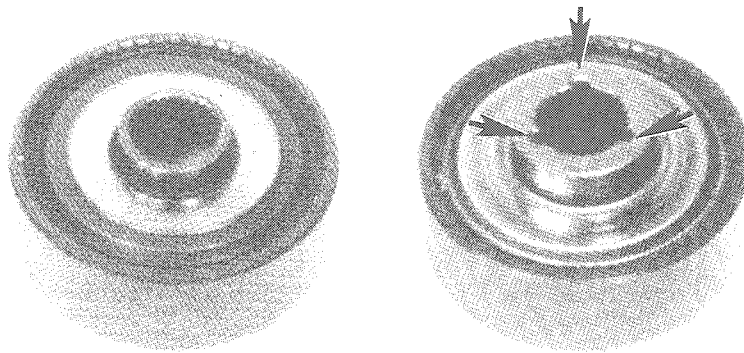
The A4LD was used with the 4.0L engine beginning in 1989. There were many changes made for durability reasons. One of the most significant changes was the use of a solid output-shaft. Because there are no lube holes, the entire rear lube circuit had to be altered. Many of the changes in the geartrain and case were made for this reason.



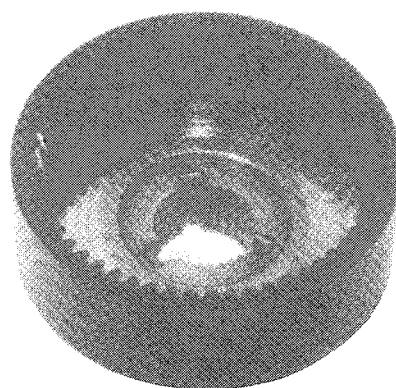
Ford



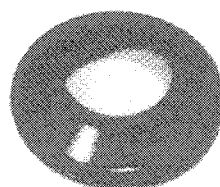
THE 4.0 LITER
CASE HAS A
WASHER BEHIND
THE RACE.



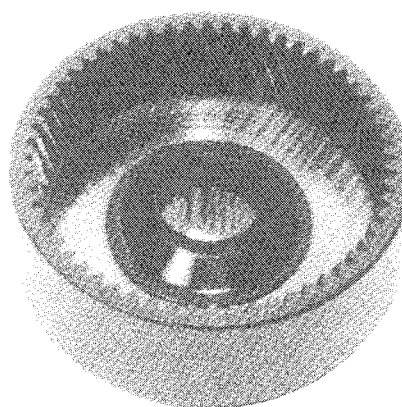
THE 4.0 LITER
RING GEAR HAS
THREE NOTCHES

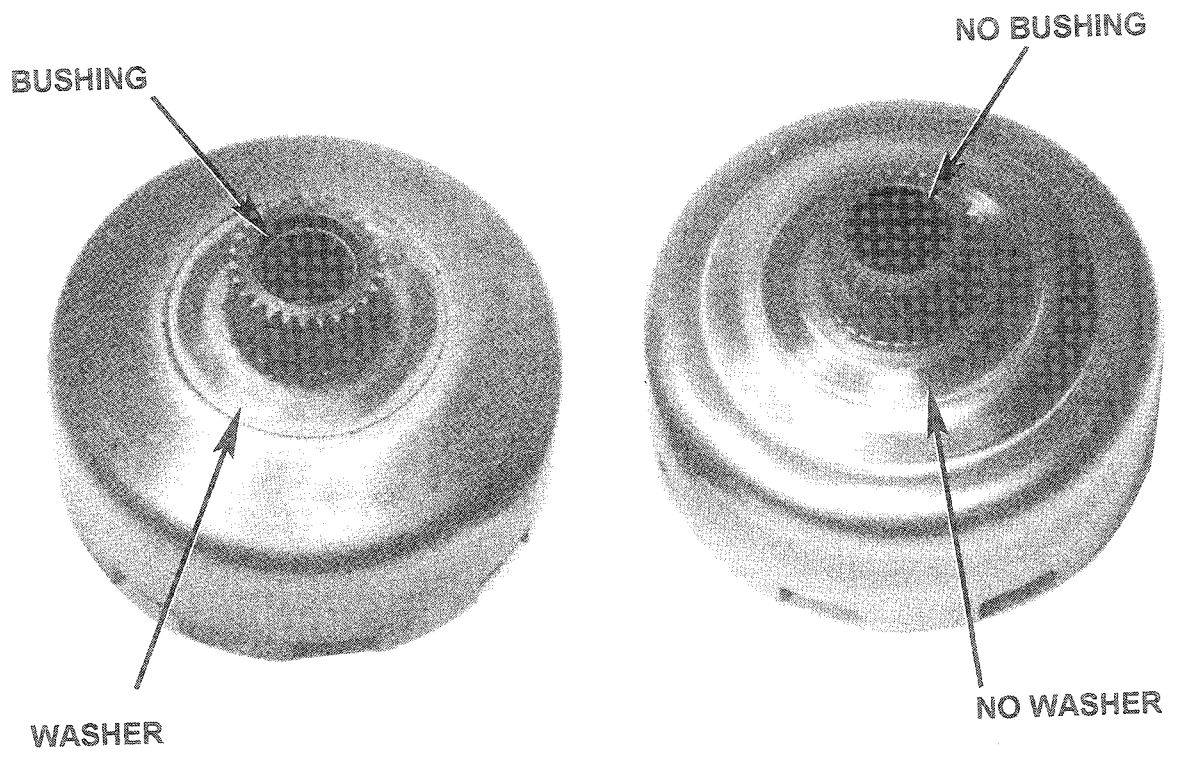


THE OIL SLEEVE FITS
BETWEEN THE RING
GEAR AND SUN GEAR
OIL SLEEVE PART
#F0TZ-7B176-A



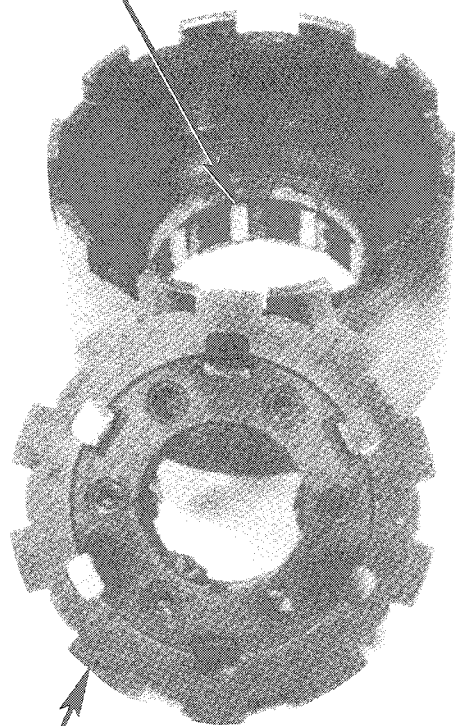
OIL SLEEVE





4.0 LITER

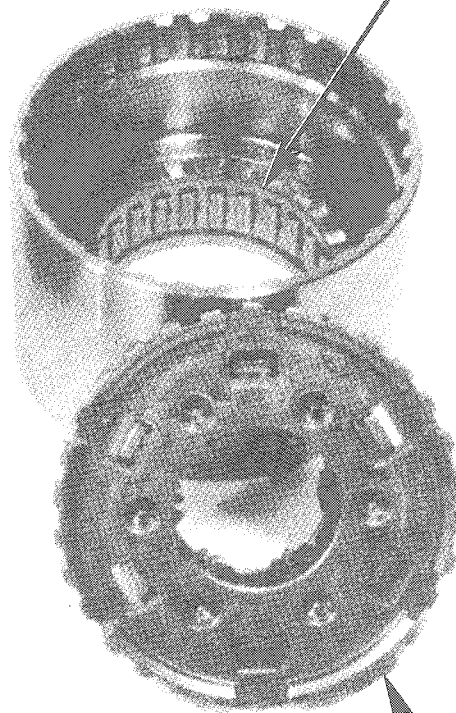
ROLLER CLUTCH



LUGS

THREE OR FOUR
PINIONS

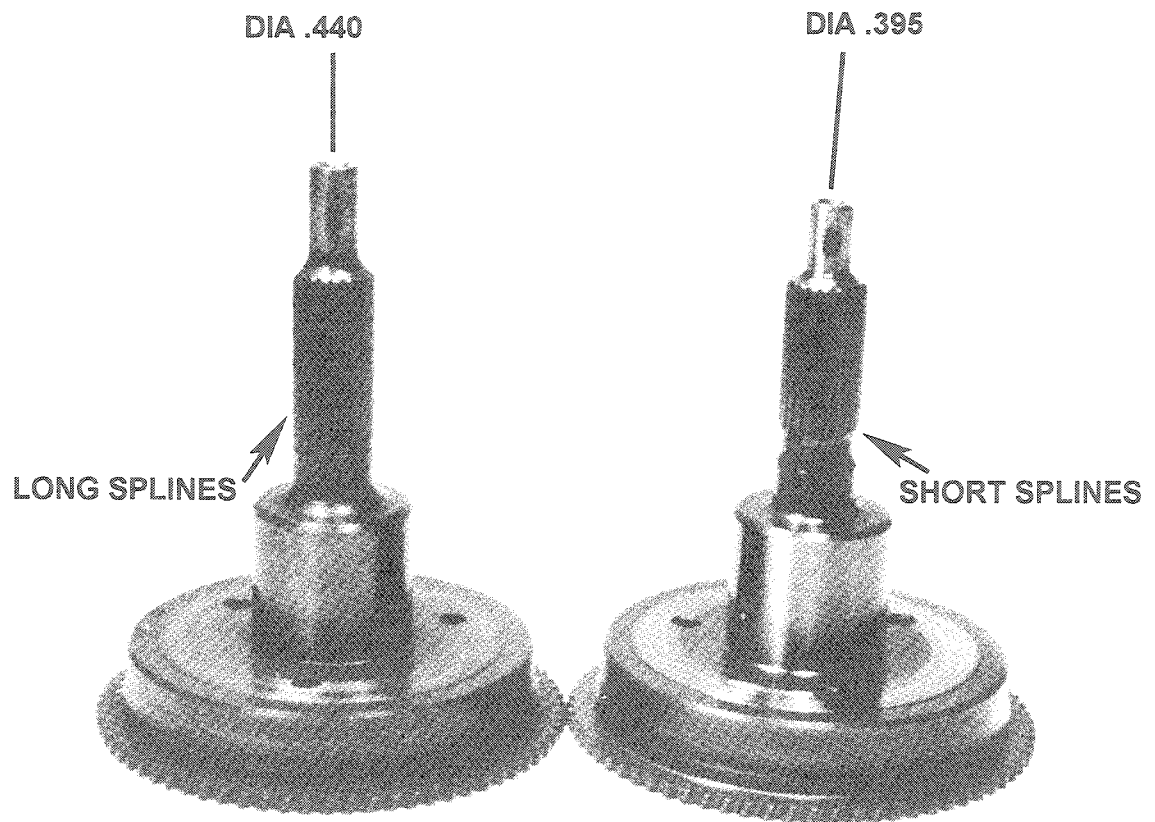
SPRAG



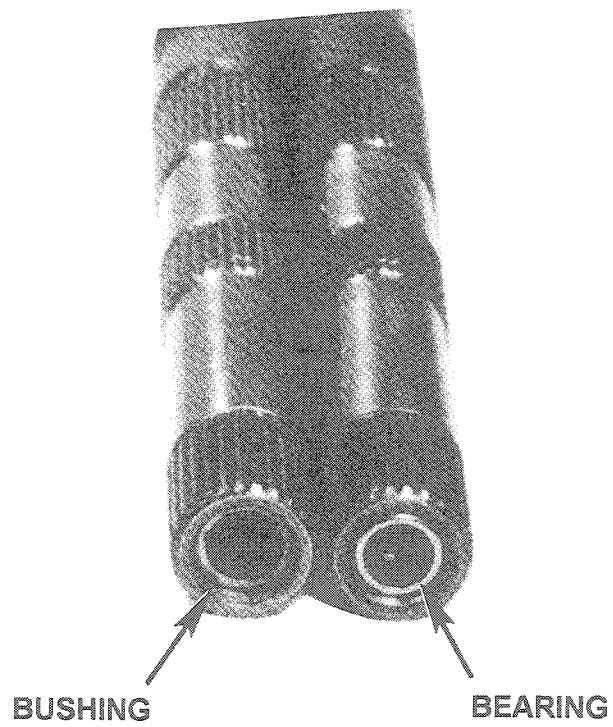
SPLINES

SIX PINIONS

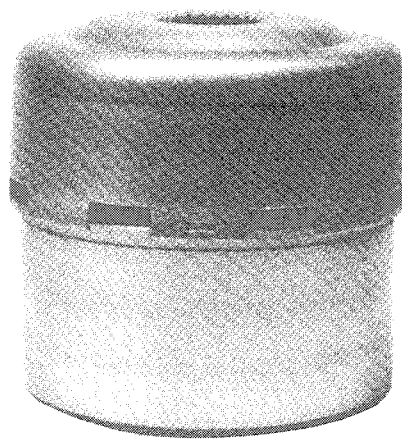
4.0 LITER



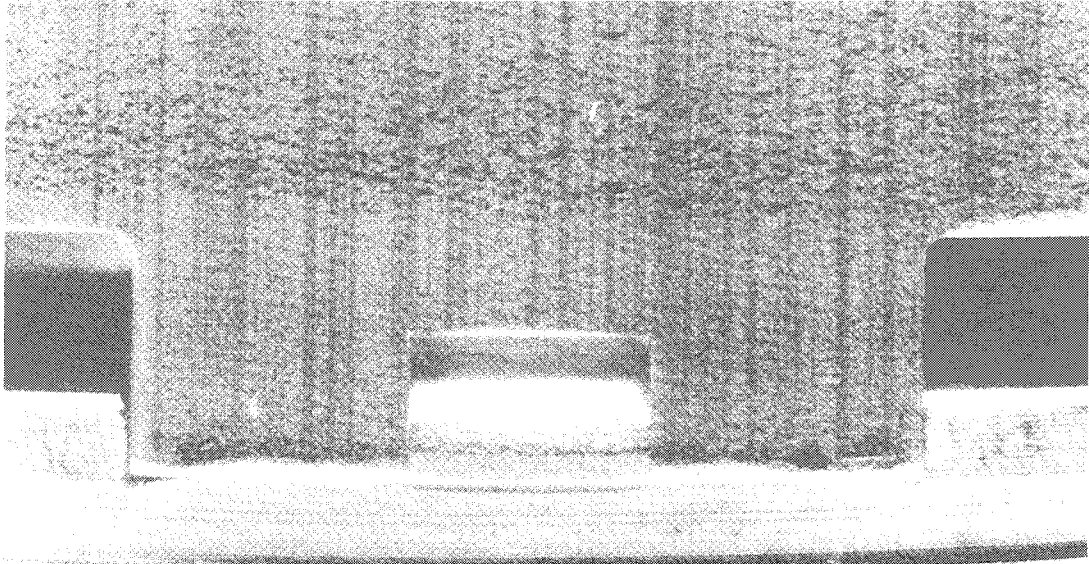
4.0 LITER



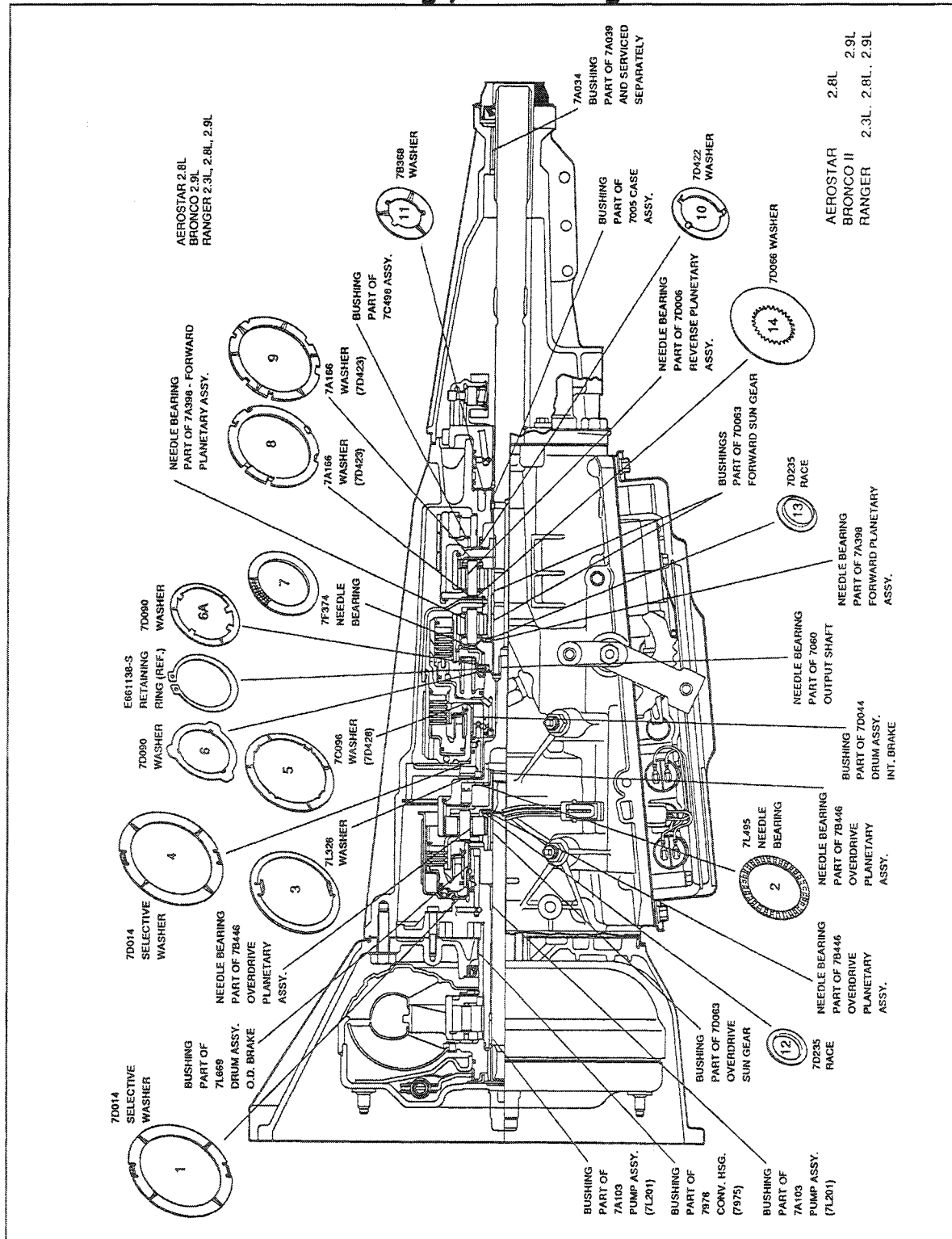
4.0 LITER

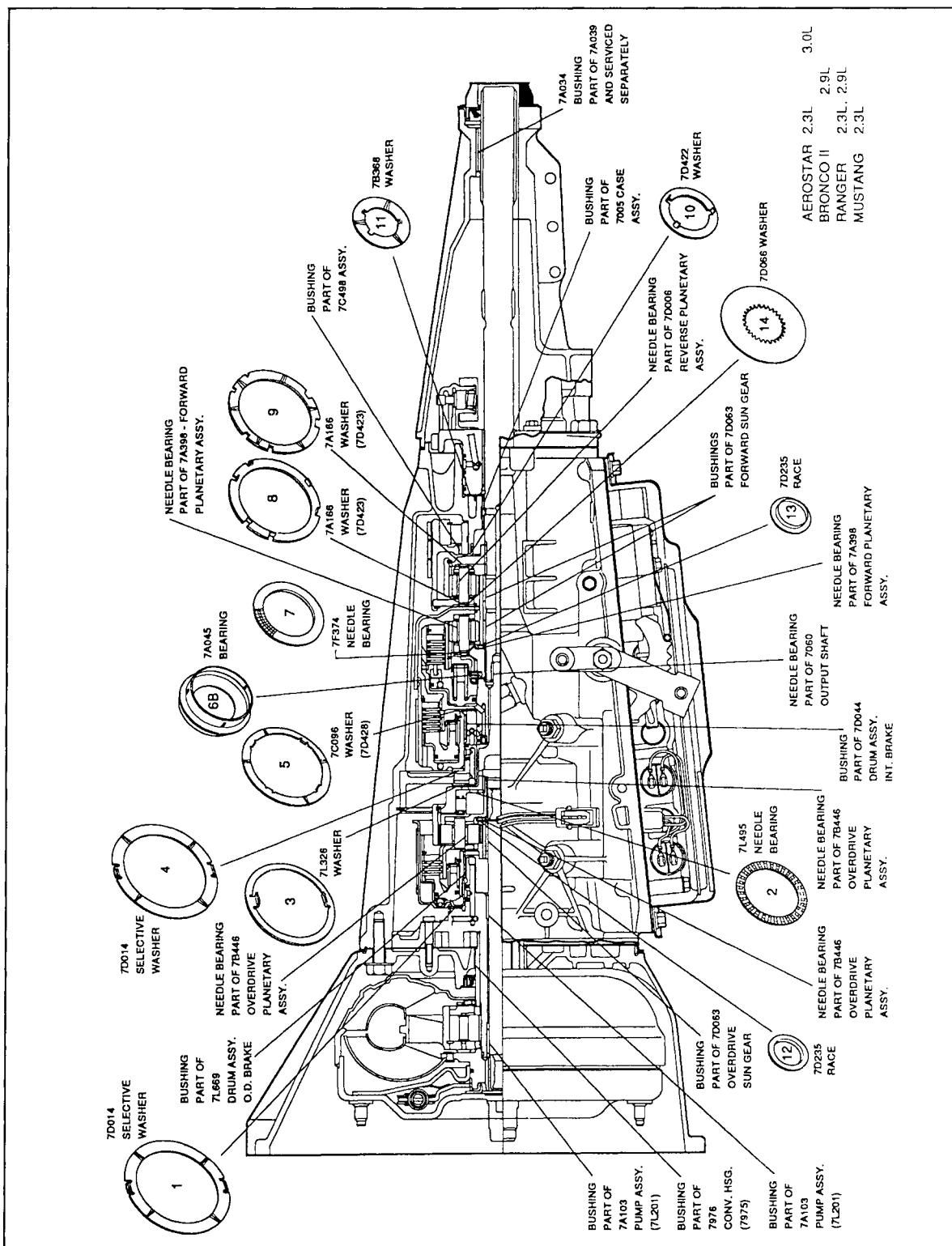


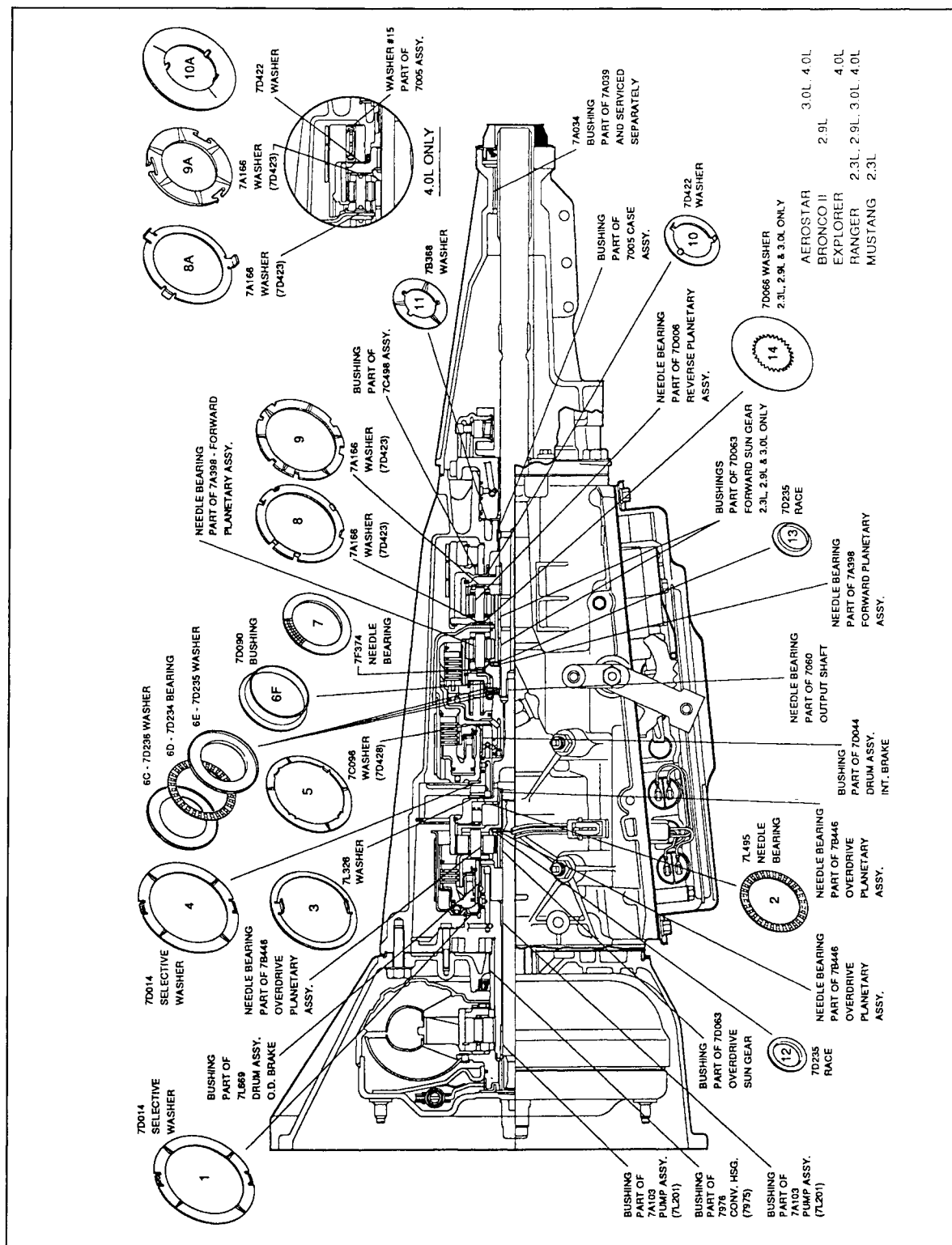
1993 'SNAP' SHELL

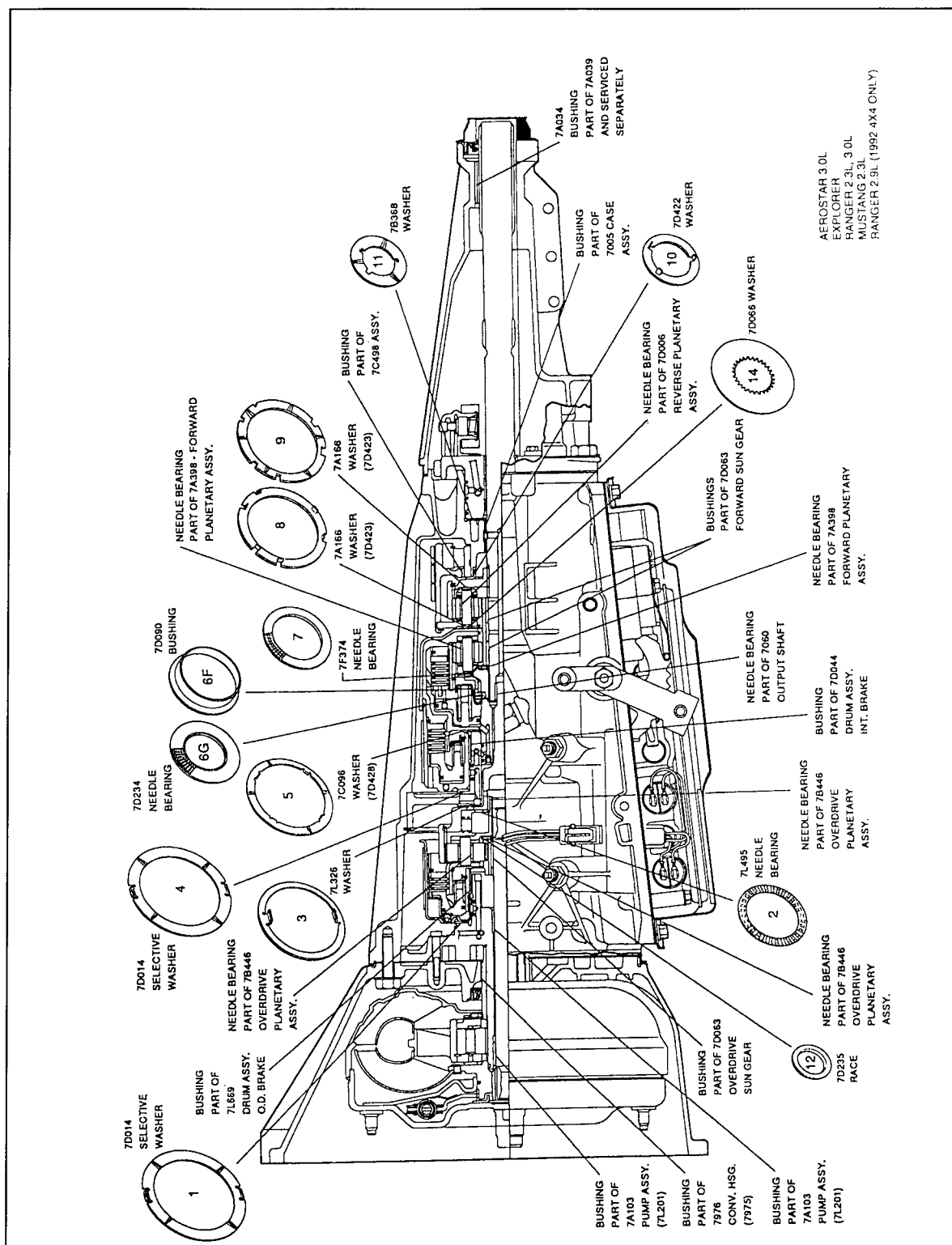


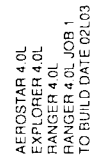
**THE SNAP
(WHEN FULLY ASSEMBLED)
WILL GRAB THIS LIP.**

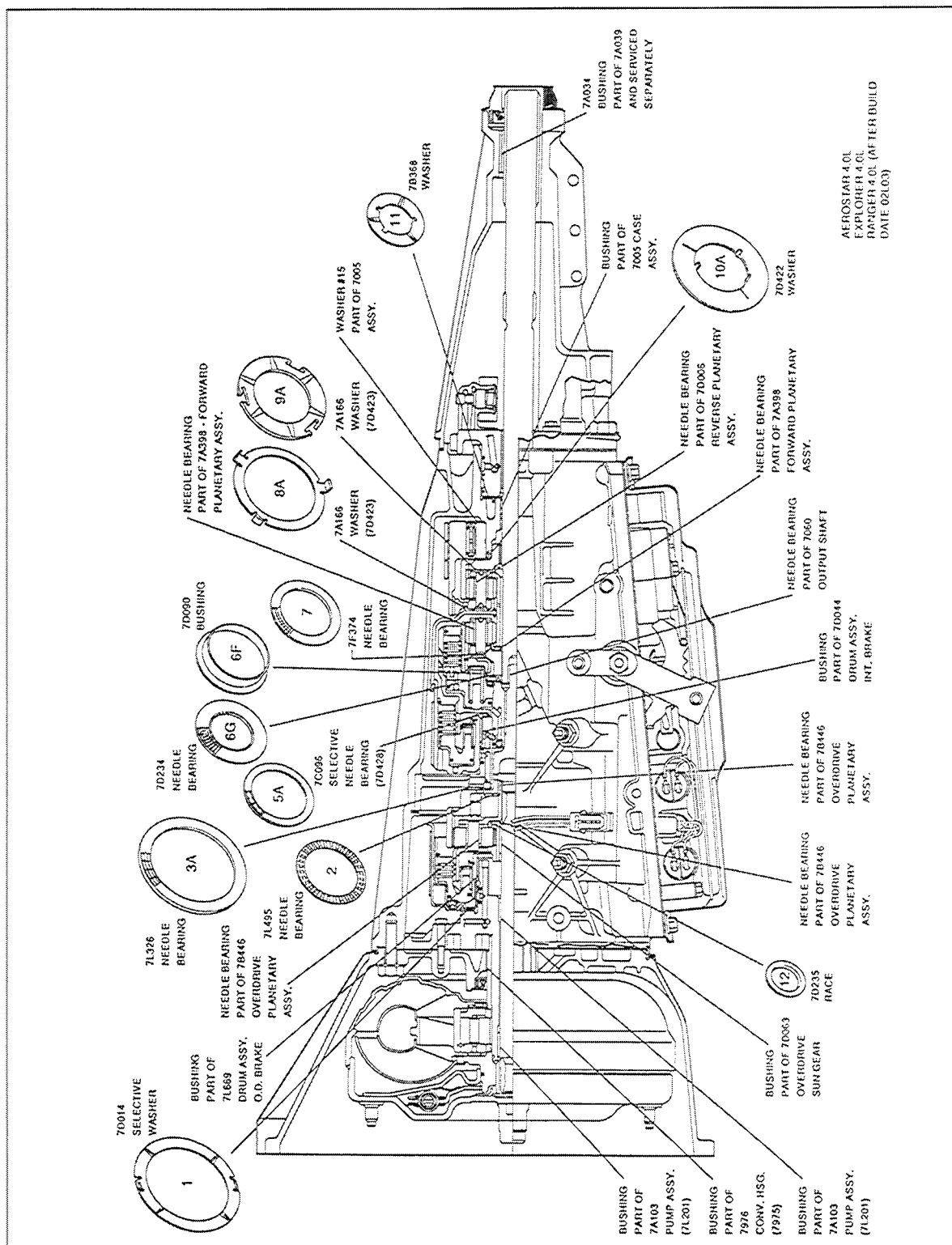








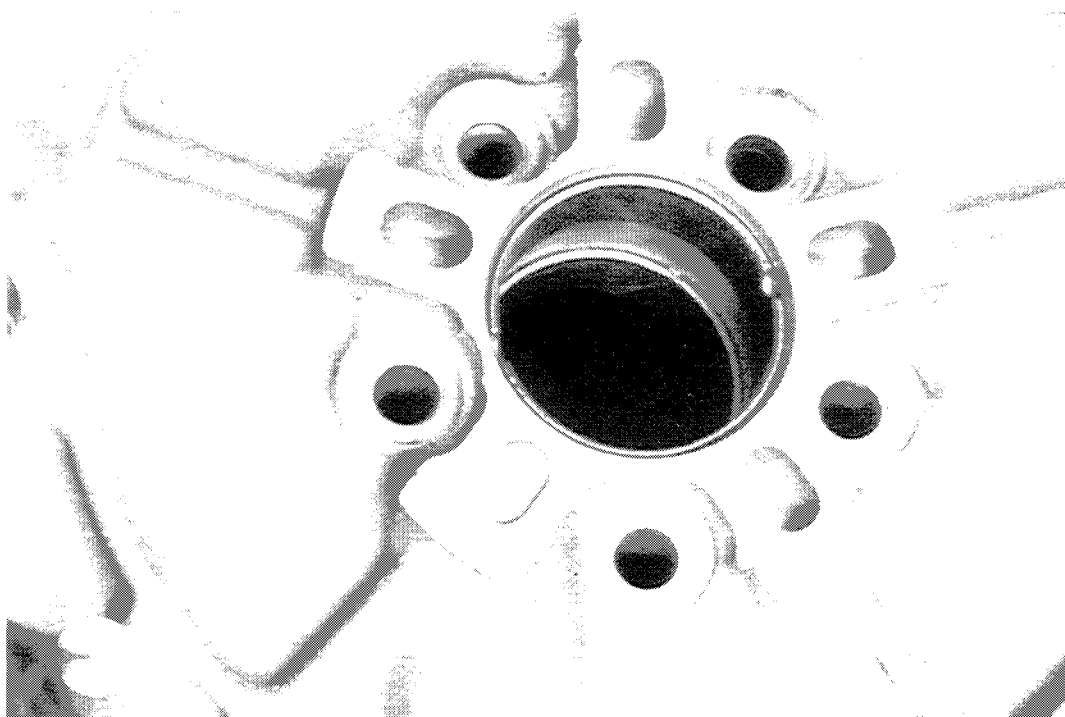




E4OD
Front Planet Failure
(Due to Lack of Lube)

There are several steps that should be taken to help minimize front planet failure.

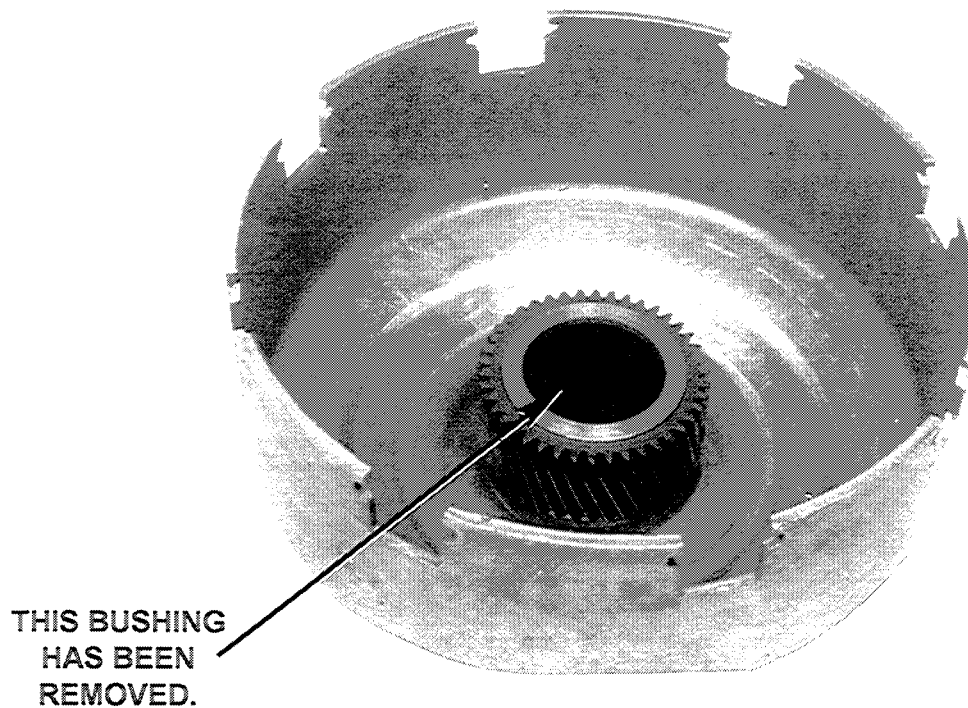
STEP 1 Replace the case bushings with the hardened set.



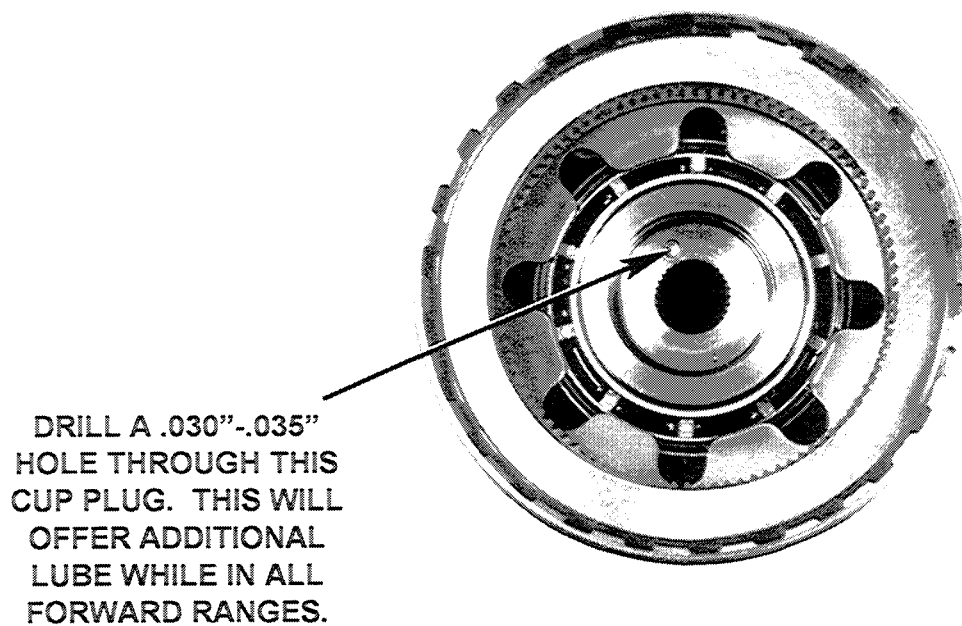
FRONT BUSHING (SLOTTED)	F2TZ-7025A
REAR BUSHING (SOLID)	F2TZ-7025B

MANY PARTS SUPPLIERS NOW HAVE THESE BUSHINGS.

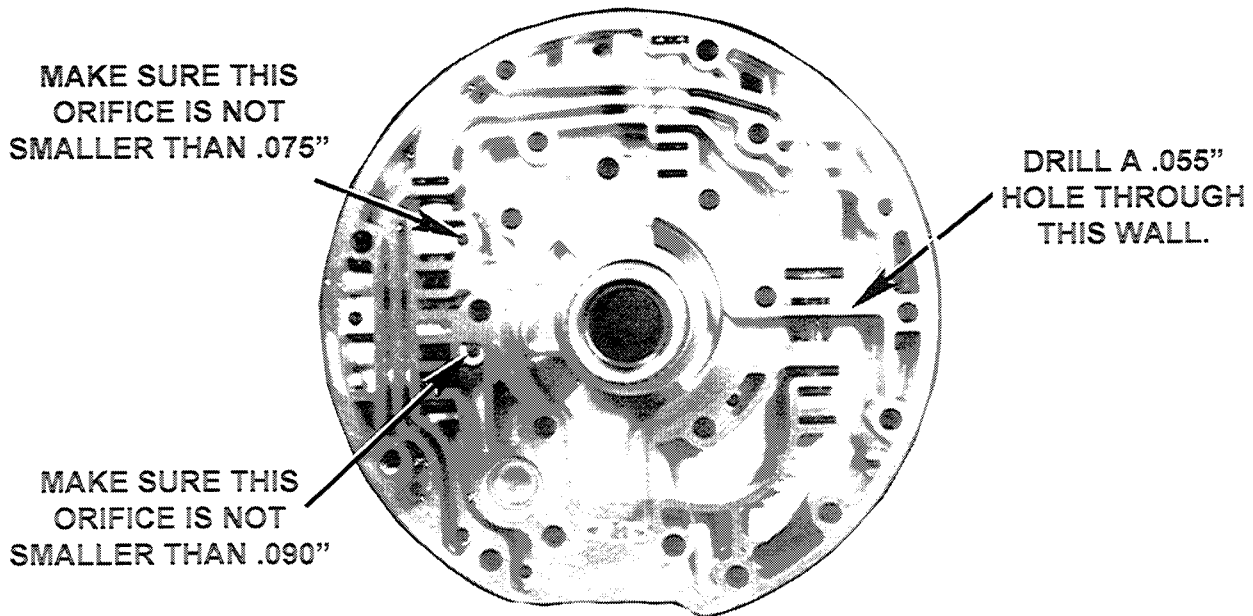
STEP 2 Remove the front bushing from the sun gear.



STEP 3 Add a lube feed to the forward clutch.



STEP 4 Modify the stator support by cross drilling.



STEP 5 Make sure the cooler is not restricted. Before the vehicle is delivered, cooler flow should be checked at the rear cooler line. There should be at least one quart in 20 seconds. If not, the cooler tank should be repaired. Keep in mind an in-line filter or cooler check valve that is installed 'backwards' will also cause low or no cooler flow.

E4OD Solenoid Harness Connector Problems

Improper installation of the solenoid harness connector can cause high line pressure, fourth gear starts, second gear starts in manual low, and no torque converter clutch engagement. The proper way to install the harness connector is shown in figure 1.

Figure 2 shows how the harness connector can be plugged in wrong and cause the problems stated earlier. The harness connector in figure 1 looks different than the one shown in figure 2. That's because: when the harness connector was removed from the solenoid body, a sleeve in the solenoid body was removed with the harness connector. It is now stuck to the harness connector. If the solenoid body is replaced, the harness connector won't fit properly.

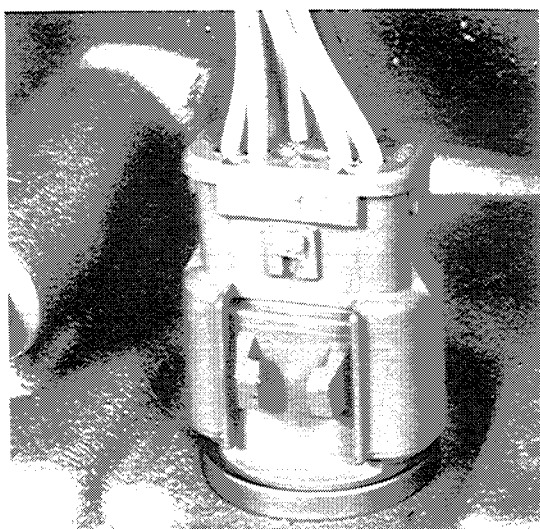


Figure 1

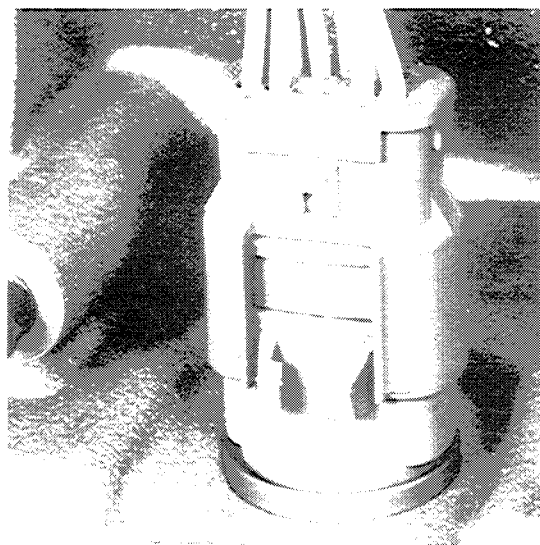


Figure 2

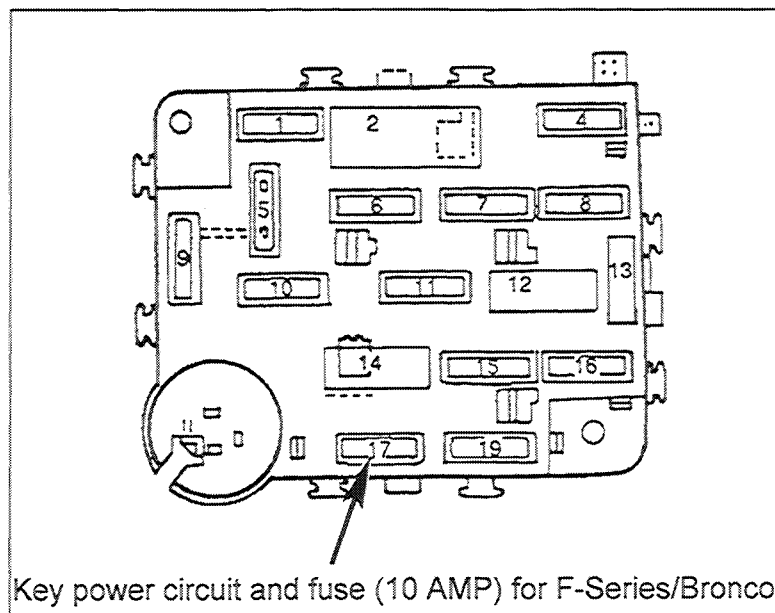
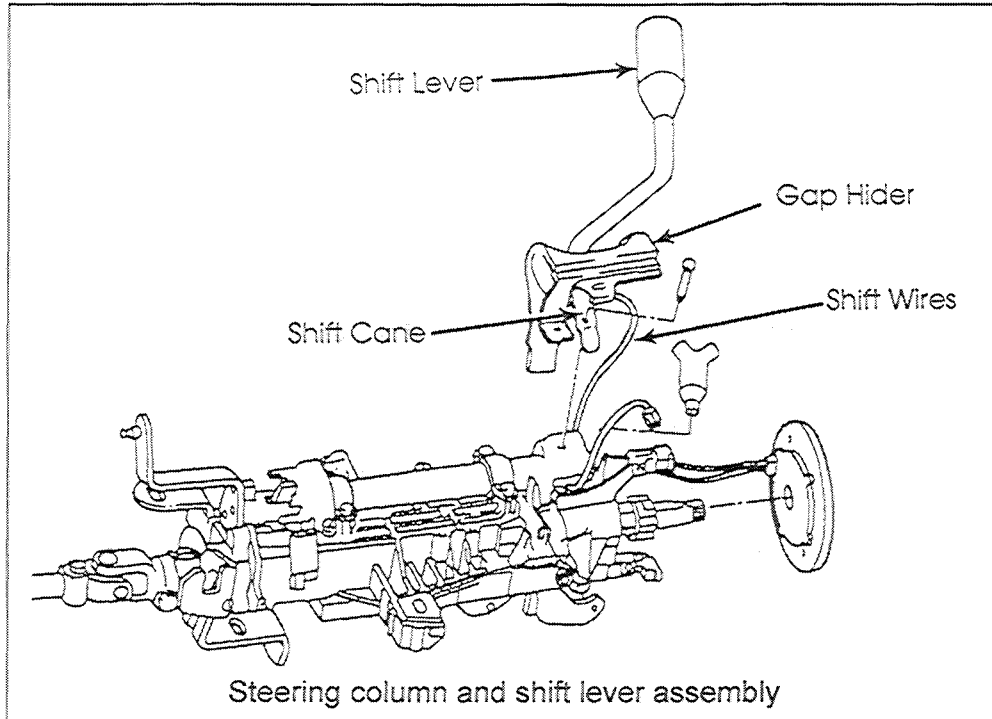
NOTE: If the harness connector lock is broken like the ones shown, it should be replaced. Many parts suppliers offer a repair kit for this.

E4OD

Stacked Shifts, No Kickdown, O/D Cancel Doesn't Work, Shift Hunting

All of these problems can be caused by a blown #17 fuse that feeds the O/D cancel button. The most common cause is a short in the wire that is located in the steering column. Through normal use, the wires leading to the 'O/D' cancel button can become worn and short to ground.

The wires should be repaired as necessary or the shifter lever assembly replaced. The part number for the shift lever assembly is F2TZ-7210-F.



E4OD

Diesel Engine Only

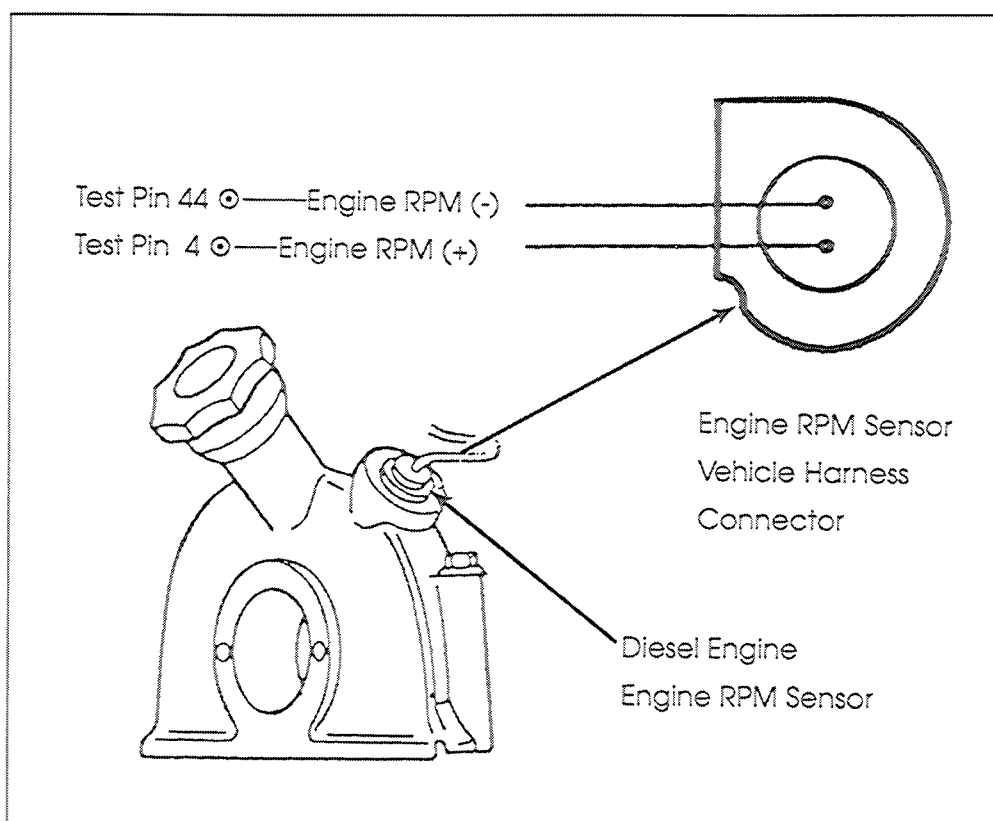
No TCC, TCC Cycling, Shift Hunting

All of these problems can be caused by a short or open of the RPM sensor. The sensor can be checked with a DMM. Set the DMM to measure frequency (Hz). The frequency should rise with engine RPM. In this particular case, the frequency will be equal to engine RPM.

EXAMPLE: Idle in Drive = .550 - 600 Hz.
Stall in Drive = 1600 - 1700 Hz.

If sensor is faulty, it should be replaced with part number E5TZ-17B384-B.

NOTE: It is best to use a break-out box for this rather than piercing the wires.



E4OD

No Upshifts, 4th Gear Starts, Harsh Upshifts

All of these concerns can be the result of an inappropriate Manual Lever Position (MLP) sensor signal. The MLP sensor consists of six resistors connected in series (ganged).

The resistance of the MLP sensor will vary based on which range the transmission is in. The MLP circuit can be checked using the following steps.

STEP 1: Check the MLPS Ground:

With the ignition on, the voltage on pin 46 (sensor ground) should not exceed .1. If the voltage is excessive, add a redundant ground to the existing ground wire (figure 3).

An additional (redundant) ground should be spliced, from the existing ground wire to a known good ground. The negative post of the battery is the best. This view is of the pins of the MLP connector pins. This test should be done with the harness connected and the ignition 'on'.

STEP 2: Check the MLPS Voltage:

The voltage at pin 30 should vary according to the position of the manual lever (figure 4).

NOTE: It is recommended that a break-out box be used. If a break-out box is not available, it will be necessary to pierce the wires to pins 30 and 46 for these tests.

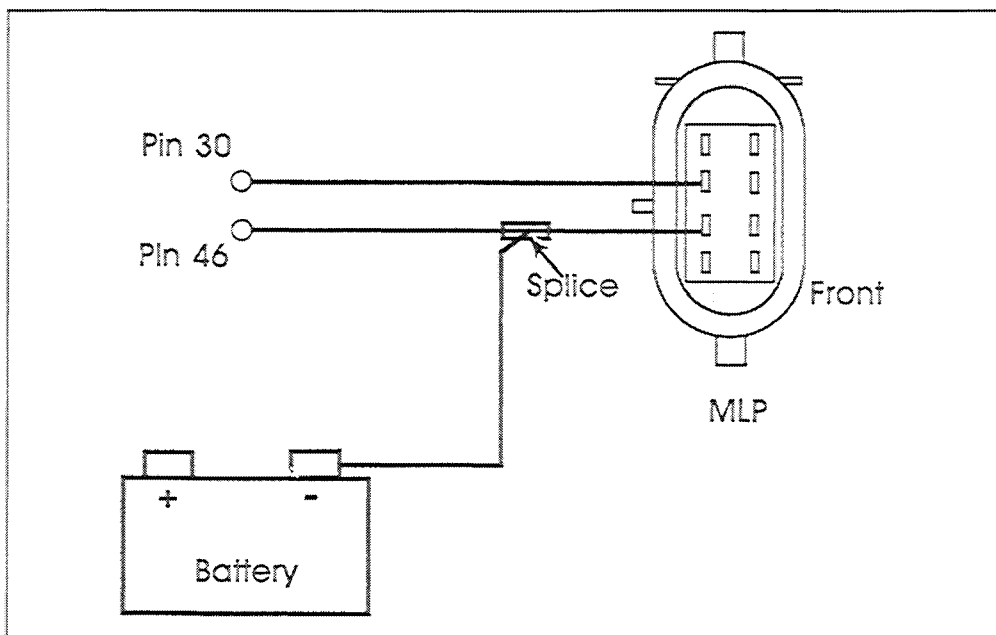


Figure 3

E4OD

No Upshifts, 4th Gear Starts, Harsh Upshifts (cont'd)

STEP 3: Check the Resistance of the MLPS:

The resistance of the MLPS (pins 30 and 46) should change with the position of the manual lever (figure 5).

NOTE: If this test is being done with a break-out box, the computer must be disconnected first (make sure the ignition is off). If this test is being done without a break-out box, remove the MLPS from the vehicle harness.

NOTE: Testing beyond this point will include tests of the harness. Consult the appropriate factory repair manual for this.

MLP Voltage (Pin 30)	
Park	4.4v
Reverse	3.6v
Neutral	2.8v
Drive	2.1v
Manual Second	1.4v
Manual Low	0.7v

Figure 4

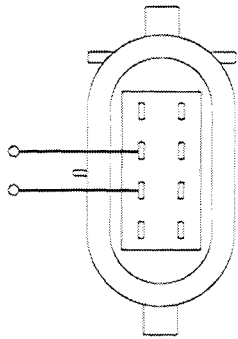
Check the resistance of these pins. 	
MANUAL LEVER POSITION	RESISTANCE VALUE SHOULD BE
P	3769 - 4608 OHMS
R	1303 - 1594 OHMS
N	660 - 807 OHMS
D	361 - 442 OHMS
2	190 - 232 OHMS
1	80 - 95 OHMS

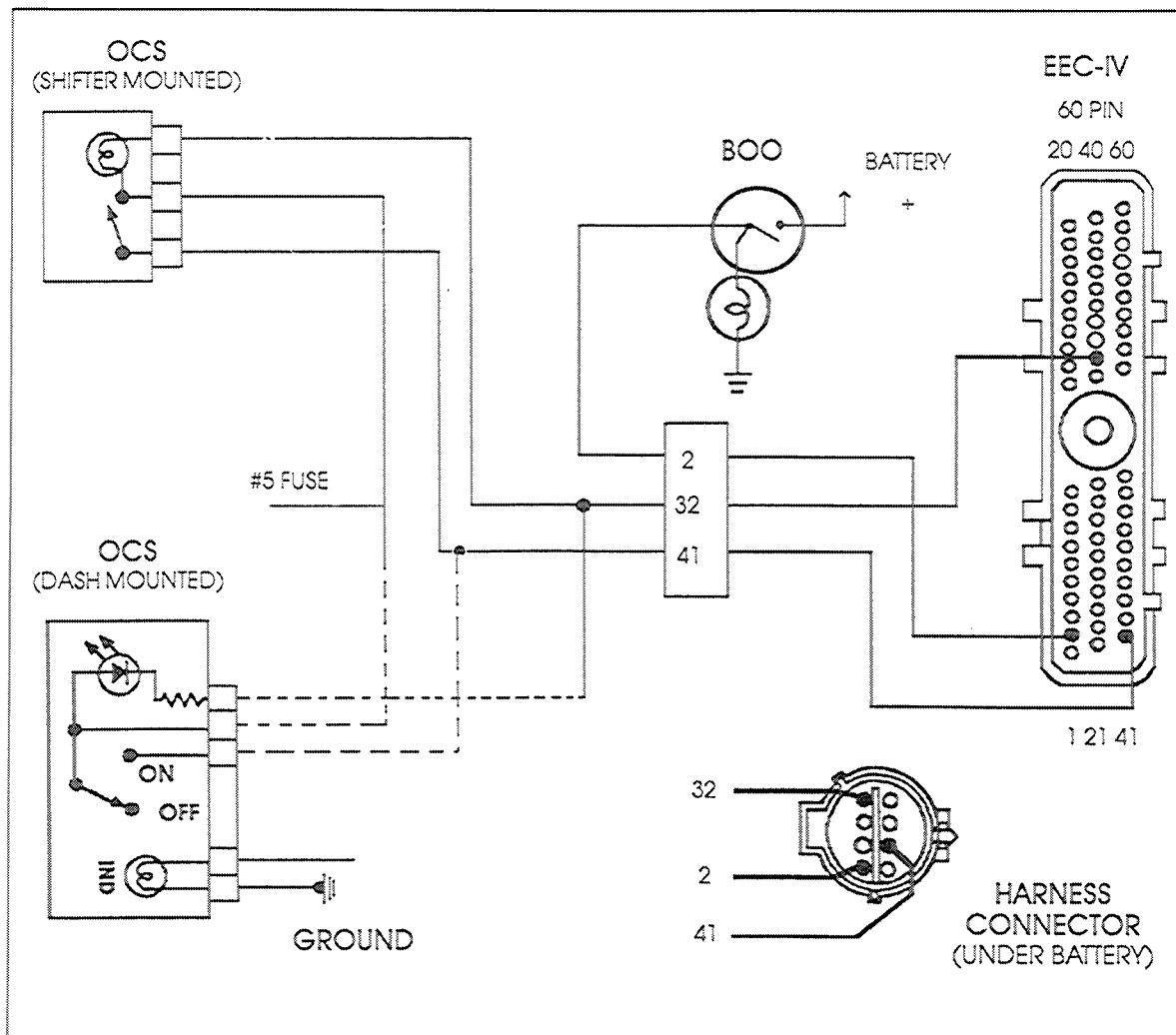
Figure 5

E4OD Diesel

'Overdrive Off' Light Cycles with Brake Pedal

A condition where the 'overdrive off' light cycles on and off while the brake pedal is pressed, is usually caused by a short between the brake on/off (BOO) switch and the overdrive cancel switch (OCS) circuits. Some diesel trucks have a harness connector that is located under or near the battery.

The BOO and OCS circuits use this connector. It is not uncommon to find that the connector or wires to the connector have corroded due to exposure to battery acid. This has been known to cause to short circuit in the connector or wires going to the connector. In most cases, the connector can be cleaned to fix this condition.

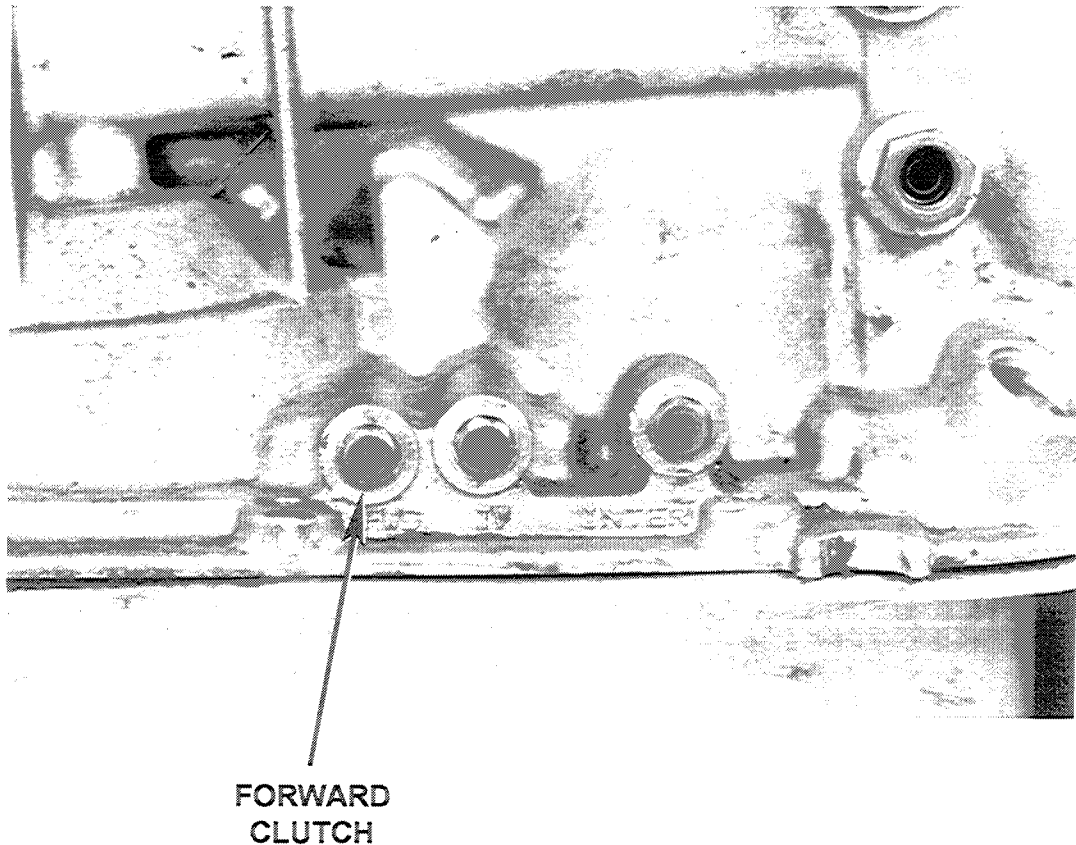


AODE

Neutrals at a Stop, and/or Broken Intermediate Roller Clutch

A neutral condition when coming to a stop can be caused by a stuck 3-4 shift valve or a partially restricted shift solenoid. To qualify the concern, compare forward clutch pressure to mainline pressure. If mainline pressure is normal but forward clutch pressure is zero, the 3-4 shift valve is still in the upshifted (4th gear) position.

A second way to qualify this concern is to drive the car in the overdrive disabled mode (shifter in 'D' position on '92 models, OD cancel button on '93 to present models). The 3-4 shift valve will never move to the shifted position so the concern should disappear.



NOTE: The mainline pressure tap is on the driver's side (not shown).

AODE

Neutrals at a Stop (cont'd)

STEP 1: Remove the pan and shift solenoid assembly.

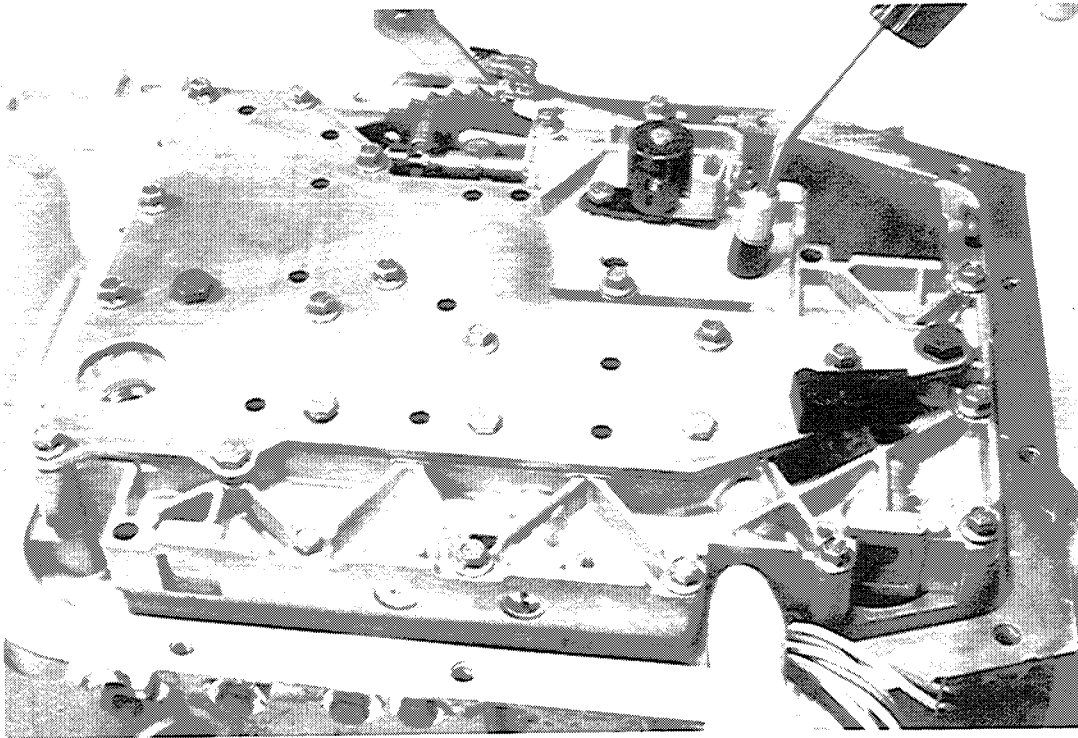
STEP 2: Reinstall the two solenoid bolts (torque to 80-100 in. lbs.). Blow into the solenoid feed hole as shown. If the 3-4 shift valve is free, you will feel an increase in spring force at the 3-4 shift valve plug while air is blown into the solenoid hole.

STEP 3: If the 3-4 shift valve is not stuck, replace the shift solenoids. The current replacement part number is F5AZ-7G484-A.

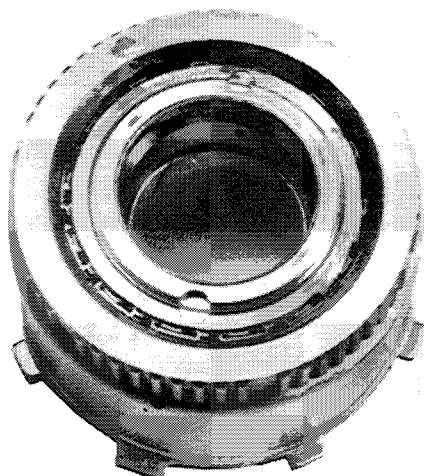
NOTE: This condition can be aggravated by high line pressure.

STEP 4: If the EPC Solenoid fits loosely, replace the solenoid and get the new design bracket.

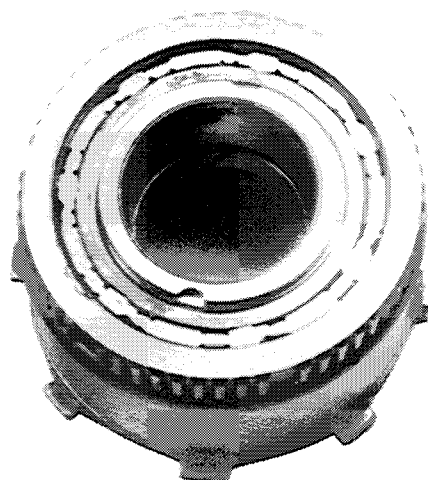
Solenoid #F3AZ-7G383-A
Bracket #F3AZ-7H111-A



Repeated neutral downshifts (4-N-2), can result in intermediate roller clutch failure. If you have this condition, replace the shift solenoids as mentioned on the previous page. An additional measure that can be taken is to use the reverse clutch drum and roller clutch from an 4R70W. Not only does it offer more rollers, but the race is sturdier. It is advisable to use this on high abuse vehicles like police cars.



**4R70W
14 ROLLERS
F3LY-7D044A**



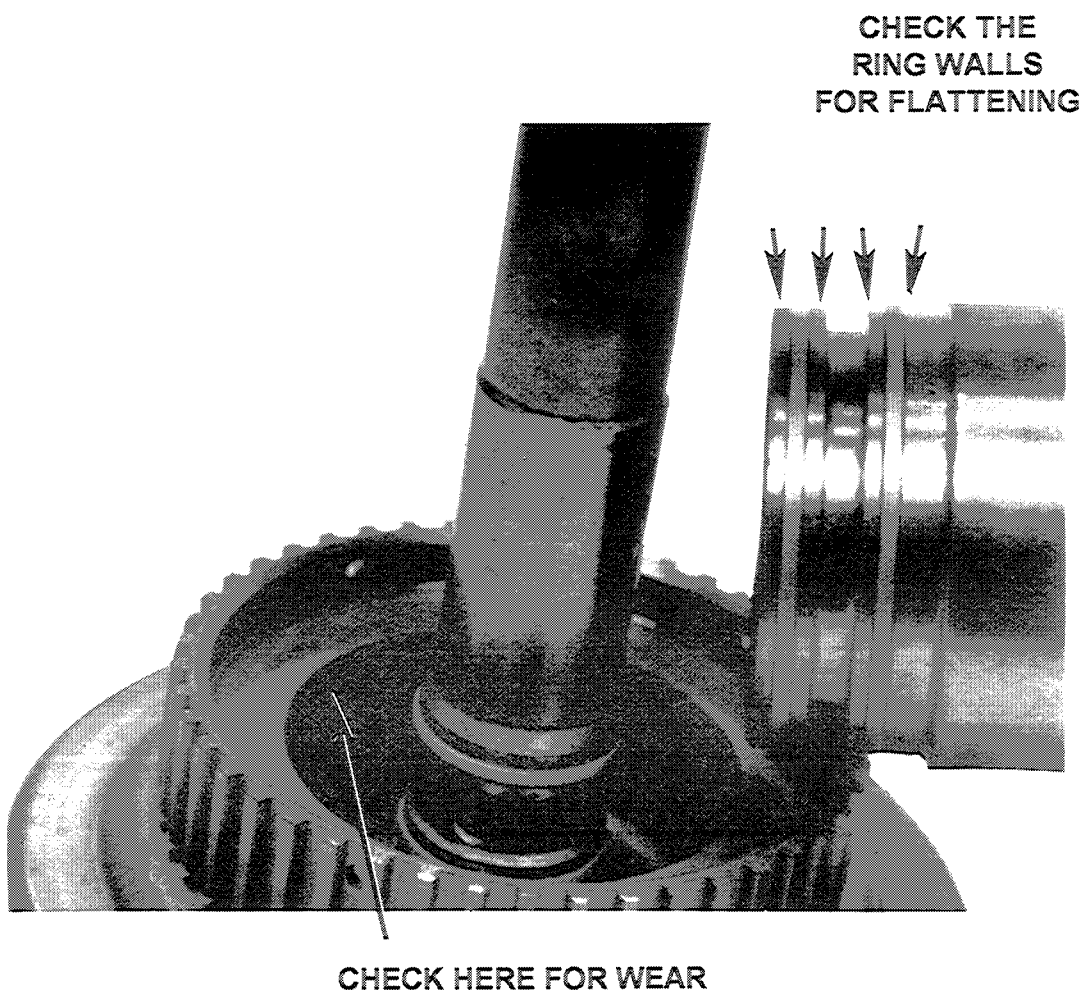
**AODE
7 ROLLERS**

AOD-E

Burnt Overdrive Band

A burnt overdrive band is usually caused by a forward clutch drum that has made contact with the stator support at the ring groove walls. This creates a forward clutch leak. Forward clutch oil is also overdrive band release oil. The band will partially apply and burn up.

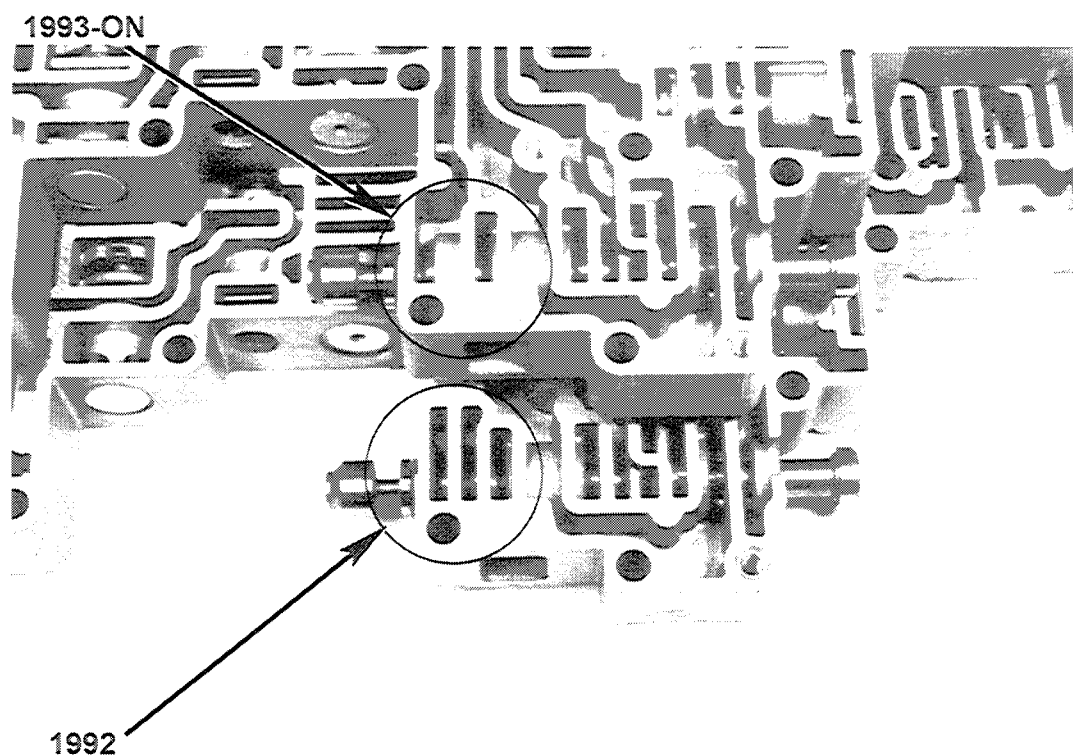
If the drum has contacted the support, replace both parts.



AOD-E

1992 vs. 1993 - Present Valve Body

1992 vehicles equipped with an AODE have a shift quadrant of "P R N OD 3 1". 1993 and later vehicles use a quadrant of "P R N D 2 1". The valve bodies vary in the manual control valve area.



NOTE: If you are familiar with "Rough Forge" system used by Ford, you'll notice that the 1992 valve body has a number that begins with "F2". The 1993 and later model begins with "F3". The rough forge number is located on the bottom of the valve body.



GENERAL MOTORS

General
Motors

GM

General Motors

GENERAL
MOTORS

General Motors

GENERAL
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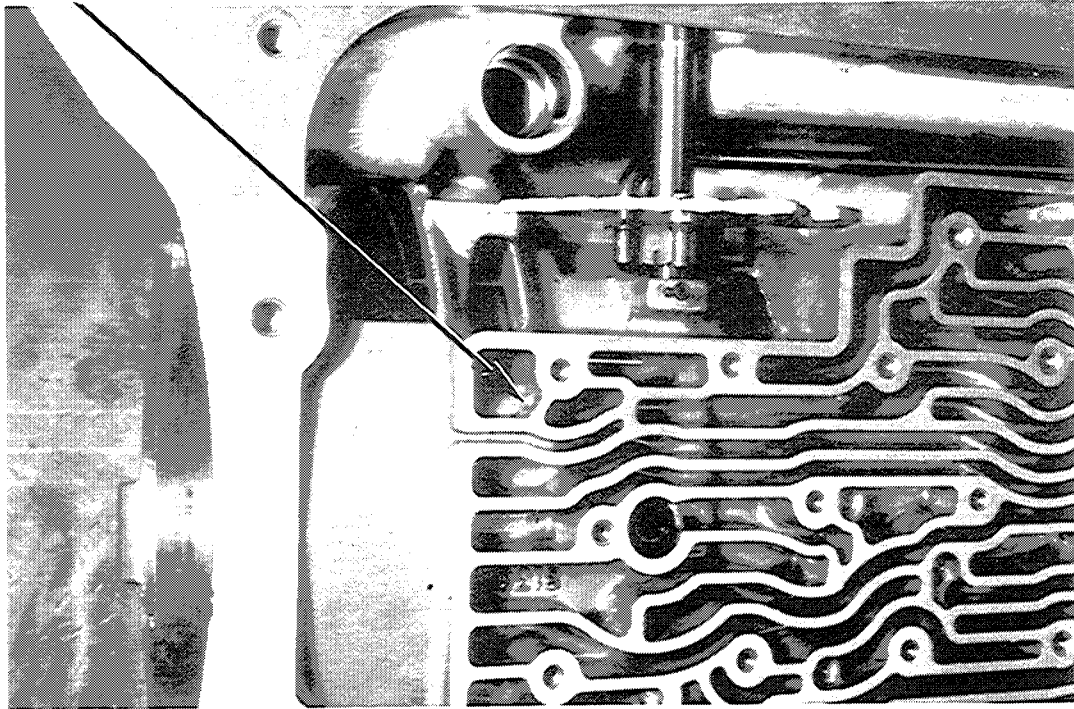
General
Motors

4L80-E High-Line Pressure in Reverse

The following rebuild procedure should be followed to reduce the possibilities of a high line pressure problem.

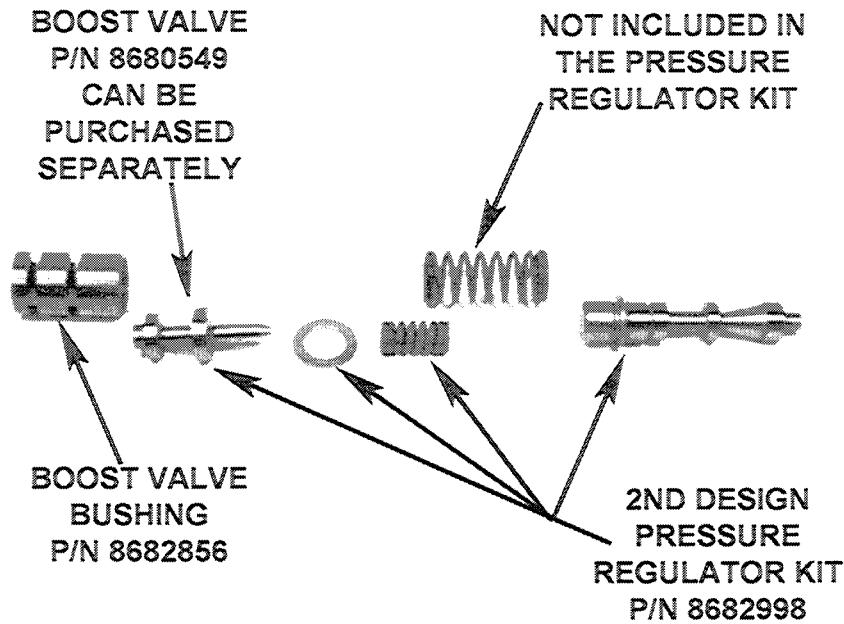
Bypass the wall that was added to the second design case. This will make separator plate and gasket mismatches not an issue. This will also bypass the orifice that was added to the second design plate.

DRILL A
1/8"-3/16"
HOLE THROUGH
THIS WALL

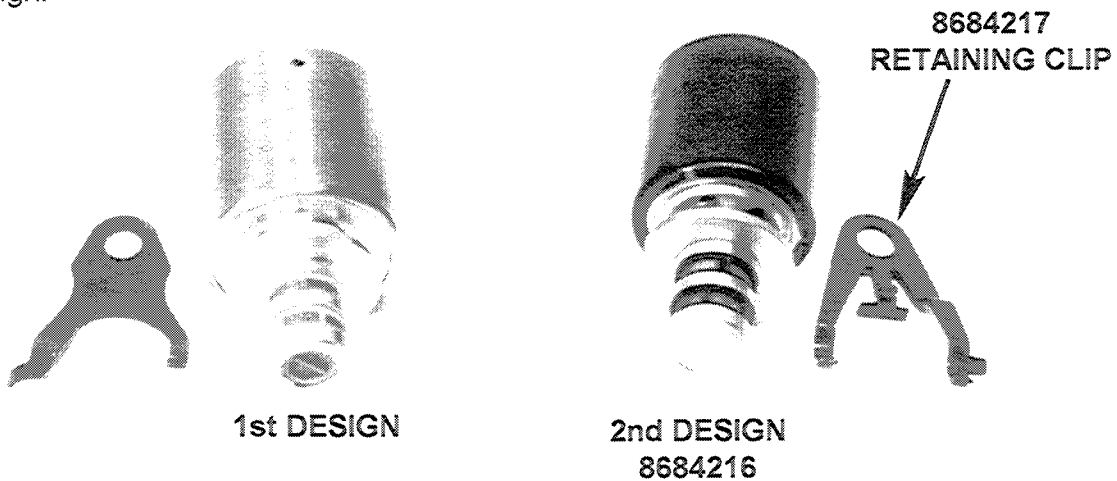


Use the second design pressure regulator valve assembly.

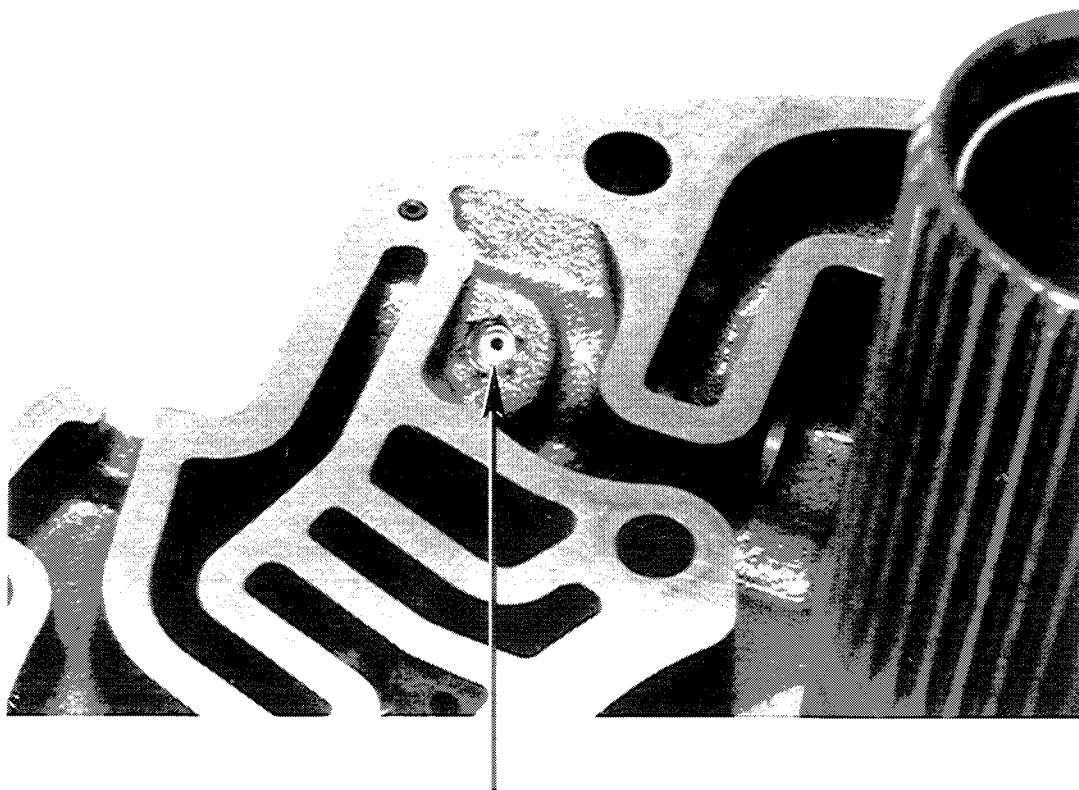
NOTE: If the 2nd design pressure regulator valve assembly is already being used, replace the boost valve and bushing as a preventive measure. The boost valve and bushing are known to wear. This wear causes a cross leak which aggravates the pressure problem.



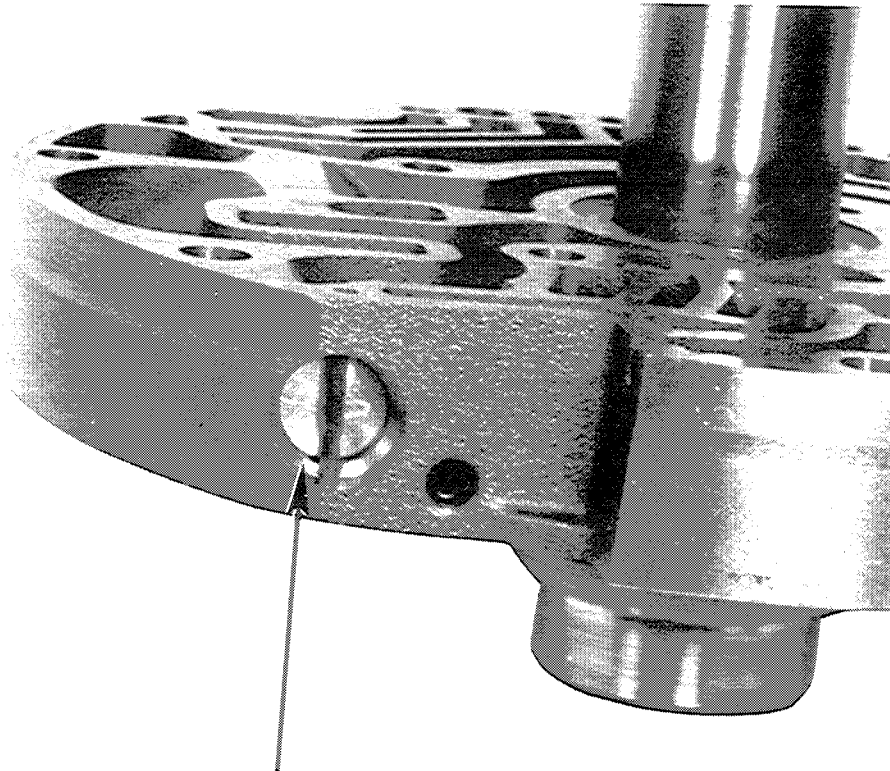
If the force motor is damaged/clogged or has high mileage, replace it with the second design.



Check/modify the stator support



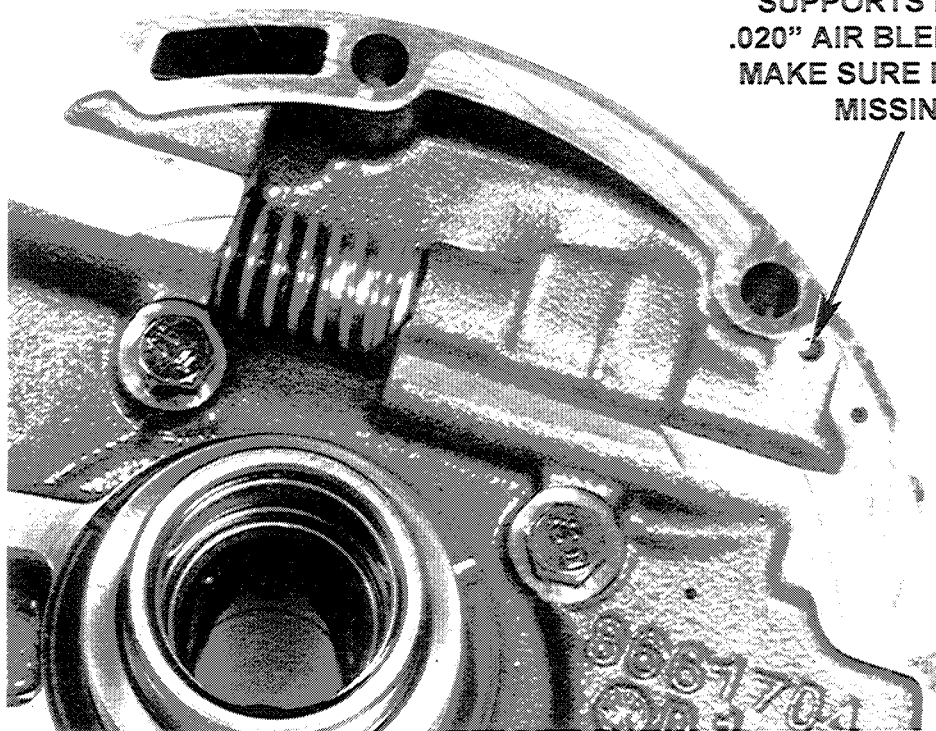
ENLARGE THE PRESSURE
REGULATOR BALANCE
HOLE TO .070"-.076"



MAKE SURE THE ALUMINUM
PLUG AT THE END OF THE
PRESSURE REGULATOR FITS
SNUGLY IN THE BORE.

Oil leaking past this plug causes the pressure regulator valve to move to a higher pressure position. Consider running a tubing cutter around this plug to enlarge it slightly. If the plug needs to be replaced the part number is 8661656.

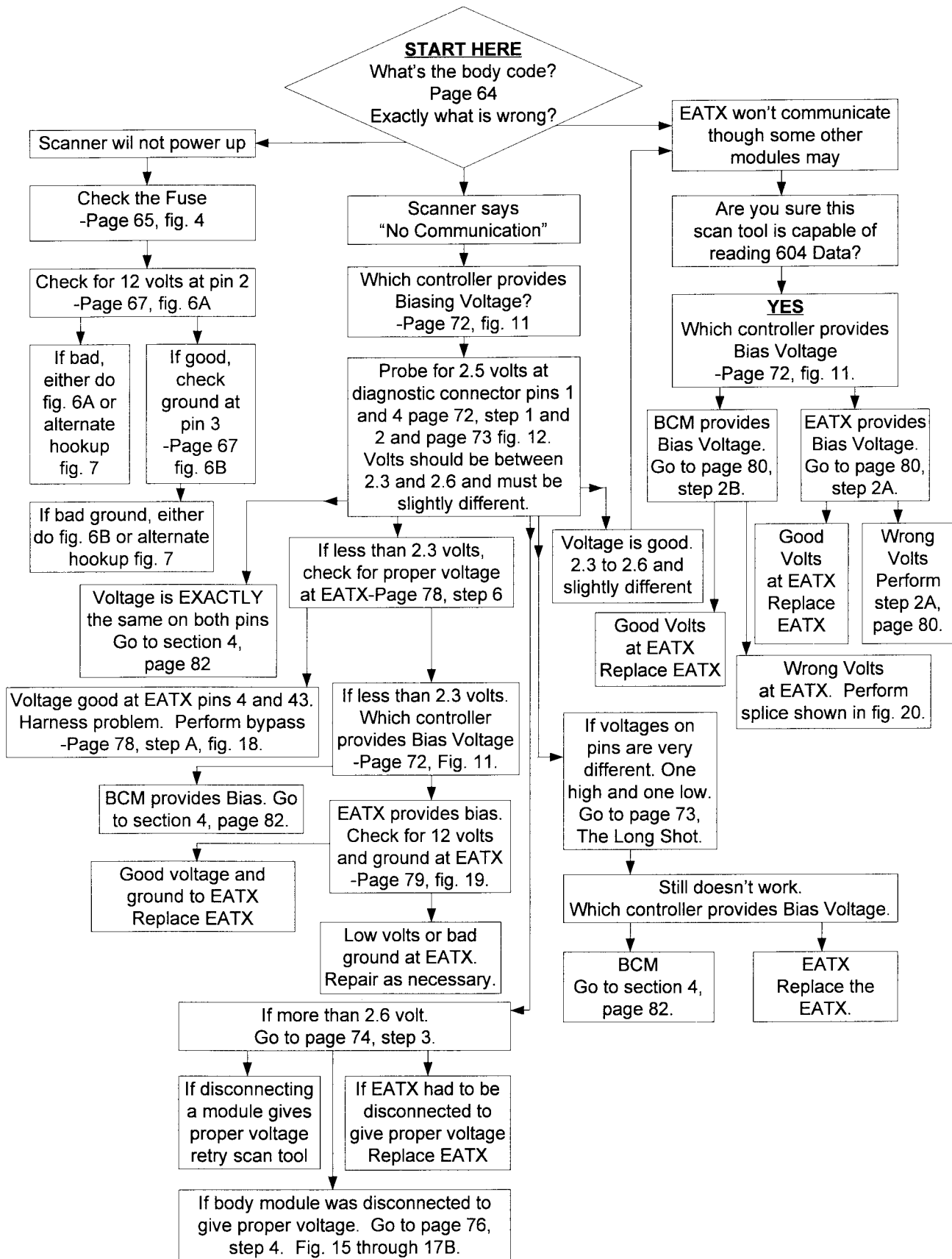
SOME STATOR
SUPPORTS HAVE A
.020" AIR BLEED HERE.
MAKE SURE IT IS NOT
MISSING.



NOTE: SUPPORTS THAT DO
NOT HAVE AN AIR BLEED
WILL NOT HAVE A HOLE
DRILLED INTO THE CASTING.



Scan Tool Will Not Work



Chrysler 41TE (A-604) and 42LE Transaxle Diagnostic Communication Systems

Today's Chrysler vehicles come with a complete array of state-of-the-art system and control devices, each dedicated to controlling a certain area. One controller will always be used to operate the engine. A separate controller will operate the 41TE or 42LE transaxle. Most, but not all, of the vehicles with these transaxles will have a separate Body Control Module, and there are many other vehicle control systems, available in many combinations, such as:

- Air Bag Control Module
- Anti-Lock Brake Controller
- Automatic Temperature Control
- Overhead Travel Information System,
or Traveler Module,
or Compass/Mini-Trip Module
- Electronic Vehicle Information Center
(may include an Engine Node)
- Keyless Entry Control Module
- Mechanical Instrument Cluster
- Electronic Instrument Cluster
- Vehicle Theft Security System Module

...just to name a few, and more are bound to follow soon.

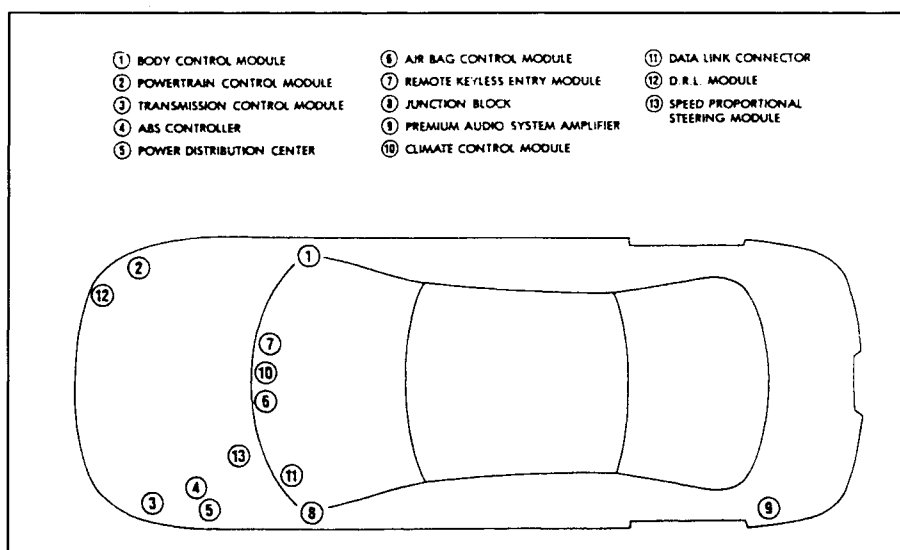


Figure 1

It is vital to understand that many different systems will co-exist within a vehicle and that these systems must be able to communicate with one another. A common link, called the C²D (or CCD, for Chrysler Collision Detection) system connects all of these modules, providing this critical communication network (figure 2).

This is the same communication link that is accessed to perform system diagnostics.

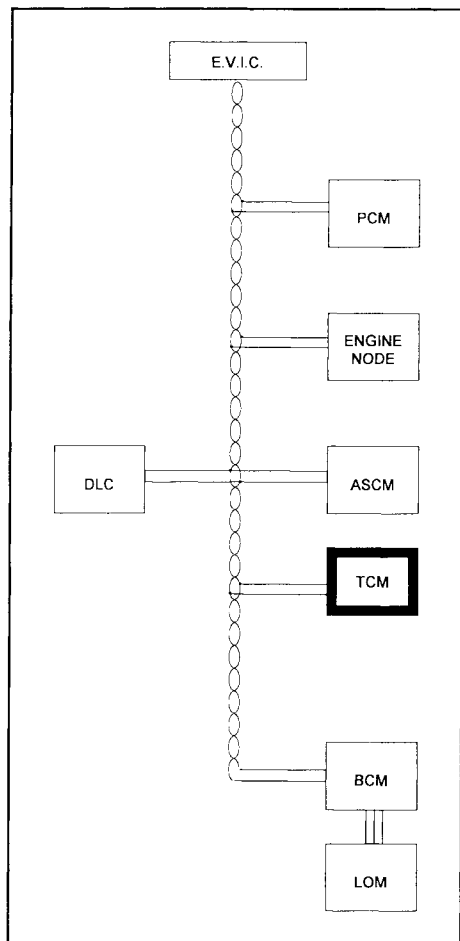


Figure 2

THE WARNING

Any one of these control systems can interrupt or completely scramble inter-system communications and/or system diagnostics!

THE CHALLENGE

Today's competent diagnostic technicians are already familiar with the relationship between these controllers and their associated inputs, outputs and data that need to be shared with other controllers.

These professionals have learned that the key to an accurate diagnosis of a control system malfunction or complaint lies in the technician's ability to:

1. Access and observe these I/O (Input/Output) signals, **when the complaint occurs.**
2. Understand how the signals you are observing **should** behave if they are working properly.
3. Observe an **improper** I/O signal that could logically cause the complaint.
4. Repair/replace the component/circuit causing the improper signal.
5. Verify that the corrected signal eliminated the complaint.

THE OBSTACLE

The ability of a technician to perform any of these five steps hinges on whether or not access to the system in question can be gained.

These procedures have been designed as a method of isolating and correcting, or bypassing problems that are likely to be encountered when trying to communicate with the onboard diagnostic system, specifically the Electronic Transaxle (EATX) controller (figure 3). These problems include:

No power to the scan-tool. The screen is blank.

or Statements from your scan-tool like:

"No communication"

"Modules not responding"

"+"

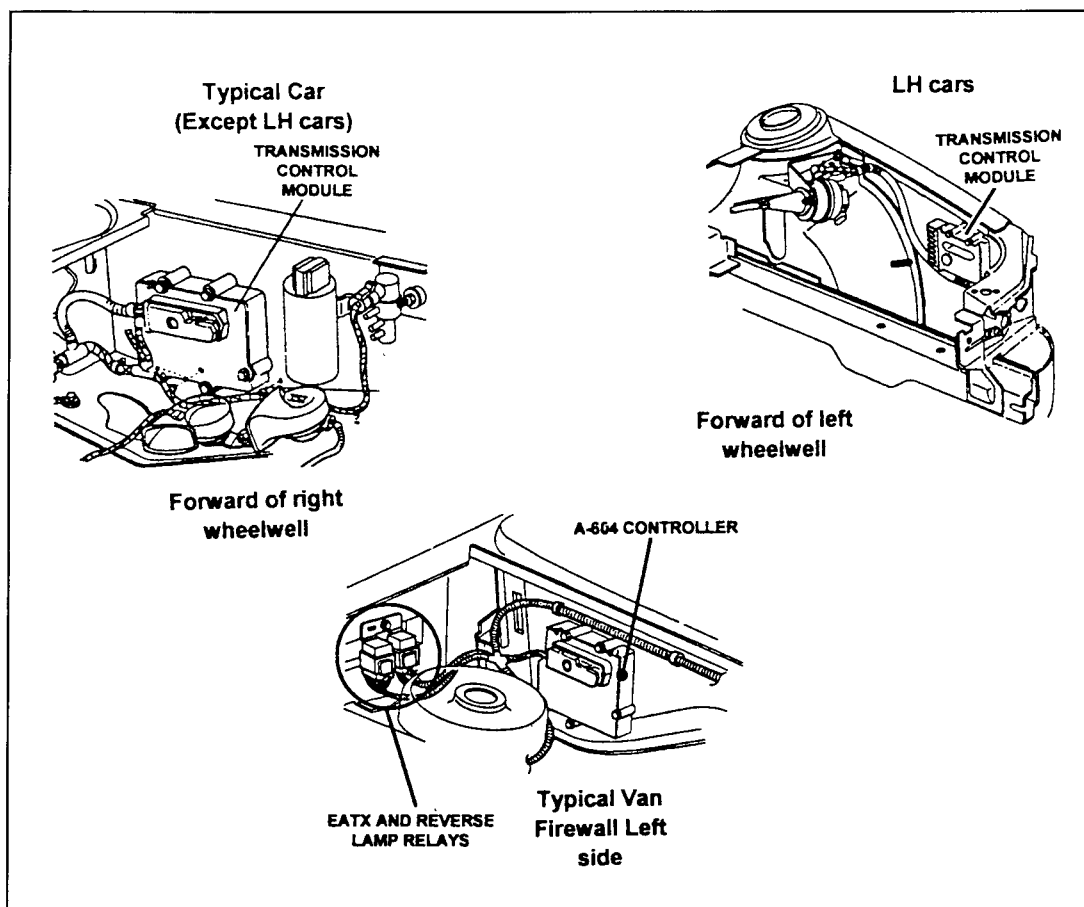


Figure 3

These problems will be classified in Sections as follows:

- Section 1** No power to the scan-tool. (Scan-tools that rely on the Diagnostic Connector for 12 volts and ground.)
- Section 2** No communication. The scan-tool device is denied access to the communication system.
- Section 3** Several modules respond, but the EATX controller isn't one of them.
- Section 4** The Last Resort. How to access the EATX controller (whether the data bus wants you to or not).

It is important to know the body code of the car that is being worked on. The chart below can be used to determine this.

MODEL	BODY CODE
Dodge Spirit Plymouth Acclaim Chrysler LeBaron WITHOUT BCM Uses EATX pins #5 & #44	AA
Dodge Dynasty Chrysler New Yorker w/ transverse powertrain	AC
Dodge Daytona	AG
Chrysler LeBaron WITH BCM No EATX pin #5 & #44	AJ
All Vans	AS
Chrysler Imperial Chrysler Fifth Avenue	AY
Chrysler LHS Chrysler Concorde Chrysler New Yorker w/ In-line powertrain Dodge Intrepid Eagle Vision	LH

Section One

No Power to the Scan Tool

Aftermarket devices may be hooked into the power circuit, such as phones, sound systems, light bars, etc. Devices like these should never share the +12 volt power wire with the C²D diagnostic connector. Consider finding another power source for these devices.

THE PATH

The chart below (figure 4) shows which fuse provides power to the diagnostic terminal. If the fuse is blown, replace it and try again. Many vehicles use the cigarette lighter fuse. If it is blown, and the new fuse blows the moment the key is turned on, disconnect the lighter and try again.

FUSE CHART

Year	Model	Fuse #	Year	Model	Fuse #
89	AA	2	92	AA	15
	AC	13		AC	15
	AS	7		AG	11
90	AA	2		AJ	11
	AC	13		AS	23
	AG	11		AY	15
	AJ	11	93	AA	15
	AS	7		AC	15
	AY	13		AG	11
91	AA	2		AJ	11
	AC	13		AS	23
	AG	11		AY	15
	AJ	11		LH	Fuse J in Power Distribution Center Feeds Fuse M1 in Junction Block.
	AS	23	94	AA	
	AY	13		AJ	
				AS	
				LH	Fuse G in Power Distribution Center Feeds Fuse M1 in Junction Block.

Figure 4

If the fuse is okay, you now have a choice of two methods of proceeding.

1. Using a reliable system schematic for the vehicle you're working on and trace the diagnostic connector's 12 volt supply circuit. Probe both sides of the in-line connectors to see if there is a bad pin connection.
2. Hook up the scan-tool using the 'Alternate Scanner Hook-up Methods' outlined in figure 6. Be sure not to accidentally bridge the connector circuits together.

Alternate Hook-Up Methods

A simple tool can be made with an old connector from a late model Chrysler vehicle. The easiest way to obtain it is at a wrecking yard. This connector is used on all applications for diagnostics.

Using the diagram below, make sure the wires are in the correct locations, then solder alligator clips to the wires.

Using colored alligator clips will make it easier to use.

EXAMPLE: Red for 12 volts in, Black for ground, Yellow for Bus positive (+) and Green for Bus negative (-).

This connector assembly can be used to make the "Alternate Hook-ups" easier.

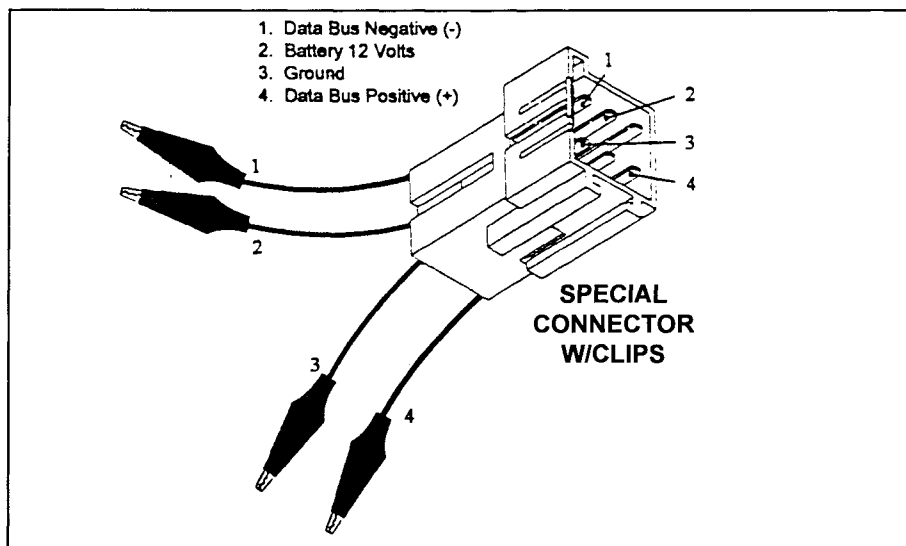


Figure 5

Special Scanning Device Hook-up Connector with clips.

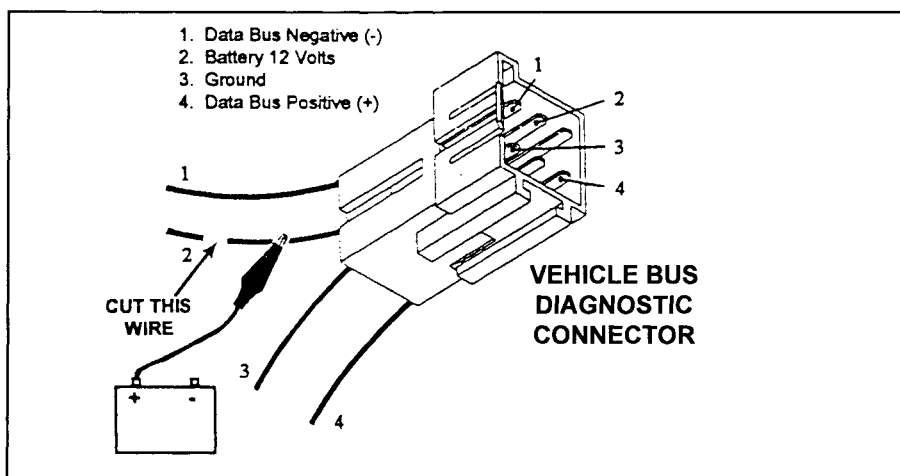


Figure 6A

Figure 6A shows cutting the power wire and splicing a good 12 volt source into the connector half of the original circuit.

No ground to the diagnostic connector ground pin can kill scanning functions just as effectively as no power. However, this is an easy one to deal with.

Verify that this is the problem by probing the wire (#3 Ground) shown in figure 6B with the positive probe of a voltmeter (the scan-tool is hooked up and the key is on.) If there is more than .1 volts, the ground is insufficient.

To fix it, splice into the circuit with a "Trailer Wiring Connector" (Scotch Lock) hooking the connector pin to a known good ground (figure 6B).

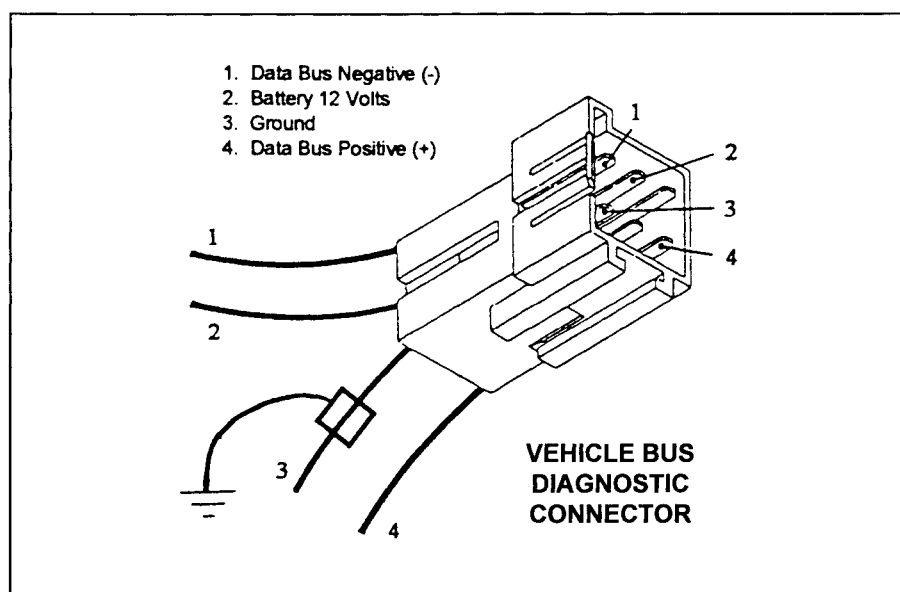


Figure 6B

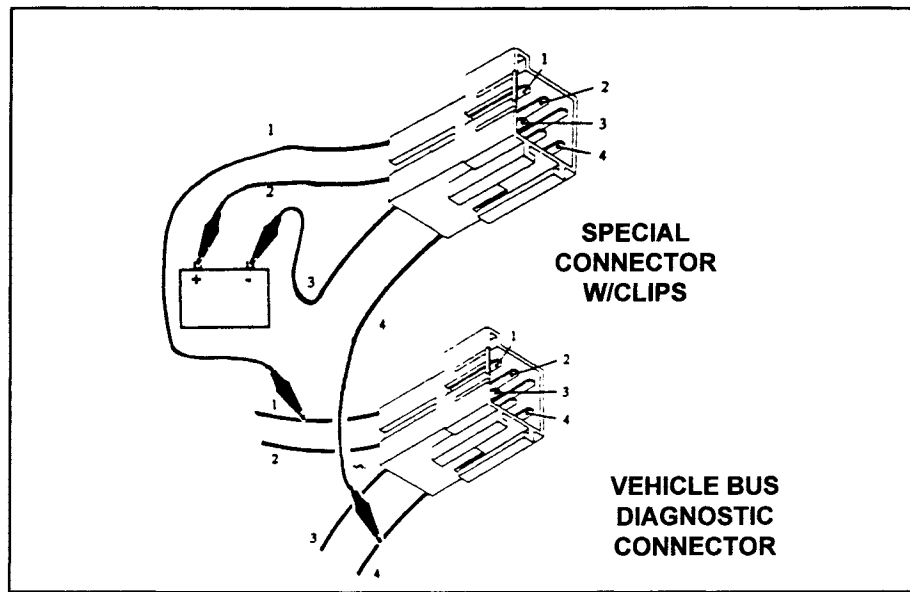
*Figure 7*

Figure 7 shows how to connect the correctly operating diagnostic connector pins to the scanner using the special connector with clips. Alternate 12 volt and ground sources replace the original source.

Section Two

No Communication

A "No communication" type message from your scan-tool and the diagnostic system, is usually caused by improper data bus 'biasing', or 'termination'. The C²D communication circuit, or '**bus**' carries messages to, from, and between almost every control module throughout the vehicle. It carries these messages over a two wire network. (Figure 8).

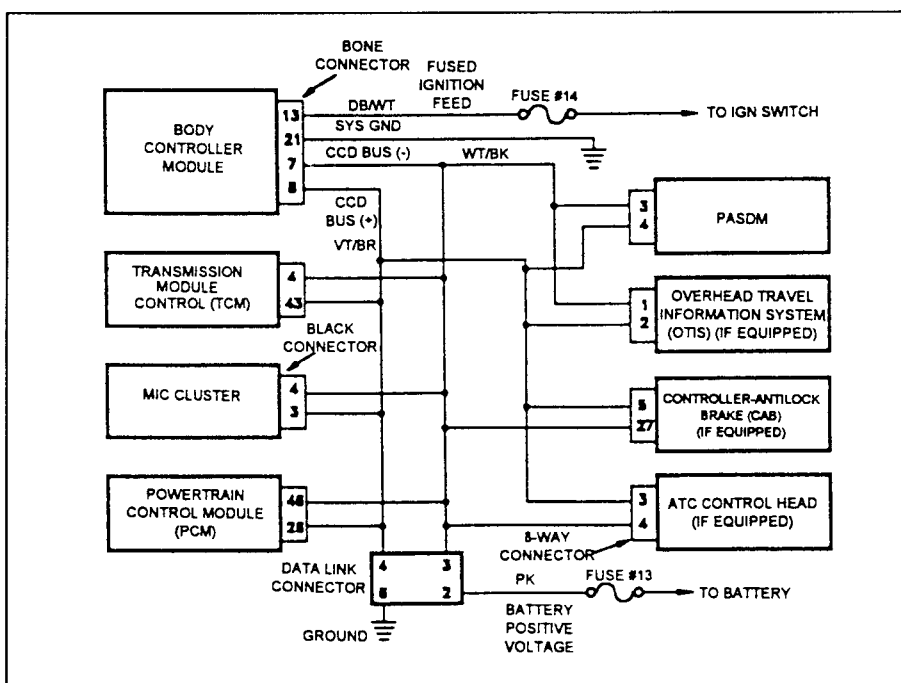


Figure 8

Message traffic is controlled by, prioritized by, and conflicts are resolved by a communication technique called 'Multiplexing'.

The multiplex programming allows any module that wants to transmit data a certain 'piece of time' to 'talk on the bus'. Whenever the bus is idle, any module may have an opportunity at a 'piece of time'. During each module's time slice, it identifies itself, transmits its data (several times in some cases), the data is checked for accuracy, and the module closes its communication. However, it is not unusual for two devices to try to communicate at the same time. To avoid a 'data collision' in the bus, the program has to determine which of the two messages is more important, and allows that message the 'right-of-way'.

These communications happen incredibly fast, (7812.5 bits per second) and the types of messages can be rather complex.

The strength of the message signal sent by each module is not very strong, on the order of milli-amperage. Since this communication circuit winds itself all over the car, there are many opportunities for other electrical currents going through nearby wires to influence and corrupt these signals.

One basic rule of electricity states that, "Any wire carrying a current creates a magnetic field around the outside of that wire." The stronger the current, the stronger the magnetic field around it, (figure 9).

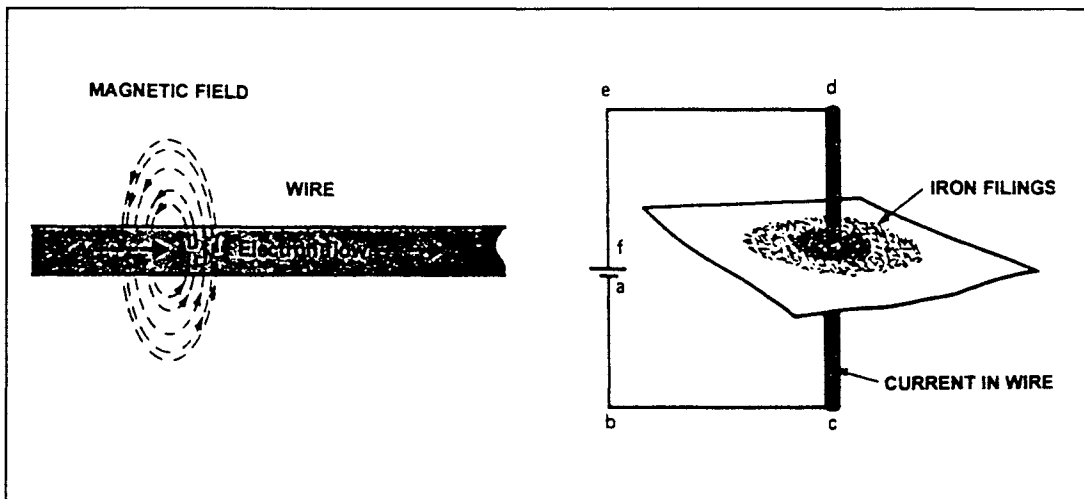


Figure 9

Another rule states that, "A moving, or changing magnetic field will create an electric current in any conductor (wire) within this field", (figure 10).

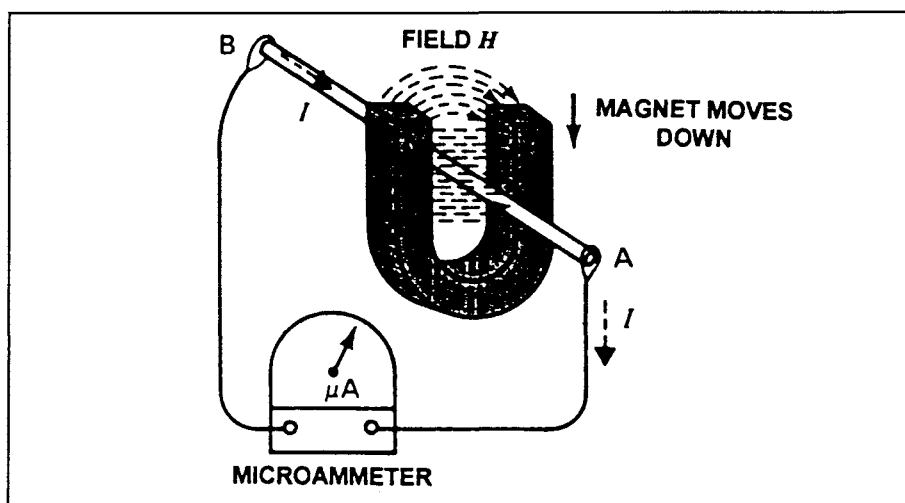


Figure 10

These stray currents, magnetically induced into the data bus, can interfere with a perfectly understandable data signal.

To get around this problem, Chrysler designed the bus with two particular points in mind.

1. Whether the bus is active or inactive, it will never be at 0 volts. The communication system normally operates between 0 and 5 volts, so the bus is always kept or **Biased** at 2.3 to 2.6 volts by one of the onboard controllers. This way, any communication signal voltages will start and remain near the systems optimum, or 'most comfortable' voltage. This 'halfway on' voltage helps ensure that all proper signals that should be 'on the bus' will be substantially over '0' volts, which makes the signals easier to process, and a small current induced by a nearby circuit won't be as likely to overpower the standing voltage of approximately 2.5 volts.

It's important to know which controller is responsible for this function, but it's quite simple to figure out.

If the vehicle that is being worked on has a Body Control Module, then it is the module that powers up the bus. If the vehicle does not have a BCM, then the EATX, (transaxle) controller is responsible for providing this 'biasing' voltage. Consult the chart labeled "Controller Providing Biasing Voltage" (figure 11) for more information on this.

CONTROLLER PROVIDING BIASING VOLTAGE

89	AA EATX AC BCM AS EATX	92	AA EATX AC BCM AG BCM AJ BCM AS BCM AY BCM
	90 AA EATX AC BCM AG BCM AJ BCM AS EATX AY BCM		93 AA EATX AC BCM AG BCM AJ BCM AS BCM AY BCM LH BCM
91	AA EATX AC BCM AG BCM AJ BCM AS BCM AY BCM	94	AA EATX AJ BCM AS BCM LH BCM

Figure 11

A certain layout of resistors inside the biasing controller is used in the circuit to divide the circuit into two halves. This layout is called "Termination". All data is transmitted across the circuit as **differences** in electrical **current** between the two bus wires. Without these resistors, the circuit would be nothing more than a solid wire, and any current in the circuit would be the same at all places. There would be no current differences between the circuit halves, therefore no signals.

2. The bus wires are twisted together. This is done so that any outside induced current that manages to get into the bus will affect both 'sides' of the circuit, since they're twisted together. It won't create a change in the current **difference** between each side of the bus circuit.

The point is, that when a scan-tool powers up but does not want to communicate with the diagnostic system it could be a simple voltage problem with the bus.

Use the following procedure to identify the source of the problem.

STEP 1 Connect a voltmeter ground probe to a good ground.

STEP 2 Individually probe both of the pins marked 'Data Bus' (pins 1 & 4) shown in figure 12 with the positive probe of the meter. They should each read between 2.3 and 2.6 volts. Whatever the readings are, they must be slightly different from each other. Approximately .1 - .3 volts.

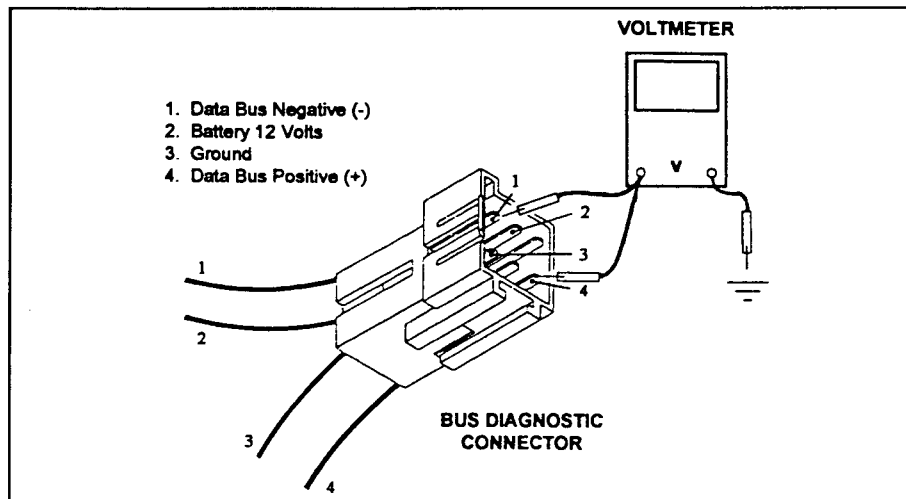


Figure 12

- * If the data pins show EXACTLY the same voltage the data bus wires are shorted together. Go to section 4 on page 82.
- * If the data pins show the proper voltage, then move on to Section Three, page 80. Modules Respond on the Bus, but the EATX controller isn't one of them.

THE LONG SHOT

- * If the data pins show you voltage differences between the data pins of 4 to 5 volts, there may be a problem with data bus termination. The resistor that separates the bus halves may be burned open. Solder a 200 ohm resistor between the bus wires (figure 13), and try the scan-tool again. If it still doesn't work and the BCM is the biasing controller go to section 4 on page 82. If the EATX is the biasing controller, replace the EATX.

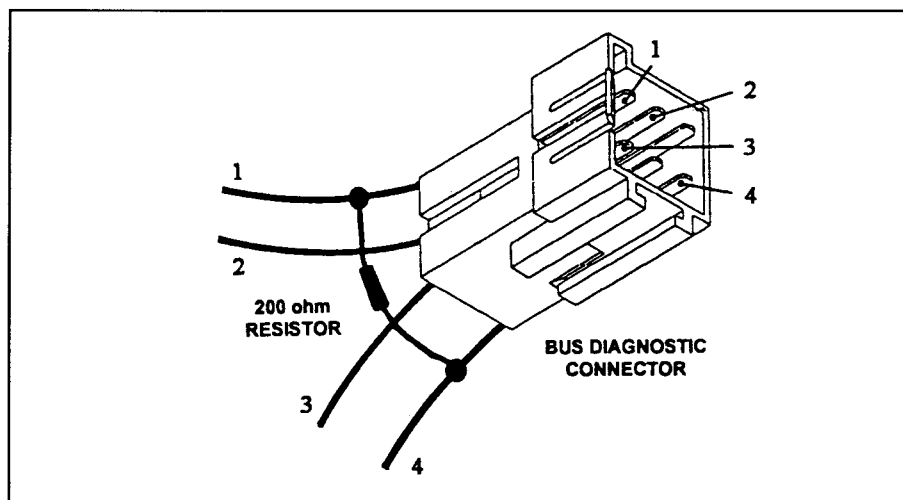


Figure 13

- * If both data pins show **less than** the proper 2.3 to 2.6 volts then go to page 78.
- * If both data pins show **greater than** the proper 2.3 to 2.6 volts, then one of the modules on the bus system is fouling up the works by allowing a higher voltage into the bus.

STEP 3 Leaving the meter hooked up as shown in steps 1 & 2, disconnect the modules that report to the bus, **one at a time**. Consult the "Vehicle Configuration" section starting on page 83 for the vehicle you're working on for a list of these devices.

Start with the easy to get to ones first, such as the engine and transaxle controllers. It would be a shame to get the headliner and back seat ripped apart just to find that the body controller behind a kick panel was causing your grief.

Keep in mind that if you disconnect the module that provides **bias** voltage to the system, and it was responsible for the problem, it will be **normal** for the observed system voltage to go to 'zero'.

Check for proper voltage on the meter each time a component is disconnected, if the meter shows no change, **reconnect** that device. If the proper 2.5 volts or zero voltage is shown after a component is disconnected, the offending circuit or system has just been found.

As long as the module that has been disconnected in order to get the correct reading wasn't the EATX controller or BCM, (if so equipped) you should now be able to communicate with the EATX controller for codes, data and CVI readings. Leave the module that failed disconnected during the test.

If the EATX controller has to be disconnected in order to get normal bus voltages, the EATX controller should be replaced.

Depending on which module had to be disconnected to get proper system voltage, the scan-tool may be missing some operating data, such as ambient temperature, engine temperature, vehicle speed, etc. There should still be enough data available to continue the diagnosis.

If the Body Control Module is disconnected and bus voltage goes to zero, then the BCM is responsible for the failure. Although communication can not be made with a bus at zero volts, all is not lost.

Remember that the EATX controller is one of the possible 'biasing' controllers.

Even on a vehicle that uses a BCM to power up the bus, the EATX controller still has the capacity and pins required to do the job. The big difference between the two systems is in the way that the EATX **wiring harness** is configured.

Figure 14A shows the bus connection configuration used in a vehicle with a BCM. The EATX connector has NO WIRES at pin locations #5 & #44 Bias Voltage. The BCM provides biasing voltage, and all that the EATX controller contributes is data pins #4 & #43 Data.

Figure 14B shows the bus connection configuration in a non-BCM vehicle. On these applications, the EATX connector pins #5 & #44 Bias Voltage are still included in the harness. This will offer the required biasing voltage to the bus circuit.

If the body controller had to be disconnected in order to get the bus voltage to behave, continue to Step 4.

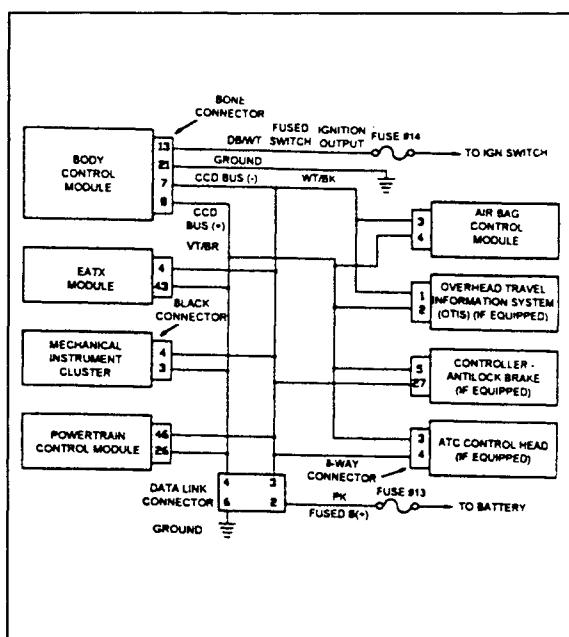


Figure 14A

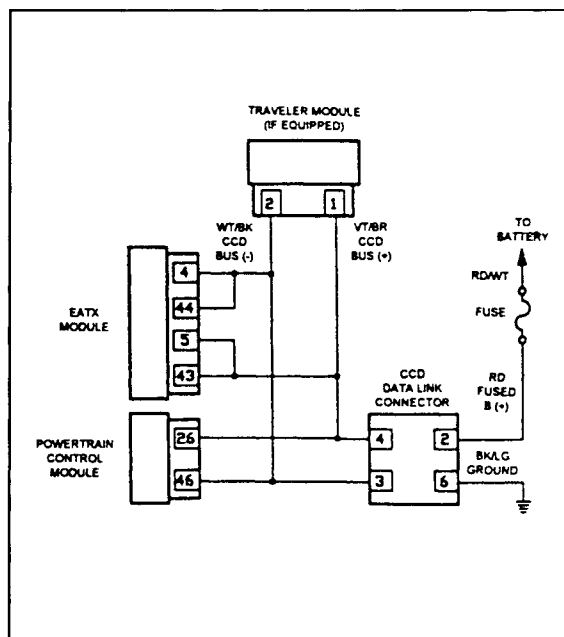


Figure 14B

STEP 4 Leave the BCM disconnected. Remove the EATX controller connector. Locate the appropriate holes for pins #5 & #44 Bias Voltage in the EATX connector, (figure 15). Thread a one foot long piece of 18 or 20 gauge wire through each of the two connector holes. **Carefully** solder these wires to pins #5 & #44 Bias Voltage on the transmission control module.(figure 16). Gently press the connector back into place over these two wires. Using trailer splice connectors, connect the wire from pin #44 Bias Voltage to wire #4 Data. Now connect the wire from pin #5 Bias Voltage to wire #43 Data, (figures 17A & B).

This wiring configuration is now the same as a Non-BCM data bus system.

The BCM is now disconnected. Since this may cause some body system malfunctions on the road, keep the vehicle in the shop.

A scan-tool should now be able to access the EATX controller. Remember, the BCM may still need replacing.

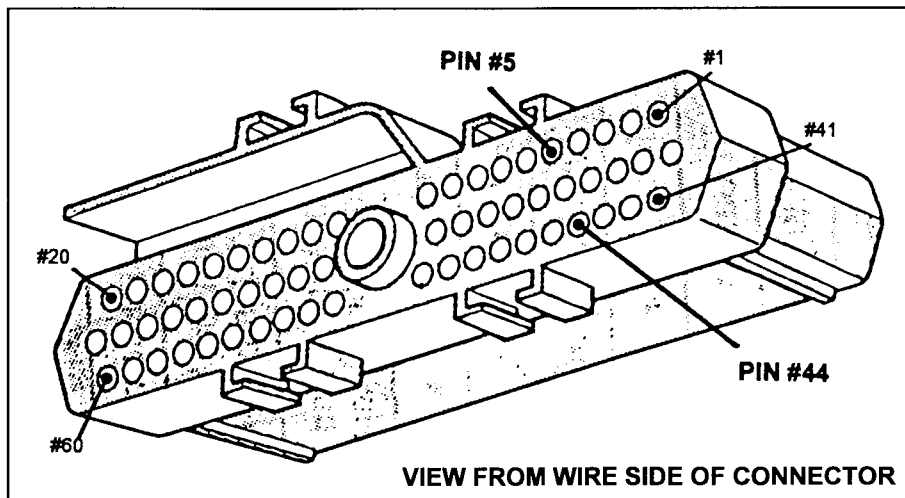


Figure 15

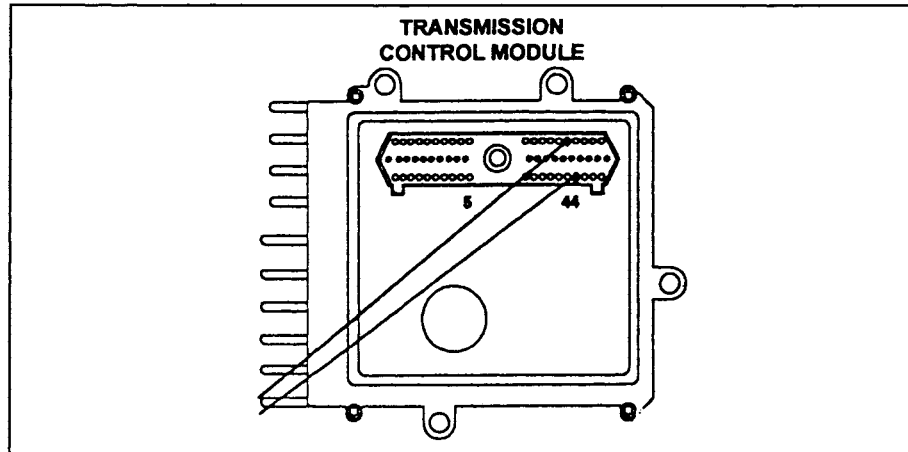


Figure 16

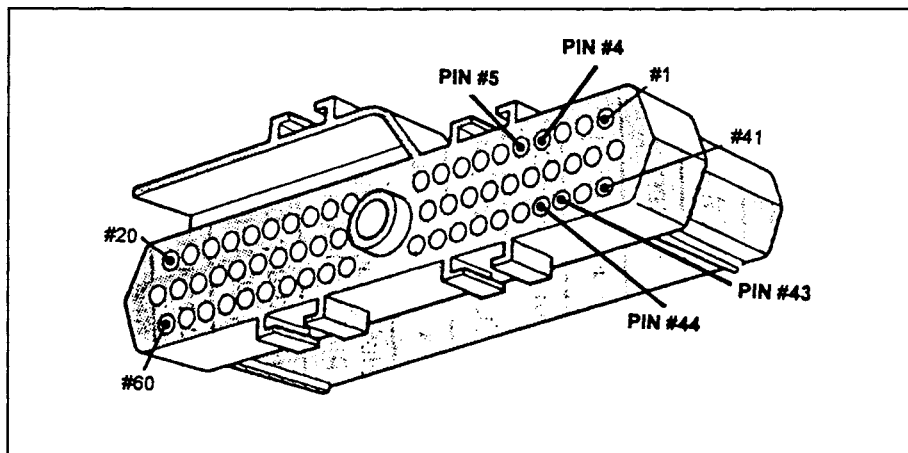


Figure 17A

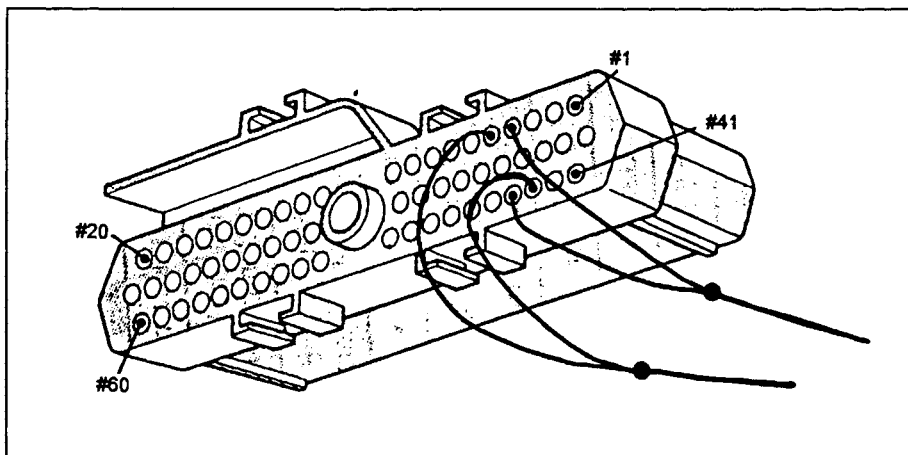


Figure 17B

If both of your data pins show **less than** the proper 2.3 to 2.6 volts, then either the controller responsible for powering up the bus isn't doing its job, or the bus's data circuit between that module and the diagnostic connector is disconnected (open) or has resistance.

There are two possible causes for this situation. Either the biasing controller isn't putting out the appropriate voltage and the whole system is down, or the controller is properly biasing the bus, but the circuit is damaged somewhere between the controller and the diagnostic connector.

STEP 5 Consult the chart labeled 'Controller Providing Biasing Voltage' (figure 11, page 72). This will tell whether the BCM or the EATX controller is **supposed** to be providing the biasing voltage.

STEP 6 With a voltmeter ground probe hooked to the negative post of the battery, probe the EATX connector pins #4 & #43 Data with the positive probe, checking for approx. 2.5 volts.

- A. If proper voltage is shown the harness is probably bad, use jumper wires to hook up a scan-tool as shown in figure 18. The scan-tool should now operate. If not, go to section 3 on page 80.
- B. If proper voltage is not shown on these pins, **and the EATX is the biasing controller**, check for proper voltage and ground **to the EATX controller**, (figure 19). If the controller isn't getting proper voltage or ground, it can't put out the proper bias voltage. If there is good voltage and ground to the controller, replace the controller.
- C. If proper voltage is not on these pins, **and the EATX is NOT the biasing controller**, then either the BCM isn't doing its job, or the bus has an open (break) in the circuit, the bus is shorted to ground, or has resistance. You have a choice. You can either try to figure out what's wrong with the BCM or the data bus, or ...

GO RIGHT TO SECTION FOUR ON PAGE 82

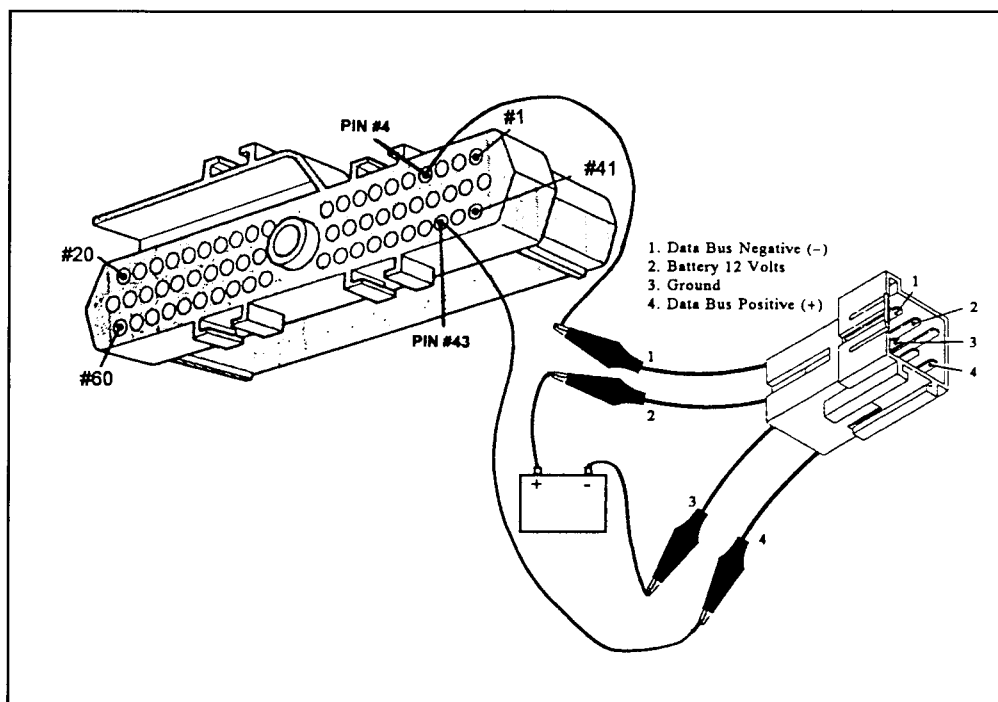


Figure 18

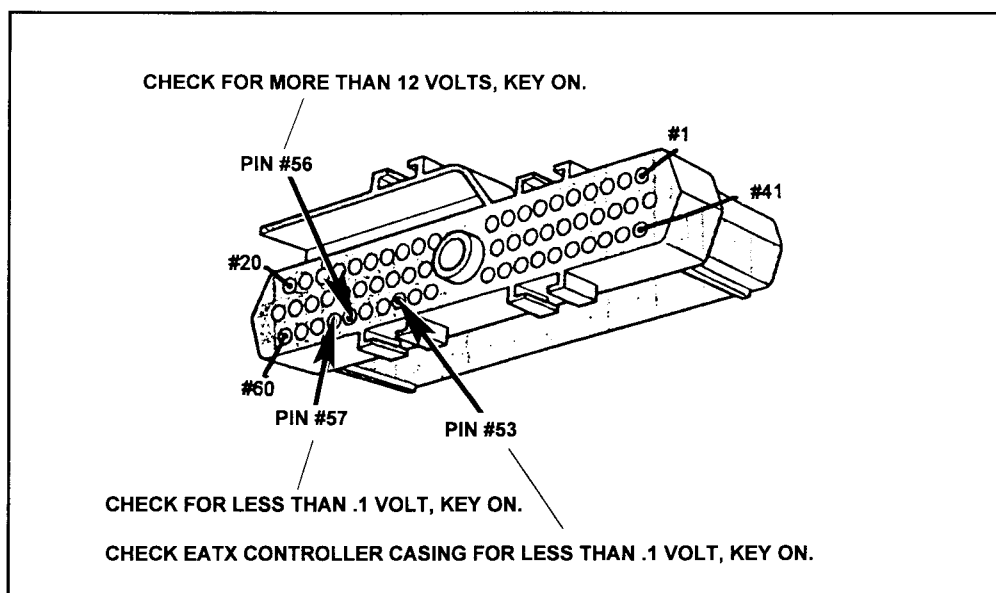


Figure 19

SECTION THREE

Modules respond on the bus, but the EATX controller isn't one of them.

By far, the most common cause of this problem is trying to access the C²D system with a scan-tool not designed, programmed or current enough to access the EATX controller!

Make sure the scan-tool is equipped to do this.

If the equipment being used is compatible with an EATX system, and this happens, then the bus is active. Therefore, the controller responsible for powering up the bus is working.

Don't assume that because the bus is active, that the vehicle has a Body Control Module, and that the BCM is powering up the bus. It is possible to have the EATX controller providing biasing voltage, but unable to communicate on the bus.

STEP 1 At the EATX controller connector, see if the connector has wires at pin locations #5 & #44 Bias Voltage, (figure 15). If so, then the EATX is providing biasing voltage. If these positions are open, the BCM provides power to the bus.

STEP 2A If the EATX provides the POWER, connect a voltmeter ground probe to the battery negative post and measure the voltage at pins #4 & #43 Data as close to the controller connector as possible. If proper bus voltage is shown, approx 2.5 volts, then replace the EATX controller. If **improper voltage** is shown, check the voltage at wires #5 & #44 Bias Voltage. If these check out okay, there is either a bad splice in the harness connecting wire #5 Bias Voltage to wire #43 Data, or wire #4 Data to wire #44 Bias Voltage. Make another splice for these connections closer to the EATX controller and check the voltage at wires #4 Data & #43 Data again. If voltage is correct, the scan-tool will probably work now. If voltage is still incorrect. Go to section 4 on page 82.

STEP 2B If the BCM provides the POWER, check the EATX connector voltage at wires #4 & #43 Data. If the correct voltage is shown, approx. 2.5 volts, then replace the EATX controller. If **improper voltage** is shown, splice a long piece of wire between wire #4 Data at the EATX controller and the bus negative wire at the diagnostic connector, (figure 20). Splice another wire between EATX wire #43 Data and the bus positive wire at the diagnostic connector. Since this is only a test, just run the wires in next to the door frame. If the scan-tool now has access to the EATX controller, you have the option of making the new circuit permanent by running the wires through the firewall.

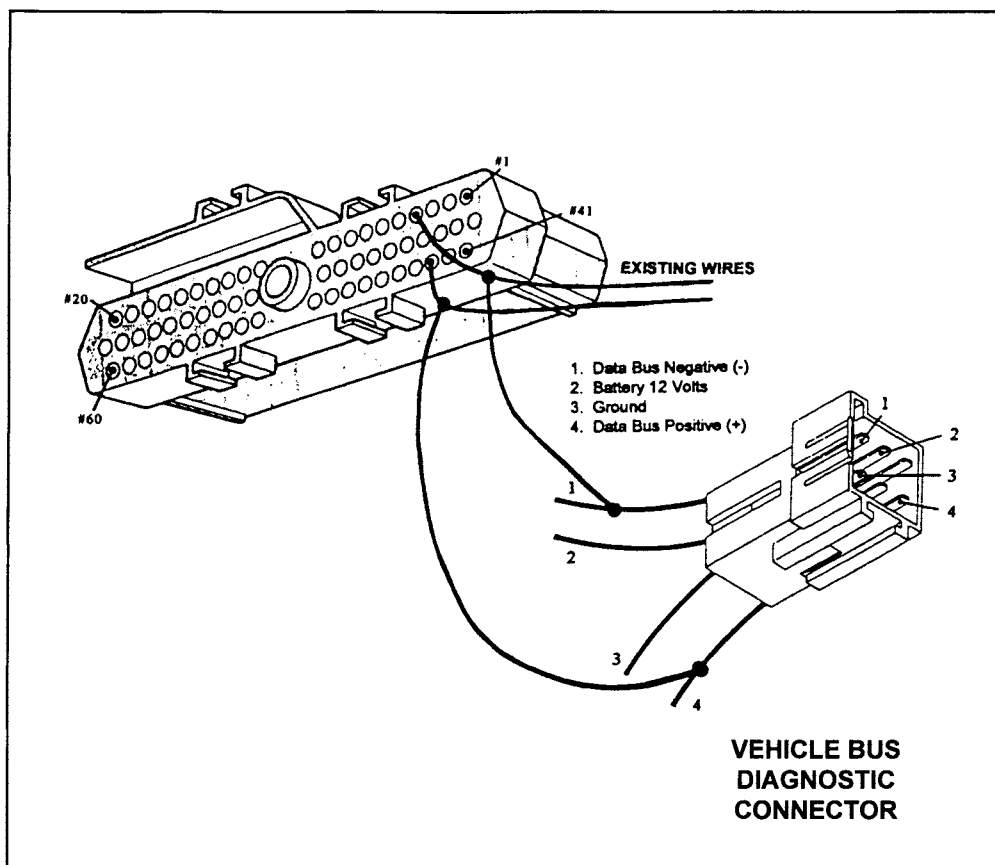


Figure 20

SECTION FOUR

The Last Resort

If the entire C²D bus system is down, follow the procedure below.

BCM BIASED VEHICLES

Cut the EATX connector bus wires #4 & #43 Data about 4 to 6 inches away from the controller. Remove the connector, and solder a couple of wires to pins #5 & #44 Bias Voltage, as outlined on page 76.

Using the trailer connectors, connect the new wires with the ends you cut coming out of the connector, joining #4 Data to #44 Bias Voltage, and #5 Bias Voltage to #43 Data, just like in figure 17B (the only difference being that the original wires are now cut). Now hook up the scan-tool to this and the battery posts using the special connector with clips (figure 21). It should now be able to offer transaxle codes and data. If not, replace the EATX.

EATX BIASED VEHICLES

The only difference between this method and the preceding one is that there are already wires coming out of pin locations #5 & #44 Bias Voltage. About 4-6 inches away from the EATX controller, cut pins #4 Data, #5 Bias Voltage, #43 Data & #44 Bias Voltage, and join them together as described above. If it doesn't work, replace the EATX.

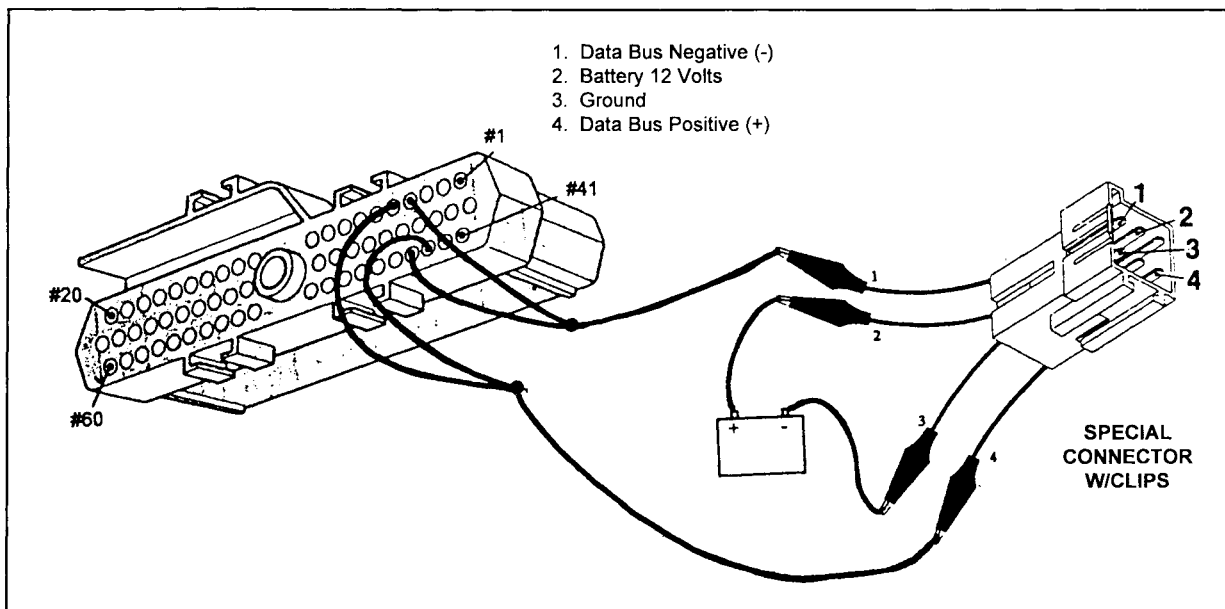


Figure 21

Vehicle Configuration

Year	Body Code	Vehicle Lines	Possible Components On C ² D Bus.
1989	AA	Dodge Spirit Plymouth Acclaim	• A-604 Transaxle Controller • Traveler • SMEC/SBEC (Engine Controller)
1989	AC	Chrysler New Yorker Dodge Dynasty	• Body Controller • EVIC • Electronic Cluster (EIC) (New Yorker) • Engine Node (w/EVIC) • Traveler • SBEC (Engine Controller) • A-604 Transaxle Controller • Security Alarm Module (SAM) (Bias when Body Controller goes asleep)
1989	AS	Dodge Caravan Plymouth Voyager	• A-604 Transaxle Controller • SBEC (Engine Controller)
1990	AA	Chrysler LeBaron Dodge Spirit Plymouth Acclaim	• A-604 Transaxle Controller • Traveler • SBEC (Engine Controller)
1990	AC AY	Chrysler New Yorker Dodge Dynasty Chrysler Imperial Chrysler Fifth Avenue	• Body Controller • SBEC (Engine Controller) • A-604 Transaxle Controller • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • EVIC (Chrysler) • Electronic Cluster (EIC) (Chrysler) • Engine Node (w/EVIC) • Air Suspension (Imperial)
1990	AJ AG	Chrysler LeBaron Dodge Daytona	• Body Controller • SBEC (Engine Controller) • A-604 Transaxle Controller • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • Overhead Compass Temp • EVIC (LeBaron) • Electronic Cluster (EIC) (LeBaron) • Engine Node (LeBaron w/EVIC) • Traveler

Vehicle Configuration

Year	Body Code	Vehicle Lines	Possible Components On C ² D Bus.
1990	AS	Chrysler Town & Country Dodge Caravan Plymouth Voyager	• A-604 Transaxle Controller • SBEC (Engine Controller)
1991	AA	Chrysler LeBaron Dodge Spirit Plymouth Acclaim	• 41TE Transaxle Controller • Traveler • SBEC (Engine Controller)
1991	AC AY	Chrysler New Yorker Dodge Dynasty Chrysler Imperial Chrysler Fifth Avenue	• Body Controller • SBEC (Engine Controller) • 41TE Transaxle Controller • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • Electronic Cluster (EIC) (Chrysler) • EVIC (Chrysler) • Engine Node (w/EVIC) • Air Suspension (Imperial)
1991	AJ AG	Chrysler LeBaron Dodge Daytona	• Body Controller • EVIC (LeBaron) • Electronic Cluster (EIC) (LeBaron) • Engine Node (LeBaron w/EVIC) • Traveler (LeBaron) • SBEC (Engine Controller) • 41TE Transaxle Controller • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • Overhead Compass Temp
1991	AS	Chrysler Town & Country Dodge Caravan Plymouth Voyager	• Body Controller • Mechanical Cluster (MIC) • Electronic Cluster (EIC) (Town & Country) • Overhead Compass Mini-Trip • 41TE Transaxle Controller • SBEC (Engine Controller)
1992	AA	Chrysler LeBaron Dodge Spirit Plymouth Acclaim	• 41TE Transaxle Controller • Traveler • SBEC (Engine Controller)

Vehicle Configuration

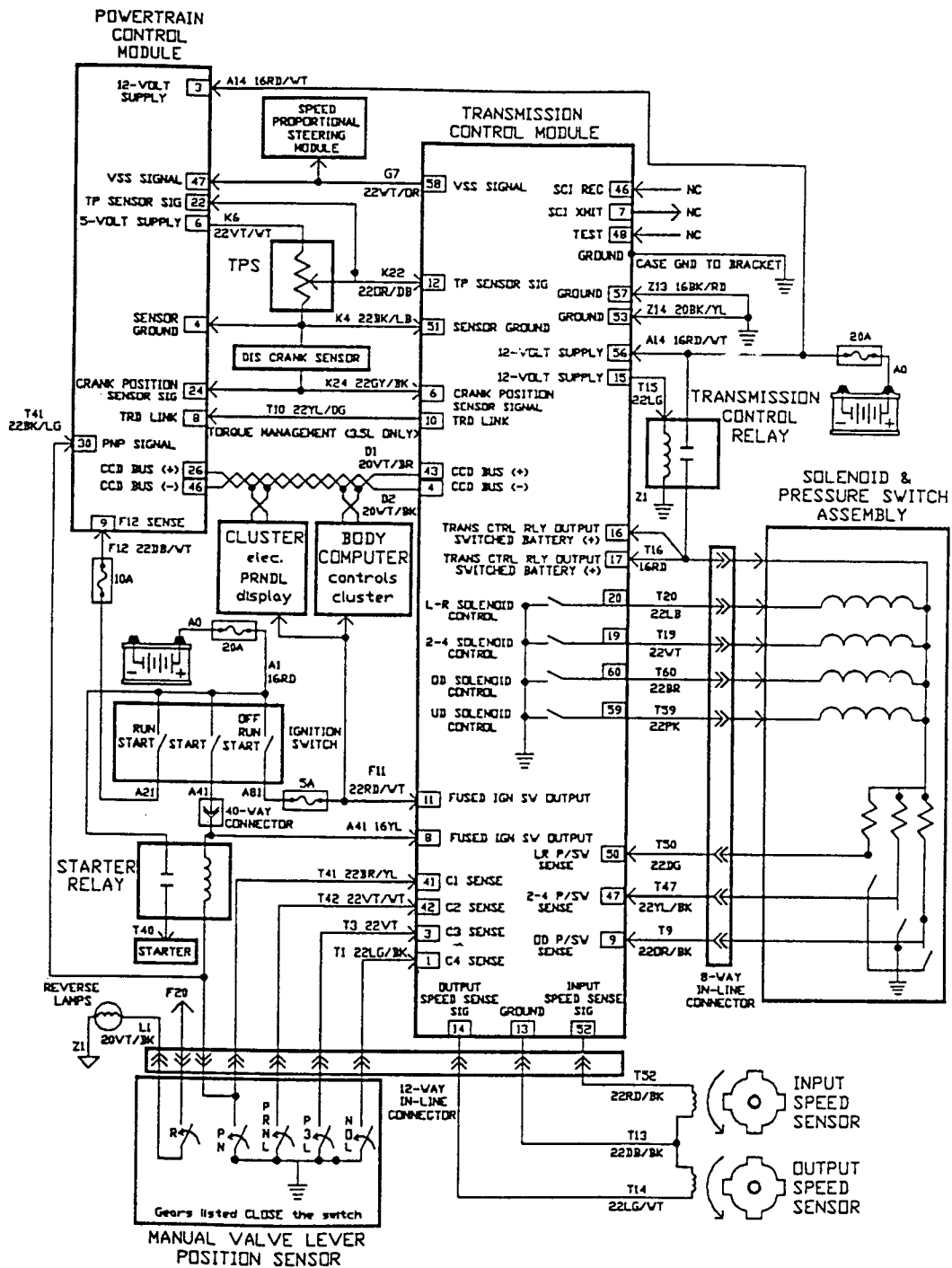
Year	Body Code	Vehicle Lines	Possible Components On C ² D Bus.
1992	AC AY	Chrysler New Yorker Dodge Dynasty Chrysler Imperial Chrysler Fifth Avenue	• Body Controller • SBEC (Engine Controller) • 41TE Transaxle Controller • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • Electronic Cluster (EIC) (Chrysler) • EVIC (Chrysler) • Engine Node (w/EVIC only) • Air Suspension (Imperial)
1992	AJ AG	Chrysler LeBaron Dodge Daytona	• Body Controller • EVIC (LeBaron) • Electronic Cluster (EIC) (LeBaron) • Engine Node (LeBaron w/EVIC) • Traveler (LeBaron) • SBEC (Engine Controller) • 41TE Transaxle Controller • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • Overhead Compass Temp
1992	AS	Chrysler Town & Country Dodge Caravan Plymouth Voyager	• Body Controller • Mechanical Cluster (MIC) • Electronic Cluster (EIC) (Town & Country) • Overhead Compass Mini-Trip • 41TE Transaxle Controller • SBEC (Engine Controller)
1993	AA	Chrysler LeBaron Dodge Spirit Plymouth Acclaim	• Transmission Control Module (TCM) • Traveler • Powertrain Control Module (PCM)
1993	AC AY	Chrysler New Yorker Dodge Dynasty Chrysler Imperial Chrysler Fifth Avenue	• Body Controller • Powertrain Control Module (PCM) • Transmission Control Module (TCM) • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • Electronic Cluster (EIC) (Chrysler) • EVIC (Chrysler) • Engine Node (w/EVIC only) • Air Suspension (Imperial)

Vehicle Configuration

Year	Body Code	Vehicle Lines	Possible Components On C ² D Bus.
1993	AJ AG	Chrysler LeBaron Dodge Daytona	• Body Controller • EVIC (LeBaron w/Engine Node) • Electronic Cluster (EIC) (LeBaron) • Engine Node (LeBaron w/EVIC) • Traveler (LeBaron) • Powertrain Control Module (PCM) • Transmission Control Module (TCM) • Security Alarm Module (SAM) (Bias when Body Controller goes asleep) • Overhead Compass Temp
1993	AS	Chrysler Town & Country Dodge Caravan Plymouth Voyager	• Body Control Module (BCM) • Mechanical Cluster (MIC) • Electronic Cluster (EIC) (Town & Country) • Overhead Compass Mini-Trip • Transmission Control Module (TCM) • Powertrain Control Module (PCM)
1993	LH	Chrysler New Yorker Chrysler LHS Chrysler Concorde Dodge Intrepid Eagle Vision	• Body Control Module (BCM) • Passenger Air Bag System Diagnostic Module (PASDM) • Automatic Temperature Control (ATC) head • Transmission Control Module (TCM) • Powertrain Control Module (PCM) • Mechanical Instrument Cluster (MIC) • Controller Antilock Brake (CAB) • Overhead Trip Information System (OTIS)
1994	AA	Chrysler LeBaron Dodge Spirit Plymouth Acclaim	• Transmission Control Module (TCM) • Traveler • Powertrain Control Module (PCM)
1994	AJ	Chrysler LeBaron	• Body Control Module (BCM) • EVIC (w/Engine Node) • Electronic Cluster (EIC) • Engine Node (w/EVIC) • Traveler • Powertrain Control Module (PCM) • Transmission Control Module (TCM) • Security Alarm Module (SAM) (Bias when Body Controller goes asleep)

Vehicle Configuration

Year	Body Code	Vehicle Lines	Possible Components On C ² D Bus.
1994	AS	Chrysler Town & Country Dodge Caravan Plymouth Voyager	• Body Control Module (BCM) • Mechanical Cluster (MIC) • Electronic Cluster (EIC) (Town & Country only) • Overhead Compass Mini-Trip • Powertrain Control Module (PCM) • Transmission Control Module (TCM)
1994	LH	Chrysler New Yorker Chrysler LHS Chrysler Concorde Dodge Intrepid Eagle Vision	• Body Control Module (BCM) • Passenger Air Bag System Diagnostic Module (PASDM) • Automatic Temperature Control (ATC) head • Transmission Control Module (TCM) • Powertrain Control Module (PCM) • Mechanical Instrument Cluster (MIC) • Controller Antilock Brake (CAB) • Overhead Trip Information System (OTIS)



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Notes

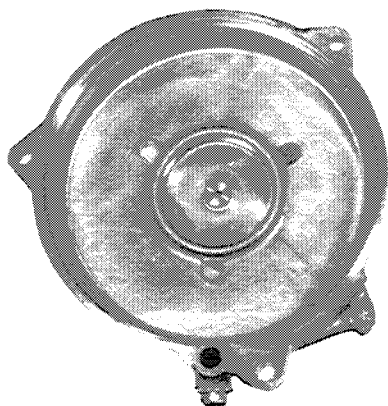
KM175 vs. KM175-5

Hard Parts Comparison

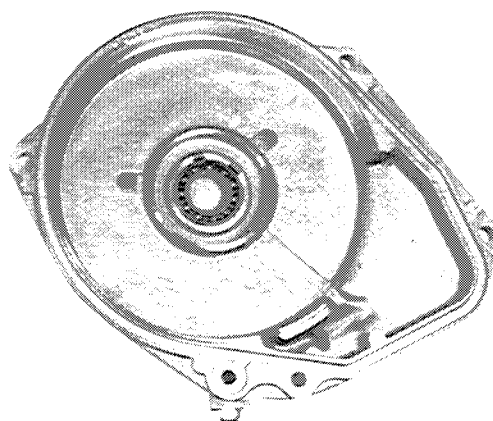
The KM175 was introduced in 1985. It was modified greatly in 1989. This unit is referred to as the KM175-5. This section contains a brief overview of the parts changes which occurred.

NOTE: None of the parts that are illustrated are interchangeable.

End Clutch Cover

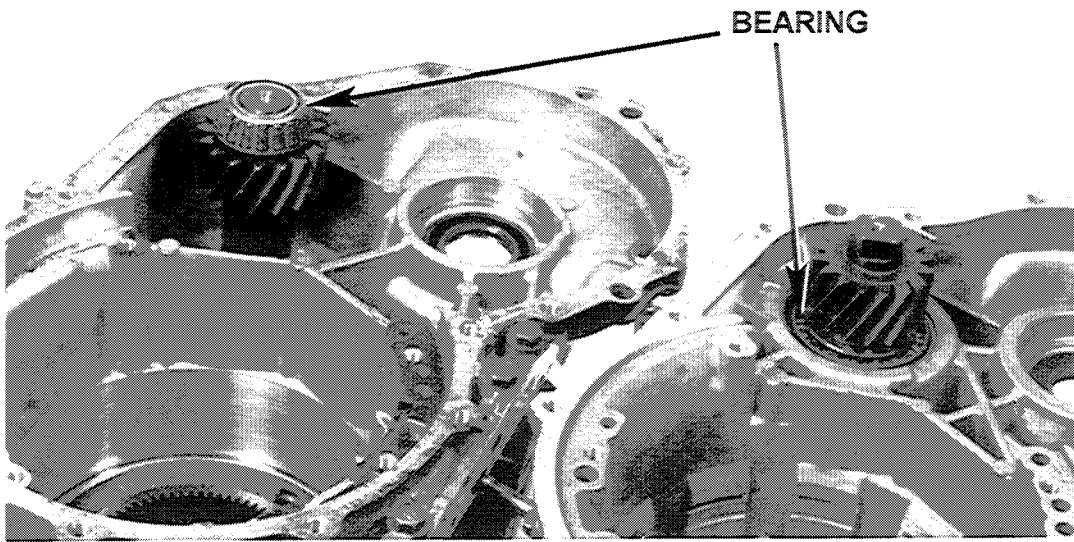


KM175



KM175-5

Case and Transfer Shaft

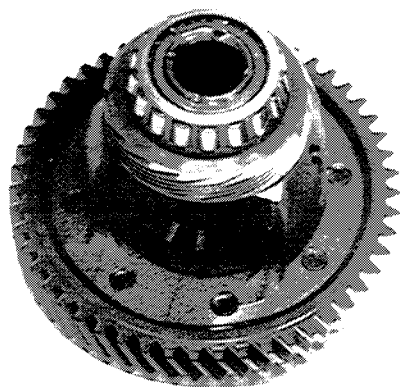


KM175

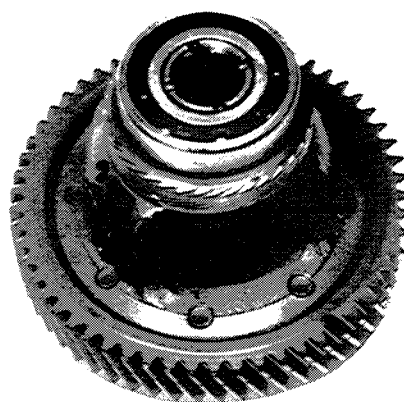
KM175-5

Notice that the bearing on transfer shaft was moved. The bearing on the other end of the shaft was also moved. Because of this, the method for setting transfer shaft end play was changed.

Differential Carrier



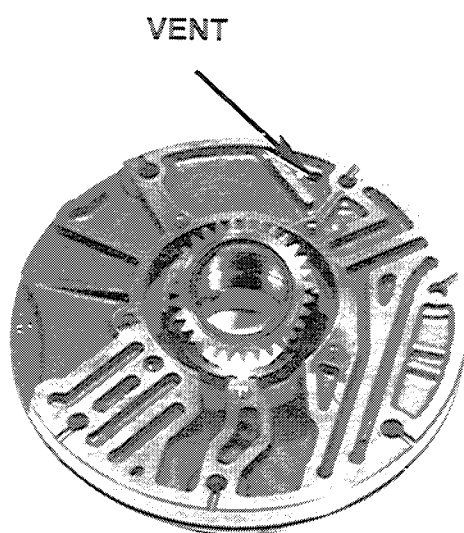
KM175
ROLLER
BEARINGS



KM175-5
BALL
BEARINGS

NOTE: There are several speedometer drive gears available. It is important that the correct gear is used for a given application.

Pump Body and Gears



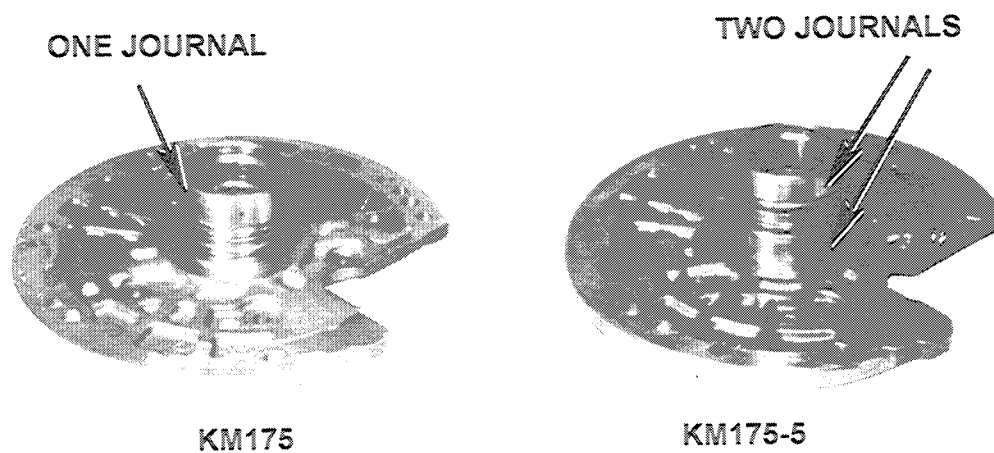
KM175



KM175-5

Notice that the pump gears are different. The thickness of the two pump bodies is also different.

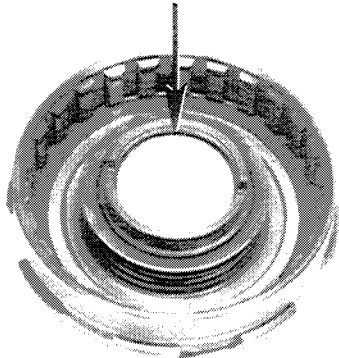
Stator Supports



NOTE: The thickness of two supports are different.

Front Clutch Drum

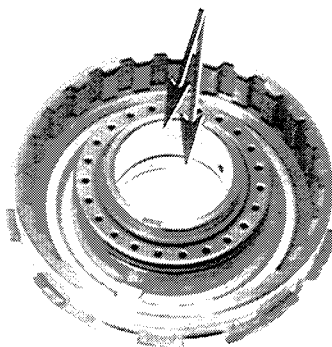
ONE BUSHING



8 LUGS

KM175

TWO BUSHINGS

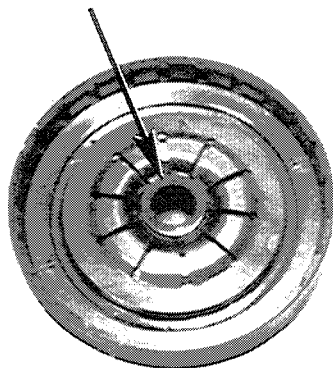


12 LUGS

KM175-5

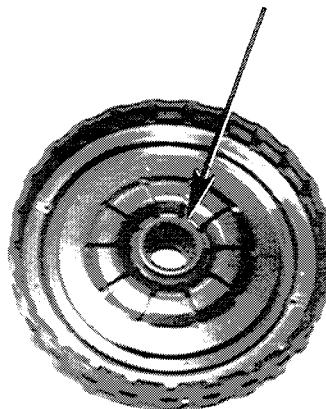
End Clutch

22
SPLINES



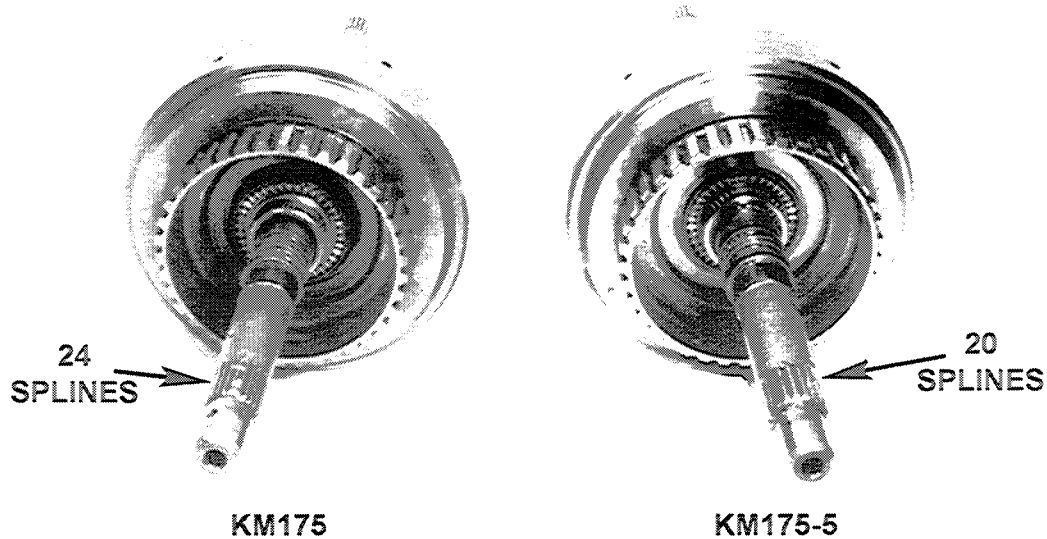
KM175

24
SPLINES



KM175-5

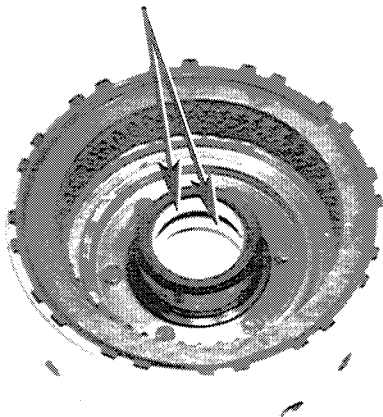
Rear Clutch Drum and Input Shaft



The input shaft used in the KM175-5 is larger in diameter than the one used in the KM175. Because of this, the drum was modified.

Low/Reverse Clutch

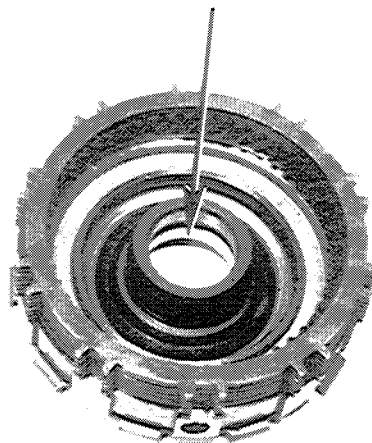
TWO BUSHINGS



KM175

THE CLUTCHES
ARE PART OF
THE SUPPORT

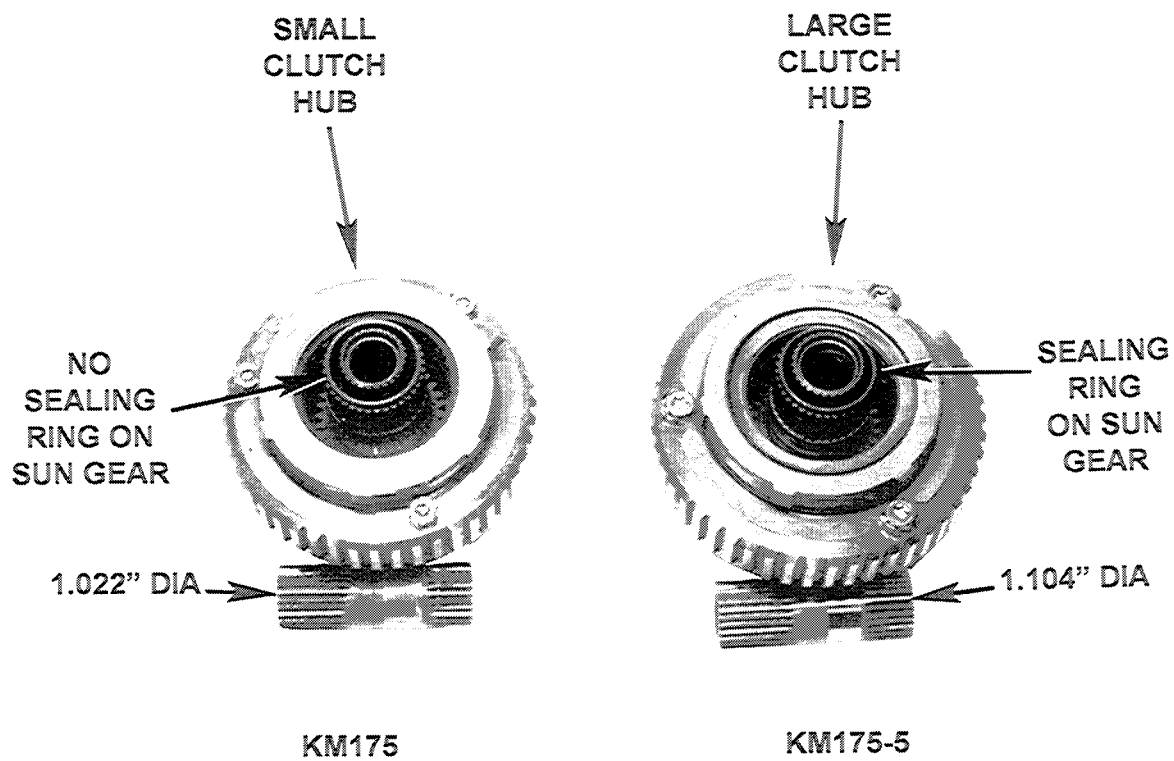
ONE BUSHING



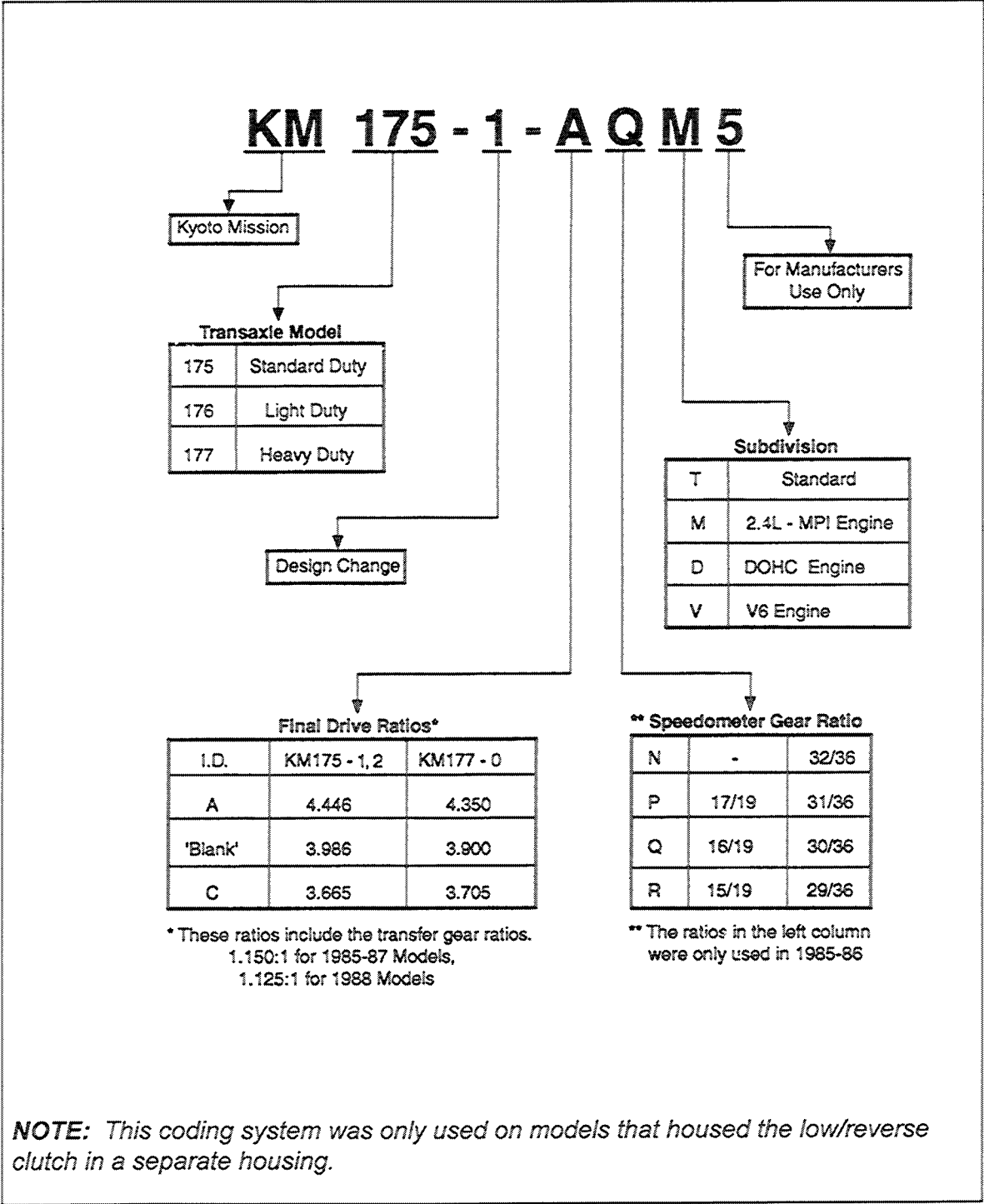
KM175-5

THE CLUTCHES
SPLINE INTO THE
CASE

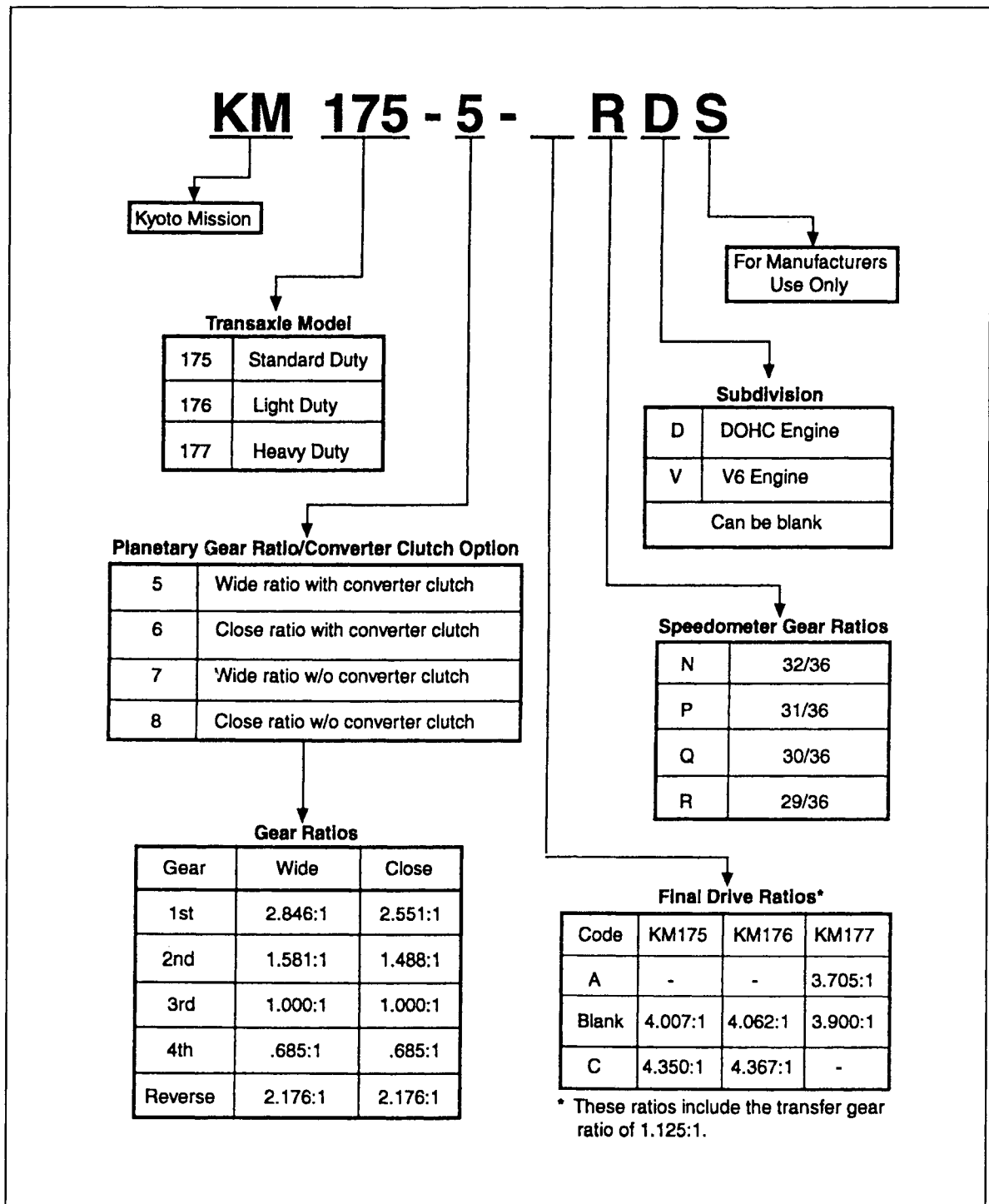
Planetary and End Clutch Shaft



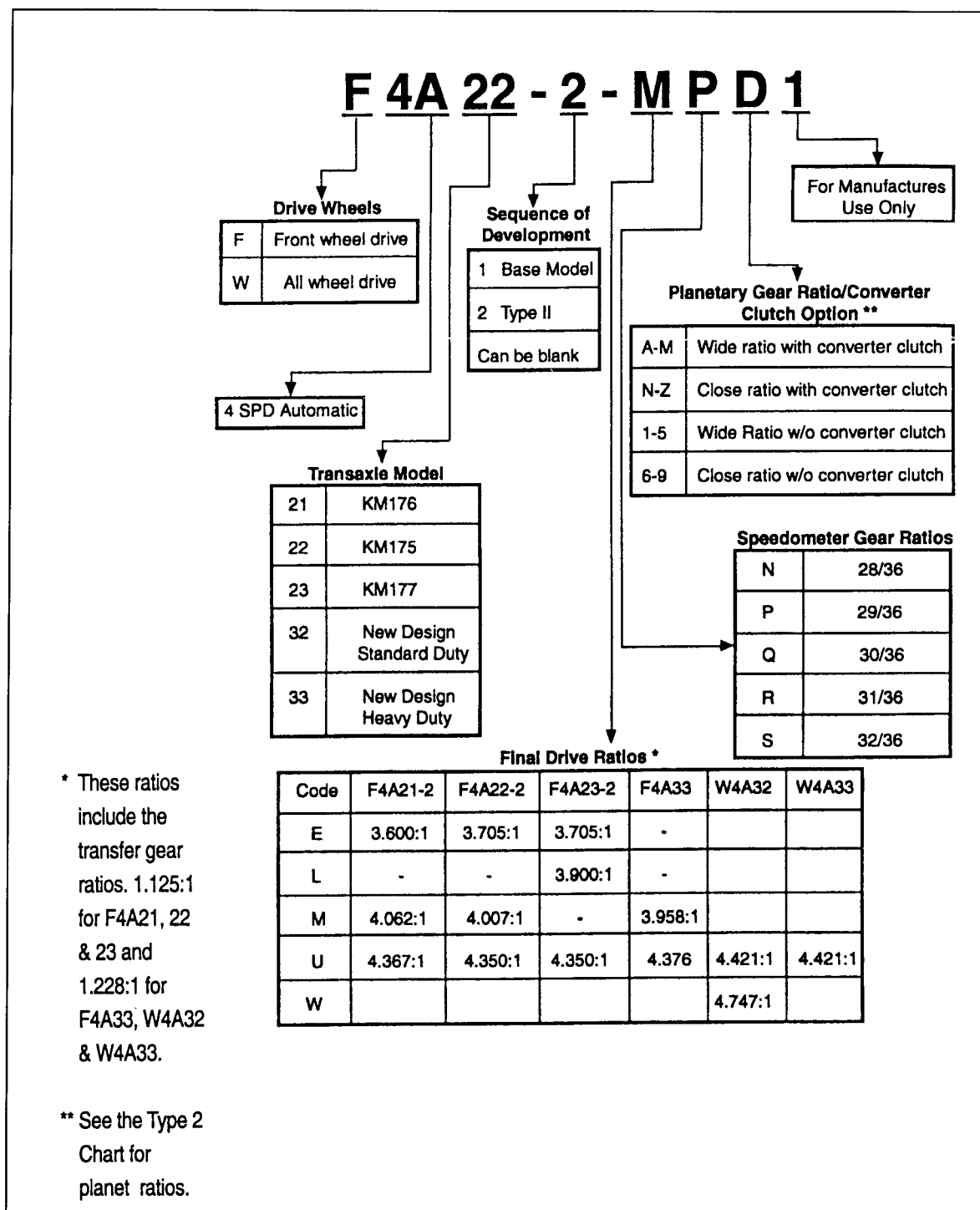
Type 1 ID



Type 2 ID



Type 3 ID



Hyundai Transaxle ID

A T/A Model	KM176-5	KM175-5	KM175-6	KM177-8
Application	4-Speed			
Engine Type	1.5L (MPI) 1.6L (DOHC)	2.0L (MPI, DOHC)	2.4L (MPI)	3.0L (MPI)
Applicable Vehicle Model	EXCEL (X-2) SCOUPE (SCL)* ELANTRA (J-1)	SONATA (Y-2)	SONATA (Y-2)	SONATA V-6

* 1993 - 94 models use the A4AF1

Transaxle Number Identification

1. Model

B: KM176-5
C: KM175-5
D: KM175-6
E: KM177-8
G: A4AF1

3. Final Drive Ratio

KM176-5
A: **4.062**
F: 4.062 (Slant)**
G: 4.367 (Slant)**
KM175-5
B: 4.007
C: 4.350
F: 4.007 (Slant)**
KM175-6
B: 4.007
KM177-8
A: 3.705
B: 3.900

4. Classification

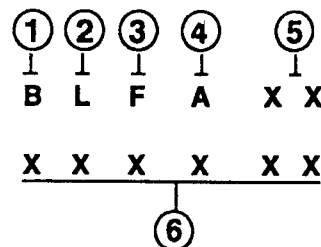
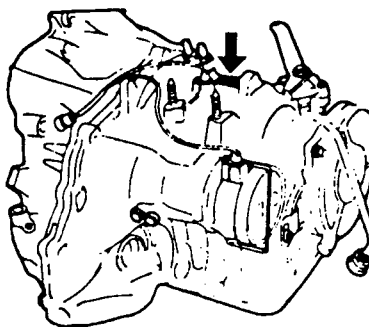
5. Spare - D = Damper

6. Serial No.

** These transaxles are fitted to an engine that is set at a slant for hood clearance.

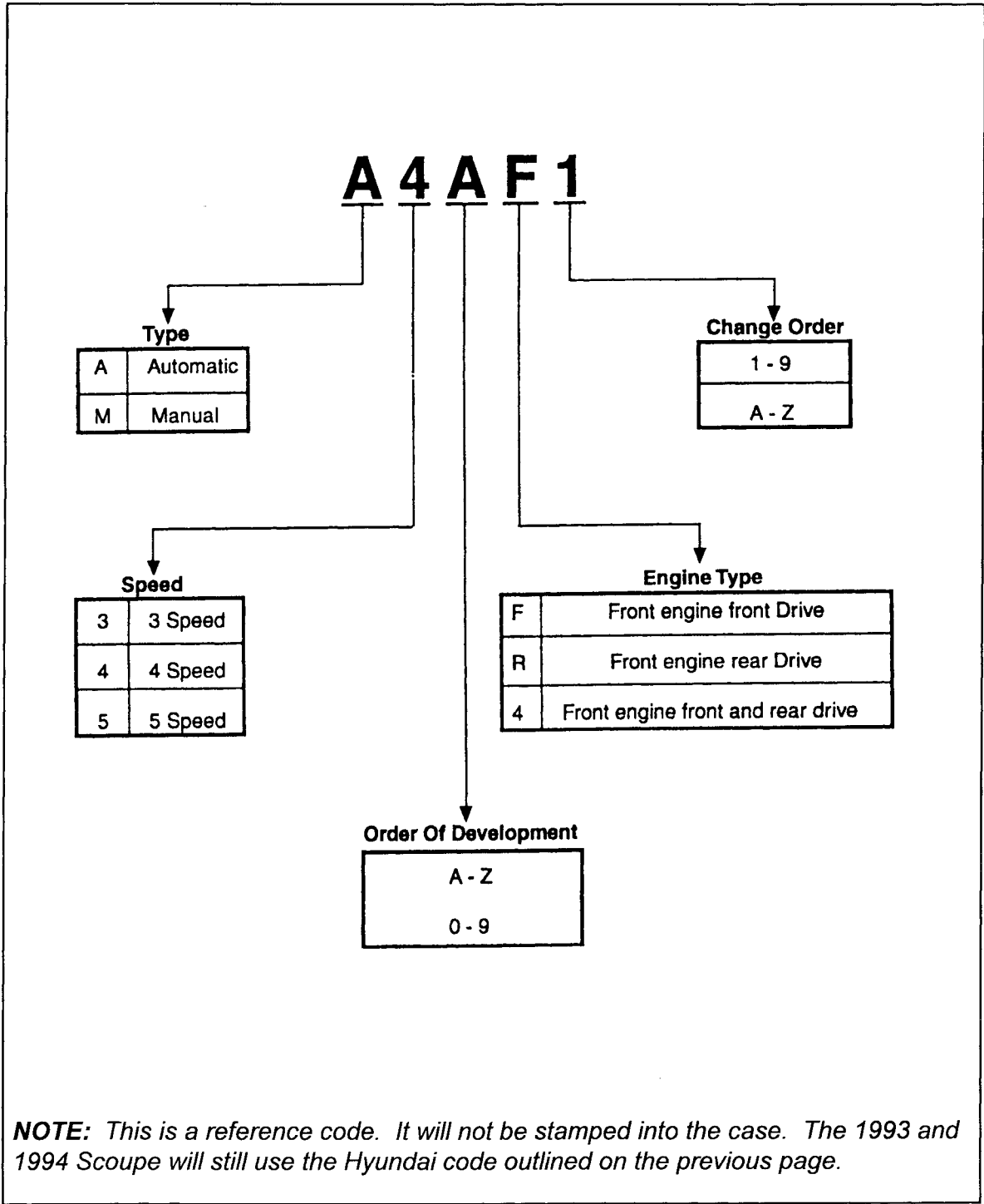
2. Year

K: 1989
L: 1990
M: 1991
N: 1992
P: 1993
R: 1994



NOTE: The Mitsubishi Precis is the same as the Excel.

1993-94 Scoupe ID



Transaxle I.D. to Model Crossreference

KM175-1 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-AQM5	85, 86 Galant	2.4
-AQM7	87 Galant	2.4

KM175-5 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-RDS	90 Laser/Talon	2.0D
-RS	90 Laser/Talon	1.8
-R1	89 Galant	2.0
CNB ??	92 Sonata	2.0D
CPB ??	93 Sonata	2.0D
CPCAD	93 Elantra	1.8
CRCAD	94 Elantra	1.8

KM175-6 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
DLB ??	90 Sonata	2.4
DMB ??	91 Sonata	2.4

KM176-5 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-PD	89 Colt	1.6
BLFAD	90 Excel, Precis	1.5
BMFAD	91 Excel, Precis	1.5
BMGAD	91 Scoupe	1.5
BNFAD	92 Excel, Precis	1.5
BNGAD	92 Elantra, Scoupe	1.5
BPFAD	93 Excel, Precis	1.5
BRFAD	94 Excel, Precis	1.5

KM177-0 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-AQV	88 Galant Sigma	3.0

KM177-8 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-AQV	89 Sigma	3.0
EKA ??	89 Sonata	3.0
ELA ??	90 Sonata	3.0
EMA ??	91 Sonata	3.0
ENA ??	92 Sonata	3.0
EPA ??	93 Sonata	3.0

NOTE: Digits with circles around them may not be the exact letter or number found on the case but can be used to decipher the code. Question marks (?) were used for digits that were unavailable.

Transaxle I.D. to Model Crossreference

F4A21-2 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-MRA	90 Colt, Mirage, Summit	1.6
-MRD1	91, 92 Colt, Mirage, Summit	1.5
-URD	91, 92 Mirage	1.6

F4A22-1 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-MPN	89 Sonata	2.4

F4A23-2 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-EP6	90 Sigma	3.0
-LN(N) ?	92-94 Colt Vista, Expo 93-94 Expo LRV	2.4
-UPQ3	94 Galant	2.4

F4A22-2 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-MPA	90 Eclipse	1.8
-MPA1	90 Eclipse	2.0D
-MPA2	90 Galant	2.0
-MPD	91, 92 Eclipse, Laser, Talon	1.8
-MPD1	91, 92 Eclipse, Laser, Talon	2.0D
-MPD3	91, 92 Galant	2.0
-MPE	93 Eclipse, 93, 94 Laser, Talon	1.8
-MPE1	93, 94 Eclipse, Laser, Talon	2.0D
-MPE4	93 Galant	2.0
-MPF5	94 Eclipse	1.8
-MQD4	91 Galant	2.0D
-MQD6	92 Galant	2.0D
-MQF1	94 Colt, Mirage, Summit	1.8
-MRF3	93 Colt, Mirage, Summit	1.8
-UN(1) ?	92-94 Colt Vista, Expo LRV	1.8

NOTE: Digits with circles around them may not be the exact letter or number found on the case but can be used to decipher the code. Question marks (?) were used for digits that were unavailable.

Transaxle I.D. to Model Crossreference

F4A33-1 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-MNN1	91 Stealth	3.0
-MNN2	91 Stealth, 3000 GT	3.0D
-MNN3	92 Diamante	3.0
-MNN4	92 Diamante	3.0D
-MNN5	92 Diamante (4WS)	3.0D
-MNP1	92 Stealth	3.0
-MNP2	92 Stealth, 3000 GT	3.0D
-MNP7	93 Stealth	3.0
-MNP8	93 Stealth, 3000 GT	3.0D
-MNP9	93 Diamante	3.0
-MNPC	93 Diamante	3.0D
-MNPE	93 Diamante (4WS)	3.0D
-MNQ1	94 Stealth	3.0
-MNQ2	94 Stealth, 3000 GT	3.0D
-MNQ3	94 Diamante	3.0
-UNQ4	94 Diamante (4WS)	3.0D
-UNQ8	94 Diamante	3.0D
-UP61	91, 92 Eclipse, Laser Talon	2.0D Turbo
-UP63	93, 94 Eclipse, Laser, Talon	2.0D Turbo
-UPQ1	94 Galant	2.4D

W4A32-1 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-UN(N) ?	92-94 Colt Vista, Expo 93 Expo LRV	2.4
-UQA	91 Galant	2.0D
-UQA2	92 Galant	2.0D
-WN(A) ?	92-93 Colt Vista, Expo LRV	1.8

W4A33-1 TRANSAXLE

I.D.	MODEL	ENGINE SIZE
-UP6	91, 92 Eclipse, Laser, Talon	2.0D Turbo
-UP61	93, 94 Eclipse, Laser, Talon	2.0D Turbo

A4AF1 TRANSAXLE

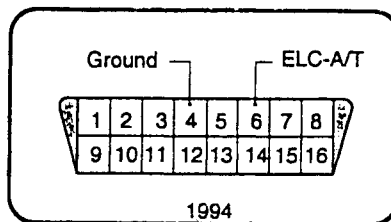
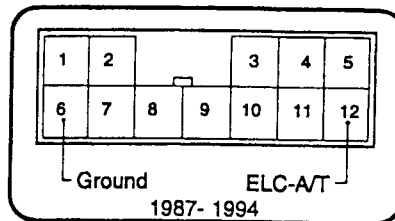
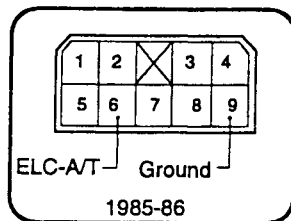
I.D.	MODEL	ENGINE SIZE
GPPAD	93 Scoupe	1.5
GRPAD	94 Scoupe	1.5

(4WS) = Four wheel steering

NOTE: Digits with circles around them may not be the exact letter or number found on the case but can be used to decipher the code. Question marks (?) were used for digits that were unavailable.

Trouble Codes

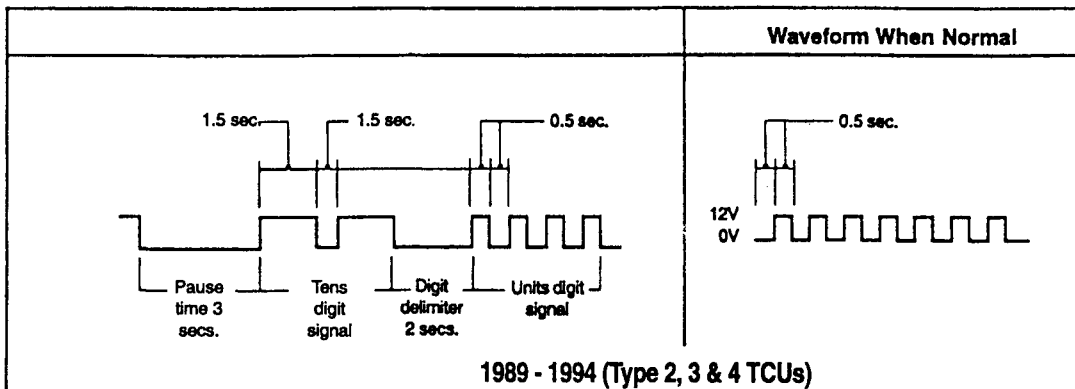
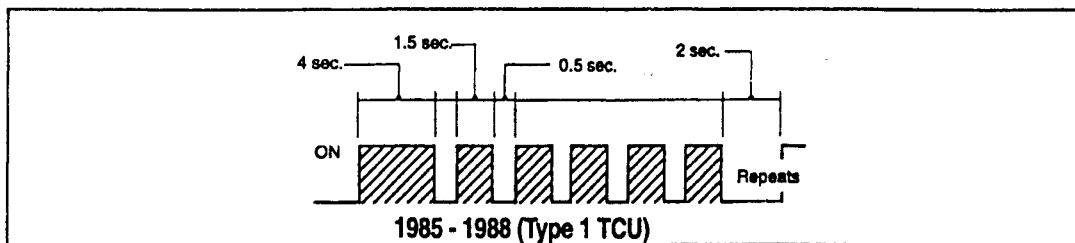
Data Link Connector Types



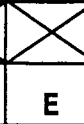
Colt, Diamonte, Galant, Stealth and 3000 GT

(OBDII Connector)

CODE FORMAT



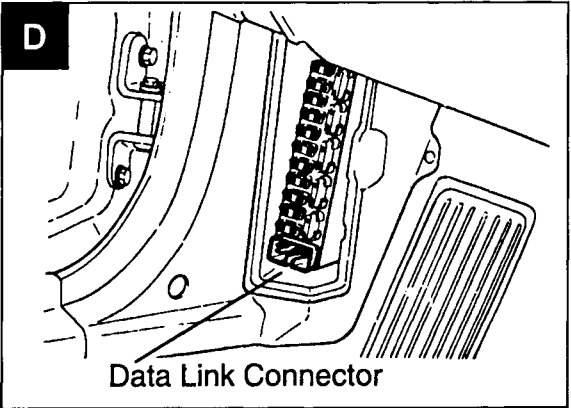
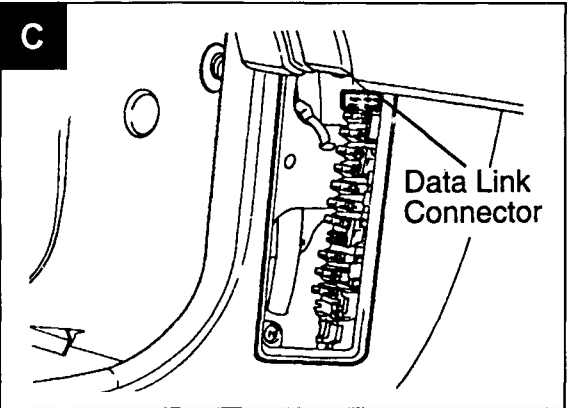
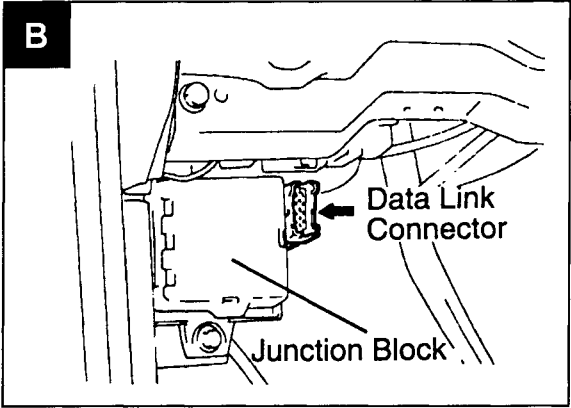
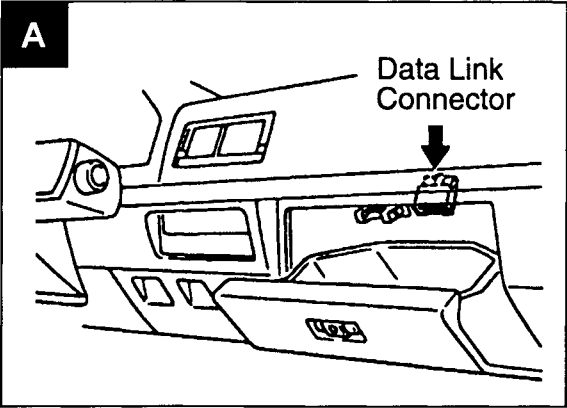
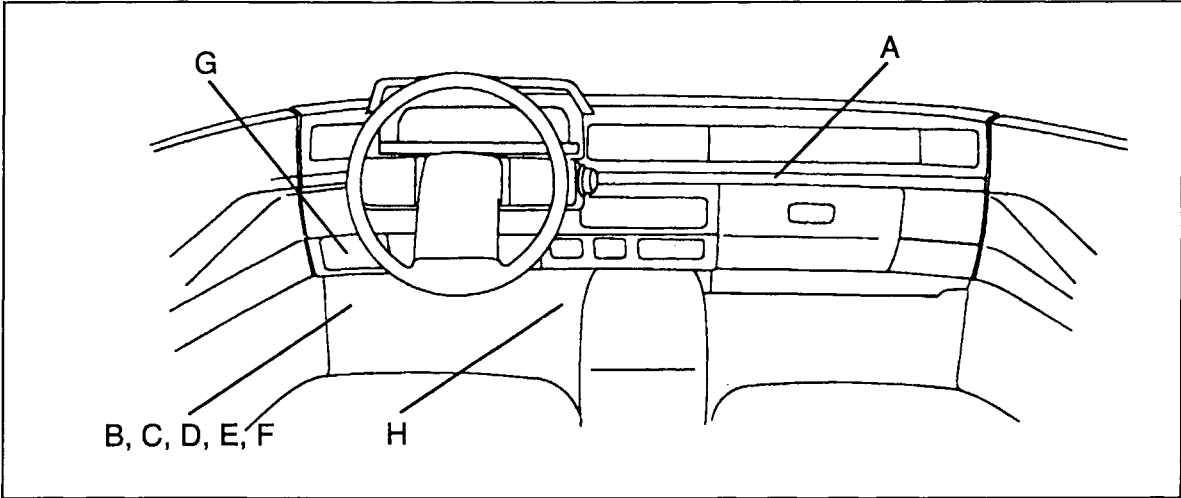
Data Link Connector Locations

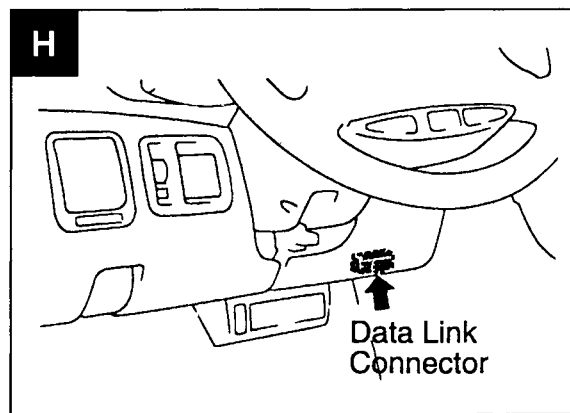
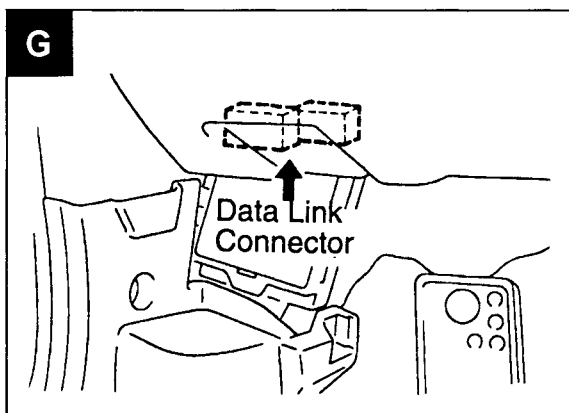
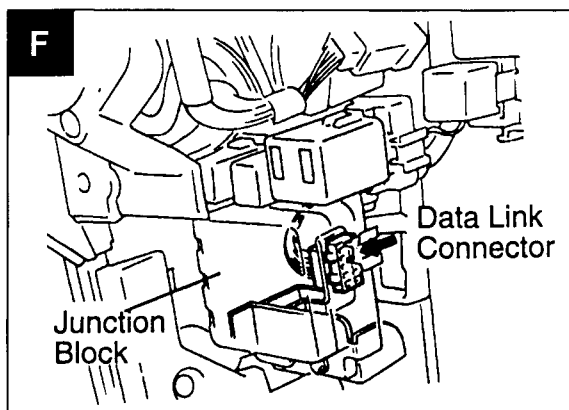
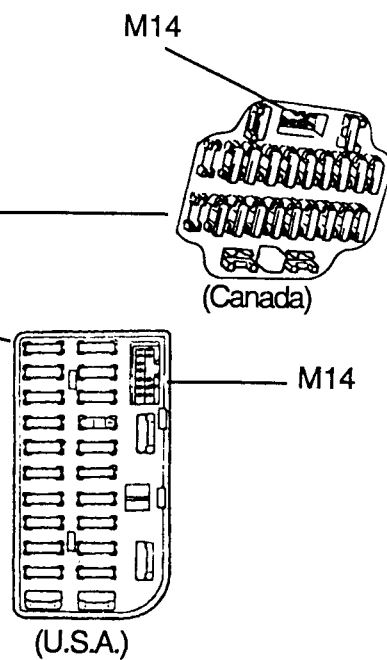
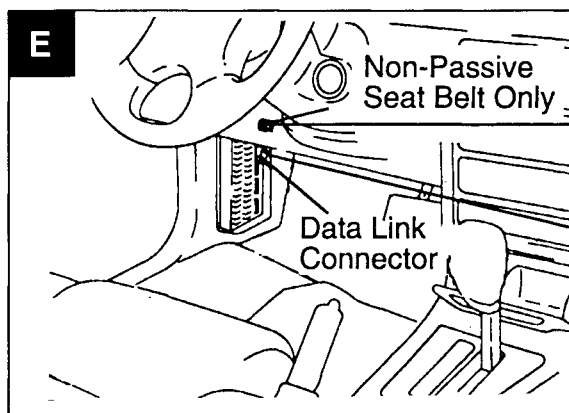
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Colt					B	B	B	B	B	G
Colt Vista								B	B	F
Diamonte								B	B	G*
Eclipse						B	B	B	B	B
Elantra								D	D	D
Excel						C	C	C	C	C
Expo								B	B	F
Expo LRV								B	B	F
Galant	A	A	A	**	B	B	B	B	B	H
Laser						B	B	B	B	B
Mirage						B	B	B	B	H
Precis						C	C	C	C	C
Scoupe							C	C	C	C
Sigma				A	A	A				
Sonata					E	E	E	E	E	
Stealth							B	B	B	H
Summit					B	B	B	B	B	G
Talon						B	B	B	B	B
3000 GT							B	B	B	H

* Diamonte Wagon = B

** See Sigma

Data Link Connector Locations





TCU Types

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Colt					2	2	3	3	4	4
Colt Vista								3	4	4
Diamonte								3	4	4
Eclipse						2	3	3	4	4
Elantra								2	2	3
Excel						2	2	2	2	3
Expo								3	4	4
Expo LRV								3	4	4
Galant	1	1	1	*	2		3	3	4	4
Laser						2	3	3	4	4
Mirage						2	3	3	4	4
Precis						2	2	2	2	3
Scoupe								2	2	3
Sigma				1	2	2				
Sonata					2	2	2	2	2	
Stealth							3	3	4	4
Summit					2	2	3	3	4	4
Talon						2	3	3	4	4

* See Sigma

Type 1 TCU Fault Codes

Code				Failure Display Code	Diagnosis	Probable Cause
1985	1986	1987	1988			
1	1	1	1		TCU malfunction; not remedied by resetting.	- Power voltage low (charging system) - TCU
2	2	2	2		First gear signal is detected at high speed.	- Pulse generator B - TCU
3	3	3	3		Vehicle speed detected by pulse generator B is much lower than actual vehicle speed.	- Pulse generator B - TCU
4	4	4	4		Operation of shift-control solenoid valve A differs from computer command.	- Shift control solenoid valve A - TCU
5	5	5	5		Operation of shift-control solenoid valve B differs from computer command.	- Shift control solenoid valve B - TCU
6	-	6	6		Kickdown servo switch signal differs from gear.	- Kickdown servo switch - Pressure control solenoid valve - TCU
7	6	7	7		A slip has been detected.	- Pulse generator A - Pressure control solenoid valve - TCU
8	7	8	8		Pressure control solenoid valve differs from computer command.	- Pressure control solenoid valve - Poorly grounded ground strap - TCU
9	-	-	-		Engine speed is diagnosed to be over 6,500 rpm.	- Pulse generator B ignition coil (ignition signal system) - TCU
10	-	-	-		The kickdown drum speed is diagnosed to be over 6,500 rpm.	- Pulse generators A and B - TCU
11	8	9	-		Malfunction of the damper clutch control system.	- Damper clutch control system - TCU
12	9	10	9		No ignition signal.	- Ignition coil - Ignition signal system - TCU

Automatic Transaxle - Troubleshooting Type 2 TCU Fault Codes

Code	Diagnostic Item	Probable Cause
21	Abnormal increase of TPS output	Excessive output
22	Abnormal decrease of TPS output	Insufficient output
23	Incorrect adjustment of the TPS	Sensor adjustment out of range throttle-position sensor system
24	Oil temperature sensor system	Open circuit
25	Kickdown servo switch system	Open circuit
26	Kickdown servo switch system	Short circuit
27	Ignition signal system	Open or short circuit
28	Accelerator switch system	Short circuit or misadjustment
31	Malfunction of the TCU	Replace TCU
32	First gear command during high-speed driving	Replace TCU
33	Pulse generator 'B' system	Open or short circuit
41	Shift control solenoid valve 'A' system	Open circuit
42	Shift-control solenoid valve 'A'system	Short circuit
43	Shift control solenoid valve 'B' system	Open circuit
44	Shift control solenoid valve 'B' system	Short circuit
45	Pressure control solenoid valve system	Open circuit
46	Pressure control solenoid valve system	Short circuit
47	Torque converter clutch control solenoid valve system	Open circuit
48	Torque converter clutch control solenoid valve system	Short circuit
49	Torque converter clutch control system	Defective hydraulic system TCC solenoid, TCU
51	A slip was detected in 1 st gear	Low line pressure, internal leaks, mechanical failure
52	A slip was detected in 2nd gear	Low line pressure, internal leaks, mechanical failure
53	A slip was detected in 3rd gear	Low line pressure, internal leaks, mechanical failure
54	A slip was detected in 4th gear	Low line pressure, internal leaks, mechanical failure

NOTE: Some 1989 Sonatas with a 4 cylinder engine will use 1985 codes.

Automatic Transaxle - Troubleshooting

Type 2 TCU Fail-Safe Codes

Code	Description	Fail-Safe	*Note (relation to fault code)
11	Malfunction of the microprocessor	3rd gear hold	31
12	First gear command during high speed driving	3rd gear (D) or 2nd gear (2, L) hold	32
13	Damaged or disconnected wiring of the pulse generator 'B' system	3rd gear (D) or 2nd gear (2, L) hold	33
14	Damaged or disconnected wiring or short circuit, of shift control solenoid valve 'A'	3rd gear hold	41, 42
15	Damaged or disconnected wiring, or short circuit, of shift control solenoid valve 'B'	3rd gear hold	43, 44
16	Damaged or disconnected wiring, or short circuit, of the pressure control solenoid valve	3rd gear (D) or 2nd gear (2, L) hold	45, 46
17	A slip has been-detected	3rd gear (D) or 2nd gear (2, L) hold	51, 52, 53, 54

*A fail-safe code is stored after the related fault code is generated four times.

Type 3 & 4 TCU Fault Codes

Code	Diagnostic Item	Probable Cause
11	Throttle position sensor system	High sensor output
12	Throttle position sensor system	Low sensor output
13	Throttle position sensor system	Sensor adjustment out of range
14	Throttle position sensor system	Sensor adjustment out of range
15	Oil temperature sensor system	Open circuit
16	High oil temperature circuit	Short circuit
17*	High oil temperature circuit	Open circuit
21	Kickdown servo switch system	Open circuit
22	Kickdown servo switch system	Short circuit
23	Ignition signal system	Open or short circuit
24	Accelerator switch circuit	Open circuit
28	Stop lamp switch system	Short circuit
31	Pulse generator 'A' system	Open circuit
32	Pulse generator 'B' system	Open circuit
41	Shift control solenoid valve 'A' system	Open circuit
42	Shift control solenoid valve 'A' system	Short circuit
43	Shift control solenoid valve 'B' system	Open circuit
44	Shift control solenoid valve 'B' system	Short circuit
45	Pressure control solenoid valve system	Open circuit
46	Pressure control solenoid valve system	Short circuit
47	Torque converter clutch solenoid system	Open circuit
48	Torque converter clutch solenoid system	Short circuit
49	Torque converter clutch solenoid system	Defective system
51	A slip was detected in 1st gear	Low line pressure, Internal leaks Mechanical failure
52	A slip was detected in 2nd gear	Low line pressure, Internal leaks Mechanical Failure
53	A slip was detected in 3rd gear	Low line pressure, Internal leaks Mechanical Failure

Type 3 & 4 TCU Fault Codes

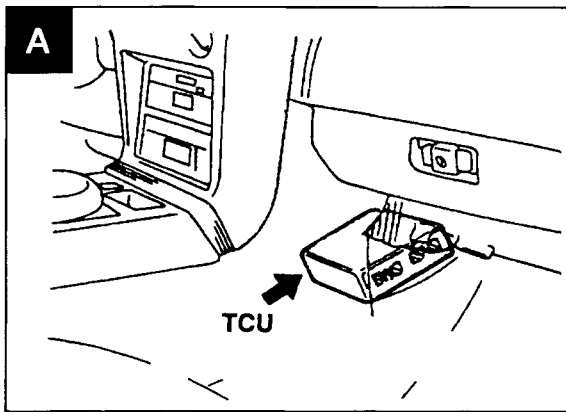
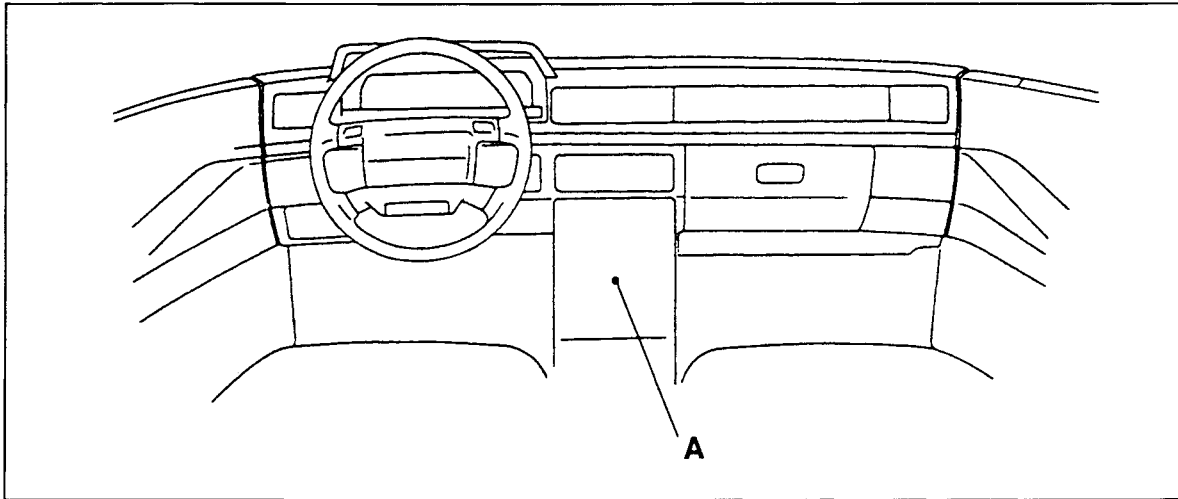
Code	Diagnostic Item	Probable Cause
54	A slip was detected in 4th gear	Low line pressure, Internal leaks Mechanical Failure
59	A torque converter chatter has been detected	Torque converter, valve body, engine miss
61	Torque reduction request signal line	Short circuit
	Torque reduction execution signal line	Open circuit
62	Torque reduction request signal line	Open circuit
63	Torque reduction execution signal line	Short circuit

* On models that do not have a high oil temperature sensor, this code represents a shorted low oil temperature circuit.

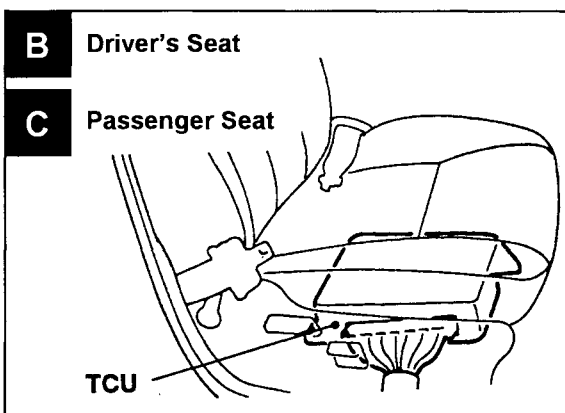
Type 3 & 4 TCU Fail-Safe Codes

Code	Description	Fail-Safe	*NOTE (relation to fault code)
81	Damaged or disconnected wiring of pulse generator 'A'	3rd gear (D) or 2nd gear (2,L) hold	31
82	Damaged or disconnected wiring of pulse generator 'B'	3rd gear (D) or 2nd gear (2,L) hold	32
83	Damaged or disconnected wiring, or short circuit, of shift control solenoid valve 'A'	3rd gear hold	41, 42
84	Damaged or disconnected wiring or short circuit, of shift control solenoid valve 'B'	3rd gear hold	43, 44
85	Damaged or disconnected wiring, or short circuit, of the pressure control solenoid valve	3rd gear (D) or 2nd gear (2,L) hold	45, 46
86	A slip has been detected	3rd gear (D) or 2nd gear (2,L) hold	51, 52, 53, 54

TCU Locations



ALL EXCEPT BELOW

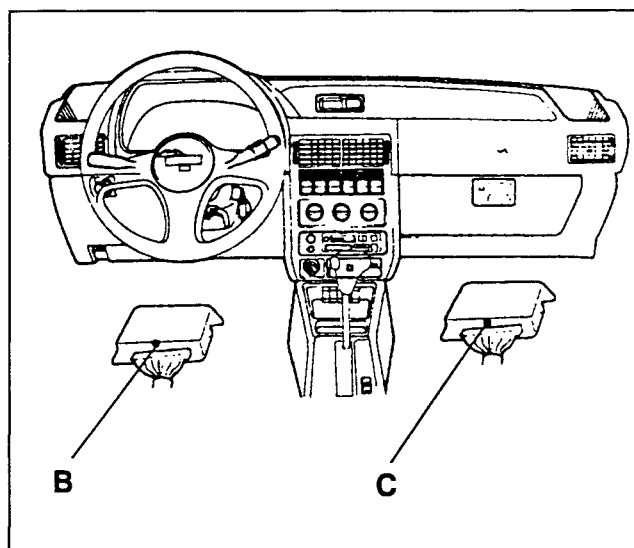


B - 1994 Scoupe

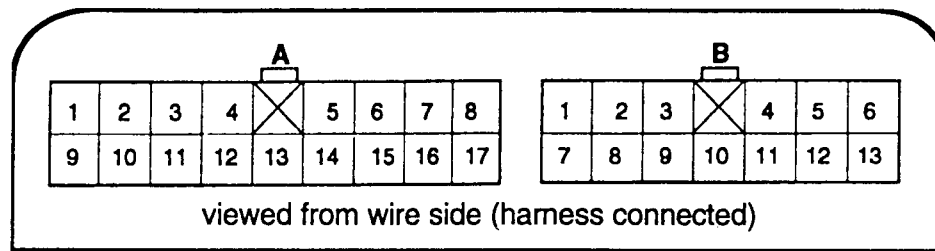
(Under the driver's seat)

C - Elantra, Excel, Precis, 1991-1993 Scoupe

(Under the passenger's seat)



Type 1



- | | | | |
|-----|----------------------------------|-----|----------------------------|
| 1A | Water temperature sensor | 1B | Pulse generator A |
| 2A | Overdrive switch | 2B | Pulse generator B |
| 3A | Inhibitor switch (R) | 3B | |
| 4A | Inhibitor switch (D) | 4B | |
| 5A | Inhibitor switch (L) | 5B | |
| 6A | Torque converter clutch solenoid | 6B | |
| 7A | Shift control solenoid valve B | 7B | Pulse generator A |
| 8A | Accelerator switch | 8B | Pulse generator B |
| 9A | Ground | 9B | Kickdown servo switch |
| 10A | Power supply (ignition switch) | 10B | Throttle position sensor |
| 11A | Inhibitor switch (P) | 11B | Vehicle speed sensor |
| 12A | Inhibitor switch (N) | 12B | On-board diagnostic output |
| 13A | Inhibitor switch (2) | 13B | Ground |
| 14A | Pressure control solenoid valve | | |
| 15A | Shift control solenoid valve A | | |
| 16A | | | |
| 17A | Ignition pulse | | |

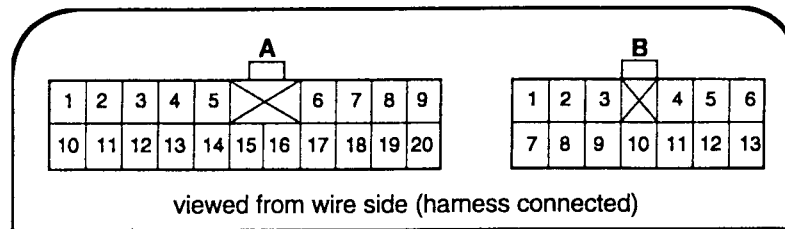
APPLICATIONS

- | | |
|-----------|----------|
| 1985-1987 | - Galant |
| 1988 | - Sigma |

NOTE: Not all TCU's will use all of these pins.

NOTE: The pin numbers that are listed are for reference only. They are not the numbers used on the wire schematics.

Type 2



- | | | | |
|-----|----------------------------------|-----|--------------------------|
| 1A* | Diagnostic test mode control | 1B | Pulse generator A |
| 2A | Overdrive switch | 2B | Pulse generator B |
| 3A | Inhibitor switch (R) | 3B | Oil temp. sensor ground |
| 4A | Inhibitor switch (D) | 4B | |
| 5A | Inhibitor switch (L) | 5B | |
| 6A | Torque converter clutch solenoid | 6B | Power supply (back-up) |
| 7A | Shift control solenoid valve B | 7B | Pulse generator A |
| 8A | Accelerator switch | 8B | Pulse generator B |
| 9A | Power mode switch | 9B | Kickdown servo switch |
| 10A | Ground | 10B | Throttle position sensor |
| 11A | Power supply (ignition switch) | 11B | Vehicle speed sensor |
| 12A | Inhibitor switch (P) | 12B | Oil temperature sensor |
| 13A | Inhibitor switch (N) | 13B | Ground |
| 14A | Inhibitor switch (2) | | |
| 15A | Pressure control solenoid valve | | |
| 16A | Shift control solenoid valve A | | |
| 17A | | | |
| 18A | Ignition pulse | | |
| 19A | On-board diagnostic output | | |
| 20A | A/C relay | | |

APPLICATIONS

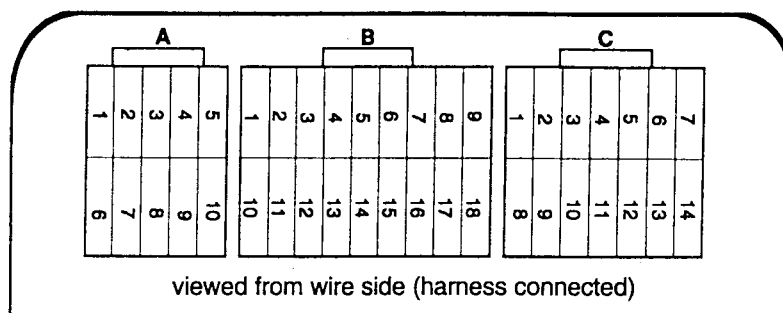
- | | |
|-----------|---|
| 1989-1990 | - Chrysler, Eagle, and Mitsubishi (except Precis) |
| 1989-1993 | - Hyundai, and Mitsubishi Precis |

* Some 1989 model cars will use this wire for a water temperature sensor.

NOTE: Not all TCU's will use all of these pins.

NOTE: The pin numbers that are listed are for reference only. They are not the numbers used on the wire schematics.

Type 3



- | | | | |
|-----|----------------------------------|-----|----------------------|
| 1A | Torque converter clutch solenoid | 1C | Inhibitor switch (P) |
| 2A | Shift control solenoid valve A | 2C | Inhibitor switch (R) |
| 3A | Oil temperature warning light | 3C | Inhibitor switch (N) |
| 4A | Power supply (ignition switch) | 4C | Inhibitor switch (D) |
| 5A | Ground | 5C | Inhibitor switch (2) |
| 6A | Pressure control solenoid valve | 6C | Inhibitor switch (L) |
| 7A | Shift control solenoid valve B | 7C | Overdrive switch |
| 8A | Engine communication signal | 8C | Pulse generator B |
| 9A | Power supply (ignition switch) | 9C | Pulse generator B |
| 10A | Ground | 10C | Pulse generator A |
| | | 11C | Pulse generator A |
| 1B | Ground | 12C | Ground |
| 2B | | 13C | Ignition pulse |
| 3B | Accelerator switch | 14C | Power mode switch |
| 4B | | | |
| 5B | On-board diagnostic output | | |
| 6B | A/C relay signal | | |
| 7B | Engine communication signal | | |
| 8B | Diagnostic test mode control | | |
| 9B | Engine communication signal | | |
| 10B | Power supply (backup) | | |
| 11B | Kickdown servo switch | | |
| 12B | Closed throttle position switch | | |
| 13B | | | |
| 14B | Oil temperature sensor | | |
| 15B | High oil temperature sensor | | |
| 16B | Throttle position sensor | | |
| 17B | Sensor ground | | |
| 18B | Vehicle speed sensor | | |

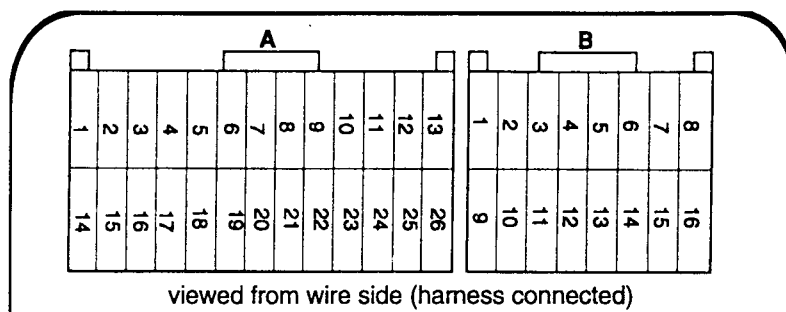
APPLICATIONS

- | | |
|------------|---|
| 1990½-1992 | - Galant |
| 1991-1992 | - Chrysler, Eagle, and Mitsubishi (except Precis) |
| 1994 | - Hyundai, and Mitsubishi Precis |

NOTE: Not all TCU's will use all of these pins.

NOTE: The pin numbers that are listed are for reference only. They are not the numbers used on the wire schematics.

Type 4



1A	Torque converter clutch solenoid	1B	Inhibitor switch (P)
2A	Shift control solenoid valve A	2B	Inhibitor switch (R)
3A	Oil temperature warning light	3B	Inhibitor switch (N)
4A	Engine communication signal	4B	Inhibitor switch (D)
5A	Accelerator switch	5B	Inhibitor switch (2)
6A		6B	Inhibitor switch (L)
7A	Kickdown servo switch	7B	Overdrive switch
8A	A/C relay signal	8B	Power mode switch
9A	On-board diagnostic output	9B	Power supply
10A	Pulse generator B output	10B	Vehicle speed sensor
11A	Diagnostic test mode control	11B	Pulse generator B
12A	Power supply (ignition switch)	12B	Pulse generator B
13A	Ground	13B	Pulse generator A
14A	Pressure control solenoid valve B	14B	Pulse generator A
15A	Shift control solenoid valve B	15B	Ground
16A		16B	Ignition pulse
17A	Engine communication signal		
18A	Engine communication signal		
19A			
20A	Closed throttle position switch		
21A	Throttle position sensor		
22A			
23A	Oil temperature sensor		
24A	Sensor ground		
25A	Power supply (backup, ignition switch)		
26A	Ground		

APPLICATIONS

1993-1994 - Chrysler, Eagle, and Mitsubishi (except Precis)

* Some 1989 model cars will use this wire for a water temperature sensor.

NOTE: Not all TCU's will use all of these pins.

NOTE: The pin numbers that are listed are for reference only. They are not the numbers used on the wire schematics.

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Notes

Notes

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4L60-E

4L80-E

E40D

AXODE

G4A-EL

A604

1996 Technical Seminar

Technical Information

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1996 Technical Seminar



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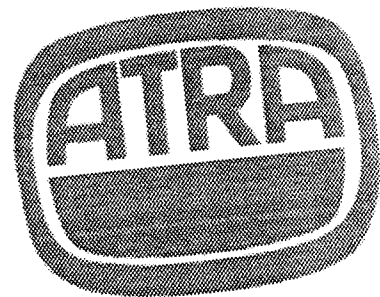
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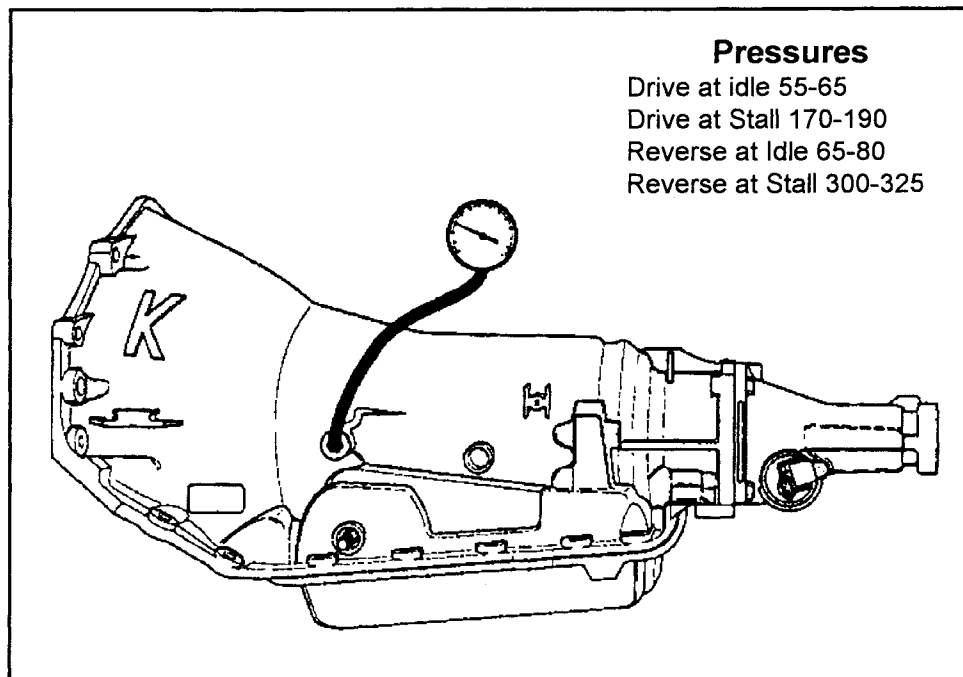
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General Motors
4L60-E



4L60-E



Range	Gear	Sol A	Sol B	2-4 Band	Reverse Input Clutch	Overrun Clutch	Forward Clutch	Input Sprag	3-4 Clutch	Low Roller Clutch	Low Reverse Clutch
P-N											
R	Reverse										
D	1st										
	2nd										
	3rd										
	4th										
D	1st										
	2nd										
	3rd							★			
2	1st							★			
	2nd							★			
1	1st							★		•	
	2nd							★			

★ = Holding but ineffective due to overrun Clutch.

• = Holding but ineffective due to low reverse Clutch.

Failsafe Mode

D	3rd
D	3rd
2	2nd
1	2nd

Gear Ratios

1st	3.06
2nd	1.63
3rd	1.00
4th	.69
Reverse	2.29

Checkballs

#1 3-4 ACCUMULATOR—Located in the transmission case, the 3-4 accumulator checkball helps control the flow of accumulator fluid to the 3-4 accumulator. When the ball is seated, accumulator fluid is forced through the #18 orifice. This action helps control the 2-4 band release during a 4-3 downshift.

#2 3rd ACCUMULATOR—Located in the valve body, the 3rd accumulator checkball directs exhausting 3rd accumulator fluid through orifice #12 and to the 3-2 control valve. This helps control the 2-4 band apply during a 3-2 downshift. During a 3-4 upshift, 3-4 clutch fluid unseats the ball for a quick feed into the 3rd accumulator fluid circuit. *NOTE: Some models do not include orifice #12 in the spacer plate. For these models, all exhausting 3rd accumulator fluid is routed to the 3-2 control valve.*

#3 REVERSE INPUT—Located in the valve body, the reverse input checkball controls the reverse input clutch apply when engine speed is at idle. During these conditions, all reverse fluid feeding the reverse input fluid circuit is routed to the ball, seats the ball, and is forced through orifice #17. This slows the flow of reverse fluid to cushion the reverse input clutch apply. When the reverse input clutch releases, exhausting reverse input fluid unseats the ball for a quick exhaust of fluid.

#4 3-4 CLUTCH EXHAUST—Located in the valve body, this checkball helps control the 3-2 downshift. Exhausting 3-4 clutch and 3rd accumulator fluids seat the ball and are forced through orifice #13. This helps control the 3-4 clutch release rate and 2-4 band apply. During a 3-4 upshift, 3-4 signal fluid unseats the ball for a quick feed into the 3-4 clutch fluid circuit.

#5 OVERRUN CLUTCH FEED—Located in the valve body, it routes either overrun fluid or D2 fluid into the overrun clutch feed fluid circuit while blocking the other fluid circuit. Overrun clutch feed fluid feeds the overrun clutch fluid circuit in the Manual gear ranges to apply the overrun clutch.

#6 OVERRUN CLUTCH CONTROL—Located in the valve body, the #6 checkball helps controls the overrun clutch apply rate. Overrun clutch feed fluid pressure seats the ball and is forced through orifice #20. This orifice slows the flow of overrun fluid to cushion the overrun clutch apply. When the overrun clutch releases, overrun clutch feed fluid unseats the ball for a quick exhaust.

#7 3rd ACCUMULATOR EXHAUST—Located in the transmission case, it unseats when 3rd accumulator fluid exhausts from the 2-4 servo to prevent residual fluid pressure from accumulating. Also, before 3rd accumulator fluid pressure seats the ball during a 2-3 upshift, any air in the circuit exhausts past the ball.

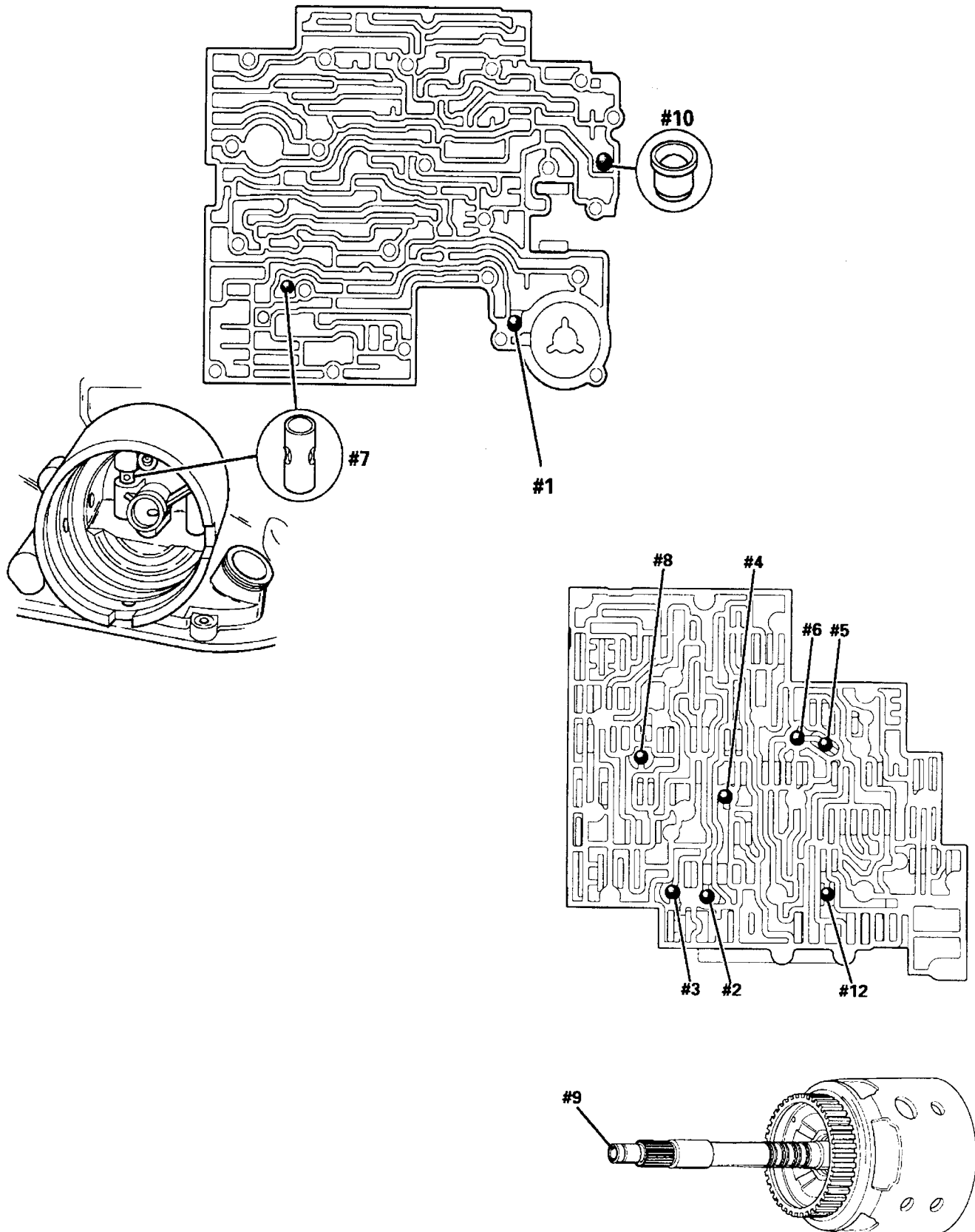
#8 1-2 UPSHIFT—Located in the valve body, the 1-2 upshift checkball helps control the 2-4 band apply during a 1-2 upshift. During the upshift, 2nd fluid pressure seats the ball and is forced through the #16 orifice. This orifice slows the flow of 2nd fluid to help cushion the band apply. When the band releases during a 2-1 downshift, exhausting 2nd clutch fluid unseats, and exhausts past, the 1-2 upshift checkball.

#9 TCC APPLY—Located in the end of the turbine shaft, the #9 checkball is a retainer and ball assembly that helps control the converter clutch apply feel. As the converter clutch applies, exhausting release fluid seats, and is orificed around the checkball. This action slows the exhaust of release fluid to control the converter clutch apply feel. When the converter clutch is released, release fluid pressure unseats the checkball and flows freely past the ball to keep the pressure plate disconnected from the converter cover.

#10 LO/REVERSE CLUTCH APPLY—Located in the transmission case, the #10 checkball is a retainer and ball assembly that helps control the lo and reverse clutch apply feel. During the clutch apply, PR fluid pressure seats, and is orificed around the checkball. This orifice slows the increase of PR fluid pressure at the clutch piston to cushion the apply feel. When the clutch releases, exhausting PR fluid unseats the checkball for a quick exhaust.

#12 FORWARD CLUTCH ACCUMULATOR—Located in the valve body, it helps controls the forward clutch apply when engine speed is at idle. During these conditions, all D4 feeding the forward clutch feed fluid circuit is routed to the ball, seats the ball, and is forced through orifice #22. This slows the increase of forward clutch feed fluid pressure to cushion the forward clutch apply. When the forward clutch releases, exhausting forward clutch feed fluid unseats the ball for a quick exhaust of fluid.

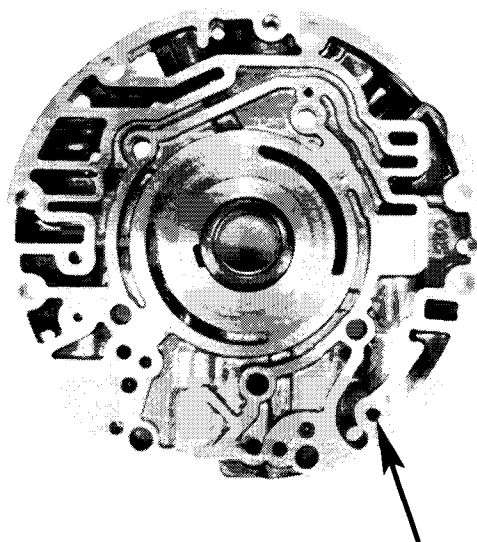
Checkballs



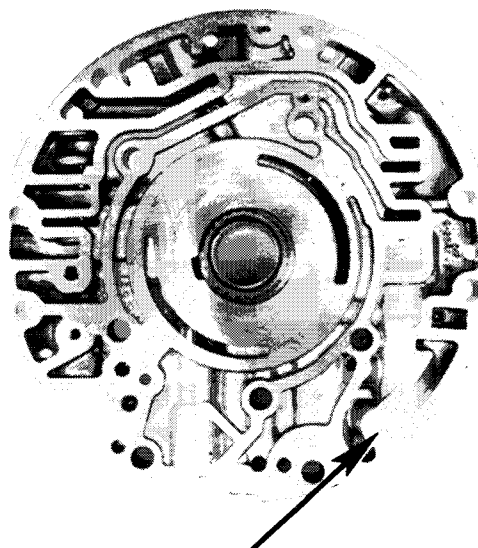
4L60-E, 700-R4 Pump Interchange

The 700-R4 pump body is interchangeable with the 4L60-E pump body. However, the stator supports are not. The 4L60-E filter will not fit the 700-R4 pump. There is also a difference in the boost pressure circuit.

700-R4



4L60-E



Note the difference in the boost pressure area.

Also note there is a difference in the pressure regulator and the boost valves.

PR ASSEMBLY

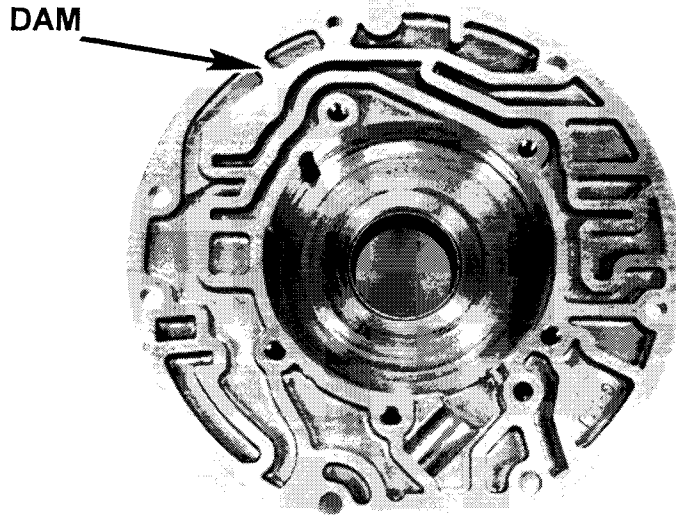


PR ASSEMBLY

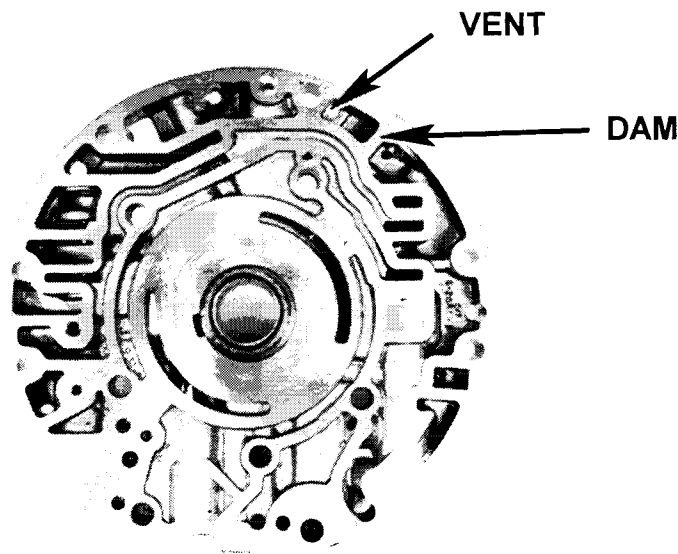


Check this orifice for debris. A plugged boost orifice will result in low line rise.

4L60-E, 700-R4 Pump Interchange (cont)



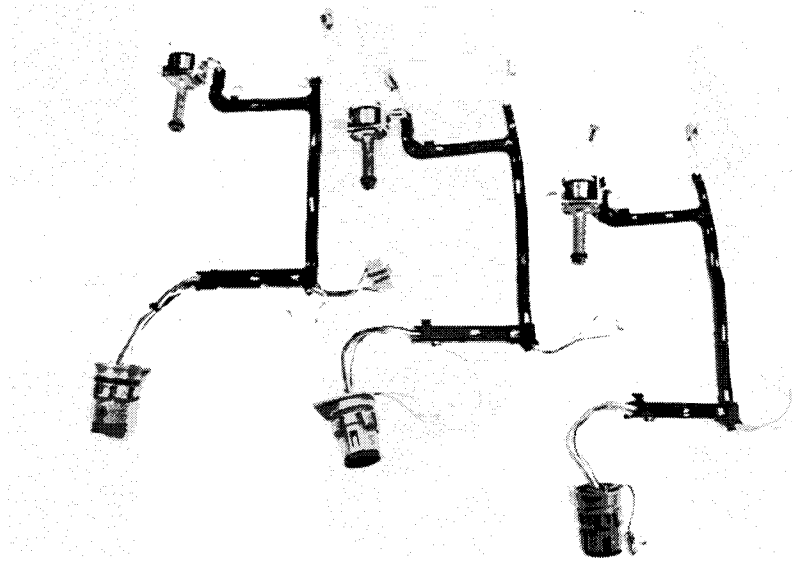
1982-84 700-R4 pump bodies do not have the dam as shown. If a 1982-84 pump body is used, it is important to plug the vent in the pump cover. Using an early pump without plugging the vent will cause low line pressure.



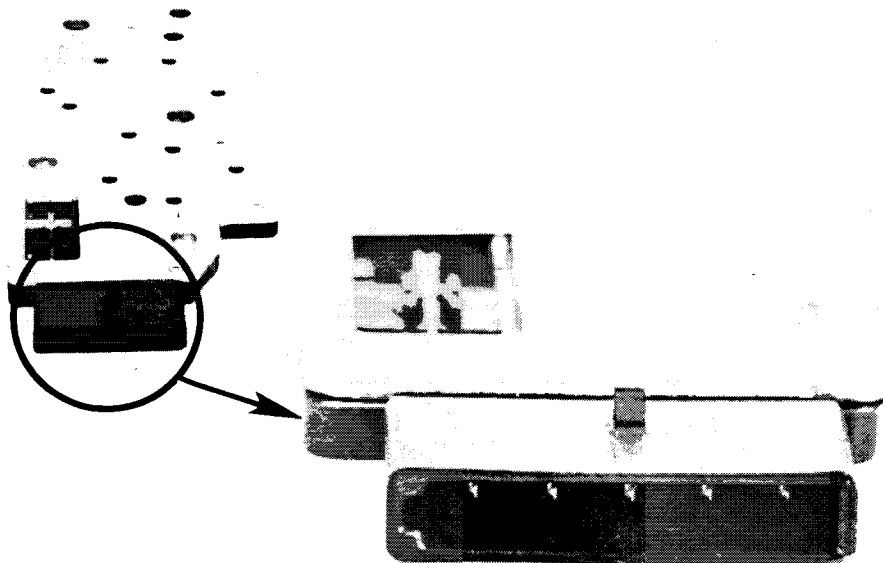
NOTE: Flat sand both pump halves to prevent a leak out the vent.

4L60-E Harness Changes

Currently, there are three different wire harnesses: 1993-94, 1995 and 1996.

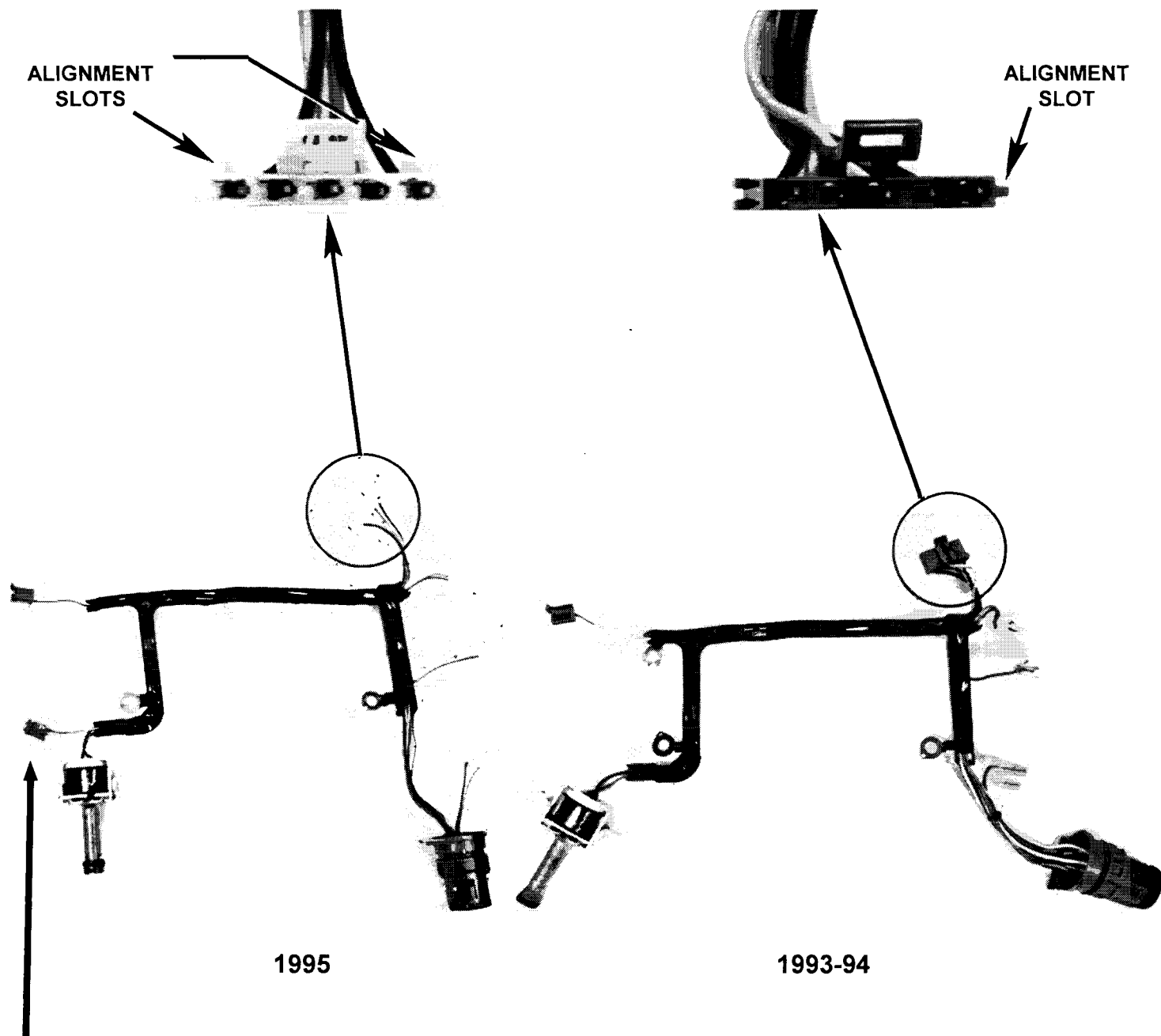


The change to the 1995 harness was made due to a change in the pressure switch manifold. The 93-94 PSM has one alignment slot on *one* edge. The 1995 PSM has *two* alignment slots on the top.



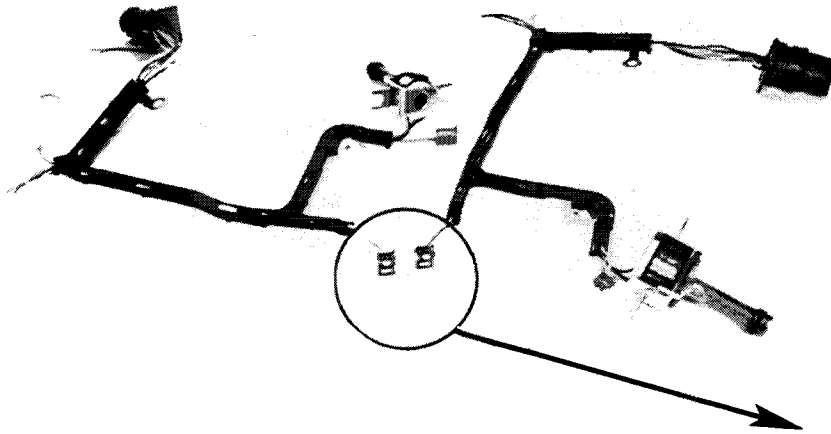
4L60-E Harness

The red 93-94 PSM connector has *one* alignment slot along one edge of the connector. A white (95 and later) PSM connector will work if the alignment slots are ground off.

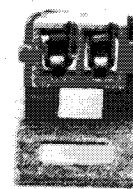


A PWM solenoid was added to the lock-up circuit in 1995.

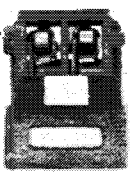
4L60-E Harness



THE WIDE TAB WAS MOVED,
MAKING IT IMPOSSIBLE TO
INTERCHANGE.



1996

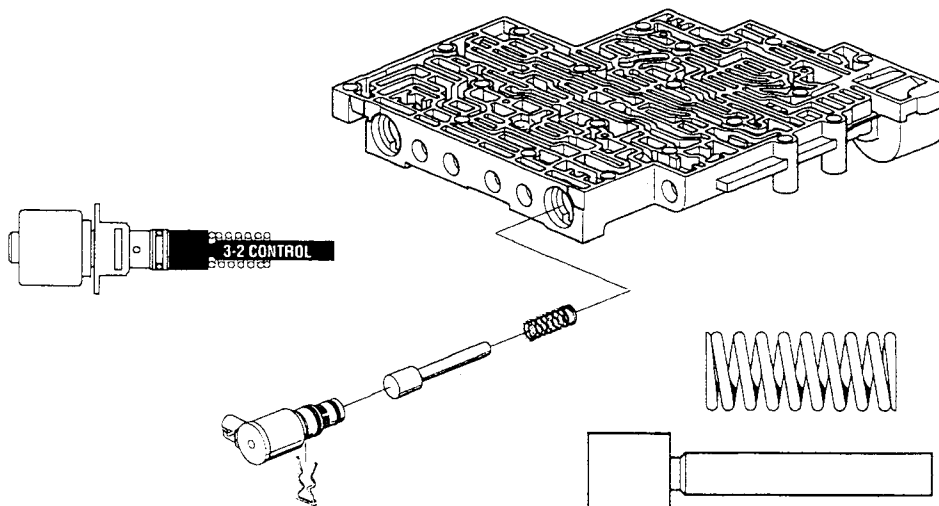


1995

1996

The 3-2 control solenoid was changed from a pulse width modulated solenoid to an on/off solenoid. The connector color for the 93-95 solenoid was blue. The 1996 connector is grey. This change also necessitated a change in the 3-2 control valve in the valve body.

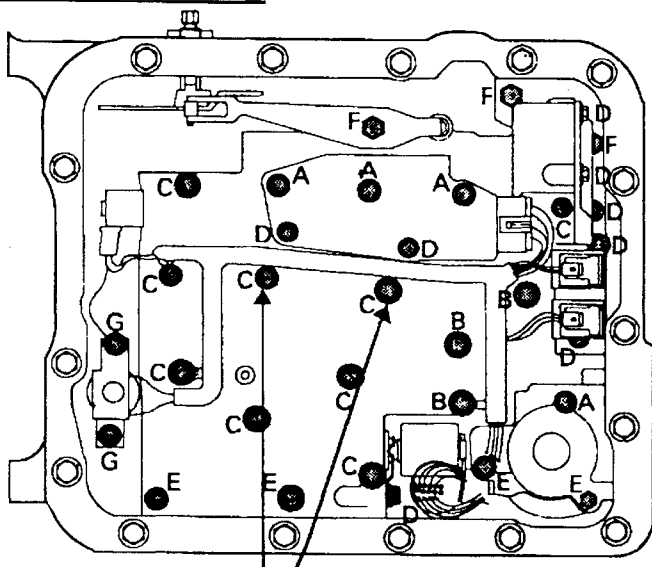
New 1996 3-2 On/Off Control



Bind-Up In Reverse/2nd Gear Starts

- Second Gear Starts
- Binds In Reverse
- Binds In Manual Low
- Binds On The 2-3 Shift
- Shuttle Shift On 2-3

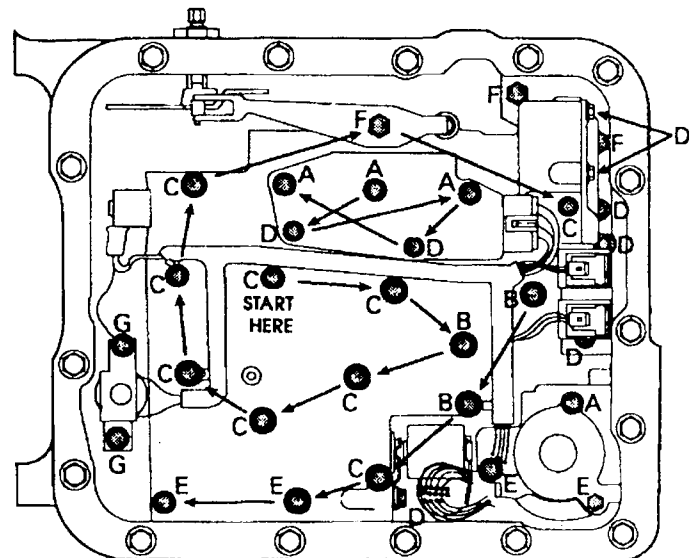
All of the before mentioned conditions can be caused by a valve body bolt that is too long, interfering with the rotation of the sun gear shell.



Make sure these bolts are not too long.

BOLT LENGTHS

A	65.0mm
B	54.4mm
C	47.5mm
D	18.0mm
E	35.0mm
F	20.0mm
G	12.0mm



Torque all valve body bolts as shown, in a spiral fashion to 96 inch-pounds.

DTC 80

Transmission Component Slipping

DTC 80 will set if the PCM detects a difference of more than 100 rpm between the engine rpm and the output shaft rpm for more than 10 seconds under the following conditions:

- Transmission in 2nd, 3rd or 4th gear.

- Lock-up engaged.

- Shifter in either D4 or D3.

- Throttle position between 0% and 35%.

- Transmission fluid temperature between 60 and 100 degrees celsius.

The PCM will respond to this code by cancelling lock-up, disabling 4th gear operation, and setting line pressure to maximum, which will result in harsh shifts. DTC 80 will be stored in memory, but will NOT turn on the MIL on the dash.

This code will automatically clear after the problem is gone and the ignition has been cycled on and off once.

***NOTE:** A faulty transmission pressure switch assembly has been known to set DTC 80.*

DTC 85

Transmission TCC Stuck ON

DTC 85 will set if the PCM has commanded lock-up 'OFF' and sees a difference of no greater than 20 rpm between the engine speed and the calculated input shaft speed for over 4 seconds under the following conditions:

- Transmission in 2nd, 3rd or 4th gear.

- Lock-up commanded 'OFF'.

- Shifter in either D4 or D3.

- Throttle position greater than 25%.

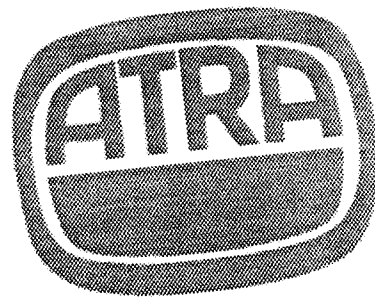
- No DTC 21, 22 or 28.

The PCM will respond to this code by commanding TCC 'ON' in all gears. This will result in lock-up right after the 1-2 shift (2nd gear oil pressure is required to move the converter clutch valve in the pump). DTC 85 will remain in memory, but will NOT turn on the MIL light on the dash. This code will clear once the problem is gone and the ignition has been cycled on and off once.

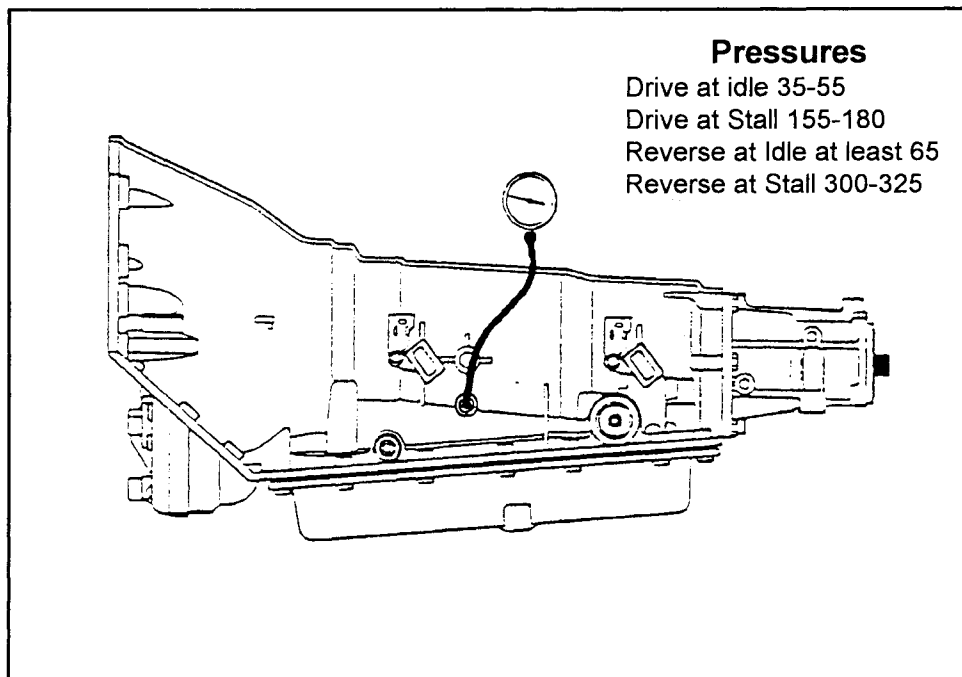
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General Motors
4L80-E



4L80-E



Range	Gear	Sol A	Sol B	Fourth Clutch	Overrun Clutch	Overdrive Sprag	Forward Clutch	Direct Clutch	Front Band	Int Clutch	Int Sprag	Low Roller Clutch	Rear Band
P-N													
R	Reverse												
D	1st												
	2nd												
	3rd												
	4th												
D	1st												
	2nd												
	3rd												
2	1st												
	2nd												
1	1st												
	2nd												

★ = Holding but ineffective due to Front Band.

• = Holding but ineffective due to Rear Band.

Failsafe Mode

D	2nd
D	2nd
2	2nd
1	2nd

Gear Ratios

1st	2.48
2nd	1.48
3rd	1.00
4th	.75
Reverse	2.08

Checkballs

#1 OVERRUN CLUTCH: Located in the transmission case, it seats to force D321 fluid through an orifice and into the overrun clutch fluid circuit. This helps control the apply rate of the overrun clutch. When the overrun clutch releases, exhausting overrun clutch fluid unseats, and flows past, the #1 checkball and into the D321 fluid circuit. This allows for a faster exhaust of overrun clutch fluid and a quick release of the overrun clutch.

#2 2ND ACCUMULATOR (Used Only On Some Models): Located in the transmission case, it seats to force accumulator fluid through an orifice before entering the 2nd accumulator circuit and filling the 2nd accumulator. This helps control the rate at which 2nd clutch fluid exhausts from the rear servo and the release rate of the intermediate clutch.

#3 FRONT BAND APPLY: Located in the transmission case, it seats to force front band apply (FBA) fluid through an orifice to help control the apply rate of the front band. When the band releases, exhausting FBA fluid unseats, and flows past, the #3 checkball. This allows for a faster exhaust of FBA fluid and a quick release of the front band.

#4 2ND CLUTCH: Located in the transmission case, it seats to force 2-3 drive fluid through an orifice and into the 2nd clutch fluid circuit. This helps control the apply rate of the intermediate clutch. When the intermediate clutch releases, exhausting 2nd clutch fluid unseats, and flows past, the #4 checkball and into the 2-3 drive fluid circuit. This allows for a faster exhaust of 2nd clutch fluid and a quick release of the intermediate clutch.

#5 3RD ACCUMULATOR: Located in the transmission case, it seats to force accumulator fluid through an orifice before entering the 3rd accumulator circuit and filling the 3rd accumulator. This helps control the rate at which 3rd clutch fluid exhausts from the 3rd accumulator and the release rate of the direct clutch.

#6 4TH ACCUMULATOR: Located in the transmission case, it seats to force accumulator fluid through an orifice before entering the 4th accumulator circuit and filling the 4th accumulator. This helps control the rate at which 4th clutch fluid exhausts from the 4th accumulator and the release rate of the direct clutch.

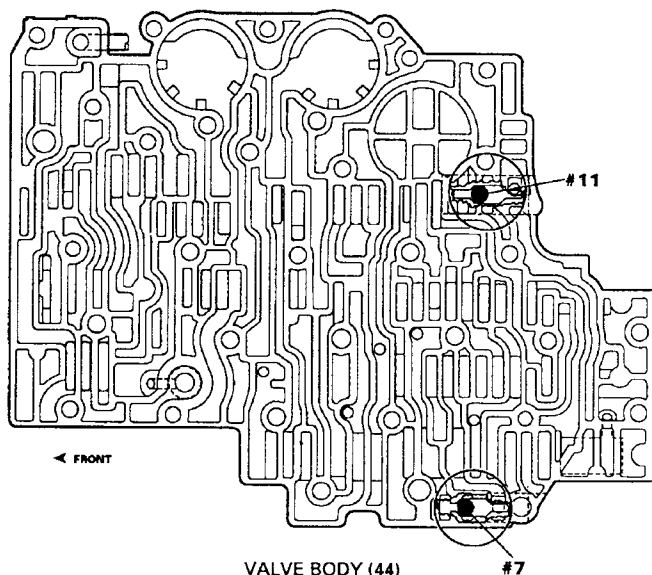
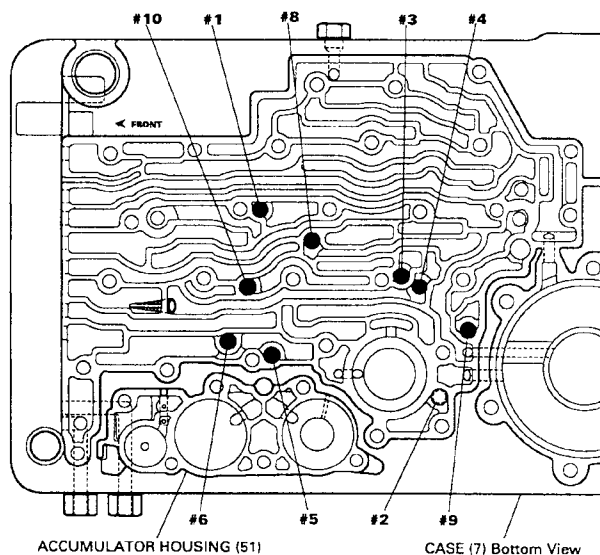
#7 LO/REVERSE: Located in the control valve body, it allows either low fluid (in Manual First) or reverse fluid (in Reverse) to enter the rear band apply circuit while blocking the other fluid circuit.

#8 3RD CLUTCH: Located in the transmission case, it seats to force 3rd clutch feed fluid through an orifice and into the 3rd clutch circuit. This helps control the apply rate of the direct clutch in Third gear. When the direct clutch releases, exhausting 3rd clutch fluid unseats, and flows past, the #8 checkball and into the 4rd clutch feed circuit. This allows for a faster exhaust of 3rd clutch fluid and a quick release of the direct clutch.

#9 REVERSE: Located in the transmission case, it seats to force reverse fluid through an orifice to help control the apply rate of the direct clutch in Reverse. When the direct clutch releases, exhausting reverse fluid unseats, and flows past, the #9 checkball. This allows for a faster exhaust of reverse fluid and a quick release of the direct clutch.

#10 4TH CLUTCH: Located in the transmission case, it seats to force 4th clutch fluid through an orifice to help control the apply rate of the 4th clutch. When the 4th clutch releases, exhausting 4th clutch fluid unseats, and flows past, the #10 checkball. This allows for a faster exhaust of 4th clutch fluid and a quick release of the 4th clutch.

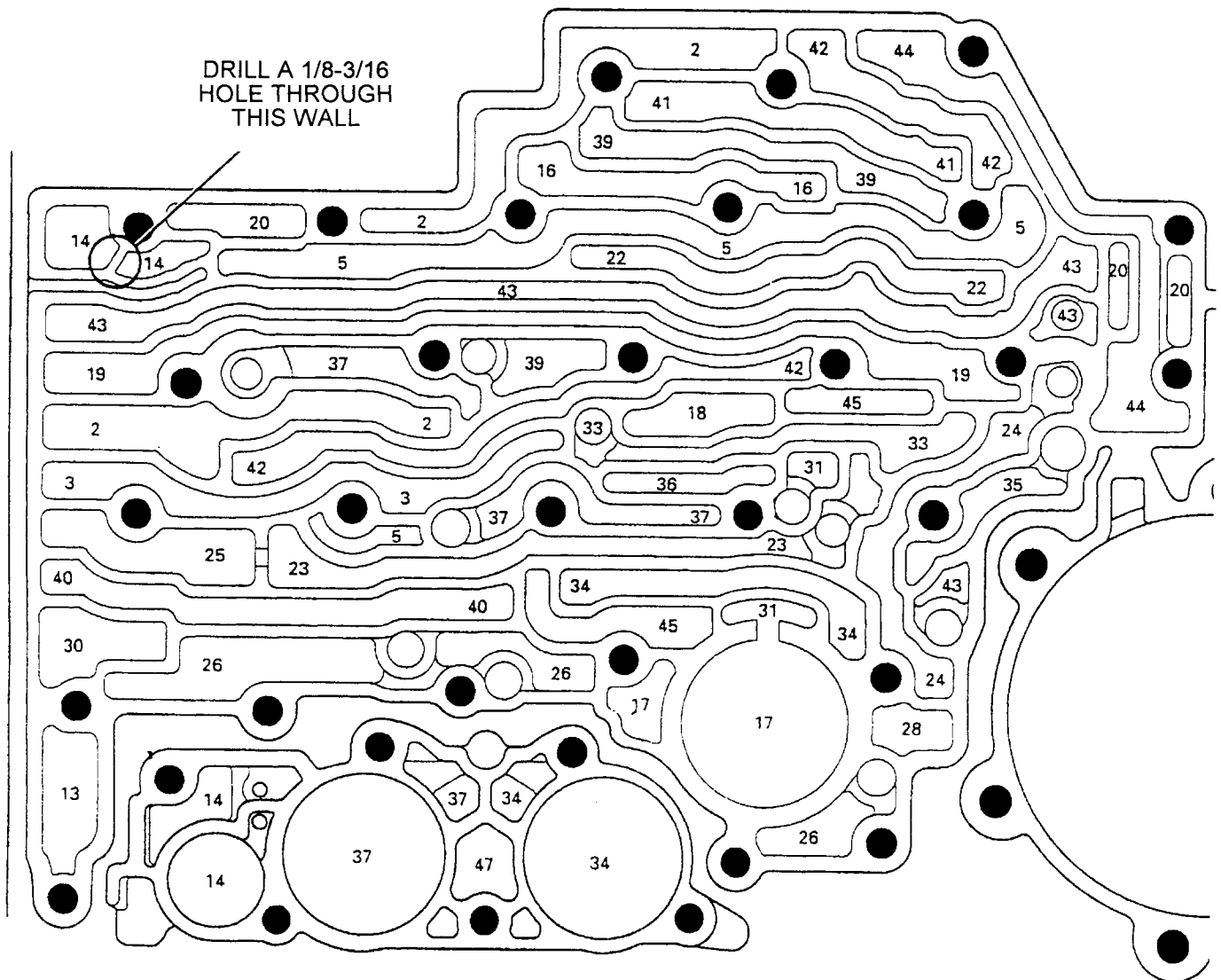
#11 3RD CLUTCH/REVERSE: Located in the control valve body, it allows either 3rd clutch fluid (in Third gear) or reverse fluid (in Reverse) to enter the 4rd/reverse circuit while blocking the other circuit.



High-Line Pressure in Reverse

The following rebuild procedure should be followed to reduce the possibilities of a high line pressure problem.

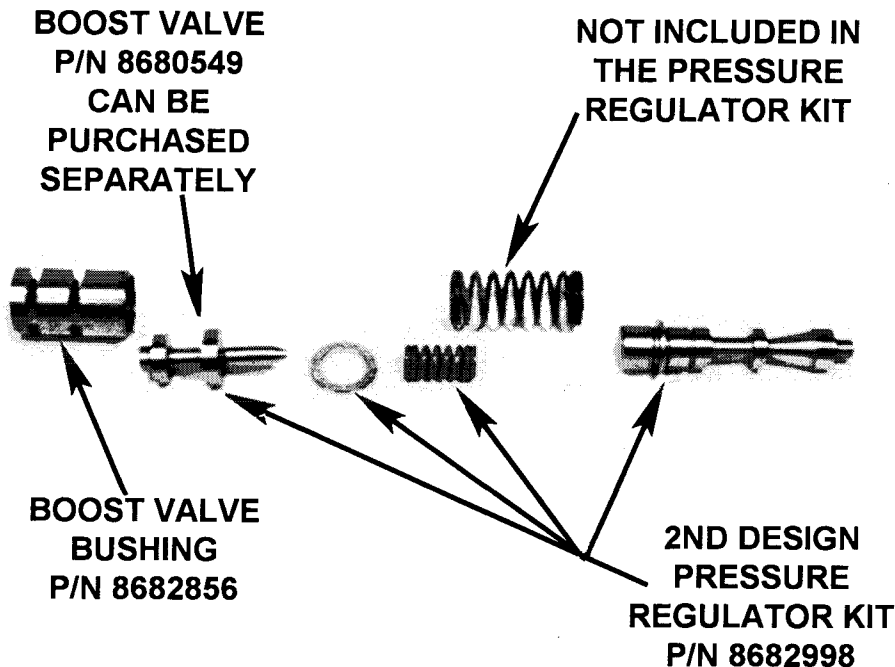
Bypass the wall that was added to the second design case. This will eliminate any problem with separator plate and gasket mismatches. This will also bypass the orifice that was added to the second design separator plate.



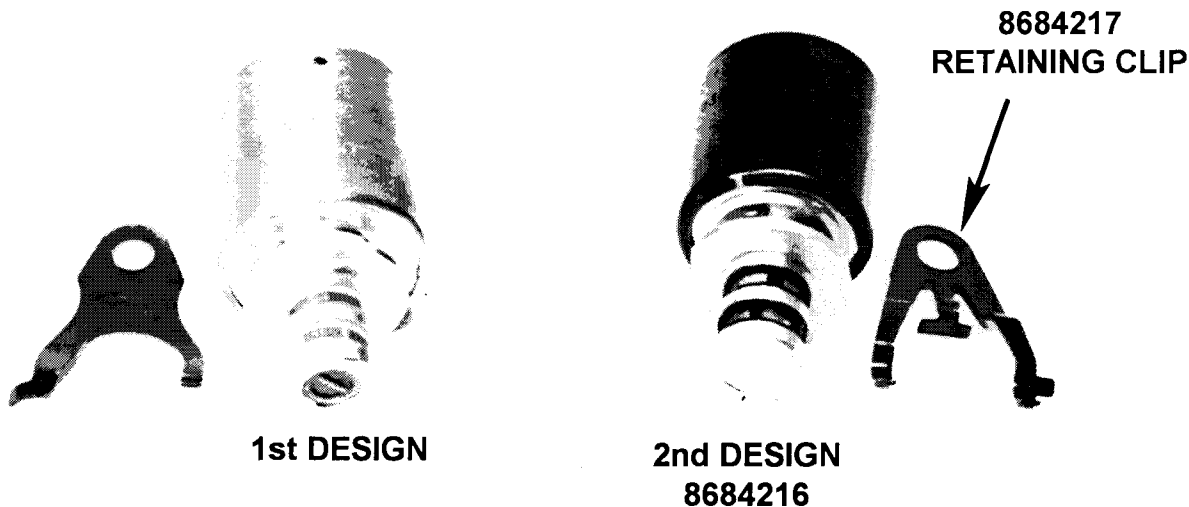
High-Line Pressure in Reverse (cont)

Replace the boost valve bushing. A worn bushing is the most common cause of high line pressure in reverse.

NOTE: The 2nd design pressure regulator assembly should also be used.



If the force motor is damaged, clogged or has high mileage, replace it with the second design. The second design force motor will work with no other changes.

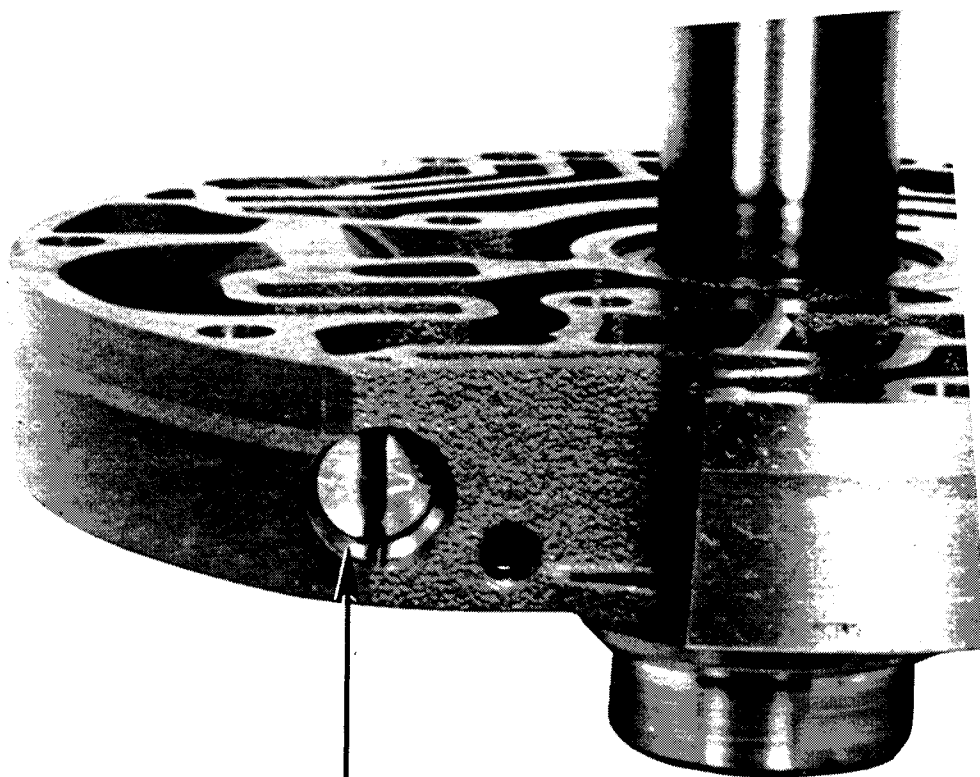


High-Line Pressure in Reverse (cont)

If the transmission is on the bench also check/modify the stator support.



**ENLARGE THE PRESSURE
REGULATOR BALANCE
HOLE TO .070"-.076"**

High-Line Pressure in Reverse (cont)

**MAKE SURE THE ALUMINUM
PLUG AT THE END OF THE
PRESSURE REGULATOR FITS
SNUGLY IN THE BORE.**

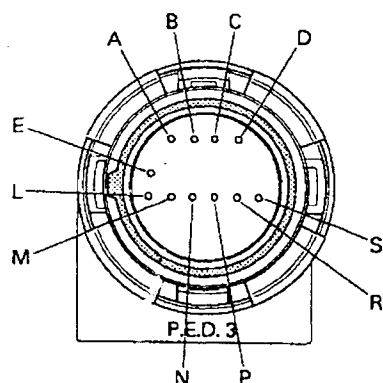
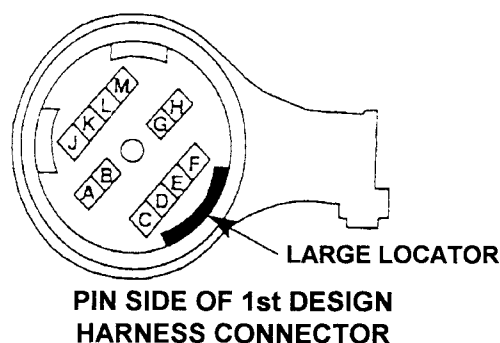
Oil leaking past this plug will cause the pressure regulator valve to move to a higher pressure position. Consider running a tubing cutter around the plug to enlarge it slightly. If the plug needs to be replaced the part number is 8661656.

Transmission Harness Change-Over

Starting May 5th, 1993, all 4L80-E transmissions came with the 2nd design case connector. The 2nd design case connector will not fit the 1st design chassis harness. If the internal harness is replaced with the 2nd design, the new chassis harness connector will need to be spliced into the harness. The part number for the harness kit is 24200161.

The pink/black wire for pin 'K' should be located and cut *before* following the factory instructions. The wire should not stick out of the harness shroud.

Now follow the instructions that came with the harness kit. The chart below can be used to help clarify the factory instructions.



1st Design—Connect to—2nd Design				
HARNESS CONNECTOR			CASE CONNECTOR	
PIN	WIRE COLOR		PIN	WIRE COLOR
A	LT GREEN		A	LT GREEN
B	YELLOW/BLACK		B	YELLOW
L	RED/BLACK		C	ORANGE
M	LT BLUE/WHITE		D	LT BLUE
C	PINK OR PINK/BLACK		E	PINK
G	BLACK/YELLOW		L	DK GREEN
H	PURPLE OR BLACK		M	PURPLE
D	PINK		N	GRAY
F	RED		P	RED
E	DK BLUE		R	DK BLUE
J	DK BLUE OR TAN/BLACK		S	WHITE
K	PINK OR PINK/BLACK			N/A

NOTE: Technically it is the 'C' wire of the old harness that is used for Pin 'E' of the new harness. However, if the harness wires have already been cut and it is not clear as to which wire is which, either will work.

Transmission Problems and Diagnostic Trouble Codes (DTCs)

Some transmission problems occur as part of a protection strategy by the PCM when a DTC is set. If any of the following problems exist, check for DTCs and the appropriate information on the following pages.

Condition	Check For These Codes
No Lock Up	71 or 74
Early Lock Up	14, 15, 58 or 59
No Lock Up AND No 4th	37, 38 or 83
No Lock Up, No 4th and Max Pressure	21, 22, 28 or 68
No 4th	39
Max Pressure	73 or 85
Failsafe—2nd only AND Max Pressure	24, 52, 53, 72, 75, 86 or 87

DTC 14 or 15

Coolant Temperature Sensor (CTS)

DTC 14 will set if the PCM sees the CTS go above 304°F (151°C) for one second.

DTC 15 will set if the PCM sees the CTS go below -34°F (-37°C) for one second.

This will cause poor driveability in the vehicle because the PCM will command lock up of the torque converter when cold.

DTC 21 or 22

Throttle Position Sensor (TPS)

DTC 21 will set if TPS voltage goes above 4.9 volts for one second.

DTC 22 will set if TPS voltage goes below 0.2 volts for one second.

For DTC 21 and 22 the PCM will command max pressure, no 4th, no lock up, and fixed shift points.

DTC 28**Pressure Switch Manifold (PSM)**

There are three wires from the computer to the PSM. Depending on the position of the switches in the PSM, any of these wires could be grounded (zero volts) or open (12 volts). The following chart shows the voltages the PCM is looking for to determine shifter position.

	WIRES		
	A	B	C
Park	12	0	12
Reverse	0	0	12
Neutral	12	0	12
D	12	0	0
D	12	12	0
2	12	12	12
1	0	12	12

Two other voltage combinations are possible, they are

0	12	0
---	----	---

and

0	0	0
---	---	---

These are called *illegal* positions and will set DTC 28. The PCM will then assume the shifter is in D4 and command no 4th, no lock up, and max pressure.

DTC 37 or 38**Brake Switch**

DTC 37 "Brake Stuck On" will set if the PCM sees the brake on and a vehicle speed of 5-20 mph for at least six seconds *then* a speed above 20 mph for six seconds *after* showing a speed of less than 5 mph. This must happen 7 times before the code will set. In other words the PCM sees a vehicle stop or almost stop (less than 5 mph) then without releasing the brake the PCM sees increasing vehicle speed past 20 mph.

DTC 38 "Brake Stuck Off" will set if the PCM sees a vehicle speed of greater than 20 mph for six seconds *then* 5-20 mph for six seconds without a brake *on* signal. This must also occur 7 times for the code to set.

For either code the PCM will command no lock up and no 4th.

DTC 39

TCC Stuck Off

In 3rd gear (1 to 1 ratio) with lock up applied, engine rpm should be the same as the transmission input rpm. If engine rpm is higher then the TCC may be slipping. DTC 39 sets if TCC slip is greater than 65 rpm for two seconds when TCC is commanded *on* and 2nd or 3rd gear is commanded by the PCM. If DTC 39 is set, the PCM will disable 4th after the vehicle reaches operating temperature.

DIAGNOSTIC NOTE: DTC 39 will not set in 4th gear. If the TCC Slips in 4th it will set code 68. If you have a code 68, drive the vehicle in D3 to see if DTC 39 sets. If it does, suspect slippage in the convertor.

DTC 58 or 59

ATF Temperature High or Low

DTC 58 will set if the ATF temperature sensor indicates a temperature above 304°F (151°C) for one second. The PCM will cause lock up in 2nd, 3rd and 4th almost all the time in an effort to keep the convertor from generating heat. This will feel like an early lock up apply and cause poor driveability.

DTC 59 sets if the ATF temperature sensor indicates below -34°F (-37°C) for one second. This DTC also causes lock up in 2nd, 3rd and 4th.

DTC 68

Overdrive Ratio Error or Transmission Component Slipping

This code can be very difficult to diagnose and fix without a clear diagnostic procedure.

DTC 68 will set if engine speed is 200 rpm higher then calculated for two seconds while in 4th gear with lock up commanded *on*. In 4th gear lock up, engine rpm should be 75% of transmission input speed. For example, if the TISS (Transmission Input Speed Sensor) is indicating 2000 rpm then engine speed should be 1500 rpm. If engine speed is 1700 rpm or more for two seconds then DTC 68 will set. The PCM will command no 4th, no lock up and max pressure. The cause of the high engine rpm could be slipping of the TCC or slipping of the 4th clutch. Drive the vehicle with the shifter in D3 and watch for a DTC 39 to be set. If DTC 39 sets in 3rd then suspect slipping of the TCC. This often causes DTC 68 to reappear when the shifter is moved back to D4.

If DTC 39 does not set in D3 but DTC 68 reappears when the shifter is moved to D4 then suspect a slipping 4th clutch. Either way, the best bet now is to use a scan tool to record data when the DTC sets. This is called taking a snap shot or recording a movie. By comparing TCC slip with TCC duty cycle, it can be determined whether the problem is with the fourth clutch or converter clutch.

4L80-E Movie Data													
FORWARD IN TIME 													
Frame	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8
Input RPM	2480	2471	2473	2474	2480	2475	2477	2472	2480	2474	2476	2461	2474
Output RPM	2477	2469	2470	2472	2479	2473	2476	2473	2477	2471	2473	2467	2471
Turbine RPM	1860	1853	1854	1855	1860	1858	1858	1856	1859	1855	1857	2467	2474
Engine RPM	2056	2065	2091	2113	2127	2132	2164	2165	2204	2223	2265	2340	2586
TCC Duty Cycle %	83	83	86	86	86	88	88	90	90	91	94	0	0
TCC Slip RPM	196	213	224	247	263	279	297	316	342	361	402	57	103
Current Gear	4	4	4	4	4	4	4	4	4	4	4	3	3
Solenoid A	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF
Solenoid B	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Vehicle Speed-MPH	54	53	53	53	54	53	53	53	54	53	53	53	53
What Codes(s) Present	None	None	None	None	None	None	None	None	None	None	None	68	68

In this example, the DTC was set at frame -9. This vehicle recorded five frames per second so the data above all happened in 2½ seconds. Beginning with frame -19, TCC slip exceeded the 200 rpm limit. The PCM immediately (two-tenths of a second later) began raising TCC duty cycle to eliminate the slip. In the next 10 frames of the movie, TCC slip continued increasing while the PCM continued to raise the TCC duty cycle. The PCM was not able to eliminate the TCC slip by clamping on the TCC harder.

This could mean that the torque convertor is slipping excessively, the duty cycle solenoid (PWM) is having no effect or MAYBE it's really NOT the TCC that is slipping. At frame -9 the two second slip time limit has run out and the PCM jumps into action to protect the transmission. The PCM is going to raise line pressure to maximum to eliminate slippage. It is also going to disable lock up in case of TCC Slip and downshift to 3rd in case of 4th clutch slippage. Notice going from frame -10 to -9, several things occur. TCC duty cycle % goes from 94 to 0 because the PCM shut off lock up. Solenoid A went from ON to OFF which caused the current gear to downshift from 4 to 3. DTC 68 was set. Most importantly the TCC Slip rpm went from 402 to 57 indicating the slip is now corrected.

Driving this vehicle in D3 would not set a DTC 39 (TCC Slip) which would lead one to believe that the TCC is not at fault in this situation. The suspect became the 4th clutch. Upon transmission removal and disassembly a broken 4th clutch housing to case bolt was found. This caused a 4th clutch leak and 4th clutch slippage which is what the PCM was seeing. A broken 4th clutch bolt is a very common cause of DTC 68 so be watching for it.

DTC 72

TOSS Transmission Output Speed Sensor

DTC 72 will set if the change in TOSS speed is greater than 1000 rpm while not in park or neutral and there is no DTC 28.

DTC 72 will set in park and neutral if the change in TOSS speed is greater than 2050 rpm and the engine speed change is greater than 300 rpm. These conditions must be met for two seconds.

When DTC 72 sets, the PCM will command the transmission to go to failsafe which is no shifts (2nd gear only) and max line pressure.

DTC 73

Force Motor Current Error

DTC 73 will set if the force motor current returning to the PCM is .16 amps higher or lower than the current sent from the PCM. When DTC 73 sets, the PCM shuts off all current to the force motor which causes maximum line pressure in the transmission. DTC 73 will only set if the force motor is shorted to ground or shorted to voltage. DTC 73 will not set if the force motor is internally shorted because the amount of current being sent by the PCM is returning to the PCM. This is one of the laws of a series circuit.

DTC 74

TISS Transmission Input Speed Sensor

For DTC 74 to set, code 24, 28 or 71 must not be present. In addition, the vehicle can not be in park or neutral. To set DTC 74 the PCM must see an engine rpm greater than 300, TOSS rpm greater than 200 and TISS rpm less than 50 for at least two seconds. When DTC 74 sets, the PCM will disable lock up.

DTC 81, 82 and 83

Solenoid Electrical Faults

The two shift solenoids (A and B) and the lock up solenoid receive constant voltage from the fuse box. To operate the solenoids, the computer controls the ground side. In addition to turning the ground on and off, the PCM also monitors the voltage on the ground wire. When the PCM turns a solenoid on by supplying a ground, the voltage on that wire should go low (less than one tenth of a volt). When the PCM turns a solenoid off by removing the ground then the voltage on the ground wire goes high (12 or more volts).

If the computer sees the wrong voltage for the command given, a DTC for that solenoid will set. Causes of high voltage could be a shorted solenoid coil, a short to voltage, or a failed quad-driver in the PCM (failed open). Causes of low voltage could be an open in the solenoid or wiring, a short to ground, or a failed quad-driver (failed closed) in the PCM. If a scan tool is used to monitor which gear is being commanded when the code is set, pinpointing the cause is rather easy.

DTC 81

Solenoid B Circuit Fault

Solenoid B is on in 3rd and 4th. This means in 1st and 2nd, the ground wire should have high voltage. In 3rd and 4th, the ground wire should have low voltage. If the PCM detects the wrong voltage it will set DTC 81. The PCM will command 2nd gear only and maximum line pressure.

If DTC 81 sets when the PCM is commanding 1st or 2nd, suspect an open or short to ground in the solenoid or its wiring. If OK then suspect a shorted quad-driver in the PCM.

If DTC 81 sets when the PCM is commanding 3rd or 4th, suspect a shorted solenoid coil, a short to voltage or an open quad-driver in the PCM.

DTC 82

Solenoid A Circuit Fault

Solenoid A is on in 1st and 4th. Just like Solenoid B, the PCM is monitoring the voltage on the ground wire. If the PCM sees the wrong voltage, DTC 82 is set. The PCM will not take any action for a DTC 82. The fault itself will cause either 1st and 4th only OR 2nd and 3rd only.

If DTC 82 sets when the PCM is commanding 1st or 4th suspect a shorted solenoid coil, a short to voltage or an open quad-driver. If DTC 82 is set in 2nd or 3rd, suspect an open or short to ground or a shorted quad-driver.

DTC 83

TCC Solenoid Fault

When the PCM sets DTC 83 it will disable lock up and disable 4th when hot. If the code sets when lock up is commanded *OFF*, suspect an open, short to ground or shorted quad-driver. If it sets when lock up is commanded *ON*, suspect a shorted solenoid, short to voltage or an open quad-driver.

No Upshifts, Skipping Gears or Wrong Gear Starts

with False Codes 81 or 82

Sometimes the above complaints will occur from the customer but the condition cannot be duplicated in the shop. If the above problems exist, and normal diagnostic procedures are not leading to a resolution, check for the improper use or installation of aftermarket electronic accessories.

Improper use of aftermarket electronic accessories, such as a remote start system, an alarm, a radar detector, a radio, or any other type of electrical accessory, may cause DTC 81 and/or 82 (solenoid circuit fault) to set when the accessory is used. The transmission will resume normal operation when DTC 81 and/or 82 is cleared or when the ignition key is cycled-off long enough to allow the DTC to become a history code.

When servicing a vehicle equipped with a 4L80-E transmission for DTC 81 and/or 82, look for the installation of a remote start device or other aftermarket electronic accessories.

Operate the remote start device or other aftermarket electronic accessory(s) to see if DTC 81 and/or 82 will set. If the codes set when the device is used, refer the customer to the company that installed the accessory(s) for corrections.

EXCEPTION: If the codes are setting when a remote start system is being used, check to see that fuse #20 (trans fuse), is being supplied battery voltage during the remote start system operation. If the remote start system is not supplying voltage to #20, this will cause DTC 81 and/or 82 to set because of no voltage to the shift solenoids. Contact the installer of the remote start system to determine the proper wiring to supply battery voltage to fuse #20.

IMPORTANT: *Add-on electrical equipment should not be wired into the transmission power circuit at any point. This could cause erratic electrical transmission operation and false codes to set.*

DTC 85

Undefined Ratio

DTC 85 will set if ratio calculations made by the PCM do not indicate a specific gear. In other words not 1st, 2nd or 3rd. The PCM does not monitor for this in 4th. This code can be set by defective transmission input or output sensors. It could also be set by slipping clutches inside the transmission. Since the transmission could be slipping, the PCM will default to maximum line pressure after setting DTC 85.

DTC 86

Low Gear Ratio

This code was referred to as solenoid B stuck closed. DTC 81 is an electrical fault in solenoid B. DTC 86 is indicating a mechanical fault in solenoid B. Like DTC 68, this code can be misleading. This code will set when the PCM is commanding 1st or 2nd but the input and output sensors are indicating 3rd or 4th. The PCM assumes the transmission is in 3rd or 4th because the solenoid is stuck closed. That is why some manuals refer to DTC 86 as solenoid B stuck closed. It is important to know that there are other causes for 3rd and 4th gear operation even when the PCM is commanding 1st or 2nd. The most common cause of this is a broken cushion plate in the direct clutch. This wedges the clutch on which causes 3rd gear. Another cause could simply be a stuck shift valve.

DTC 87

High Gear Ratio

Sometimes referred to as solenoid B stuck open. This code is really the opposite of a code 86. The PCM is commanding 3rd or 4th but the TISS and TOSS are indicating 1st or 2nd. Once again this could be a stuck open solenoid or it could be a stuck shift valve. It could also be caused by a completely burnt direct clutch that won't apply.

Notes on Solenoid Codes

Keep in mind that DTC 86 and 87 are indicating mechanical problems. The PCM is commanding shifts and not seeing them. This generally indicates electrical components are functioning properly. An electrical problem in the solenoids will generate a DTC 81 or 82.

Multiple Codes Being Set At Once

If several DTCs are present it is not very likely that several components all happened to fail at the same time. You must look for something common to them all. Try checking harnesses and connectors for shorts and opens. Also BE SURE to check the TISS and TOSS signals by watching them on a scan tool or checking them for rising frequency and AC voltage with a voltmeter. REMEMBER the PCM is depending on the TISS and TOSS for much of the information used to calculate whether to set many DTC's.

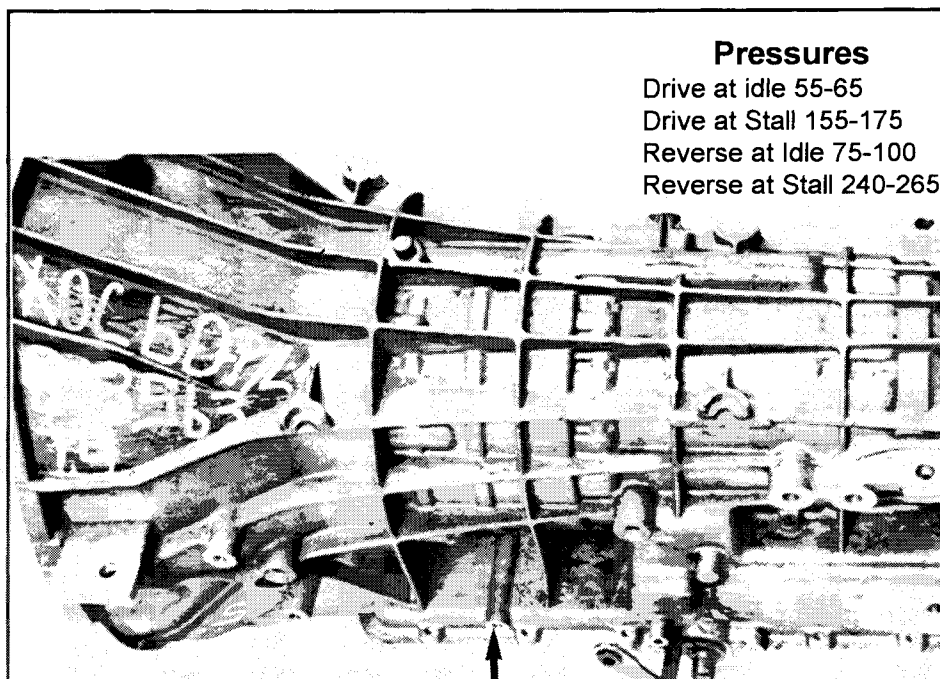
E4OD

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Ford
E4OD



E40D



Pressures

Drive at idle 55-65
 Drive at Stall 155-175
 Reverse at Idle 75-100
 Reverse at Stall 240-265

Range	Gear	Sol 1	Sol 2	Fourth Clutch	Overdrive Sprag	Overdrive Clutch	Coast Clutch	Int Clutch	Int Sprag	Int Band	Direct Clutch	Low Reverse Clutch	Low Roller Clutch
P-N													
R	Reverse												
D	1st						●						
	2nd						●						
	3rd						●						
	4th												
2	1st								★				
1	2nd												

★ = Holding but ineffective due to Band.

● = The coast clutch applies in **D** when the O/D cancel switch is preseed.

Failsafe Mode

D	4
2	2
1	2

Gear Ratios

1st	2.71
2nd	1.54
3rd	1.00
4th	.71
Reverse	2.18

Checkball Locations

Balls 1 through 9 used on all models.

- 1: Separate two and reverse flow at low reverse modulator valve.
- 2: Separates manual two flow and reverse flow to the 4-3-2 timing valve and the coast clutch shift valve.
- 3: Forces direct clutch to exhaust through orifice during 3-2 downshift.
- 4: Forcing band servo apply pressure through orifice while bypassing the orifice on exhaust.
- 5: Forces intermediate clutch to exhaust through orifice during 2-1 downshift.
- 6: Feeds reverse flow through 4-3-2 shift timing valve.
- 7: Separates solenoid four flow from either the manual two flow or the reverse flow which shifts the coast clutch shift valve.
- 8: Forces coast clutch feed fluid through orifice for 4-3 downshift and manual 1 or 2 pull-ins while allowing free exhaust.
- 9: Forces overdrive clutch to exhaust through orifice during 4-3 downshift.

Balls 10 and 11 used on 1989 models only.

- 10: Separate reverse flow and direct clutch accumulator flow into the direct clutch.
- 11: Facilitates fast exhaust of direct clutch when coming out of reverse.

Balls 12 through 14 used on early 1989 models only.

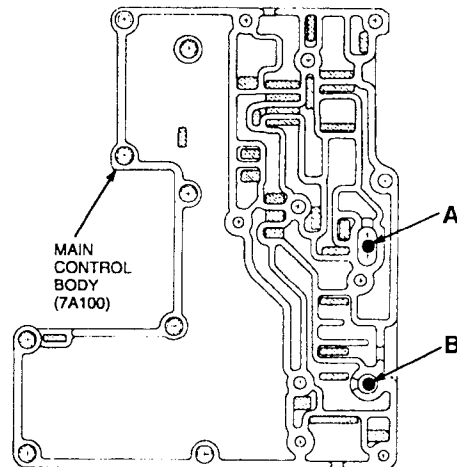
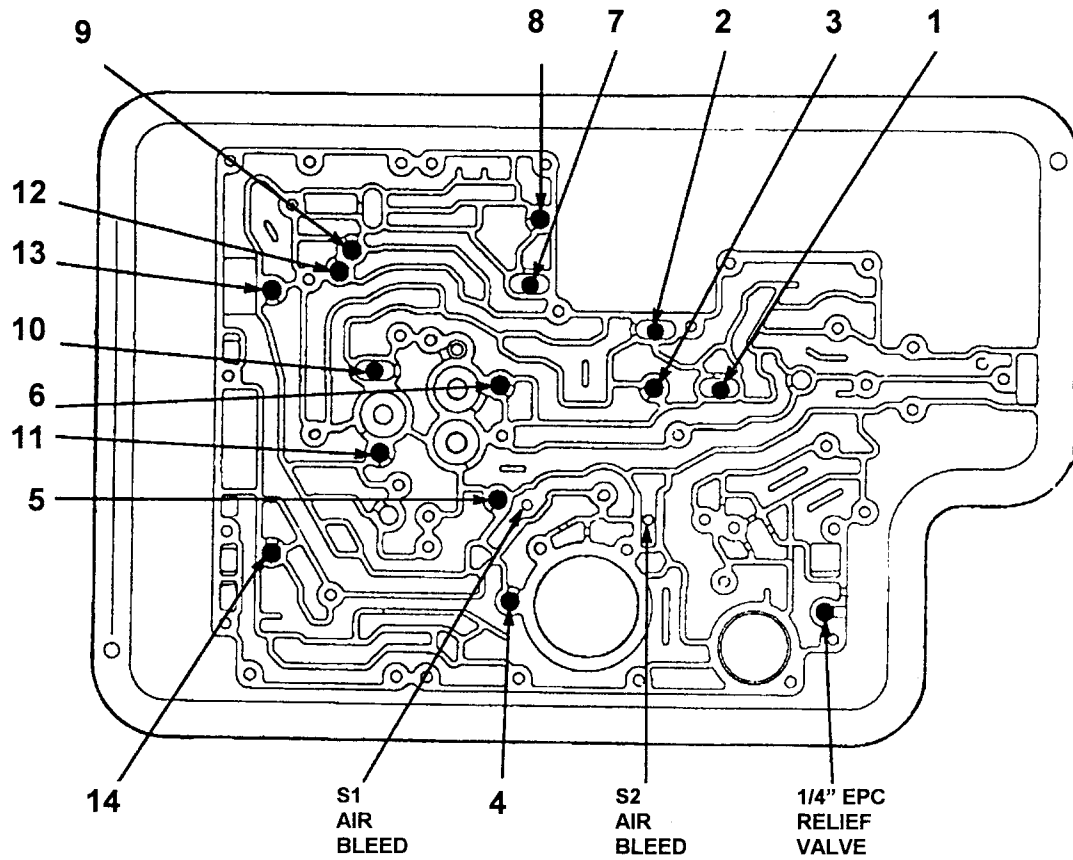
- 12: Bypasses direct accumulator plunger feed orifice during 3-2.
- 13: Bypass overdrive accumulator plunger feed orifice during 4-3.
- 14: Bypasses intermediate accumulator plunger feed orifice during 2-1.

- A: (Main Control Body) Separates manual two flow and solenoid two flow into the 1-2 manual transition valve which supplies flow to prevent 1-2 shift valve from shifting.
- B: (Main Control Body) Forces forward engagement pressure through orifice while allowing free exhaust.

EPC Relief Valve (Spring and ¼" Steel Ball)

Electronic Pressure Control blowoff valve controls EPC pressure to a maximum of 690 kPa (100 psi).

Checkball Locations



Notes on Ford Trouble Codes

Ford refers to service codes as on-demand codes and continuous codes. The vehicle electronic control assembly (ECA) transmits these codes in groups during the self-tests. Ford test procedures are very specific about the order in which self-tests should be performed and codes should be diagnosed and serviced. The specified order for Ford tests and code diagnosis are as follows:

Key-On, Engine-Off (KOEO) Test

KOEO codes are the result of a system self-test. The self test will test the processor, *some* actuators and *some* sensors. KOEO DTC's are sometimes called hard or on demand codes.

Continuous Memory Codes

As the vehicle is driven, the control module will continuously check some sensors and actuators and its own CPU. If a sensor goes out of range for a time period (50-300 milliseconds) and repeats the error, a code will set. This is a continuous memory code and is NOT just an intermittent problem. Intermittent problems will show up as continuous memory codes, but so will some chronic problems. Most transmission codes only show up as continuous memory codes.

Key-On, Engine-Running (KOER) Test

KOER codes are also the result of a self test but with the engine running. Some of the sensors tested are different than the KOEO or continuous codes. Only by checking all three codes (KOEO, Continuous, and KOER) can one be sure of an accurate diagnosis.

Wiggle Tests

The wiggle test is a built-in function of the Ford EEC-IV engine computer, or electronic control assembly (ECA). Wiggle testing is a sensitive self-test feature that recognizes problems as they occur and stores a service code in memory.

Basically, the wiggle test puts the ECA in a normal operating mode with the added ability to transmit a signal pulse to the self-test output (STO) terminal in the vehicle test connector. One can then wiggle, shake and twist the wiring harnesses, connectors, and components to try to recreate an intermittent problem. The ECA monitors the entire EEC-IV system during the wiggle test. If it recognizes a fault, it sends a signal pulse to the STO terminal, which a scan tool can recognize. The ECA simultaneously stores a service code for the fault in its own memory.

That's an important point. The ECA stores the code in its own memory. It doesn't transmit it to the scan tool during the wiggle test.

NOTE: *You should do a wiggle test both with the engine off and with the engine running. It is also possible to road test the vehicle with the ECA in the wiggle test mode.*

Pump Modifications

For Reducing Converter Clutch Slippage and O/D Planet Failure

The following pump modifications are recommended for improving lubrication and converter clutch apply. This will reduce occurrences of the very common code 62.

STEP 1: Remove the overdrive planetary lube plug. This can be done by driving the plug into its bore until it comes out the other side, or it can be pulled out with a screw extractor (figure 1).

STEP 2: Plug the hole as shown in figure 2 then stake the plug in place. GM part number 8611710.

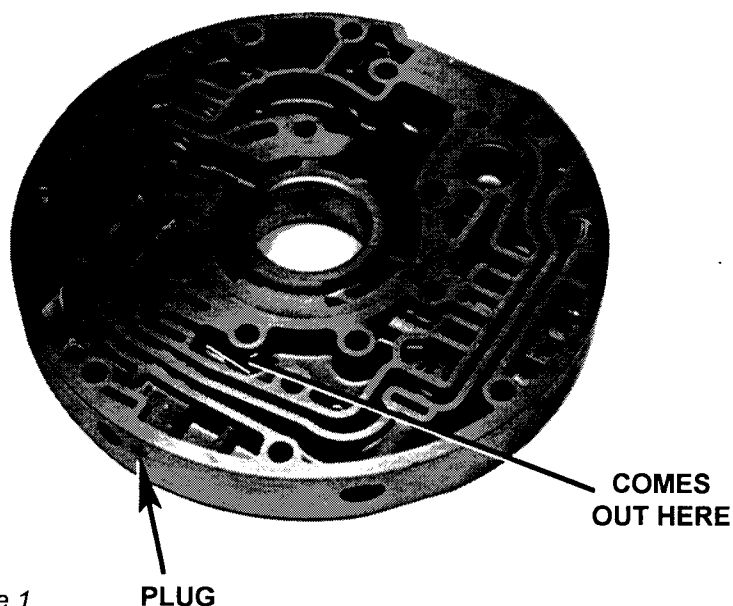


Figure 1

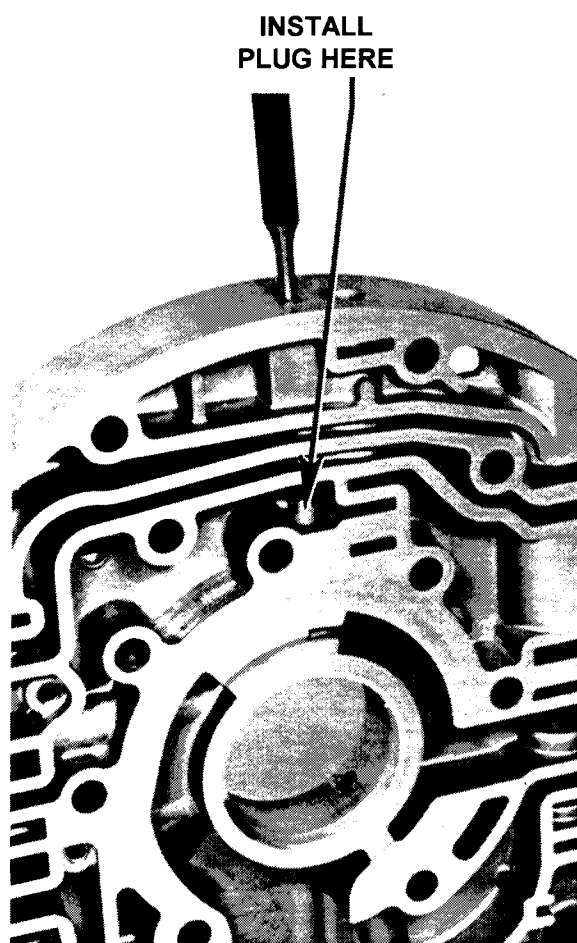


Figure 2

Pump Modifications (cont)

STEP 3: Install a spacer on top of the first plug as shown in figure 3, then install a second plug. A spacer is optional but is a good safety measure in case the first plug comes loose. The spacer (if used) should be long enough to touch both plugs. For example, measure the depth of the hole after the first plug is installed. Subtract the height for the second plug. This is a length of the spacer that is needed. After installing the second plug, stake it in place. GM part number 8611710 can be used for both plugs.

STEP 4: Remove the stator shaft from the pump cover and drill a .065" hole as shown in figure 4. Use caution while removing and replacing the stator shaft so as not to damage the pump cover. Heating the pump cover before installing the stator shaft will help the shaft go in more easily. This can be done in a hot water parts washer. Remove any shavings from the casting before installing the shaft.

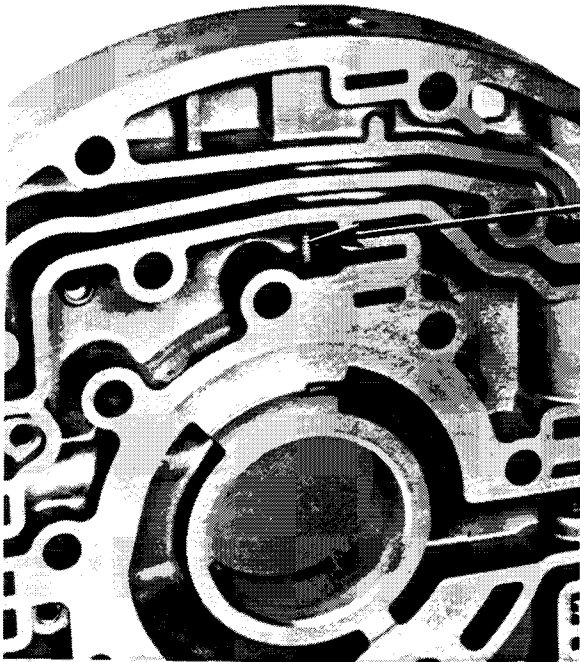


Figure 3

SPACER

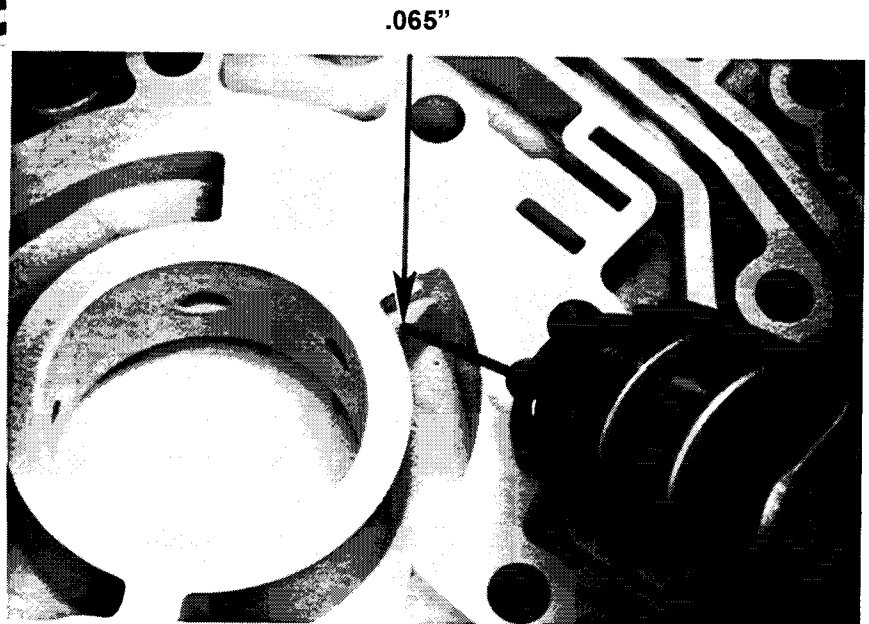


Figure 4

Pump Modifications (cont)

STEP 5: Drill through the wall of the pump cover as shown in figure 5.

- Make sure this orifice is not smaller than .075".
- Make sure this orifice is not smaller than .090".
- Drill a .055" hole through this wall.

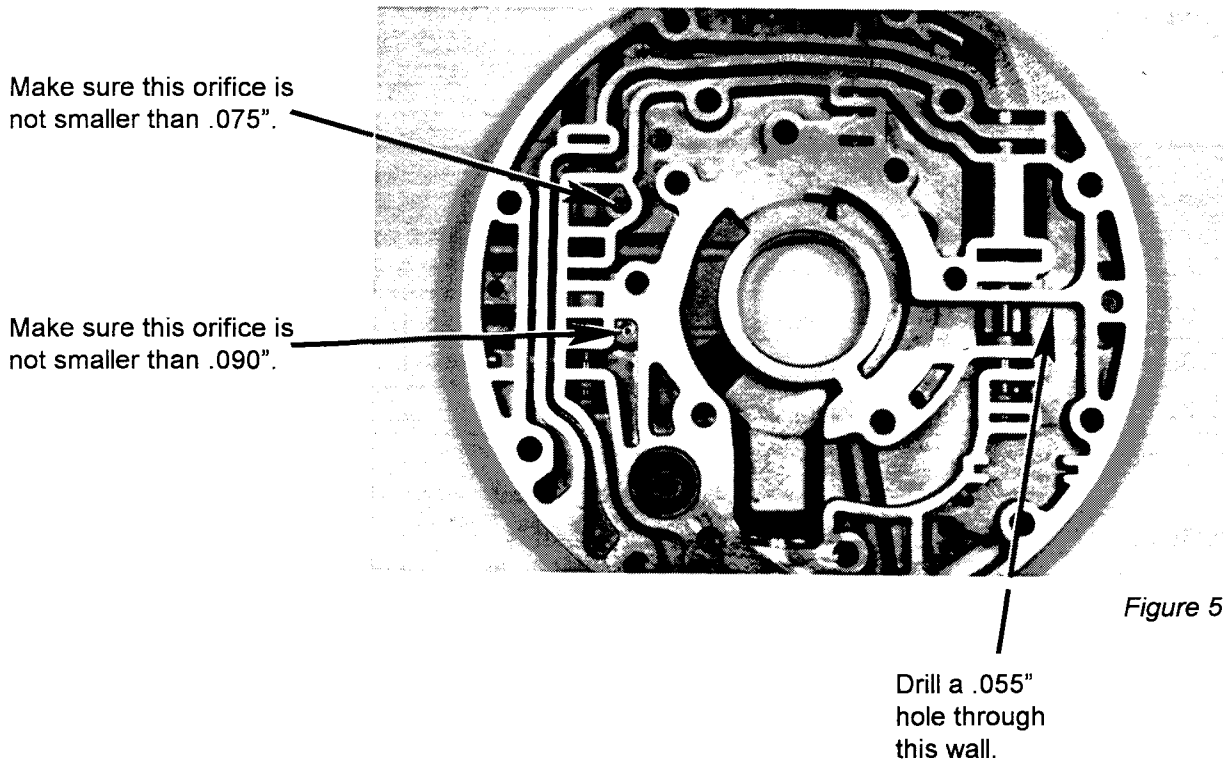


Figure 5

NOTE: A vibration (not a shudder) at approximately 60 m.p.h. when the torque converter clutch (TCC) is engaged, may be due to loose rivets inside the torque converter. Loose rivets can not be inspected from the outside of the converter. However, if you rebuild your own torque converters, make sure you check them as they are often overlooked. Do not confuse this with a shudder.

E4OD

7.3 Diesel Transmission Controller Assembly

Through the years, there have been many updates to the controller assemblies used in Ford vehicles. None more so than the E4OD controller used in the 7.3 Diesel applications.

The most current group of updated controllers replaces the previous version which had been known to cause DTC (Diagnostic Trouble Code) 62, TCC slippage, even though all other areas of the lock-up system functioned properly.

The following controllers provide for a much improved operating strategy that will drastically improve driveability with better pressure rise control and lock-up timing, compared to 1992 and earlier controllers.

These controllers will retro-fit all to models back to 1989. Consult the chart to locate the correct controller part number for your application.

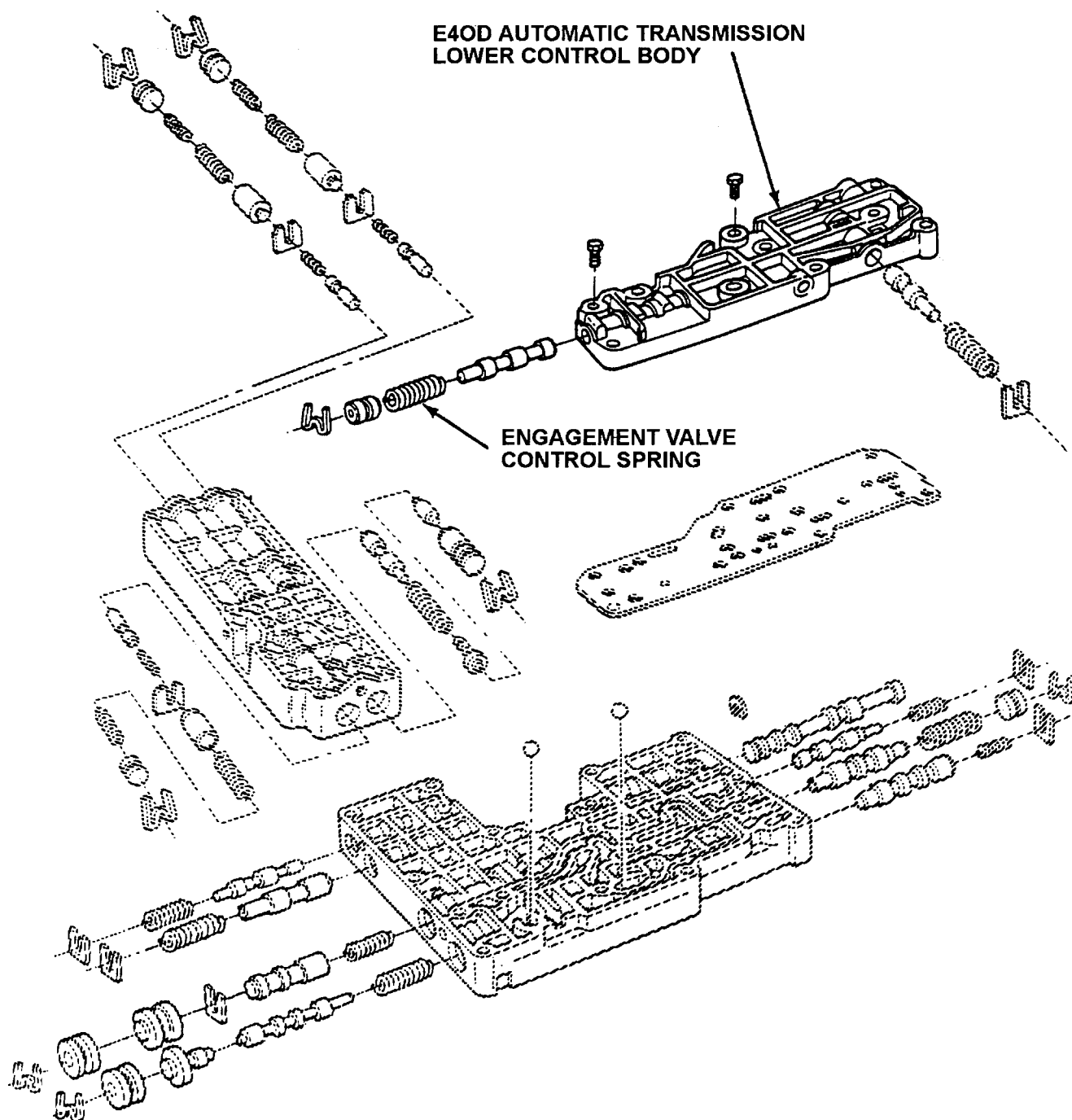
ENGINE	VEHICLE	APPLICATION	PCM PART NUMBER
7.3L	F-Series Econoline	50 States	F4TZ-12B565-AA
7.3L	F-Series Econoline	High Altitude	F4TZ-12B565-CA
7.3L	Super Duty	50 States	F4TZ-12B565-BA
7.3L	Super Duty	High Altitude	F4TZ-12B565-DA
7.3L Turbo	F-Series	50 States High Altitude	F4TZ-12B565-EA
7.3L Turbo	Super Duty	50 States High Altitude	F4TZ-12B565-FA

No Line Pressure Rise in 3rd

Some E4ODs will not have a line pressure rise or change in 3rd gear. They will operate normally in 1st and 2nd. The controllers listed here can be used to resolve this condition. The vehicles in question will have 1992 computers. DO NOT order a replacement computer based on the previous computers part number or you will get another 1992 computer. Order a computer based on the vehicles VIN number or on the calibration code sticker. This sticker is usually on a door jam but may also be on the radiator core support or on the engine.

Double Bump or Delayed Reverse Engagement

Some vehicles may exhibit a harsh double bump or a delayed reverse engagement when the accelerator pedal is immediately depressed after selecting reverse. Acceptable operation is observed when waiting two (2) or more seconds before attempting to accelerate. This concern may be caused by the engagement control valve spring in the lower control body. Removing the spring may correct the problem.



E40D

Delayed Engagements

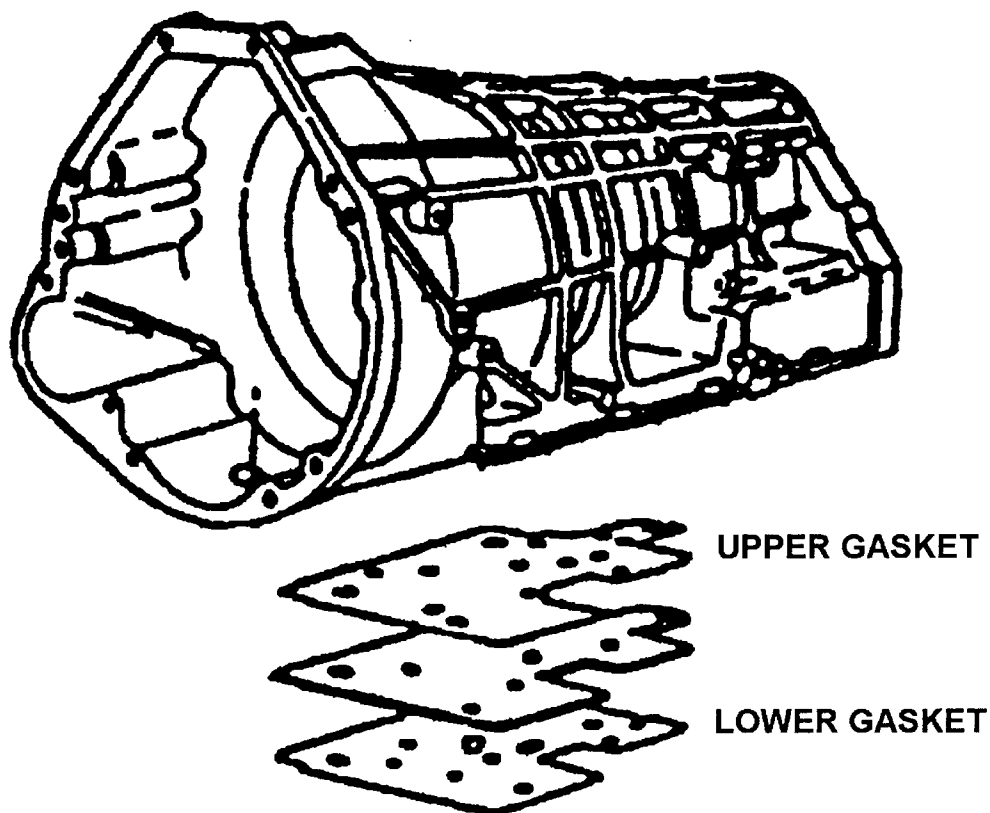


Figure 1

An orifice is created by the use of a slot in the lower valve body gasket (figures one and two). This orifice feeds the line modulator circuit.

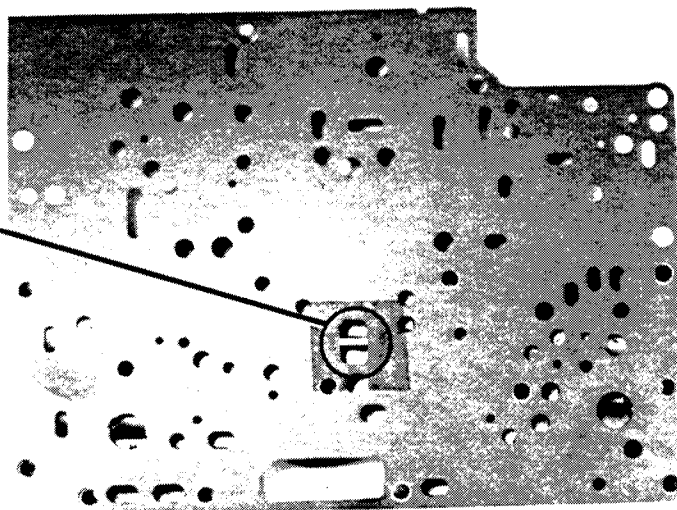


Figure 2

E40D Delayed Engagements (cont)

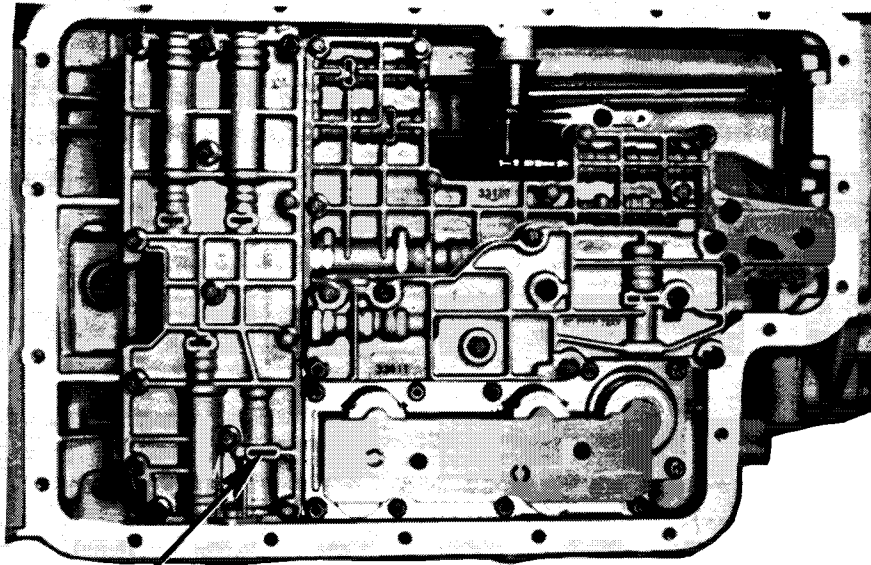


Figure 3

Some of the oil provided by this orifice (the slot in the gasket), is exhausted through a vent at the line modulator valve (figure 3).

Using a lower valve body gasket that is thicker than original specifications will increase the volume of oil that is exhausted. A delayed engagement can result if the lower gasket is too thick. The original gasket thickness is .010".

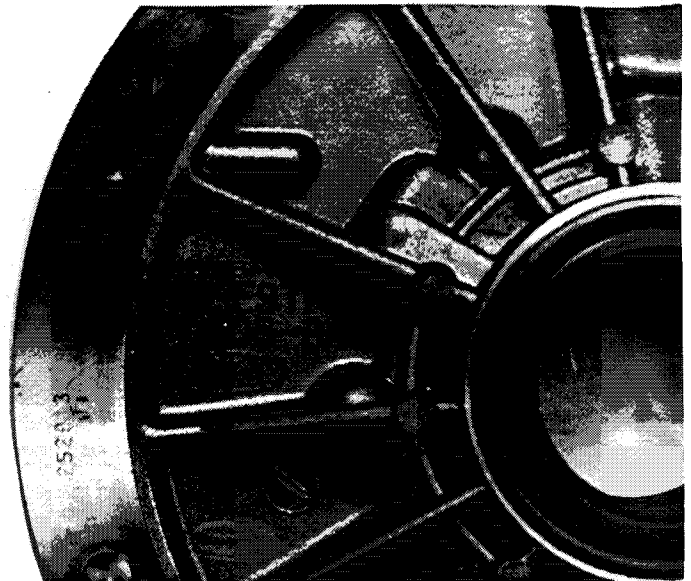
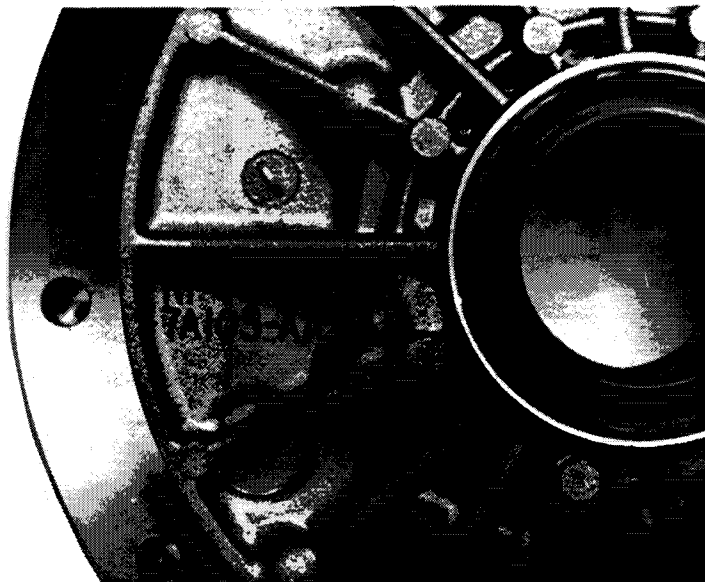
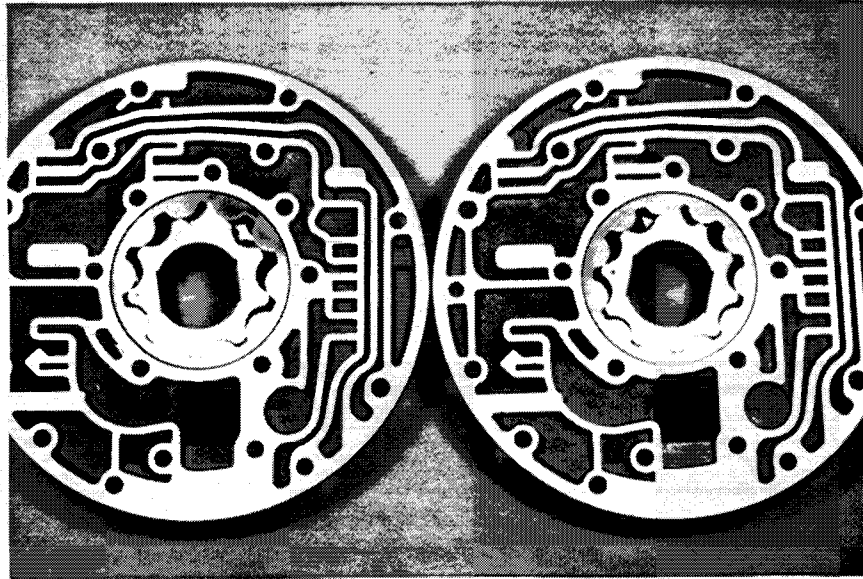
IMPORTANT: It is perfectly acceptable (and in some cases, desirable) to use a thicker gasket between the case and main separator plate (upper valve body gasket).

NOTE: The effects of a thick gasket are noticeable only when EPC pressure is low (e.g. engine at an idle).

E4OD

Pump Upgrade

The E4OD pump has been upgraded for higher capacity. This is particularly helpful for engagement delays while hot. The part number for the second design pump is F5TZ-7A103-A.



E4OD

No Forward Engagement in the O/D Select Mode, 4-3 Flare

These symptoms are usually caused by a worn or broken O/D Sprag.

In the O/D select mode, the coast clutch is released and all input torque is transmitted through the O/D sprag. When the transmission shifts to overdrive the O/D sprag over-runs.

In the O/D cancel mode, the coast clutch is applied and overrides the O/D sprag.

Ford has updated the O/D sprag with a roller clutch kit which retrofits all E4OD transmissions (Ford part number F5TZ-7A089A). This kit includes the inner and outer races, the roller clutch and a new snap-ring (Figure 1).

The roller clutch assembly is similar to the earlier sprag. When installed correctly, the inner race freewheels counter clockwise (Figure 2).

A large contributing factor of the O/D sprag failure is that everytime the vehicle is started, the computer resets to the O/D select mode. Because of this, most driving is done without the coast clutch applied.

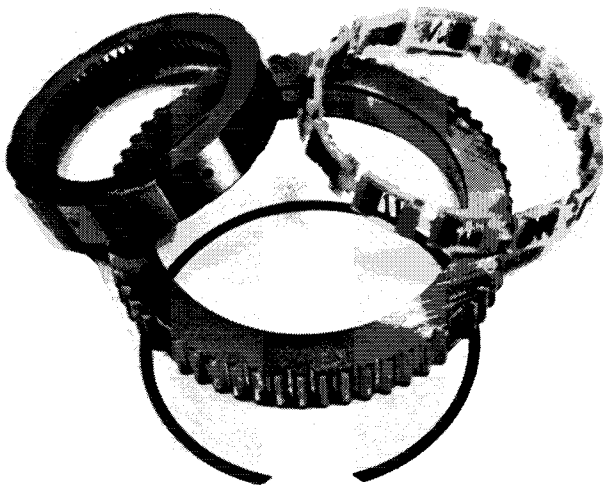


Figure 1

INNER FACE FREEWHEELS
COUNTER CLOCKWISE.

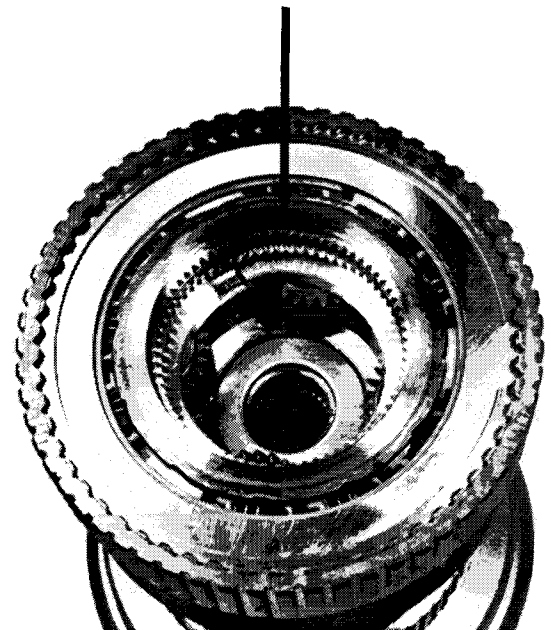


Figure 2

No Forward Engagement in the O/D Select Mode, 4-3 Flare (cont)

Heavy loads, full throttle starts and other types of abusive driving put a great deal of stress on the O/D sprag.

To remove some of this stress, block the coast clutch shift valve toward the retainer. To do this, remove the coast clutch shift valve assembly. Remove one and one half coils from the spring (figure 3). Reinstall the assembly with the spring first, then the valve, and then the retainer (Figure 4).

With the coast clutch shift valve blocked in this position, the coast clutch will be applied in first, second and third gear in both the O/D cancel and O/D select mode. The 3-4 shift valve will release the coast clutch in overdrive to allow the sprag to over-run.

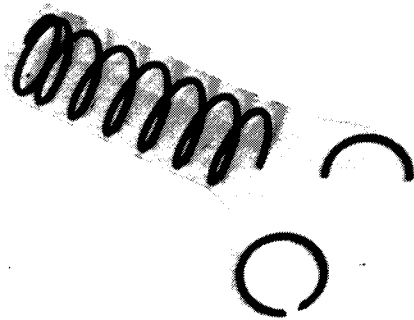


Figure 3

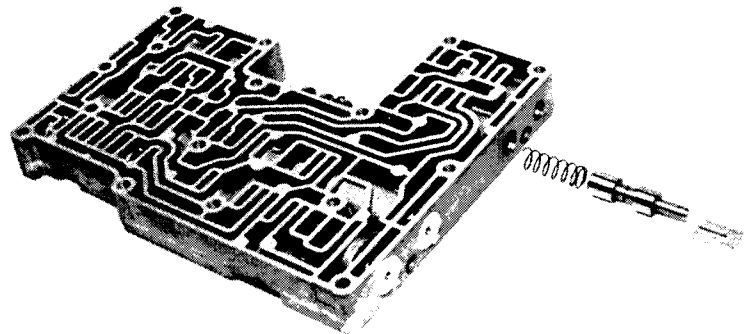


Figure 4

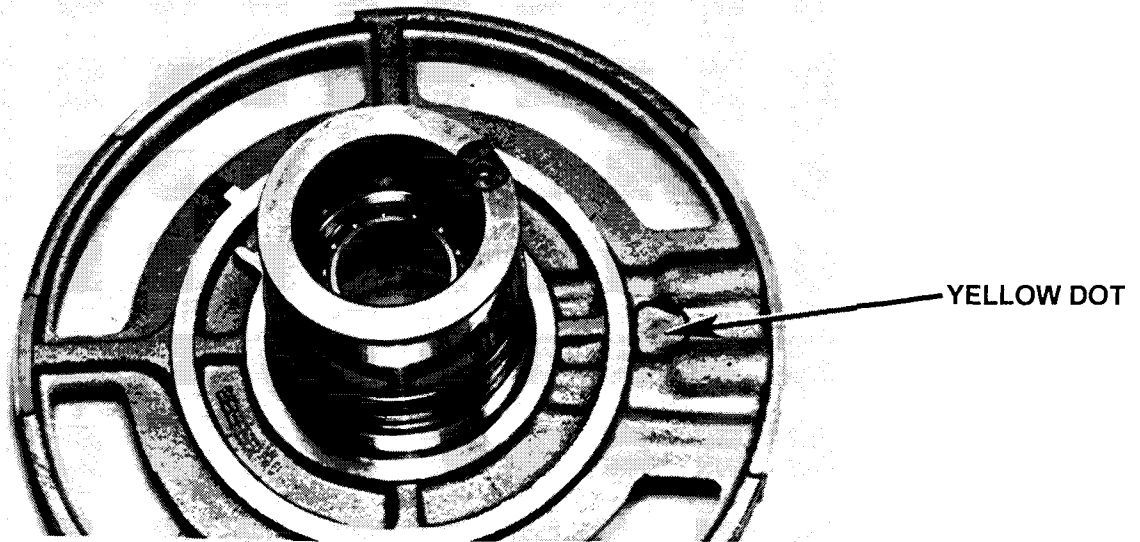
Ball Bearing Center Support

A service kit for upgrading 1989-94 E4OD transmissions with the 1995 ball bearing center support components has been released for service.

The kit consists of the following:

- 1 (one) Ball Bearing Center Support Assembly
- 1 (one) Overdrive Center Shaft
- 1 (one) #5 Needle Bearing
- 1 (one) Orificed Cup
- Instruction Sheet #6712

NOTE: If the output shaft is already equipped with a cup plug, do not use the cup plug from this kit. Only use the cup plug in this kit if the output shaft has a removable bushing.



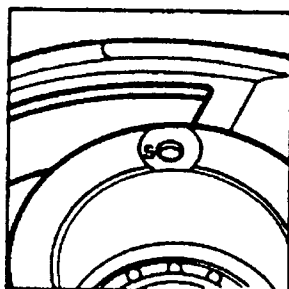
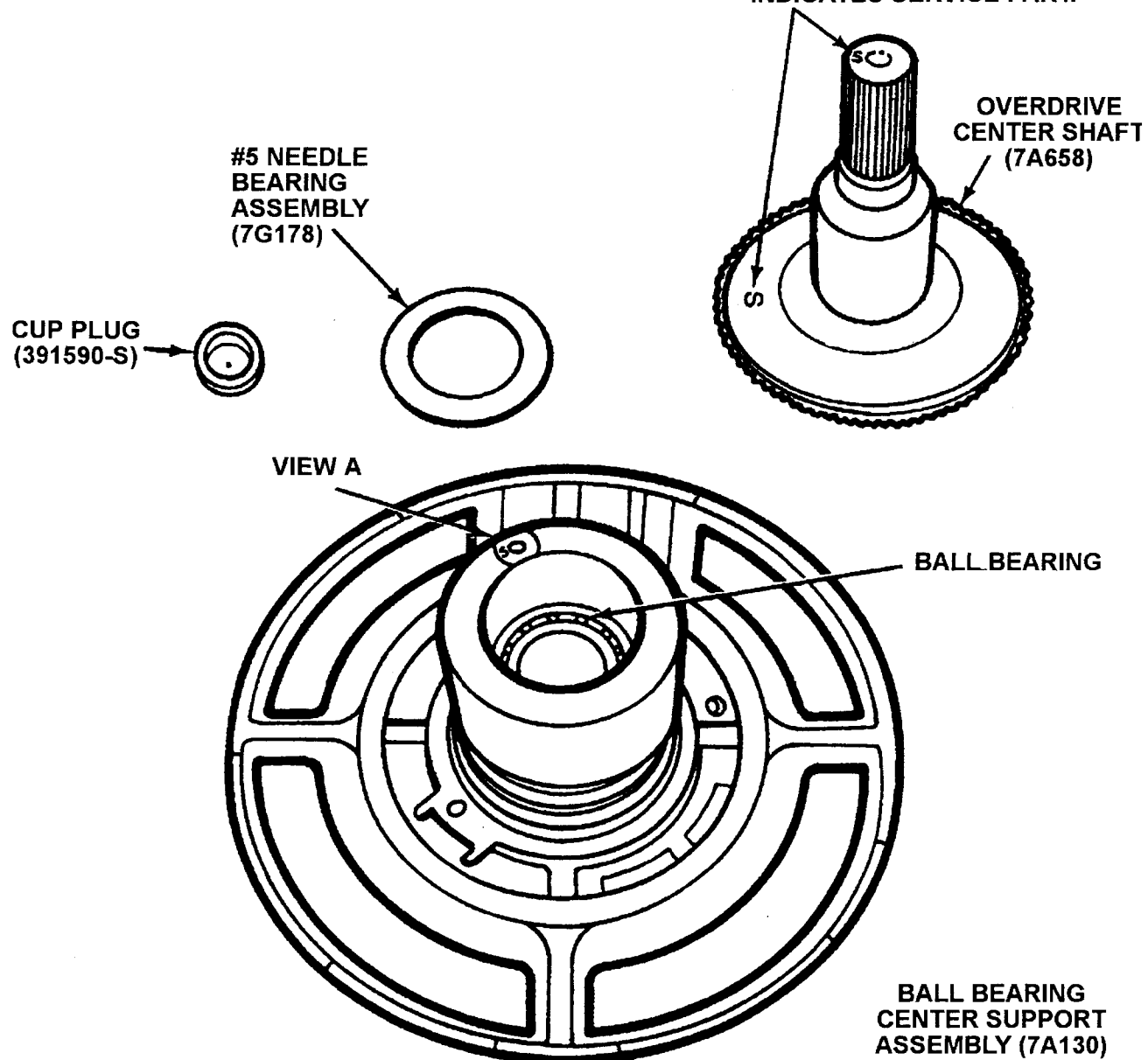
Delayed forward engagements and/or heat stained forward clutch plates may be evident on vehicles which have had the new Center Support Kit built before 4/7/95.

NOTE: Use only service kits having yellow paint on the center support and a yellow dot on the outside of the shipping carton.



Ball Bearing Center Support (cont)

NOTE: THE LETTER 'S' COULD BE IN EITHER LOCATION. THE 'S' INDICATES SERVICE PART.



VIEW A

LETTER 'S' INDICATES
SERVICE KIT PART

No 2-3 Upshift or 2-3 Bindup

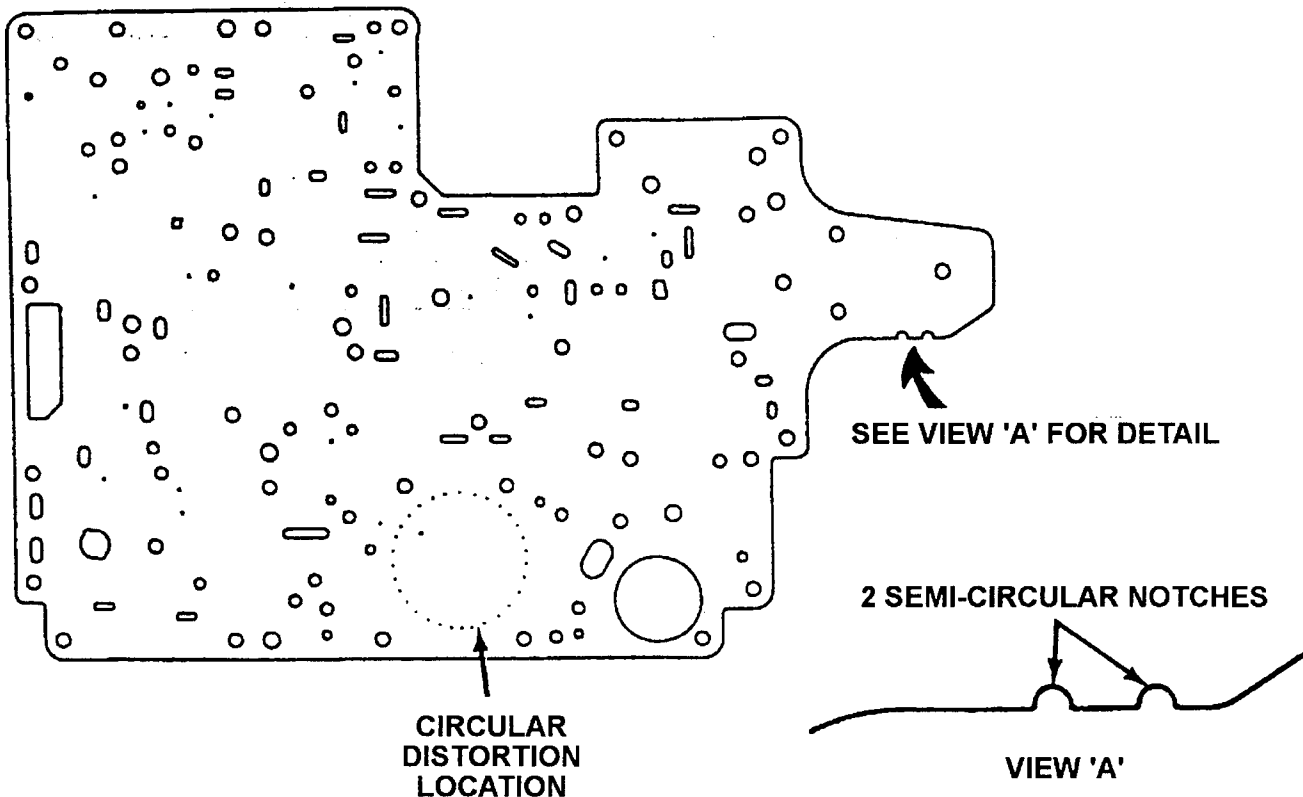
Some vehicles may exhibit a no 2-3 upshift or a 2-3 bindup. This may be the result of cross leakage caused by distortion of the control valve body separating plate.

- Remove both separator plate gaskets.
- Examine the separator plate for deformation in the intermediate servo area.

NOTE: The separator plate gaskets must be removed to see the distortion.

If distorted, replace the separator plate with a new control valve body separator plate (F4TZ-7A008-A).

CONTROL VALVE BODY SEPARATING PLATE
1990 THROUGH PRESENT MODEL YEAR



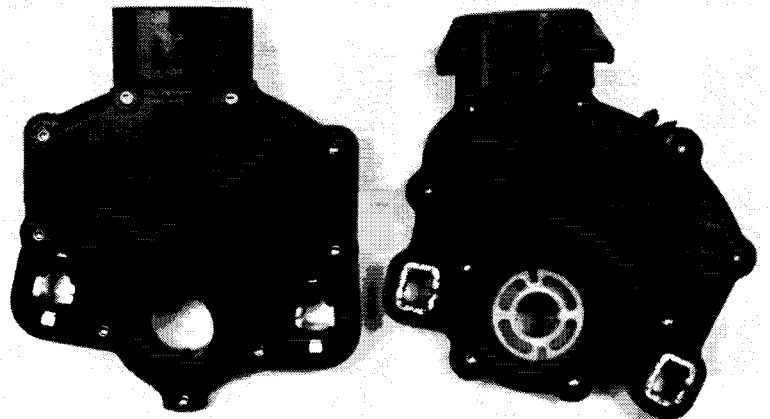
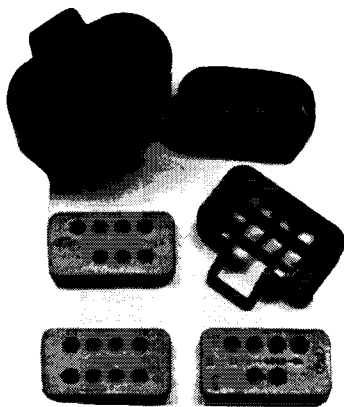
Shift Concerns or Harsh Engagement Concerns Due to Water Intrusion of the MLP Sensor

Some vehicles may exhibit no shifts, 4th gear starts, or a harsh engagement concern due to water intrusion into the MLP sensor and vehicle harness. There may also be a number of DTCs along with these concerns.

If water penetration is present and/or DTCs have been set, replace the MLP sensor and the vehicle harness connector with Ford's sensor service kit (F5TZ-7A247-A).

The Service Kit contains:

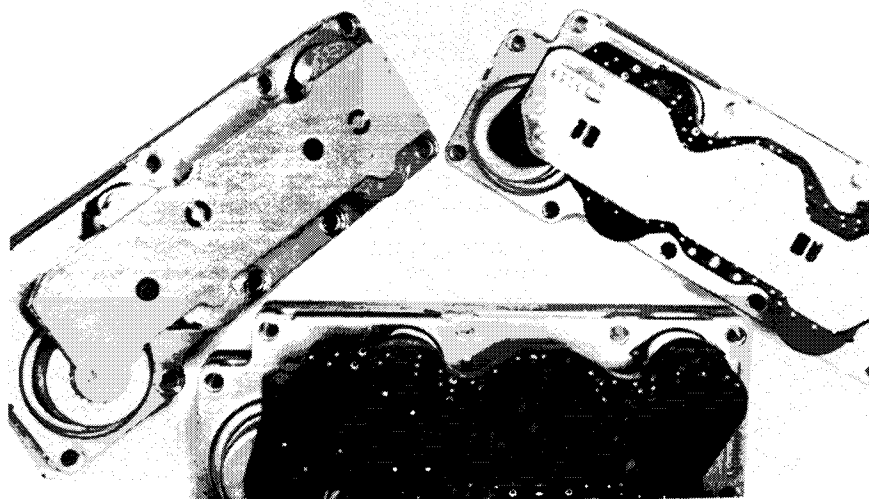
- One (1) MLP Sensor
- One (1) Connector Assembly
- One (1) "Red" Pin Separator Plate
- One (1) 6-Pin Grommet
- One (1) 8-Pin Grommet
- One (1) 7-Pin Grommet
- One (1) Instruction Sheet



New Solenoid Bodies

There are now two new solenoid bodies for the E4OD. One to service 89-94 vehicles and one for 95-96 vehicles.

ORIGINAL
FOR 1989-94
(BLUE COVER)



REPLACEMENT
FOR 1989-94
(CLEAR COVER)

1995-96

(BLACK COVER)

89-94 Solenoid Body Changes

- Molded lead frame with a clear cover. The new frame replaces the circuit board.
- Updated shift solenoids
- New connector WITHOUT the Aluminum bushing.
- Redesigned EPC Solenoid which resists clogging.
- Part Number E9TZ-7G391-A

95-96 Solenoid Body Changes

- All the above listed for the 89-94
- Molded frame has a black cover
- New connector in which the seal has been move to the vehicle harness
- ECM protection diodes have been moved from the solenoid body to the ECM.
- Part Number F5TZ-7G391-A

IMPORTANT: The 1995-96 solenoid body is NOT interchangeable with the 89-94 solenoid body.

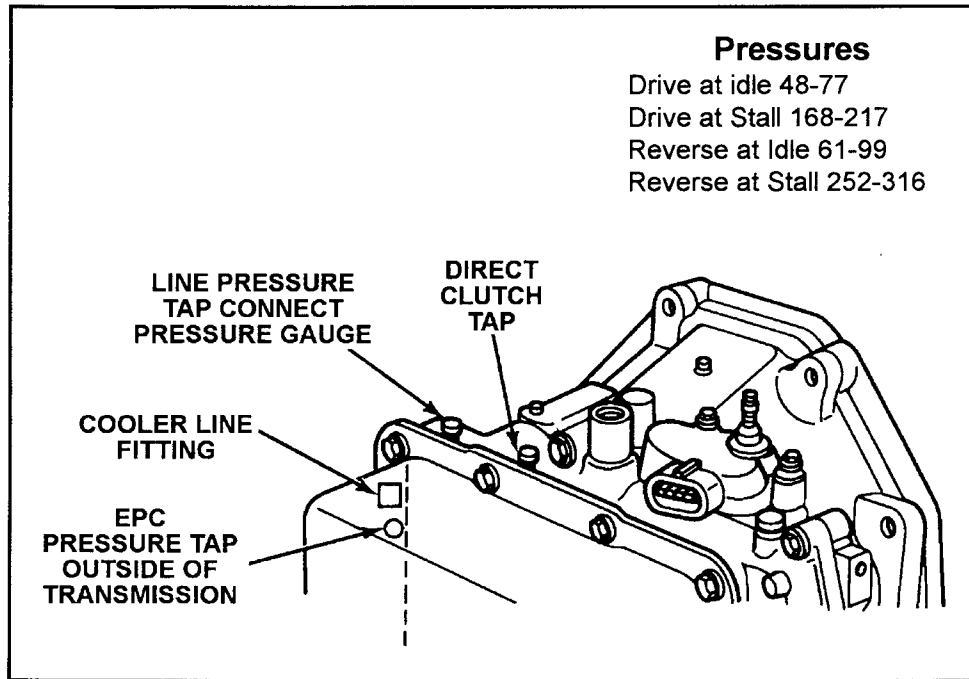
AXOD-E

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Ford
AXODE



AXODE



Range	Gear	Sol 1	Sol 2	Sol 3	O/D Band	Forward Clutch	Low One-Way Clutch	Direct Clutch	Direct One-Way	Int Clutch	Rev Clutch	Low Int Band
P-N												
R	Reverse											
D	1st											
	2nd											
	3rd											
	4th											
D	1st											
	2nd											
	3rd											
L	1st											

★ = Holding but ineffective due to Clutch.

Failsafe Mode

D	3
D	3
1	2

Gear Ratios

1st	2.77
2nd	1.54
3rd	1.00
4th	.69
Reverse	2.26

Checkballs

NUMBER

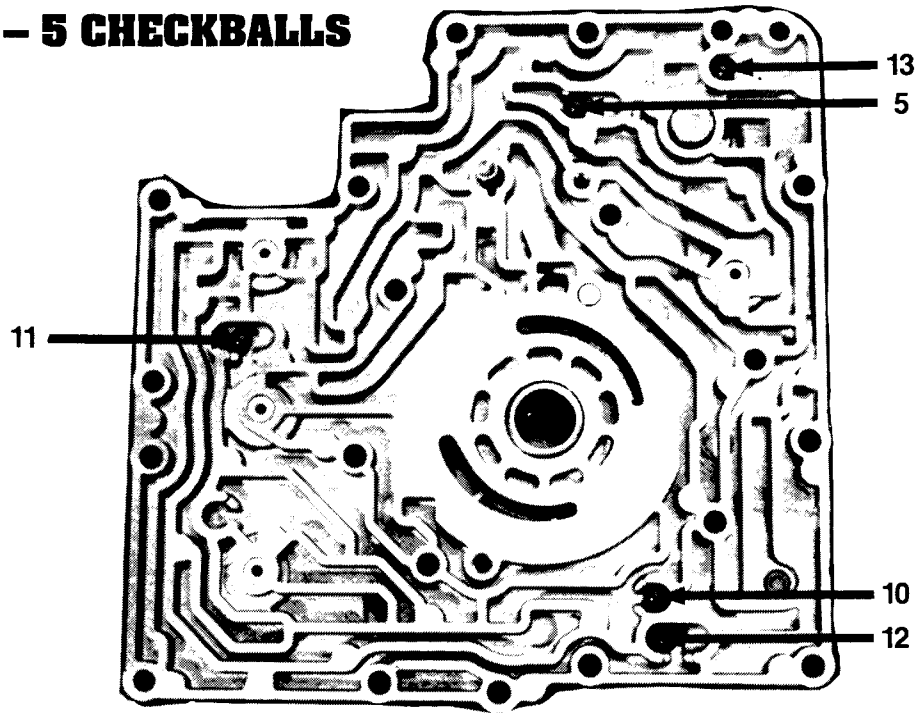
- 1 Reverse clutch orifice.
- 2 Forward clutch orifice.
- 3 1-2 Servo check, (Causes drive oil to go through the 2-3 servo regulator and engagement control valve before it gets to the servo).
- 4 Overdrive servo orifice.
- 5 Forward clutch control shuttle (shuttles 1st-2nd gear oil, and reverse oil, to move the forward clutch control valve).
- 6 1-2 servo release check (causes servo release oil to go thru the 3-2 control valve during a 3-2 downshift).
- 7 Direct clutch exhaust check (causes the direct clutch oil to exhaust thru the #9 checkball during the 3-2 downshift).
- 8 Direct clutch shuttle (shuttles direct clutch oil and manual low oil to feed the direct clutch).
- 9 Direct clutch orifice.
- 10 Servo release check (provides an exhaust for servo release oil in 1st and reverse).
- 11 Direct clutch oil shuttle (shuttles between 3rd gear oil & 4th gear oil to feed the direct clutch).
- 12 Engagement control valve shuttle (shuttles T.V. oil & 2nd gear oil to control the engagement control valve).

NOTE: 4 checkball configurations only use 2nd gear oil.

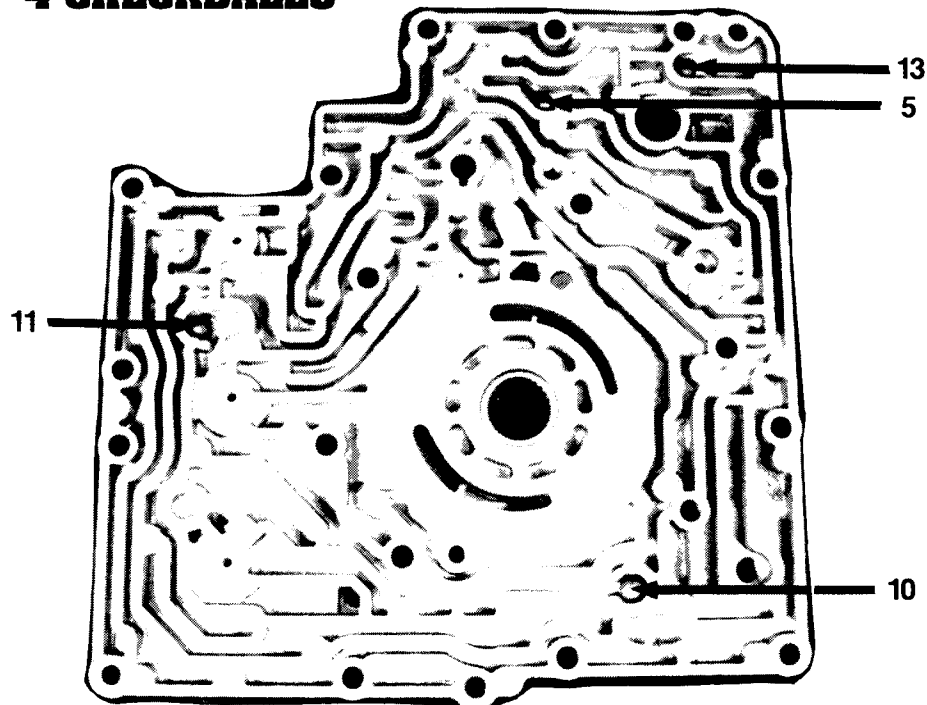
- 13 Forward clutch control valve feed orifice.

Checkballs

EARLY 1991 – 5 CHECKBALLS

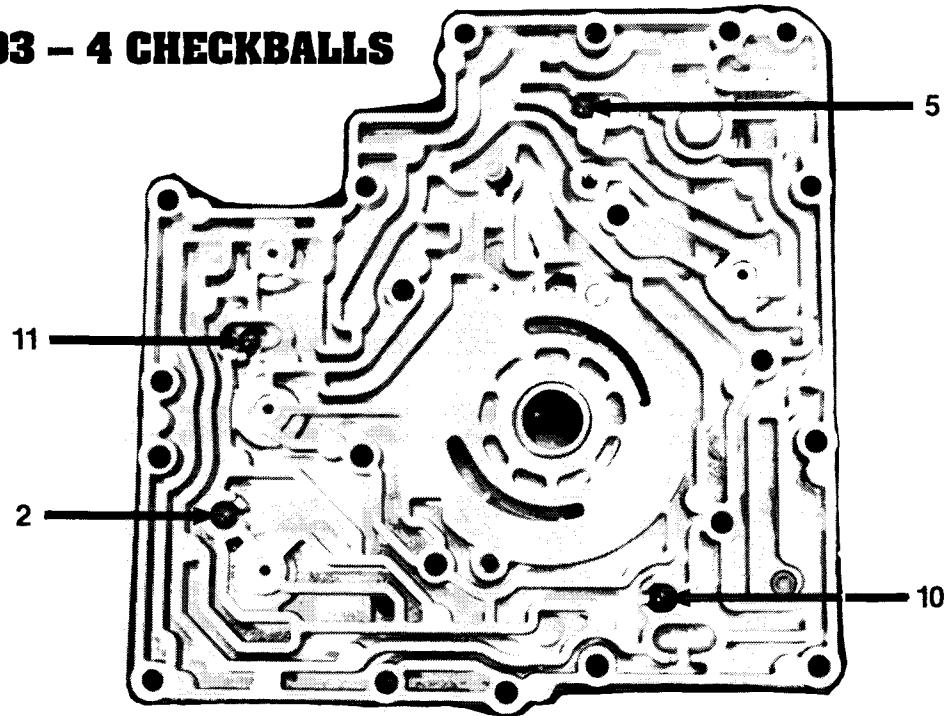


LATE 1991 – 4 CHECKBALLS



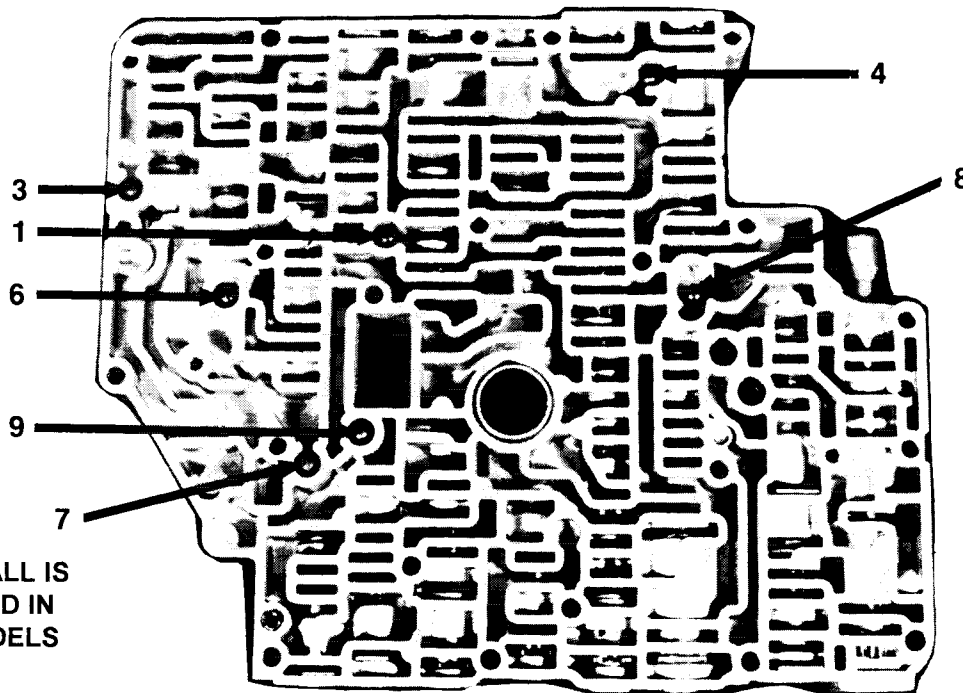
Checkballs

1992 AND 1993 – 4 CHECKBALLS



1991 AND 1992 VALVE BODIES USE 7 CHECKBALLS

1993 VALVE BODIES USE 6 CHECKBALLS

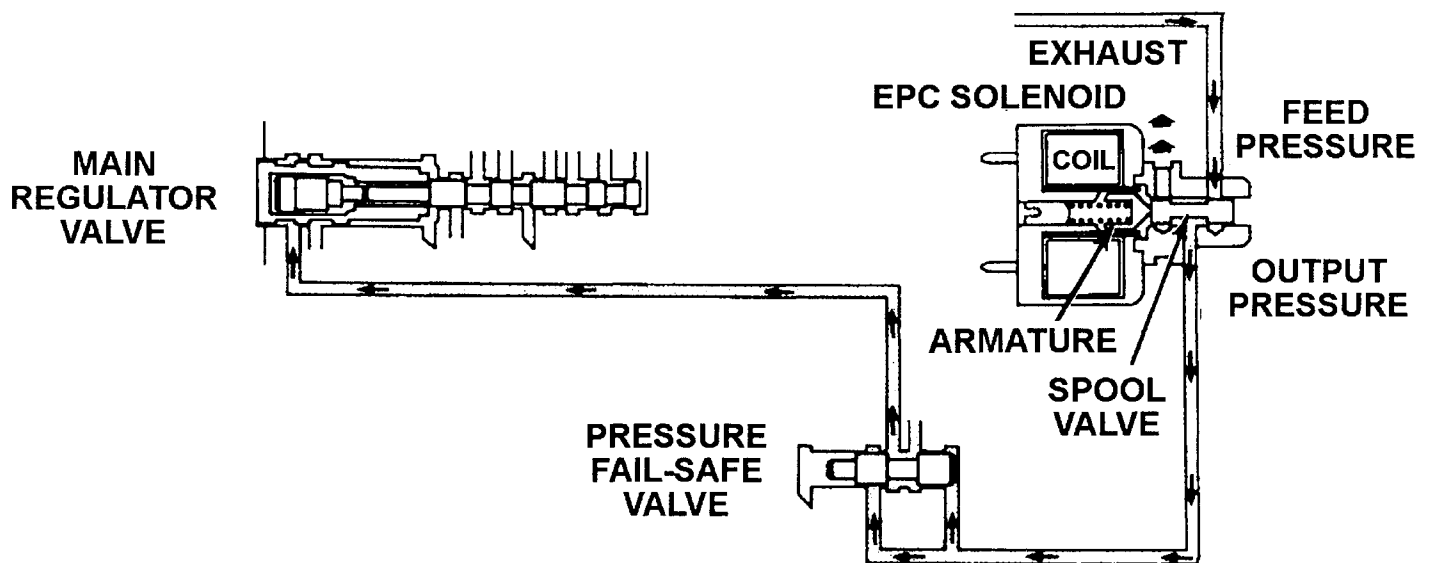


THE #7 BALL IS
NOT USED IN
1993 MODELS

Ford AXODE Line Pressure Concerns

Line Pressure Systems Principals of Operations

The AXODE minimum line pressure is controlled by the main pressure regulator valve opposing the main pressure regulator spring force. Line pressure is engineered to be increased above minimum pressure by two different systems. One system is used when the manual valve is moved into the reverse position. A second system is engineered to increase line pressure by applying additional force to the pressure regulator boost valve. It is used mainly to increase pressure to prevent clutch and band slippage under increasing loads in forward or reverse. It is electronically controlled by the Powertrain Control Module (PCM). Based on the information the PCM receives from input sensors it provides a varying amount of current to the Electronic Pressure Control (EPC) solenoid.



The EPC solenoid assembly has an internal moveable spool valve. With no current applied, spring pressure holds the spool valve to the right, and allows maximum main line IN flow through the valve. As the PCM applies more current to the solenoid, the armature is pulled to the left by the magnetic force of the solenoid coil. This lowers the spring force on the spool valve allowing it to move to the left and lower main line IN flow which will reduce the EPC OUT flow. The EPC circuit pressure may exhaust through the solenoid exhaust port when necessary.

High Line Pressure In Park

It is normal for the PCM system to raise EPC pressure to 40-60 psi and therefore line pressure to 130-150 psi when the transmission oil temperature is below 150° Fahrenheit. This is in park only, and is prior to the initial engagement.

Pressure at Idle (psi) * * *

GEAR	EPC	LINE	DIRECT CLUTCH
P##	40-60##	130-150##	—
P	10-20	48-77	—
R	10-20	61-99	—
N	10-20	48-77	—
OD	10-20	48-77	—
D/2	10-20	48-77	—
1	10-20	48-77	40-60

Pressure at Wide Open Throttle (WOT) Stall (psi) * * *

GEAR	EPC	LINE	DIRECT CLUTCH
P	—	—	—
R	70-90	252-316	—
N	—	—	—
OD	70-90	168-217	—
D/2	70-90	168-217	—
1	70-90	198-247	40-60

Special Note: This condition will occur when the TRANSMISSION OIL TEMPERATURE is below 150°F AND this is the INITIAL engagement.

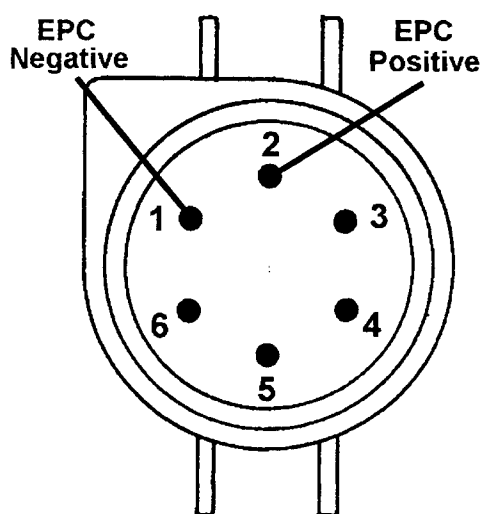
* * * Approximate Pressures

High Line in Forward and Reverse (cont)

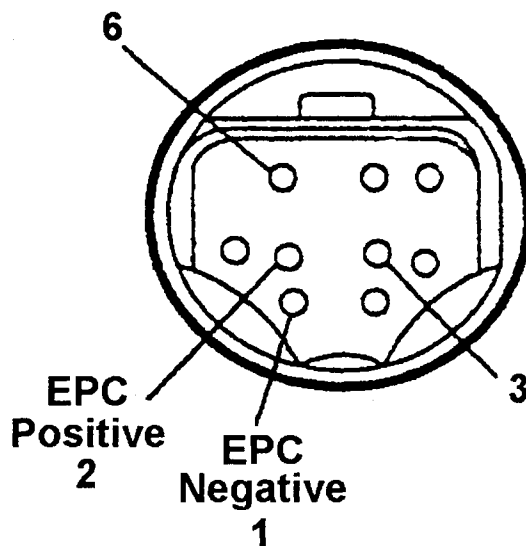
For high line conditions (other than a cold start in Park) perform the following:

1. Clear codes
2. Road test (on the road, not with the wheels off the ground)
3. Check codes—repair as necessary
4. Test the PCM signal to the EPC solenoid. There is more than one method to test the signal, however, the simplest may be a voltage drop test. Be certain the transmission is at operating temperature. On the top case connector locate the EPC positive and negative wires. With the harness remaining attached to the connector, test the signal between the two wires. The signal should be approximately 4 to 5 volts at idle in the overdrive position. With the brakes firmly applied it should be approximately 1 volt at wide open throttle stall. If the voltage is lower than specification at idle there may be a PCM system problem. This does not necessarily indicate the PCM is defective. Perform an electrical evaluation of the input sensors using a scan tool or break out box.
5. Test EPC pressure. It should be 0-5 psi at idle in overdrive with the transmission at operating temperature.

**91-92
CASE CONNECTOR
(TOP)**



**93-ON
CASE CONNECTOR**



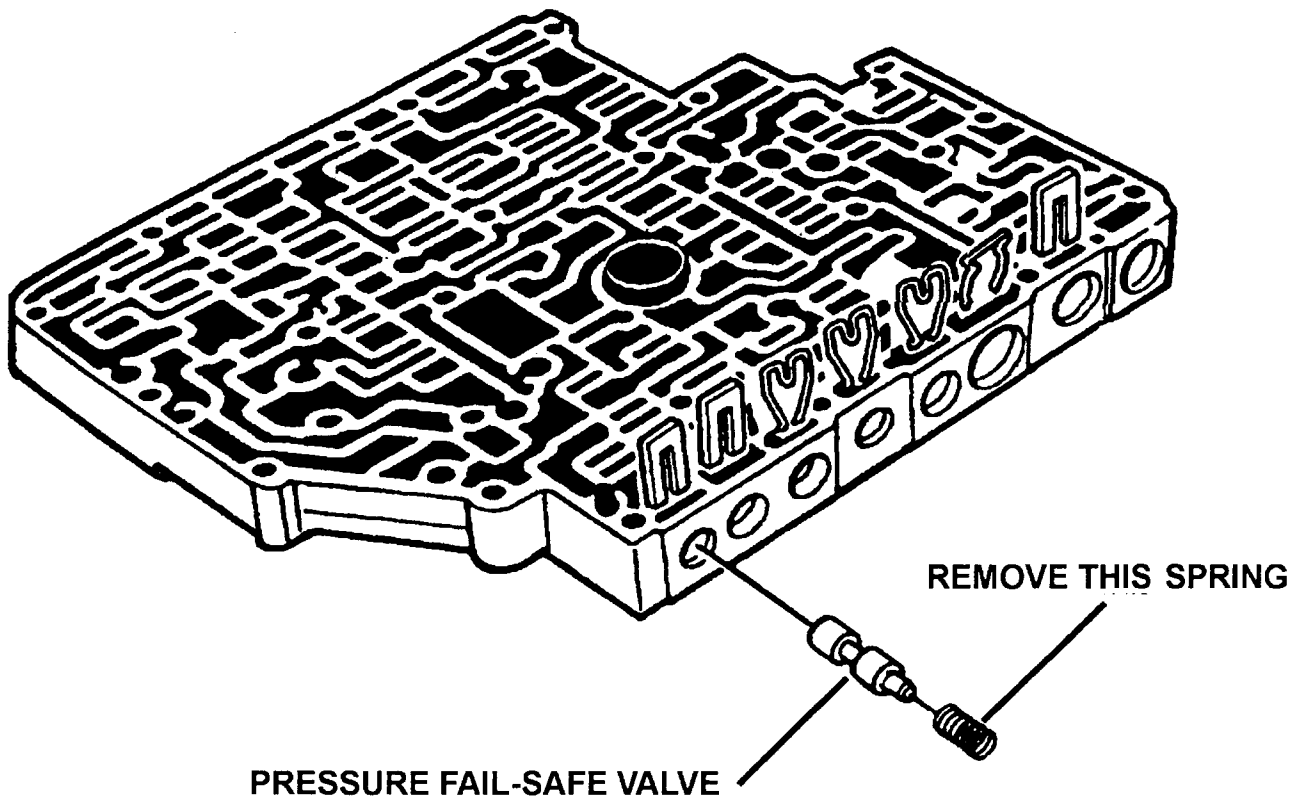
High Line in Forward and Reverse (cont)

- 6A. If EPC pressure is normal, check the valve body, pump, and channel casting for warpage. Inspect the gaskets for cross leaks. Check for a sticking pressure regulator valve. Re-torque the valve body bolts.
- 6B. If EPC pressure is high, disconnect the harness from the top case connector and test the resistance of the EPC solenoid at the transmission case connector between the two EPC pins. The resistance of the EPC solenoid should be 3.2 - 5.5 ohms at approximately 68 to 70° Fahrenheit. It may be slightly higher when it is warmer. Test the resistance between the EPC positive pin and the case. Test the resistance between the EPC negative pin and the case. The resistance should not be lower than 20,000 ohms (20K ohms). If the resistance does not meet specifications, test the EPC solenoid with it disconnected from the internal wiring. If it is now within specifications, the internal wiring may be defective.

COMPONENT	OHMMETER LEADS BETWEEN TERMINALS	RESISTANCE SHOULD BE	
EPC SOLENOID	1 & 2	3.2 - 5.5 ohms	
LOCK-UP SOLENOID	5 & 6	91 CONTINENTAL AND ALL 92 MODELS .75 - 2 ohms 91 TAURUS & SABLE 21 - 36 ohms	
TOT SENSOR	3 & 4	TRANSMISSION FLUID TEMPERATURE	
		°F	RESISTANCE
		32-58	100K-37K
		59-104	37K-16K
		105-158	16K-5K
		159-194	5K-2.7K
		195-230	2.7K-1.5K
		231-266	1.5K-0.8K

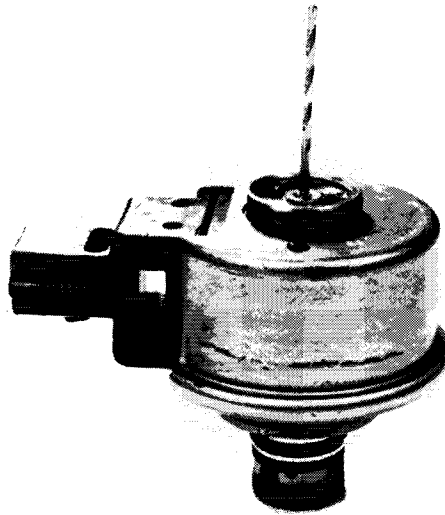
High Line in Forward and Reverse (cont)

7. If the EPC solenoid resistance meets specifications and high EPC pressure exists, inspect for a missing or damaged small diameter O-ring on the EPC solenoid. With only the small O-ring on the EPC solenoid, test for good compression of the O-ring into the pump. Be certain to install the large O-ring on final assembly.
8. Inspect the valve body for a pressure failsafe valve stuck in the 'at rest' position. It is recommended that the pressure fail-safe valve be disabled during any valve body repair or service. Removing the spring will disable the valve.



High Line in Forward and Reverse (cont)

9. Inspect the EPC solenoid coil and plunger assembly for correct operation by placing the shank end of a 3/32 drill through the brass set screw. Momentarily touch the two EPC solenoid terminals with 12 volts. The 3/32 drill should quickly move outward. If it does not move, replace the solenoid.

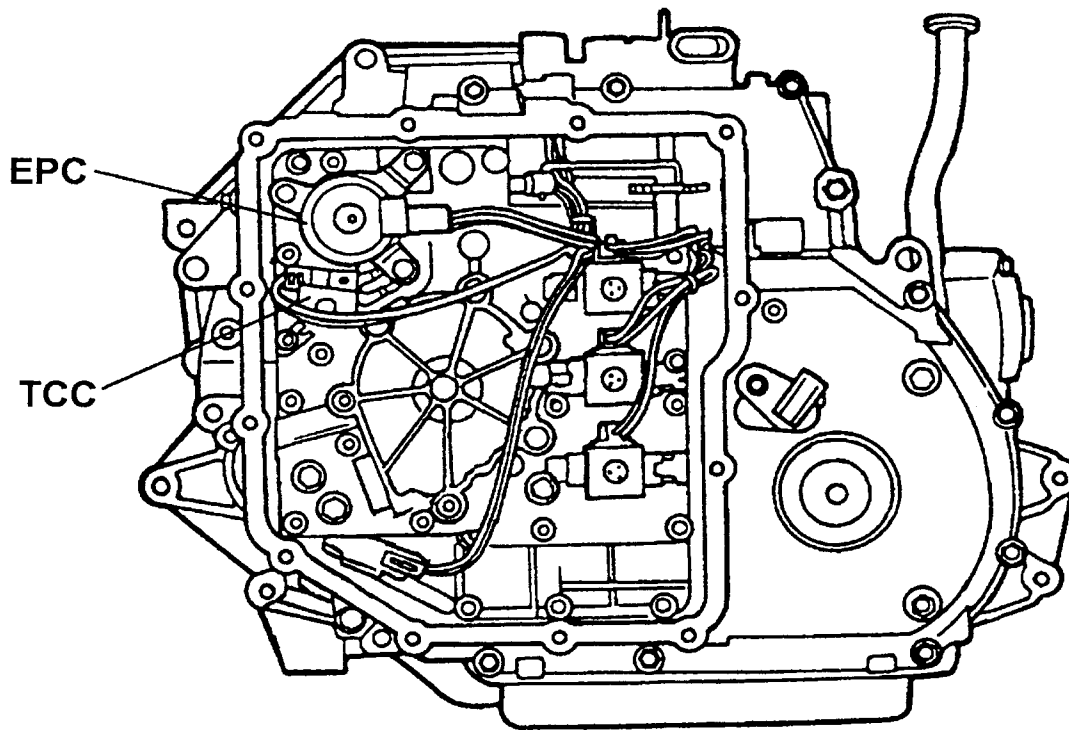


10. With the screen removed use tape to cover all EPC OUT pressure holes except one. Use tape to cover all line pressure IN holes except one on the opposite side from the remaining open hole for EPC OUT pressure. By leaving holes open on opposite sides there will be less confusion during air testing. Apply air to the solenoid LINE PRESSURE IN location. Air should freely exhaust on the opposite side of the solenoid at the EPC OUT pressure location. If it does not, replace the EPC solenoid.
11. Momentarily apply 12 volts to the solenoid terminals and air test as in step 10. Air should not exhaust at the EPC OUT PRESSURE location. If air freely exhausts as before, replace the solenoid. Remove the tape and reinstall the screen. NOTE: The above test may be able to determine if a solenoid has a serious problem that is constantly occurring but may not detect all solenoid problems, especially flow problems. It may be necessary to more thoroughly test the solenoid with solenoid test equipment designed exactly for that purpose.

TCC Pulsing On and Off in All Gear Positions, High Line Pressure, No Codes

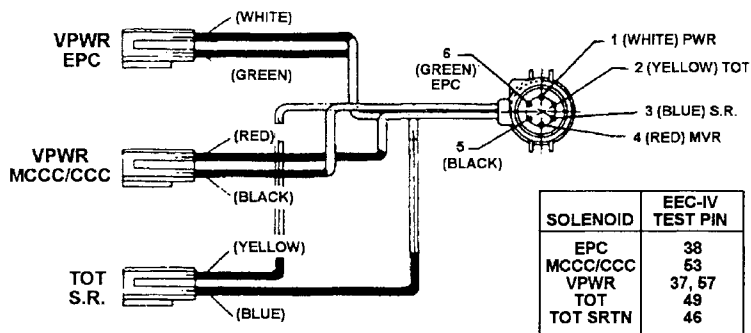
This condition may be caused by the EPC and TCC solenoid connectors being installed backward. To check this, remove the top connector and verify that the appropriate resistance exists across the terminals. If not, remove the side cover and check the connections.

NOTE: *Harness must go behind manual valve linkage and be secured to hole in separator plate.*



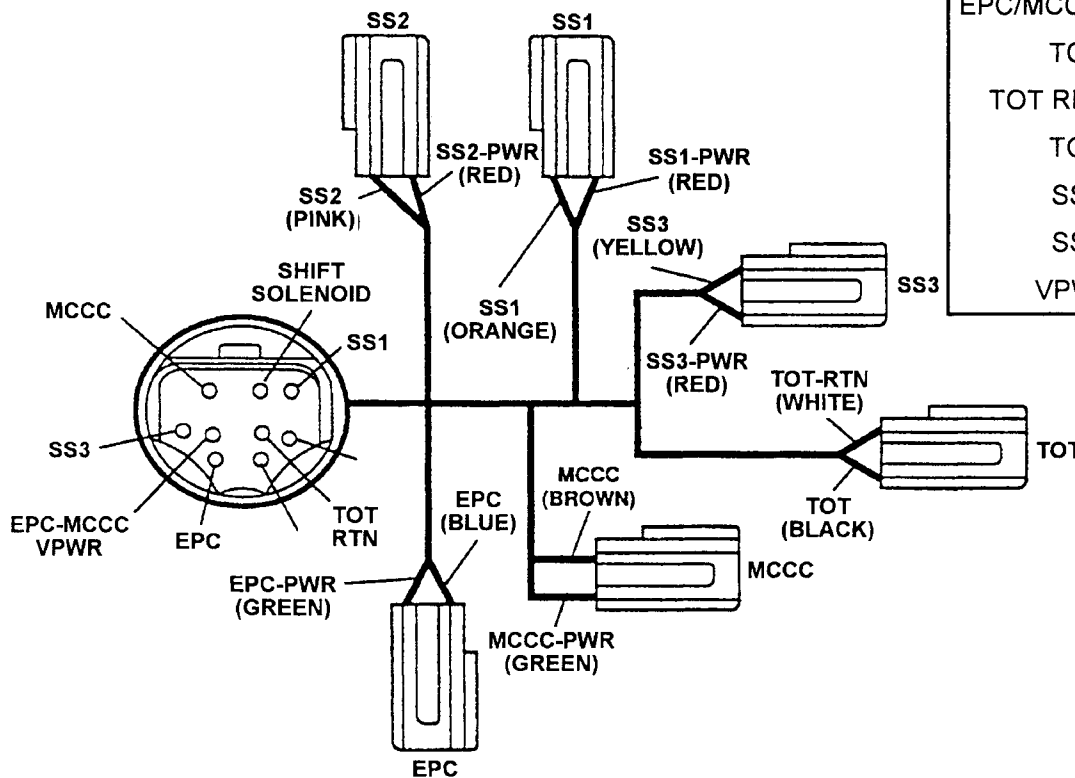
TCC Pulsing On and Off, High Line Pressure, No Codes (cont)

CONNECTOR—TOP OF TRANSMISSION



COMPONENT RESISTANCE

ITEM	OHMS
EPC	3.25-5.5
MCCC/CCC	
'91 Taurus and Sable	21-36
'91 Continental	
All '92-'95	.75-2.0
TOT	37,387 at 68°F (20°C)
TSS	100-200
Shift Solenoids	15-25



TRANSMISSION CONNECTOR

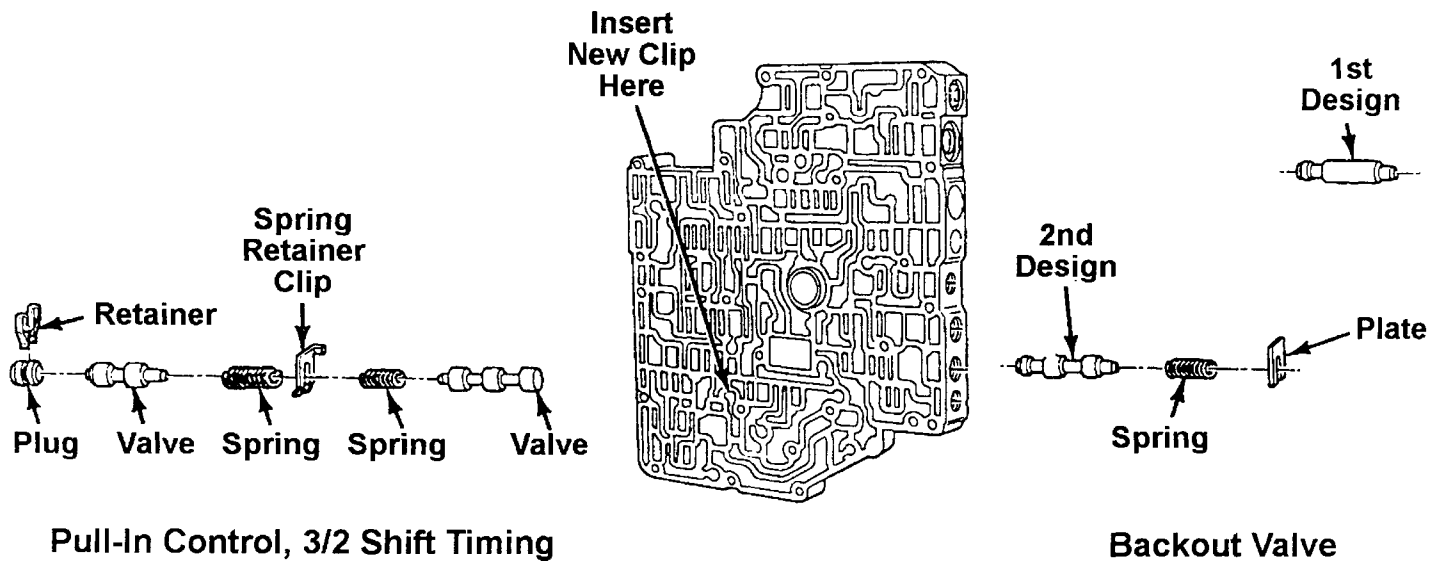
SOLENOID	PCM TEST PINS
EPC	38
SS3	55
EPC/MCCC-VPWR	37, 57
TCC	53
TOT RETURN	46
TOT	49
SS2	52
SS1	51
VPWR	37, 57

Neutrals on the 3-2 Downshift

Remove and clean all valves

NOTE: A broken spring retainer clip will cause the transmission to shift into neutral during a 3-2 downshift (F1DZ-7F194-A).

NOTE: If your working on an early-built 1991 model the main control should be updated. Install a main control separator plate repair Kit.



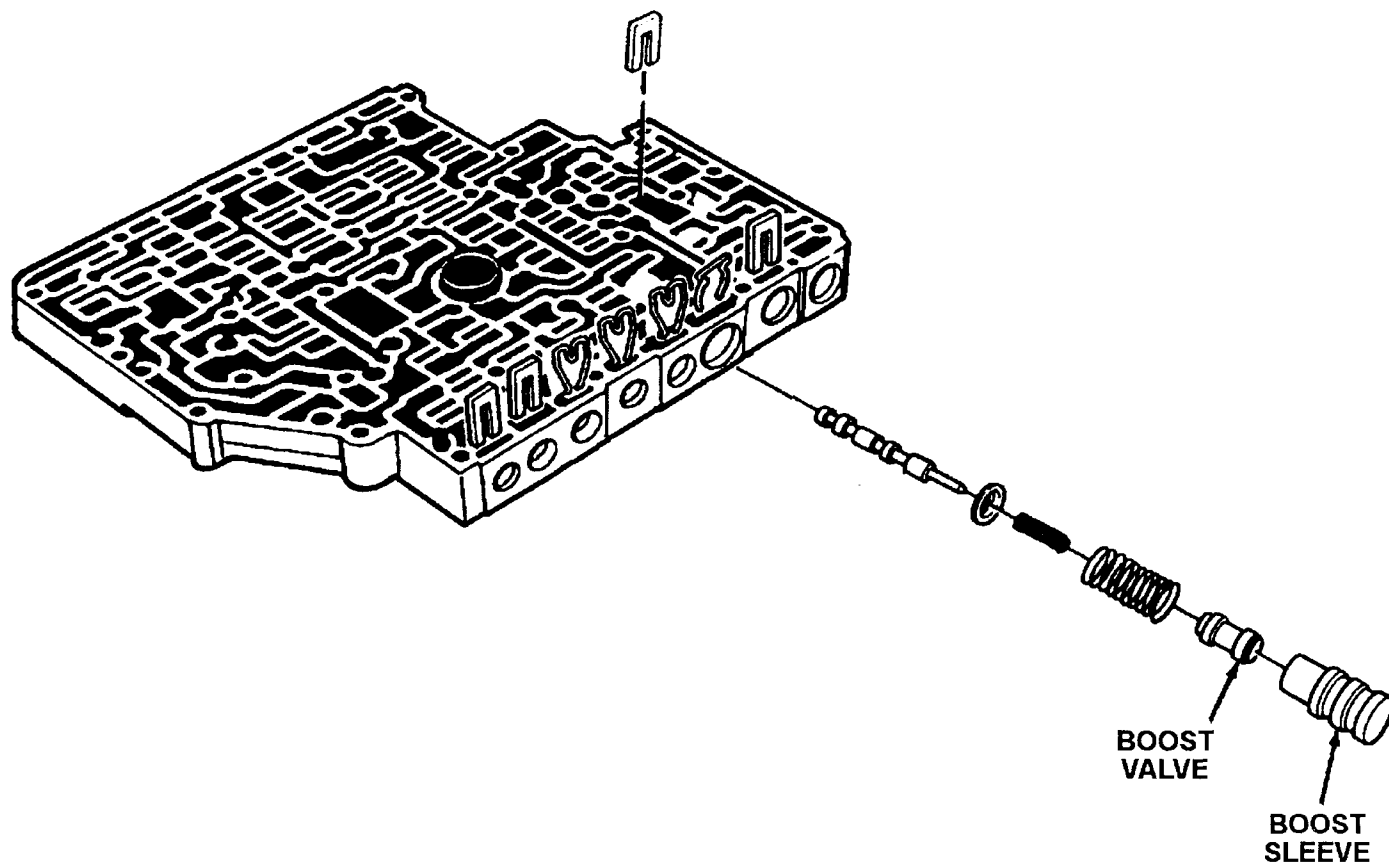
The Ford part numbers are:

- F1DZ-7A142-B - 3.0L Taurus/Sable
- F1DZ-7A142-C - 3.8L Taurus/Sable
- F1DZ-7A142-D - 3.8L Police
- F1OY-7A142-B - 3.8L Continental

NOTE: Make sure the replacement valve is the same diameter as the original. If the replacement is larger than the original, the kit will not work.

Low Line Rise

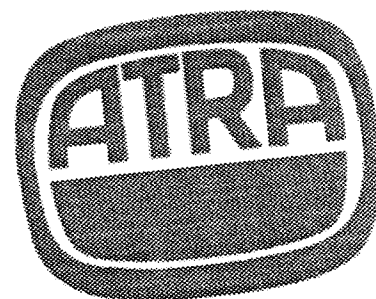
A condition of low line pressure rise causing clutch or band failure may be caused by the boost valve wearing the inside diameter of the boost sleeve. This can also cause flairs on the upshifts. An updated replacement valve and sleeve is available in the aftermarket.



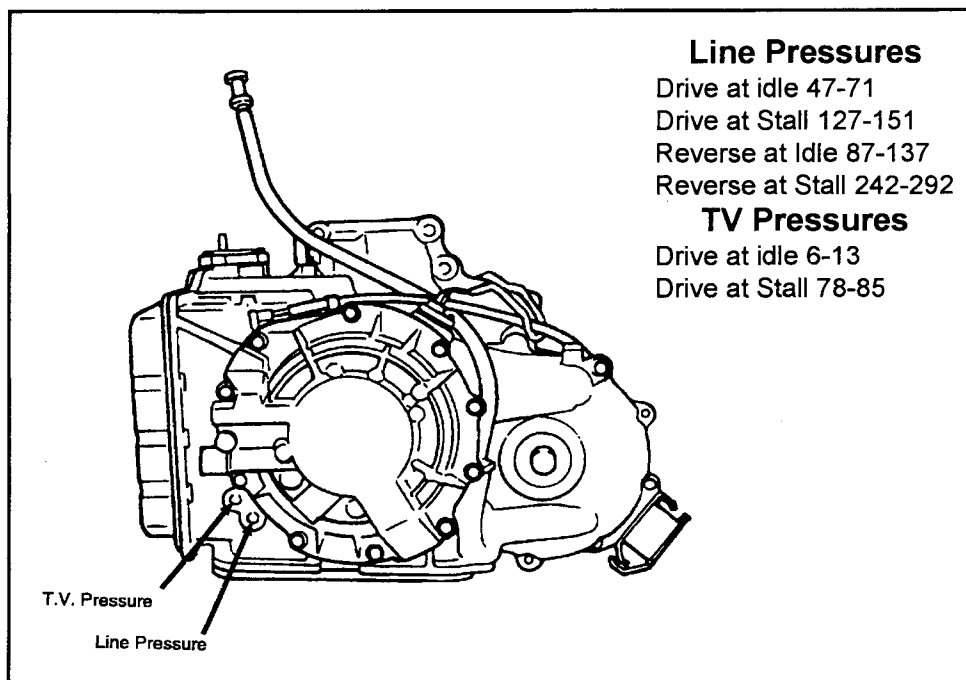
G4A-EL

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Mazda
G4A-EL



G4A-EL



Range	Gear	1-2 Sol	2-3 Sol	3-4 Sol	Forward Clutch	Forward Sprag	Coast Clutch	2-4 Band	2-4 Servo Pressure		3-4 Clutch	Low Roller Clutch	Low reverse Clutch	Reverse Clutch
									Apply	Release				
P														
R	Reverse													
N	<2mph													
N	>3mph													
D	1st													
	2nd													
	3rd<25mph													
	3rd>25mph													
	4th													
2	2nd													
	3rd<25mph													
	3rd>25mph													
1	1st											★		
	2nd													

★ = Holding but ineffective due to Low Reverse Clutch.

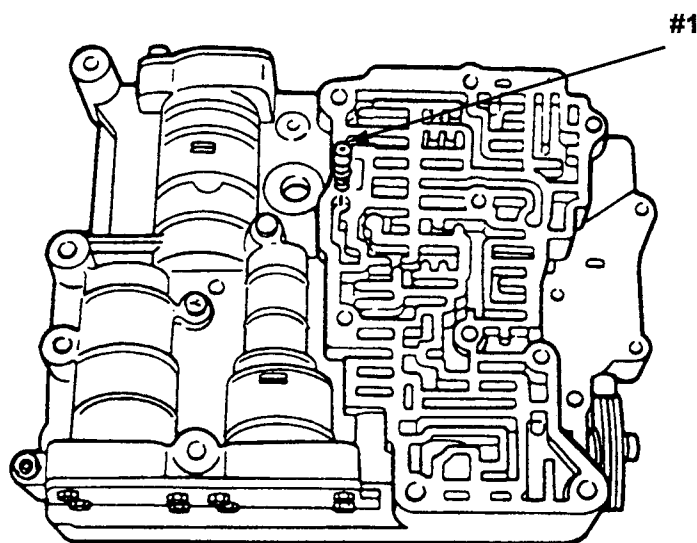
Failsafe Mode

D	3
2	3
1	1

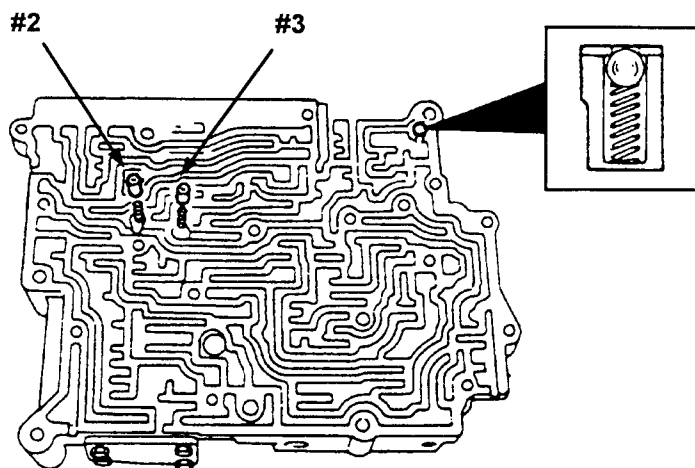
Gear Ratios

1st	2.80
2nd	1.54
3rd	1.00
4th	.70
Reverse	2.33

Orifices

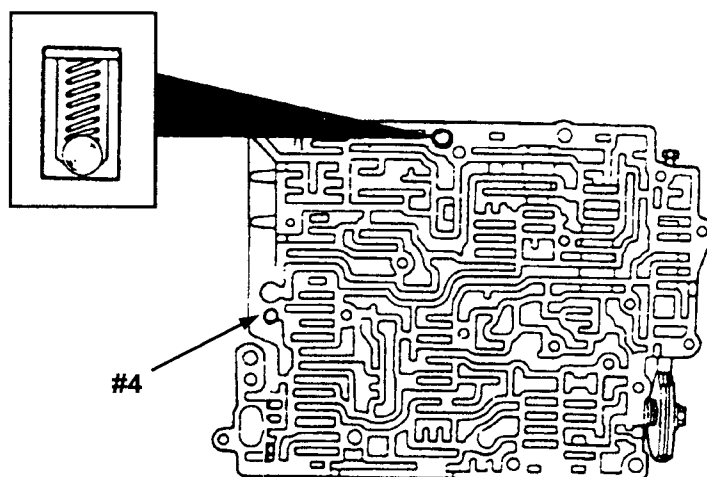


- #1 Size-.031"
3-4 Clutch Feed
NOTE: Enlarge to .040"-.045"

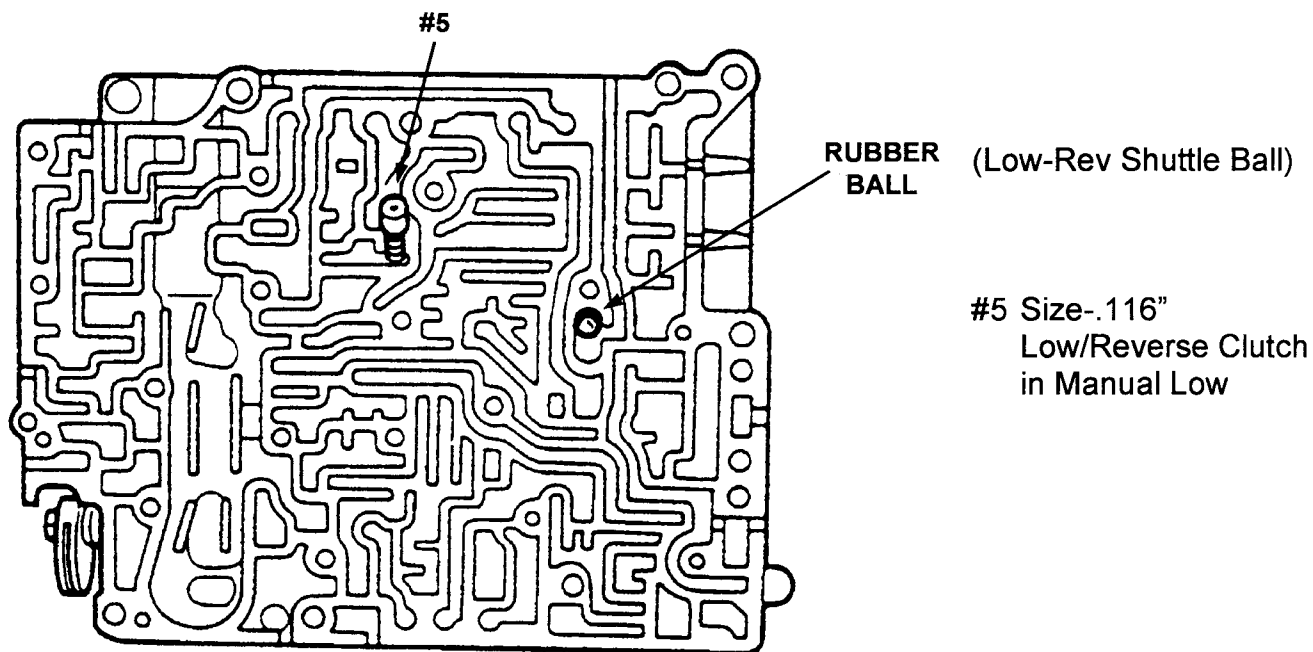


- #2 Size-.077"
2-4 Servo
(3-4 Shift Feel)

- #3 Size-.077"
Forward Clutch Feed



- #4 Size-.031"
2-4 Servo
(1-2 Shift Feel)

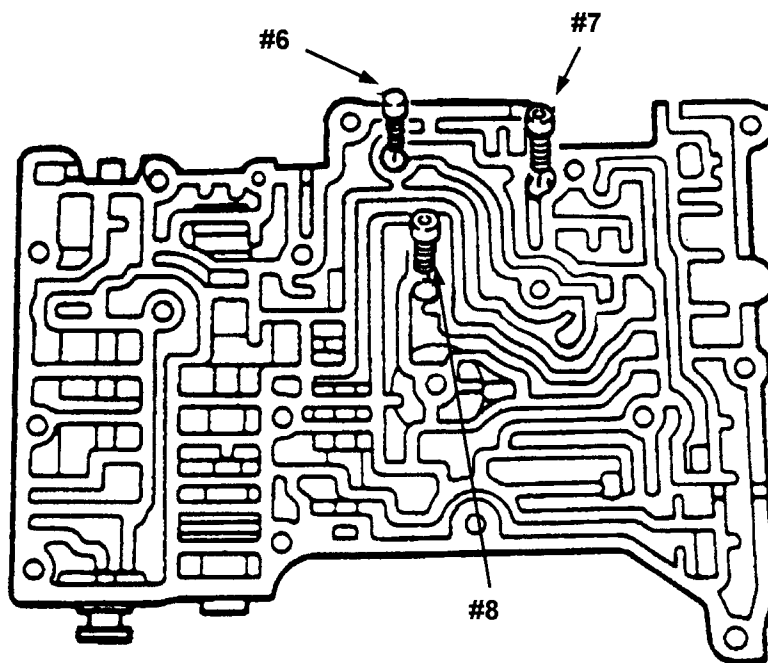


#6 Size-.039"
Coast Clutch Apply

#7 Size-.059"
Reverse Clutch Apply

#8 Size-.077"
Low/Rev Clutch Exhaust

NOTE: Some models do
not use #8 orifice.



Overheating and Torque Converter Burn Up

For those who are not familiar with the overheating problem or have not experienced it yet, here are some of the symptoms. Extremely burnt fluid, converter paint that is blistered from heat and in extremely severe cases the speedometer gears will melt. This condition is best described as a 'nuclear meltdown'.

After months of researching this problem. It has been found that in most cases the overheating problem is caused by two things: Low converter charge and/or leaks into the converter release circuit while in lock-up.

The converter is charged either through the converter release passage or through the converter apply passage (depending on whether or not lock-up is commanded).

When lock-up is not commanded, converter charge is supplied through the tip of the input shaft and enters the converter between the front cover and the converter clutch. This is called 'release' pressure. From there, converter charge flows around the clutch, through the converter and exits through an exhaust hole in the stator support, after which it then goes to the cooler (figure 1).

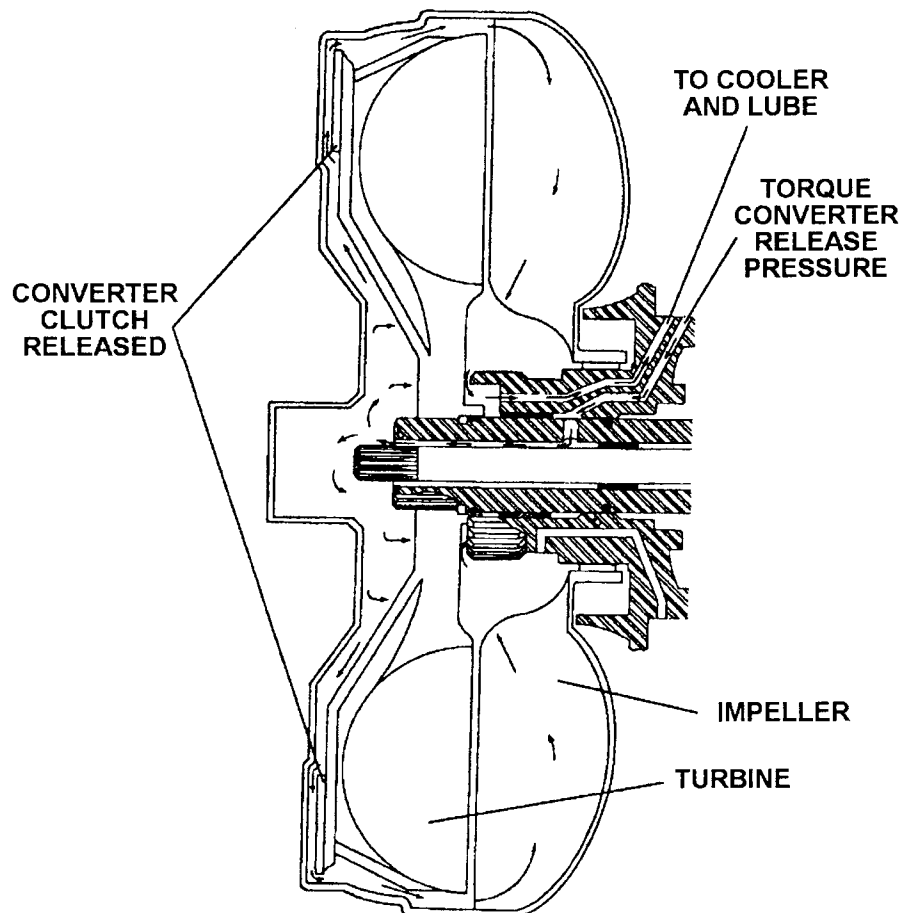


Figure 1

Overheating and Torque Converter Burn Up (cont)

When lock-up is commanded, converter release pressure is exhausted and converter charge is supplied through the stator support. Pressure is supplied between the impeller and turbine. The oil used here is called apply pressure because it pushes converter clutch against the front cover, applying the converter clutch. The oil then flows out to the cooler through the exhaust hole in the stator support (figure 2).

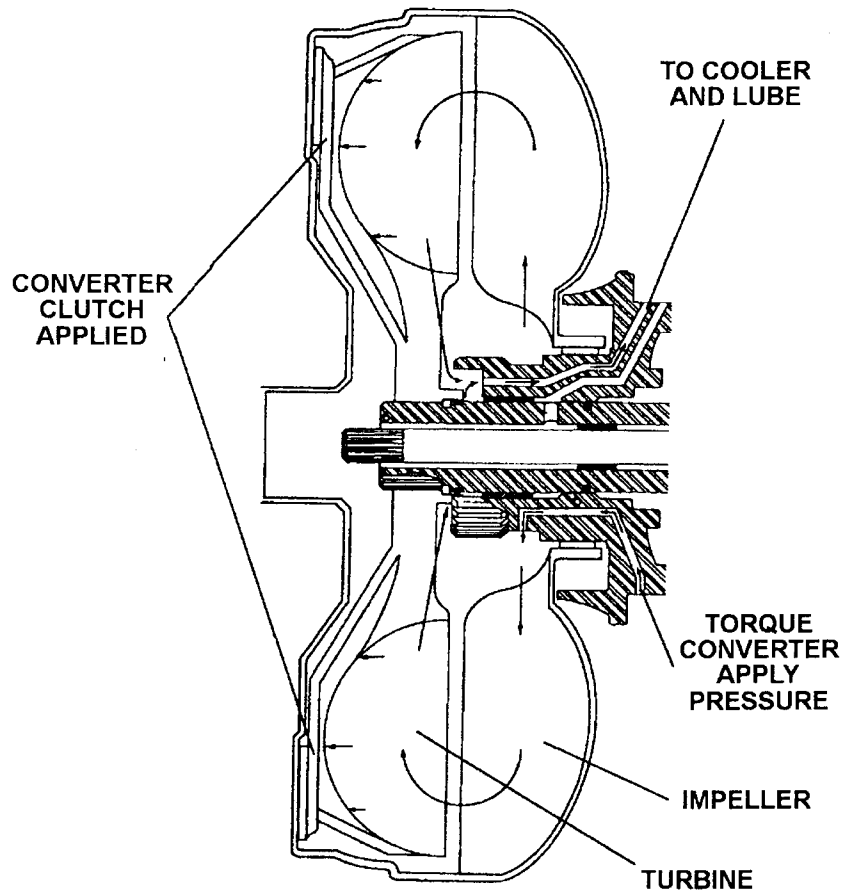


Figure 2

While in lock-up, converter release pressure must remain at zero psi. Any pressure in the release circuit during lock-up will try to push the converter clutch away from the cover. For example, if converter apply pressure is 35 psi but converter release pressure is 25 psi, there is only 10 psi applying the clutch. This will cause the clutch to slip, creating a tremendous amount of friction and heat.

Overheating and Torque Converter Burn Up (cont)

Leaks into the converter release circuit can come from three sources. First, converter apply pressure can leak past a worn stator support to input shaft bushing or loose fitting converter o-ring. Secondly, third clutch apply pressure can leak past the Teflon™ sealing ring located toward the front of the input shaft (which supports the pump drive shaft), can allow lube oil to leak into the converter release circuit (figure 3).

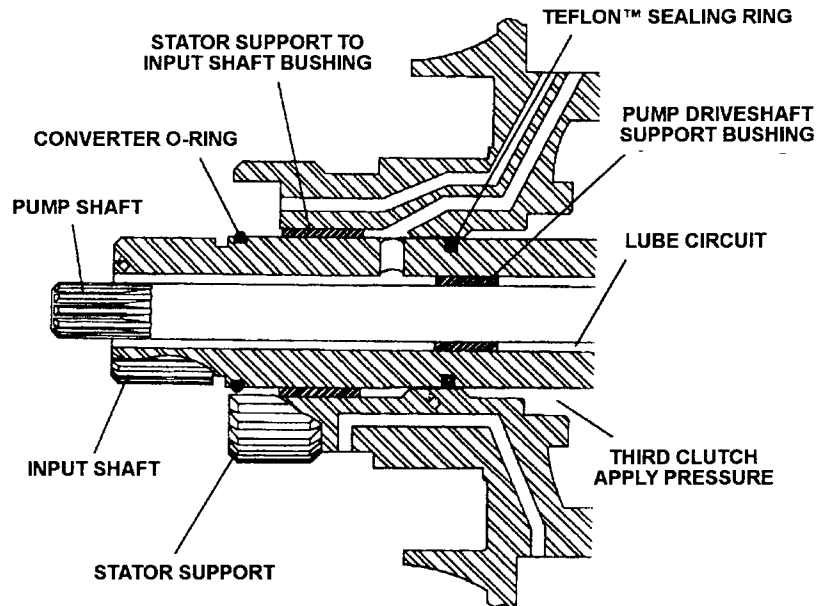


Figure 3

To put this into perspective, think of it this way. During lock-up, the release circuit is exhausted through a .045"-.055" orifice. Any oil that leaks into the converter release circuit must exhaust through this orifice. This leaves very little tolerance for excessive bushing clearance. The only way to test for this condition is to monitor converter release pressure and converter apply pressure with a pressure gauge (figure 4). Some G4A-EL/4EAT cases have cup plugs sealing these pressure taps. During the rebuild, these cup plugs should be removed. Drill and tap the holes with an eighth inch pipe tap to allow access to these ports with a pressure gauge.

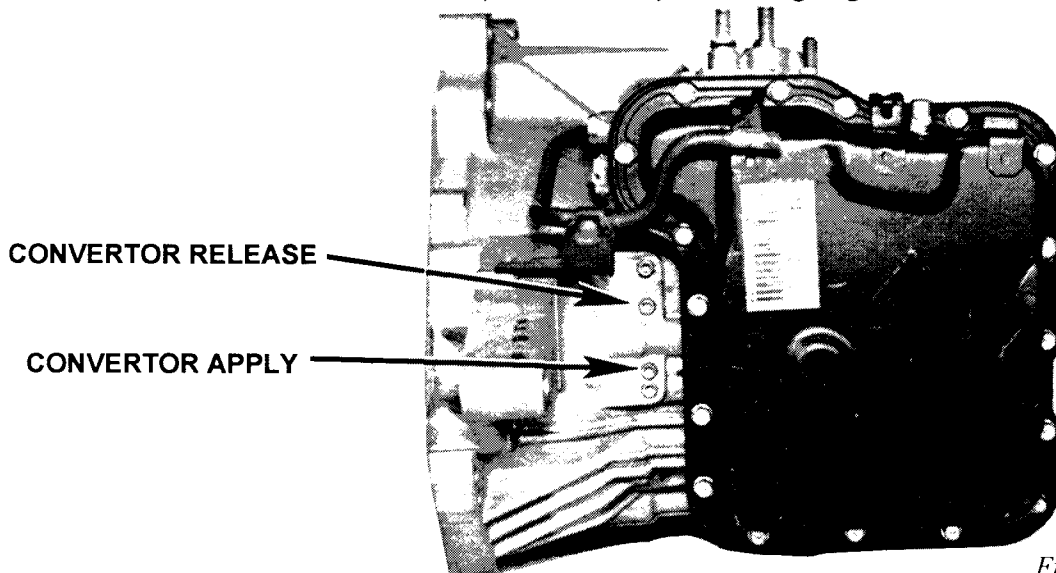


Figure 4

Overheating and Torque Converter Burn Up (cont)

When the converter is unlocked, converter release pressure should be 30-50 psi. Converter apply pressure is normally 10-15 psi lower. When lock-up is commanded, converter release pressure should drop to zero psi. Converter apply pressure should be about 30-50 psi.

These pressures should be checked when the transmission is hot. Many systems will fail after temperatures reach 200°F.

The second and most common cause of overheating is low converter charge. Installing the best cooler money can buy will not help if there is no oil flow.

The G4A-EL/4EAT pump assembly (figure 5), it looks similar to a 700-R4 pump. These two pumps are similar only if they are compared as vane and rotor (variable displacement) pumps, however, when looking at how the pump slides are controlled, the two pumps are very different.

The P.R. (pressure regulator) valve of the 700-R4 moves the slide by controlling decrease pressure. With this type of system, line pressure and converter charge are satisfied before the slide is moved to a lower volume position.

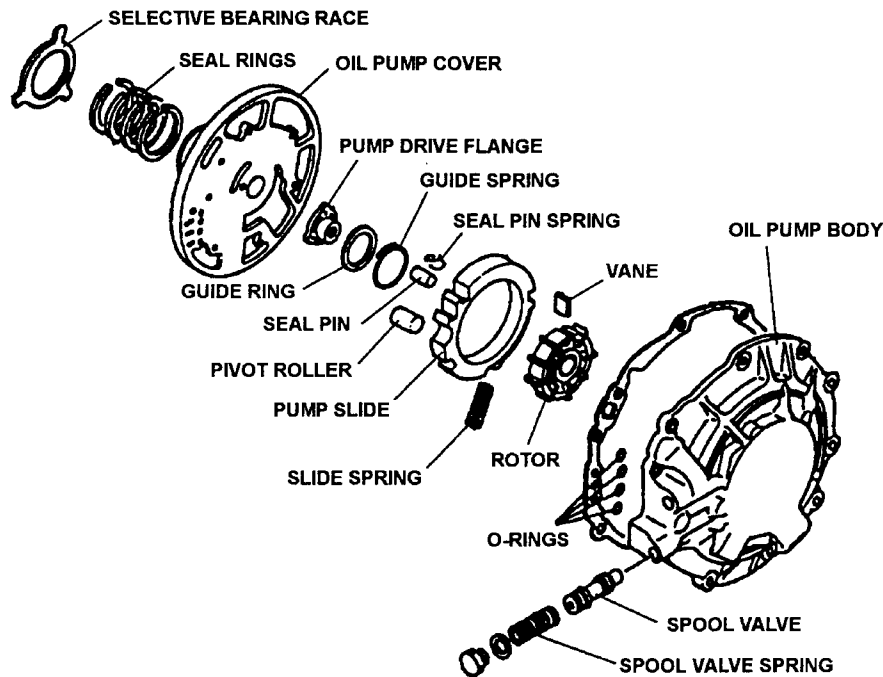


Figure 5

Overheating and Torque Converter Burn Up (cont)

With the G4A-EL/4EAT system, all pump volume travels through a hole in the center of the spool valve located in the pump (figure 6). The P.R. valve, located in the valve body only controls mainline pressure and converter charge. If the P.R. valve senses too much line pressure it simply dumps the excess (figure 7). This causes the volume rate to exceed the flow limit of the spool valve, forcing it to move in the direction of oil flow. In this position the spool valve delivers decrease pressure to the pump slide which then moves it to a lower volume position. Read this paragraph again, it is the key to understanding the system.

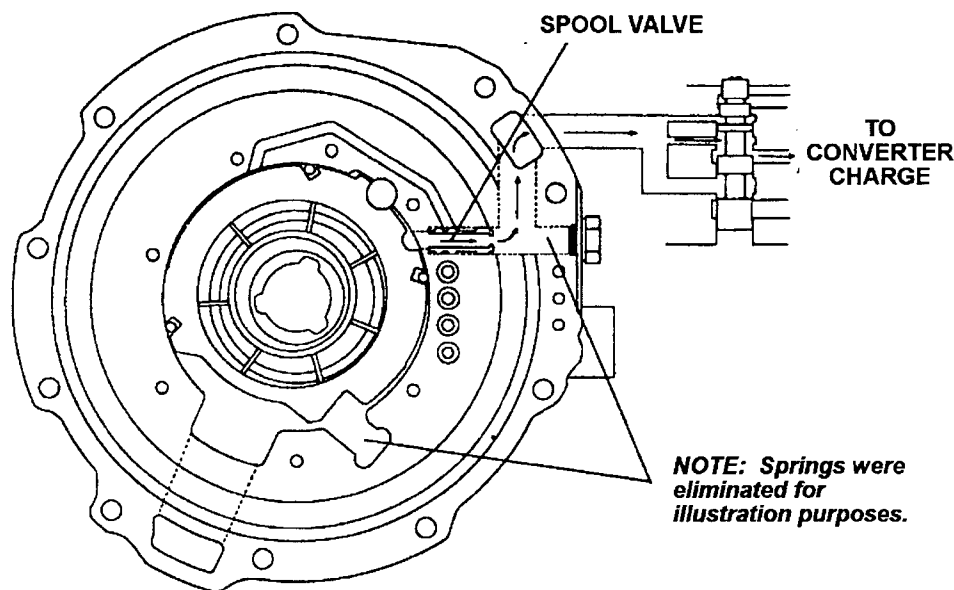


Figure 6

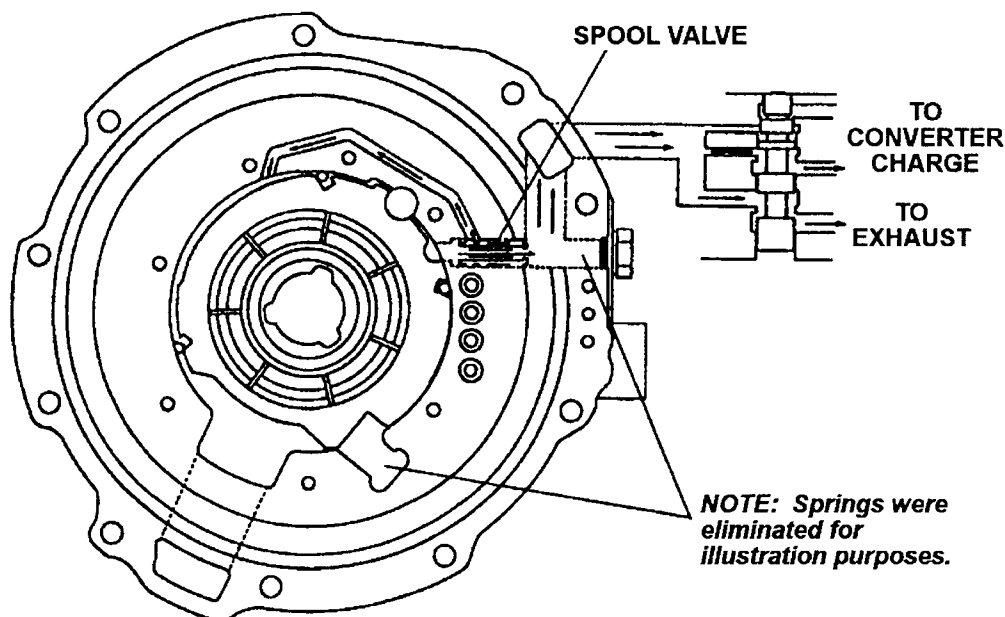


Figure 7

Overheating and Torque Converter Burn Up (cont)

The problem with this type of system is that when there is a mainline pressure leak (somewhere after the spool valve) it causes an increase in oil flow through the spool valve. The extra volume signals the spool valve to move the slide to the decrease position while the P.R. valve lowers converter charge in an attempt to maintain adequate line pressure. Low converter charge is one of the leading causes of the severe overheating problems associated with the transmission.

During the inspection of the pump assembly it is not uncommon to see flat spots worn into the side of the seal pins and grooves worn in the pump body where the pins ride. When this type of damage occurs, line pressure is allowed to leak past the seal pins and pressurize the decrease circuit. If this damage is severe enough the seal pins will tilt in the groove and cause the slide to become stuck. This type of damage will cause low mainline pressure and low converter charge. If this or any other damage is present replace the pump.

Figure 8 illustrates the proper way to install the seal pins and springs, vanes, vane rings and spool valve. Any variations may cause a low pump volume output condition.

Due to the lack of pump slide support, the slide can move off the pivot roller. In other words, even a pump without wear can cause a low volume output that lowers converter charge and cooler flow.

The following modification can be made to the pump to eliminate this problem, even if it has wear in the seal pin areas.

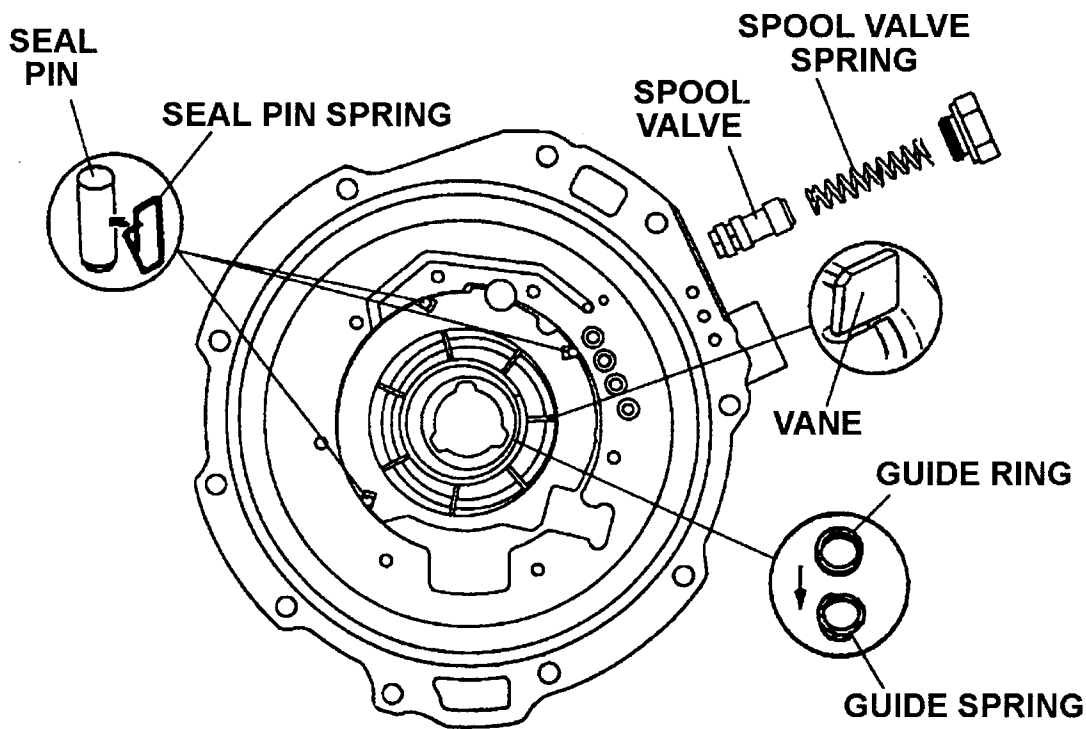


Figure 8

Overheating and Torque Converter Burn Up (cont)

Step One

Block the pump slide to the maximum volume position (the direction the slide spring is pushing the slide). A blocker pin can be made out of a $\frac{1}{4}$ " bolt. To allow for heat expansion the pin should have .005"-.010" clearance when installed between the spring seat and the slide lever (figure 9). When the blocker pin is finished, it should be installed inside the slide return spring. Make sure the slide travel is limited to .010".

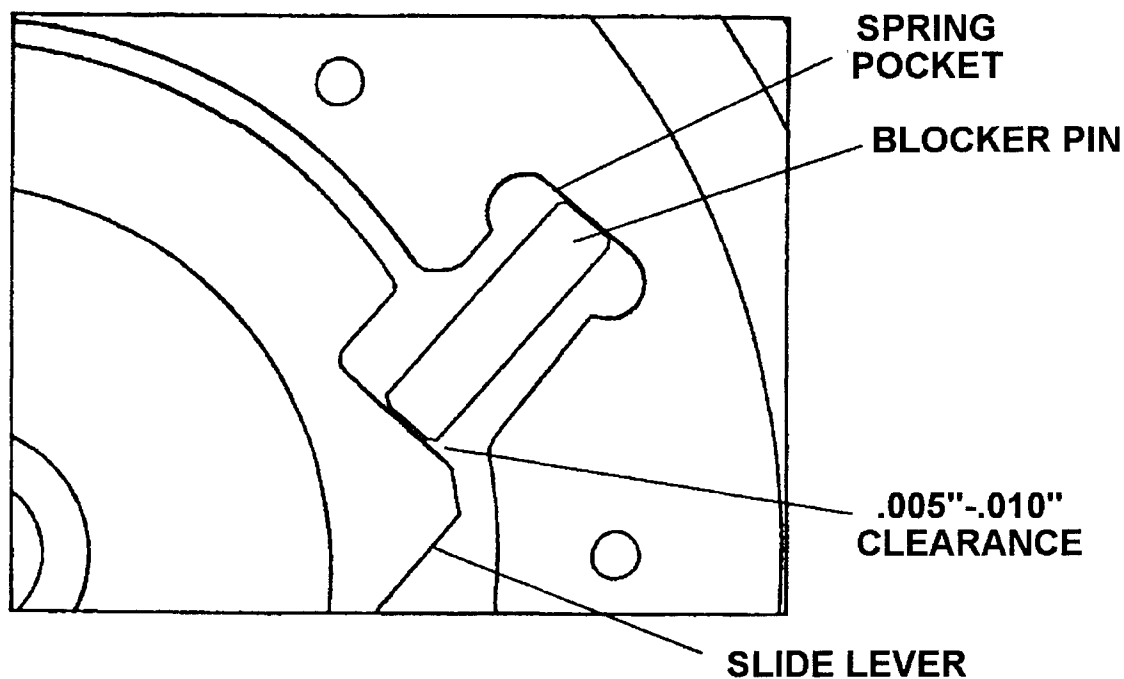


Figure 9

Overheating and Torque Converter Burn Up (cont)

Step Two

Discard the spool valve and spring (the spool valve and spring are no longer needed with this modification). Using a $\frac{1}{4}$ " drill, machine a shallow counter sink into the spool valve vent hole approximately .030"-.040" deep (figure 10). Next thread the vent hole with a 10-24 tap and install a 10-24 threaded Allen head set screw. Mushroom the top of the set screw with a punch to expand it into the counter sunken area. This will prevent the set screw from entering the line pressure circuit. make certain the set screw is not above the surface of the pump body (figure 11).

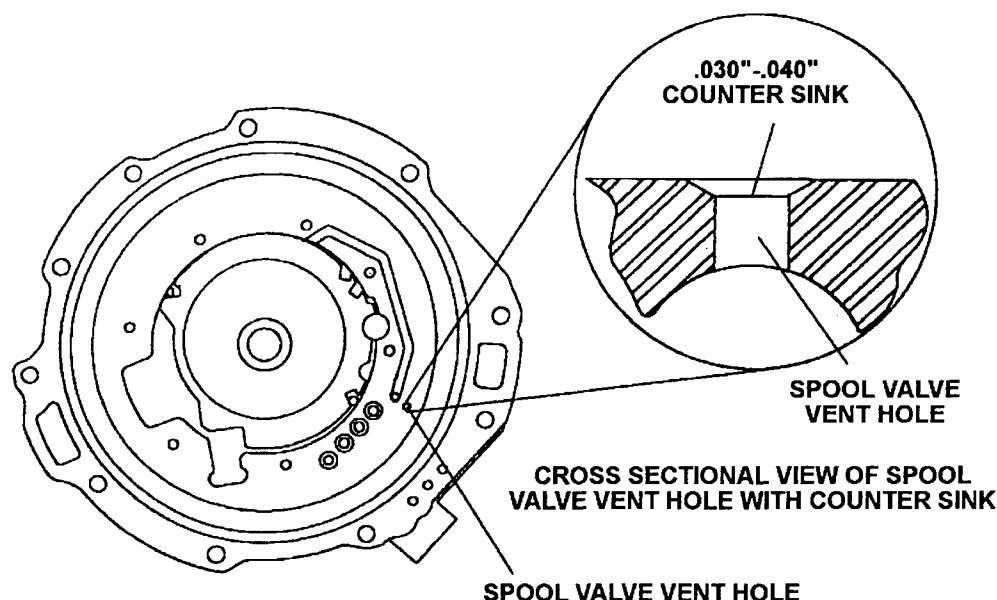


Figure 10

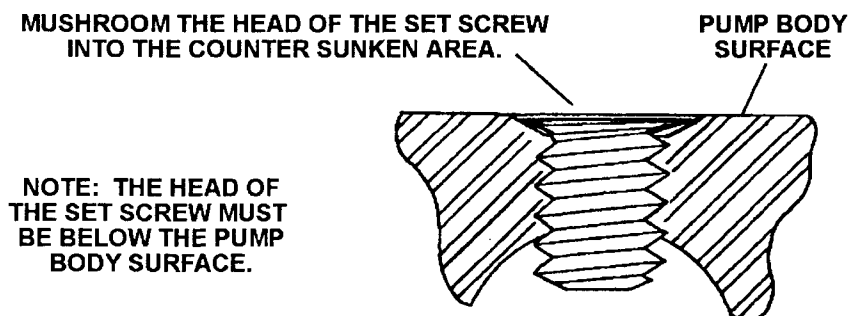


Figure 11

Overheating and Torque Converter Burn Up (cont)

Step Three

Inspect the three seal pins for wear. Install the best looking seal pin into seal pin pocket 'A' (figure 12).

Replace the original seal pin spring with two coil springs. One will push against the bottom half and the second will push against the top half of the pins. To do this, locate some coil springs that measure .200"-.220" in diameter. Then trim the springs until they fit between the seal pin and the seal pin pocket (figure 13). When cut properly, the springs will be almost coil bound. Always install the springs with the smooth uncut end contacting the seal pin. Never install a spring with the cut end contacting the seal pin.

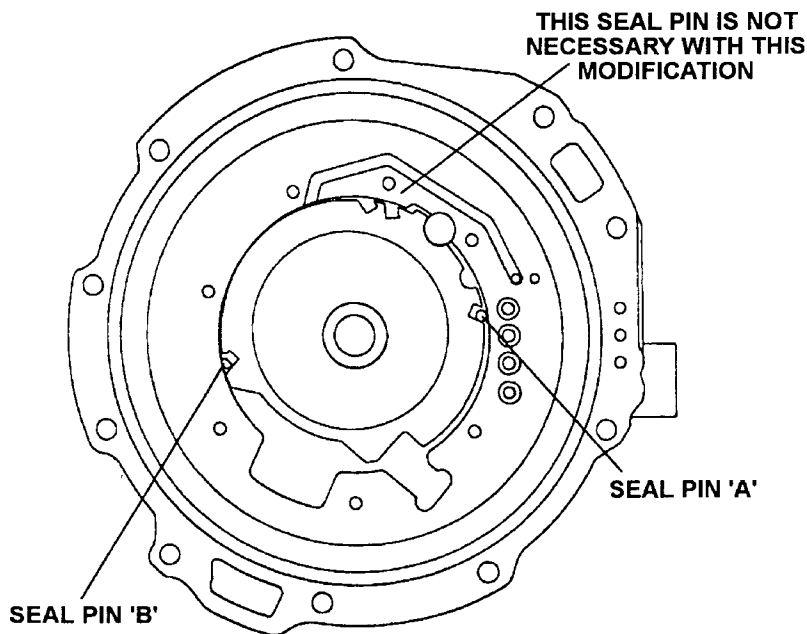


Figure 12

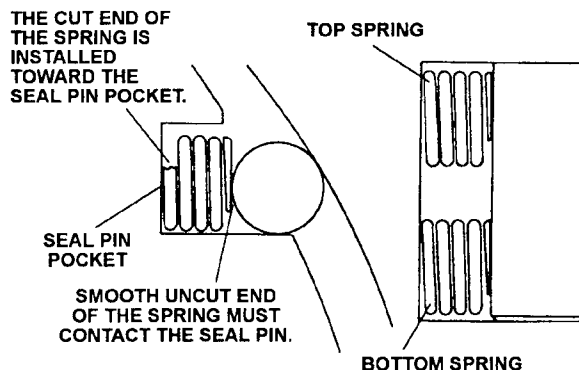


Figure 13

Overheating and Torque Converter Burn Up (cont)

Step Four

Grind a flat spot down the entire length of one of the remaining seal pins until the diameter measures .150"-.160" in thickness (figure 14). Install this seal pin into seal pin pocket 'B' with the flat side facing the pocket (figure 12). Two coil springs should be installed in this location using the same procedure as in step three. The only difference is that the flat spot is installed with the round side contacting the pump body and the flat side contacting the springs (figure 15).

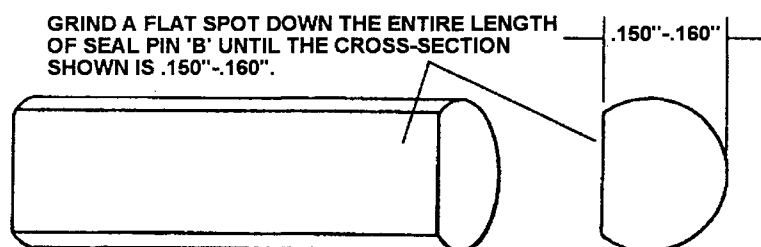


Figure 14

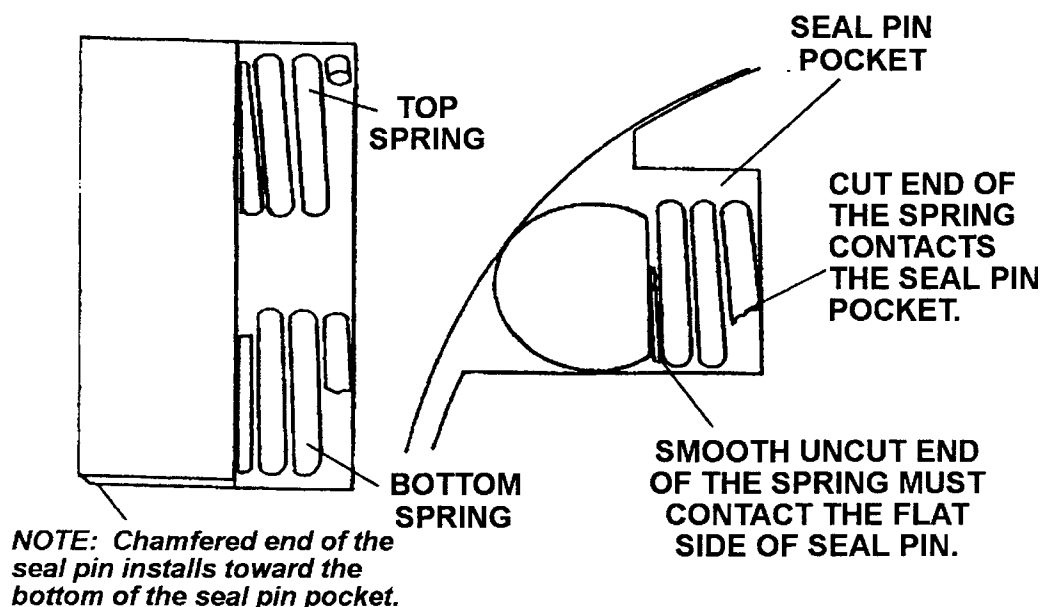


Figure 15

A spring that works well for this modification is a lock-up control valve spring from a Nissan RL4R01A (Nissan part number 31742-48X07). These springs are not a normally stocked item so I suggest not waiting until you need them before placing an order. You can order a dozen for the cost of a fast food lunch.

Sometimes the pressure regulator valve bore will have excessive wear. This can make the valve stick in the exhausting position which will also lower mainline pressure and converter charge. To check for this type of wear, put a side load on the pressure regulator valve and stroke the valve in the bore. If the valve feels sticky, try to lightly hone the bore with 320 grit sandpaper. If a light hone does not work, replace the valve body.

Overheating and Torque Converter Burn Up (cont)

While you are inspecting that pressure regulator bore, drill a 'line to lube hole' through the valve body wall with a .045"-.055" drill (figure 16).

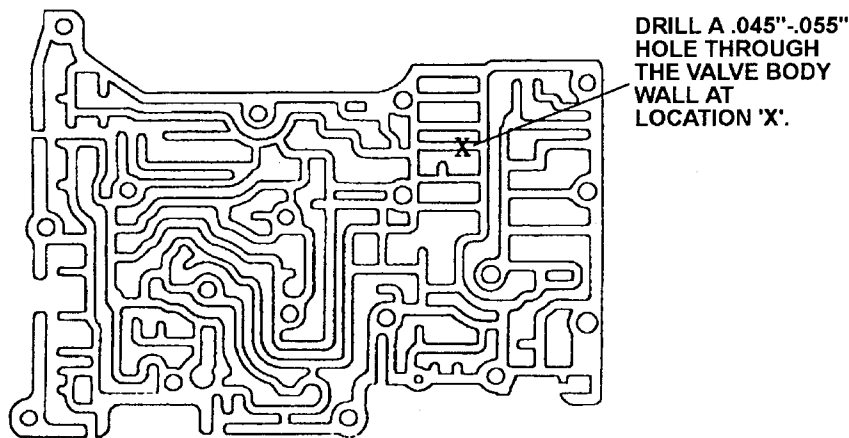


Figure 16

Whenever possible use metal accumulators with rubber O-rings that fit snugly in the bore. If plastic accumulators must be used, inspect them for cracks and warpage. Before installing rubber O-rings you should smooth-out the square feed hole located near the top of the accumulator bore to prevent the ring from being cut (figure 17). If you use Teflon™ rings you may need to custom fit your own so they will seal tightly in the bore.

Always flat-sand the valve body with 320 grit sand paper on a thick piece of glass or other flat surface. These valve bodies do warp.

During final assembly torque all of the valve body bolts to 60 inch lbs. Washers should be used on all of the bolts. The bolts may bottom out without the washers.

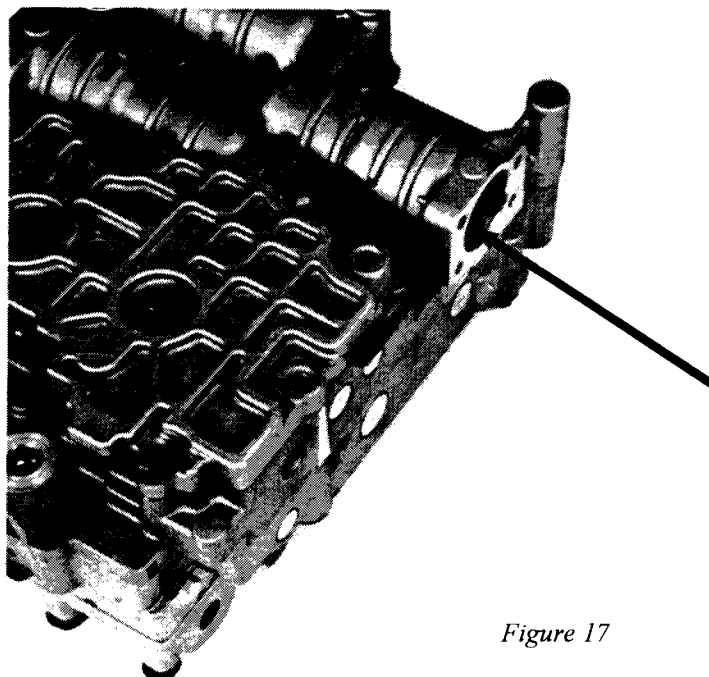


Figure 17

Overheating and Torque Converter Burn Up (cont)

It is important that the Teflon™ sealing ring located on the input shaft fits properly in the stator shaft bore (figure 18). This ring seals third clutch pressure from converter release pressure. Failure of this ring can result in third clutch damage as well as a soft lock-up or a slip in the converter clutch, resulting in excessive heat.

NOTE: Throttle valve adjustment is very critical. T.V. pressure should always be adjusted with a gauge. The proper setting is 8-12 psi at an idle and it should rise smoothly to 85-90 psi at full throttle.

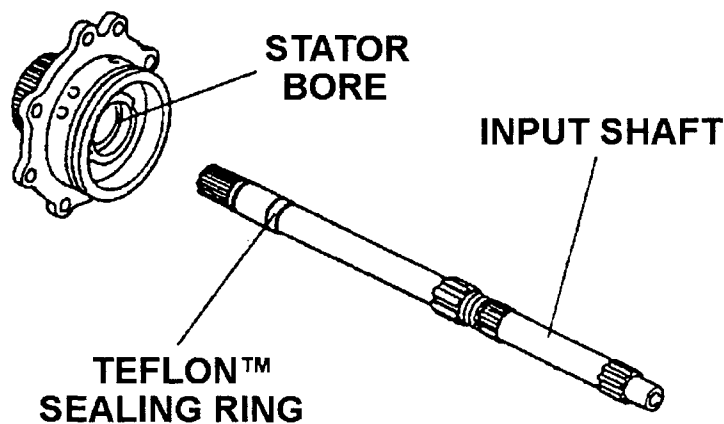


Figure 18

T.V. balance problems are also becoming more common. Drilling the T.V. balance hole to .055" should be a rebuild procedure (figure 19).

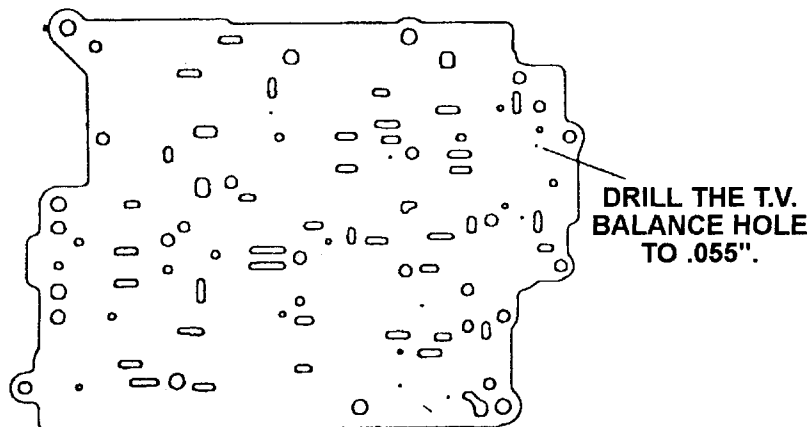
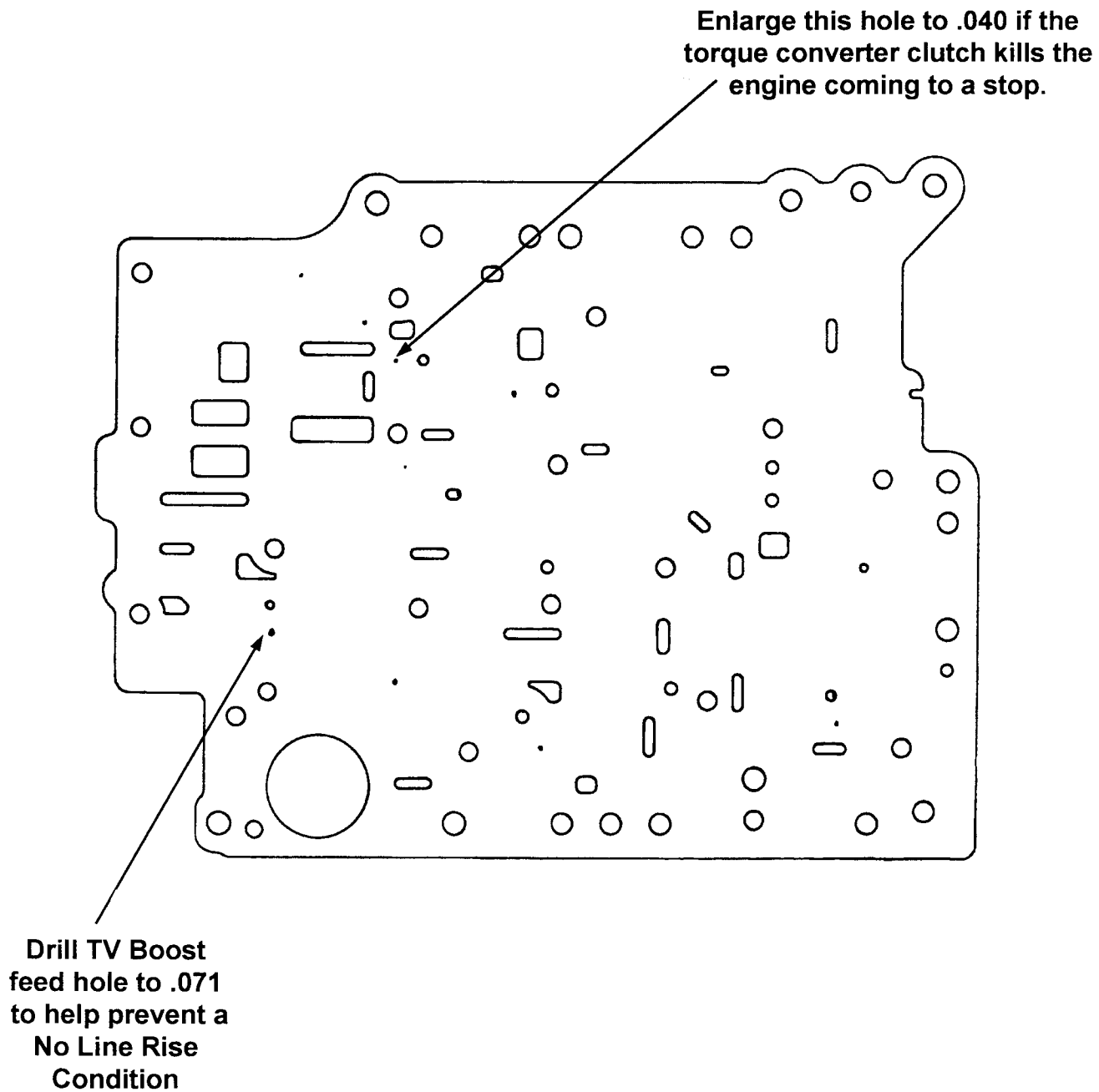


Figure 19

Additional Separator Plate Modifications

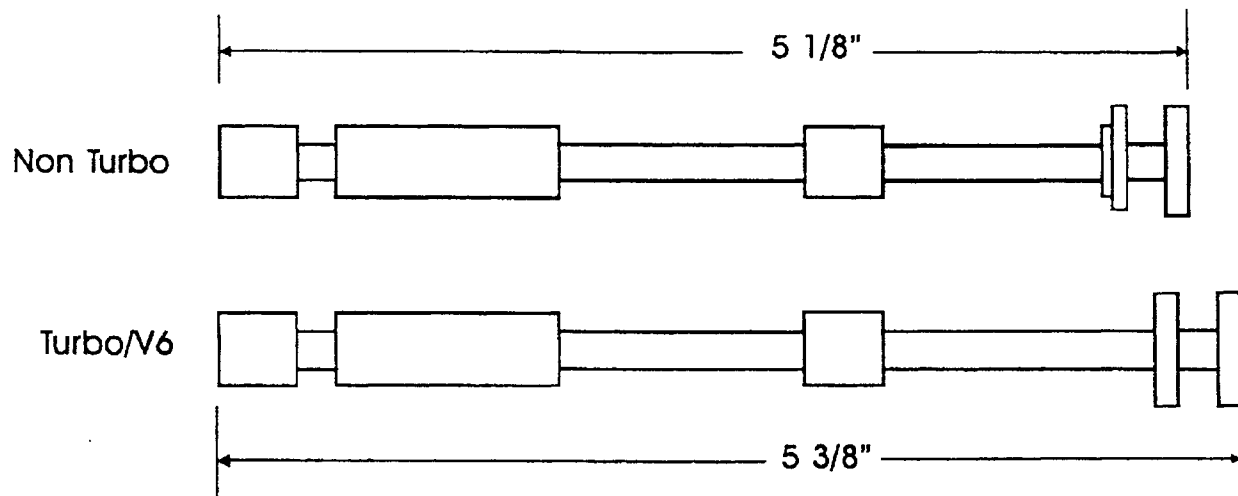


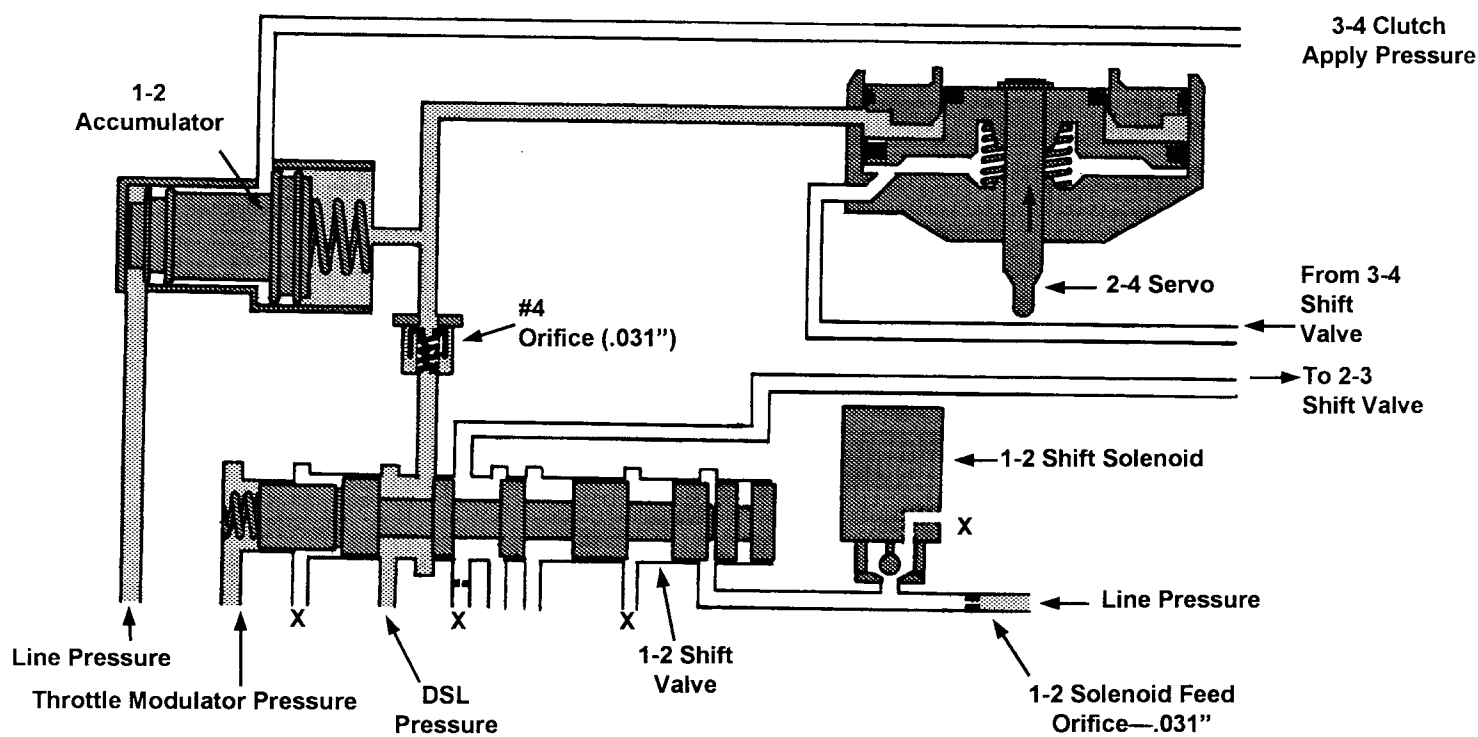
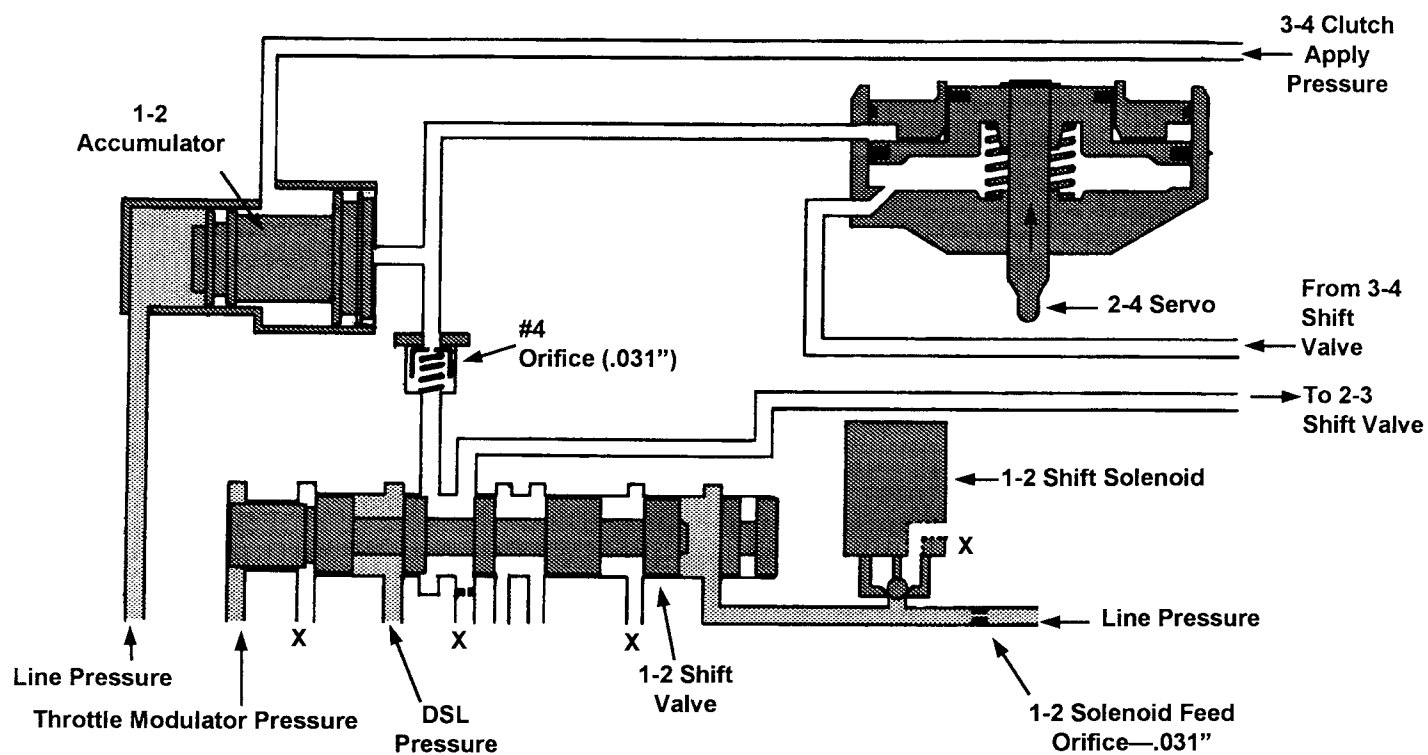
Make sure the gasket does not cover these holes.

Engagement Problems

- Bind up in Reverse
- Bind up in Drive
- Drives forward in Neutral
- Drives backward in Neutral
- Neutrals in Drive
- Neutrals in Reverse

These symptoms may be caused by installing the wrong length manual valve when changing valve bodies. Complete valve body assemblies can be installed in any application however the manual valve must match the case. Non turbo cases use a manual valve length of 5 1/8", the turbo and V-6 cases use a 5 3/8" manual valve.





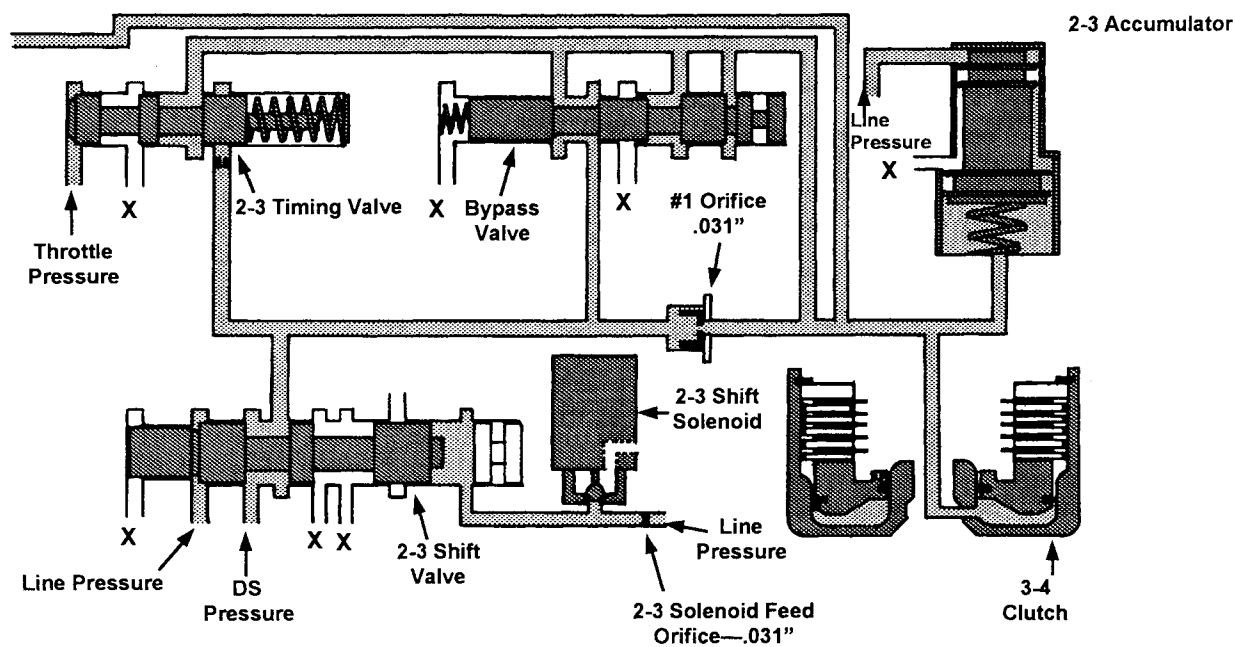
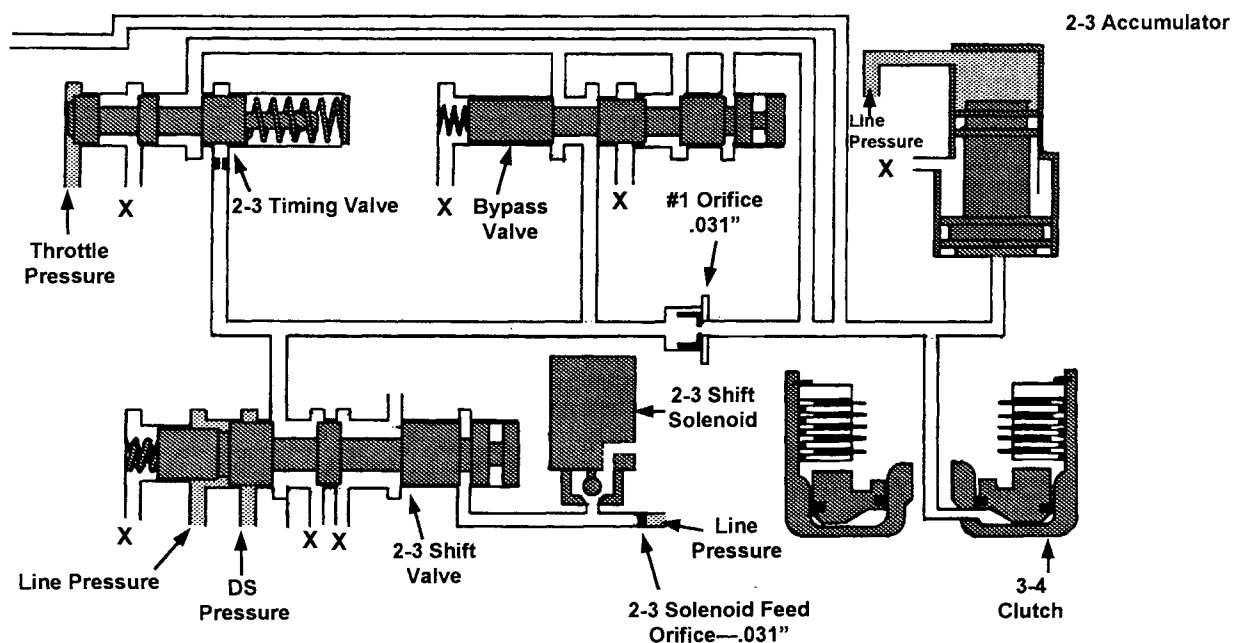
1-2 Shift Valve Operation

Line pressure is fed to the 1-2 shift solenoid through a .031" orifice. When no power is supplied to the solenoid, pressure is trapped, forcing the 1-2 shift valve to move away from the end plug. In this position, pressure is blocked and the servo apply circuit is exhausted.

When power is supplied to the 1-2 shift solenoid, the solenoid exhausts the pressure between the 1-2 shift valve and the end plug allowing the spring and modulated throttle pressure to force the valve toward the end plug. In this position the 1-2 shift valve delivers DSL (Drive, Second, Low) pressure to the servo and accumulator through a .031" orifice.

Common Problems

1. No 1st gear, has good 2nd, 3rd and 4th gear.
Common Cause: Leak in the solenoid circuit, end plug or a plugged 1-2 solenoid feed hole.
2. No 2nd gear, has good 1st, 3rd and 4th gear.
Common Cause: Leak in the large seal ring of the 1-2 accumulator.
3. No 2nd or 4th
Common Cause: Restricted 1-2 solenoid
4. Hard 2nd gear after rebuild, normal line pressure.
Common Cause: Mislocated #4 orifice.



2-3 Shift Valve Operation

DSL pressure is fed to the 2-3 shift solenoid through a .031" feed orifice. When power is fed to the shift solenoid, pressure between the 2-3 shift valve and end plug is exhausted allowing line pressure and the spring to move the valve toward the end plug. In this valve position DS (Drive, Second) pressure is blocked and the 3-4 clutch circuit is exhausted.

When power to the 2-3 shift solenoid is turned off pressure is trapped forcing the 2-3 shift valve to move away from the end plug. In this valve position DS pressure is delivered to the 2-3 accumulator and 3-4 clutch through a .031" orifice. DS pressure also travels to the 2-3 timing valve and bypass valve. Under certain conditions these valves will bypass the .031" orifice for a faster 3-4 clutch apply.

Common Problems

1. Soft 3rd gear shift, 3-4 clutch burn up.

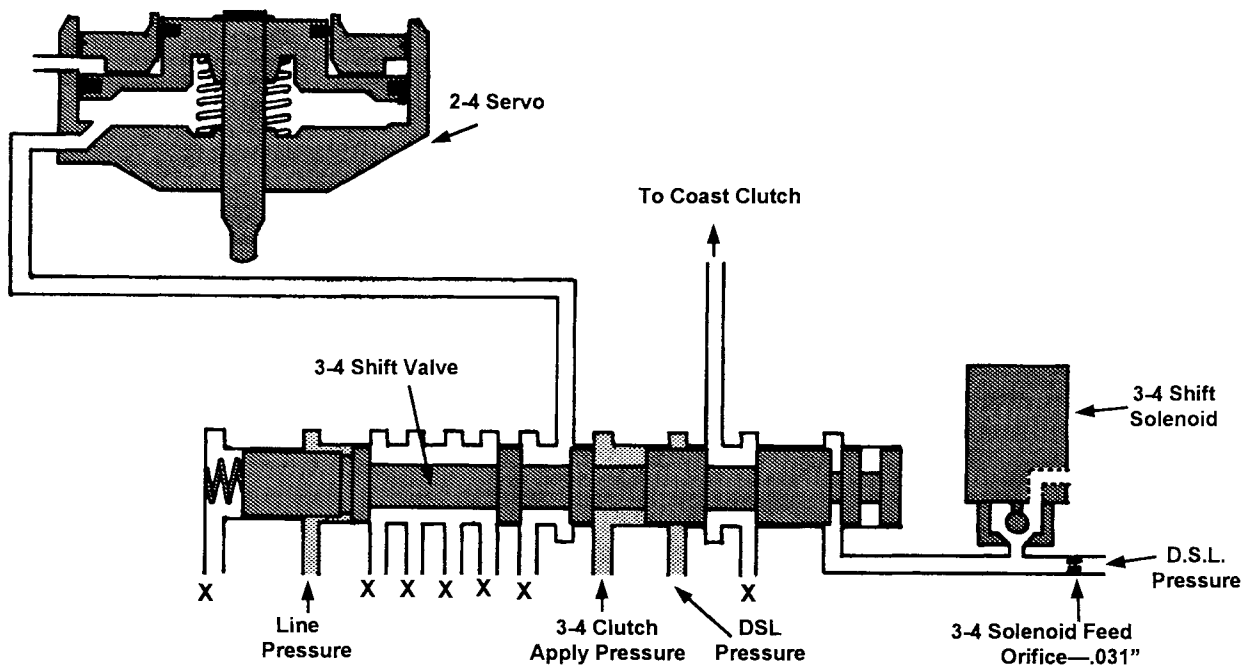
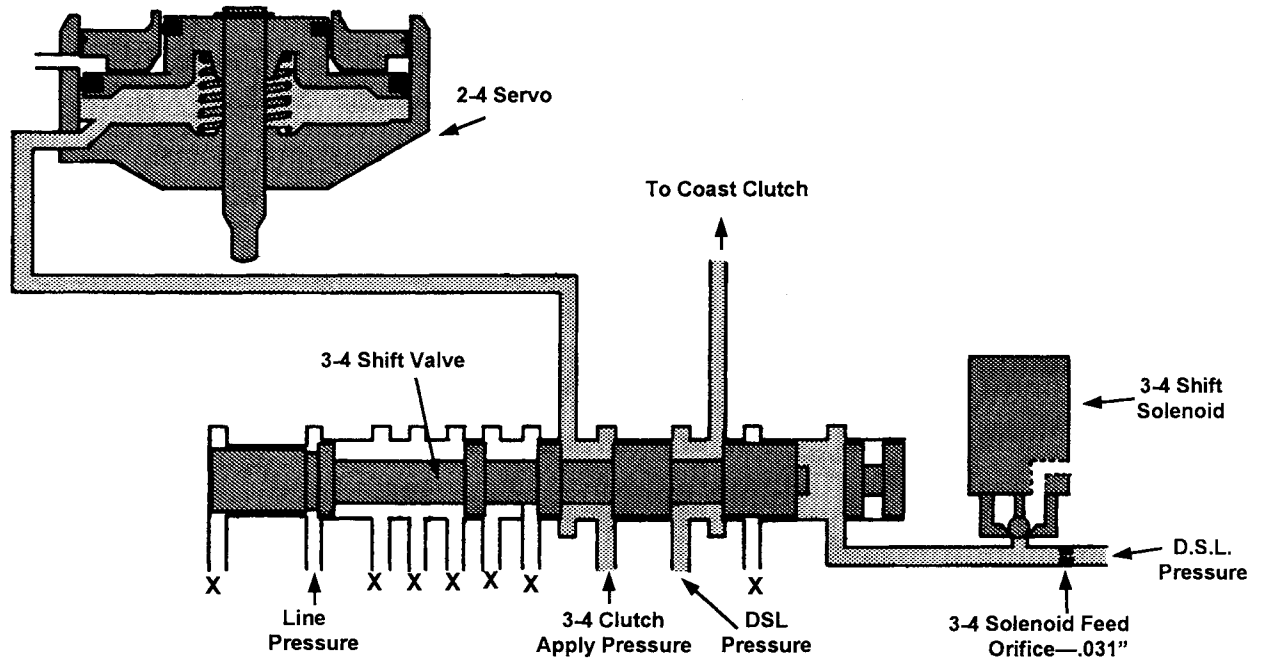
Common Cause: Bypass valve stuck away from the end play, leak in the large seal ring on the 2-3 accumulator.

2. No 3rd or 4th

Common Cause: Leak in the solenoid circuit, end plug or a restricted feed orifice to the solenoid.

3. Third gear start

Common Cause: Restricted 2-3 shift solenoid.



3-4 Shift Valve Operation

DSL pressure is fed to the 3-4 shift solenoid through a .031" orifice. When power to the 3-4 solenoid is turned off, pressure is trapped forcing the 3-4 shift valve to move away from the end plug. In this position DSL pressure is delivered to the coast clutch. If present, 3-4 clutch apply pressure is delivered to the release side of the servo.

With power supplied to the solenoid, pressure between the 3-4 shift valve and end plug is exhausted, allowing line pressure and spring force to move the valve toward the end plug. In this position DSL pressure is prevented from applying the coast clutch, and 3-4 clutch apply pressure is prevented from reaching the release side of the servo.

Common Problems

1. No 4th gear, has a good 1st, 2nd and 3rd gear.
Common Cause: Restricted 3-4 shift solenoid or stuck 3-4 shift valve.
2. 3-4 Shift hunt
Common Cause: Leak in the 3-4 solenoid circuit or end plug. May also be caused by a restricted or blocked 3-4 solenoid feed orifice.

Computer System ID

It is important to correctly identify the computer system type you are working on by using the model year and engine type. Each computer type uses a different connector and slightly different inputs.

MODEL YEAR	ENGINE	COMPUTER SYSTEM
87	All	Type I
88-89	All	Type II
90-92	2.2L Turbo 3.0L V-6	Type III
90-92	2.2L Non-Turbo	Type IV

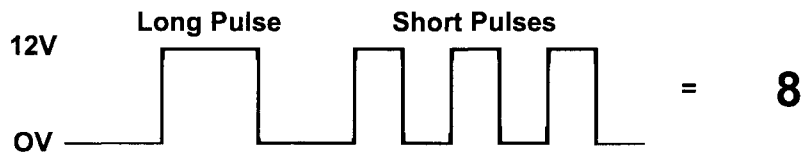
- Type I** This system is used only in '87 model 626. This is the only system to use an O/D cancel mode and a kickdown switch.
- Type II** Beginning in 1988 Mazda stopped using the O/D cancel and began using the confusing Hold mode. The Type II computer also marked the end of the kickdown switch, air conditioner cut off relay, cruise control input and the beginning of the no load signal. The no load signal controls idle speed for smoother engagements.
- Type III** The only major change was the addition of the downshift signal. This function commands the engine computer to lower engine power during a forced downshift with throttle opening at 5/8 or more.
- Type IV** This type no longer uses a separate transmission computer. The engine and transmission are both controlled by the same computer. All transmission related input switches, with the exception of the water temperature switch are still used and shift strategies are the same.

Type I Code Retrieval

Type I code retrieval consists of a three step procedure. Before you begin, locate the six pin diagnostic connector containing three wires. This connector can be found sticking out of the transmission computer harness within 8 inches from the computer connector. The computer is mounted under the dash, left of the steering column. Make sure the key is on and the O/D cancel switch is positioned up.

Step One

Probe the Black/Yellow wire with the positive lead of an analog voltmeter. Probe the Blue/Black wire with the negative lead. The needle will read a pattern of long and short 12 volt pulses. The long pulses indicate 5 and the short pulses indicate 1. Once the pattern is finished the computer will continue to repeat the same pattern after a short pause.



Step Two

Move the negative lead to the Blue/White wire. The needle may or may not pulse. If it pulses, then count the pulse as a 10.

Step Three

Add the numbers from Step One and Step Two and the total is the code number. If additional codes exist, cycle the O/D cancel button to advance to the next code.

Blue/Black	Blue/White	Code
	No Pulses	$5 + 1 + 0 = 6$ Throttle Position Sensor Circuit
	Pulses	$0 + 1 + 10 = 11$ Pulse Generator Circuit
	Pulses	$0 + 3 + 10 = 13$ Vehicle Speed Sensor Circuit
	Pulses	$5 + 1 + 10 = 16$ 1-2 Solenoid Circuit
	Pulses	$5 + 2 + 10 = 17$ 2-3 Solenoid Circuit
	Pulses	$5 + 3 + 10 = 18$ 3-4 Solenoid Circuit
	Pulses	$5 + 4 + 10 = 19$ Lock-Up Solenoid Circuit

Type II and III Code Retrieval

When a problem is detected by the computer the Hold light will blink indicating a code has been set. Code retrieval for the Type II and III systems is relatively simple. The computer is located under the dash left of the steering column. The Blue six pin diagnostic connector with two wires and the Blue single pin connector both stick out of the computer harness within 8 inches of the computer connector. Ground the single pin, turn on the key and watch the Hold light blink. A long blink indicates ten while a short blink indicates one. Add the tens and the ones together to decipher the code. If more than one code exists in memory the next code will automatically follow.

EXAMPLE: 6 long blinks followed by 3 short blinks indicate a code 63.

Transaxle Codes

6	Vehicle Speed Sensor
12	Throttle Position Sensor
55	Pulse Generator
57	Downshift Signal
60	1-2 Solenoid Circuit
61	2-3 Solenoid Circuit
62	3-4 Solenoid Circuit
63	Lock Up Solenoid Circuit

Type IV Code Retrieval

Because the Type IV computer controls the engine and transaxle both sets of codes are combined. If an engine code is set, the check engine light will blink to indicate a problem. If a transaxle code is set, the hold light will blink. To retrieve codes first locate the green or black six pin diagnostic connector containing two wires and the green or black single pin connector. Both are located in the engine compartment near the drivers side hood hinge. Ground the green single pin connector and turn on the key. The check engine light will blink to indicate both engine and transaxle codes. Like Type II and III a long blink indicates ten and a short blink indicates one.

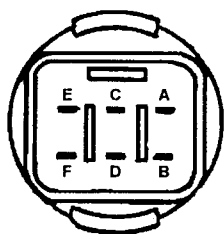
Engine Codes

1	Ignition Pulse
8	Airflow Meter
9	Water Thermosensor
10	Intake Air Thermosensor
12	Throttle Position Sensor
14	Atmospheric Pressure Sensor
15	Oxygen Sensor
16	EGR Position Sensor
17	Feedback System
25	Solenoid Valve (Pressure Regulator)
26	Solenoid Valve (Purge Control)
28	Solenoid Valve (EGR)
34	ISC Valve

Transaxle Codes

6	Vehicle Speed Sensor
12	Throttle Position Sensor
55	Pulse Generator
57	Downshift Signal
60	1-2 Solenoid Circuit
61	2-3 Solenoid Circuit
62	3-4 Solenoid Circuit
63	Lock Up Solenoid Circuit

Shift Solenoids



SOLENOID CONNECTOR FACE VIEW

Input	Resistance to Ground	Code
A— No Input	N/A	N/A
B—Lock-up Solenoid	13-27 ohms	63
C—3-4 Solenoid	13-27 ohms	62
D—2-3 Solenoid	13-27 ohms	61
E—2-3 Solenoid	13-27 ohms	61
F—1-2 Solenoid	13-27 ohms	60

NOTE: If a solenoid code (60-63) is set the computer will not use that particular solenoid. However, all solenoids without codes set will still be used.

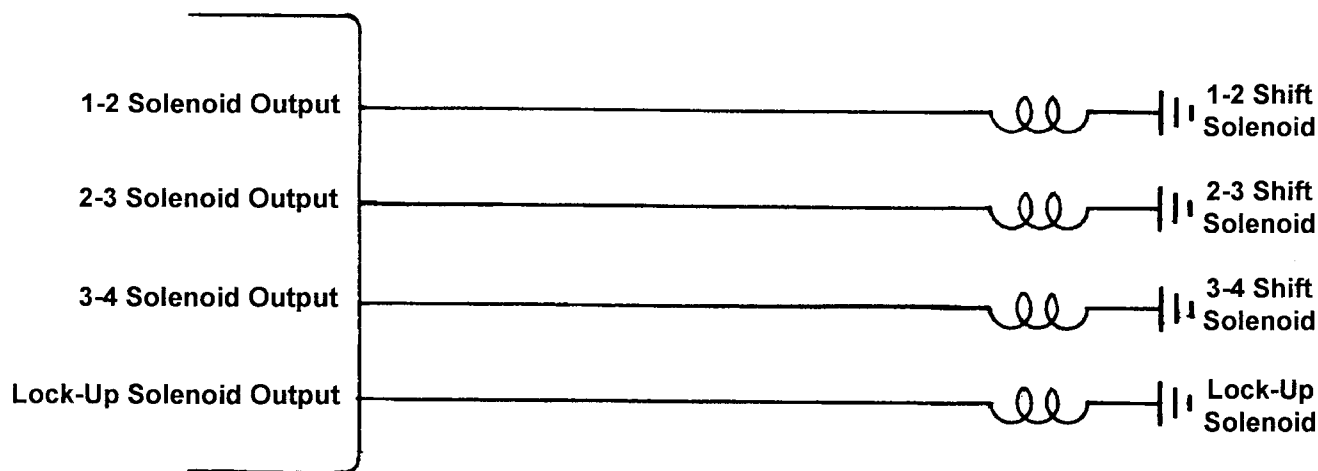
Solenoid Circuit Resistance Test

Using the computer pin voltage charts, located in the back of this section, select the correct solenoid output pin. Connect one of the analog ohm meter leads to ground and probe the solenoid output wire with the other lead. Resistance should be 13-27 ohms. During this test, wiggle the solenoid harness from the case connector to the firewall. If a bad section of the solenoid harness is wiggled, the ohms reading will fluctuate.

Solenoid Circuit Amperage Test

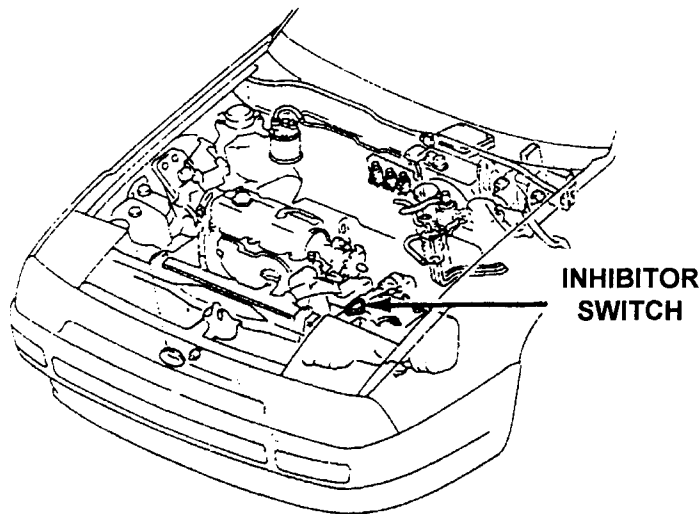
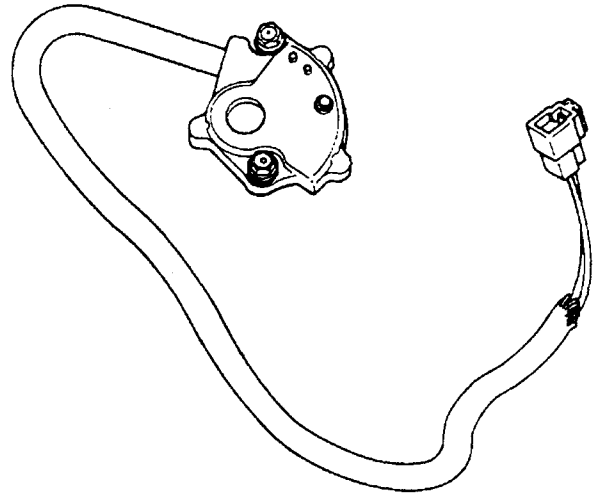
A more thorough test of the solenoid circuit is an amperage test. Disconnect the computer and connect one lead of a digital ammeter lead to a positive voltage source, the other lead to the solenoid output wire in the harness connector. This should turn the solenoid on accurately measuring the circuits ability to maintain proper current flow. Current through this circuit should be between 0.60-0.95 amps. Since amperage will vary with temperature, monitor the solenoid amperage for at least five minutes.

If the solenoid circuit failed one or both tests, the problem is in the wiring, connections or solenoid. Test areas separately starting with solenoids.



Inhibitor Switch

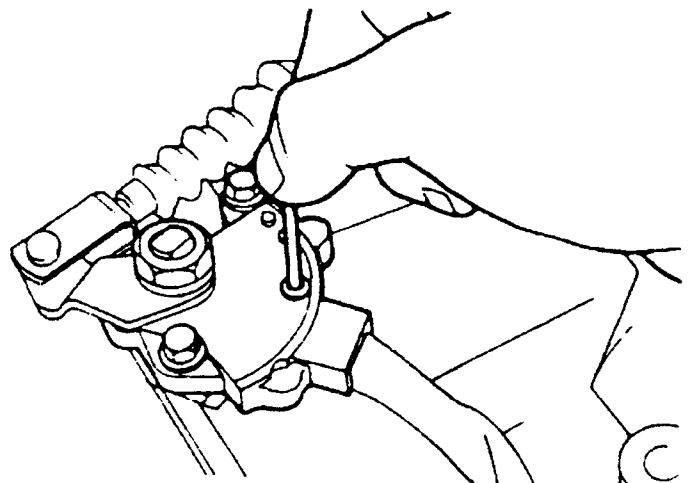
The inhibitor switch tells the computer the manual range that has been selected. Without this information the computer will not perform the correct shift strategies. A common problem is a blown fuse which supplies 12V to pin C. This will cause 3rd gear start because the computer thinks neutral was selected.



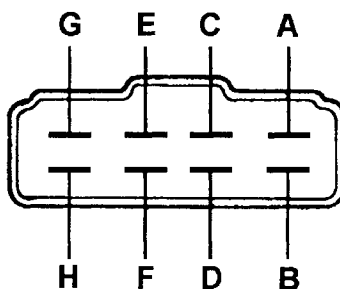
Location: Mounts to the upper part of the case on the manual shaft.

Function: Sends information about manual range selected, turns on the back up lights, operates the manual lever position indicator light on some models and serves as a neutral safety switch.

Adjustment: Remove the small access screw from the switch. In neutral align the small hole with a pin.



Eight Pin Inhibitor Switch



CONNECTOR VIEW: Pin side—sensor connector

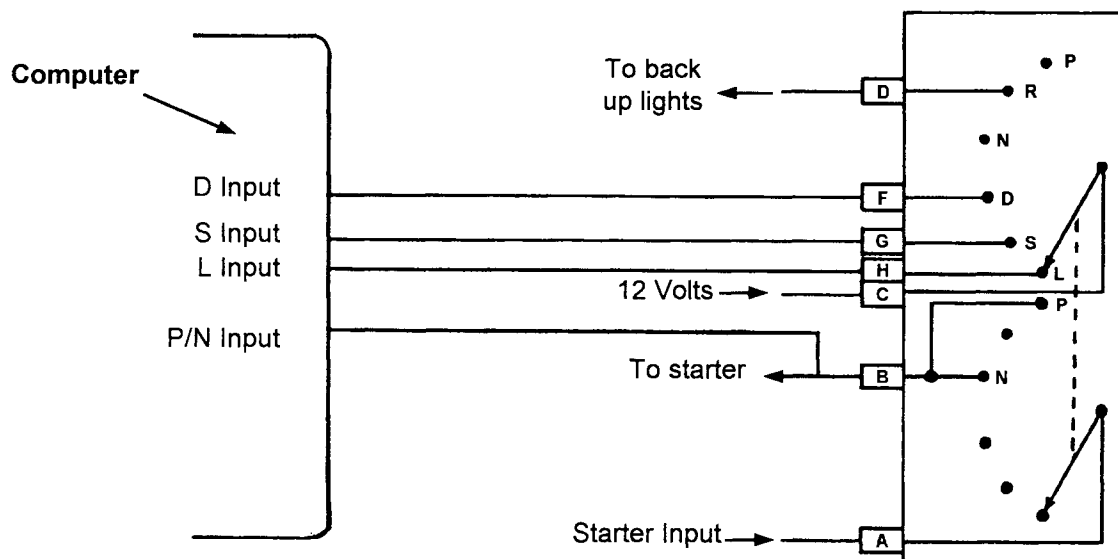
VOLTAGE CHART
Terminal Voltage

	A	B	C	D	E	F	G	H
P			12	-	-	-	-	-
R			12	12	-	-	-	-
N			12	-	-	-	-	-
D			12	-	-	12	-	-
S			12	-	-	-	12	-
L			12	-	-	-	-	12

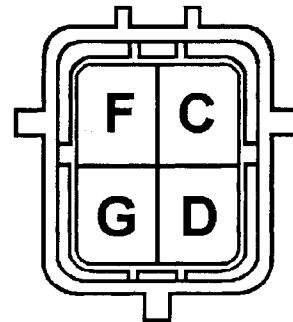
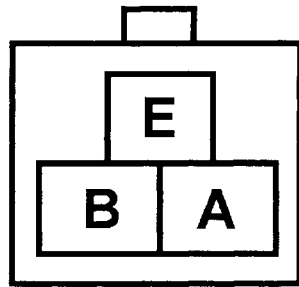
CONTINUITY CHART

	A	B	C	D	E	F	G	H
P	●	●						
R			●	●				
N	●	●						
D			●	—	—	●		
S			●	—	—	—	●	
L			●	—	—	—	—	●

Wiring Schematic



Seven Pin Inhibitor Switch



CONNECTOR VIEW: Pin side—sensor connector

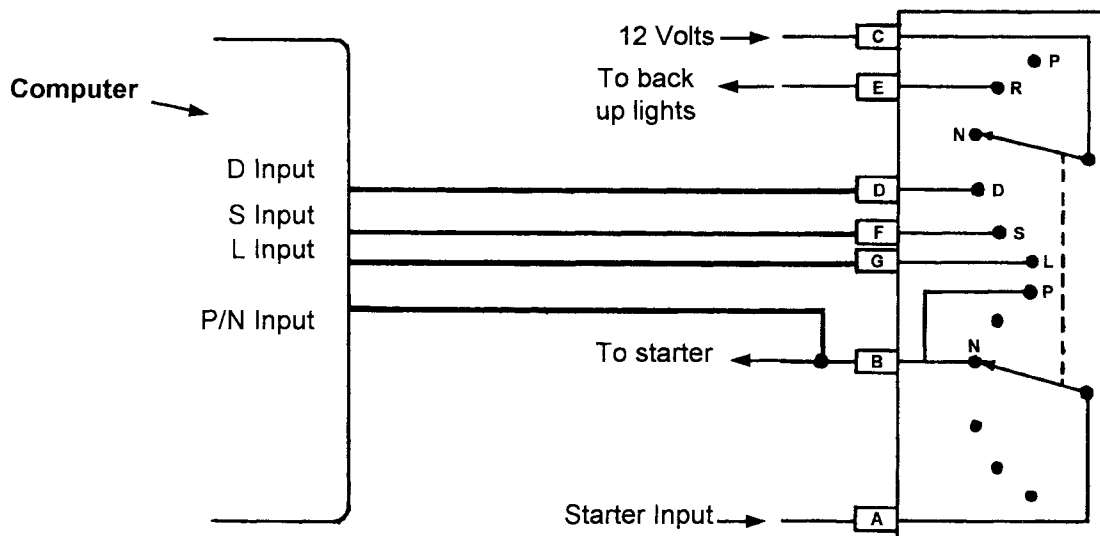
VOLTAGE CHART
Terminal Voltage

	A	B	C	D	E	F	G
P			12	-	-	-	-
R			12	-	12	-	-
N			12	-	-	-	-
D			12	12	-	-	-
S			12	-	-	12	-
L			12	-	-	-	12

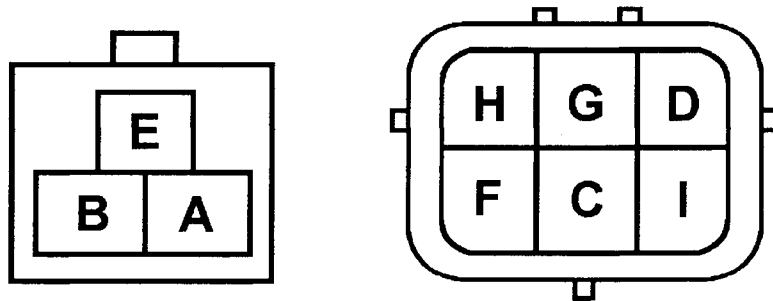
CONTINUITY CHART
Continuity

	A	B	C	D	E	F	G
P	●	●					
R			●	—	●		
N	●	●					
D			●	●			
S			●	—	—	●	
L			●	—	—	—	●

Wiring Schematic



Nine Pin Inhibitor Switch



CONNECTOR VIEW: Pin side—sensor connector

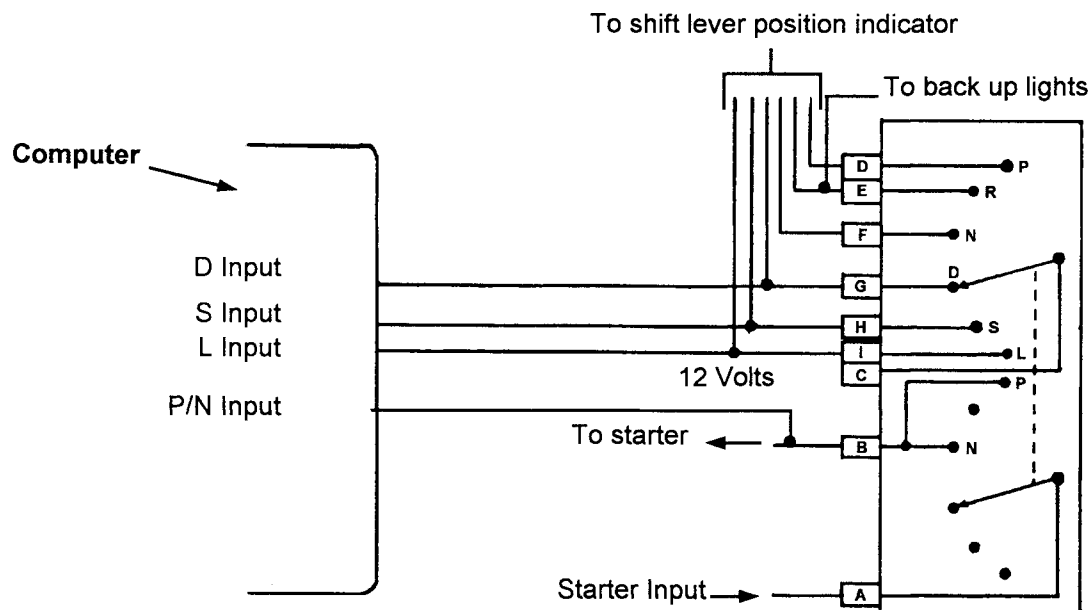
VOLTAGE CHART
Terminal Voltage

	A	B	C	D	E	F	G	H	I
P			12	12	-	-	-	-	-
R			12	-	12	-	-	-	-
N			12	-	-	12	-	-	-
D			12	-	-	-	12	-	-
S			12	-	-	-	-	12	-
L			12	-	-	-	-	-	12

CONTINUITY CHART

	A	B	C	D	E	F	G	H	I
P	●	●	●	●					
R			●	●	●				
N	●	●	●	●		●			
D			●	●			●		
S			●	●				●	
L			●	●					●

Wiring Schematic



Throttle Position Sensor

TPS signal return voltage is used by the computer to detect throttle opening. This information is used to select shift timing according to the amount of acceleration select by the driver.

PIN FUNCTIONS

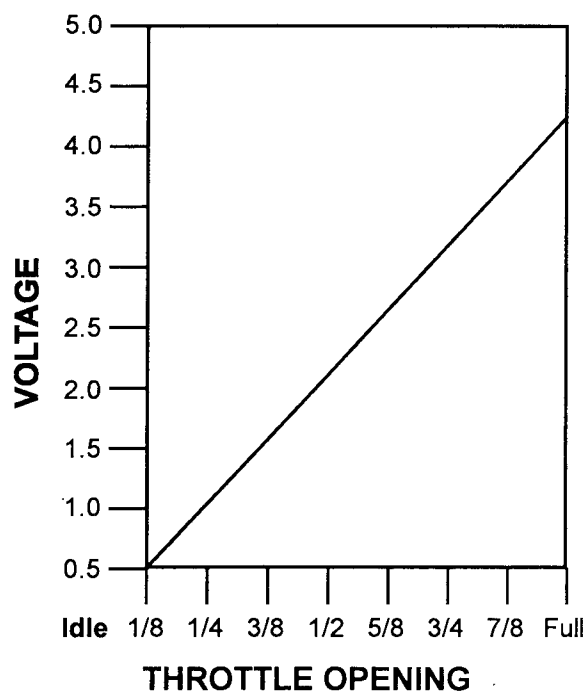
A—TPS Signal Return
B—Ground
C—5 Volt Reference
D—Idle Switch

RESISTANCE CHART

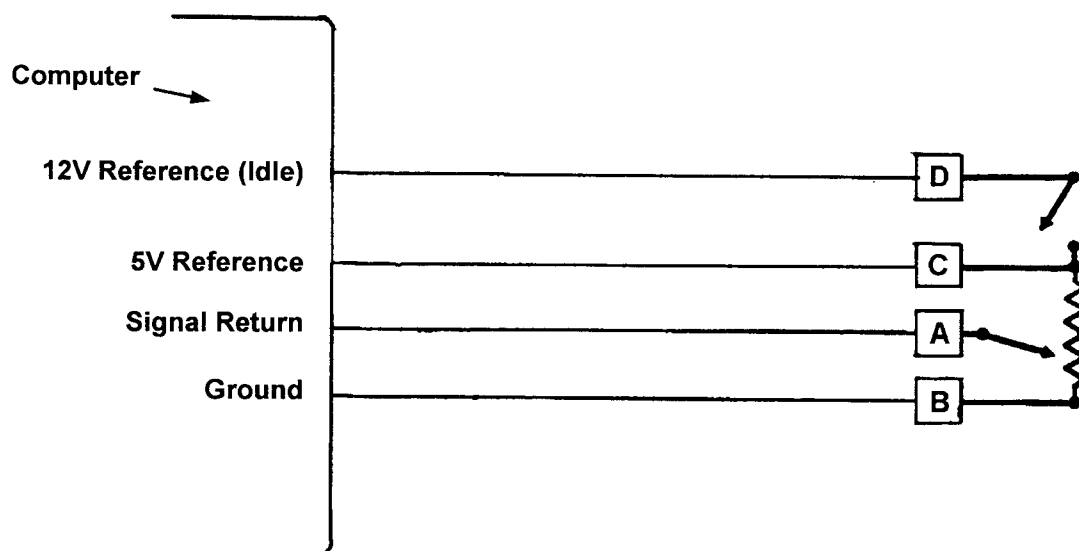
Terminal \ Condition	Ground	Fully Opened
A $\longleftrightarrow$ B	Approx. 500 ohms	Approx. 4.5 k ohms
B $\longleftrightarrow$ C	4 ~ 6 k ohms	

VOLTAGE CHART

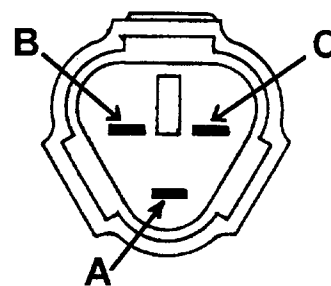
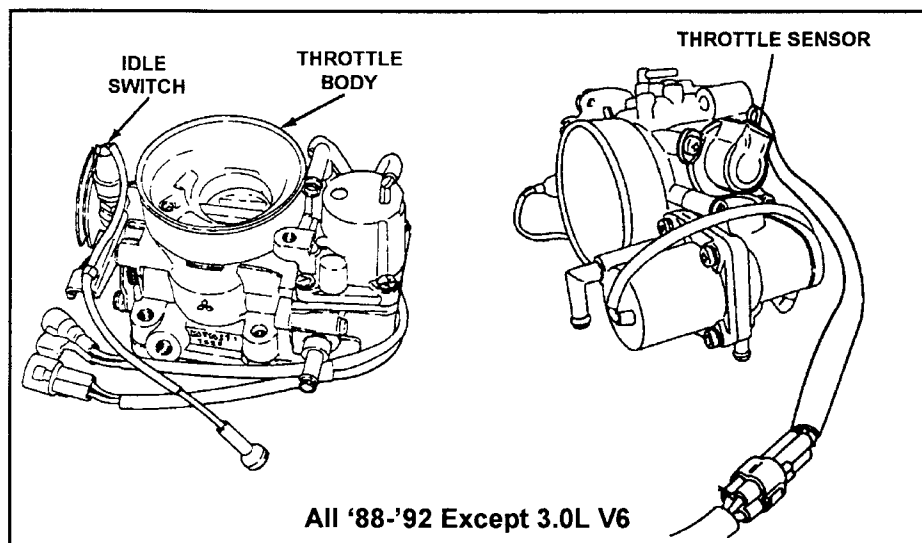
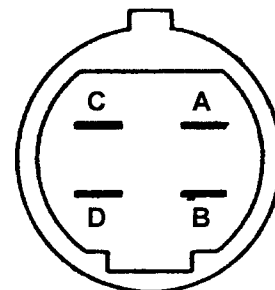
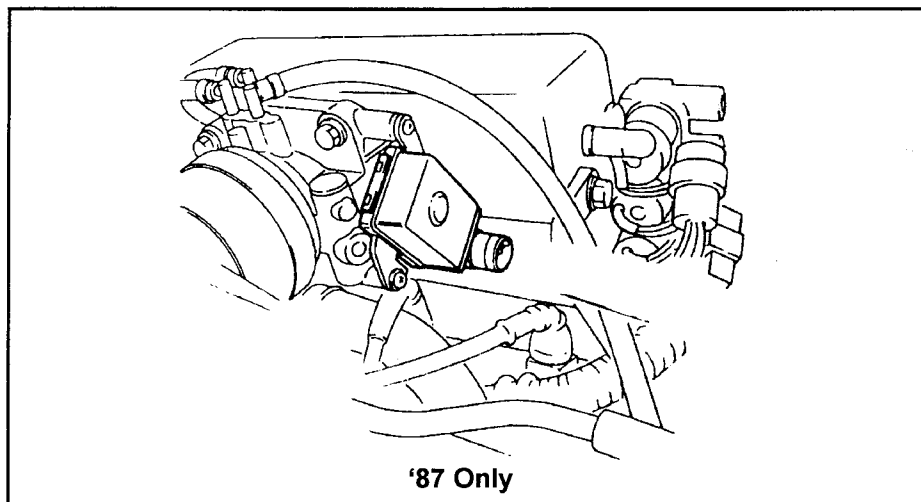
Terminal \ Condition	Ground	Fully Opened
A (V _T)	0.4 ~ 0.6V	Approx. 4.0V
B (GND)	Below .010	
C (V ₅)	4.5 ~ 5.5V	
D (IDL)	Below 1.5V	



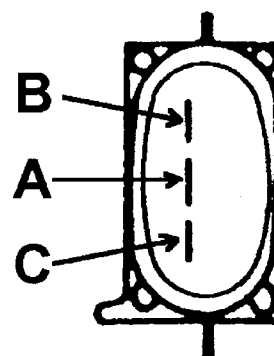
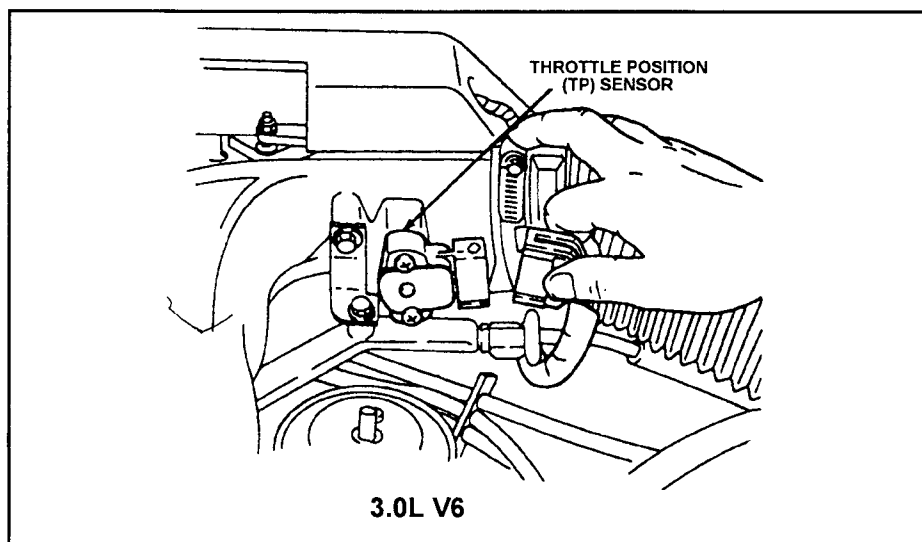
WIRE DIAGRAM



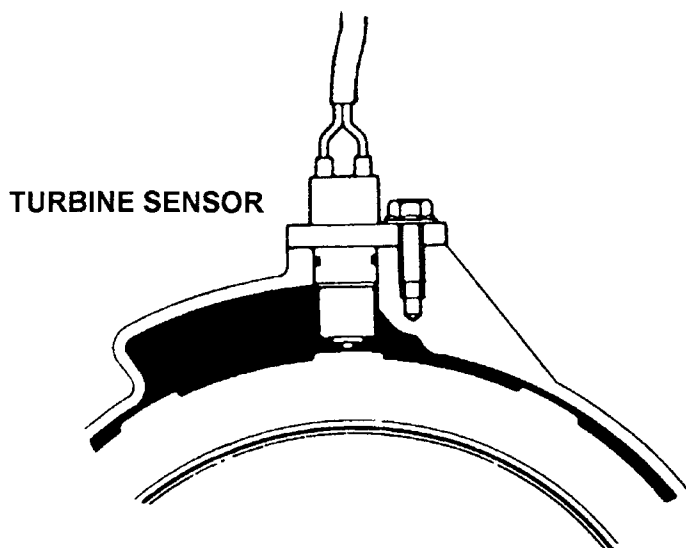
Throttle Position Sensor



NOTE: Pin D is located on the Idle Switch



Pulse Generator



Location: Mounts to the top of case just above the input drum.

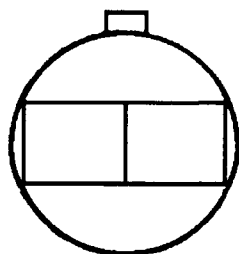
Function: The pulse generator reads input rpm by counting the 12 high spots on the outside diameter of the input drum.

Resistance: Resistance between the two wires should read 00-400 ohms.

Voltage: The pulse generator produces AC voltage and frequency when the drum spins. AC voltage will vary between .05-4.0 and frequency between 0-1200 Hz (Hertz).

Code: 55

Code Strategy: No O/D and no converter lockup.



Resistance, AC voltage and frequency can be monitored by probing the two pulse generator wires with the harness connected or disconnected.

The computer relies on a Pulse Generator (P.G.) for a primary speed sensor and the VSS (Vehicle Speed Sensor) is used as a back-up for the P.G. The computer calculates road speed from input RPM and gear ratio commanded by the computer. This can allow for many strange symptoms because the computer assumes the transaxle is doing what was commanded. An '88 626 non-turbo for example will make the half throttle 1-2 upshift at approximately 3700 RPM (23-25 mph). At the same throttle opening the computer will command the 2-3 upshift at approximately 4000 RPM (46-50 mph). If the computer commands the 1-2 shift but the transaxle stays in 1st gear the computer assumes the transaxle is in 2nd gear. At 4000 RPM the computer will command 3rd gear. If the transaxle shift 1-3 at 23-26 mph input RPM drops to approximately 1500 RPM. At this point the computer now thinks the vehicle slowed down and commands a 3-2 down shift. A 1-3 shift hunt will occur.

Forward clutch slippage can cause a 2-3 shift hunt that can appear to be a bad TPS. Many hidden problems like clutch and band slippage can be diagnosed by monitoring frequency of the pulse generator and comparing the reading to vehicle speed.

Pulse Generator (cont)

Input RPM	Pulse Generator Frequency	Vehicle Speed MPH			
		1st Gear	2nd Gear	3rd Gear	O/D
50	10	0.33	0.59	.92	1.32
100	20	0.65	1.2	1.85	2.64
200	40	1.32	2.4	3.7	5.28
300	60	1.97	3.6	5.54	7.92
400	80	2.63	4.8	7.39	10.56
500	100	3.3	6	9.24	13.2
1000	200	6.6	12	18.48	26.4
2000	400	13.2	24	36.96	52.8
3000	600	19.8	36	55.44	79.2
4000	800	26.4	48	73.92	105.6
5000	1000	33	60	92.4	132
6000	1200	39.6	72	110.8	158.39

NOTE: The above vehicle speeds were calculated by using a tire that was 72.2" circumference. Many variables such as the wrong speedometer gears can make this chart less accurate.

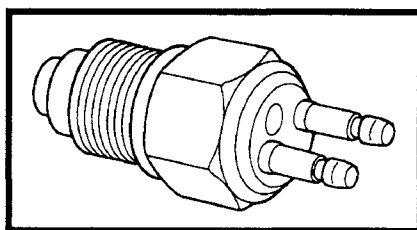
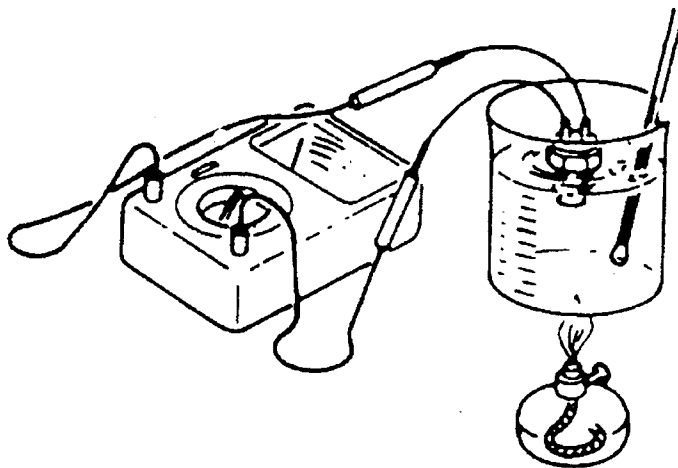
Water Temperature Switch

Continuity Test

When the sensor is cold (Below 149°F (-65°C) the two terminals will have continuity. When heated in water above 162°F (72°C) the switch opens to tell the computer it's warm.

CONTINUITY CHART

Water Temperature	Continuity
Below 162°F (72°C)	Yes
Above 162°F (72°C)	No

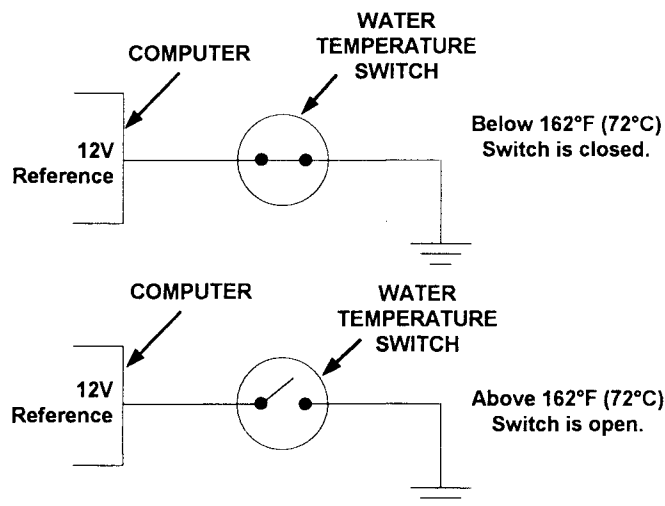
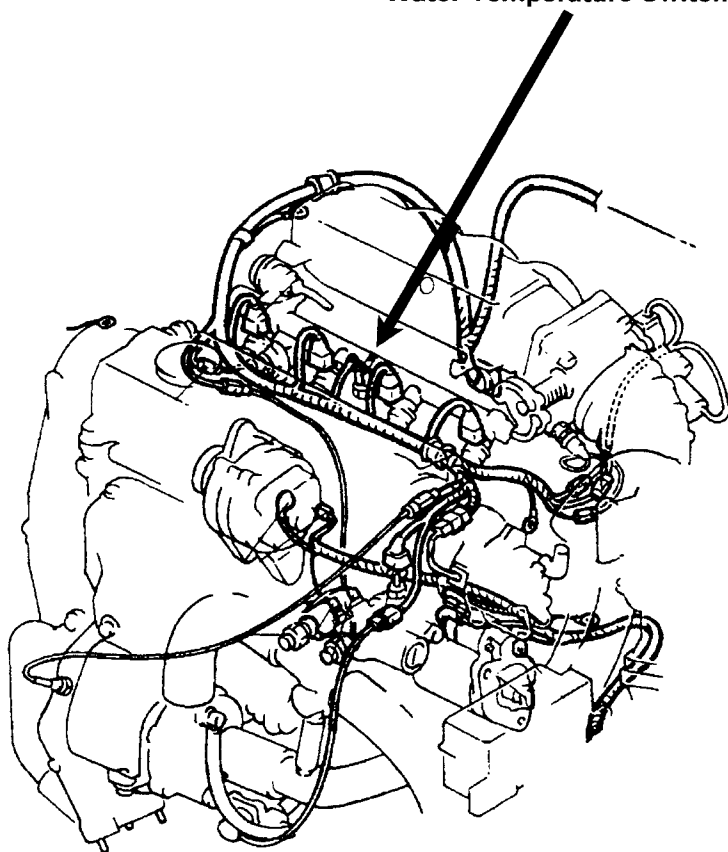


Water Temperature Switch

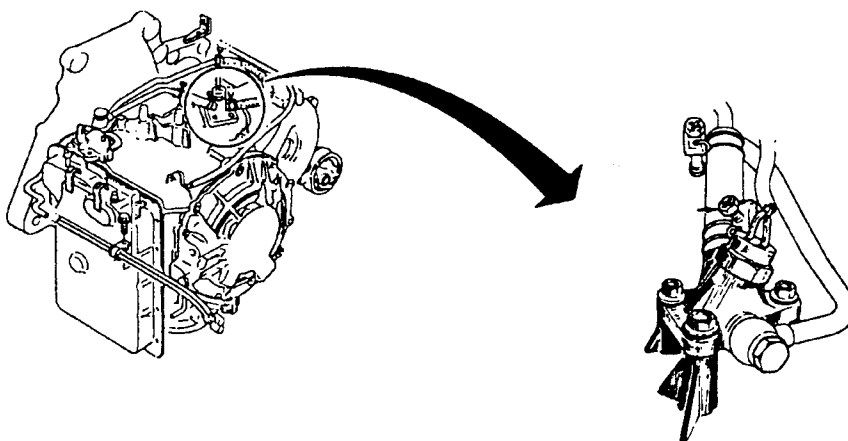
VOLTAGE CHART

Water Temperature	Volts
Below 162°F (72°C)	Below 0.10
Above 162°F (72°C)	12

When testing the water temperature switch in the vehicle, first locate the harness wire that supplies voltage to the sensor. Back probe that harness connector with the positive lead, and ground the negative lead of your voltmeter and follow the voltage chart as a guide.



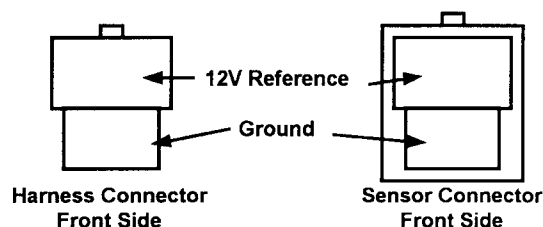
Fluid Temperature Switch



LOCATION: Located in the thermo switch box bolted to the case above the differential.

FUNCTION: Signals the computer when fluid temperature reaches above 302°F (150°C).

CODE: N/A

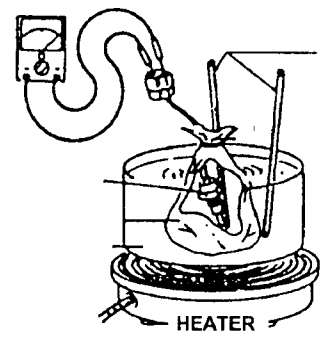


CONTINUITY TEST

Probe both pins of the sensor connector with a ohm meter. The readings should correspond with the continuity chart.

CONTINUITY CHART

OIL TEMPERATURE	CONTINUITY
Below 302°F (150°C)	NO
Above 302°F (150°C)	YES

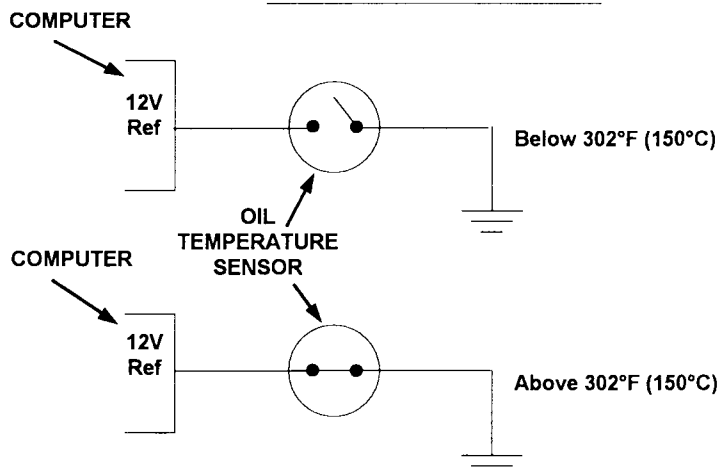


VOLTAGE TEST

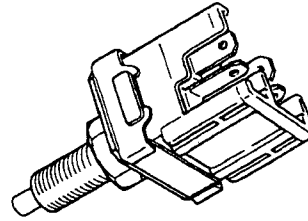
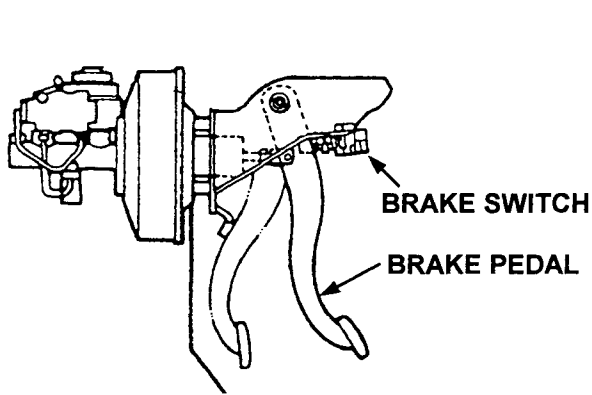
With the sensor connected back probe the 12V reference wire for voltage. The readings should correspond with the voltage chart.

VOLTAGE CHART

OIL TEMPERATURE	VOLTAGE
Below 302°F (150°C)	12
Above 302°F (150°C)	Below 0.10



Brake Switch

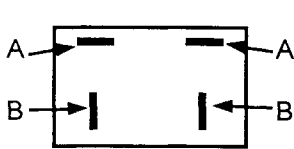


LOCATION: Mounted above the brake pedal.

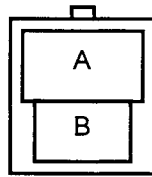
FUNCTION: The computer uses this information to cancel lock-up when the brakes are applied.

CODE: N/A

BRAKE SWITCH



Switch Connector



Harness Connector

CONTINUITY TEST

Probe A and B terminals with an ohm meter. If the switch is good it should correspond with the continuity chart.

CONTINUITY CHART

Button	CONTINUITY
Pushed in	NO
Released	YES

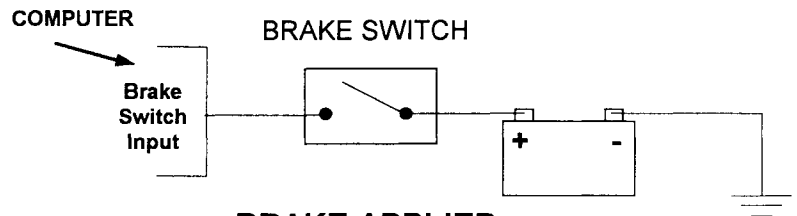
VOLTAGE TEST

With the brake switch adjusted properly check voltage of pins A and B. Voltage should correspond with the voltage chart.

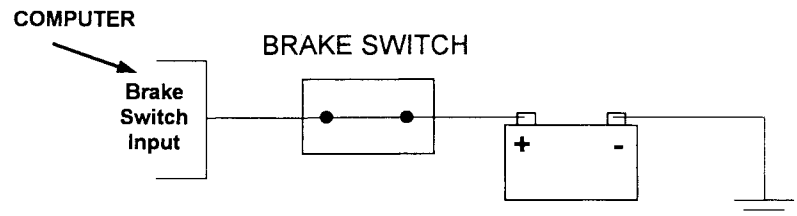
VOLTAGE CHART

Brake Pedal	A	B
Released	12	zero
Applied	12	12

BRAKE RELEASED



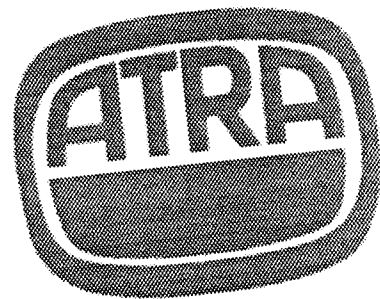
BRAKE APPLIED



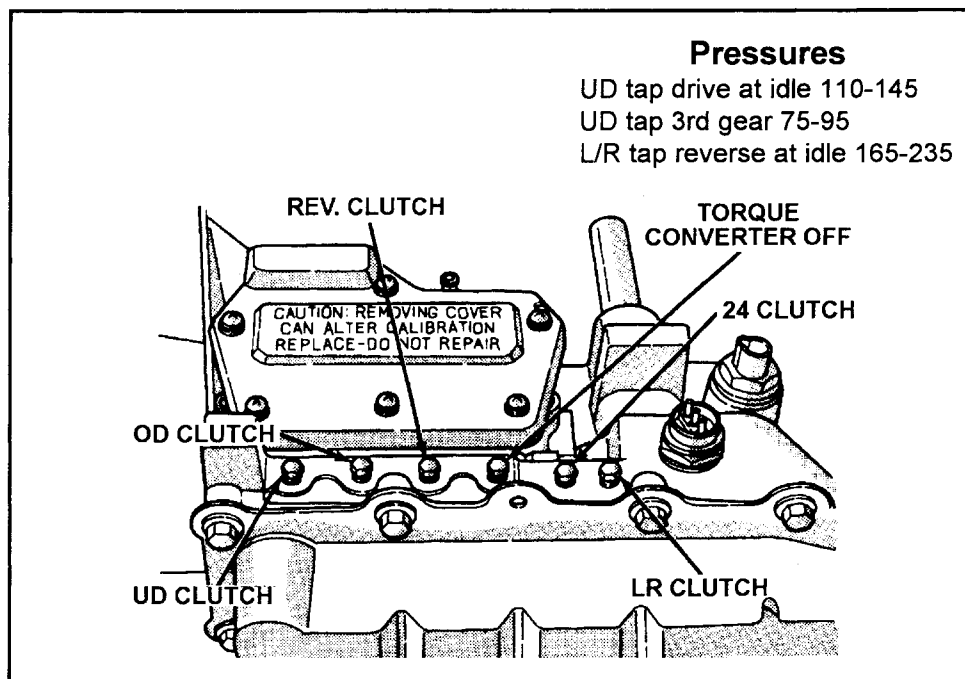
A604

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Chrysler
A604



A604



Range	Gear	LR/LU Sol	2-4/LR Sol	UD Sol	OD Sol	LR Clutch	2-4 Clutch	OD Clutch	UD Clutch	Rev Clutch
P-N										
R	Reverse									
D	1st									
	2nd									
	3rd									
	4th									

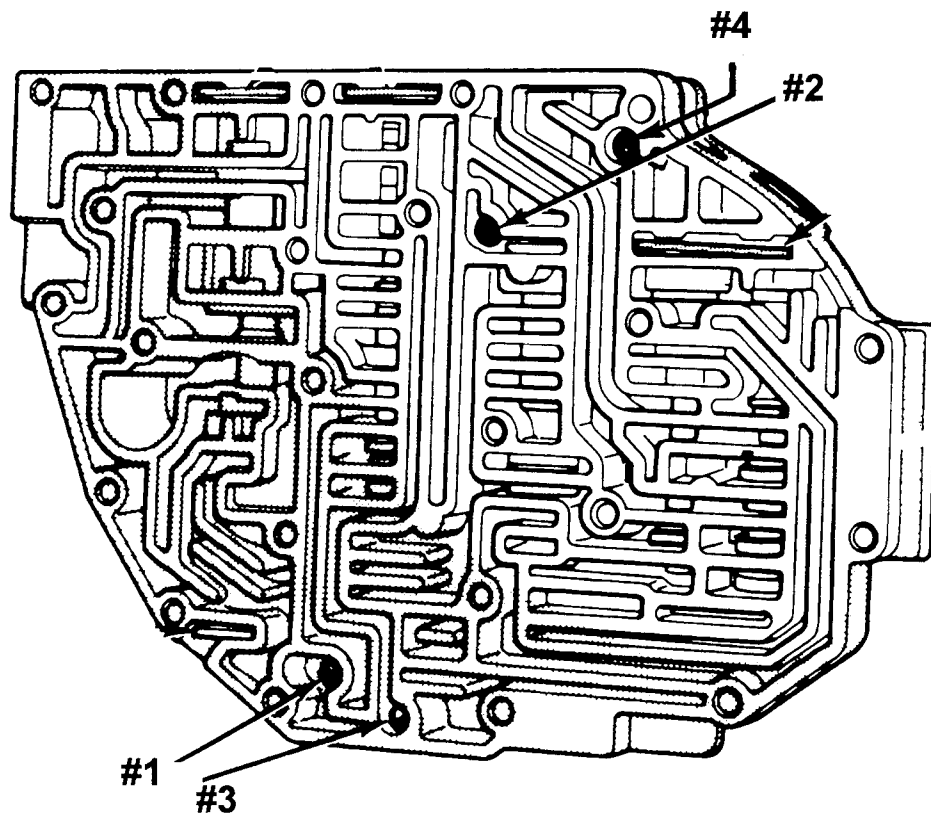
Failsafe Mode

D	2nd
D	2nd
1	2nd

Gear Ratios

1st	2.84
2nd	1.57
3rd	1.00
4th	.69
Reverse	2.21

Checkballs



- #1 LR Shuttle
- #2 UD Feed and Bypass—will not allow UD feed to bypass the UD solenoid. UD oil can bypass the solenoid during the release.
- #3 Keeps line oil out of the L/R circuit in 2nd, 3rd and 4th gear.
- #4 Reverse Clutch Orifice

Chrysler 604 Notes & Tips

Being aware of the following information can make the 604 work better and can avoid some embarrassing customer situations. Let's start by saying that there are essentially two control systems in use. The early system, which covers 89-92 and the late system which is 93-95. Most of the information that follows concerns the late system. The points that a technician must be aware of are: Adaptive Learn, Quick Learn, Road Test Procedures, EMCC and Electronic Pinion Factor.

Adaptive Learn

Adaptive learn is the computers ability to continuously monitor the shift quality and make changes in its output signals to maintain the desired shift quality. How does the computer do this? When the computer commands a shift, it also watches the turbine sensor. When it see's the turbine sensor speed begin to change, it knows that the clutch pack has reached zero clearance and has begun to apply. The computer stores a number in its memory called CVI (Clutch Volume Index). This number is related to how long it took for the turbine sensor to start to change after the computer commanded the shift. The computer stores CVI numbers for four clutch packs. These four clutch packs are: Low/Reverse (LR), Overdrive (OD), Underdrive (UD), and two-four (2-4). As the clutches wear, the CVI numbers increase. Using the CVI numbers the computer will tell a worn clutch to begin to apply sooner to compensate for the wear.

A common failure is the breaking of the snap ring for the overdrive/underdrive clutch. With a broken snap ring, this clutch cannot apply but the computer doesn't know this. The computer just see's a long apply time and raises the OD CVI to its maximum. Eventually the computer see's the problem and goes to the limp-in mode (second gear only). After rebuilding the transmission the computer need to learn a new CVI number. A problem often occurs while the computer is learning the new CVI. The overdrive clutch applies during the 2-3 upshift. The 2-4 clutch also releases during this shift. If the computer thinks the OD clutch is worn, high CVI, then the computer will apply the OD clutch long before the 2-4 clutch releases. This results in a bind-up during the 2-3 upshift. Most shops have experienced a 2-3 bind-up right after rebuild. The computer will eventually learn the correct CVI and correct the shift problem but while it is learning, the 2-3 bind-up is burning the OD clutch. To prevent this problem on early (89-92) systems you should disconnect the battery to reset all CVIs.

NOTE: 95 vehicles or earlier vehicles with 1995 updated controllers will NOT reset values or lose adaptive learn memory by disconnecting the battery.

The new or reset CVI number is not the correct value, it's just a middle of the road number that may or may not be closer than the high CVI that the computer currently has in memory. After the CVIs have been reset, the vehicle should be driven on the lift with a scan tool connected to the CCD bus connector. Watch the 2-4 and OD CVIs on the scan tool. As the transmission upshifts, these CVIs should change. If the CVIs are changing then continue to shift on the lift until the numbers settle down or quit changing much. That means the computer has the CVIs pretty close. Now you can drive the vehicle on the road.

NOTE: Most late controllers will NOT update CVIs on the lift. Drive the vehicle on the road but be sure to use light throttle at first.

Many sources have stated that the vehicle should not be ran on the lift because the computer will learn the wrong CVI numbers. This may be true on a vehicle that has never been worked on but it's not true after rebuild. Remember, the computer either has high CVIs in its memory or reset values in its memory, either way the numbers are wrong. By running the vehicle on the lift the computer will learn values that are pretty close to what they should be but while it's learning, the 2-3 bind-up is occurring with no load on the vehicle. This will help prevent the OD clutch burn up. After the CVI numbers have stabilized on the lift, you will notice the 2-3 bind-up is gone. Now you can drive on the road. Follow the Road Test Procedure on the next page.

IMPORTANT: The computer learned the new CVIs under no load. This means the numbers in memory are probably less than they should be. The vehicle should be driven only under light throttle until the OD and 2-4 CVI numbers reset a little. Once these numbers restabilize, you can drive at heavier throttle opening. Beginning in 1993 there is a better way around this problem. This better way is called Quick Learn.

Quick Learn

Quick Learn is a function that Chrysler has put in the computer that can be triggered by most late scan tools. Following the procedure in the scan tool book will trigger this function. It goes something like this. The scan tool will tell you to have the vehicle in park with foot on the brake and start the vehicle. It will not go on to the next function until it sees all conditions correct. It will tell you to shift to neutral. It will then say shift to OD. Once in OD, components will be engaging and disengaging in the transaxle. It will then tell you the procedure is done and to shift to Park. This will take all of about five seconds. The computer was turning on clutch packs and watching the sensors to get some CVIs that are pretty close to actual. The quick learn procedure replaces the battery disconnect-run it on the lift procedure that was discussed earlier. The vehicle will still have to be driven on the road in order to fine tune the numbers.

IMPORTANT (again): The OD and 2-4 CVIs are updated during upshifting but the UD and LR CVIs are only updated during kickdowns. The UD is updated during a kickdown out of fourth and the LR is updated during a kickdown into first. (For 1995, the UD is updated on initial engagement). After upshifting at light, medium and heavy throttle several times, you must make some 4-2 and 2-1 kickdowns to dial in the UD and LR CVIs. Use the following road test procedure.

Road Test Procedure

1. Maintain constant throttle opening during shifts.
2. Accelerate the vehicle with a light throttle-opening and make 15 to 20 1-2, 2-3, and 3-4 upshifts.
3. Accelerate from a stop to approximately 45 mph at moderate throttle opening and make another 15 to 20 upshifts.
4. Accelerate from a stop at heavy throttle and make a few upshifts.
5. With vehicle speed below 25 mph, make 5 to 8 wide-open-throttle kickdowns to 1st gear from either 2nd or 3rd. Allow 5 seconds or more of operation in 2nd or 3rd before performing each kickdown.
6. With vehicle speed above 25 mph, and the vehicle in 4th gear, make 5 to 8 part-throttle to wide-open-throttle kickdowns to either 3rd or 2nd gear from 4th gear. For example, 4-3 or 4-2 kickdowns. Allow 5 seconds or more of operation in 4th, before performing the kickdown.

Following the above procedures should get the proper CVIs in the computer with the least amount of trouble and save the most amount of time.

Electronic Pinion Factor

QUICK NOTE: Beginning in 1993, the 604 no longer has a vehicle speed sensor mounted on the differential. This sensor was used to operate the speedometer. The computer now uses the transaxle output speed sensor to calculate speedometer values. In order to do this calculation, the computer must be told the correct axle ratio and tire size. This number is called the electronic pinion factor. If you replace a '93 or later computer the speedometer will not work until an electronic pinion factor has been entered. Currently only the DRB II or DRB III can perform this procedure.

EMCC

Some 1992 and most 93 and later 604s had something called EMCC or Electronically Modulated Converter Clutch. EMCC allows partial lock up or controlled slippage of the converter clutch. When the vehicle is new, EMCC is disabled until the torque converter clutch has a chance to break in. It goes like this, for the first 500 miles there is no EMCC. Between 500 and 1500 miles EMCC will gradually begin operating. After 1500 miles, EMCC will operate normally. After a rebuild or replacement of the torque convertor, another break-in period is required. Most scan tools can do something called EMCC reset. This will start the cycle over again. In other words, no EMCC for 500 miles, then gradual EMCC for the next 1000 miles. After 1500 miles, its all back to normal.

IMPORTANT NOTE: EMCC has been known to cause early deterioration of the transmission fluid (15,000-30,000 miles) and cause lock up shudder. Chrysler dealerships have a repair for this condition. The dealership will either reprogram the PCM or replace the PCM if it is one that doesn't accept reprogramming. This will eliminate the EMCC feature completely. 1995 vehicles no longer have EMCC.

Technical Seminar

Electronics

41TE (A604)

4L60-E

E40D

4L30-E

KM175

ZF

Mazda



This manual has been compiled and produced by the Automatic Transmission Rebuilders Association ("ATRA") solely for the benefit and improvement of the automatic transmission rebuilding industry. The information contained in this book is based on the best information and data available to ATRA at the time of publication. While every effort has been made to attain accuracy and completeness neither ATRA nor any other person who has publication shall be liable to the reader or any other person for any direct, indirect, incidental or consequential damages, expenses, lost profits or other damages arising out of the use of this publication.

1997 Technical Seminar



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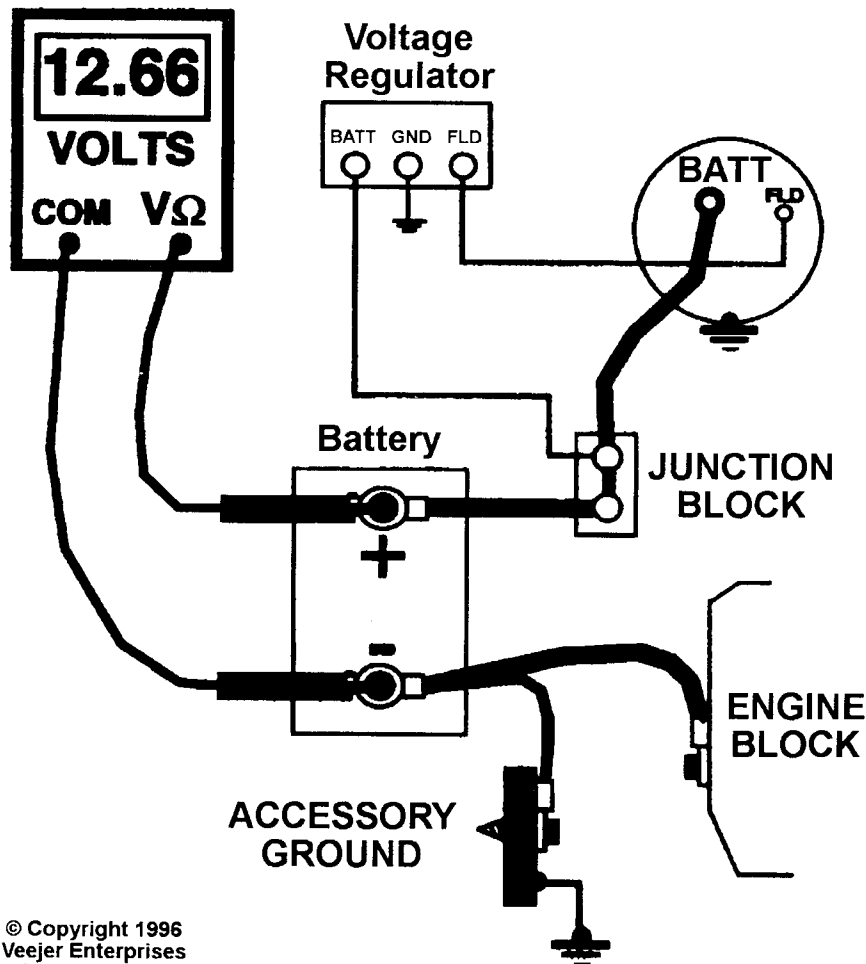


Check the State of the Basic Electrical System

This is as important to the proper function of the on board computer(s) as checking the fluid level of the transmission is to the transmission. If any problems appear in the basic electrical system, some if not all of the individual systems may not work properly. To properly check-out the basic electrical system do the following:

Battery Voltage

Measure battery voltage with a DVOM at the posts first, then the cables. The voltage should be between 12.45v and 12.66v at both the posts and the cables. If the voltages are different, you more than likely have a poor connection at the cables. Clean the cables and re-test.



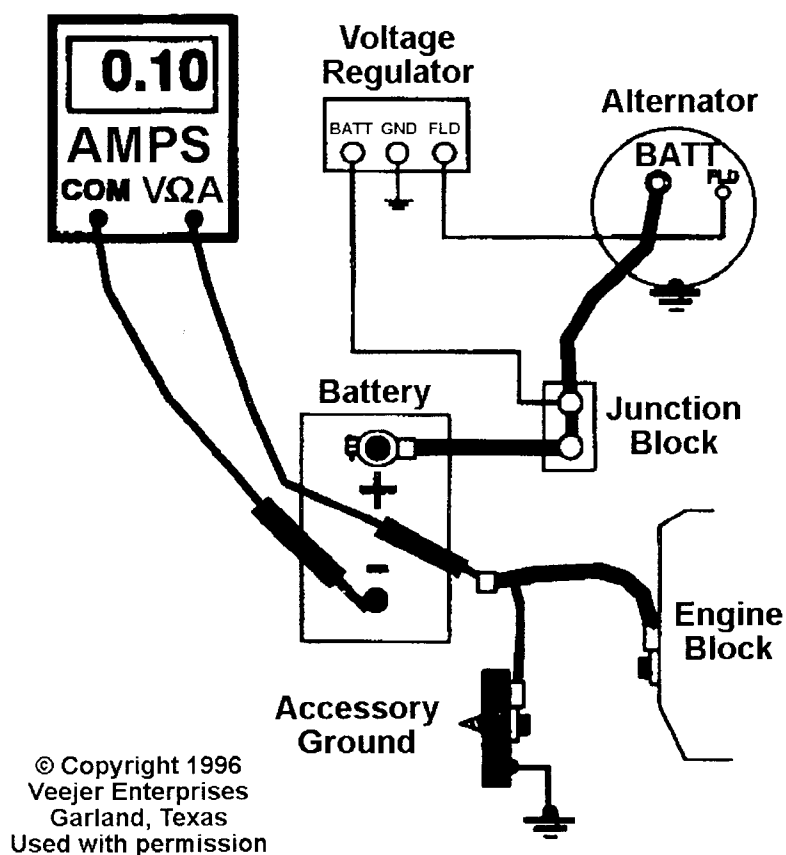
Battery Voltage	State of Charge
12.66	100%
12.45	75%
12.24	50%
12.06	25%
11.89	Discharge

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If battery voltage is low, try recharging the battery, then perform a battery drain test with the key off.

Battery Drain Test

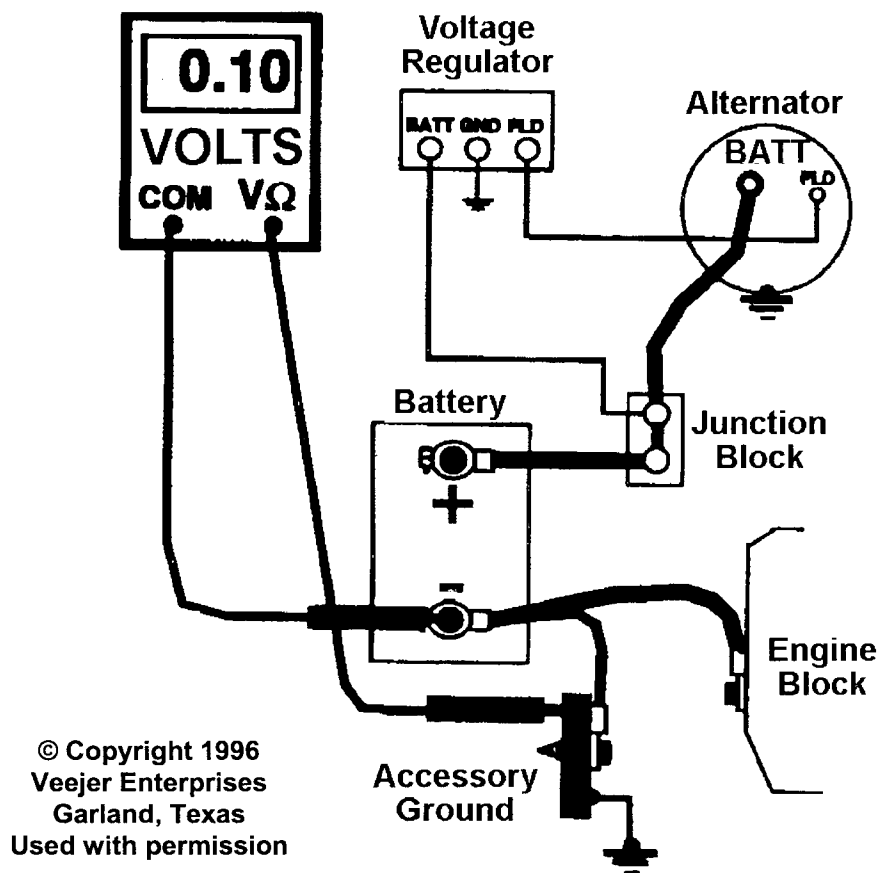
- To perform this test make sure the ignition key is off. Turn off all accessories.
- Remove the negative battery cable.
- Connect the red lead of an ammeter to the removed cable.
- Connect the black lead to the negative battery post.
- Read the current draw in milliamps. It should be no more than 60 milliamps. Any more than 100 milliamps constitutes a serious draw.
- If the current draw is too large, further tests to determine the source of the current draw will be needed.



- If the battery current draw is acceptable, measure the specific gravity of all six battery cells. If the battery is a sealed battery, this test cannot be performed.

Measure the Accessory Ground Voltage Drop

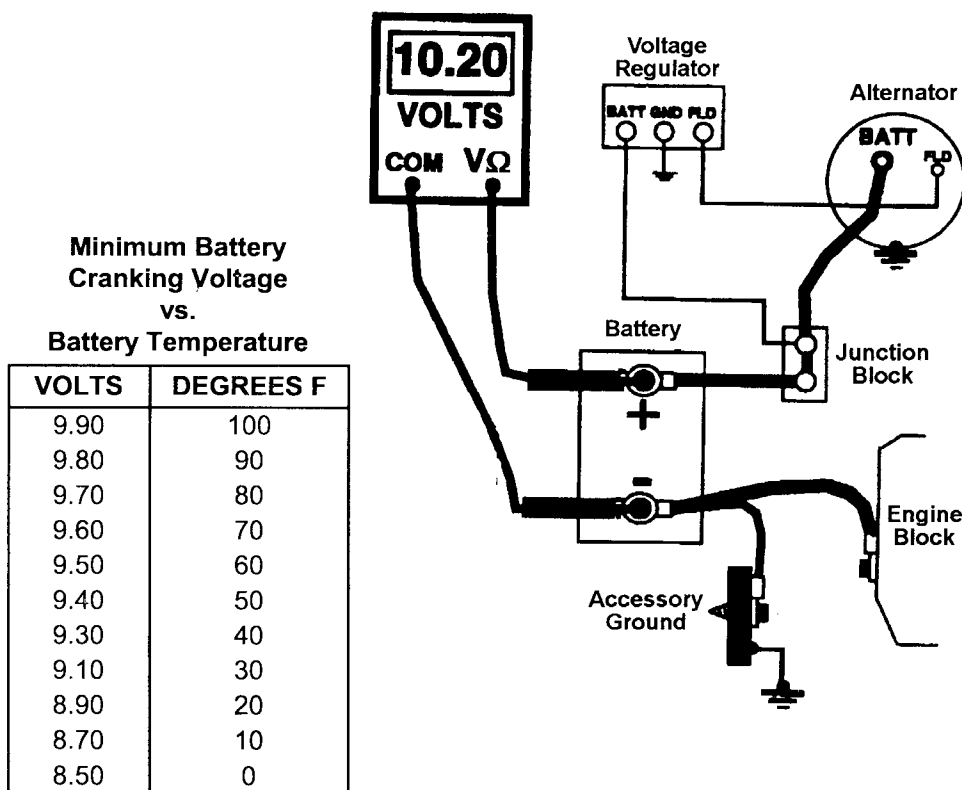
- Place the negative test lead on the battery negative post.
- Place the positive test lead on the vehicles accessory ground.
- Turn on the ignition (do not start engine)
- Turn on the high beam headlights, a/c or heater blower motor on high, electrical windshield wipers, and the radio.



- The voltage drop should be no more than .1v. Anything more indicates corrosion or poor connections in the accessory ground. Anything more than .3v is not acceptable. Cleaning or replacement of the accessory ground cable should reduce the voltage drop.
- When finished with this test, turn all electrical loads off.

Measure the Battery Post Cranking Voltage

- Connect the test leads of the DVOM to the battery posts, and crank the engine. Do not start the engine. Installing a spark plug on the ignition coil wire and grounding the plug to the engine is recommended: Failure to do so can damage the ignition module.
- The battery voltage will drop during cranking.



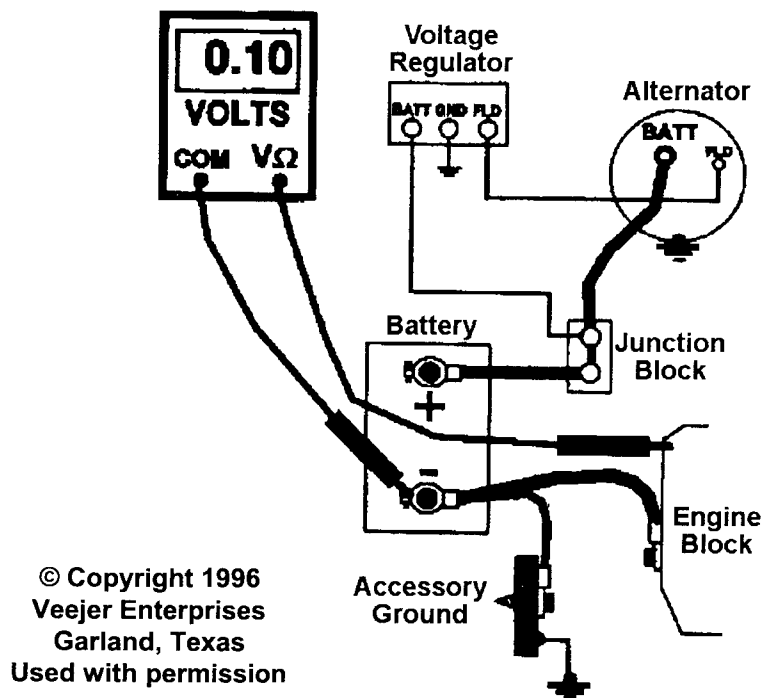
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- If the actual battery voltage is higher than in the chart, it indicates a healthy battery.
- If cranking voltage is low, the battery could be at fault or the starter current draw could be too high. Check the starter current draw with an inductive ammeter or an ammeter designed to withstand three to four hundred amps. Not a Digital Ammeter.

Note: Starter current draw can vary. Check the manufacturers specifications. These can be found in an electrical wiring diagram manual.

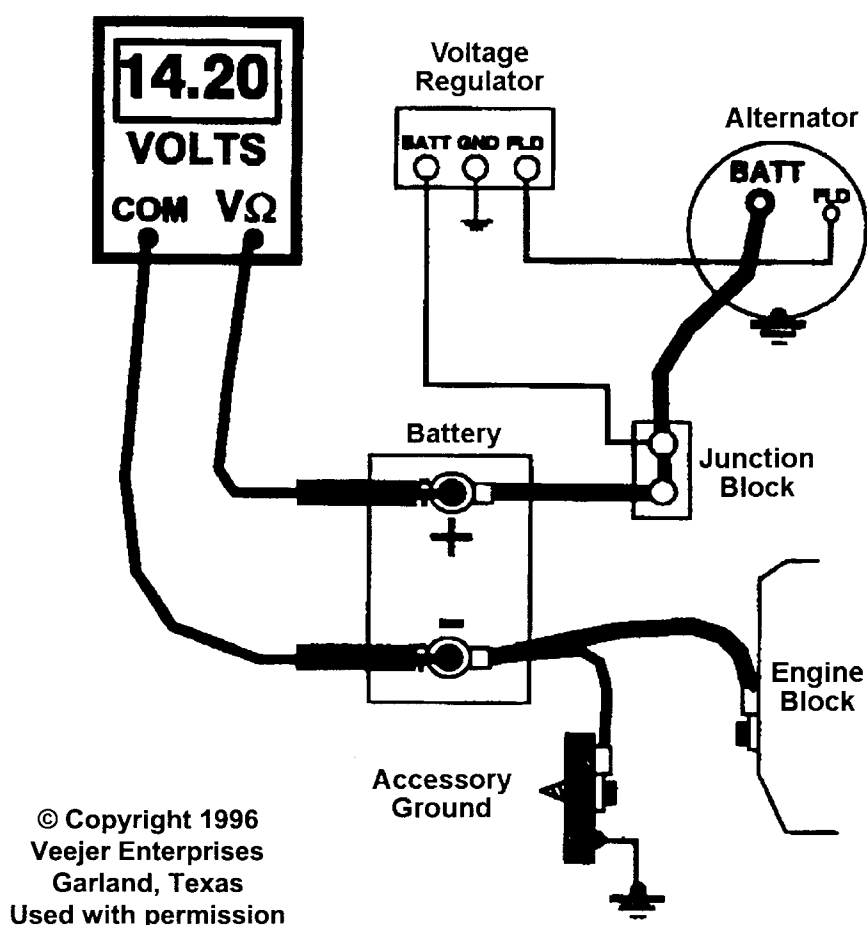
Measure Engine Ground Voltage Drop While Cranking

- To do this test simply connect the negative lead of a DVOM to the negative post of the battery.
- Connect the positive lead of the DVOM to the engine block.
- The allowable voltage drop is 0.1v. Any more than 0.1v indicates corrosion or a loose connection in the engine ground circuit. Any more than 0.3v is *not* acceptable. Cleaning or replacement of the engine ground cable would be in order before proceeding any further.



Measure the Charging Voltage at the Battery Terminals with Engine Cold

- This one is very simple to do. With the engine running about 1500 rpm, place the DVOM leads on the battery posts like you are going to check the voltage at the battery posts (positive lead to positive post, negative lead to negative post).
- The charging voltage is what you see on the meter. Normally, this voltage is about 2v more than the battery voltage with the engine off.



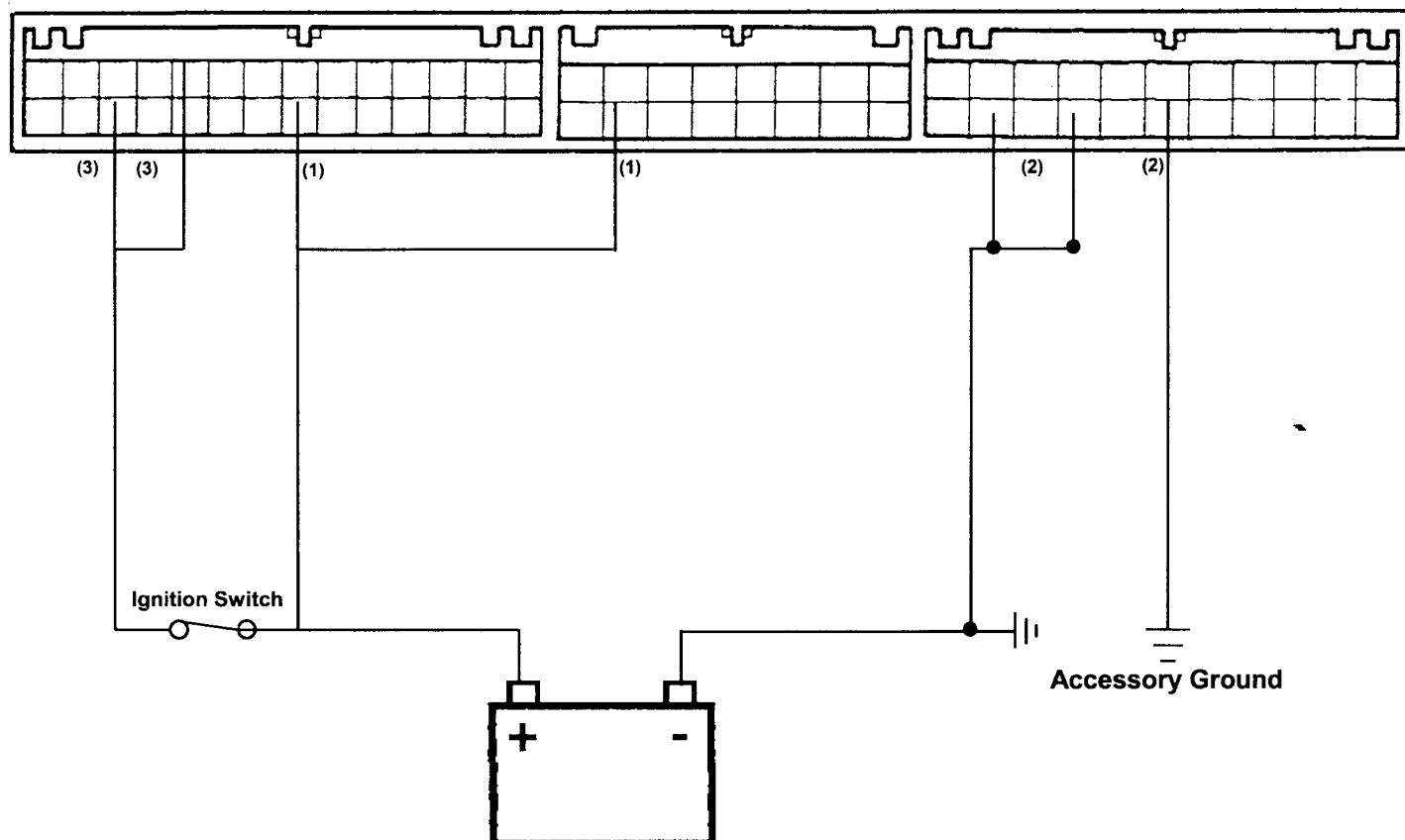
NOTE: The only reading you can trust is the DVOM reading at the battery posts. Not a diagnostic machine or at the back of the alternator.

Check for Diagnostic Trouble Codes

Depending on the type of system, retrieving DTC's may be the next step. Example: A slipping 1-2 shift on a Nissan Maxima that has no trouble codes is not as important as a slipping 604 that is in fail safe with a gear ratio error code. The Nissan computer's strategy will not be affected by a slip since the DTC's it produces are related to open or shorted circuits. The 604 system is sensitive to gear slips and other problems. It will react to a variety of driving conditions and vary its operating strategy based on inputs received and outputs obtained.

When a DTC is retrieved and is determined to be related to the fault at hand then a complete test of the related circuit would be in order. If the circuit is electrical then the next section is for you. Note: A good habit to get into is checking the power and ground circuits of the computer before any other tests are done.

To check the power and ground circuits at the computer first locate the power leads going into the computer (1) and measure the voltage at the leads. This should be done with the harness connected to the computer. Next, measure the voltage at the ground leads (2). Turn on ignition switch and measure the voltage at the ignition leads (3). Re-test the voltage at (2). Voltage at the (1) and (3) should be: Battery voltage all the time at (1) and with the ignition switch on at (3). Ground voltage all the time (2) Battery voltage should be no less than 12.4v and ground voltage should be no more than 0.1v.

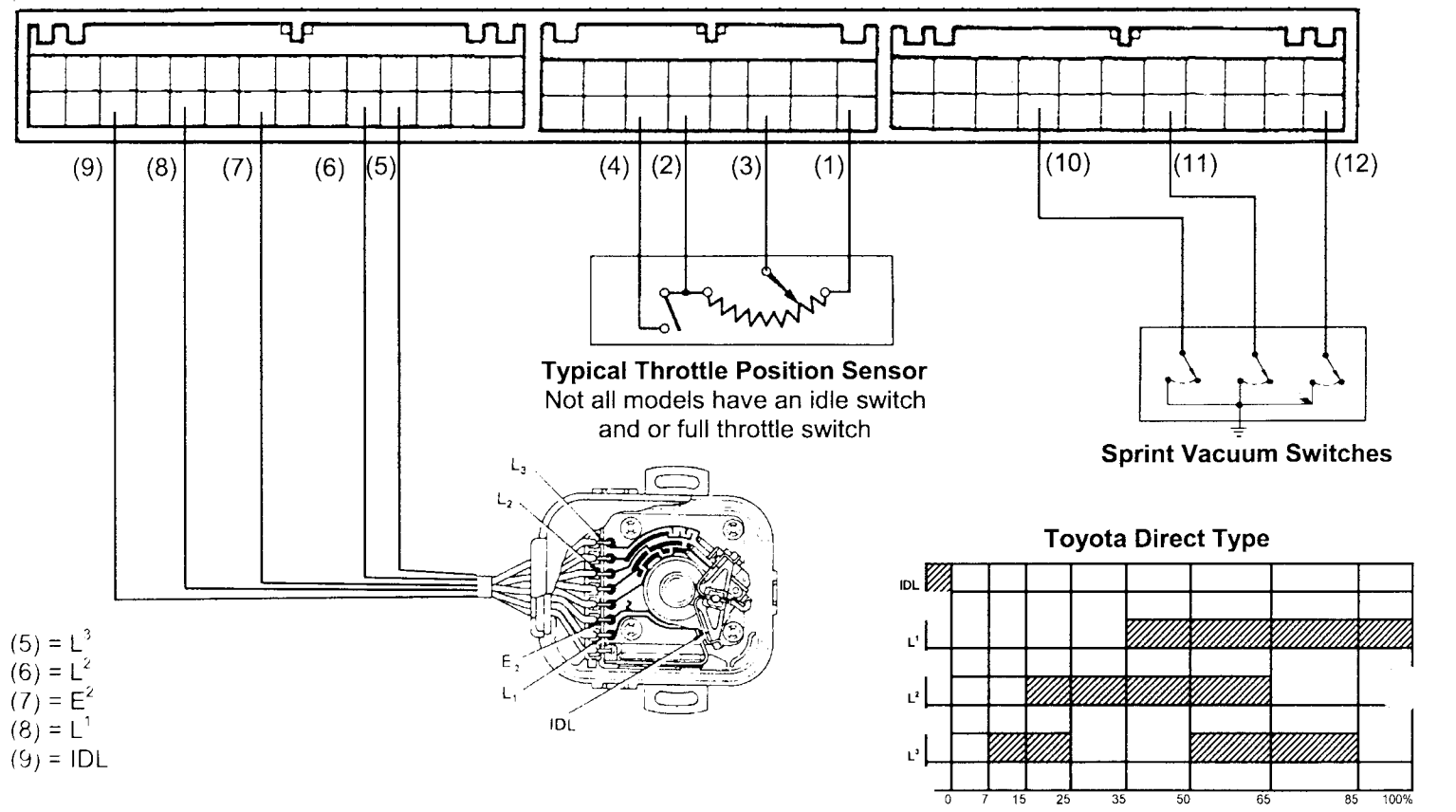


Testing TP Sensors and Switches

The most typical throttle position sensor is a 3 wire variable resistor. Some of these have variations such as an idle contact and/or a full throttle contact incorporated into the switch. The TP sensor still uses a 3 wire variable resistor. The contacts are independent of the 3 wire variable resistor. To test a TP sensor, measure the incoming voltage to the sensor (1) usually 5v. Next, measure the ground voltage (2). Then measure the sweep voltage at (3). Most voltage sweeps are .5v-4.5v. This should be done slowly so a smooth transition can be watched on a DVOM. Most idle contacts and full throttle contacts are open and closed switches. Check for a state of electrical change at (4) when throttle is moved from fully closed to fully open.

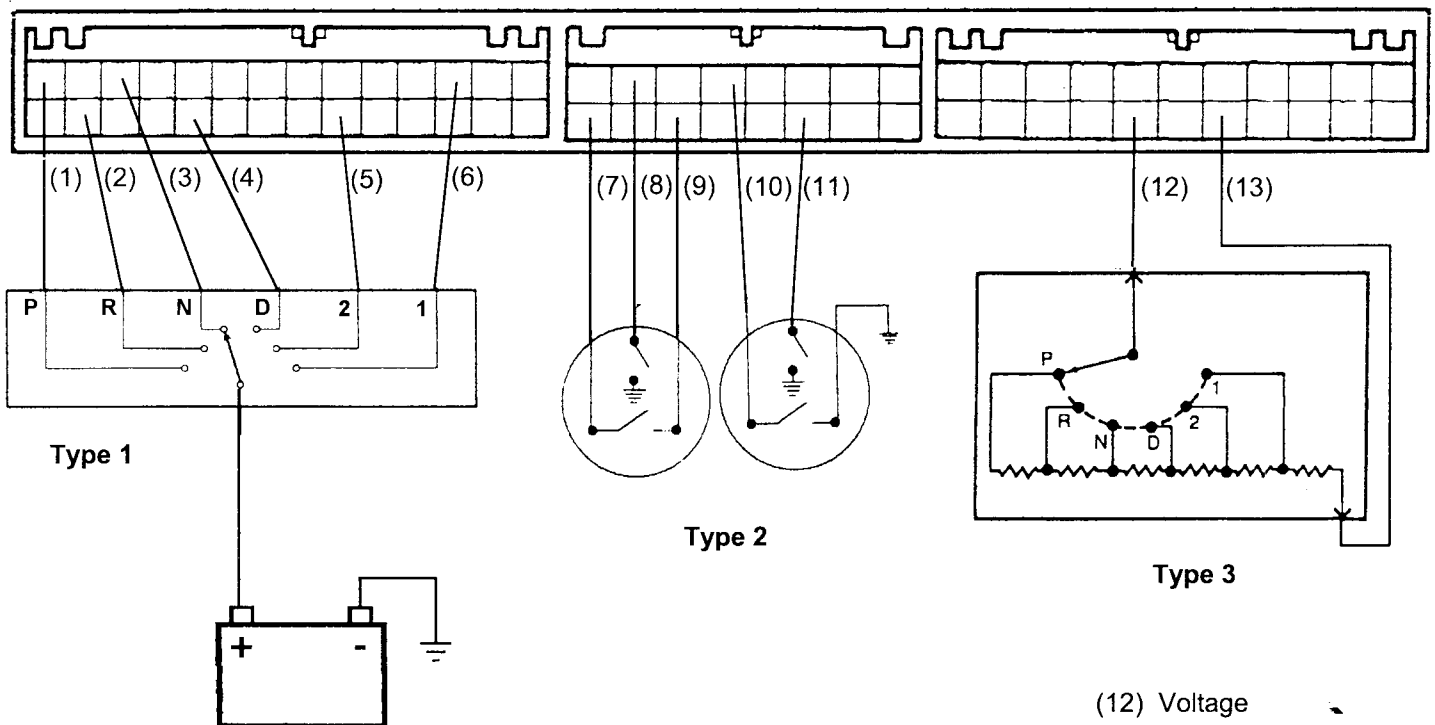
The Toyota direct type TP sensor uses a different approach. It will ground 4-5 different signals at different throttle angles to determine throttle position. Note the chart shows when the circuits are grounded to E2. (7) Example: Idl is grounded only at an Idle. L3 (5) is grounded only from 7% - 25% and 50% - 85%.

The switches that the sprint uses are vacuum sensitive. All three are normally grounded. As vacuum rises they open. The three switches are calibrated to open at different amounts of vacuum. Example: (10) may open at 2-3 inches and (11) may open at 6-7 inches and (12) at 11-12 inches. The computer feeds 12v to the switches. At 0 inches of vacuum the three circuits' voltages would be 0v. As vacuum rises each circuit will show 12v at different stages dependent upon engine vacuum.



Manual Lever Position Sensors

Manual lever position sensors come in a variety of styles. Some use multiple circuits to tell the computer what position the manual lever is in. Some use a single circuit. Some use pressure. Type 1 sensors are normally classified as inhibitor switches. Some of this type may not send all of the inputs to the computer. This is typical of an import. Example: (1) will send battery voltage only in park. (2) will send voltage in reverse. (3) through (6) in their respective positions. Type 2 is a Chrysler type used on both front wheel drives and rear wheel drives. The 604 uses two of these switches. The 42LE and 96 and later 604s use a similar type of signal incorporated into one switch. (7) may send out a voltage signal which will be received at (9) only in reverse and OD. (8) will have voltage in reverse, drive, 2 and L but not P or N. Type 3 is a Ford style manual lever position sensor. This type sends a voltage out on a single circuit (12) through a series of resistors to ground. (13) The computer measures this same circuit (12) for the remaining voltage. What is left over is the lever position. See the chart below.



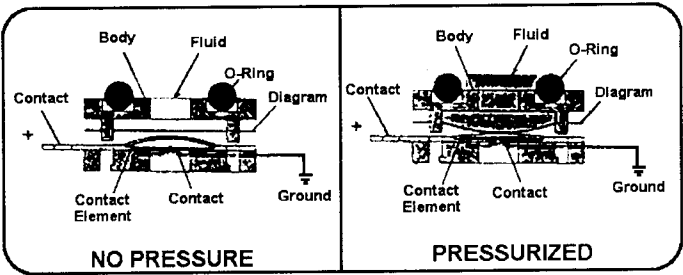
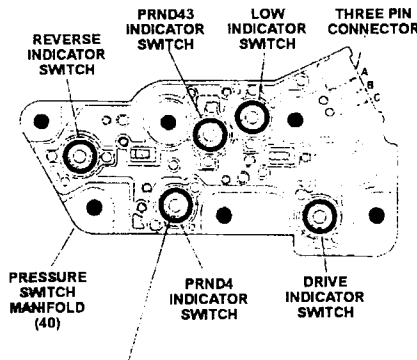
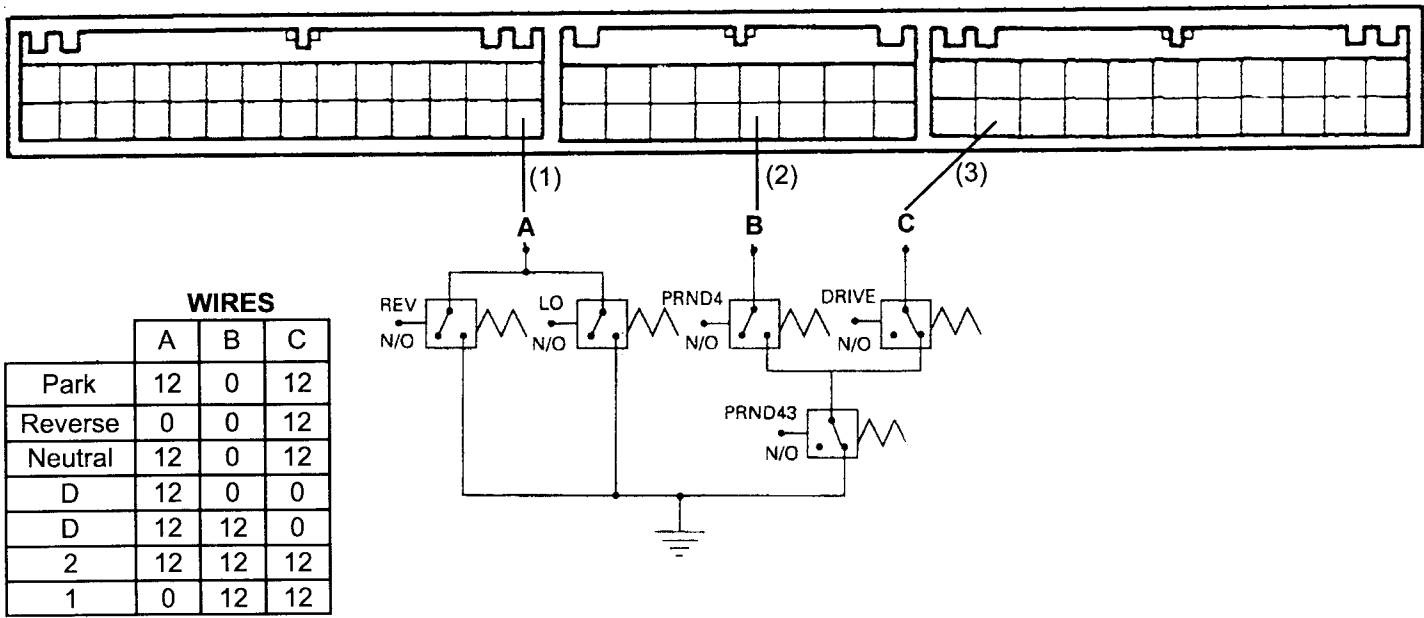
(12) Voltage

P	4.4v
R	3.5v
N	2.8v
D	2.1v
2	1.4v
1	0.7v

4L80E Pressure Switch Manifold

This type of manual lever position sensor uses pressure switches to tell the computer where the manual valve is. These five switches are connected on three circuits. These three circuits (1) (2) (3) will have 12v or 0v left on them depending on the state of the five switches. The example shown is the 4L80E Pressure Switch Manifold (PSM) in the D3 Range.

- (1) Will have 12 volts because the reverse and low switches are open due to no pressure in those circuits.
- (2) Will have 12 volts because the PRND4 pressure switch is open due to no pressure in that circuit.
- (3) Will have 0v because the Drive and PRND43 switches have pressure in those circuits. When the switches are pressurized they will close permitting current flow.



NOTE: The 4L60E pressure switch assembly is similar.

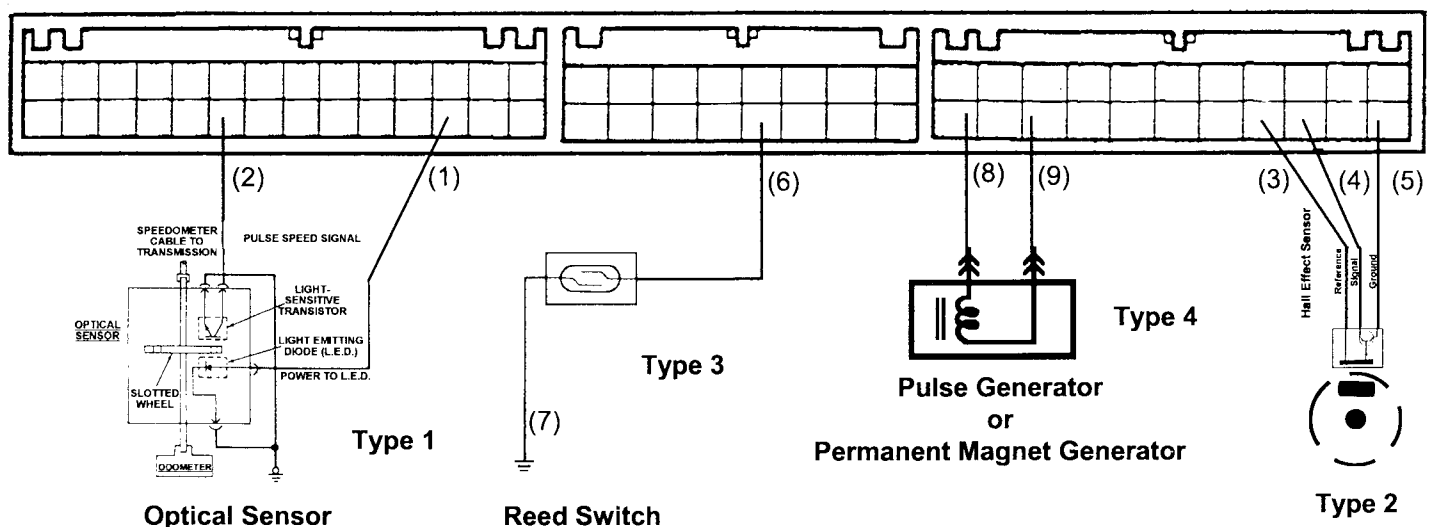
Speed Sensors

Speed sensors come in a variety of styles and are used to sense the speed of a drum, shaft, gear or cable. Type 1 is an optical sensor. The computer sends a voltage (1) to an LED (Light Emitting Diode) which produces a light source. The speedometer cable turns a wheel with slots in it. When the slot lines up with the LED, the light passes through and shines on a light sensitive transistor or photocell. This permits the voltage at (2) to go to ground. When the wheel blocks the LED the photocell turns off and the voltage at (2) remains. The computer would then count the pulses and divide them by how many slots are in the wheel to determine the speed of the wheel.

Type 2 is a hall effect type speed sensor. This type of sensor uses a slotted wheel, a magnet, a semiconductor material and a transistor. As voltage is sent out from the computer (3) (or another source) it passes through the semiconductor material and goes to the base of the transistor which turns the transistor on full pulling the voltage on (4) to ground (5). As the slot in the wheel passes in front of the magnet a magnetic flux interrupts the current flow in the semiconductor and reduces the voltage at the base of the transistor. This raises the voltage at (4). The computer counts the voltage changes and divides it by the number of slots in the wheel to determine the speed of the wheel.

Type 3 is a reed switch. This simple device uses a set of contacts which are brought together when a magnetic field is introduced. A voltage is sent by the computer at (6) and goes to ground (7) when the contacts are closed. The computer counts the voltage pulses and divides by the number of magnets to determine, the speed of the magnets which are usually connected to a shaft.

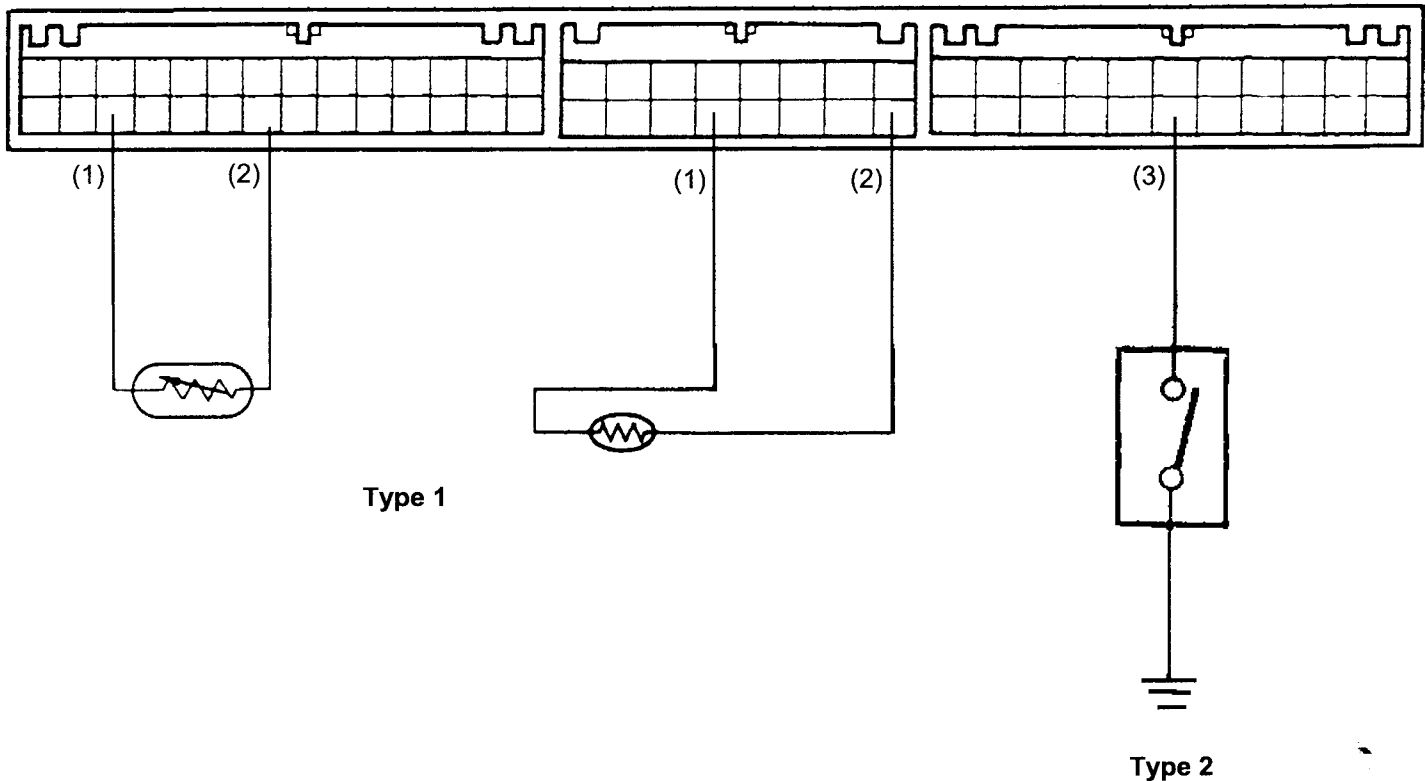
Type 1, 2 and 3 are a digital type sensor which put out a on-off type signal. Type 4 speed sensors are pulse generators. This type will produce an AC voltage. It consists of a permanent magnet wrapped by wire. When a metal that can conduct a magnetic field passes close to the magnet, a magnetic field, builds around the windings. When the metal passes away from the magnet the field collapses and produces an induction in the windings. This induction produces a current. The fluctuation of current building and collapsing produces an AC voltage signal. The computer measures the frequency or number of collapses of the AC voltage at (8) and (9) and determines the speed of the metal which is usually attached to a drum, shaft, cable or gear.



Temperature Sensors

These type of sensors are affected by temperature. Type 1 sensors are thermistors which are a variable resistor which changes resistance with temperature. A voltage is sent by the computer (1) and goes through the resistor to ground at (2). The computer measures the voltage left over at (1) to determine the temperature.

Type 2 sensors are a fixed temperature sensor. This type of sensor will open or close at a predetermined temperature. The computer sends a voltage at (3). Depending on the range of the sensor, the voltage will go to ground or will be ungrounded. The computer monitors the voltage and determines if the switch is open or closed.



Pressure Control Solenoids

Pressure control solenoids are used to regulate pressures inside the transmission. This is done by either varying the current or the pulse width of a signal to a magnet wrapped with wire (a coil) which will manipulate a shaft or plunger. The plunger will react to a pin, ball or valve pushing against the plunger. This type of solenoid is used in domestic transmissions as well as foreign.

Pulse width modulation is a means of controlling the pressure that the solenoid outputs by controlling the duty cycle while maintaining a constant frequency (cycles per second). What this means is the solenoid is turned on and off at a fixed amount of times per second. The ratio of on and off per cycle can change with in each second which is the duty cycle.



Example 1: This represents one cycle. The time frame or frequency is determined by how long it took to complete the cycle. Let's say it took one second. This would represent 1hz (cycles per second) with a duty cycle (ratio) of 50%. Off half the time and on half the time.

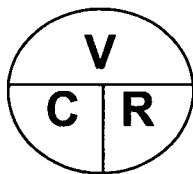


Example 2: This example shows the same second with a duty cycle (ratio) of 50% but the frequency has changed to 2 hz (2 times per second).



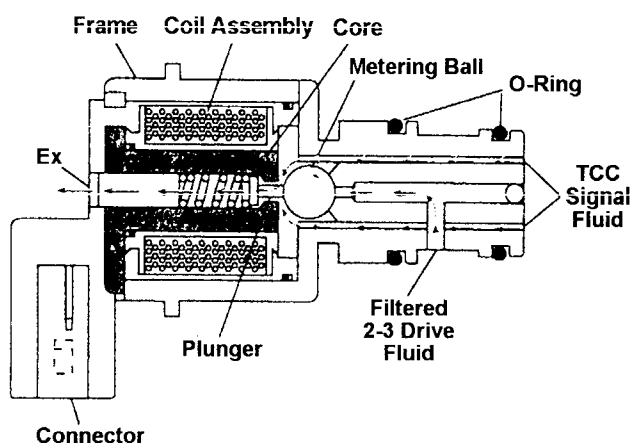
Example 3: This example shows the same 2 hz however the duty cycle has changed. The amount of off time has increased and the amount of on time has decreased. This would be considered a 20% duty cycle. If measuring the signal with a voltmeter. The duty cycle would determine the reading on the voltmeter. At 50% duty cycle the voltage would average to 50% or half of the source voltage. So 12 volts at 50% would show 6 volts. 75% duty cycle would show 9 volts. With the voltage reading changing this would mean that the current would also change. Remember the VCR chart (see below). If one changes so does another. Since the resistance of the solenoid remains the same, the current must change also. If the solenoid resistance is 3 ohms and we feed it 12v then the current would equal 4 amps. If the voltage dropped to 9 volts then the current would drop to 3 amps. A 100% duty cycle would produce 4 amps based on 12 volts. At 75% duty cycle would produce 3 amps based on 12 volts.

Example: 100% of 12 volts = 12 volts ÷ 3 ohms = 4 amps
 75% of 12 volts = 9 volts ÷ 3 ohms = 3 amps

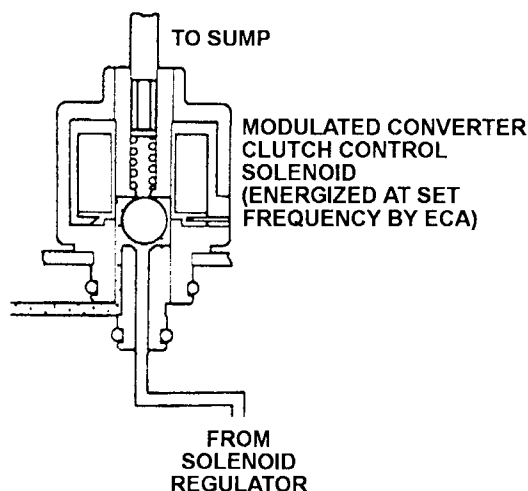


Force Motors and PWM Solenoids

These two types of solenoids are pressure control solenoids. The difference is that a PWM solenoid is usually constructed of a coil, plunger and a ball. The frequency is usually lower than that of a force motor. The 4L80-E PWM solenoid, for example, controls the pressure to the TCC regulator valve and the converter clutch shift valve (once in second gear). This pressure is called Torque Signal. This is done by turning the solenoid on and off 32 times per second (32 Hz). That means the plunger is moving in and out of the coil 32 times per second. When filtered 2-3 drive oil pressure is introduced to the solenoid, the ball blocks the oil from entering the Torque Signal circuit. When the solenoid pulses, the ball allows some of the filtered 2-3 drive oil pressure to enter the torque signal circuit. The idea here is to control the position of the two valves which will determine when lock up will occur and how it will feel. The "when" part is strictly when the solenoid turns on. The "how" depends on the duty cycle of the solenoid. The longer the duty cycle the firmer the apply. This type of solenoid is usually checked with a scanner or a DVOM that reads duty cycle (percentage of on time). It defaults to 0 PSI when off.



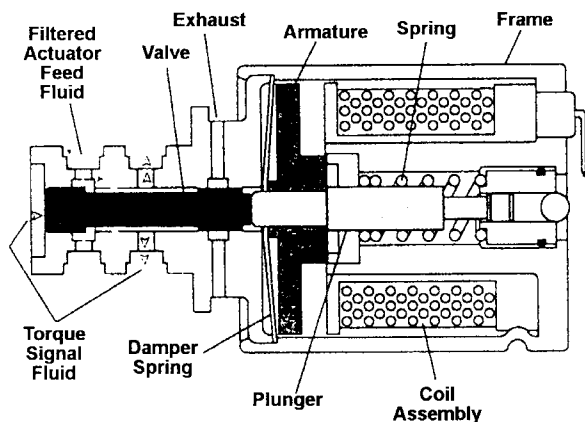
PWM (4L80E)



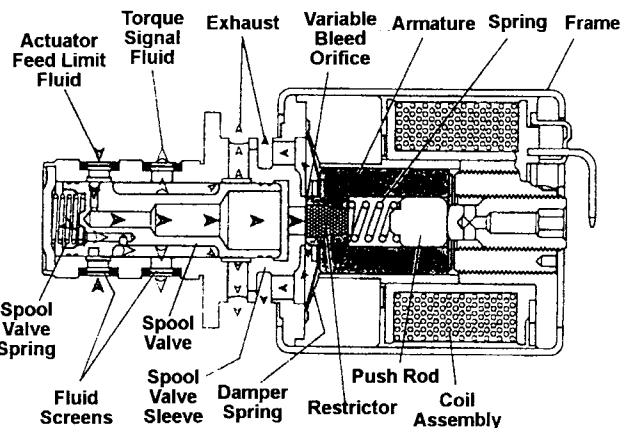
PWM (AXODE)

Force Motors

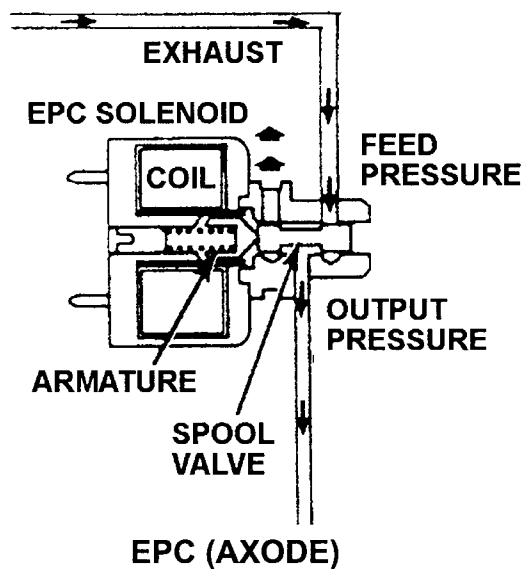
A force motor is usually constructed of a coil, plunger and either a valve or a pin. The force motor is very similar to a vacuum modulator in its operation. As vacuum rises in the modulator the modulator valve pushes against the plunger to lower the modulator pressure (TV pressure). As the current raises in the force motor, the valve pushes against the plunger (or the pin) and lowers the torque signal, EPC or line pressure control. The force motor in the 4L80E runs on a frequency of 295.5 Hz. This provides for a smoother operation of the valve or pin. The valve position in the force motor controls the pressure output of the solenoid. Typically this solenoid is never turned fully on or off. To control this solenoid the duty cycle is changed just like on the PWM solenoid. However the current flow is what is monitored or in some cases the voltage drop across the solenoid terminals.



FORCE MOTOR (4L80E BOSCH)



FORCE MOTOR (4L60E HOLLEY)



EPC (AXODE)

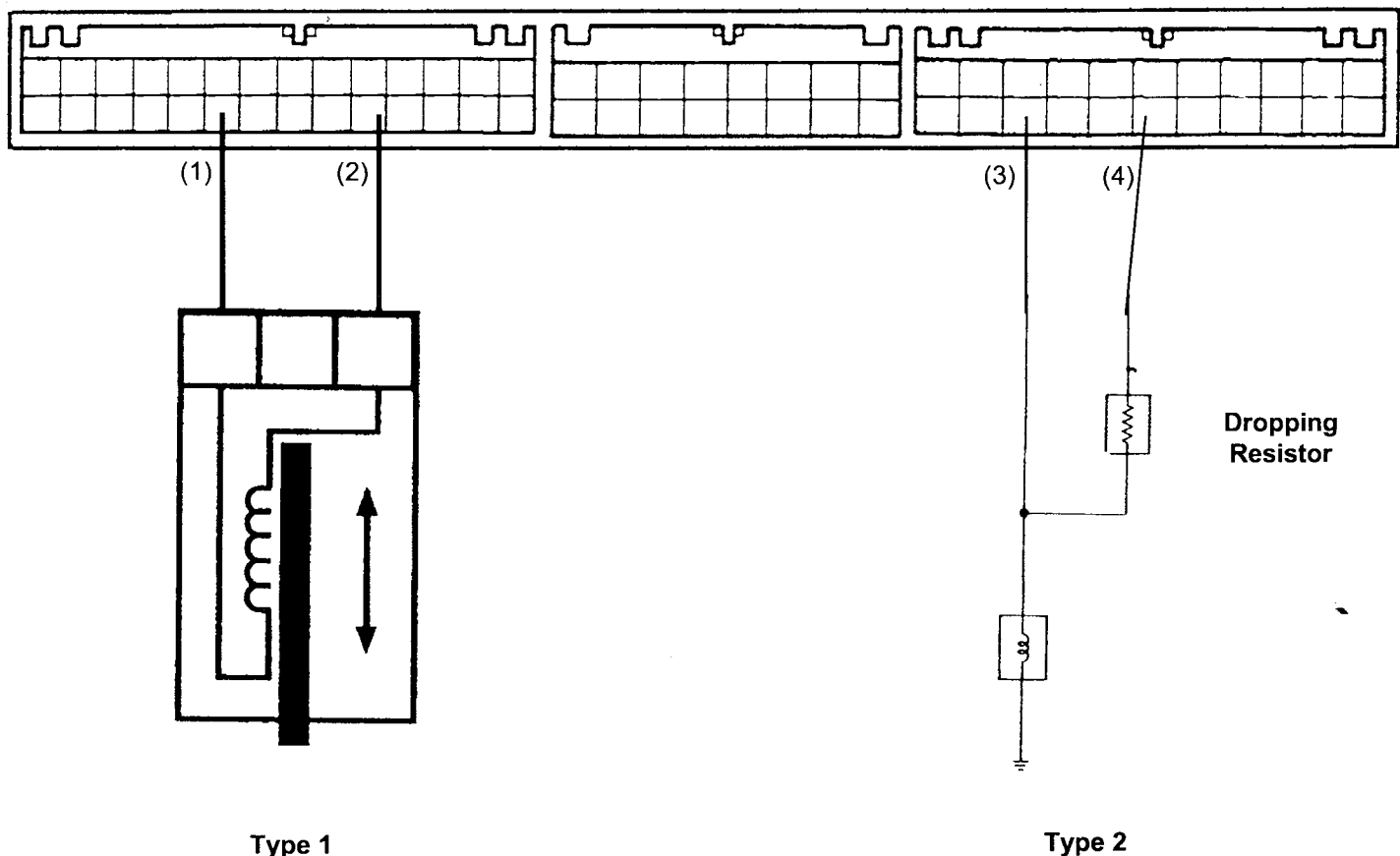
Pressure Control Solenoids

Two ways of controlling these solenoids are ground control and power control. Type 1 solenoids are usually ground controlled. The computer or an ignition source sends a voltage to the solenoid (1) and the computer regulates the ground side (2) to control current flow through the solenoid. Type 2 solenoids are normally grounded or power controlled. The computer regulates the current or voltage at (3) and the current or voltage passes through the solenoid to ground. Some of these solenoids are fed through a dropping resistor on (4), while (3) is still regulated by the computer.

Some transmissions use a similar solenoid to feed the clutches directly. Example: 604 and 42LE. Some manipulate a valve which will send pressure to a clutch. Example: Saturn.

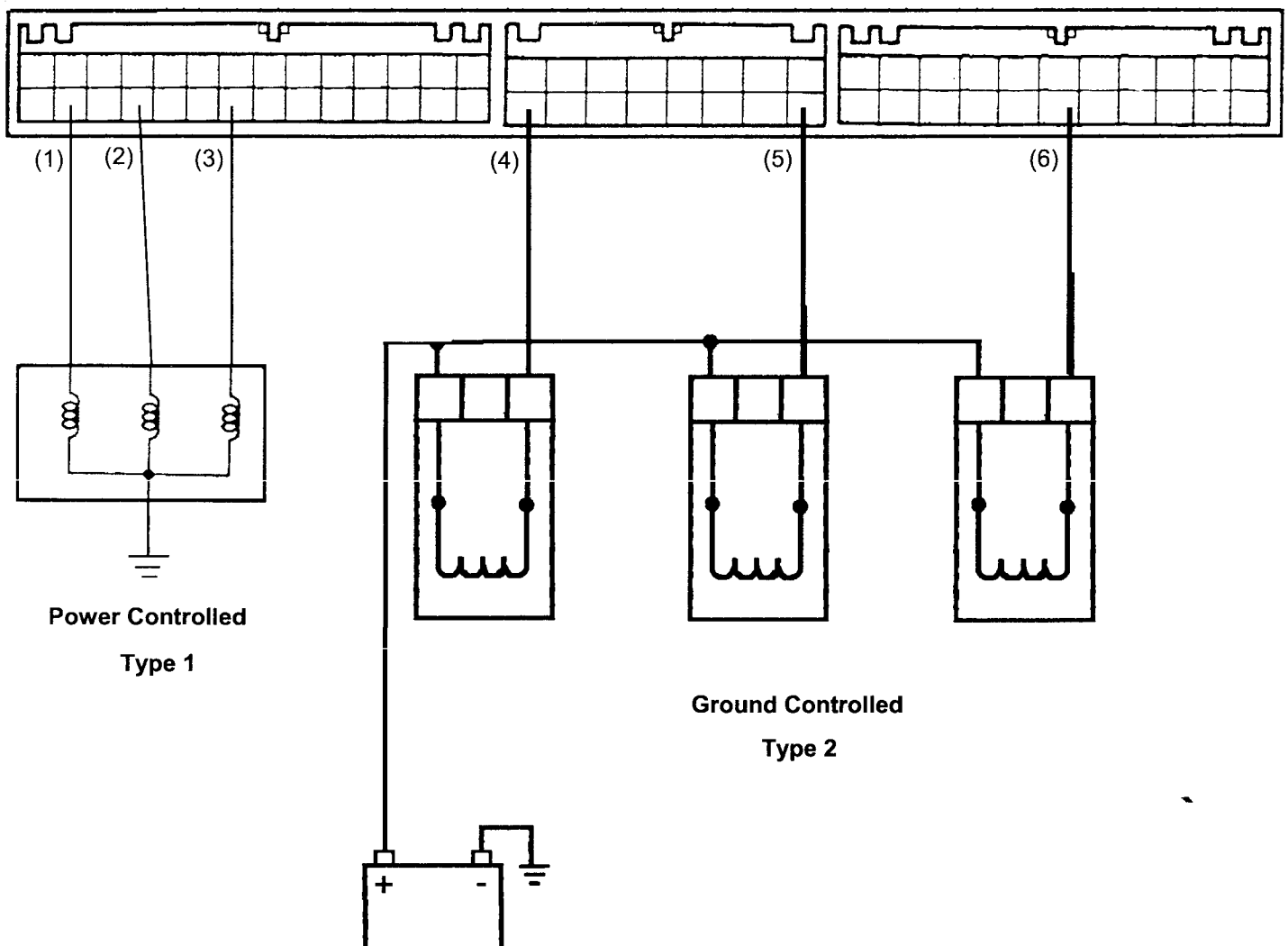
These solenoids can be tested in several ways

1. Measure the voltage drop across the terminals; as voltage goes down, pressure goes up.
2. Measure the current flow in one wire; as current goes down, pressure goes up.
3. A PWM solenoid is usually monitored with a scanner, however a DVOM can verify the signal by watching the duty cycle.



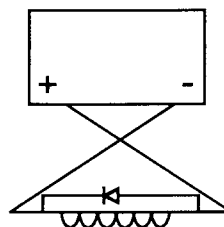
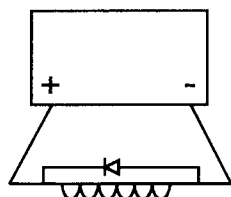
Shift Solenoids

The computer will send a voltage signal to solenoids that are normally grounded such as type 1; (1) (2) and (3). The pattern of on or off solenoids determines the gear ratio of the transmission. A Type 2 solenoid is ground controlled, which usually receives voltage from a battery source such as an ignition switch or relay. The computer will ground (4) (5) and (6) to turn on the solenoids in a pattern which will determine the gear ratio of the transmission. These types of solenoids manipulate shift valves.



How To Test A Solenoid

- Measure the resistance
- Measure the current flow
- Test the mechanical state
- Place the leads of an ohmmeter on the terminals of the solenoid; positive on one side, ground on the other side. If the reading is too high or too low, the solenoid is faulty. Some solenoids have a diode in them. Check them with a diode tester or an analog ohmmeter.



To do this, first connect the leads as in example #1. Then switch the leads as in example #2. Two different readings indicate a good diode. If the readings are the same, the diode is shorted or opened. When checking resistance on a solenoid with a diode, the higher resistance reading is the actual solenoid coil resistance.

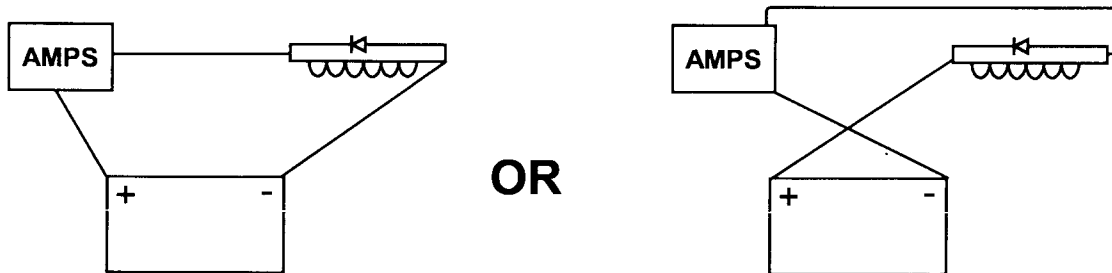
NOTE: To use the diode checking feature of a DVOM, the diode must be remove from the solenoid.

Current Flow

$$\text{Voltage} \div \text{Resistance} = \text{Current Flow}$$

To measure current flow connect an ammeter to one lead of the solenoid. Connect the other lead of the ammeter to the battery. The other lead of the solenoid is connected directly to the battery.

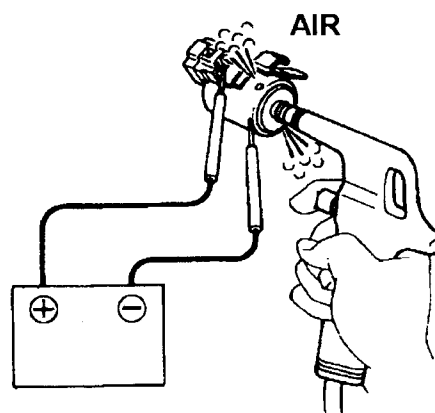
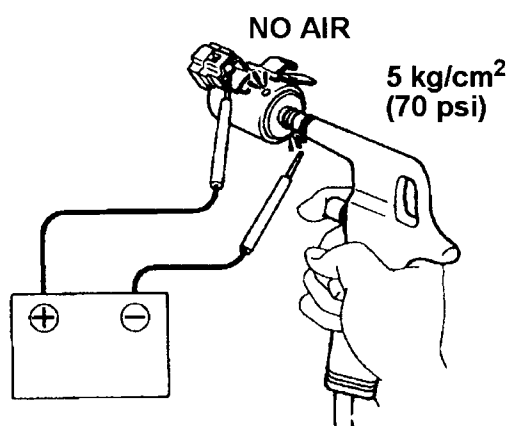
NOTE: Keep the polarity of the solenoid the same. Positive to the positive post and negative to the negative post.



If the current flow is too high the solenoid is shorted and should be replaced.

Mechanical State

The mechanical state of the solenoid can be checked while testing the current flow. When the solenoid is off, is there flow? When the solenoid is on, is there flow?



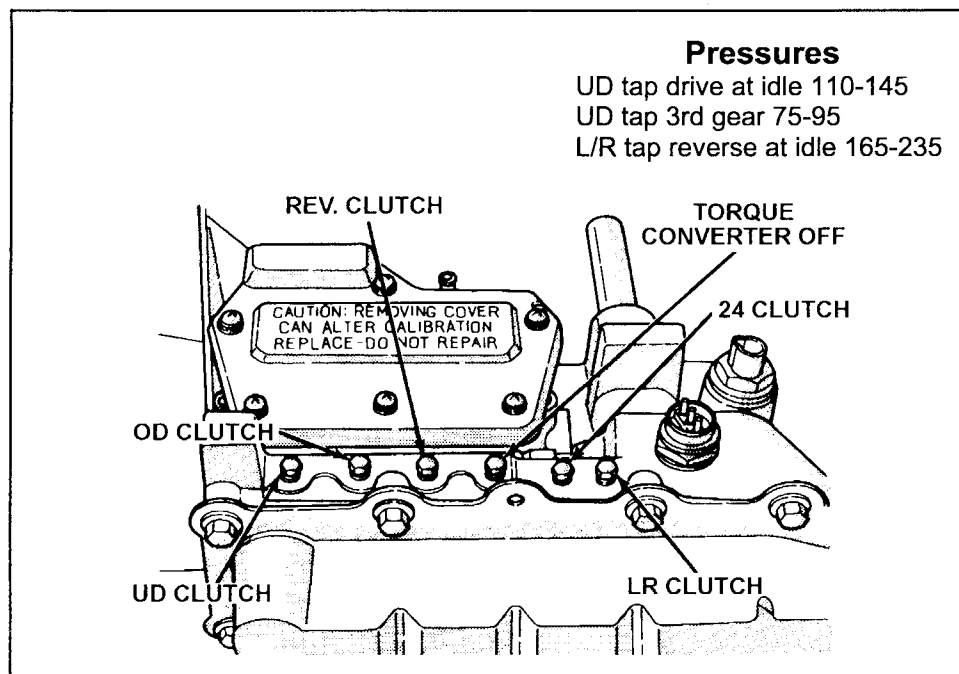
41TE (A604)

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41TE (A604)



4ITE (A604)



Range	Gear	LR/LU Sol	2-4/LR Sol	UD Sol	OD Sol	LR Clutch	2-4 Clutch	OD Clutch	UD Clutch	Rev Clutch
P-N										
R	Reverse									
D	1st									
	2nd									
	3rd									
	4th									

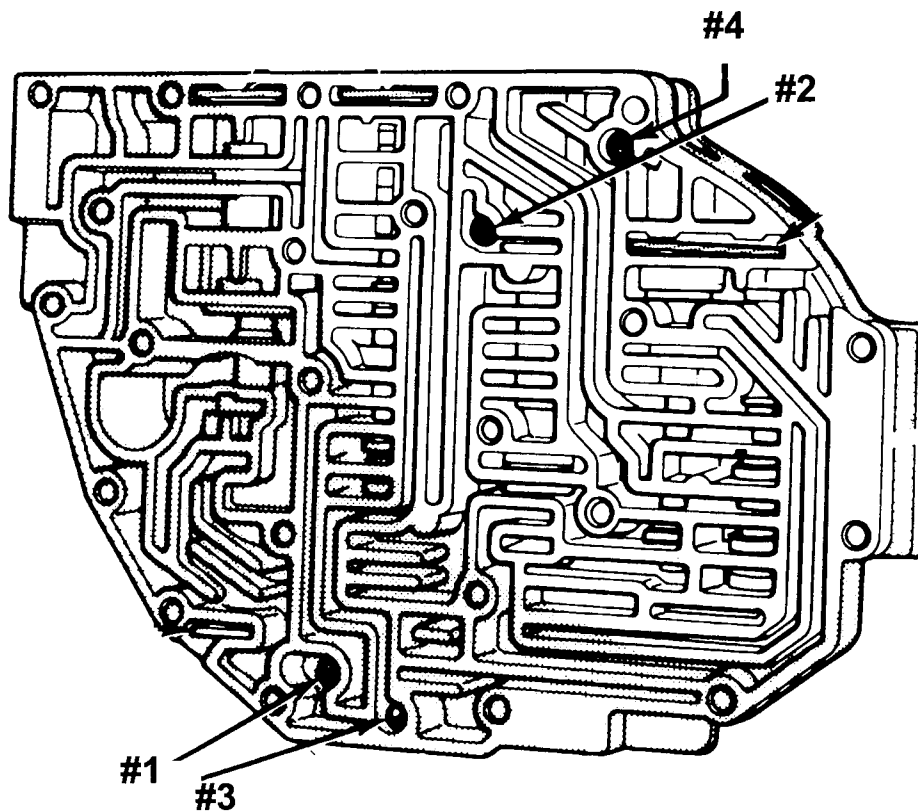
Failsafe Mode

D	2nd
D	2nd
1	2nd

Gear Ratios

1st	2.84
2nd	1.57
3rd	1.00
4th	.69
Reverse	2.21

Checkballs



- #1 LR Shuttle
- #2 UD Feed and Bypass—will not allow UD feed to bypass the UD solenoid. UD oil can bypass the solenoid during the release.
- #3 Keeps line oil out of the L/R circuit in 2nd, 3rd and 4th gear.
- #4 Reverse Clutch Orifice

Transaxle Controllers

Once again, Chrysler's ongoing efforts to keep their products operating as properly as possible have resulted in a new generation of transaxle controllers. The computer programming for the 1995 year model transaxles has corrected some complaints effectively enough that the designers have incorporated these changes into new controllers for all non-'flash programmable' year models and applications that use the 41TE or 42LE. Late model controllers can be re-programmed, or 'flashed' by **Chrysler's DRB diagnostic equipment and software**. This brings these controllers up to date with these latest refinements.

The section 'Identifying Flashable Controllers' later in this article explains how to tell whether you need to replace the controller, or have it re-programmed.

Application Chart

1989-1991	3.0 Engine	4796121
1990-1991	3.3 & 3.8 Engine	4796122
1992	3.0 Engine	4796123
1992	3.3 & 3.8 Engine	4796124
1993-1995	All 42LE	4797708
1993-1995	All 41TE w/ 3.0 and larger engine	4686606
1995	2.5 Engine (Cirrus/Stratus)	4606105

These new controllers correct many different complaints. Driving feel, or 'driveability' characteristics, as well as certain electrical sensing and diagnostic operations have been improved.

Complaints addressed are:

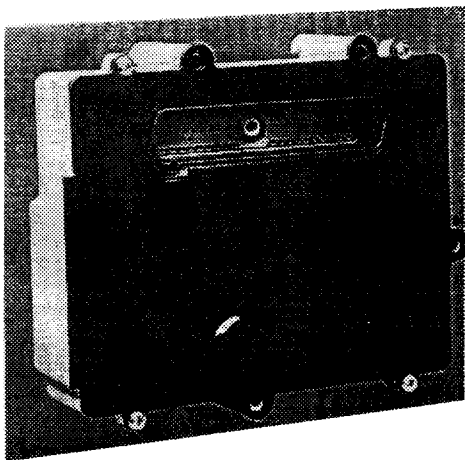
- TCC chatter during EMCC partial lock-up.
- Coastdown tip-in bump.
- Coastdown shift harshness.
- Harsh/delated engagement in some cases.
- Poor shift quality after battery disconnect.
- False solenoid body pressure switch fault codes.

Although there can be many internal causes of these complaints that should be eliminated first, the new controllers can help, if not, correct these problems.

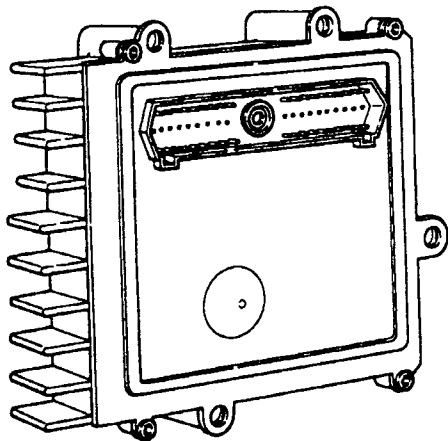
However, **according to the designers of these systems**, all calibrations used in these controllers still rely on the exclusive use of Mopar (Chrysler Parts) Type 7176 ATF.

Identifying Flashable Controllers

Any EATX controller that does not have cooling fins on the outside of the casing is not 'flash programmable'. Earlier controllers with cooling fins can also be 'non-flashable'. Check the part number list below to find out if your controller is 'un-flashable'. These controllers, and all controllers without cooling fins must be replaced to implement the updated programming.



Early—No Fins



Late—Has Fins

Non- Flashable TCM s with Cooling Fins

- 4686174
- 4686175
- 4686208
- 4686209
- 4686223
- 4686224
- 4686490
- 4686491

Controllers Requiring Modification

Certain models of the new generation of controllers will not be compatible with the older vehicle operations in one area. They will have a problem with unintentional shifting from fourth to third gear, or third to fourth gear (at fourth gear speeds) whenever the brake pedal is pushed. The part number of these controllers are:

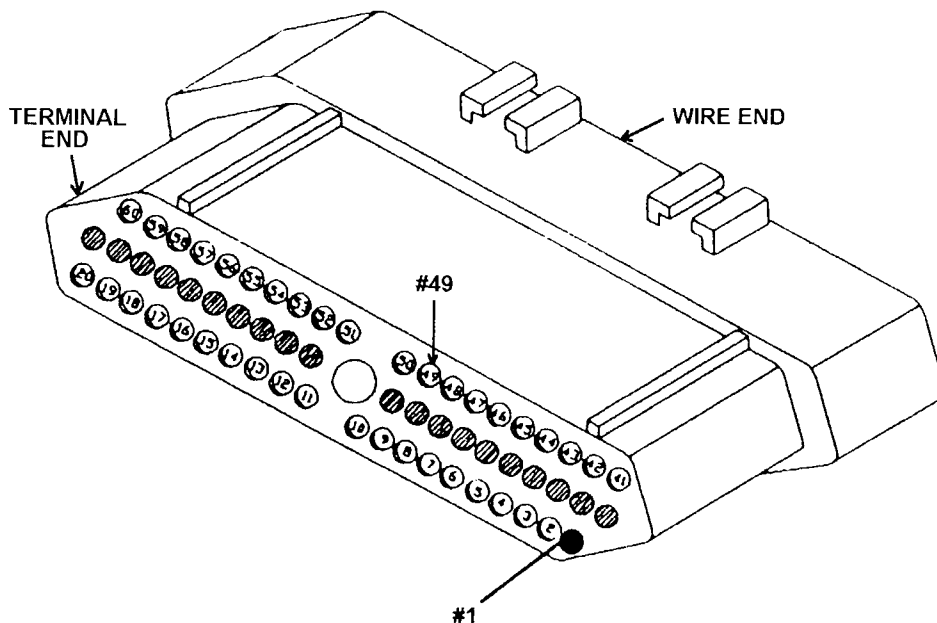
4796121

4796122

4796123

4796124

The modification to correct this problem is quite simple. Locate the wire at Pin #49 on the TCM harness connector. If there is no wire at this location, no modification is required. If there is a wire, cut the wire approx. 3" from the TCM connector. Fold 1" of each wire end back on itself. Slide a 2" piece of shrink tubing over each of the folded ends and shrink the tubing to seal the wire ends. The new TCM will now work properly.



Optional Modification on Vehicles with a Wire at Pin Number 49

This modification has NOT been approved by Chrysler.

(But it works pretty cool anyway.)

For New Generation controllers on pre-1993 vehicles.

The previous page covers a modification to prevent unintentional 3-4 and 4-3 shifts when you step on the brake pedal. The brake switch sends a 12 volt signal to Pin #49 of the TCM to cause this. While this can be very unnerving when stepping on the brake pedal, and the previous procedure corrects this, you might offer your customer an option of being able to lock out fourth gear at highway speeds (such as driving through the hills) without having to tolerate the late 2-3/3-2 shift pattern of the regular 'D' shifter position.

You need to mount a MOMENTARY connecting, not grounding, switch in the instrument panel, or somewhere approved by the customer. Run a 5 amp fused wire from a 12 volt circuit to one side of the switch. Run another wire from the other side of the switch to TCM Pin #49. Modification is complete.

Now, when you are in the 'O/D' shifter position, in fourth gear, if you hit the new switch the unit will shift to third and stay there as long as you don't downshift or come to a stop. If you want fourth gear back, (and you're still going fast enough) just hit the switch again.

Electronic Pinion Factor

Starting in 1993, Chrysler consolidated vehicle speed sensing systems in their vehicles. Prior to 1993, a pulse generator style speed sensor in the transaxle extension housing provided a speed signal to tell everything EXCEPT the transmission controller how fast the vehicle is going. The transmission controller used the output speed sensor on the side of the transmission for vehicle speed input.

Deciding that this was redundant, Chrysler reconfigured the system so that the transmission output speed sensor would be the one speed sensor signal for all vehicle systems (Except ABS).

One challenge was to make a small number of transmission controller models fit a large number of different applications. Different gear ratios and tire sizes required flexibility in this area. To accommodate these differences, the transaxle controller is programmed to condition the output speed sensor signal by multiplying it by a variable 'pinion factor' number, as well as a tire size value. The TCM converts output speed sensor values to equal 8000 pulses per mile and sends this conditioned signal to the PCM. This variable pinion factor and tire size is entered into TCM memory by the Chrysler DRB series diagnostic equipment whenever a controller is first installed into a vehicle. Setting the pinion factor and tire size factor calibrates the controller for that particular vehicle. This way, one particular controller part number can fit many different vehicle applications.

If this programming is not performed when a new controller is installed, there will be no vehicle speed signal, therefore no speedometer reading.

Calibration and inaccuracy problems can occur if a controller, programmed for one vehicle, is put into another. If the transfer gears, ring/pinion ratio, or tire size are not identical, you can count on an inaccurate speedometer reading. If you suspect a problem with the accuracy of the speedometer, but you don't have access to a Chrysler DRB II or III scanning tool, there is a way for you to check the accuracy of the vehicle speed signal the TCM is sending the PCM.

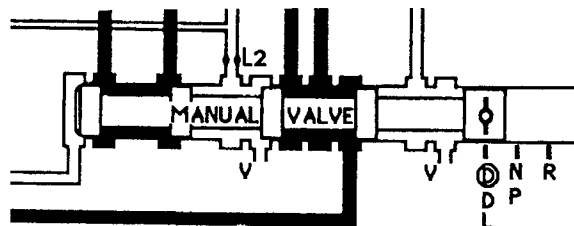
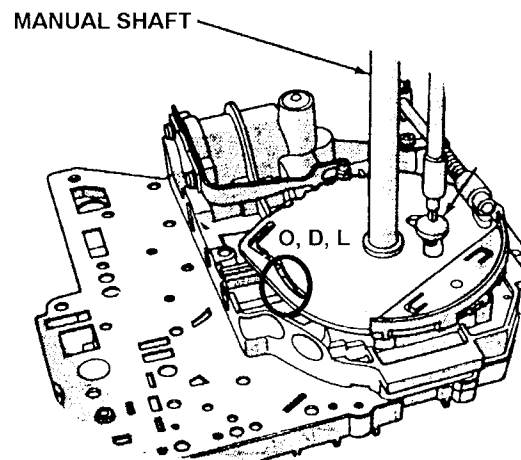
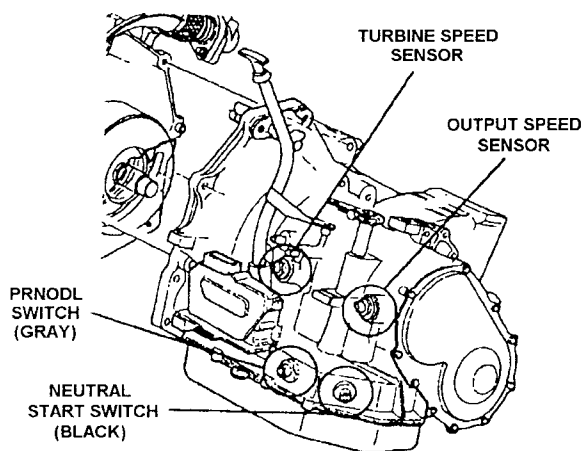
You will need a stop watch, a DVOM capable of reading frequency (hz) and a nearby stretch of highway that has little signs marking off each mile.

On the vehicle with the suspected wrong speedo reading, connect your DVOM positive lead to either TCM pin #58 or PCM pin #47 and ground the other lead. Use jumper wires if necessary so you can drive the vehicle while your passenger watches the meter. Using mile markers on the highway and your stop watch, go an exact indicated 60 mph as shown on your speedometer. At correctly calibrated speeds will have you passing a mile marker at exactly 60 second intervals. If it takes more than a couple of seconds shorter or longer than a minute to go from marker to marker, there is an accuracy problem. Find out what indicated speed you need to achieve to pass a marker every 60 seconds. This is true 60 mph. Take note of your meter's frequency readings at both indicated and true 60 MPH.

On a properly calibrated system, you should show a reading of 133 hertz at exactly 60 MPH. If you have an accuracy problem, and your meter shows 133 hertz at the indicated speed of 60 MPH, then the TCM is programmed with the wrong Pinion Factor, or tire size, or both. If your meter shows 133 hertz at the true speed of 60 MPH, then the TCM is sending out the correct signals to the PCM. The problem is not the TCM's pinion factor or tire size programming.

Neutral Safety/PRNODL Switch Check

Information from these two switches is one of the most important inputs to the EATX controller. The combined status of both switches provides the only way for the controller to know which forward gear the driver has selected.



Neutral Safety/PRNODL Switch Check (cont'd)

Keep in mind that a malfunction of these switches can cause problems, even if that malfunction is for a **very short time**. Possibly too short for you or your monitoring method to detect.

If you suspect a possible switch malfunction, it is far more practical from a diagnostic standpoint to install **two new switches** and retest for the malfunction.

During any testing with the shift linkage disconnected, keep in mind the *seventh shifter position*, past Manual Low, used to retain the park rod during valve body service. Do not inadvertently consider this to be the Low position. The chart below shows this as the (I)nstall position.

(For bench testing, Park is full CCW of shift lever.)

Neutral Safety Switch (furthest from sol. body)

Shifter Position	P	R	N	O	D	L	I
NS1-Center pin/Ground	C	O	C	O	O	O	O
RL1-Outer/Outer pins	O	C	O	C	O	O	O

P-R-N-O-D-L Switch (closer to sol. body)

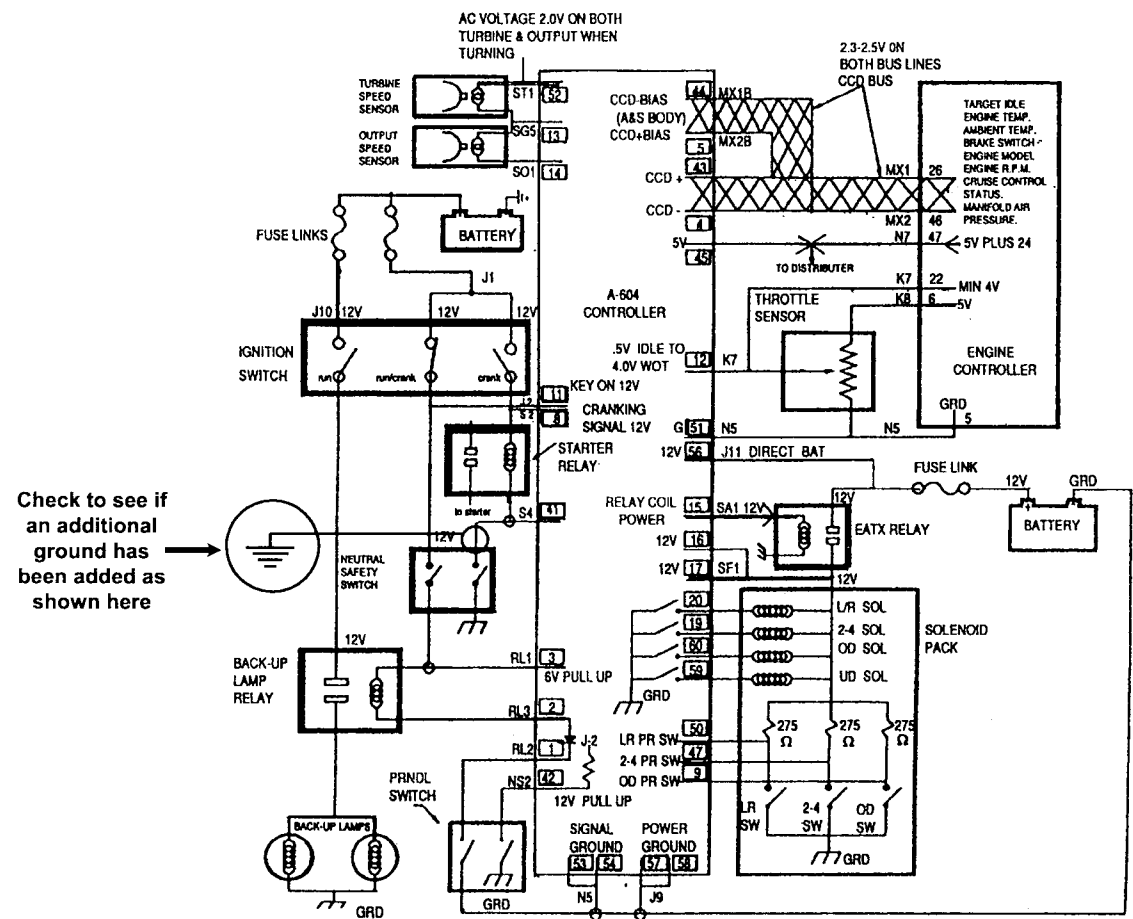
Shifter Position	P	R	N	O	D	L	I
NS2-Center pin/Ground	C	O	O	O	O	C	O
RL2-Outer/Outer pins	O	C	C	O	C	O	C

Don't forget position I, the VB installation position.

Neutral Safety Switch

When a malfunction of the NSS keeps the starter from operating, some technicians have been known to add a ground to the starter relay terminal to allow starting in any gear. While this will allow the engine to be started, it also sends erroneous information to the 41TE controller regarding shifter position information, causing a shift pattern malfunction in the forward ranges as a result of the NS1 circuit having a full time ground to TCM pin 41.

To test for this condition, check to see if the starter operates in all gear positions. If so, the starter relay has a full-time ground hooked up to it. Correct the problem with the NSS circuit, then disconnect this ground.

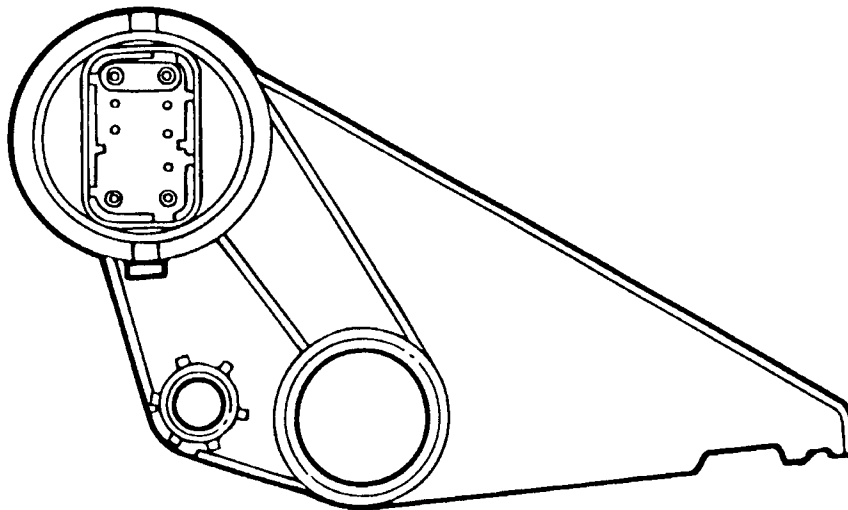


Transmission Range Sensor

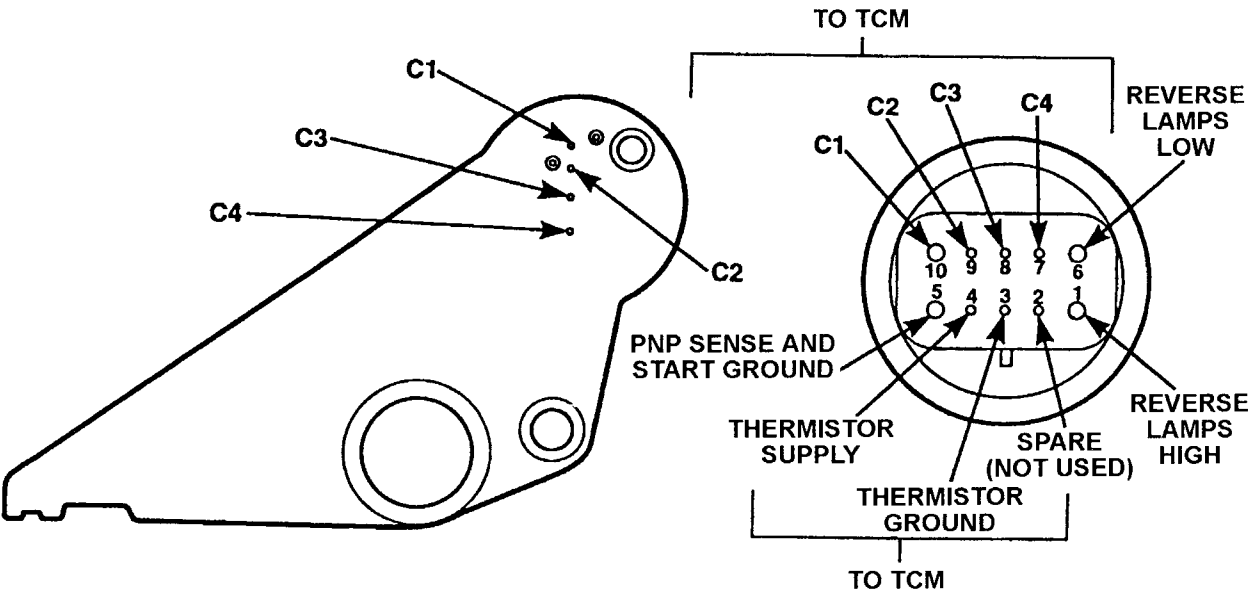
For the 97 model year, the transmission range sensor is located on top of the valve body. This sensor replaces the PRNODL position switch and the Neutral Safety Switch on 41TE/AE vehicles prior to the 96 model year. This sensor allows for accurate transaxle gear position measurement. This sensor is similar to the MVLPS that is currently on the 42LE transaxle.

Located within the sensor is a separate transmission temperature sensor. This sensor measures the transmission fluid sump temperature. The transmission temperature sensor is serviced with the transmission range sensor as a unit.

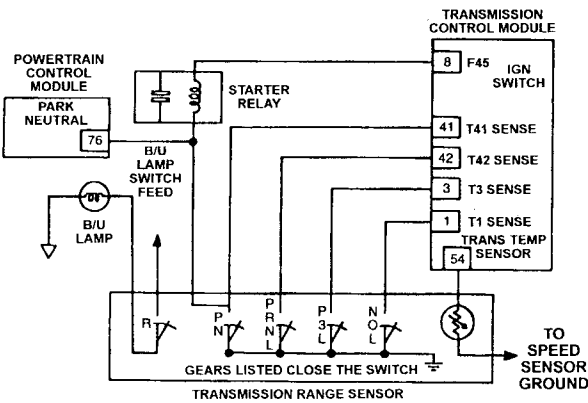
The transmission range sensor (on the valve body) sends signals to the TCM of the position of the transaxle manual valve lever. The TCM receives the switch signal and processes the data. The TCM sends the Shift Lever Position (SLP) information to the Body Control Module (BCM) and the Cluster electronic PRNDL display via the CCD bus. The Cluster electronic PRNDL display illuminates the appropriate shifter position indicator on the instrument cluster.



Transmission Range Sensor (cont'd)



PIN	CIRCUIT	OPERATION
10	T41 (C1 Sw.)	Grounded in P, N
9	T42 (C2 Sw.)	Grounded in P, R, N, L
8	T3 (C3 Sw.)	Grounded in P, 3, L
7	T1 (C4 Sw.)	Grounded in N, OD, L
6	L1 (Reverse Lamp Low)	Power Out to Back-Up Lamps
5	T41	PNP Sensor (To PCM) Starter Relay Coil Ground
4	T54	Thermister Supply (Temp. Sensor Signal)
3	T13	Thermistor (Temp. Sensor) Ground
2	Not Used	
1	F20 (Reverse Lamp High)	Fused Ignition Switch Output (Run)

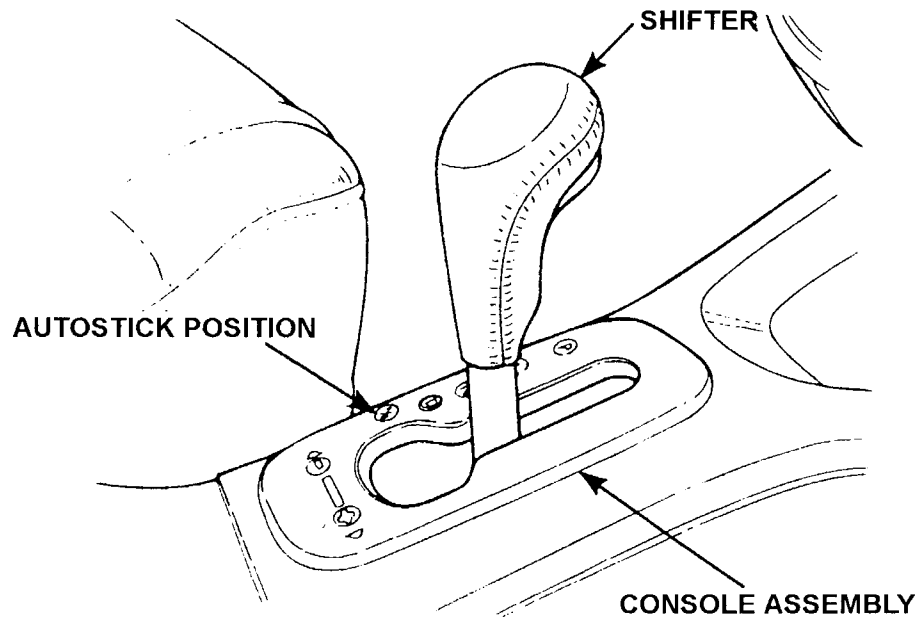


Autostick Operation

(Stratus)

Autostick is a driver-interactive automatic transaxle feature that offers manual gear shifting capability providing the driver more control.

The Autostick feature may be used for everyday driving and for special situations depending on driver preference. It offers the opportunity to maximize engine braking, eliminate undesirable upshifts and downshifts, and improve overall performance. Autostick can also provide more vehicle control during passing, city driving, slippery conditions, grades, trailer towing, and many other situations.



The Autostick position is located below the overdrive position and is identified by the A/S + or - symbol. When the shift lever is placed in the A/S position, it can be moved laterally. Pulling the lever toward the driver (-) triggers a downshift and pushing the lever toward the passenger (+) triggers an upshift. This allows for almost total control over desired gear engagement.

Drivers can shift into or out of Autostick mode at any time without lifting their foot off the accelerator. When the OD (overdrive) mode is selected, the transaxle operates automatically, shifting between the four available gears. When Autostick is desired, the driver simply moves the shift lever from overdrive to A/S. The transaxle remains in the current gear until the driver selects an upshift or downshift or a safety override is necessary. When shifting from Autostick to overdrive, the driver moves the shift lever forward into overdrive. The transaxle immediately begins shifting automatically.

When in Autostick mode, the selected gear 1, 2, 3 and 4 is displayed on the instrument cluster to inform the driver which transaxle gear is currently engaged.

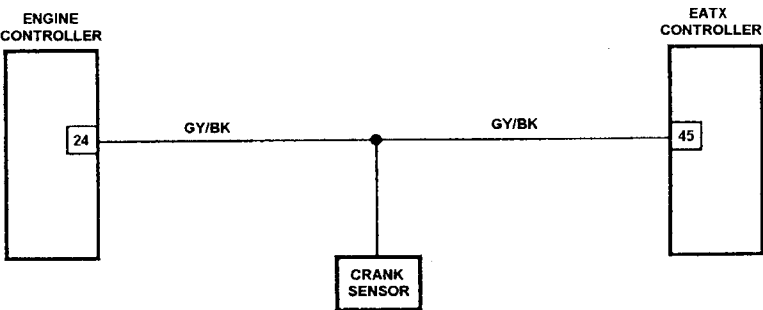
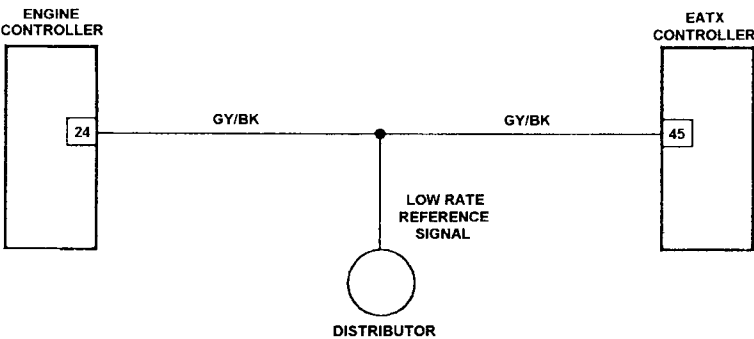
4ITE (A604) Controllers

Engine Speed Sensing Problems

Between 1989 and 1992 there are different transaxle controller engine groups listed. A 3.0 liter engine group and a 3.3/3.8 liter engine group. Although the operating strategy and programming of the controllers does not differ between these two engine groups, there is one big difference between these two engine classifications. The difference is in the way that the transaxle controller reads engine RPM.

All versions of A604 controllers get two types of engine RPM signal. The controller gets a direct RPM signal from the engine, and gets a second RPM signal from across the CCD data bus. This way the controller can tell the difference between a stalled engine and an engine RPM sensor failure. If the direct signal quits, but the CCD bus signal doesn't, the controller knows that the direct signal is bad, and sets trouble code 18. If both signals show zero, this means that either the engine died, or the direct signal AND the CCD bus have failed, the former being much more likely.

The big difference between the 3.0 transaxle controller and the 3.3/3.8 controller is the type of direct engine RPM signal the controller receives. The 3.0 engine transaxle controller gets a low rate distributor reference signal directly from the distributor. However, the 3.3 and 3.8 engines have no distributor. Engine speed is read directly from a crankshaft position sensor.



Engine Speed Sensing Problems (cont'd)

These two types of signal are quite different, and the transaxle controllers are programmed to understand either one or the other, but not both. If a crank sensor type controller gets installed in a distributor signal car, or vice-versa, the engine RPM data received won't make any sense to the controller. The unit will immediately go into failsafe, or 'Limp-In' mode.

Your scanner will show you obviously wrong engine speed readings when you check for trouble codes. It may show around 400 RPM even when you wind up the engine, or it may show 9600 RPM at any speed, even at idle. This will usually NOT set trouble code 18, which is the code for an engine speed signal problem. Direct engine speed signals need to be almost zero for this code to set.

If you need to order a new controller, compare the service part number listed in the 'New Controllers' section of this book with the vehicle year and engine size you are working on to be sure you have a matched set.

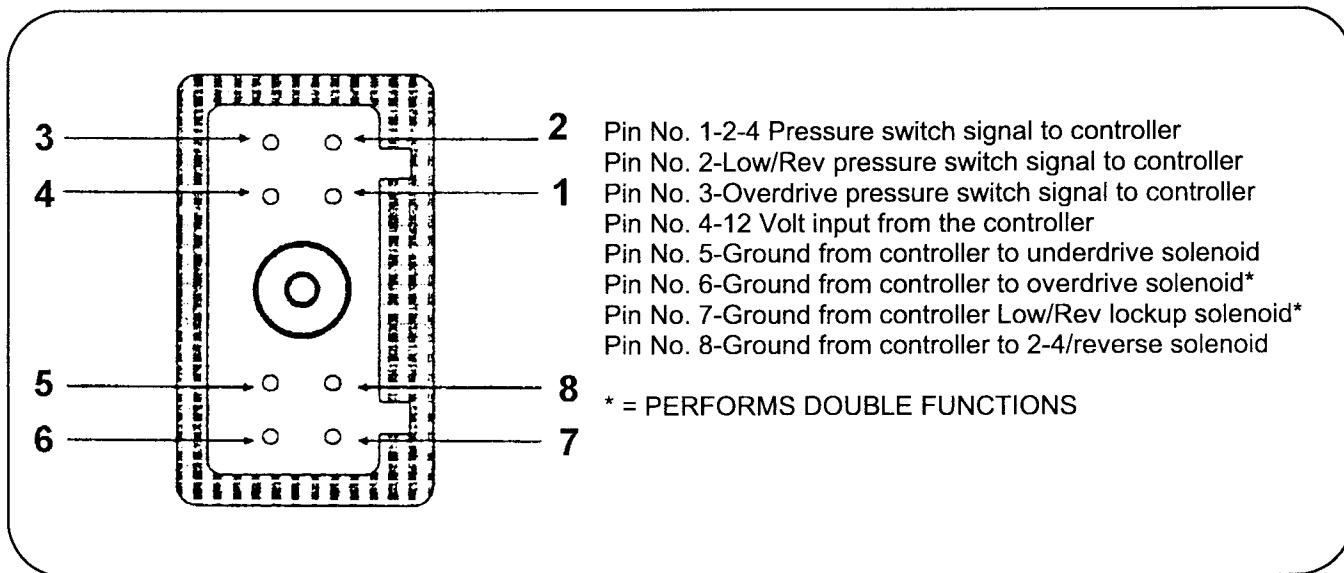
If a new computer you just installed gives you bogus engine RPM readings, or goes to immediate failsafe, double-check the part number of the controller you've got with the engine size it's supposed to fit. You may have the right year, but the wrong engine size group.

Solenoid Body Electrical Check

All solenoid body electrical functions can be checked in two stages.

The first check determines if the solenoids have a good circuit through the solenoid body to the proper ground paths.

The second check determines whether the solenoids have any improper ground paths, as well as checking pressure switch function and resistor integrity.



Solenoid Body Connector

Check 1: Connect one lead from your ohmmeter to solenoid body pin #4. Connect the other ohmmeter lead to pins 5, 6, 7 & 8 one at a time. If all readings show 3.0 to 3.1 ohms, the solenoids have good circuits through the solenoid body.

Check 2: Connect one lead from your ohmmeter to the aluminum body of the solenoid body. Connect the other ohmmeter lead to solenoid body pins 5, 6, 7 & 8 one at a time. You should have no connection, or 'Out Of Limits' on all four pins.

- A. If you show a connection on any pin less than 300 ohms, you have a short to ground in a solenoid circuit. Replace the solenoid body.
- B. If you show a connection on all pins between 300 and 325 ohms, you have a closed pressure switch circuit. Either replace the solenoid body, or disassemble and inspect it following the 'Solenoid Body Service' section of this program.

Solenoid Body Electrical Check (cont'd)

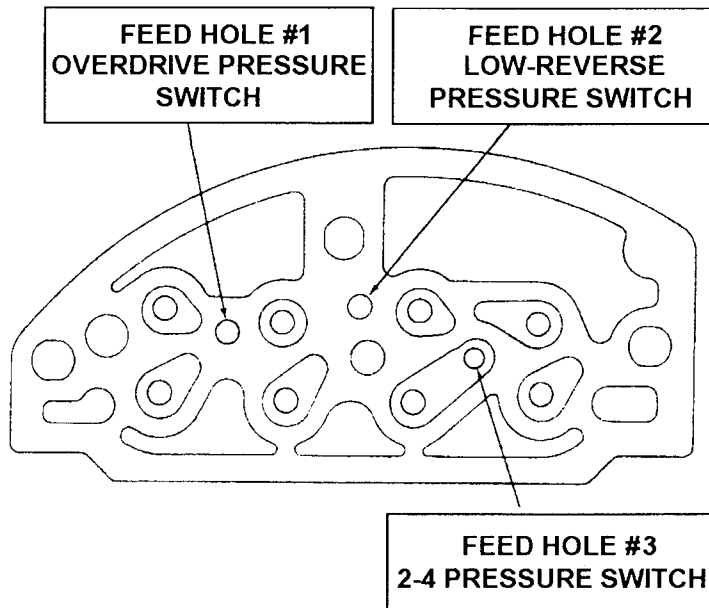
If all pins show no connection, leave your ohmmeter hooked up for the last pin check (one lead to ground, one lead to pin 8), and apply air pressure to the solenoid body ports shown in Figure 1 in the following manner:

Apply 60 psi air pressure to make sure that the pressure switches can close under minimal pressure conditions.

Apply 150 psi or more (up to 250 psi) to make sure that the circuits can handle the high pressures sometimes sent to the switches.

These pressures, when applied to each of the switch passages, should cause your ohmmeter to read between 300 and 325 ohms. As pressure is released, the ohmmeter reading must immediately change back to an open circuit. If your solenoid body shows you any readings other than those outlined here, either replace the body, or inspect it according to the 'Solenoid Body Service' section.

View of the Bottom of the Solenoid Assembly



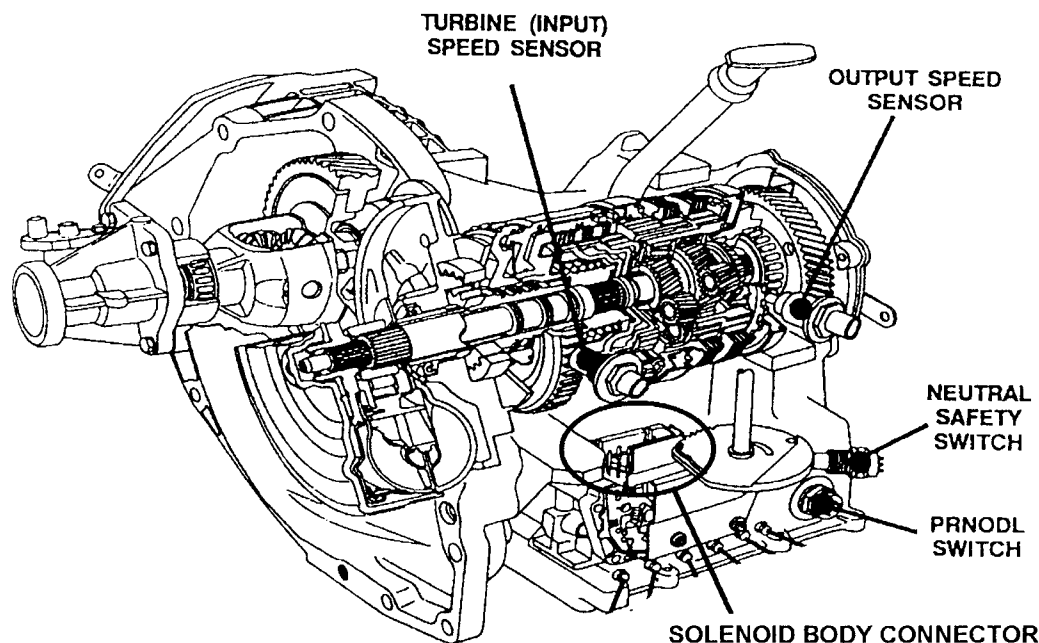
Harness Connection Repairs

Pin-to-pin connections can be a problem for the 41TE and 42LE unit control systems. Age, corrosive environments and repeated disconnecting and reconnecting can take their toll on the pin's ability to carry the proper amount of current and voltage.

These connections, due to the very high precision of the control systems, need to be in perfect working order or else some very difficult to diagnose problems will develop.

To help you meet this demand, Chrysler has provided repair kits for the harness connections that can cause trouble.

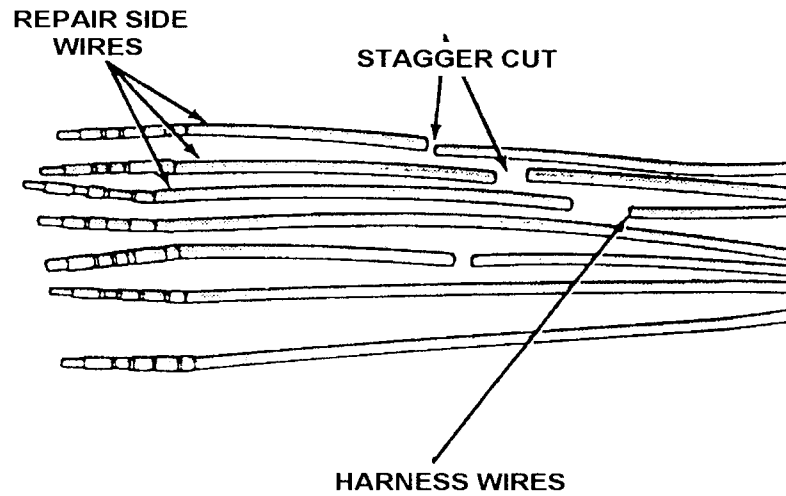
Speed sensor connector repair kits come under #4419478.



PRNODL and NSS switch connector kits come under #4638996. Keep in mind that this kit fits the late 'weather-proof' type connection. If your switches use the old exposed three pin hook-up, you will be needing new switches as well.

Solenoid body connector repair kits come under #4419476.

Harness Connection Repairs (cont'd)



TCM 60 pin connector repair kits come under #4419479. This kit comes with wires that have pins at both ends. Each of these wires are actually two repair wire ends. Cut them in half, and match up colors as best as you can. The plastic connector parts are not included in this kit.

Clutch/TCC Chatter Problems

Chatter problems during shifts and during TCC operation seem to be pretty easy to create during a rebuild. Here are some things you can do during a rebuild to help minimize the chance of this happening to you.

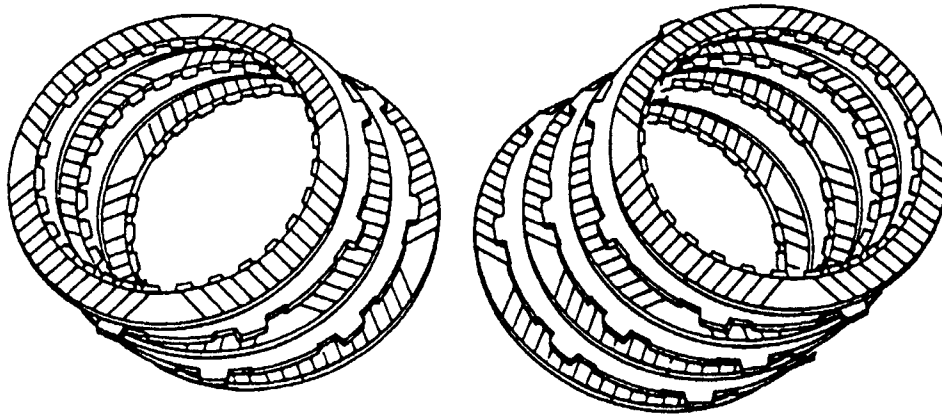
Use the proper fluid type. The readily available and common varieties of Dexron II/III and Mercon ATF are not specifically formulated to help combat chatter in the 41TE or the 42LE. Chrysler's Mopar 7176 ATF is. This formulation gives you the best odds for avoiding chatter. This fluid is available at the dealer under these part numbers:

Quart=4467721

Gallon=4467722

There are also additives available, such as the LubeGard HFM(tm) ATF supplement that provide an alternative.

Control your clutch stack thickness. The 41TE/42LE units are particularly sensitive to variations in assembled clutch pack thickness. To control this, sort the clutches and steels from your kit into separate piles for each clutch assembly. Take just the clutches from one pack and measure the thickness of that stack at four places around the stack. Rotate the plates in the stack until the thickness around the stack is within .001" at all four measured points.



Using a felt marker, make line-up marks on the edge of the stack. Do the same to the steels for that clutch, then each of the other separate groups of clutches and steels. What may seem like a pain now will fade in time as you discover how well it works.

The steel plate teeth have sharp edges on one side. Round these off with a wire wheel.

Cooler Bypass Valve

The 41TE (604) has a crucial need for an uninterrupted flow of lube oil. One area that can cause problems with lube flow is the cooler circuit. Restrictions in the cooler circuit reduce the amount of oil returning from the converter to the transmission as lube oil, and this can cause destroyed gear train parts.

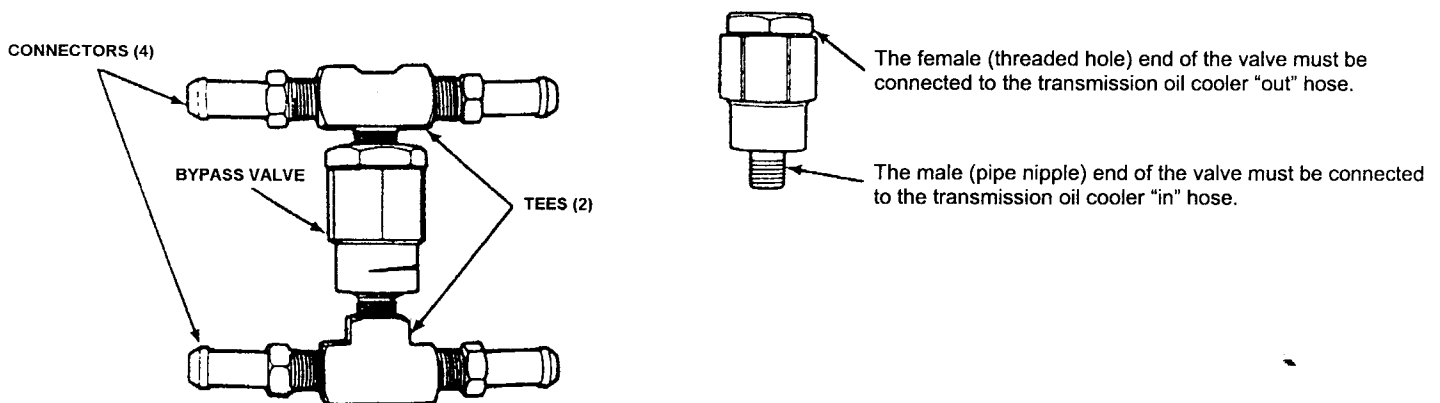
From 1989 through 1990, there was no provision for any cooler restrictions in the original design. It wasn't until almost 1991 that cooler restrictions were found to be the cause of most gear train failures.

Starting in 1991, a cooler bypass valve was installed into the case behind the pump gasket. If cooler restrictions caused outgoing cooler pressure to go above a certain point, this valve would give the excess pressure a way back to the cooler return line without having to go through the cooler. This keeps the lube circuit in the unit well charged at all times, regardless of the condition of the cooler flow.

For all previous units (1989-1990), a kit was designed that allows you to splice in a different style bypass valve into (between) the cooler lines. This provides the same protection as the designed-in valve. You can order this kit from Chrysler:

Part #5252836

Although this kit was designed to work on a Chrysler vehicle, you will find it quite useful on any unit suffering from lube failures caused by cooler restrictions, such as the Nissan RE4R01A, the Ford E4OD, the THM 4L60 (700), etc.



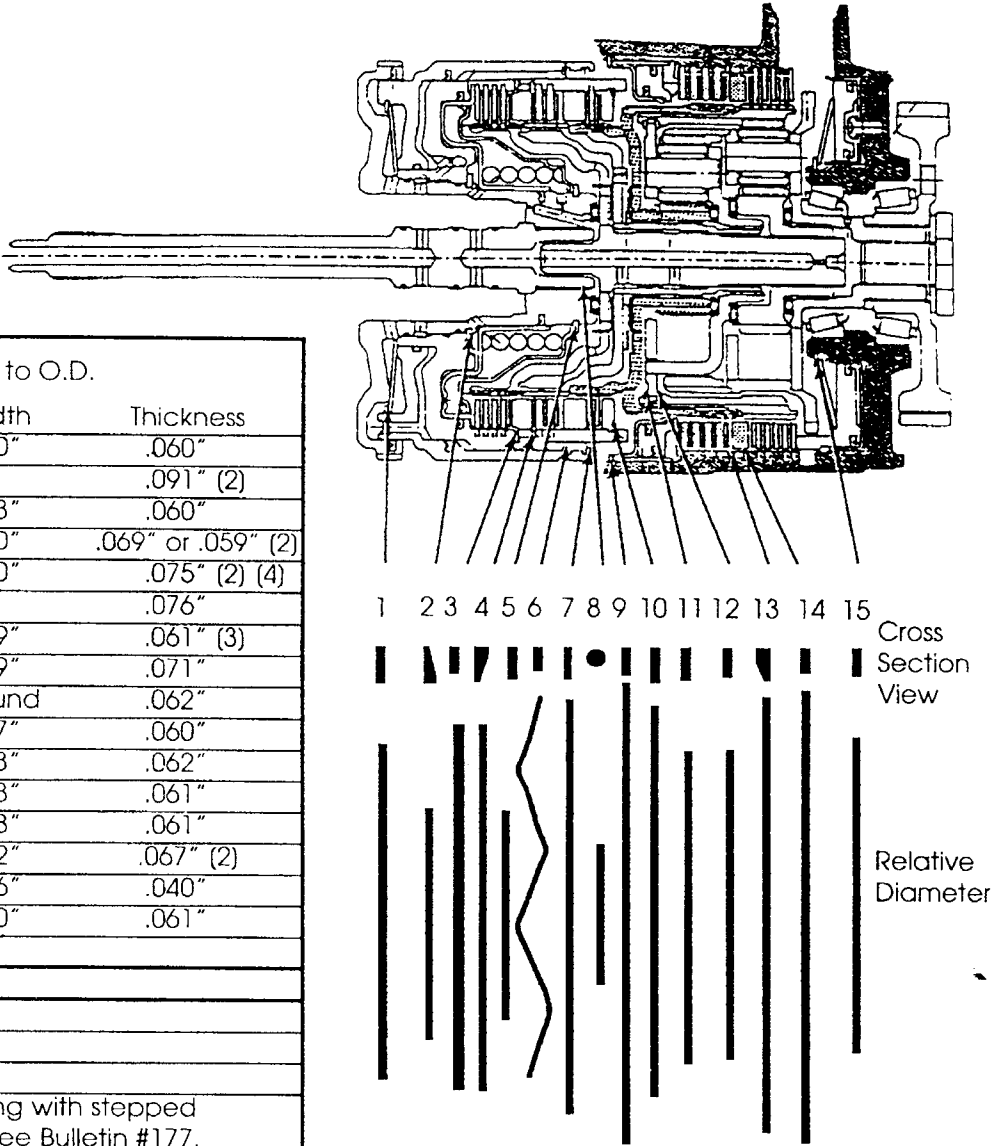
Chrysler Bypass Valve, #5252836

Snap Ring Chart

If you have a Chrysler 41TE apart, and you are not very familiar with the internal arrangement, one of the more confusing things you may encounter is the number and variety of snap rings you will find inside one of these units.

Here is a chart showing the approximate location and dimension of the different snap rings you'll find throughout the unit.

	Approx. Relaxed	I.D. to O.D.	
		Width	Thickness
1	5 1/4"	.220"	.060"
2	2 5/8"	(1)	.091" (2)
3	5 15/16"	.173"	.060"
4A	6 1/2"	.140"	.069" or .059" (2)
4B	6 1/2"	.140"	.075" (2) (4)
5	2 5/16"	(1)	.076"
6	7 1/16"	.109"	.061" (3)
7	7 1/2"	.109"	.071"
8	1 1/16"	Round	.062"
9	7"	.187"	.060"
10	5 3/4"	.153"	.062"
11	4 5/8"	.138"	.061"
12	4 5/8"	.138"	.061"
13	7 5/16"	.142"	.067" (2)
14	6 3/4"	.156"	.040"
15	3 7/16"	.260"	.061"
(1)	Tru-arc™		
(2)	Beveled		
(3)	Waved		
(4)	Upgrade snap ring with stepped pressure plate - see Bulletin #177.		



Underdrive/Overdrive Pressure Plate

Be certain you replace a broken or worn pressure plate with the right style for the drum you are using. One common mismatch involves using an early three O/D clutch input drum that needs a pressure plate. The most commonly available plate is the new style plates that come with the new thicker snap ring. This will not work properly in the early drum, because this drum has a much larger space between the pressure plate snap ring grooves. This means that the pressure plate will not be solidly locked into position, but instead will be free to move up and down between the snap rings. This is guaranteed to totally foul up the clutch clearances you THINK you are setting this unit up with.

If for some reason you absolutely must use an early three plate input drum, make sure you use one of the early, thickest group of selective plates. Pressure plate thicknesses:

6.52mm (.257")

7.01mm (.276")

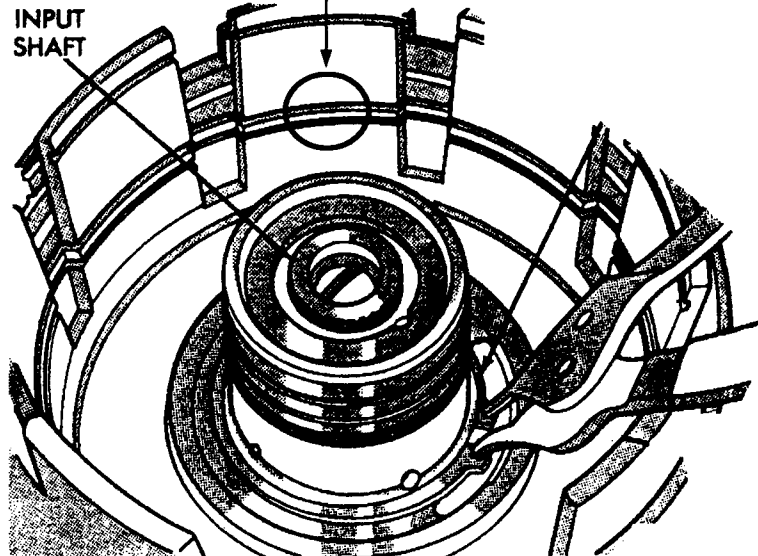
7.50mm (.295")

7.99mm (.315")

Measure the width of this rib to identify drum.

EARLY =
.125" BETWEEN GROOVES

LATE =
.085" BETWEEN GROOVES



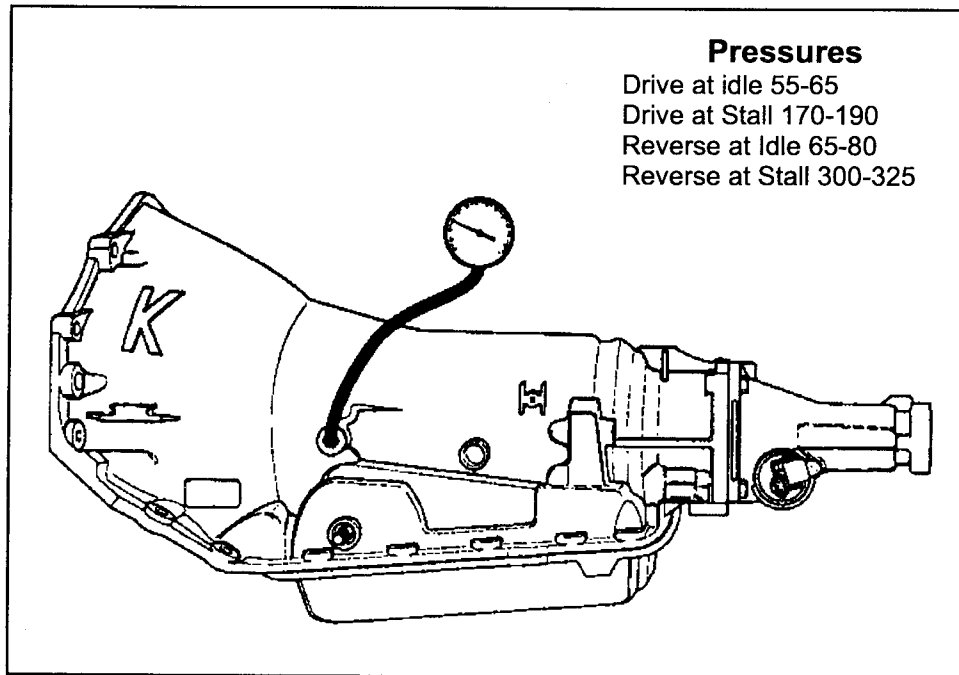
4L60-E

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4L60-E



4L60-E



Range	Gear	Sol A	Sol B	2-4 Band	Reverse Input Clutch	Overrun Clutch	Forward Clutch	Input Sprag	3-4 Clutch	Low Roller Clutch	Low Reverse Clutch
P-N											
R	Reverse										
D	1st										
	2nd										
	3rd										
	4th										
D	1st										
	2nd										
	3rd										
2	1st										
	2nd										
1	1st										
	2nd										

★ = Holding but ineffective due to overrun Clutch.

• = Holding but ineffective due to low reverse Clutch.

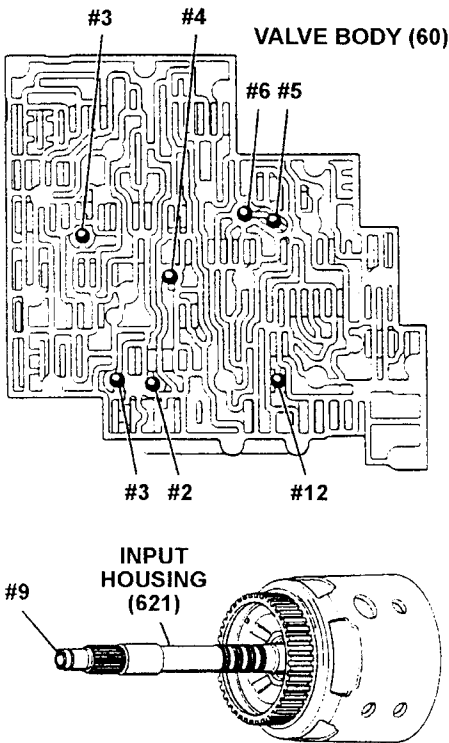
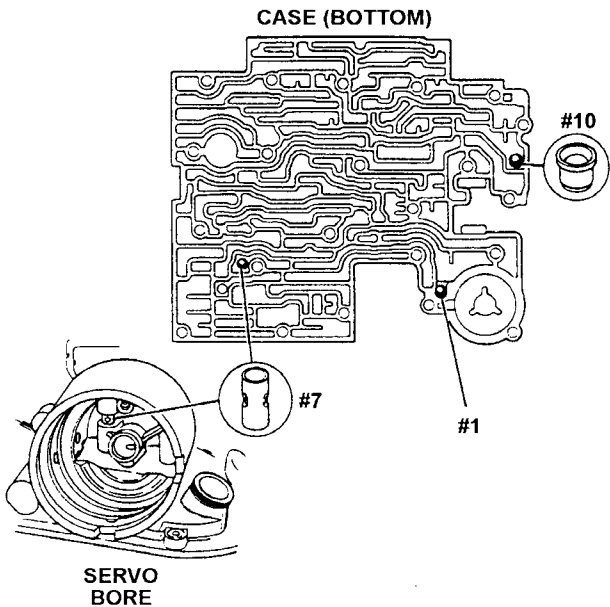
Failsafe Mode

D	3rd
D	3rd
2	2nd
1	2nd

Gear Ratios

1st	3.06
2nd	1.63
3rd	1.00
4th	.69
Reverse	2.29

Checkball Locations and Functions



#1 3-4 ACCUMULATOR: Located in the transmission case, the 3-4 accumulator checkball helps control the flow of accumulator fluid to the 3-4 accumulator. When the ball is seated, accumulator fluid is forced through the #18 orifice. This action helps control the 2-4 band release during a 4-3 downshift.

#2 3rd ACCUMULATOR: Located in the valve body, the 3rd accumulator checkball directs exhausting 3rd accumulator fluid through orifice #12 and to the 3-4 control valve. This helps control the 2-4 band apply during a 3-2 downshift. During a 3-4 upshift, 3-4 clutch fluid unseats the ball for a quick feed into the 3rd accumulator fluid circuit.

#3 REVERSE INPUT: Located in the valve body, the reverse input checkball controls the reverse input clutch apply when engine speed is at idle. During these conditions, all reverse fluid feeding the reverse input fluid circuit is routed to the ball, seats the ball, and is forced through orifice #17. This slows the flow of reverse fluid to cushion the reverse input clutch apply. When the reverse input clutch releases, exhausting reverse input fluid unseats the ball for a quick exhaust of fluid.

#4 3-4 CLUTCH EXHAUST: Located in the valve body, this checkball helps control the 3-2 downshift. Exhausting 3-4 clutch and 3rd accumulator fluids seat the ball and are forced through orifice #13. This helps control the 3-4 clutch release rate and 2-4 band apply. During a 3-4 upshift, 3-4 signal fluid unseats the ball for a quick feed into the 3-4 clutch fluid circuit.

#5 OVERRUN CLUTCH FEED: Located in the valve body, it routes either overrun fluid or D2 fluid into the overrun clutch feed fluid circuit while blocking the other fluid circuit. Overrun clutch feed fluid feeds the overrun clutch fluid circuit in the Manual gear ranges to apply the overrun clutch.

#6 OVERRUN CLUTCH CONTROL: Located in the valve body, the #6 checkball helps controls the overrun clutch apply rate. Overrun clutch feed fluid pressure seats the ball and is forced through orifice #20. This orifice slows the flow of overrun fluid to cushion the overrun clutch apply. When the overrun clutch releases, overrun clutch feed fluid unseats the ball for a quick exhaust.

#7 3rd ACCUMULATOR EXHAUST: Located in the transmission case, it unseats when 3rd accumulator fluid exhausts from the 2-4 servo to prevent residual fluid pressure from accumulating. Also, before 3rd accumulator fluid pressure seats the ball during a 2-3 upshift, any air in the circuit exhausts past the ball.

#8 1-2 UPSHIFT: Located in the valve body, the 1-2 upshift checkball helps control the 2-4 band apply during a 1-2 upshift. During the upshift, 2nd fluid pressure seats the ball and is forced through the #16 orifice. This orifice slows the flow of 2nd fluid to help cushion the band apply. When the band releases during a 2-1 downshift, exhausting 2nd clutch fluid unseats, and exhausts past, the 1-2 upshift checkball.

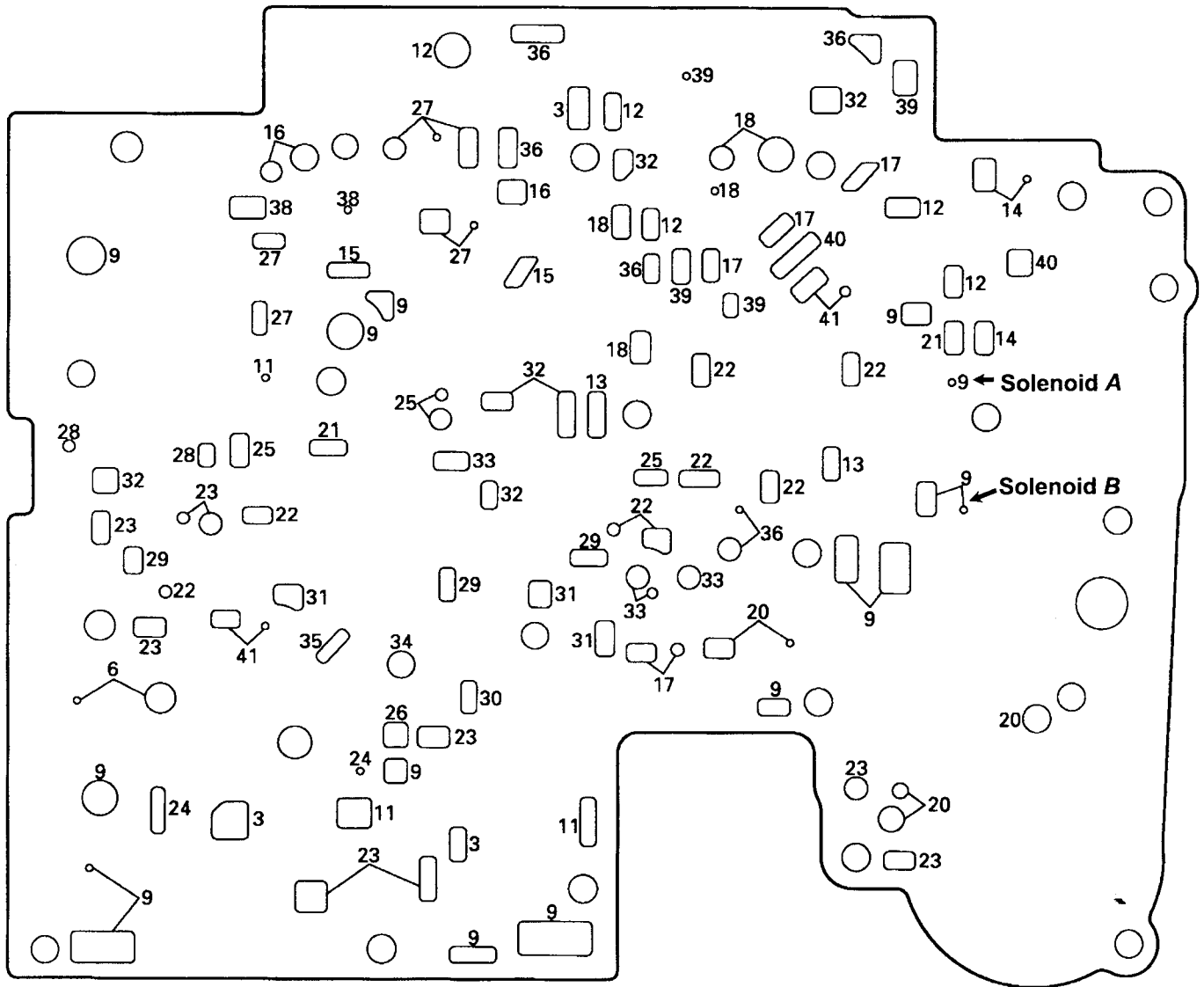
#9 TCC APPLY: Located in the end of the turbine shaft, the #9 checkball is a retainer and ball assembly that helps control the converter clutch apply feel. As the converter clutch applies, exhausting release fluid seats, and is orificed around the checkball. This action slows the exhaust of release fluid to control the converter clutch apply feel. When the converter clutch is released, release fluid pressure unseats the checkball and flows freely past the ball to keep the pressure plate disconnected from the converter cover.

#10 LO/REVERSE CLUTCH APPLY: Located in the transmission case, the #10 checkball is a retainer and ball assembly that helps control the lo and reverse clutch apply feel. During the clutch apply, PR fluid pressure seats, and is orificed around the checkball. This orifice slows the increase of PR fluid pressure at the clutch piston to cushion the apply feel. When the clutch releases. Exhausting PR fluid unseats the checkball for a quick exhaust.

#11 FORWARD CLUTCH ACCUMULATOR: Located in the valve body, it helps controls the forward clutch apply when engine speed is at idle. During these conditions, all D4 feeding the forward clutch feed fluid circuit is routed to the ball, seats the ball, and is forced through orifice #22. This slows the increase of forward clutch feed fluid pressure to cushion the forward clutch apply. When the forward clutch releases, exhausting forward clutch feed fluid unseats the ball for a quick exhaust of fluid.

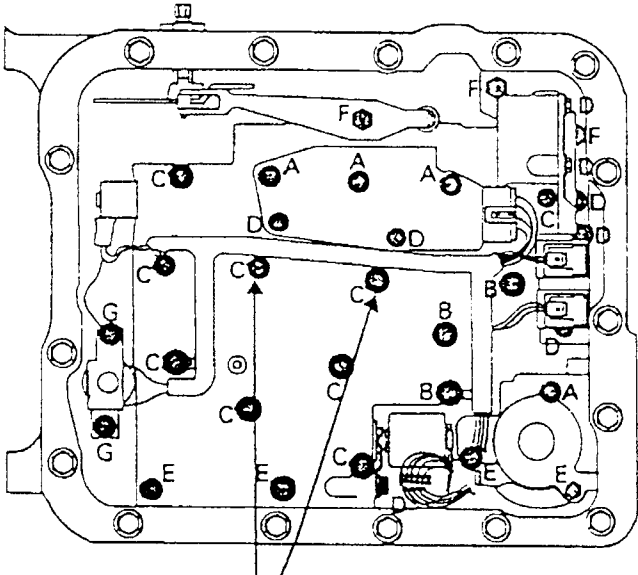
Wrong Gear Starts, No Fourth Gear

These malfunctions can be caused by leaking shift solenoids, or insufficient solenoid feed. During rebuild, the feed holes for shift solenoid A and B should be enlarged to .030" - .035".



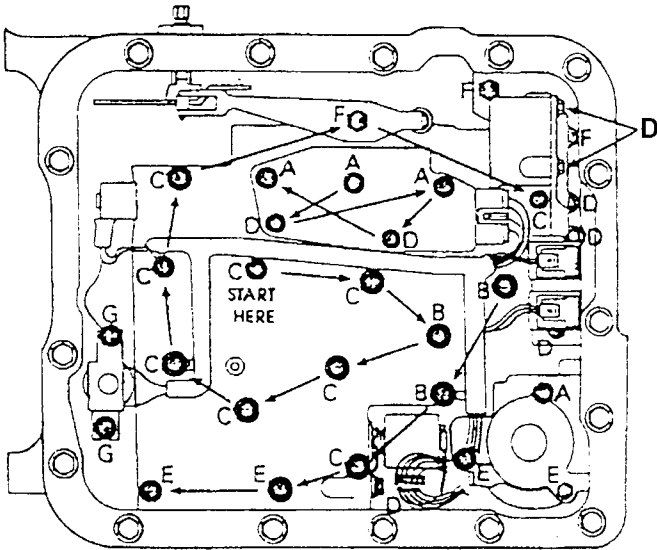
NOTE: If the shift solenoids leak when energized with 12 volts, they should be replaced.

Valve Body Bolt Reference



Bolt location.

Make sure these bolts are not too long.



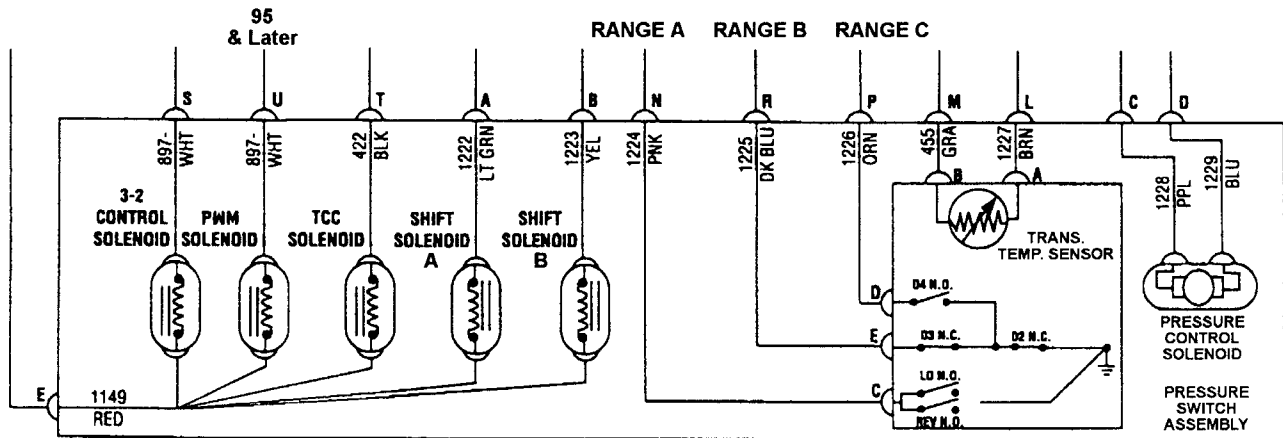
Torque Sequence.

A	65.0mm	
B	54.4mm	8mm head
C	47.5mm	
D	18.0mm	8mm head
E	35.0mm	
F	20.0mm	
G	12.0mm	8mm head

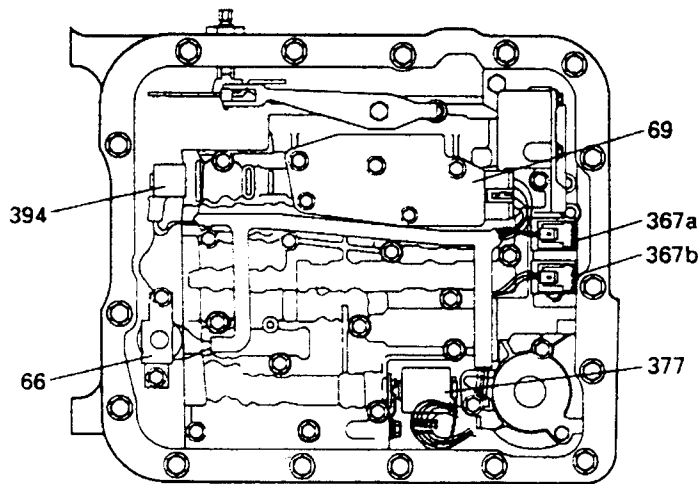
Torque all valve body bolts as shown, in a spiral pattern to 96 inch-pounds. Torque should be done in stages, 30-60 final 96-inch pounds.

NOTE: Improper bolt location can give you second gear starts, bind up in reverse, bind up in manual low and a bind on the 2-3 shift, and or shuttle shifting on 2-3 shift.

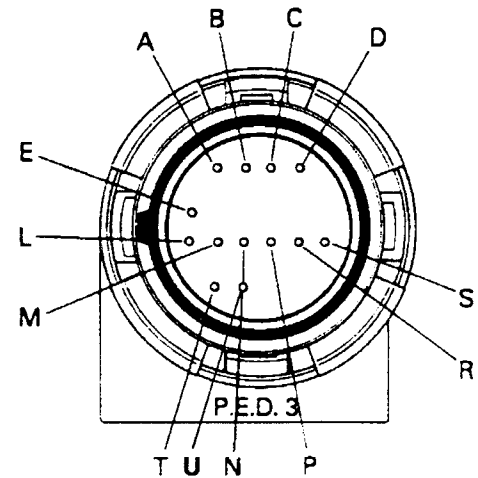
Internal Transmission Wiring Harness



N.C. = Normally Closed Switch
N.O. = Normally Open Switch



- 66 Solenoid Assembly and Wiring Harness
- 69 Pressure Switch Manifold
- 367a Shift Solenoid A
- 367b Shift Solenoid B
- 377 Pressure Control Solenoid
- 394 3-2 Control Solenoid



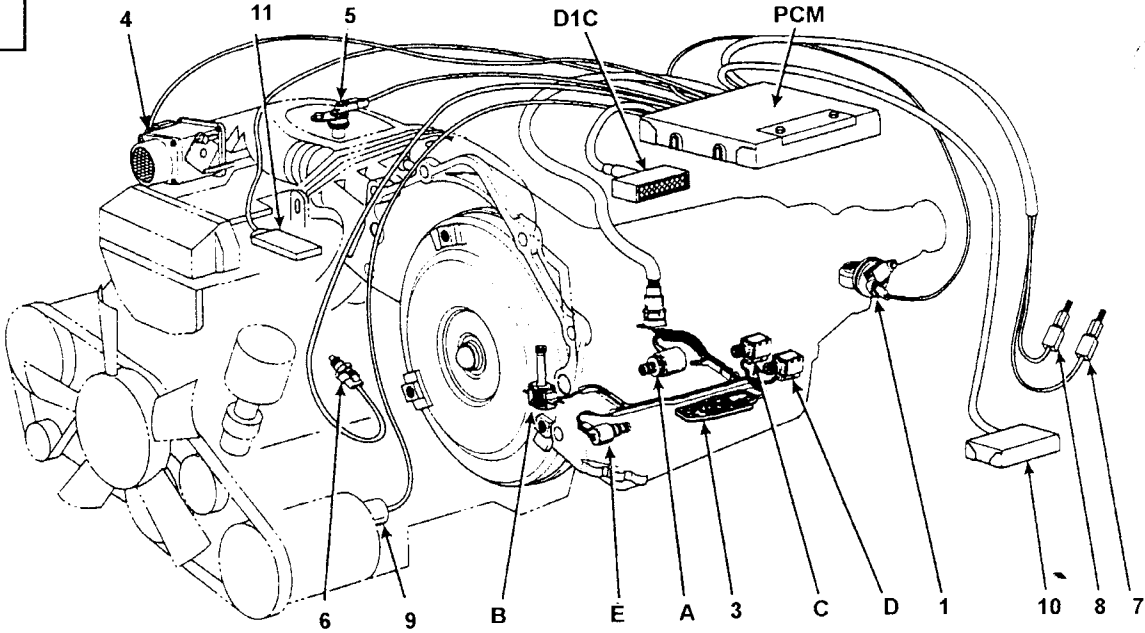
Cavity	Function
A	Shift Solenoid A (Low)
B	Shift Solenoid B (Low)
C	Pressure Control Solenoid (High)
D	Pressure Control Solenoid (Low)
E	Both Shift Solenoids, TCC Solenoid, and 3-2 Control Solenoid (High)
L	Transmission Fluid Temperature (High)
M	Transmission Fluid Temperature (Low)
N	Range Signal "A"
P	Range Signal "C"
R	Range Signal "B"
S	3-2 Control Solenoid (Low)
T	TCC Solenoid (Low)
U	TCC PWM Solenoid (Low) (Only used on 95 and later)

Electrical Components

°C	°F	RESISTANCE
-40	-40	100544
-28	-21	52426
-16	10	18580
-4	23	12300
0	32	9379
7	40	7270
19	58	3520
31	86	2232
43	110	1200
55	131	858
67	145	675
79	176	333
91	194	241
103	213	154
115	239	115
127	260	7*9
139	284	60
151	302	47

COMPONENT	WIRE COLOR	PASS-THRU PIN	RESISTANCE	CKT#
Shift Solenoid A	RED	E *	20-40 Ohms	1149B
	LT GRN	A		1222
Shift Solenoid B	RED	E *	20-40 Ohms	1149A
	YEL	B		1223
3-2 Control Solenoid	RED	E *	9-14 Ohms	1149C
	WHT	S		897
Pressure Control Solenoid	PPL	C	3.5-8 Ohms	1228
	LT BLU	D		1229
TCC Solenoid	RED	E *	20-40 Ohms	1149E
	BLACK	T		422A

* Spliced internally to Pin E



INFORMATION SENSORS

1. Vehicle Speed Sensor

2. Transmission Fluid Temperature Sensor

3. Fluid Pressure Switch Assembly (PSA)

4. Throttle Position Sensor (TPS)

5. Engine Speed Sensor

6. Engine Coolant Temperature Sensor

7. Brake Switch

8. 4 Wheel Drive Low Switch

9. Air Conditioning Request

10. Cruise Control Information

11. Manifold Absolute Pressure Sensor



ELECTRONIC CONTROLLERS

• Powertrain Control Module (PCM)



ELECTRONICALLY CONTROLLED TRANSMISSION COMPONENTS

A. Pressure Control Solenoid

B. Torque Converter Clutch Solenoid

C. Shift Solenoid "A"

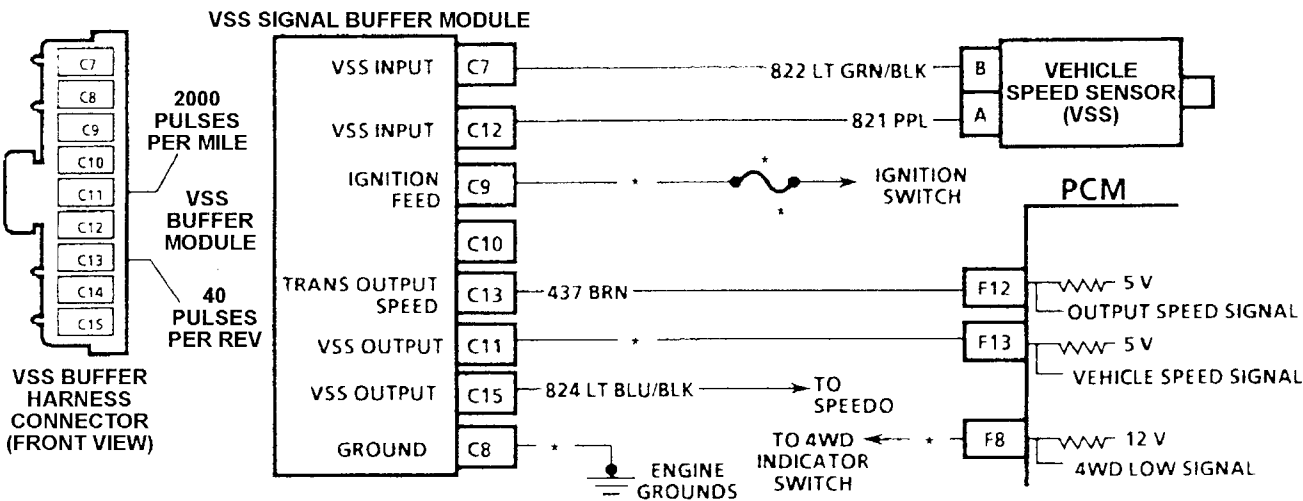
D. Shift Solenoid "B"

E. 3-2 Control Solenoid

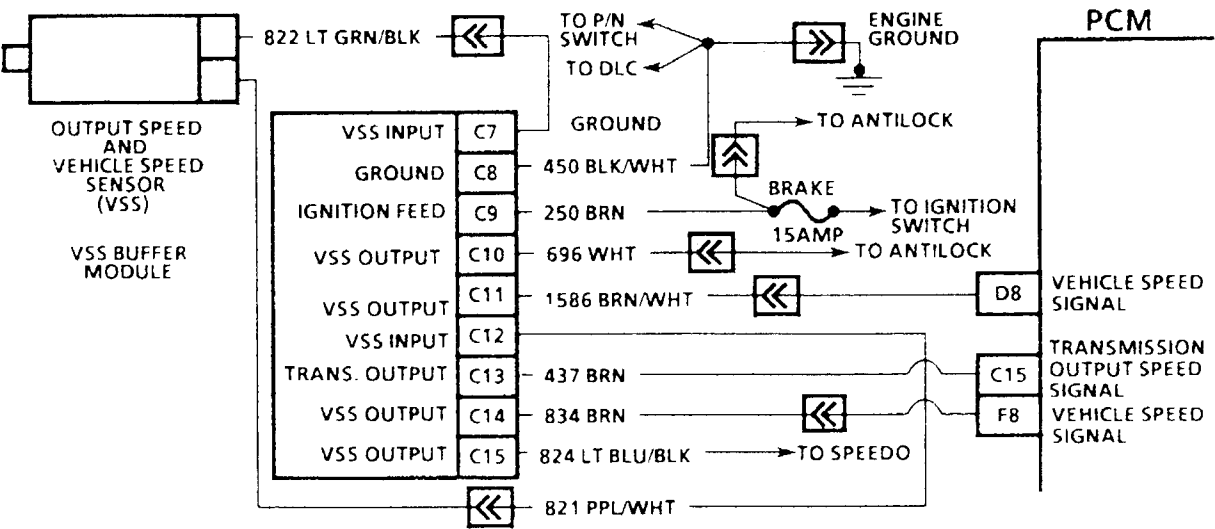
VSS Circuit Loss

Code 16 or 72

The V.S.S. buffer module can give us a number of shift concerns. The buffer converts the V.S.S. signal sent by the speed sensor into a D.C. signal to indicate transmission output speed.

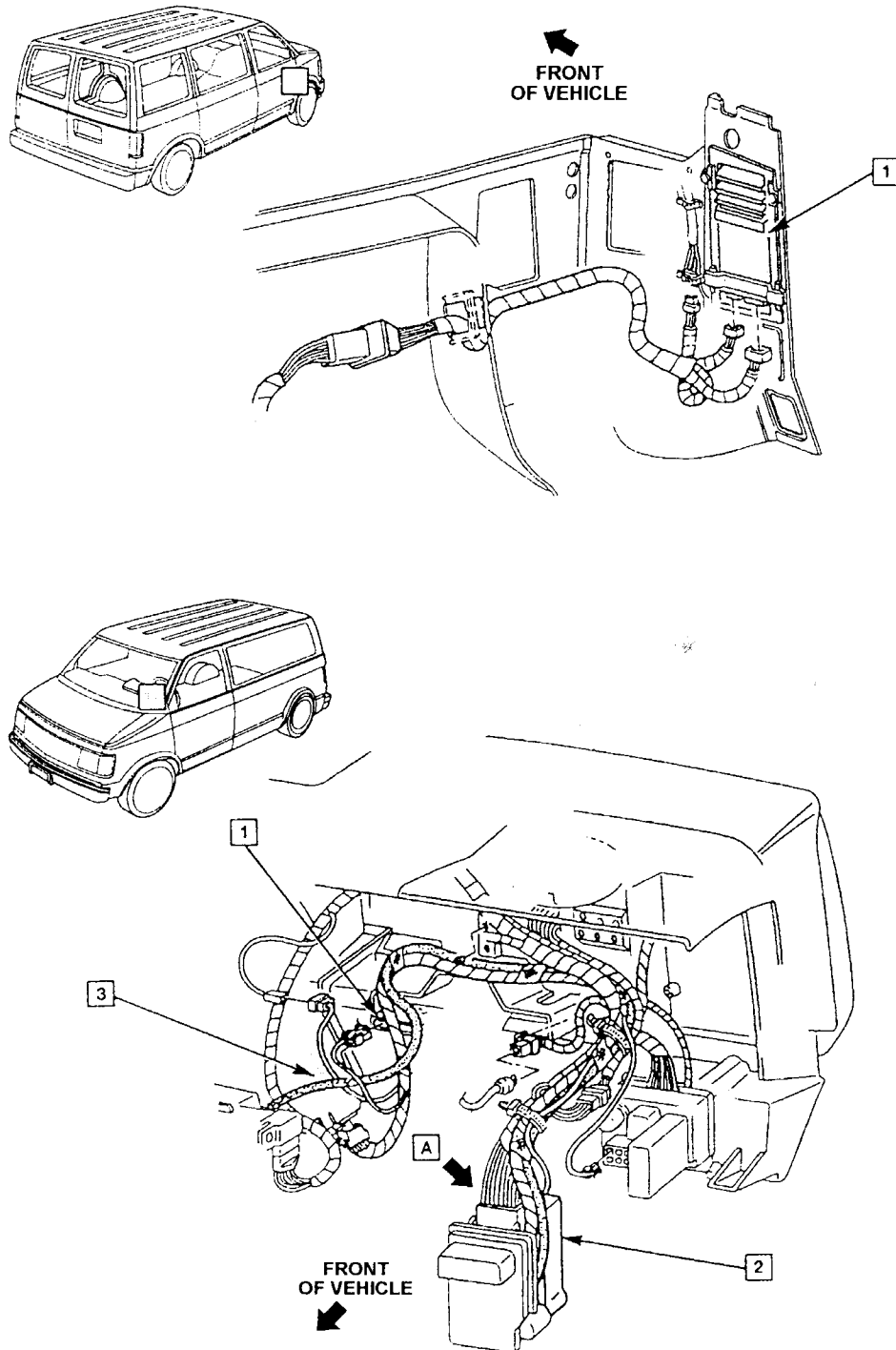


DTC 72 GAS—VEHICLE SPEED SENSOR (VSS) CIRCUIT LOSS

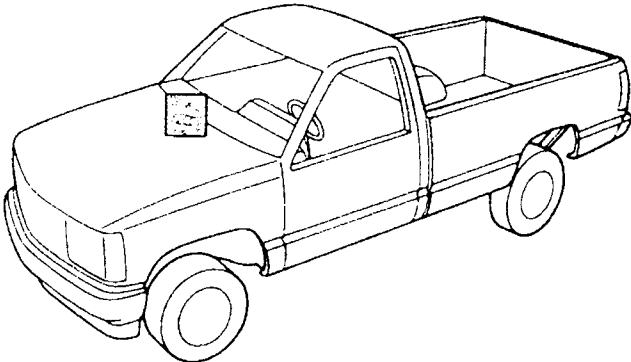


DTC 16 DIESEL

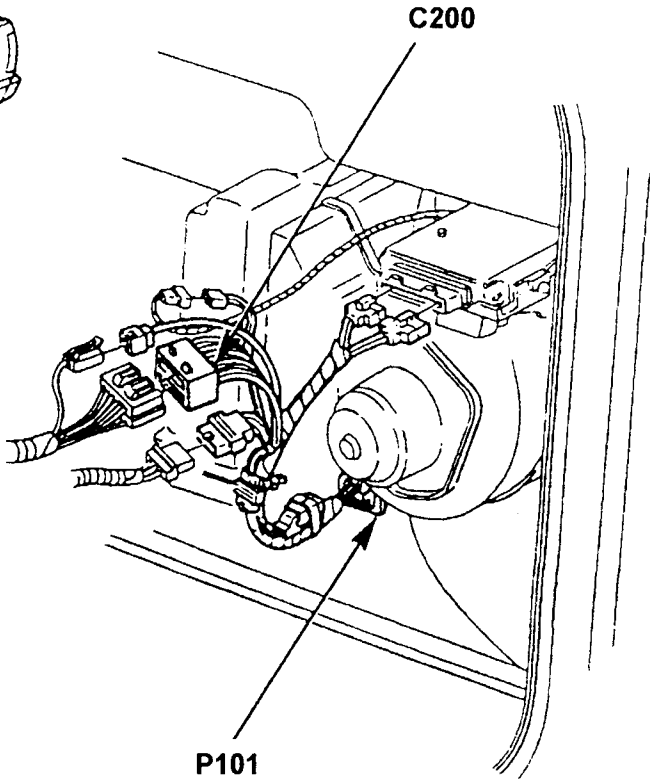
Location of the PCM and the VSS Buffer Module M/L Van



**Location of the PCM
and the VSS Buffer Module
C/K Trucks**

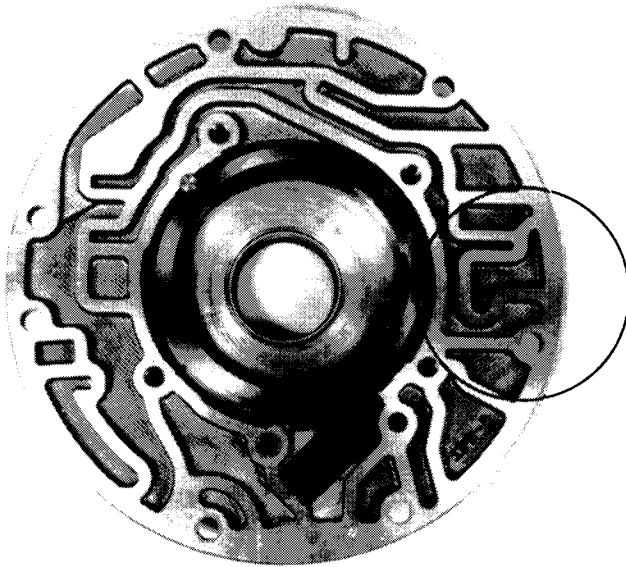


FRONT
OF VEHICLE

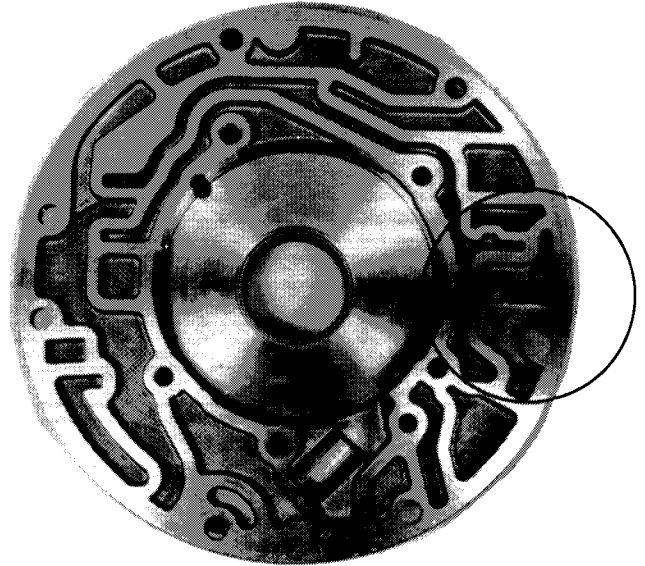


Pump Changes

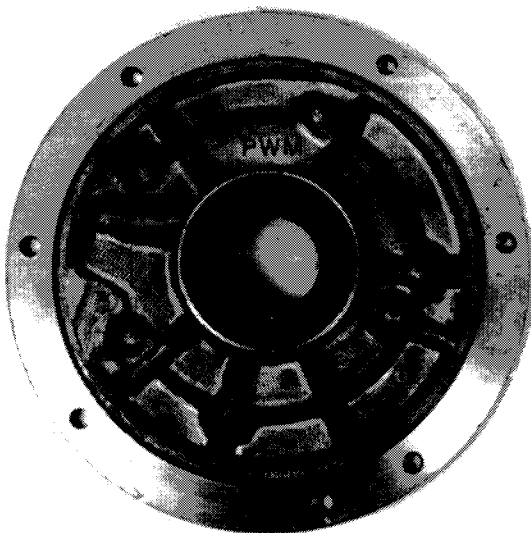
There are four types of oil pumps available at this time for the 4L60E. Non-modulated, modulated, modulated with bolt-on bell housing, and new for 1997 13 vane pump (shown on page 68). ID is simple.



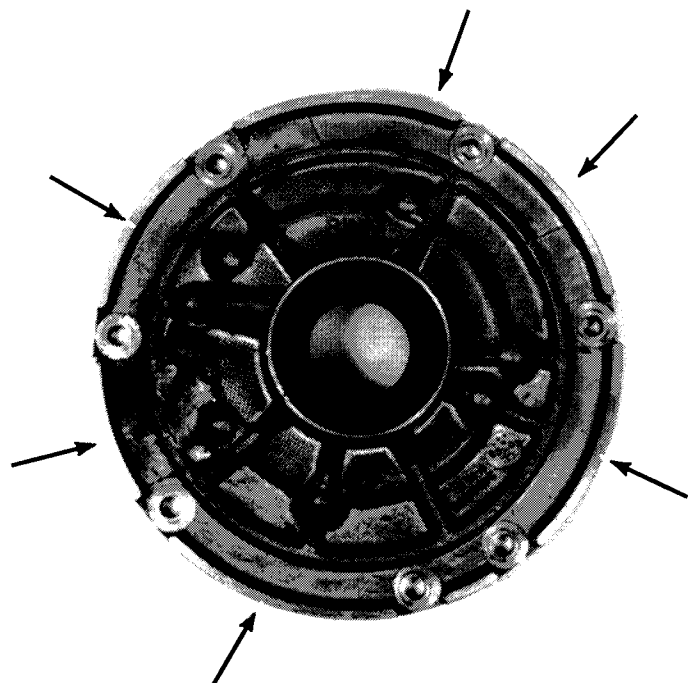
Non-PWM



PWM



One Piece Case



Bolt-On Bellhousing
(Notice the support ridges)

Pump Changes (cont'd)

Stator Support



Non-PWM



PWM

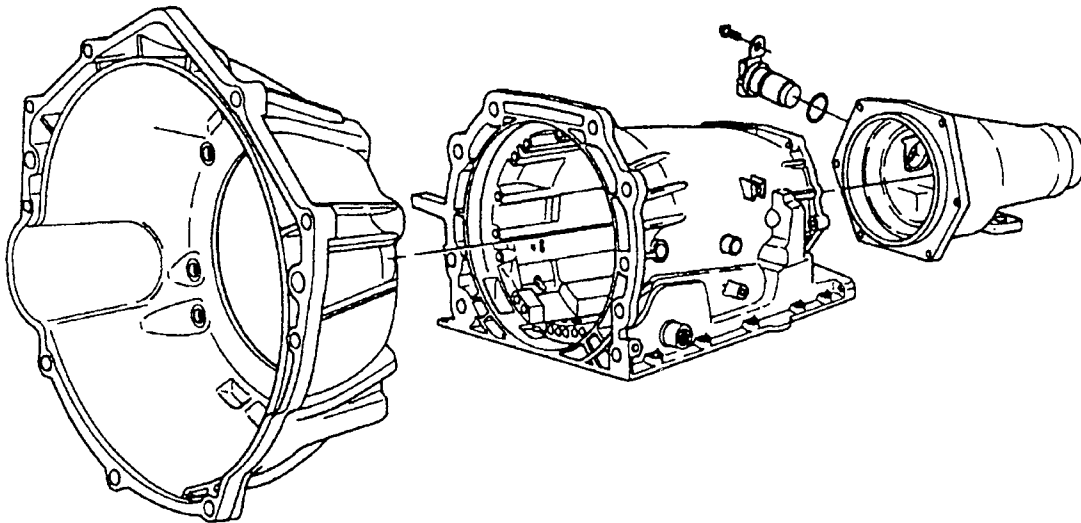
Changes for 1996

The Hydra-matic 4L60-E transmission has changed many areas for the 1996 Model Year:

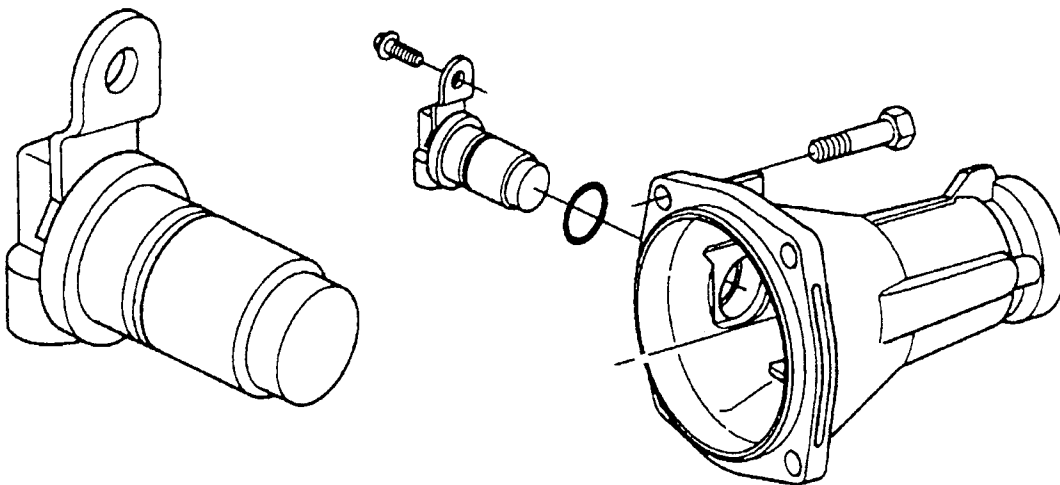
- Two piece case/enhanced flexibility for future applications
- Speed sensor/in-line, enhanced manufacturing and cost
- Extension assembly/right hand side mounted speed sensor and increased strength
- 3-2 Control line-up/discrete on/off solenoid and simplified design
- Manual valve/to ease linkage adjustment
- Forward clutch wave plate/enhanced gear shift and commonize parts
- Pump assembly/raised rib for two piece case
- Torque converter assembly/brazed turbine blades for increased strength
- Quick connect cooler fittings

Changes for 1996 (cont'd)

Two Piece Case & Case Extension

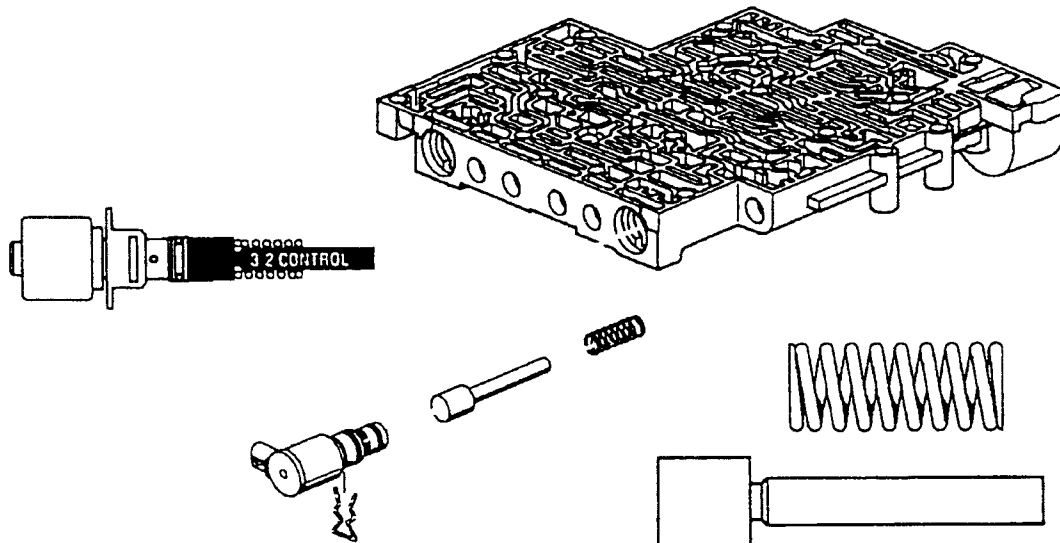


Case Extension & In-Line Speed Sensor

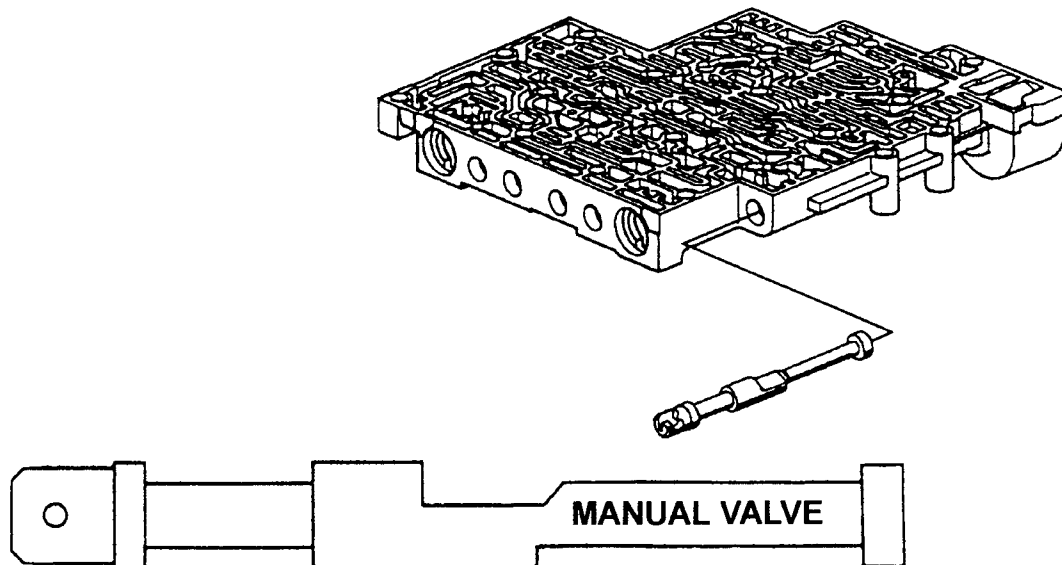


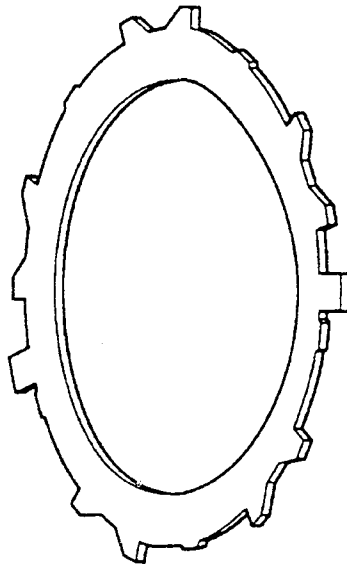
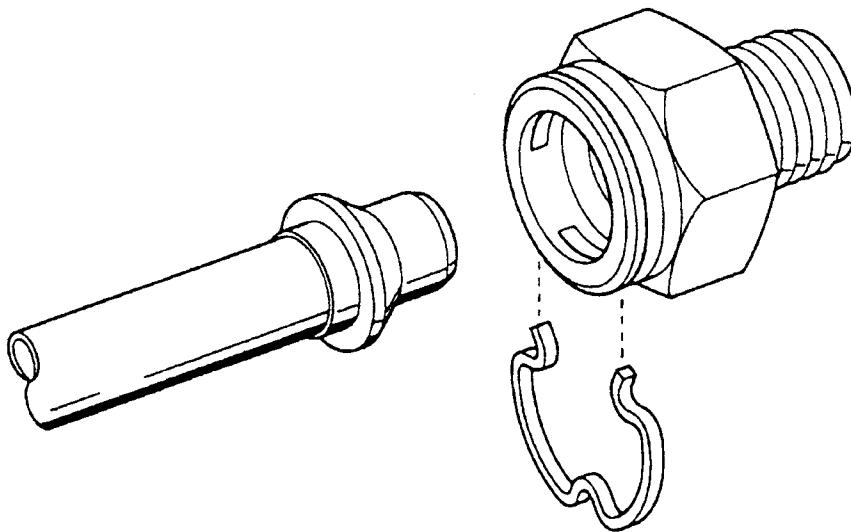
Changes for 1996 (cont'd)

3-2 On/Off Control



Manual Valve



Changes for 1996 (cont'd)**Forward Clutch Plate (Waved)****Quick Connect Cooler Fittings**

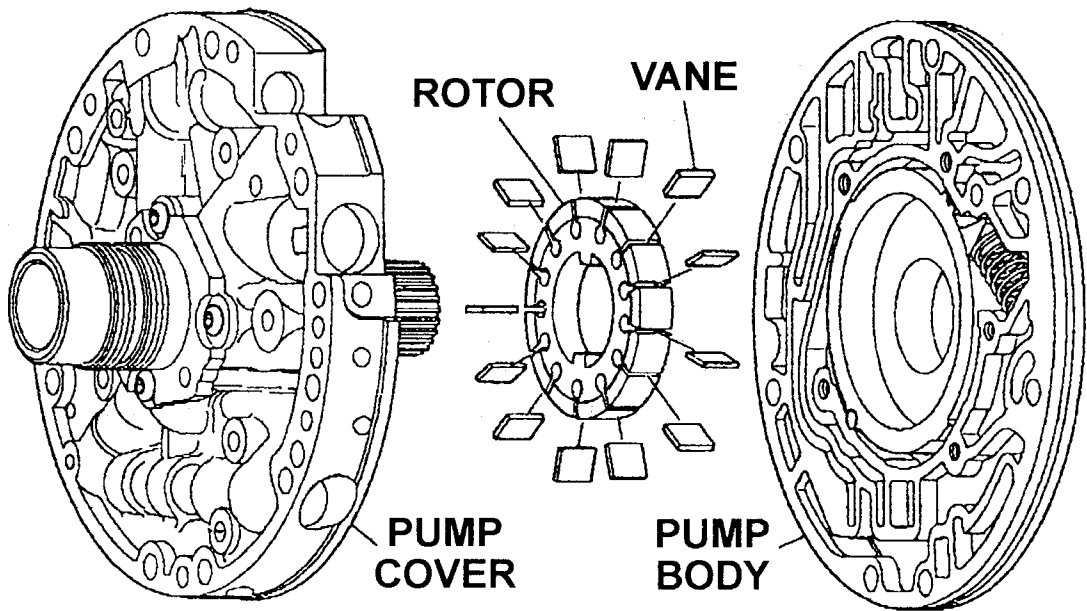
Changes for 1997

The HYDRA-MATIC 4L60-E transmission has received the following refinements for the 1997 model year:

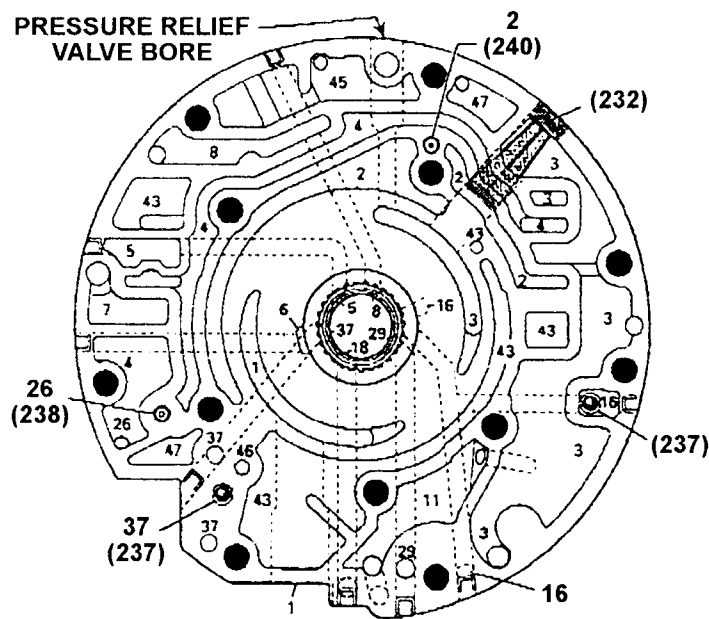
- Oil pump (13 vanes) / to balance pressure and reduce noise
- Channeling in pump cover / 13 vane pump
- Inputs stamped and bonded pistons (forward and overrun clutches) / eliminated forward clutch damage
- Spring assembly (overrun clutch) / bonded piston change
- Reverse and low & reverse clutch pack turbulator plates (slots in plates) / to improve cooling and lubrication
- 3-4 clutch friction plates / new material for improved durability
- 3-4 clutch steel plates / new material for improved durability
- Aluminum spool valves / anodized material to reduce leakage
- Wiring harness / push-on feature, positive pressure control solenoid connector to ease assembly
- Revised speed sensor bracket / new protective bracket for shipping

Changes for 1997 (cont'd)

Thirteen Vane Oil Pump

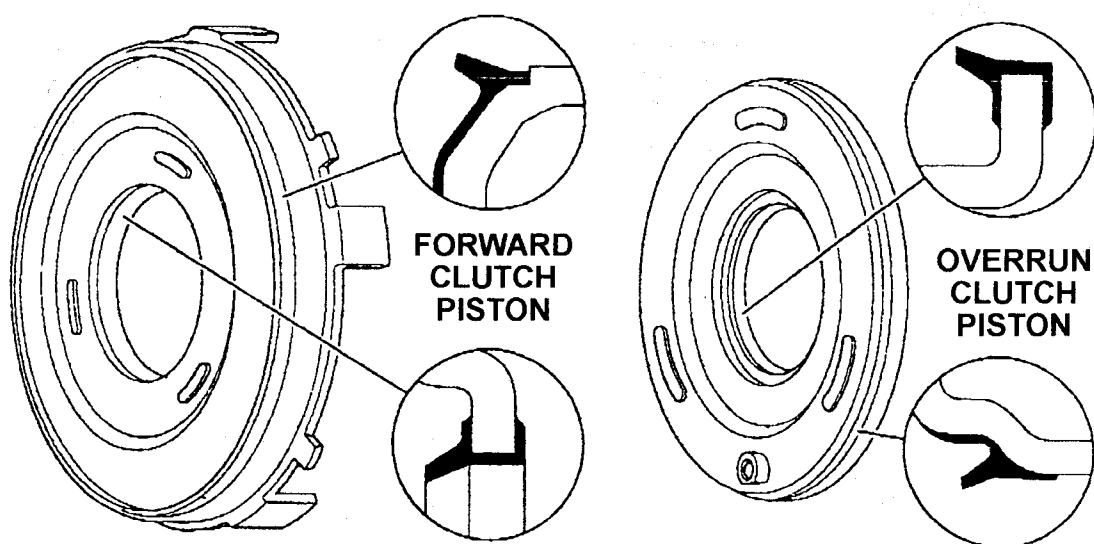


Channeling in Pump Cover

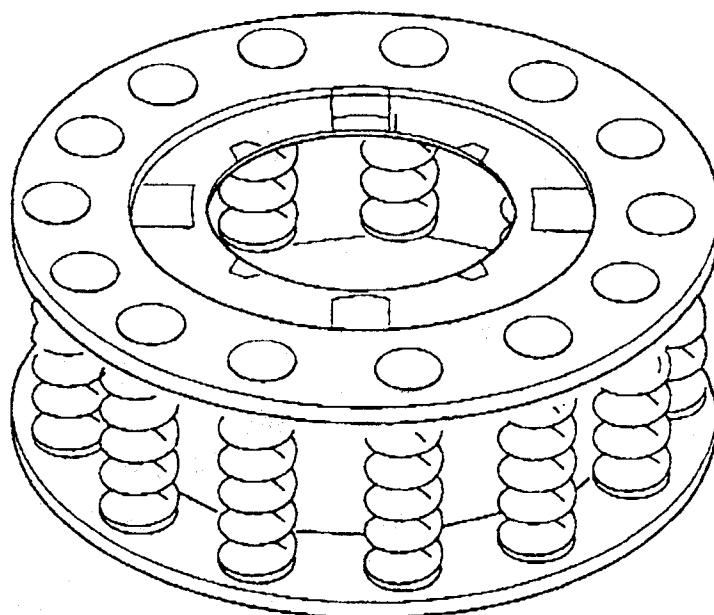


Changes for 1997 (cont'd)

Stamped and Bonded Pistons

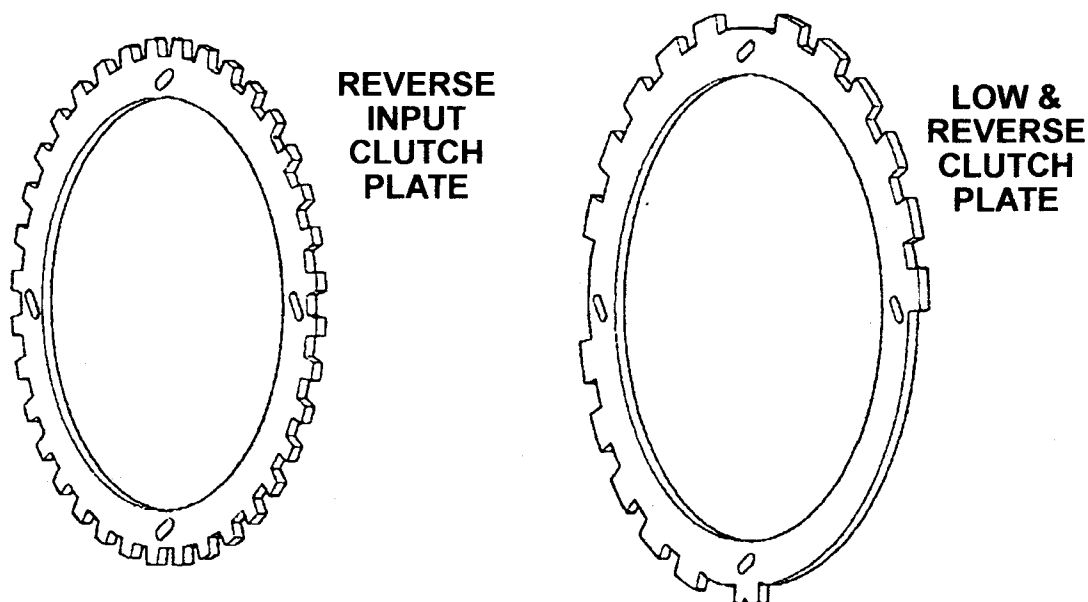


Spring Assembly (Overrun Clutch)

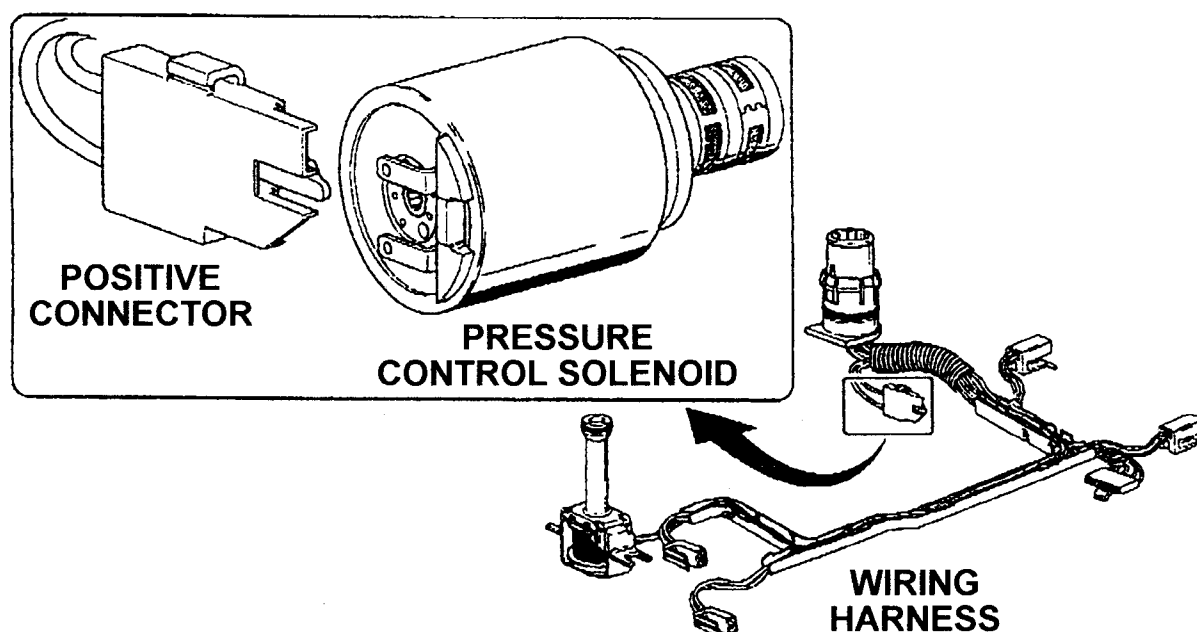


Changes for 1997 (cont'd)

Turbulator Plates (Slots in Plates)

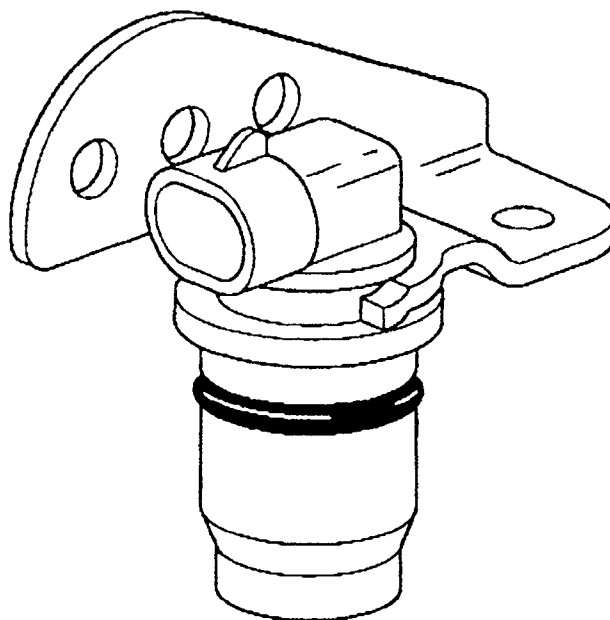


Wiring Harness/Push-On Feature, Positive Pressure Control Solenoid Connector



Changes for 1997 (cont'd)

New Protective Speed Sensor Bracket



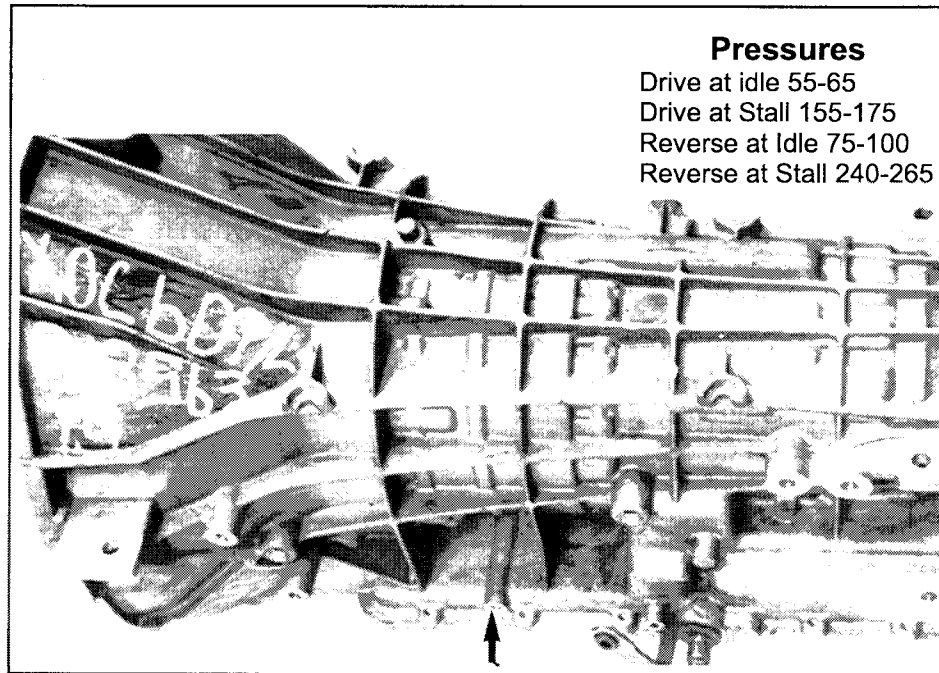
E4OD

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MLPS Codes	81
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E4OD



E40D



Range	Gear	Sol 1	Sol 2	Fwd Clutch	Overdrive Sprag	Overdrive Clutch	Coast Clutch	Int Clutch	Int Sprag	Int Band	Direct Clutch	Low Reverse Clutch	Low Roller Clutch
P-N													
R	Reverse												
D	1st						●						
	2nd						●						
	3rd						●						
	4th												
2	1st								★				
1	2nd												

★ = Holding but ineffective due to Band.

● = The coast clutch applies in **D** when the O/D cancel switch is preseed.

Failsafe Mode

D	4
2	2
1	2

Gear Ratios

1st	2.71
2nd	1.54
3rd	1.00
4th	.71
Reverse	2.18

Checkball Locations

Balls 1 through 9 used on all models.

- 1: Separate two and reverse flow at low reverse modulator valve. (Eliminated in 1996)
- 2: Separates manual two flow and reverse flow to the 4-3-2 timing valve and the coast clutch shift valve.
- 3: Forces direct clutch to exhaust through orifice during 3-2 downshift.
- 4: Forcing band servo apply pressure through orifice while bypassing the orifice on exhaust.
- 5: Forces intermediate clutch to exhaust through orifice during 2-1 downshift.
- 6: Feeds reverse flow through 4-3-2 shift timing valve.
- 7: Separates solenoid four flow from either the manual two flow or the reverse flow which shifts the coast clutch shift valve.
- 8: Forces coast clutch feed fluid through orifice for 4-3 downshift and manual 1 or 2 pull-ins while allowing free exhaust.
- 9: Forces overdrive clutch to exhaust through orifice during 4-3 downshift.

Balls 10 and 11 used on 1989 models only.

- 10: Separate reverse flow and direct clutch accumulator flow into the direct clutch.
- 11: Facilitates fast exhaust of direct clutch when coming out of reverse.

Balls 12 through 14 used on early 1989 models only.

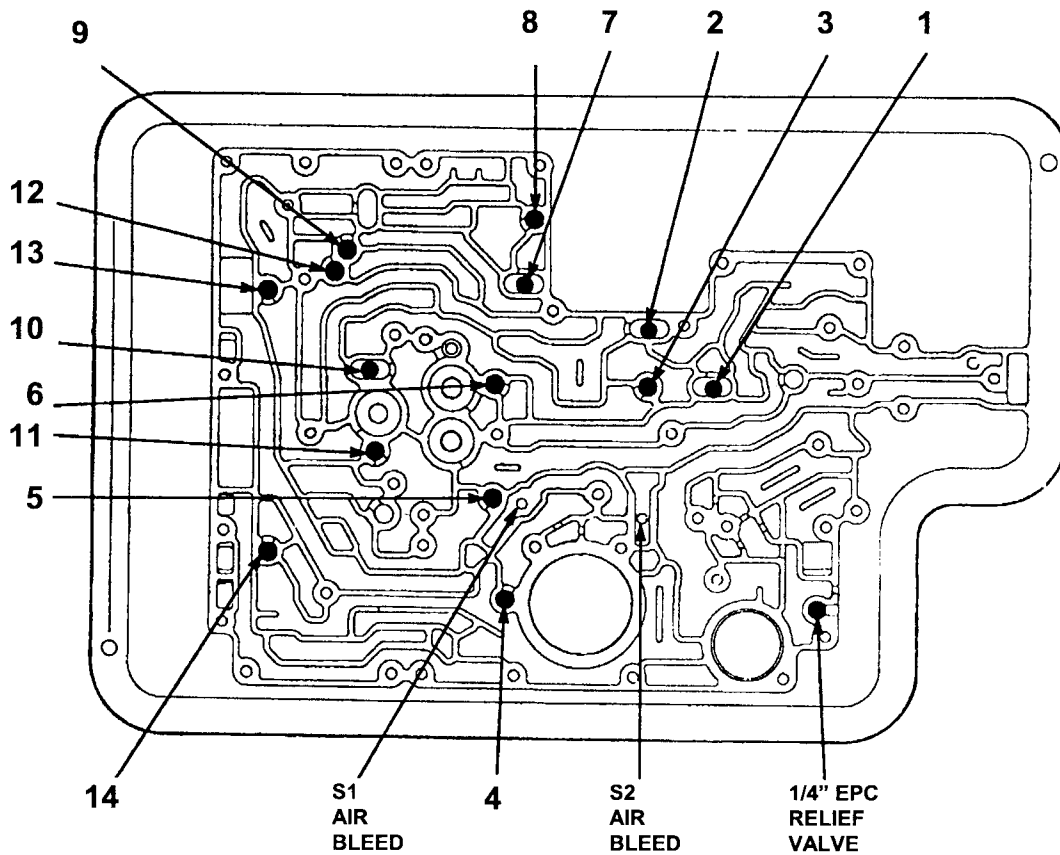
- 12: Bypasses direct accumulator plunger feed orifice during 3-2.
- 13: Bypass overdrive accumulator plunger feed orifice during 4-3.
- 14: Bypasses intermediate accumulator plunger feed orifice during 2-1.

- A: (Main Control Body) Separates manual two flow and solenoid two flow into the 1-2 manual transition valve which supplies flow to prevent 1-2 shift valve from shifting.
- B: (Main Control Body) Forces forward engagement pressure through orifice while allowing free exhaust.

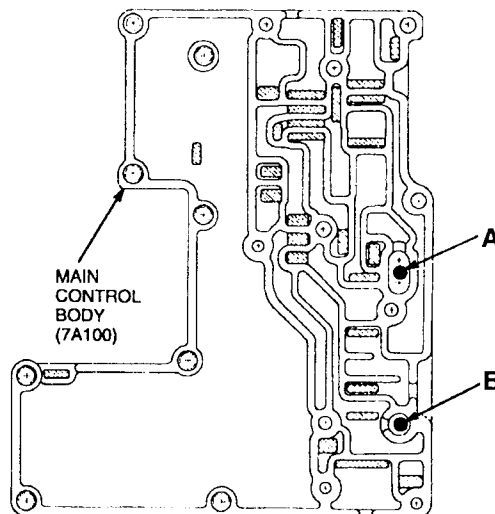
EPC Relief Valve (Spring and ¼" Steel Ball)

Electronic Pressure Control blowoff valve controls EPC pressure to a maximum of 690 kPa (100 psi).

Checkball Locations



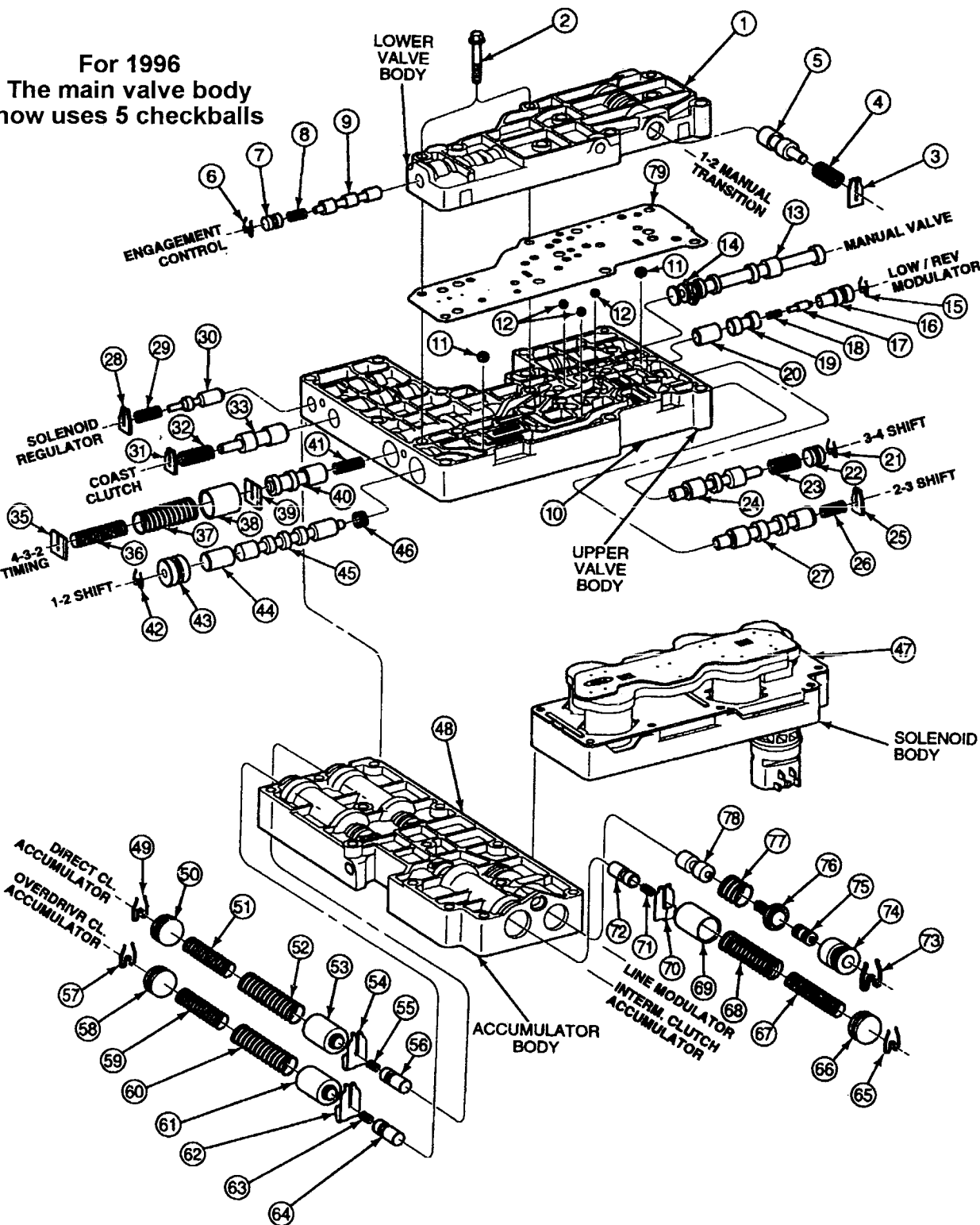
NOTE: Ball #1 eliminated in 1996



1989-1995
(For 1996, See next page)

1996 Valve Body Checkball Locations

For 1996
The main valve body now uses 5 checkballs



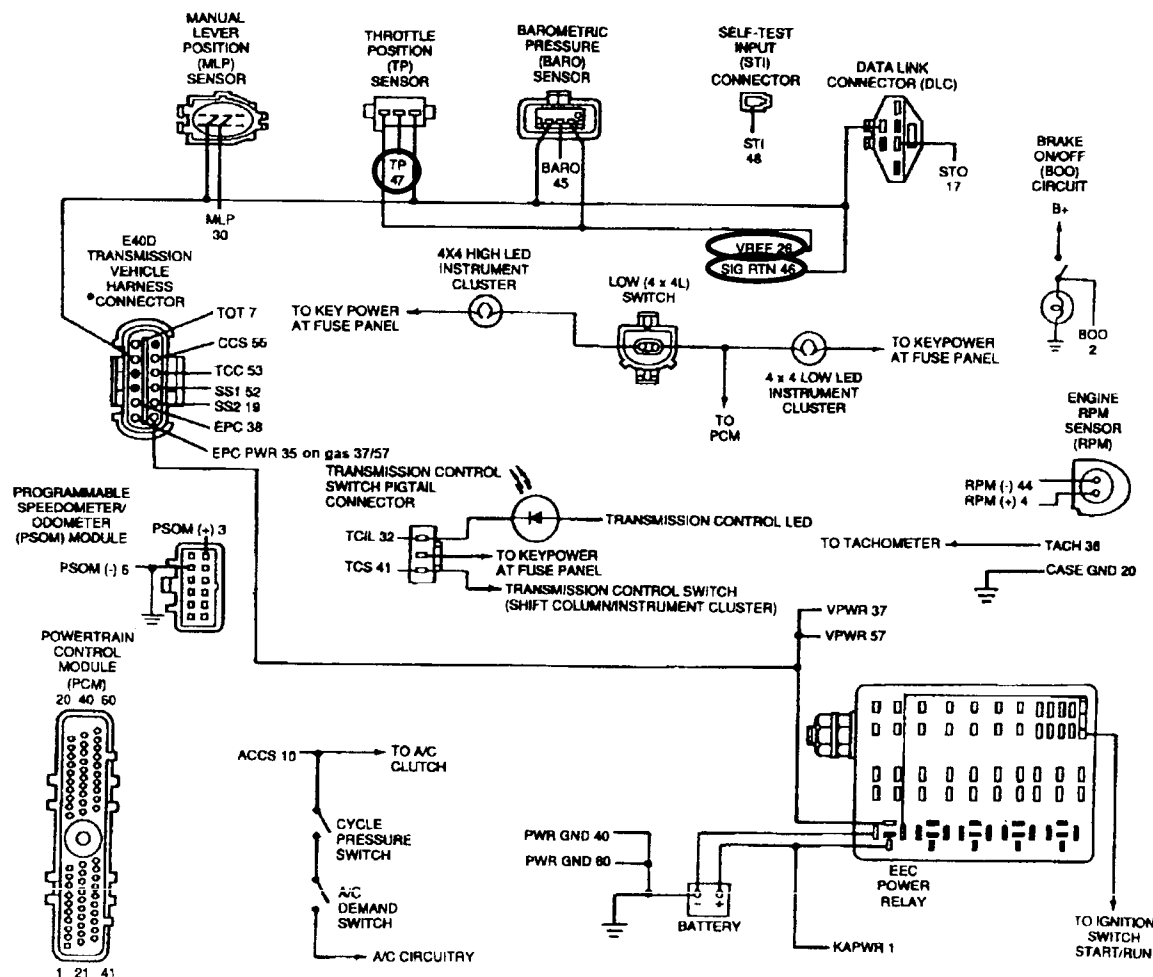
EEC-IV Pre Diagnostic Tests

- [illegible]

How to Diagnose Stubborn Codes (cont'd)

TPS/FIPL Codes 23, 33, 43, 63, 73 / 122, 123, 124 and 125

- The voltage parameter of the TP/FIPL is greater than .73 volts and less than 4.84 volts. Voltage signals that do not fall within these specifications will set these codes.
- Check that the Throttle Lever/Injector pump lever travels all the way with throttle wide open.
- TPS / FIPL should have 5v on the input lead (pin 26) and less than 0.1v on the ground lead (pin 46).



NOTE: On diesel models, the accelerator pedal must be held at WOT during the KOEO test.

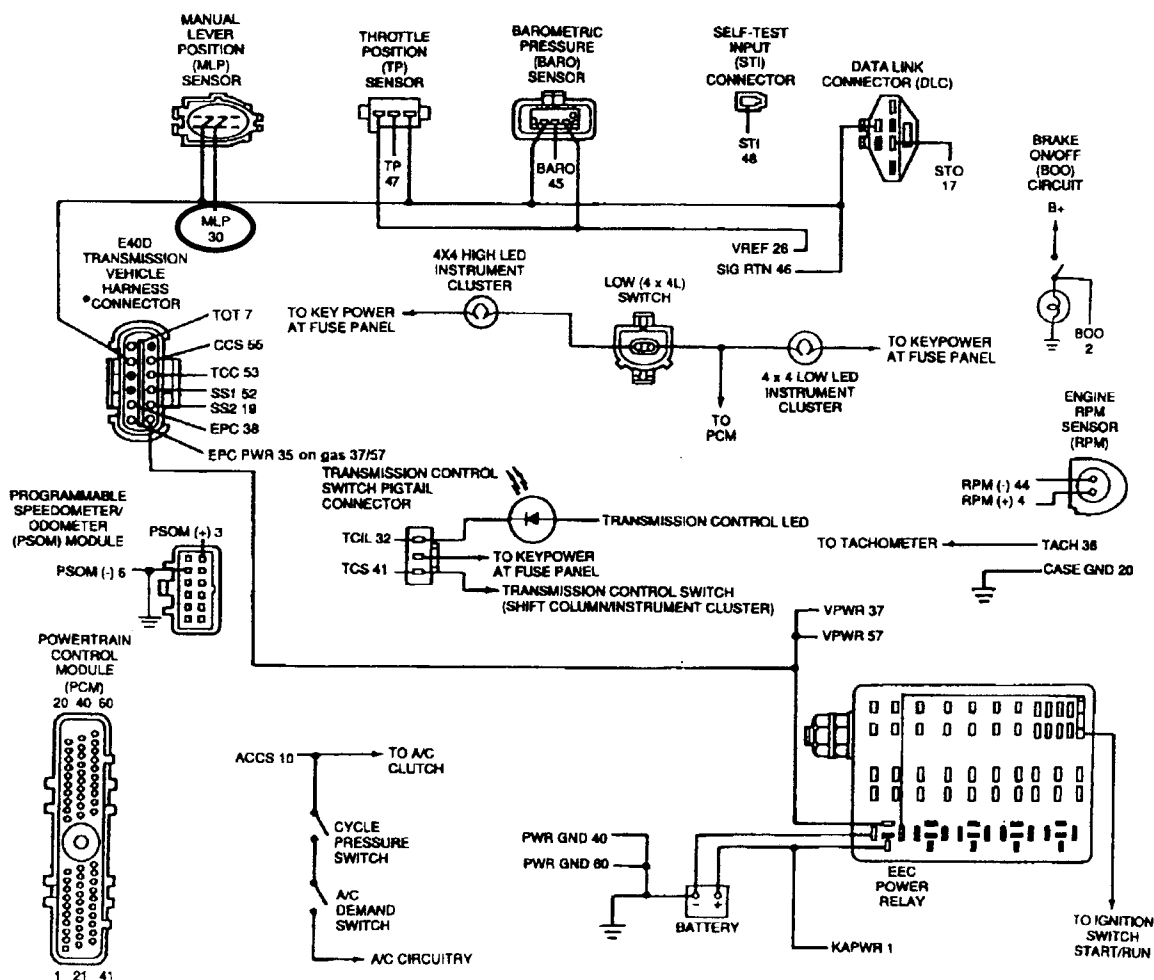
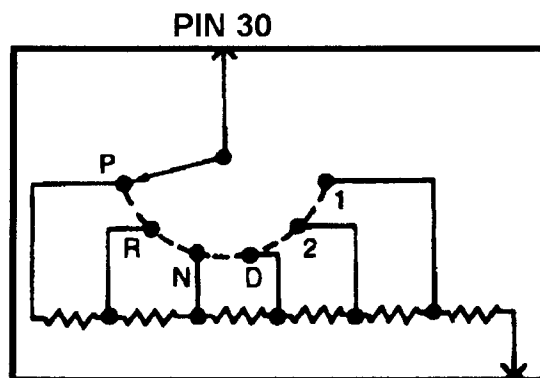
How to Diagnose Stubborn Codes (cont'd)

MLPS Codes 67 / 522, 634 and 654

- KOEO should be performed in park with all accessories off.
- Check for 4.4v in park at pin 30.

MLP Sensor Data* Voltage values calculated for VREF = 5.0v (These values may vary 15% due to sensor and VREF variations)

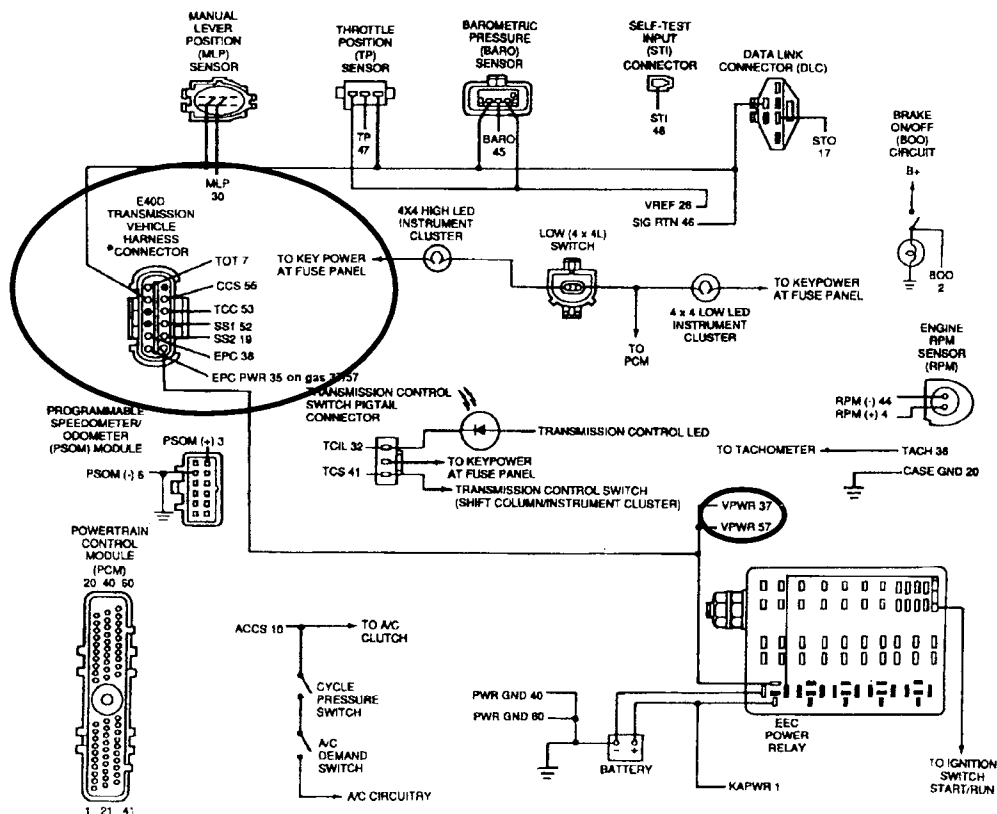
Transmission Shift Position	Voltage * Volts	Resistance Ohms
P	4.4	4.16K
R	3.5	1.44K
N	2.8	733
D	2.1	401
2	1.4	211
1	.7	81



How to Diagnose Stubborn Codes (cont'd)

Solenoids Codes 91, 92, 93, 94 / 621, 622, 624, 625, 626 and 629

- Most of these codes are set during KOEO.
- Inspect the solenoid connector for poor connection or no connection.
- Disconnect the 60 pin EEC-IV processor.
- With the ignition off, connect the positive lead of a DVOM to pin 37 or 57.
- Connect the negative lead to a good ground (Battery negative post is best): There should be no voltage.
- Remove the negative lead of the DVOM from the battery and place it on pin 19. Switch the DVOM to ohms. Test the resistance of solenoid 2; pin 52 for solenoid 1; pin 53 for solenoid 3; and pin 55 for solenoid 4. The acceptable resistance should be 20-30 ohms.
- Next, test the resistance of the EPC solenoid by placing the negative lead of the DVOM on pin 38. On Diesel applications move the positive lead of the DVOM to pin 35. The acceptable resistance is 3-5 ohms.
- Perform a current draw test on the shift solenoids. First verify that pin 37 or 57 has battery voltage with the ignition on engine off.
- Next connect the positive lead of a digital ammeter to pin 19, 52, 53 or 55 and ground the negative lead to the battery negative post. Each solenoid should have approximately .5 amp draw.
- To test the current draw on the EPC connect the positive lead of the digital ammeter to pin 38 and ground the ammeter to the battery negative post. On a Diesel applications you will need to install a jumper wire between pins 37 and 35. Caution: do not leave the ammeter connected to the EPC solenoid for more than a few seconds. This may damage the solenoid. The current draw should be no more than 5 amps.



VSS / PSOM Code 29 / 452

- Test the voltage between pins 3 and 6 at the EEC-IV Processor.
- Test the frequency at pins 3 and 6. The frequency should raise from 0v Hz at 0 mph to about 67 Hz at 30 MPH.
- Test the AC voltage and frequency at the the VSS or the DSS. The AC voltage and frequency at the VSS should be same as at the computer. On 1992 and later the AC voltage and frequency at the DSS should be approximately 3.5v and 667hz at 30 mph. Note: When replacing the DSS do not use a sealant on the o-ring. This may move the sensor away from the sensor ring causing a loss of the signal.
- The VSS resistance should be between 190 and 250 ohms. The DSS resistance should be between 1300 and 1550 ohms.

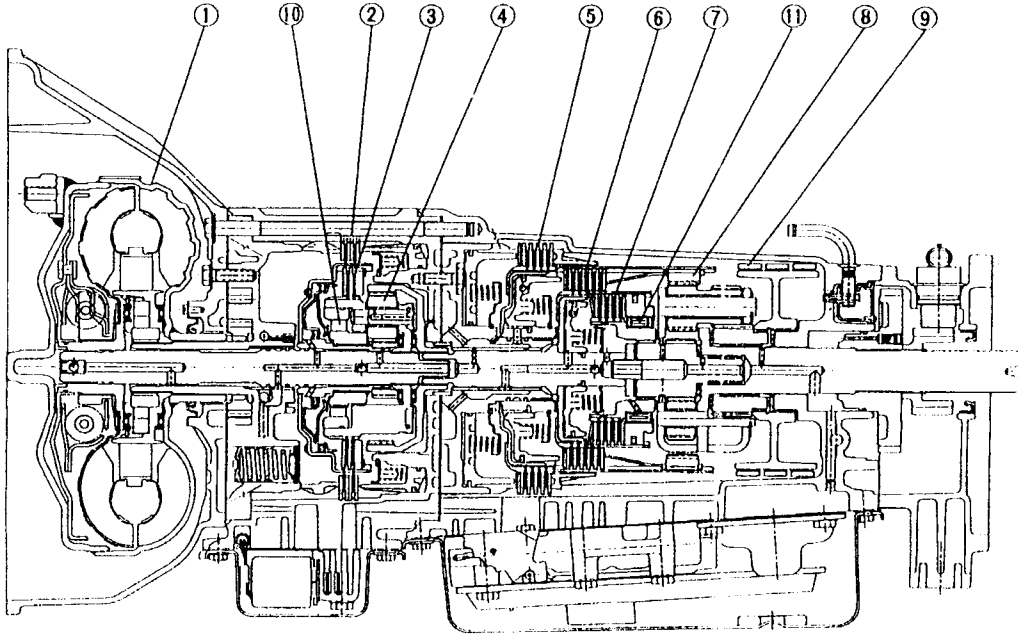
4L30-E

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Delayed Forward Engagement.....	94

4L30-E

4L30-E

Clutch and Band Application



- | | | |
|----------------------------------|----------------------------------|--|
| 1. TORQUE CONVERTER-CLUTCH (TCC) | 5. REVERSE CLUTCH (RC) | 9. BRAKE BAND (B) |
| 2. FOURTH CLUTCH (C4) | 6. SECOND CLUTCH (C2) | 10. OVERDRIVE FREE WHEEL
(ONE WAY CLUTCH) (OFW) |
| 3. OVERRUN CLUTCH (OC) | 7. THIRD CLUTCH (C3) | 11. SPRAG FREE WHEEL
(ONE WAY CLUTCH) (PFW) |
| 4. OVERDRIVE UNIT | 8. RAVINGNEAUX PLANETARY GEARSET | |

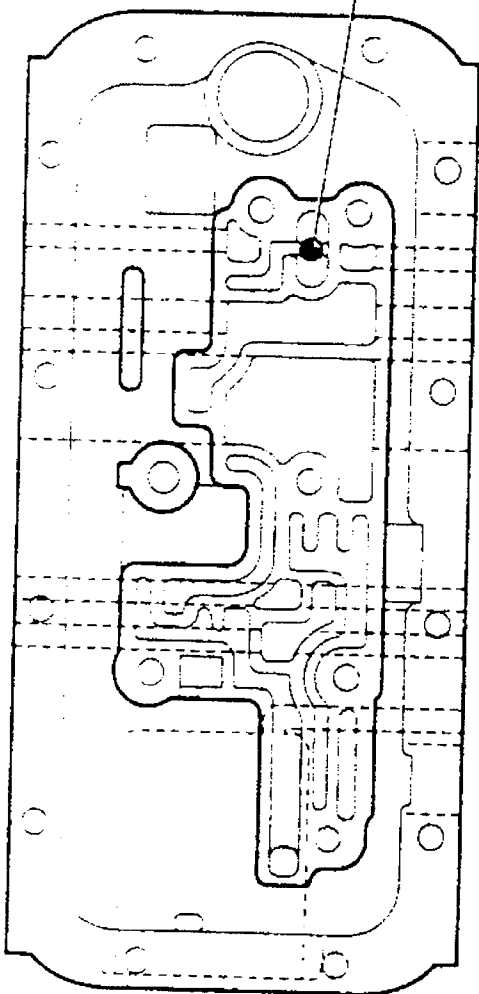
Range	Gear	RATIO	BAND	CLUTCHES					FREE WHEEL	
			B	C2	C3	C4	OC	RC	PFW	OFW
P / N	—	—	—	—	—	—	ON	—	—	—
D	1	2.856	ON	—	—	—	ON	—	LD	LD
	2	1.618	ON	ON	—	—	ON	—	—	LD
	3	1.00	—	ON	ON	—	ON	—	LC	LD
	4	0.723	—	ON	ON	ON	—	—	LC	—
3	3	1.00	—	ON	ON	—	ON	—	LC	LD
	2	1.618	ON	ON	—	—	ON	—	—	LD
	1	2.856	ON	—	—	—	ON	—	LD	LD
2	3	1.00	—	ON	ON	—	ON	—	LC	LD
	2	1.618	ON	ON	—	—	ON	—	—	LD
	1	2.856	ON	—	ON	—	ON	—	LD	LD
L	2	1.618	ON	ON	—	—	ON	—	—	LD
	1	2.856	ON	—	ON	—	ON	—	LD	LD
R	—	2.00	—	—	—	—	ON	ON	LD	LD

LC = LOCKED IN COAST

LD = LOCKED IN DRIVE

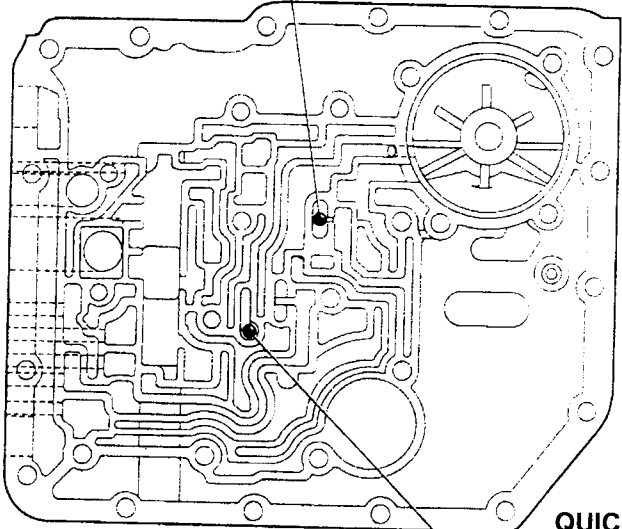
Checkballs

REVERSE
SHUTTLE



ADAPTER CASE
(AUX. VALVE BODY SIDE)

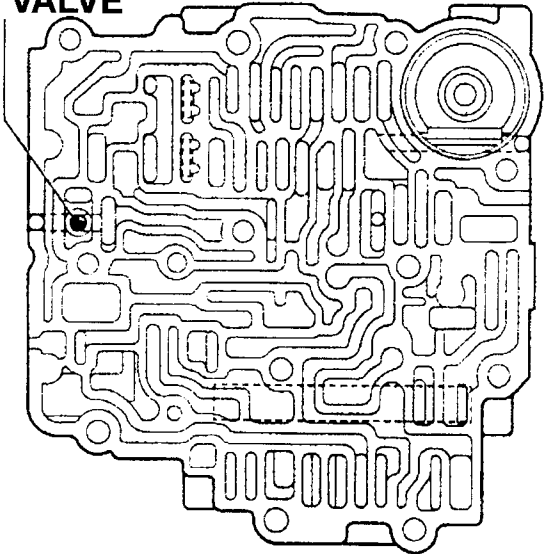
D 3 2
SHUTTLE



MAIN CASE
(TO VALVE BODY)

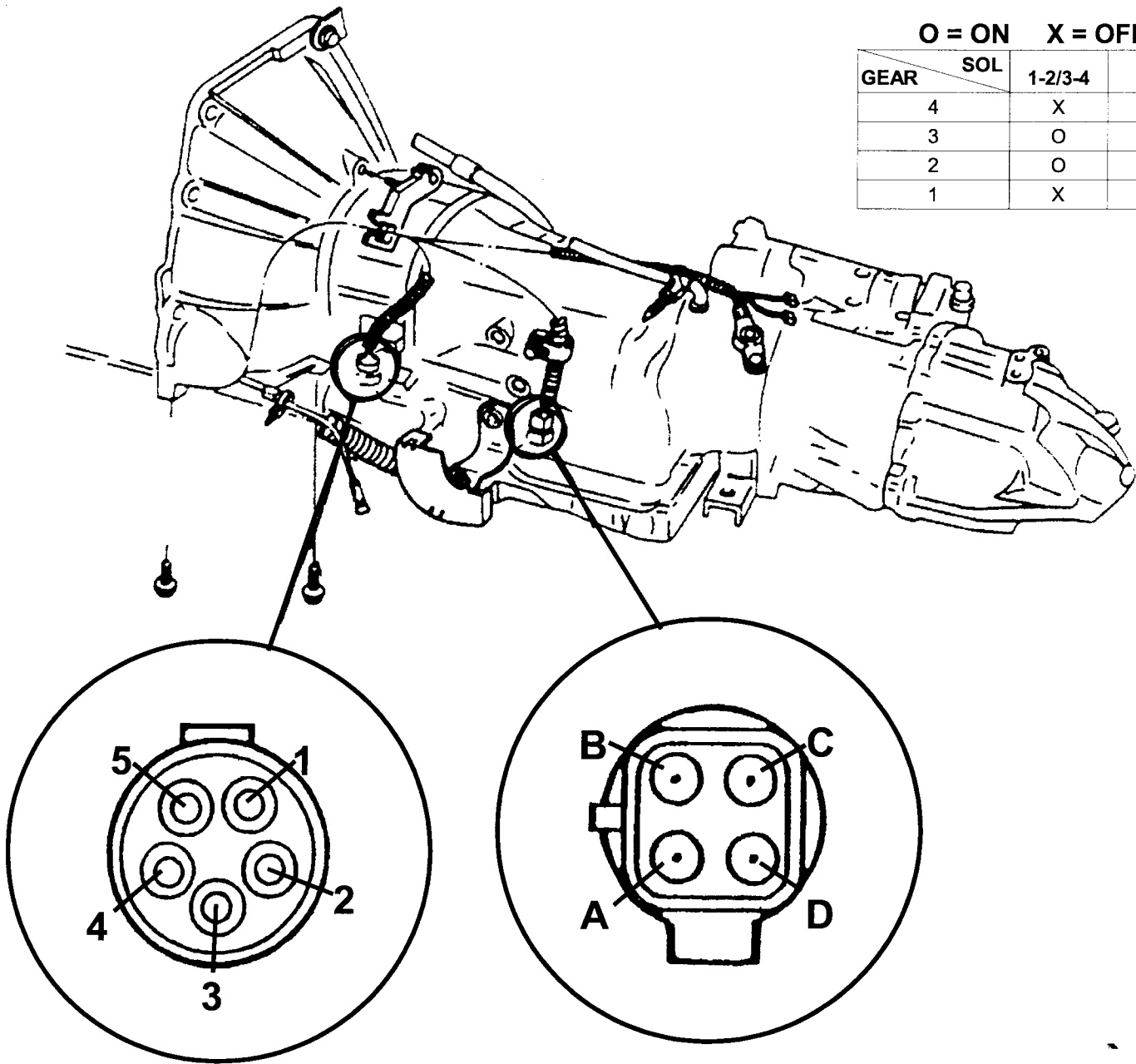
QUICK
DUMP
VALVE

3RD CLUTCH
CHECK VALVE



VALVE BODY
(MAIN CASE)

Electrical Connectors



O = ON X = OFF

GEAR	SOL	1-2/3-4	2-3
4	X	X	X
3	O	O	X
2	O	O	O
1	X	X	O

PIN	COMPONENT	RESISTANCE
1	Lock-up Solenoid	17.5-18.5 ohms
2	Force Motor (+)	3.7-4.7 ohms
3	Force Motor (-)	
4	TOT	*
5	TOT	

PIN	COMPONENT	RESISTANCE
A	2-3 Solenoid	17.5-18.5 ohms
B	Band Apply Solenoid	9.5-10.5 ohms
C	Ground	—
D	1-2 / 3-4 Solenoid	17.5-18.5 ohms

* Varies with temperature

Code 32

Force Motor Solenoid Circuit (Signal Voltage Low)

Circuit Description

The force motor solenoid is a variable position solenoid whose plunger moves in relation to the current received from the TCM. The TCM uses the force motor solenoid to control line pressure. By changing the line pressure, the TCM controls shift feel. The TCM determines the proper gear by using electronic inputs to read engine load, engine speed, and vehicle speed. As operating conditions change, the TCM changes the plunger's position by varying the amount of current (amperage) sent through the solenoid.

Line pressure can vary from less than 50 psi to more than 200 psi. The line pressure varies inversely to the amount of current. High current causes low pressure and low current causes high pressure.

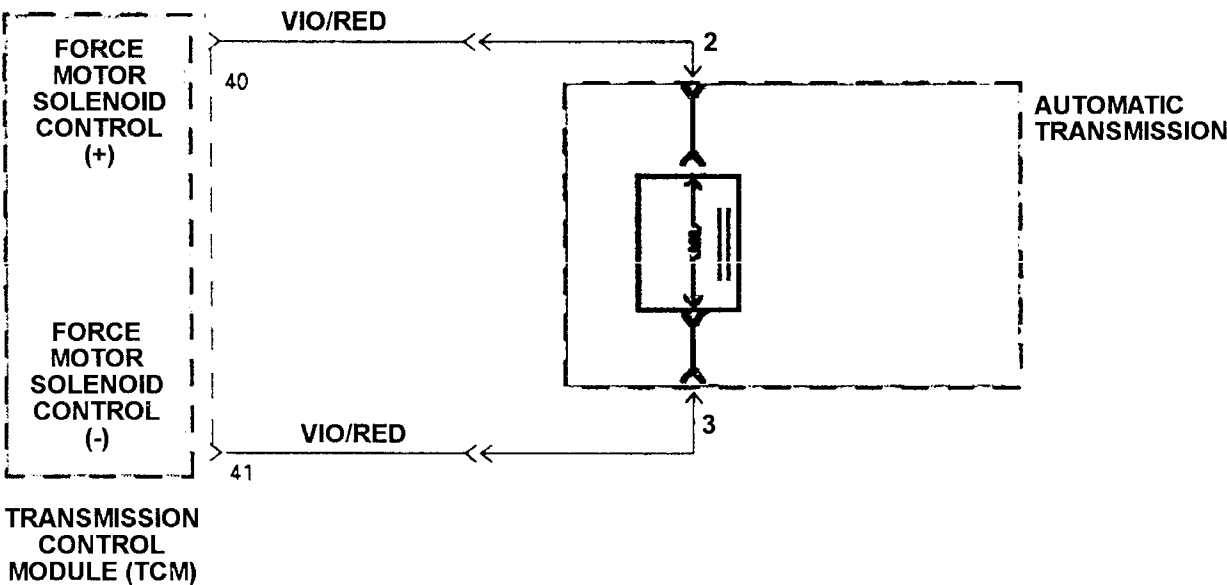
Test Description

Numbers below refer to circled numbers on the diagnostic chart.

- 1. This test determines if the solenoid windings or wires to the solenoid are open.
- 2. This test determines if the wiring or the solenoid is shorted.
- 3. This test isolates the open circuit.

Diagnostic Aids

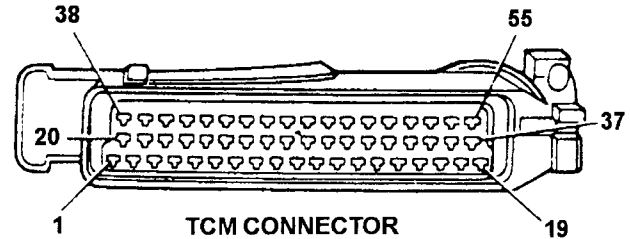
Fault Code 32 sets when the TCM detects a current draw less than 95 milliamps (0.095 amps) between terminals 40 and 41. Fault Code 33 sets when the TCM detects a current draw greater than 1.5 amps between terminals 40 and 41. In the event of an electrical failure, the force motor solenoid is turned off, allowing maximum fluid pressure.



Code 32

Force Motor Solenoid Circuit (Signal Voltage Low)

- ①
- IGNITION SWITCH OFF.
 - DISCONNECT TCM CONNECTOR.
 - CONNECT OHMMETER BETWEEN TERMINALS 40 AND 41 OF TCM CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?



YES

NO

- ②
- CONNECT OHMMETER BETWEEN TERMINAL 40 OF TCM CONNECTOR AND GROUND.
- DOES DISPLAY INDICATE AN OPEN CIRCUIT?

- ③
- DISCONNECT AUTOMATIC TRANSMISSION ADAPTER CASE CONNECTOR (FRONT)
 - CONNECT OHMMETER BETWEEN TERMINALS 2 AND 3 OF FEMALE HALF OF THE CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

NO

YES

NO

- ②
- CONNECT OHMMETER BETWEEN TERMINAL 41 OF TCM CONNECTOR AND GROUND.
- DOES DISPLAY INDICATE AN OPEN CIRCUIT?

REPAIR WIRES FOR OPEN BETWEEN TERMINAL 40 OR 41 AND ADAPTER CASE CONNECTOR.

YES

NO

- ③
- DISCONNECT SOLENOID CONNECTOR.
 - CONNECT OHMMETER BETWEEN SOLENOID TERMINALS.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

• CHECK FOR FAULTY TCM CONNECTION. IF OK, REPLACE TCM.

• CHECK WIRING BETWEEN TERMINALS OF TCM CONNECTOR AND SOLENOID CONNECTOR FOR A SHORT. IF OK, REPLACE FORCE MOTOR SOLENOID.

YES

NO

REPAIR WIRES FOR OPEN BETWEEN ADAPTER CASE CONNECTOR AND SOLENOID CONNECTOR.

REPLACE FORCE MOTOR SOLENOID.

Code 33

Force Motor Solenoid Circuit (Signal Voltage High)

Circuit Description

The force motor solenoid is a variable position solenoid whose plunger moves in relation to the current received from the TCM. The TCM uses the force motor solenoid to control line pressure. By changing the line pressure, the TCM controls shift feel. The TCM determines the proper gear by using electronic inputs to read engine load, engine speed, and vehicle speed. As operating conditions change, the TCM changes the plunger's position by varying the amount of current (amperage) sent through the solenoid.

Line pressure can vary from less than 50 psi to more than 200 psi. The line pressure varies inversely to the amount of current. High current causes low pressure and low current causes high pressure.

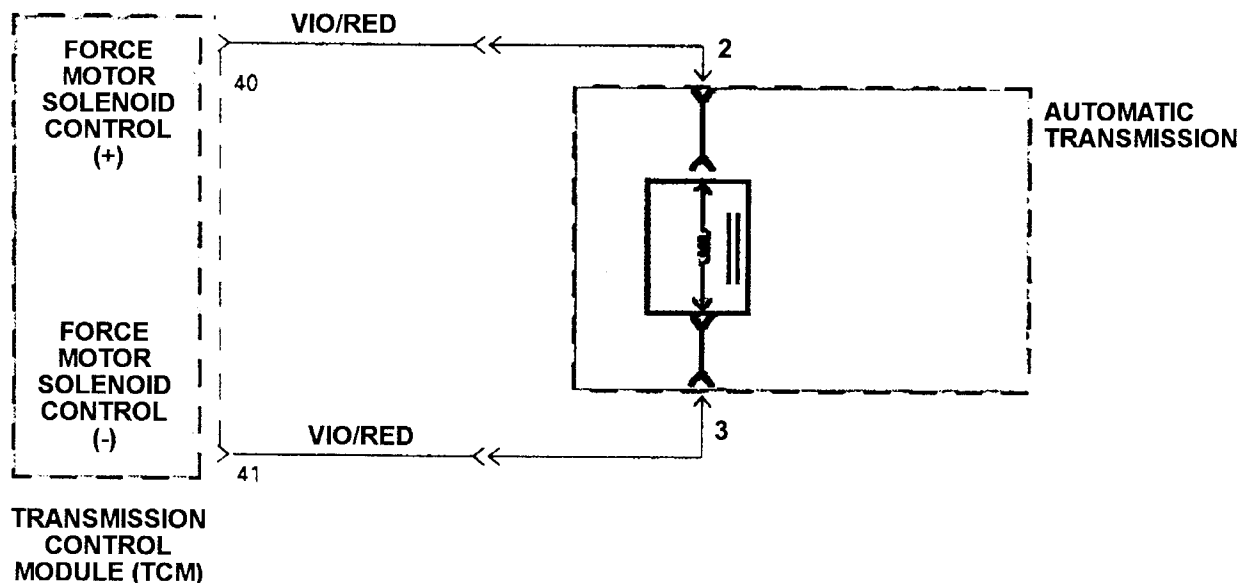
Test Description

Numbers below refer to circled numbers on the diagnostic chart.

1. This test determines if the solenoid windings or wires to the solenoid are open.
2. This test checks for a short to voltage at terminals 40 and 41 of TCM connector.
3. The wire between terminal 40 of the TCM connector may be shorted to a supply wire to another solenoid at the adapter case connector.
4. The wire between terminal 2 of the adapter case connector may be short to a supply wire to another solenoid at the adapter case connector.

Diagnostic Aids

Fault Code 32 sets when the TCM detects a current draw less than 95 milliamps (0.095 amps) between terminals 40 and 41. Fault Code 33 sets when the TCM detects a current draw greater than 1.5 amps between terminals 40 and 41. In the event of an electrical failure, the force motor solenoid is turned off, allowing maximum fluid pressure.



Code 33

Force Motor Solenoid Circuit (Signal Voltage High)

- 1
- IGNITION SWITCH OFF.
 - DISCONNECT TCM CONNECTOR.
 - CONNECT OHMMETER BETWEEN TERMINALS 40 AND 41 OF TCM CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

- 2
- CONNECT VOLTMETER BETWEEN TERMINAL 40 OF TCM CONNECTOR AND GROUND.
 - IGNITION SWITCH ON.
- DOES DISPLAY INDICATE APPROXIMATELY 0 VOLT?

YES

- CHECK FOR FAULTY TCM CONNECTION.
- IF OK, REPLACE TCM.

NO

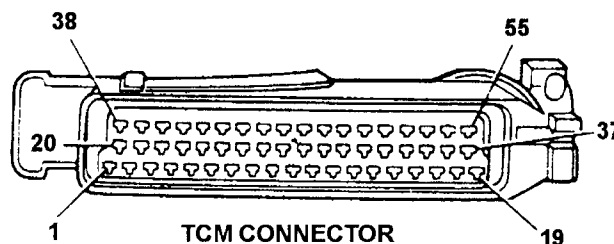
- 2
- CHECK WIRING BETWEEN TERMINALS OF TCM CONNECTOR AND SOLENOID CONNECTOR FOR A SHORT TO VOLTAGE.
- DOES DISPLAY INDICATE A SHORT TO +?

YES

- IF SHORT TO +:
1. BETWEEN TERMINAL 41 AND SOLENOID, REPAIR AND REPLACE TCM.
 2. BETWEEN TERMINAL 40 AND SOLENOID, REPAIR

NO

REPLACE FORCE MOTOR SOLENOID



NO

- 1
- DISCONNECT AUTOMATIC TRANSMISSION ADAPTER CASE CONNECTOR (FRONT).
 - CONNECT OHMMETER BETWEEN TERMINALS 2 AND 3 OF FEMALE HALF OF THE CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

- 3
- REPAIR WIRES FOR OPEN/SHORT BETWEEN TERMINAL 40 AND ADAPTER CASE CONNECTOR WIRE.

NO

- DISCONNECT SOLENOID CONNECTOR.
 - CONNECT OHMMETER BETWEEN SOLENOID TERMINALS.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

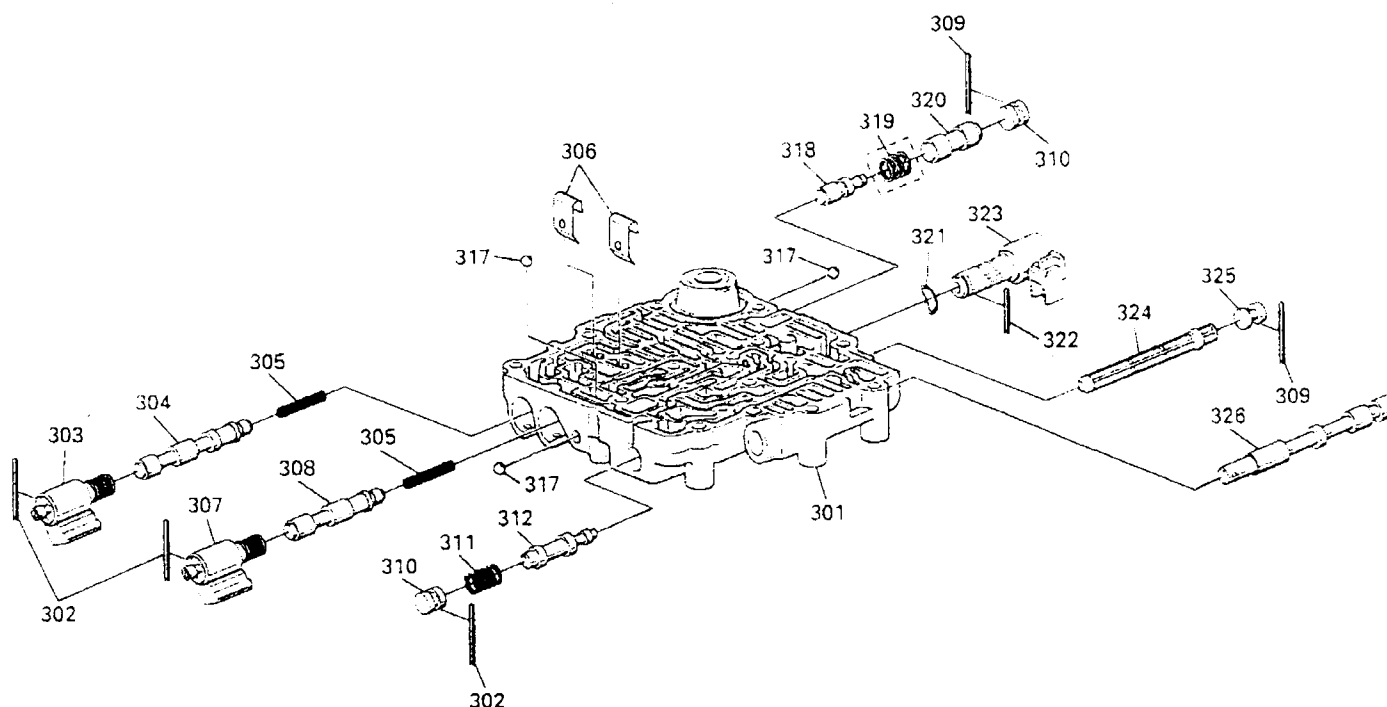
- 4
- REPAIR WIRES FOR OPEN/SHORT BETWEEN ADAPTER CASE CONNECTOR AND ANOTHER WIRE.

NO

REPLACE FORCE MOTOR SOLENOID.

Delays Forward

A delayed forward engagement condition can be caused by Band Control Solenoid (323). It is not uncommon for the solenoid feed screen (324) to break apart, clogging the solenoid. If the screen is broken, replace **both** the screen and the solenoid.



301 BODY, VALVE MAIN CASE
 302 PIN, SPRING
 303 SOLENOID ASSEMBLY, ON/OFF N.C.
 304 VALVE, 1-2 & 3-4 SHIFT
 305 SPRING, 1-2 & 3-4 (2-3) SHIFT
 306 RETAINER, VALVE
 307 SOLENOID ASSEMBLY, ON/OFF N.O.
 308 VALVE, 2-3 SHIFT
 309 PIN, SPRING
 310 PLUG, VALVE BORE
 311 SPRING, VALVE LOW PRESSURE CONTROL

312 VALVE, LOW PRESSURE CONTROL
 317 BALL, CHECK
 318 VALVE, 1-2 ACCUMULATOR CONTROL
 319 SPRING, 1-2 ACCUMULATOR CONTROL (OPTIONAL)
 320 VALVE, 1-2 ACCUMULATOR
 321 WASHER, WAVED PWM SOLENOID
 322 PIN, SOLENOID PWM
 323 SOLENOID ASSEMBLY, BAND CONTROL PWM
 324 SCREEN ASSEMBLY, PWM SOLENOID
 325 PLUG, SCREEN
 326 VALVE, MANUAL

Isuzu Part Numbers

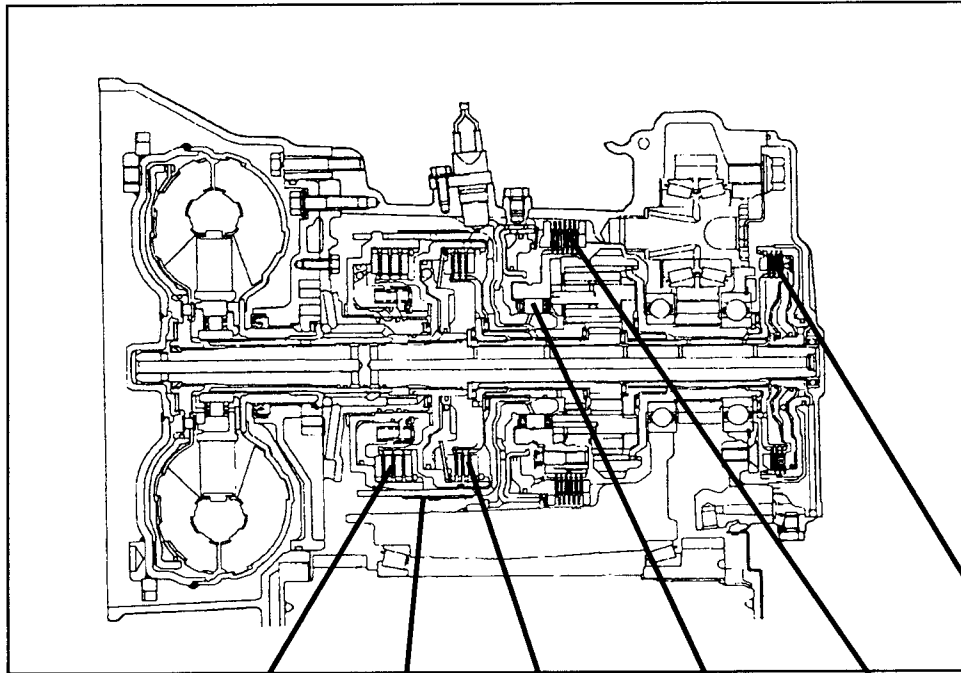
Band Apply Solenoid	8-96042-006-0
Band Apply Solenoid Screen	8-96041-012-0

KM175

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No Forward	117

KM175



KM175

Range	Gear	Direct (Front) Clutch	Inter-mediate Band	Forward (Rear) Clutch	Low Sprag	Low Reverse Clutch	End Clutch
R	Reverse	Applied				Applied	
D	1st			Applied	Applied		
	2nd		Applied	Applied			
	3rd	Applied		Applied			Applied
	4th		Applied				Applied
2	1st			Applied	Applied		
	2nd		Applied	Applied			
L	1st			Applied	Applied ★	Applied	

 = Applied or holding

★ = Ineffective due to Low Reverse Clutch

Gear Ratios

	Wide Ratio	Close Ratio
1st	2.846:1	2.551:1
2nd	1.581:1	1.488:1
3rd	1.0:1	11.0:1
4th	.685:1	.685:1
Reverse	2.176:1	2.776:1

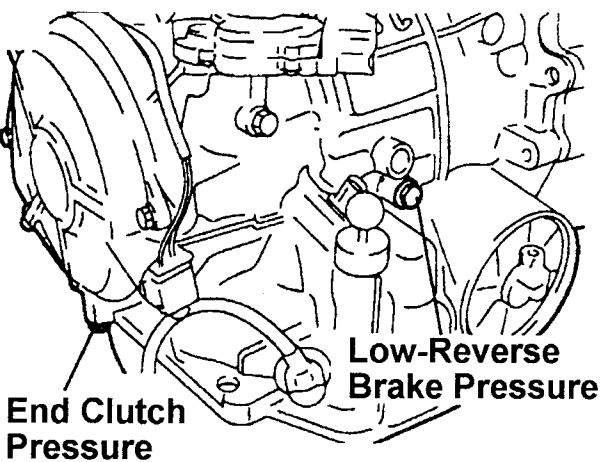
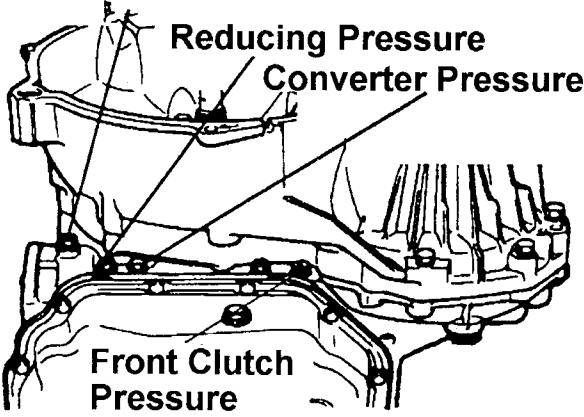
Failsafe Mode

D	3rd
2	3rd
1	3rd

Pressure Tap Locations

KM175-1 (1985-86 Galant)

Kickdown Brake Pressure



Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	36-56	•	•	•	•	••
N	Approx. 2500*	Neutral	36-56	•	•	•	•	29-34
D	Idling*	2nd gear	36-56	15-30	•	•	•	••
D (Sw-On)	Approx. 2500*	4th gear	36-56	89-97	•	89-97	•	••
D (Sw-Off)	Approx. 2500*	3rd gear	36-56	89-97	89-97	89-97	•	••
2	Approx. 2500*	2nd gear	36-56	89-97	•	•	•	••
L	Approx. 1000*	1st gear	36-56	•	•	•	43-60	••
R	Approx. 2500*	Reverse	36-56	•	165-251	•	165-251	••

- Must be less than 2 psi
- Pressure is present but not the standard value

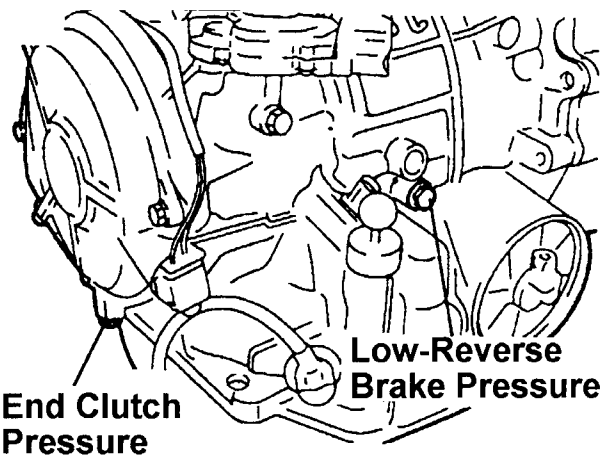
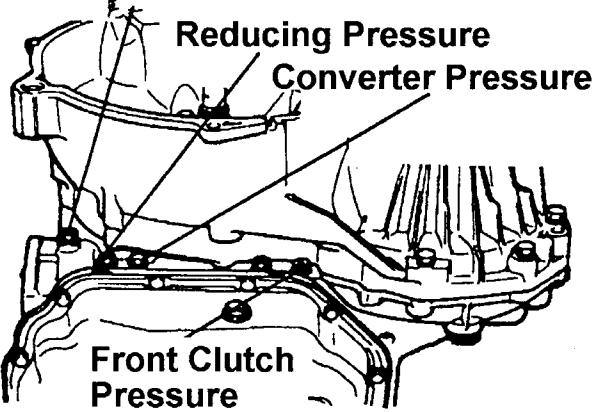
Pressure Specification Chart 2

KMI75-1 (1987 Galant)

Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	48-72	•	•	•	•	••
N	Approx. 2500*	Neutral	48-72	•	•	•	•	50-64
D	Idling*	2nd gear	48-72	15-30	•	•	•	••
D (Sw-On)	Approx. 2500*	4th gear	48-72	118-128	•	118-128	•	••
D (Sw-Off)	Approx. 2500*	3rd gear	48-72	118-128	118-128	118-128	•	••
2	Approx. 2500*	2nd gear	48-72	118-128	•	•	•	••
L	Approx. 1000*	1st gear	48-72	•	•	•	43-60	••
R	Approx. 2500*	Reverse	48-72	•	234-319	•	234-319	••
	Approx. 1000*				214 or more	•	214 or more	

Pressure Tap Locations (cont'd)
KM175, KM176, KM177, F4A21, F4A22, F4A23
(1989-96 All)

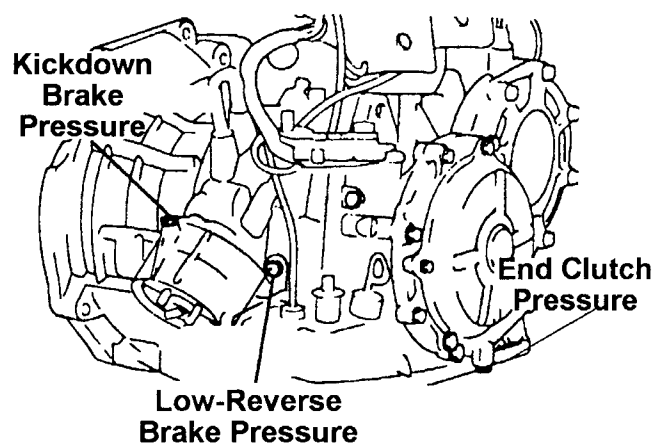
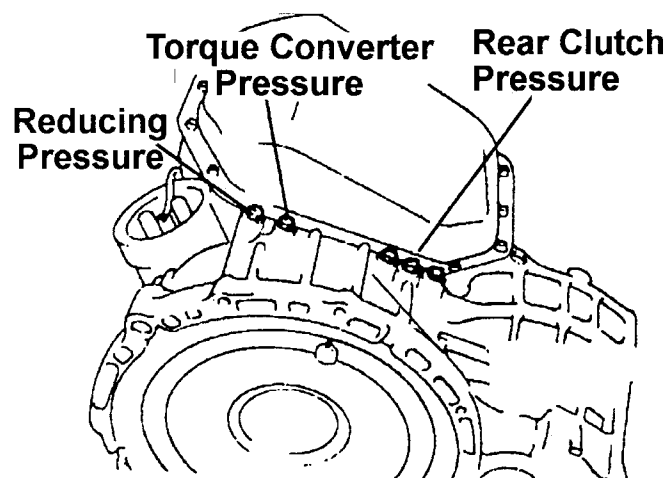
Kickdown Brake Pressure



Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Approx. 2500*	Neutral	52-71	•	•	•	•	••
D	Idling*	2nd gear	52-71	15-30	•	•	•	••
D (Sw-On)	Approx. 2500	4th gear	52-71	120-131	•	120-131	•	51-84
D (Sw-Off)	Approx. 2500	3rd gear	52-71	120-131	120-131	120-131	•	51-84
2	Approx. 2500	2nd gear	52-71	120-131	•	•	•	51-84
L	Approx. 1000*	1st gear	52-71	•	•	•	43-60	••
R	Approx. 2500	Reverse	52-71	•	238-325	•	238-325	51-84
	Approx. 1000*				218 or more		218 or more	

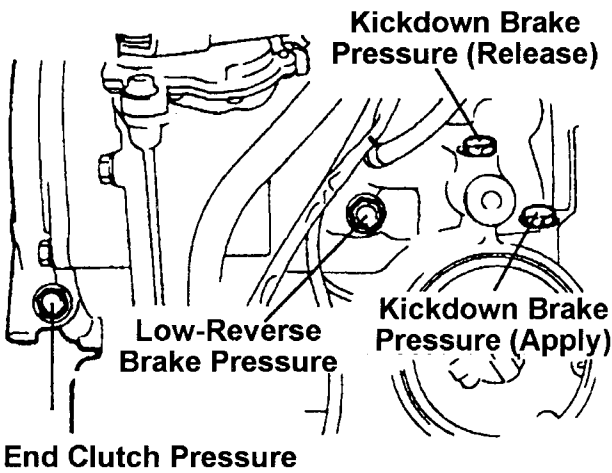
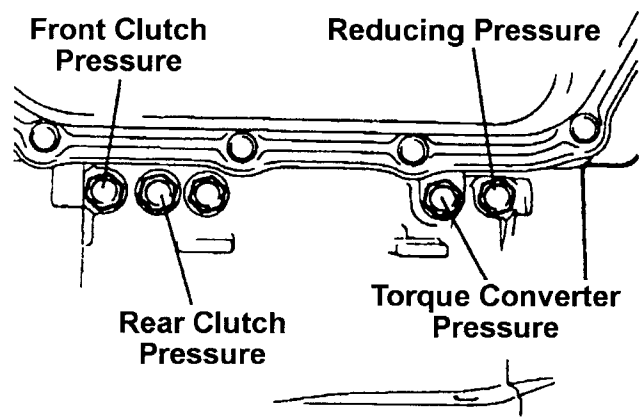
Pressure Tap Locations (cont'd)

A4AF1 ('93, '94 Scoupe)



Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	53-70	•	•	•	•	••
D	Idling*	2nd gear	53-70	14-30	•	•	•	••
D (Sw-On)	Approx. 2500*	4th gear	53-70	118-128	•	118-128	•	56-84
D (Sw-Off)	Approx. 2500*	3rd gear	53-70	118-128	118-128	118-128	•	56-84
2	Approx. 2500*	2nd gear	53-70	118-128	•	•	•	56-84
L	Approx. 1000*	1st gear	53-70	•	•	•	43-63	••
R	Approx. 2500	Reverse	53-70	•	233-318	•	233-318	56-84
	Approx. 1000*				213 or more		213 or more	

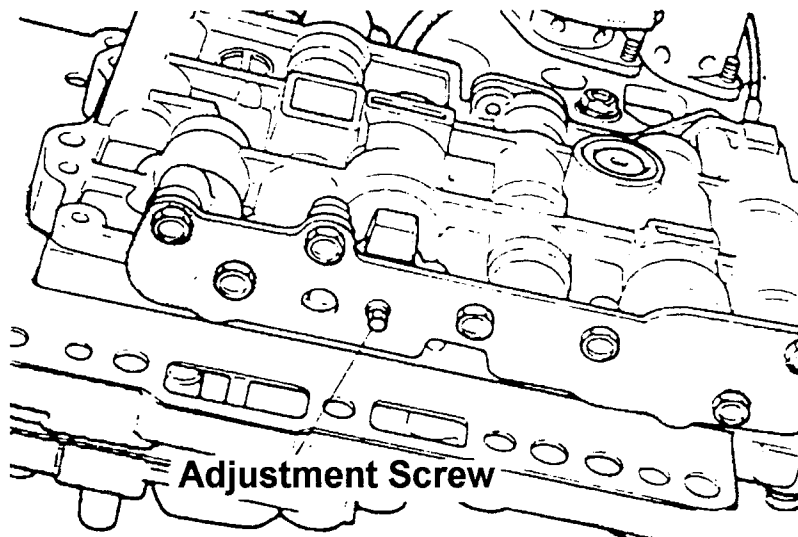
Pressure Tap Locations (cont'd)
F4A33, W4A32, W4A33



Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Kickdown Brake Pressure (apply)	Front Clutch Pressure	Rear Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	52-70	.	.	.	.	.	.	..
D	Idling*	2nd gear	52-70	15-30	.	.	106-120	.	.	..
D (Sw-On)	Approx. 2500*	4th gear	52-70	120-131	.	.	.	120-131	.	65-94
D (Sw-Off)	Approx. 2500*	3rd gear	52-70	120-131	120-131	118-128	120-131	120-131	.	65-94
2	Approx. 2500*	2nd gear	52-70	120-131	.	.	120-131	.	.	65-94
L	Approx. 1000*	1st gear	52-70	.	.	.	120-131	.	44-65	..
R	Approx. 2500	Reverse	52-70	.	238-325	238-325	.	.	238-325	65-94
	Approx. 1000*				218 or more	218 or more			218 or more	

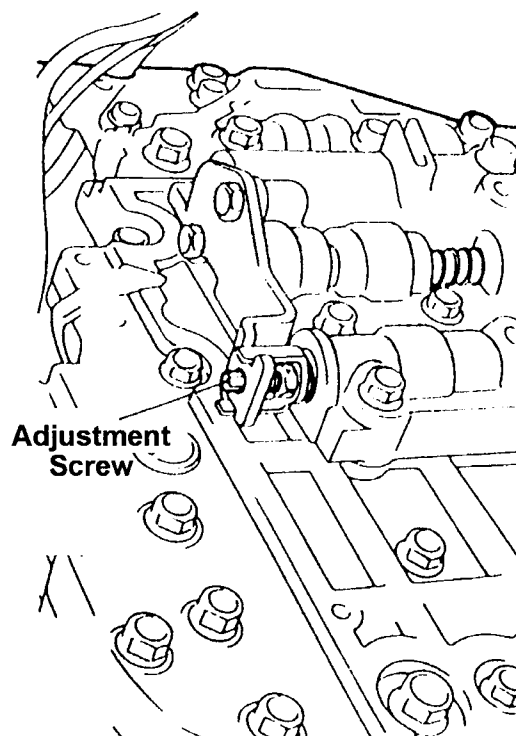
Pressure Adjustment

Main Line Pressure



NOTE:
Each turn of the
screw affects
pressure
approximately 5 psi.

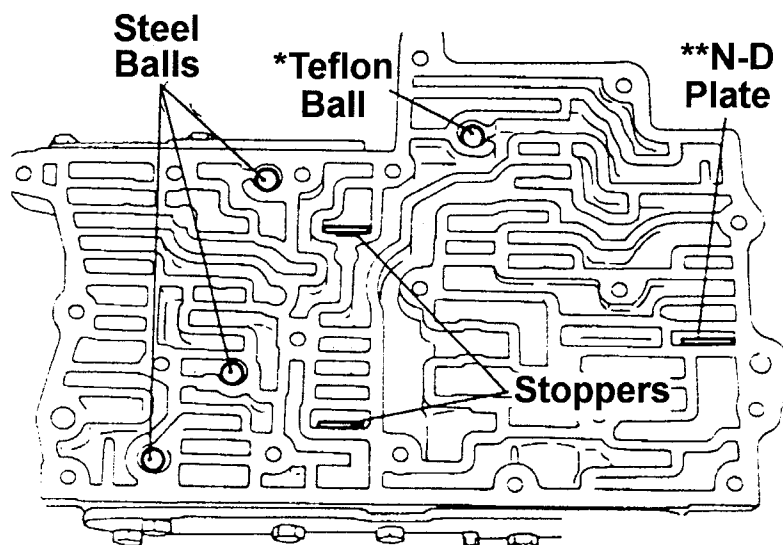
Reducing Pressure



NOTE:
Each turn of the
screw affects
pressure
approximately 6 psi.

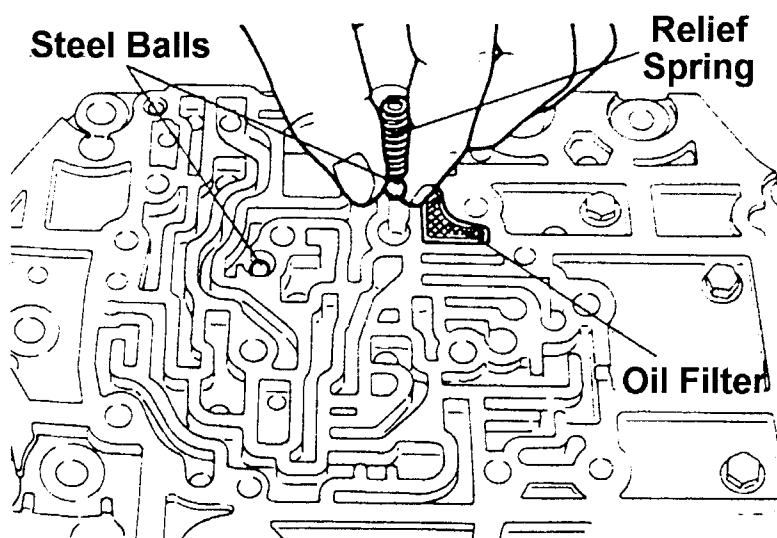
IMPORTANT: Reducing pressure is used, in part, to control shift feel.
Higher pressure will offer firmer shifts.

Checkballs



* 1985-90 models
use a steel ball

** Used with 1991
and later only.

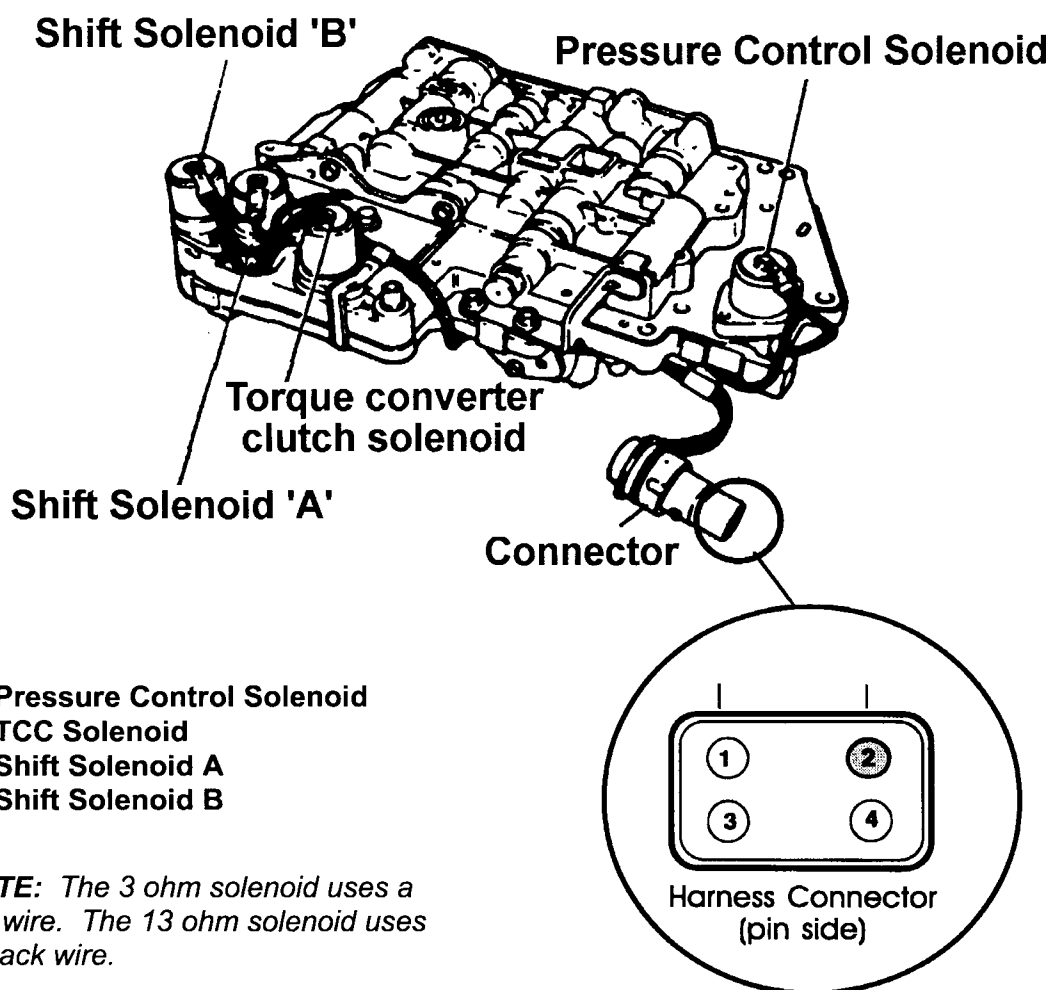


TCC Failure

TCC Solenoid Change

The TCC solenoid used on all 1993 and later Chrysler and Mitsubishi F4A and W4A transaxles (except Precis) is different than the solenoid used on earlier models. The resistance of the previous solenoid is 3 ohms. The new solenoid has a resistance of 13 ohms.

Caution should be taken when changing solenoids (or valve bodies) to prevent interchange of the solenoid types. Using the 3 ohm solenoid on a 1993 and later vehicle will damage the TCU (Transaxle Control Unit).



Planet Failure

Often times the mainshaft will become clogged with friction material from the torque converter. The best way to clean the shaft is to remove the end plug, then blow air through the shaft at the end of the shaft and the lube feed hole.

The part number for the plug is:

MF 665531	10mm (.400")	1989-92
MD712132	8mm (.320")	1992-96

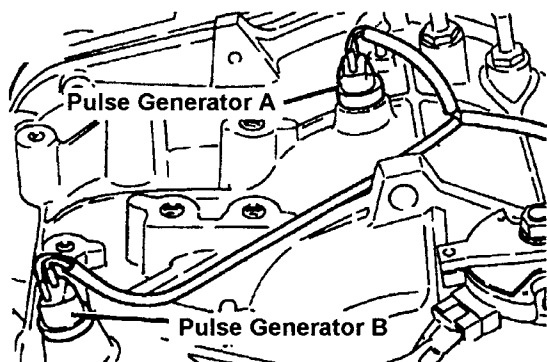


Third Gear Starts

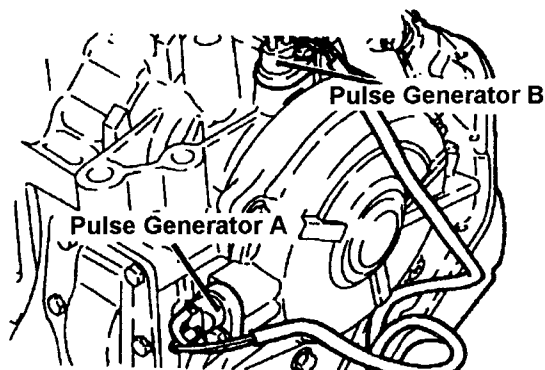
A third gear (limp-in) condition after rebuild can be caused by pulse generator 'A' and 'B' installed in the incorrect location.

Pulse generator 'A' senses the rpm of the sun gear shell (or the turbine shaft on some models) and has solid green wires leading to it. Pulse generator 'B' senses the rpm of the transfer shaft and has green wires with a black tracer. The length of the wires can vary from model to model. Do not install the pulse generators based on wire length.

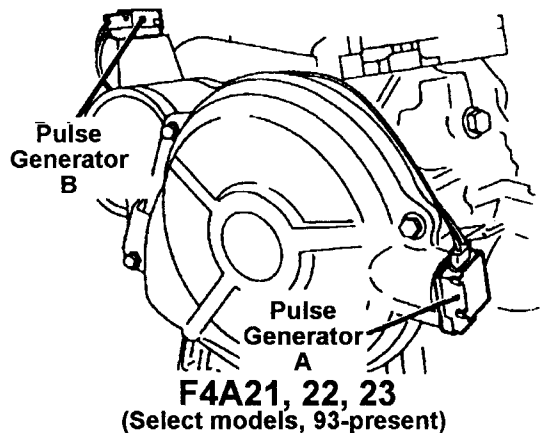
CAUTION: The first design (round) pulse generator connector has the same configuration as some mass airflow sensor connectors. The second design (rectangular) pulse generator connector has the same configuration as the second design solenoid harness connector. It is possible on some models to cross-connect the components resulting in limp-in mode (third gear only).



KM175, 176, 177, F4A21, 22, 23

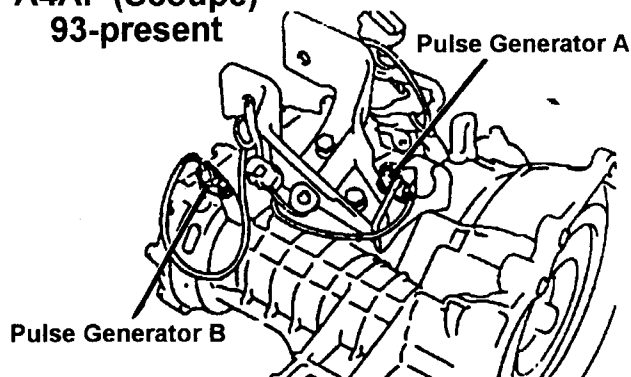


F4A33, W4A32, 33



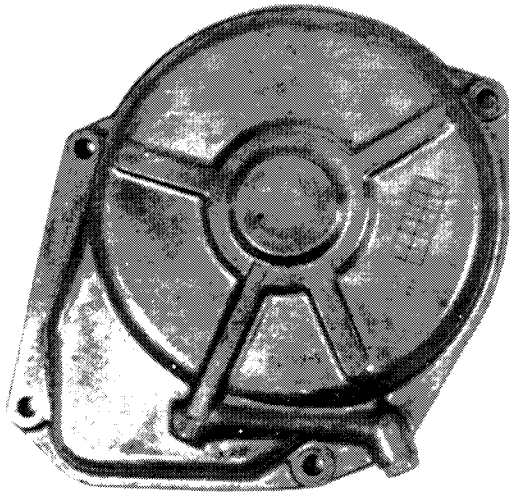
F4A21, 22, 23
(Select models, 93-present)

A4AF (Scoupe)
93-present

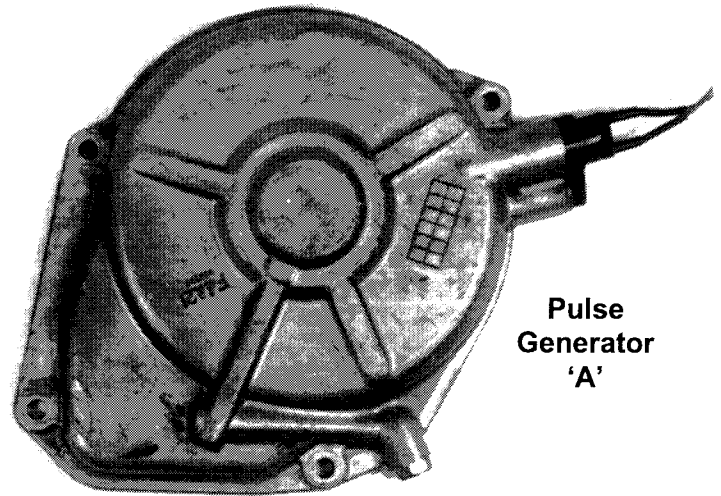


End Clutch Drum Change

The end clutch drum was modified in 1993 for models that used a pulse generator on the end clutch cover. The added length of the drum lugs is essential for proper pulse generator 'A' function.

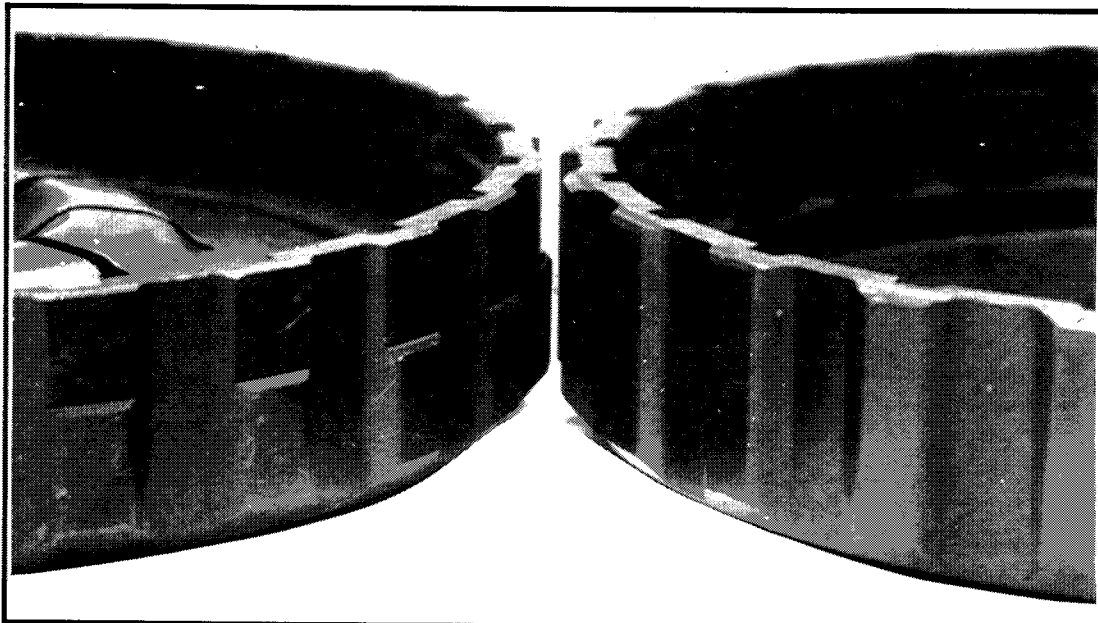


1989-92



1993-ON

NOTE: All F4A33 and W4A32 & 33 units use the late style drum. Production of these units began in 1991.



1989-92
(Half-Length Lugs)

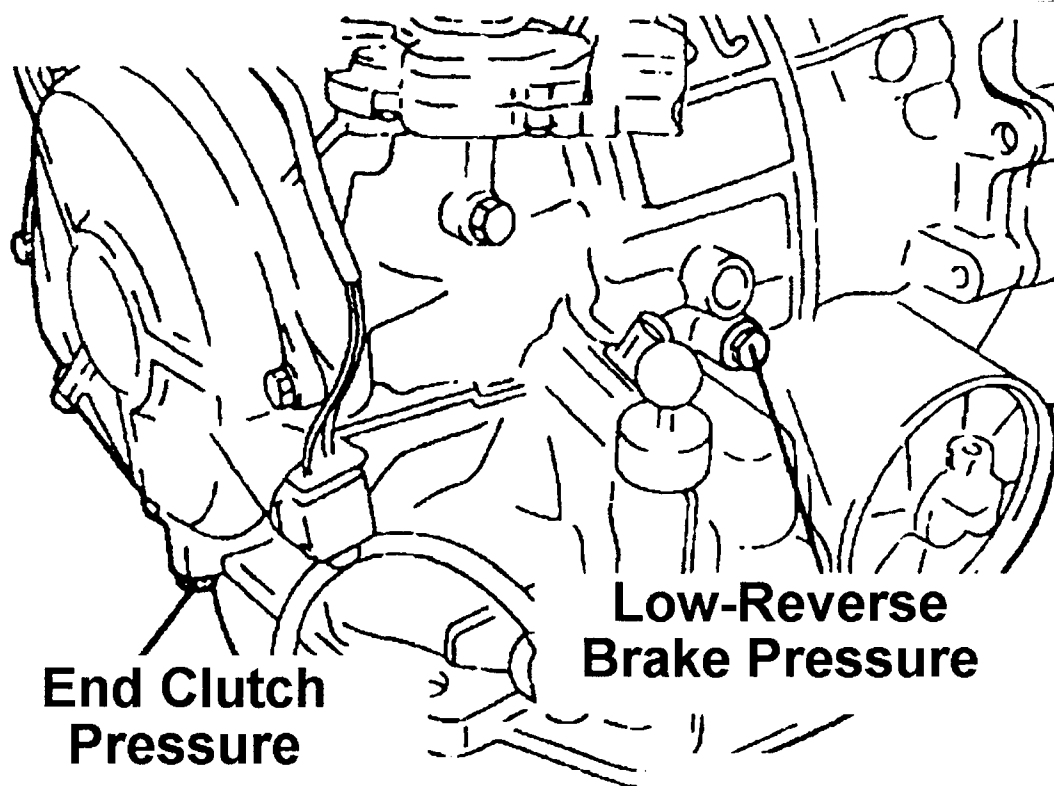
1993-ON
(Full-Length Lugs)

Shifts 1-2-3-Neutral

The KM Series four speed transaxles have an end clutch, which is applied in third and fourth gear. When the end clutch does not apply, the transaxle neutrals on the 3-4 shift. The following procedures should be performed to diagnose the end clutch.

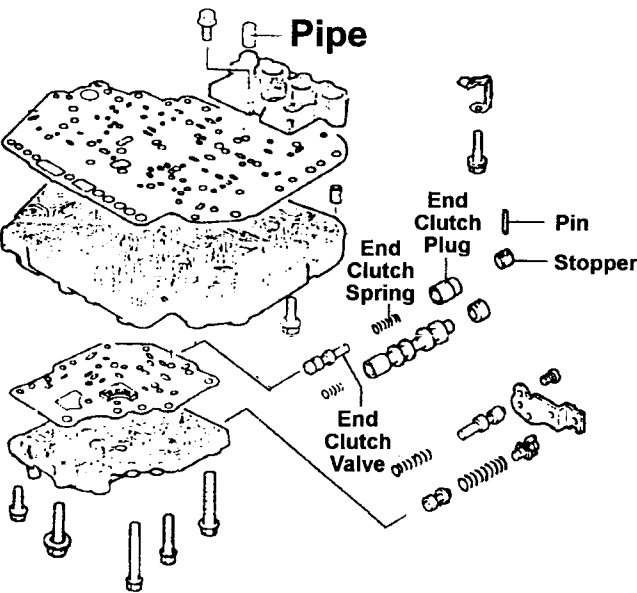
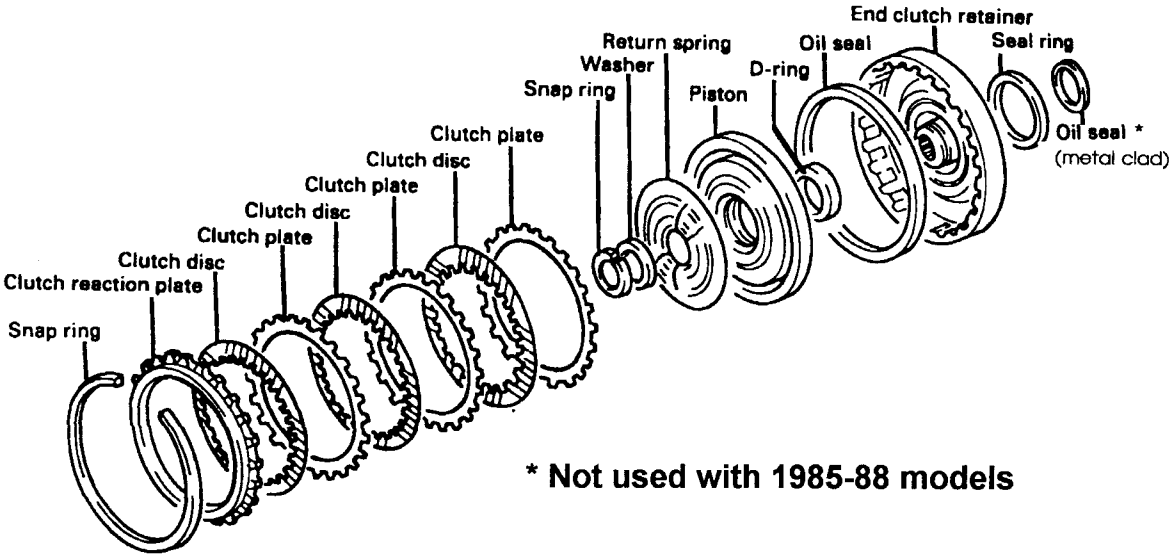
STEP 1 Install a pressure gauge on the end clutch tap

STEP 2 With the transaxle in third gear, end clutch pressure should be 118-128 psi (87-97 psi for 1985-86 Galant).



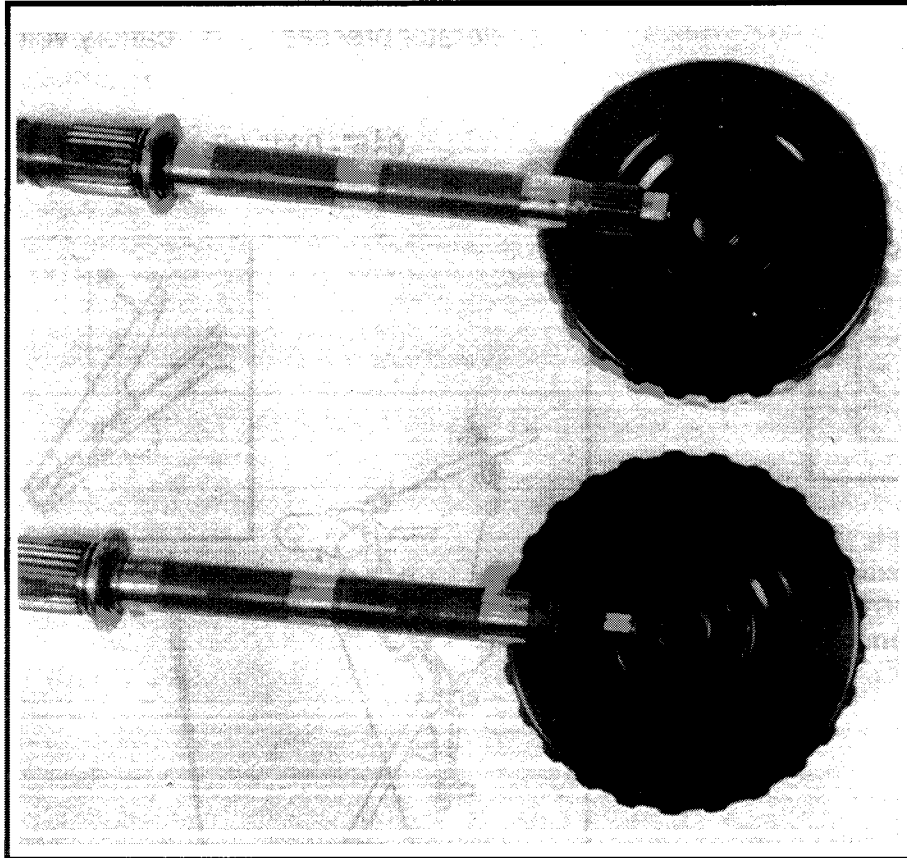
Shifts 1-2-3-Neutral (cont'd)

- STEP 3** If the pressure at the end clutch is low, the problem is usually caused by a leak in the end clutch piston seals, sealing ring or drum seal.
- STEP 4** If there is no pressure at the end clutch, the problem is usually caused by a stuck end clutch valve or missing valve body to case feed pipe.



Mainshaft Change

The mainshaft was modified toward the end of the 1992 production year. The end clutch seal journal diameter was reduced. The large and small journal shafts are interchangeable provided the seal is correct.



1989-91

1992-ON

1st Design Seal #MD722531

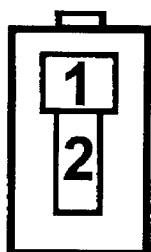
2nd Design Seal #MD736847

Harsh Coast-down Shifts

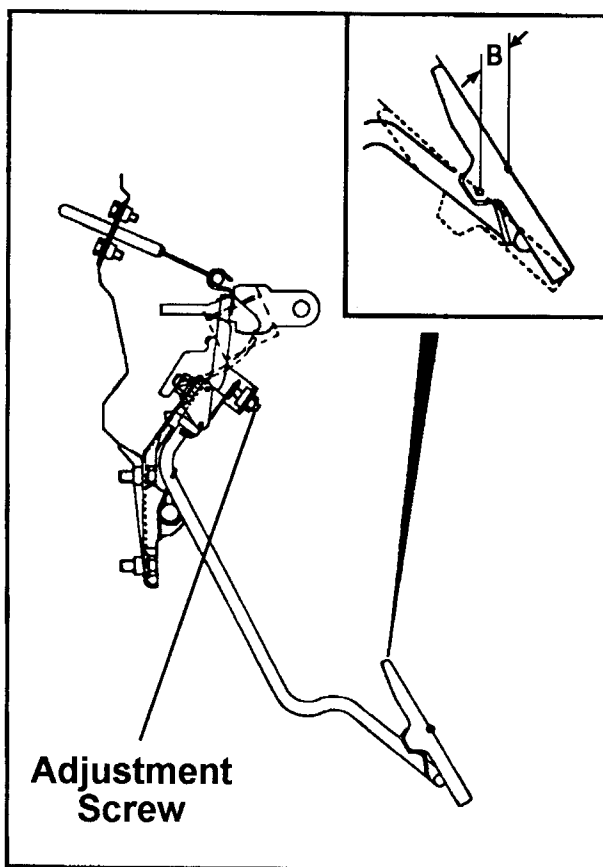
A harsh coast-down shift is usually caused by an accelerator switch that is out of adjustment. The accelerator switch is used to signal the TCU that the driver is or is not stepping on the accelerator. The test procedure is outlined below.

Voltage check between pins one and two accelerator released = zero volts (less than .1)
accelerator pressed = battery voltage

.016"-.031" (distance B)



Accelerator
Switch
Harness
Connector

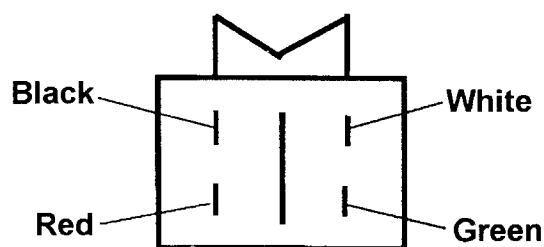


Third and Reverse Only

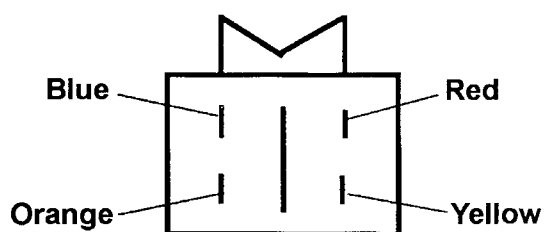
Multiple Codes

Some KM175 series transaxles may have multiple codes set in computer memory and have only third and reverse after overhaul.

This condition may be caused by plugging the pulse generator connector into the solenoid harness and the shift solenoid connector into the pulse generator harness. Use the figures below to correctly identify the harness connectors and locations.

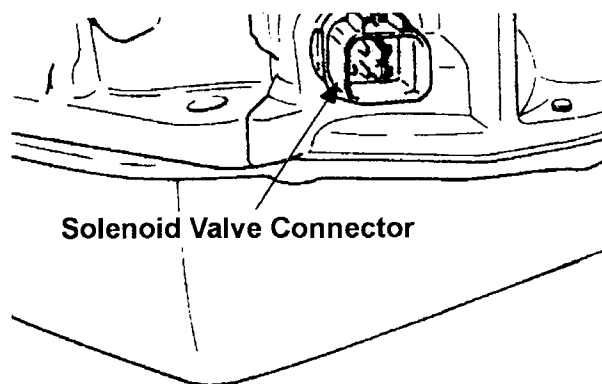
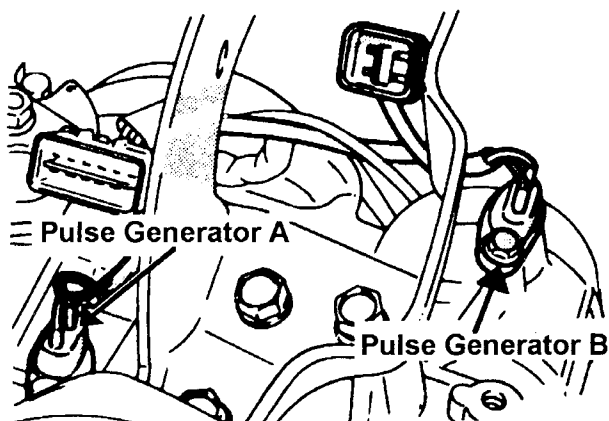


**Harness Connector for
Pulse Generator**



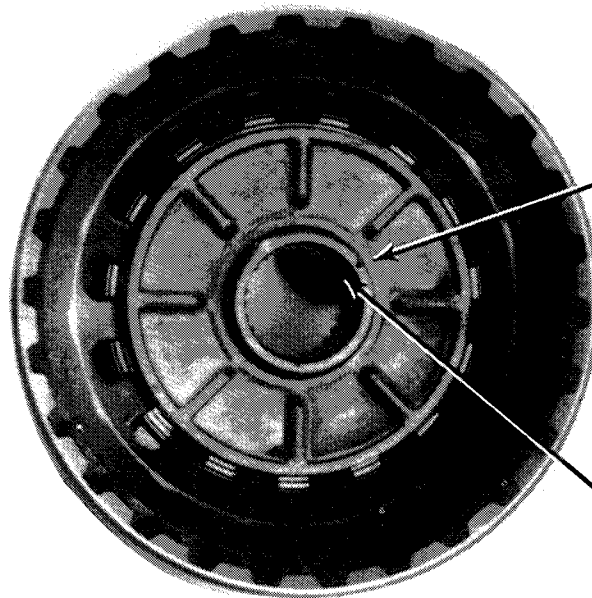
**Harness Connector for
Transaxle Solenoids***

** Some models may vary*



Delayed Forward Engagement

A delayed forward engagement can be the result of a mis-assembly of the rear clutch drum and input shaft. 1989 and later KM175 series transaxles (including the KM176, 177, F4A21, F4A22, F4A23, F4A33, W4A32 and W4A33) use three slots in the turbine shaft to feed the three holes in the rear clutch drum. It is important that the holes in the drum line-up with the slots on the shaft.

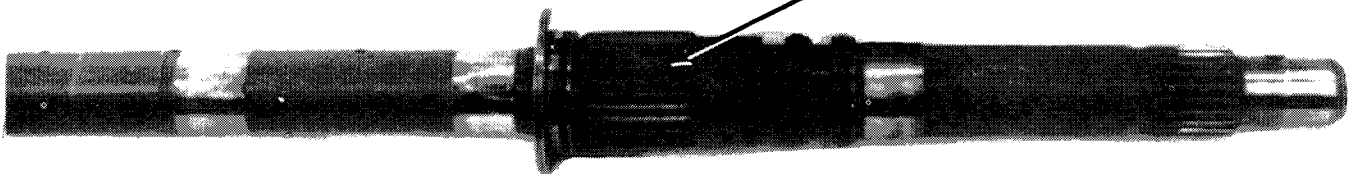


HINT: Line up one of the slots in the shaft with the ID mark in the drum.

The slots in the shaft must line up with the holes in the drum

The drum has three holes.

The shaft has three slots.

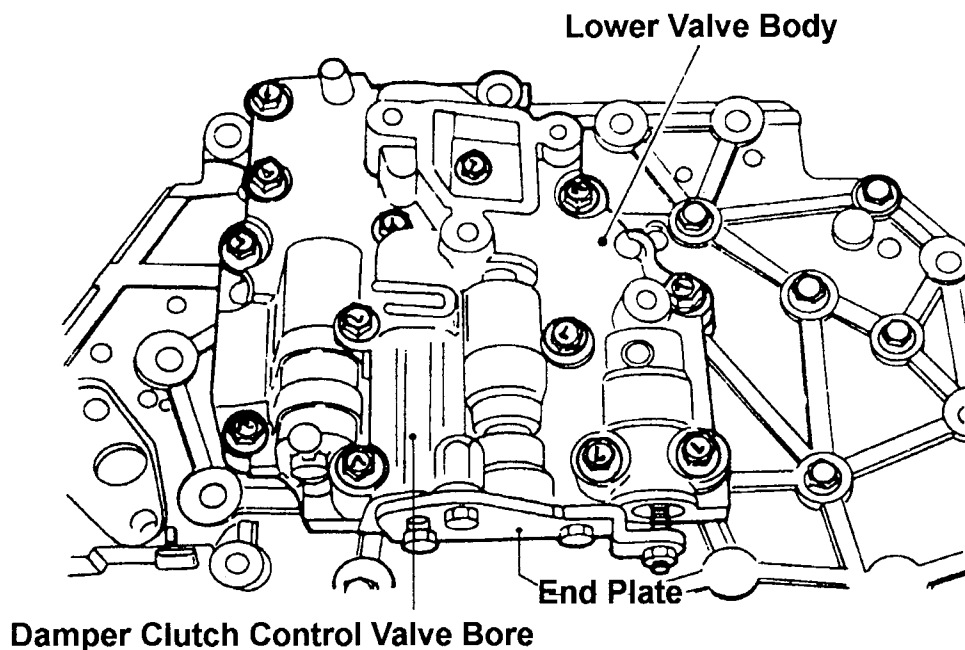


No Movement After Rebuild

No Torque Converter Charge

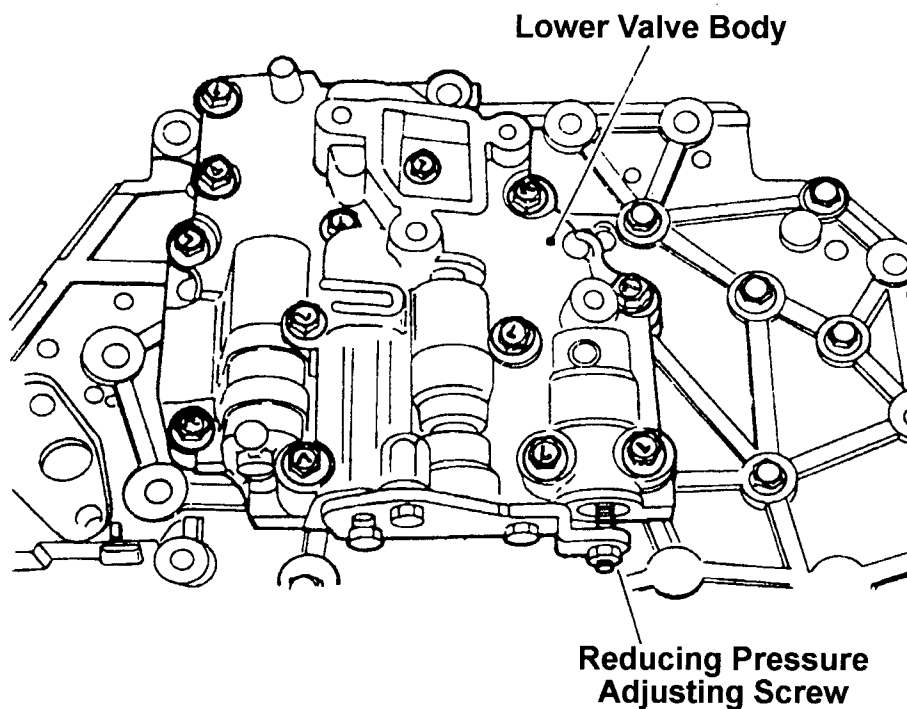
A no movement condition after rebuild can be caused by a stuck damper clutch control valve. The following procedure should be used to prevent the valve from sticking.

- STEP 1** Tighten the lower valve body bolts to 36-48 in. lbs.
- STEP 2** Remove the end plate that retains the damper clutch control valve.
- STEP 3** If the valve is dragging in the bore, loosen the bolts surrounding the valve until it moves smoothly.
- STEP 4** Attach the filter. Make sure the valve does not drag in the bore after the filter bolts are tightened.



2-3 Flare

The KM175 series valve body has no provisions for changing the shift feel of one shift without affecting the others. Assuming clutch clearance and servo travel are correct (and the front clutch air checks with low pressure), adjust reducing pressure higher. This will increase the pressure to all of the shifting elements. Provided the 1-2 shift, 3-4 shift and torque converter apply do not become aggressive, this adjustment will usually fix the complaint. However, often times, a 2-3 flare condition is due to the composition of the friction plates. If raising reducing pressure does not correct the 2-3 flare, check this list of factory frictions below.

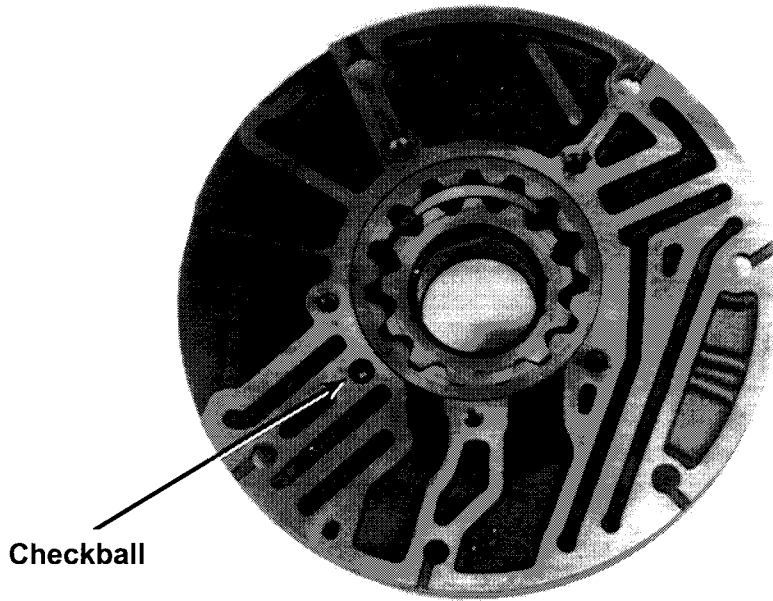


The following is a list of factory front clutch frictions

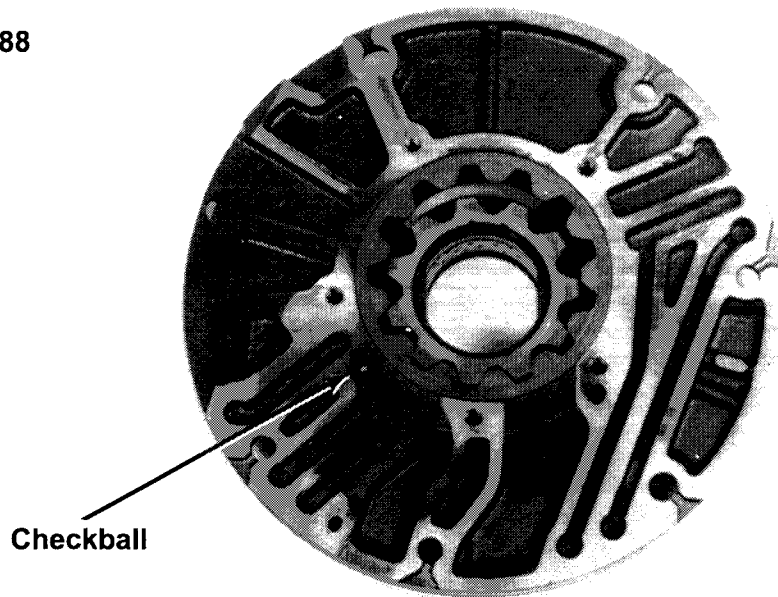
1985-88	MD 713655
1989-96	MD 737892
1991-96	MD 735828 (32 and 33 Series)

No Forward After Rebuild

A no forward condition after rebuild can be caused by a missing checkball between the pump halves. The checkball diameter is 9mm (.354") for 1985-90 models. 1991 and later models use a 5.5mm (.218") ball.



1985-88



1991-On

ZF

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Slips on 2-3	134
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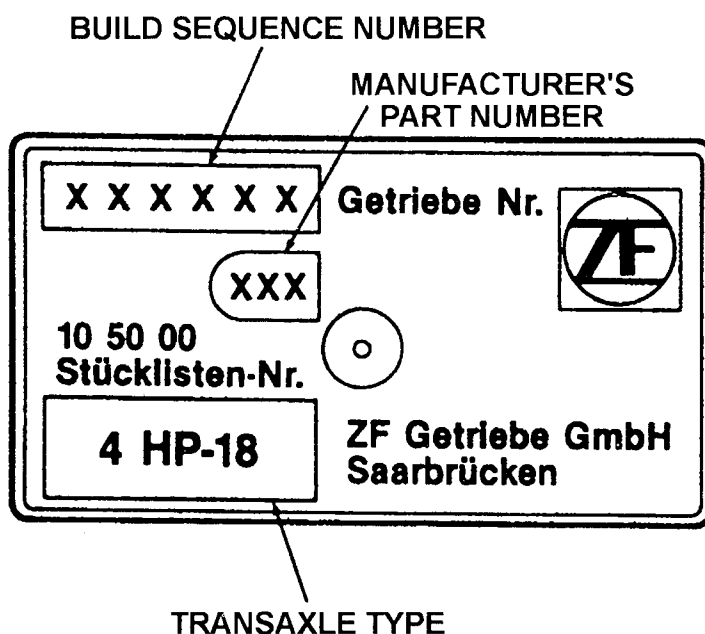
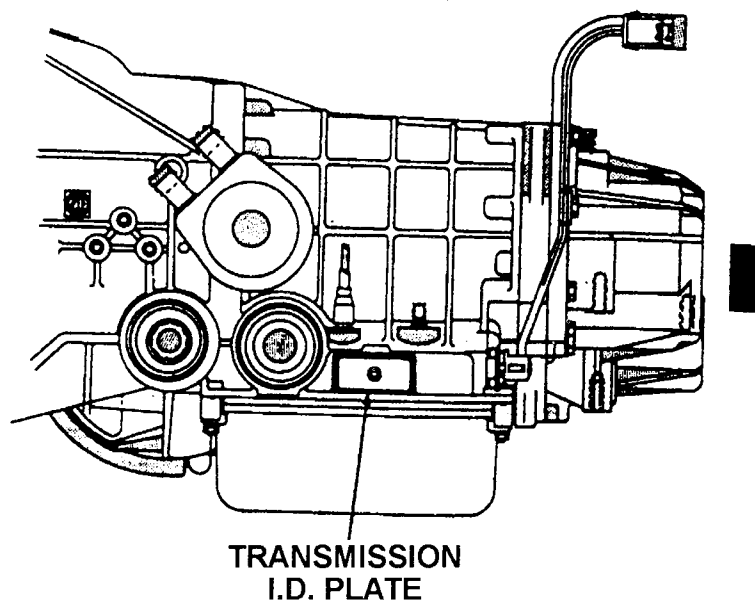
ZF



ZF-4

Transaxle Identification

The transaxle identification plate is on the left side of the case above the oil pan. The information on the plate consists of the build sequence number, manufacturers part number and the transaxle type.

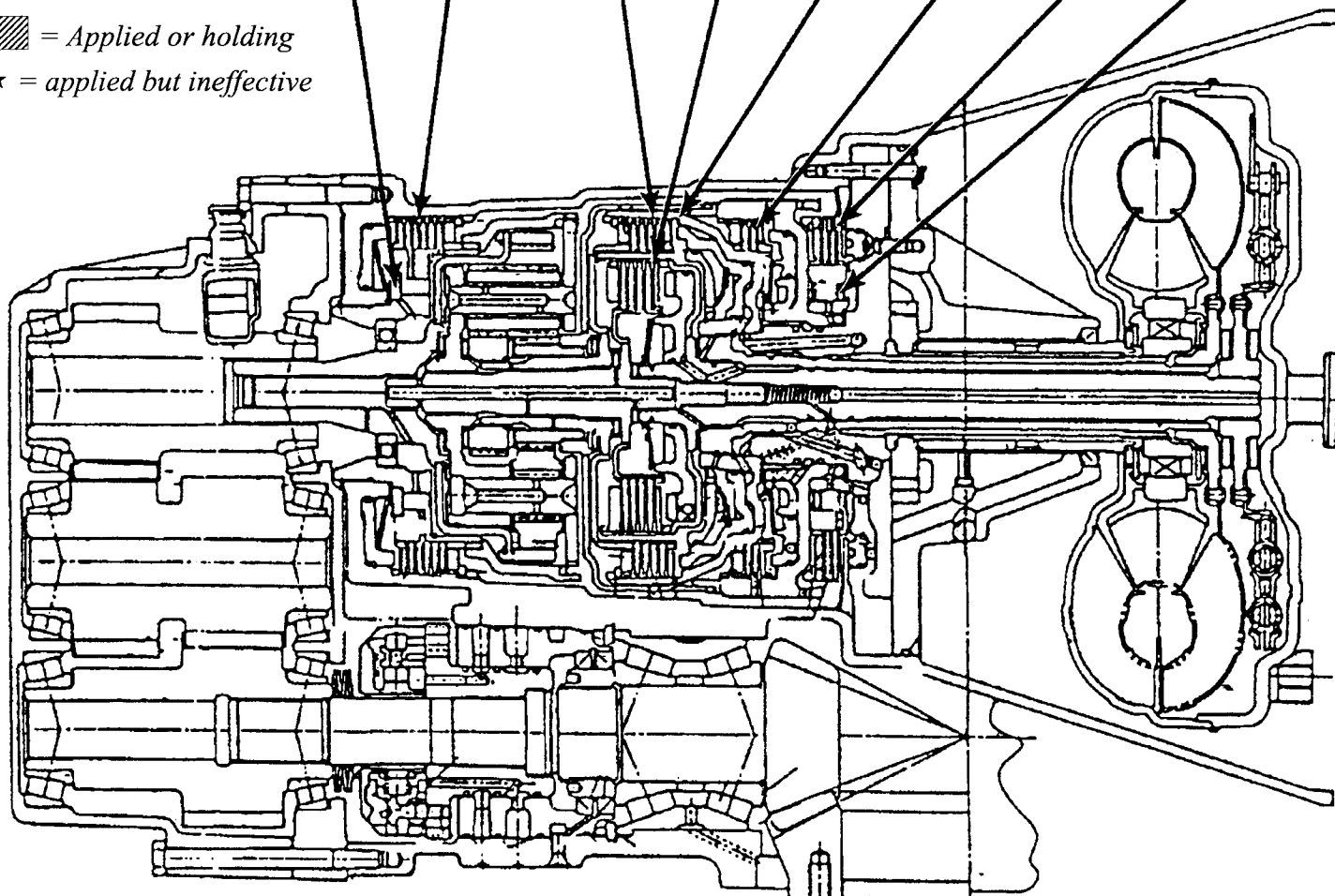


ZF

Range	Gear	Low Roller Clutch	"D" Low/Rev Brake	"A" Forward Clutch	"E" 3-4 Clutch	"C1" 2-4 Band	"B" Reverse Clutch	"C" Intermediate Brake	Intermdiate Sprag
R	Reverse								
D	1st								
	2nd								
	3rd								
	4th								
2	1st								
	2nd								
L	1st								

▨ = Applied or holding

★ = applied but ineffective

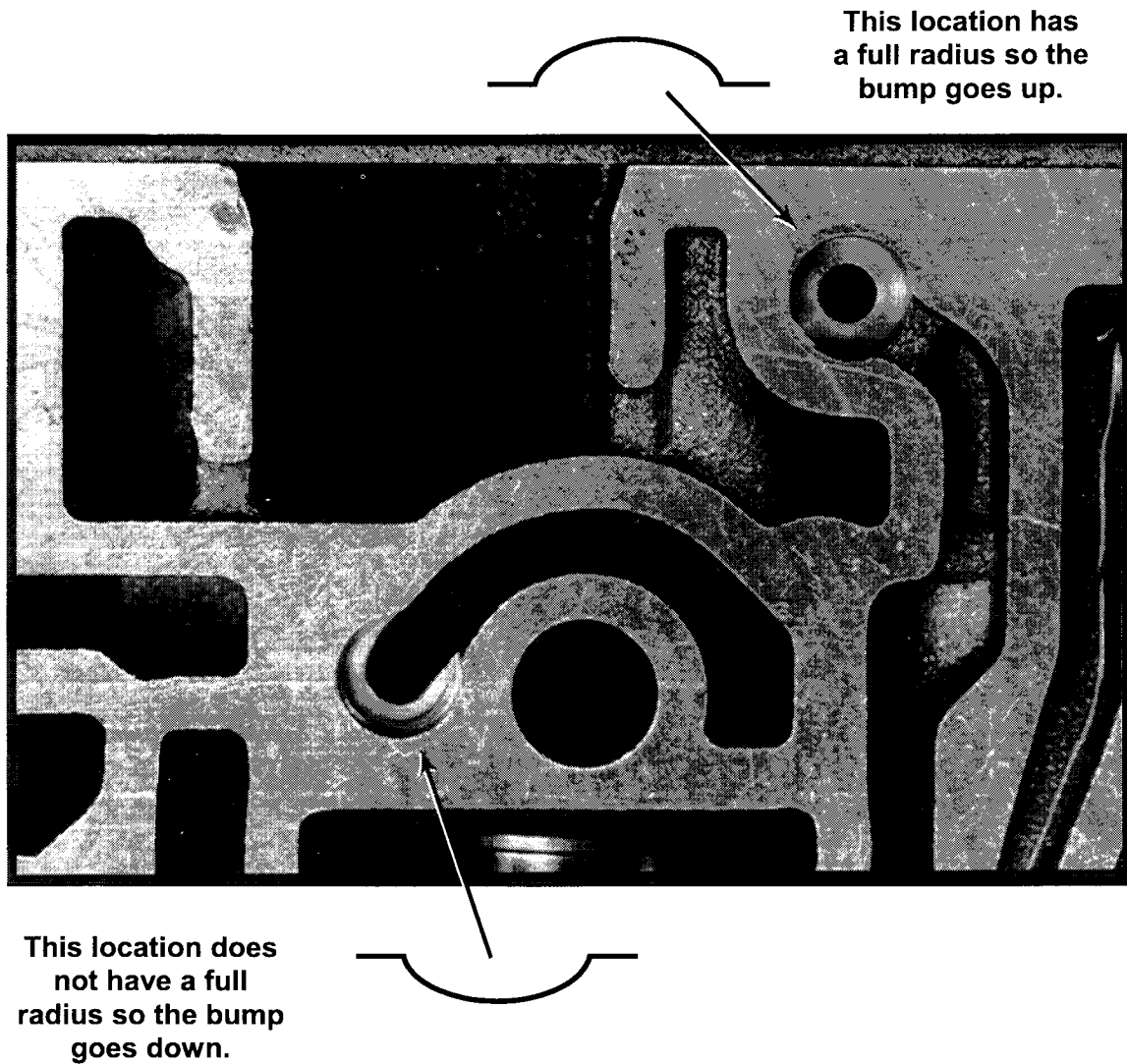
**Gear Ratios**

1st	2.58:1
2nd	1.41:1
3rd	1.00:1
4th	.74:1
Reverse	2.88:1

Orifice Placement

BMW, Peugeot, Volvo, Lincoln

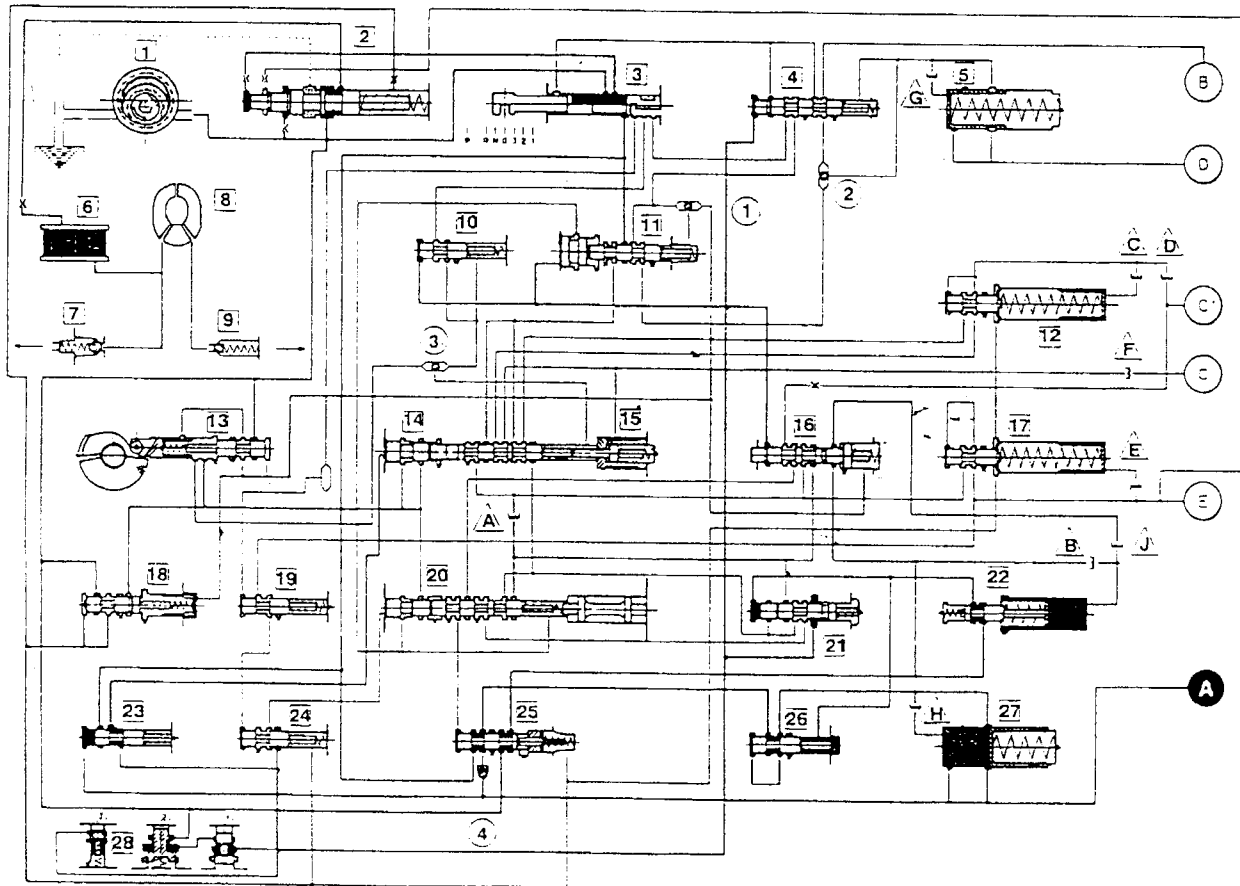
ZF uses removable orifices in their automatic transmission. Use the following information for proper orifice placement (bump up or bump down).



NOTE: Many reference manuals show these orifices upside down, always use this method for the proper placement.

Oil Chart, Valve Body

Eagle Premier, Peugeot



NOTE: For clarity we have renamed some of the valves to help indicate their true functions. Where this was done, the factory name will be listed in brackets.

VALVE DESCRIPTIONS

1. PUMP
2. PRESSURE REGULATOR VALVE
3. MANUAL CONTROL VALVE
4. LOW/REV LOCK-OUT VALVE—[1st Reverse lock-up valve]
This valve prevents the "D" clutch from applying above a certain speed. The "D" clutch is used for manual low and reverse.

Valve Descriptions (cont'd)

5. "D" DAMPER (ACCUMULATOR)
Feed to the "D" clutch is through orifice G until the damper bottoms out. At that time the orifice is bypassed. The spring controls how long it takes to bypass orifice G.
6. COOLER
7. CONVERTER RELIEF
8. TORQUE CONVERTER
9. DRAINBACK VALVE (IN THE LUBE CIRCUIT)
10. 2ND LOCK-OUT VALVE—[2nd lock-up valve]
This valve will not allow a 3-2 downshift above a certain speed.
11. 1-2 SHIFT VALVE
12. "C" CLUTCH VALVE & DAMPER (ACCUMULATOR)
Even though the "C" brake is a band, this is still called a clutch valve. During the initial apply of the band, the servo pressure is modulated through the clutch valve. As the damper is stroked, the servo feed pressure increases due to the increasing spring pressure applied to the clutch valve. The damper rate is controlled by orifice C.
13. THROTTLE VALVE
14. 2-3 SHIFT VALVE
15. 1-2-3 SEQUENCE VALVE—[Not named]
This valve will not allow the 2-3 shift valve to stroke until the 1-2 shift valve is in the 2nd gear position.
16. ORIFICE CONTROL VALVE
This valve is controlled by TV & Governor Pressure. When TV pressure is high, orifice A (3-4 shift feed) and orifice J (4-3 timing control valve feed) are bypassed. When governor pressure is high and TV pressure is low, oil is allowed to flow through these orifices.
17. "E" CLUTCH VALVE & DAMPER (ACCUMULATOR)
See "C" clutch valve & damper
18. MODULATOR VALVE
19. 4TH LOCK-OUT VALVE—[3rd lock-up valve]
This valve indirectly prevents a 3-4 shift in manual, 3 2 or 1 by blocking 3rd gear oil from the 2-3-4 sequence valve.
20. 3-4 SHIFT VALVE
21. 4-3 DOWNSHIFT VALVE
This valve controls the 4th gear oil exhaust during a 4-3 downshift. 4th exhaust oil is restricted until the 4-3 timing control valve signals the downshift valve at which point 4th gear exhaust is allowed to exhaust with no restrictions. This action controls the "C" band release during a 4-3 down shift.

Valve Descriptions (cont'd)

22. 4-3 TIMING CONTROL VALVE—[Time control valve]

This valve controls when the 4-3 downshift valve & the 4-3 capacity modulator valve will stop regulating. The speed at which this valve is stroked is controlled by orifice B and orifice J.

23. 4-3-2 SEQUENCE VALVE

This valve ensures that the downshifts will occur in the right sequence by replacing governor pressure with line oil at the 2-3 shift valve. This binds the 2-3 shift valve in the shifted position as long as the "A" clutch is not pressurized (4th gear).

24. 2-3-4 SEQUENCE VALVE

This valve blocks governor pressure from getting to the 3-4 shift valve until the "E" clutch is pressurized. This will ensure that the shifts occur in the right sequence.

25. A CLUTCH EXHAUST VALVE—[3-4 traction valve]

This valve is used to exhaust "A" clutch oil during a 3-4 shift.

26. 4-3 CAPACITY MODULATOR VALVE—[4-3 traction valve]

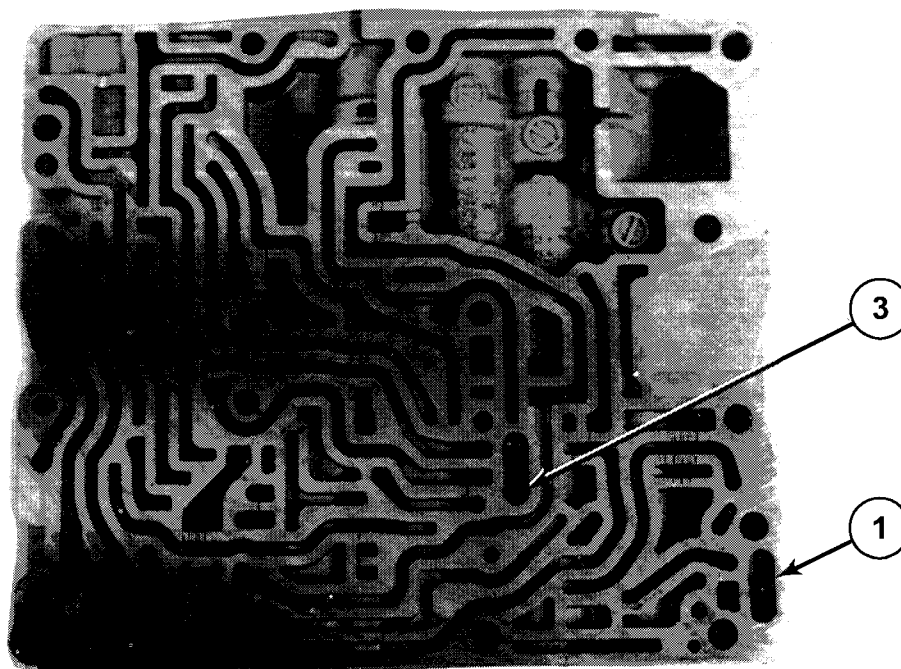
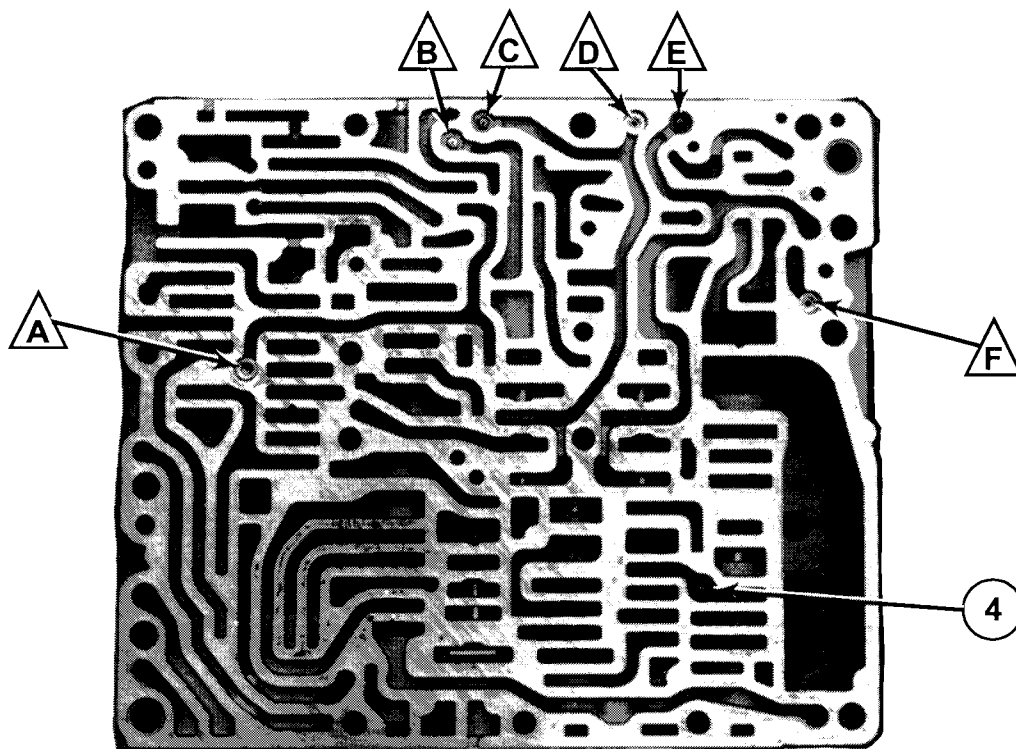
This valve modulates "A" clutch oil during a 4-3 downshift. After a 4-3 timing control valve signal is received, "A" clutch apply oil is no longer modulated.

27. "A" CLUTCH DAMPER (ACCUMULATOR)

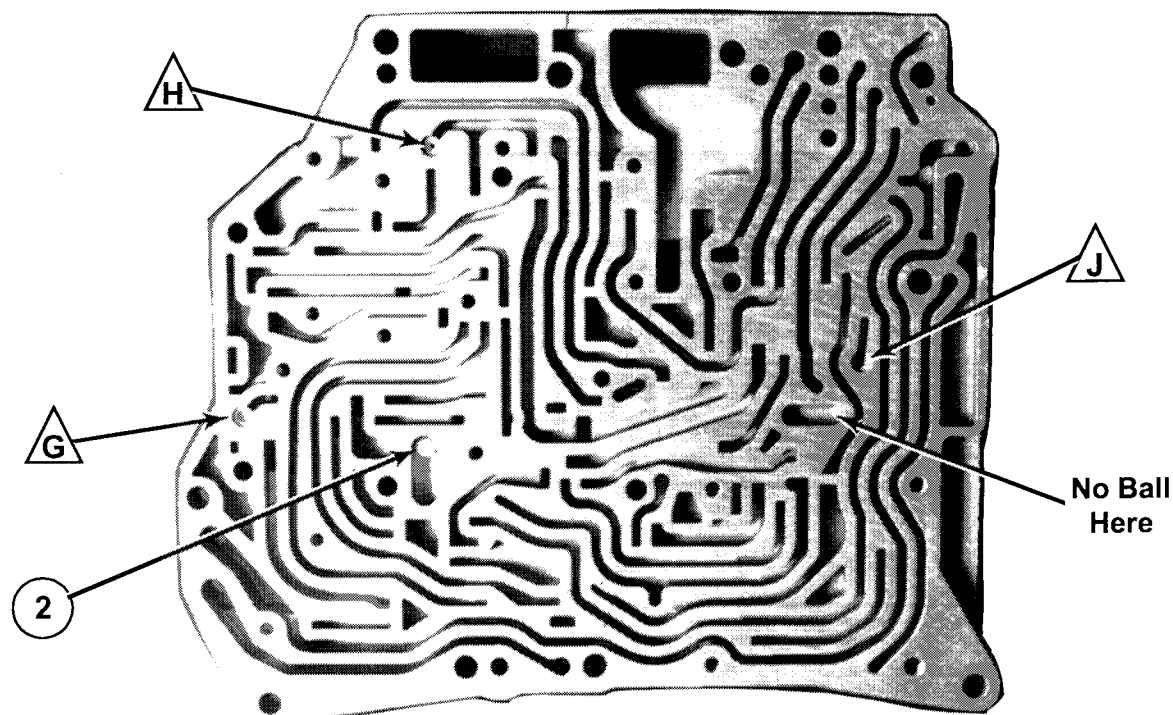
See "D" clutch damper (accumulator)

28. GOVERNOR

Orifice Locations & Size



Check Ball & Orifices Sizes



Check Ball & Orifice Sizes

① 4.5 mm (.178")

② 6 mm (.235")

③ 4.5 mm (.178")

④ 6 mm (.235")

△A .024"

△B .024"

△C .031"

△D .059"

△E .031"

△F .067"

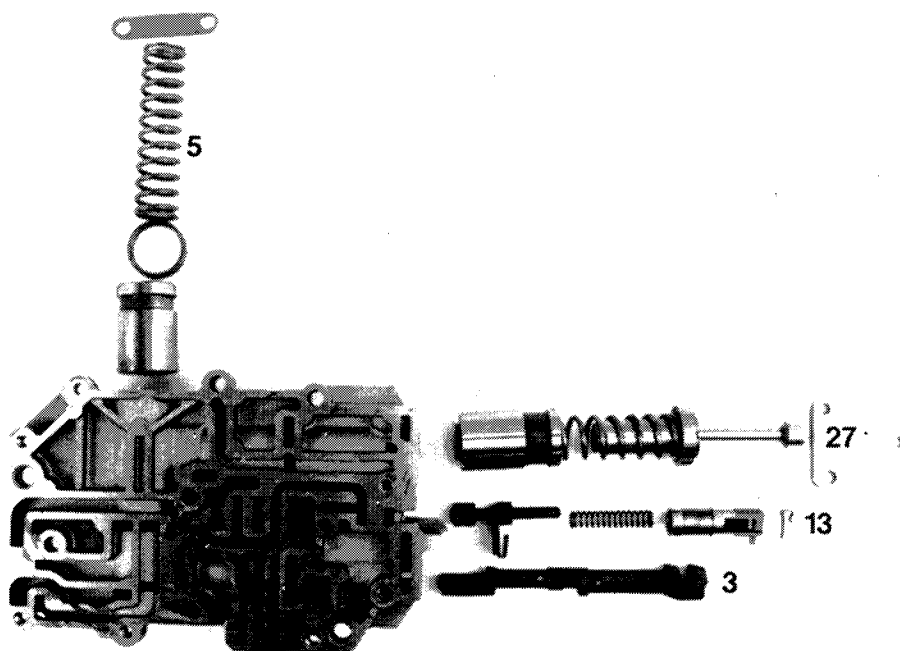
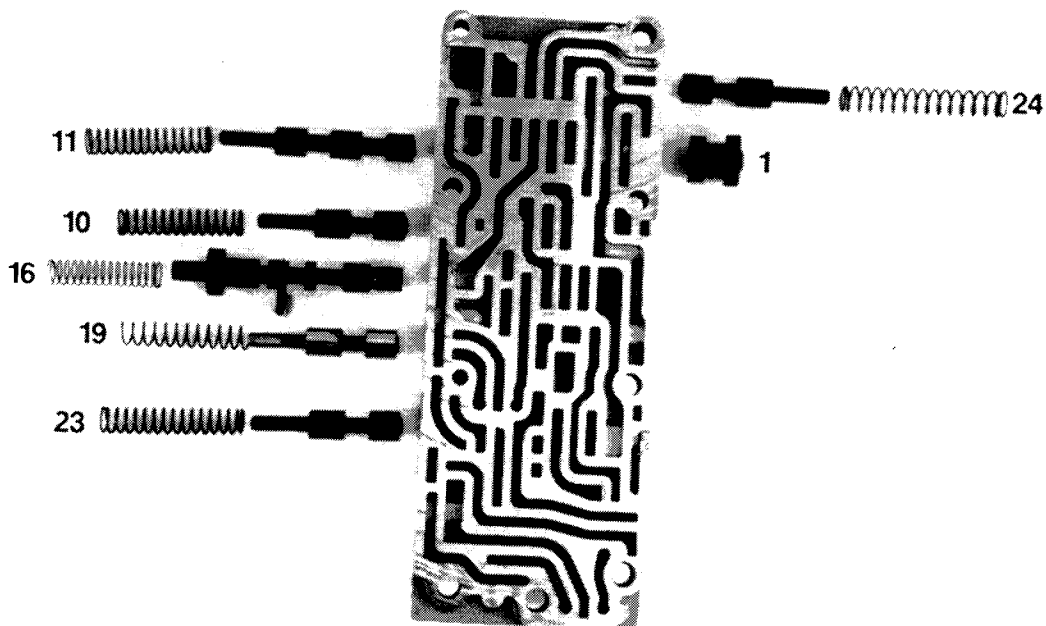
△G .026"

△H .059"

△J Not used on most models

NOTE: The orifice sizes here are for reference only. Yours may be slightly different.

Valve Positions

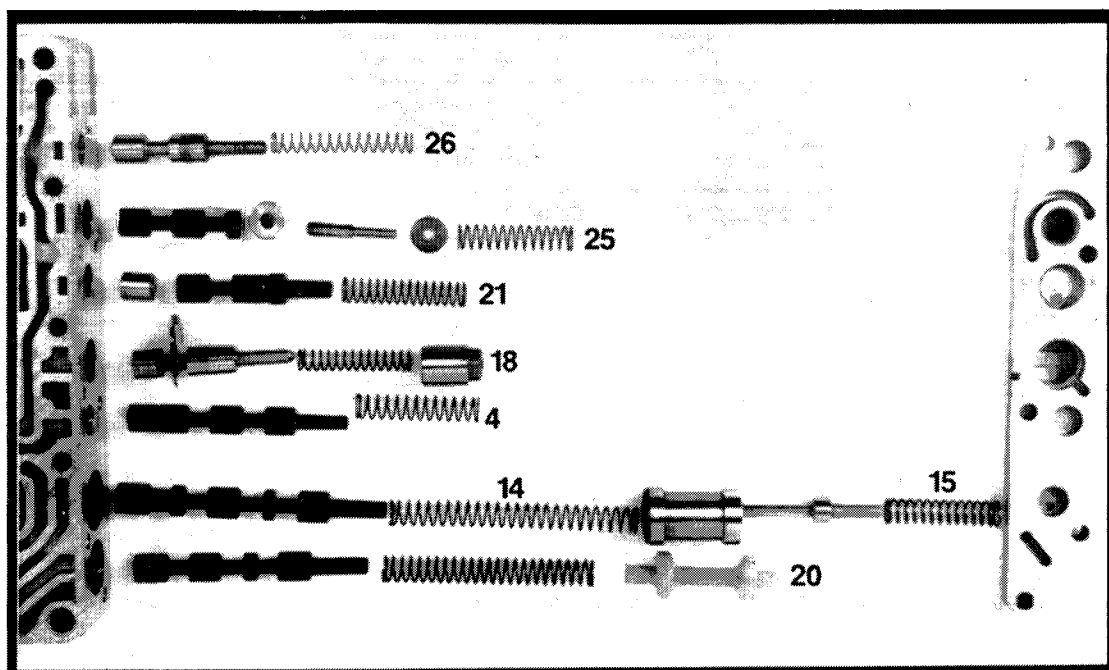
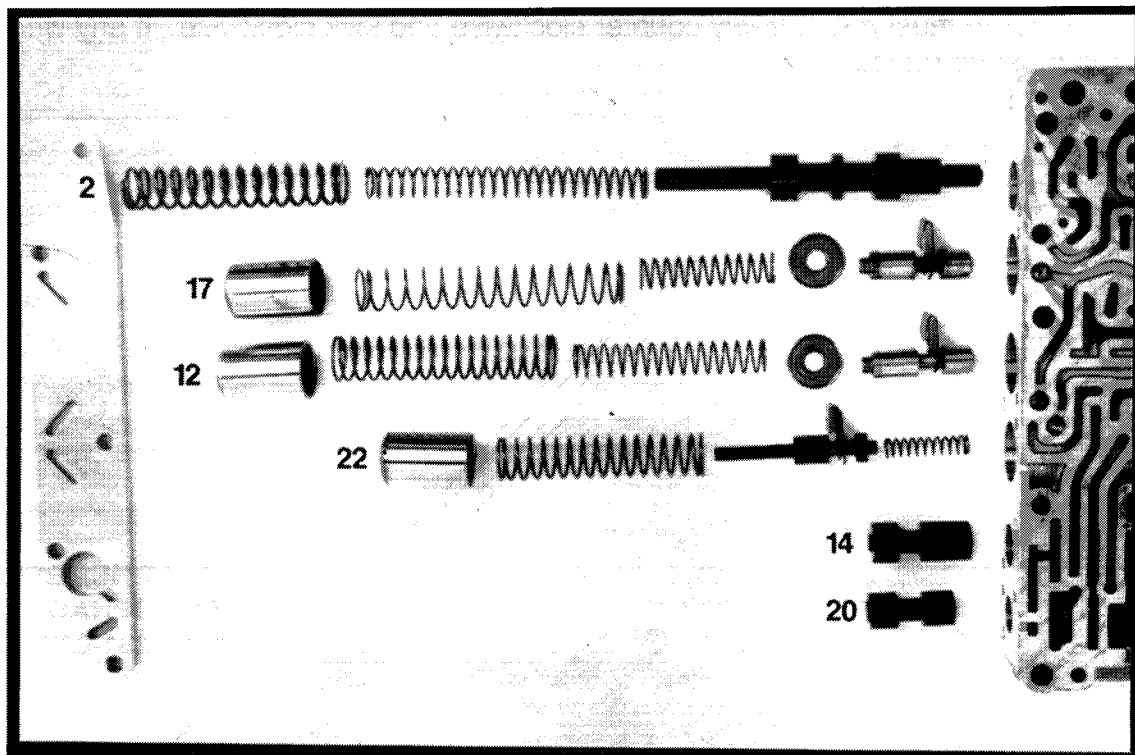


ZF Part Numbers

Case I.D.	Part Number
006	0732-042-211
010/015	0732-042-170
021	0732-042-185

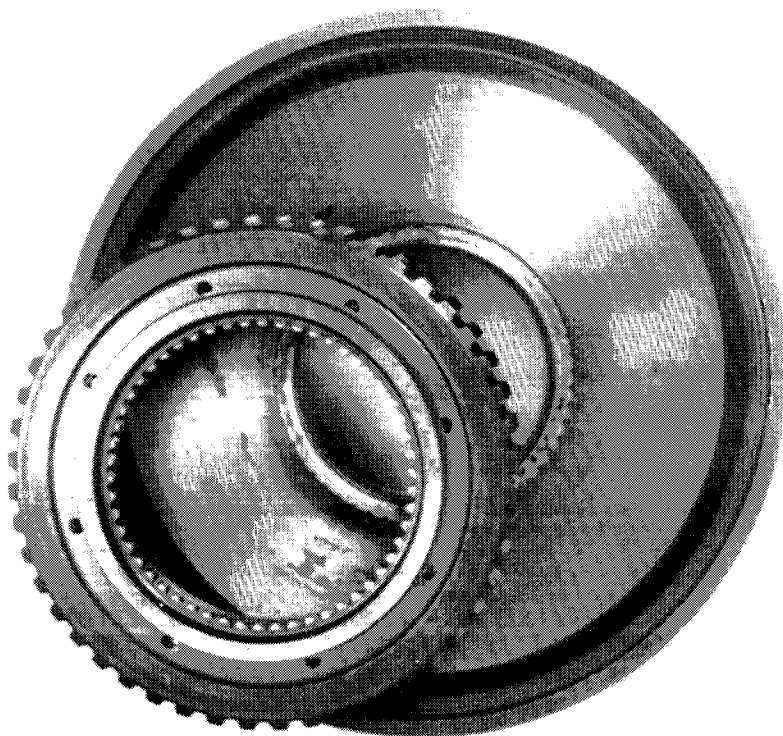
NOTE: A damaged or broken "A" clutch accumulator spring will result in harsh "A" clutch application.

Valve Positions



Sprag Rotation

The intermediate sprag must rotate freely counter clockwise and lock clockwise. If any wear is detected, sprag must be replaced.

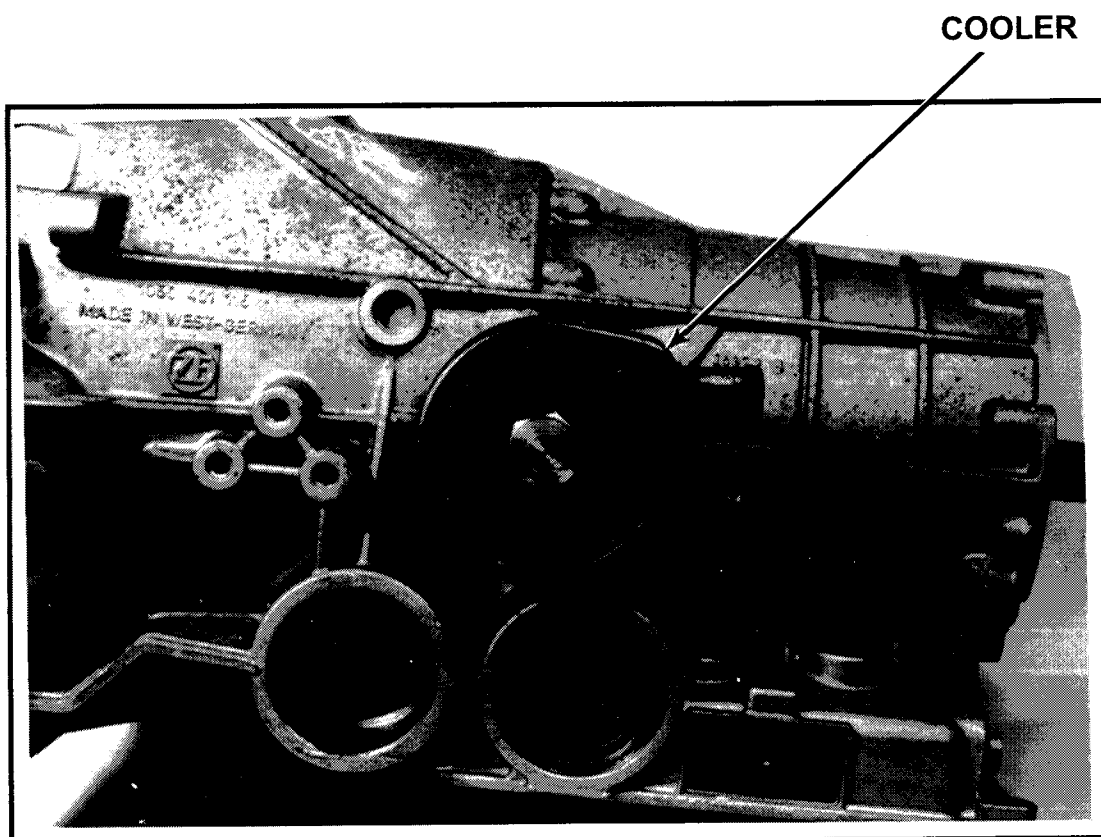


**ZF PART NUMBER
FOR SPRAG
1050-231-026**

NOTE: *The low/rev roller clutch is indexed and may only be assembled one way.*

Cooling System

The oil cooler that bolts to the side on the transmission is not serviceable! If the system is contaminated heavy with metal or fiber material the cooler must be changed.

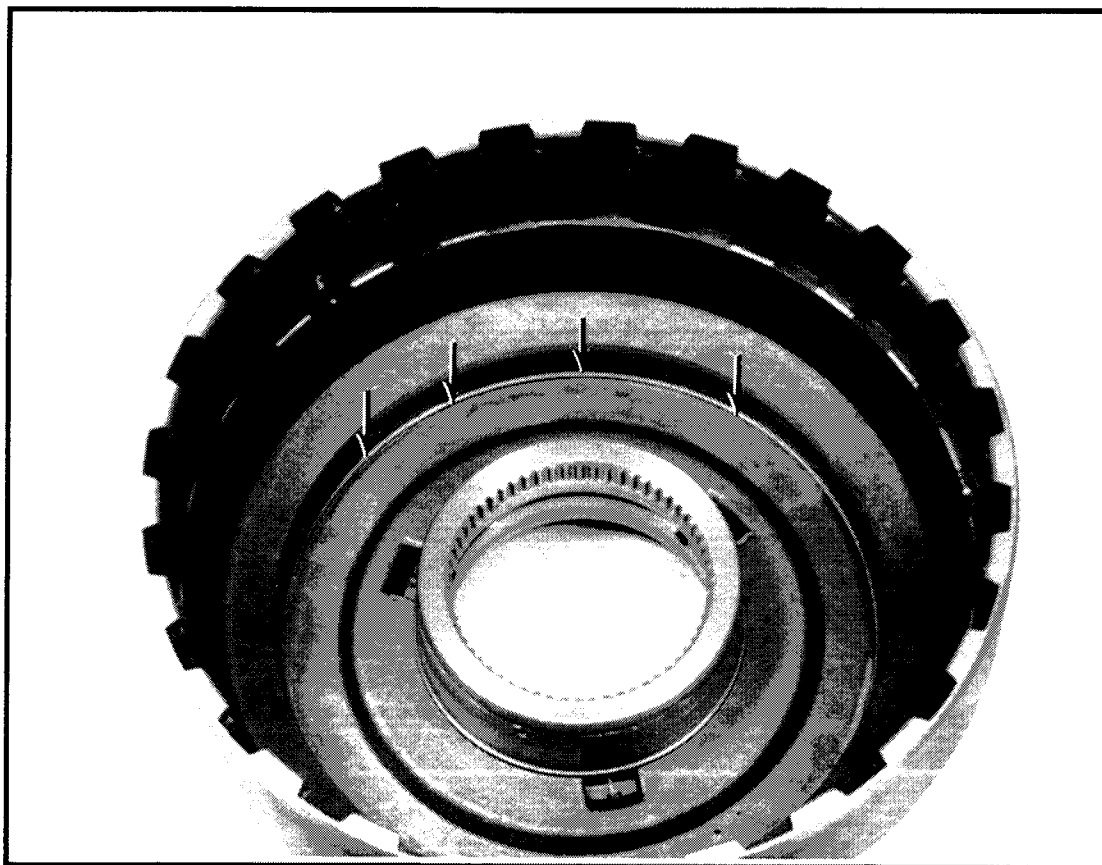


Chrysler Part Number for Cooler: 33004606

No Forward When Hot

This condition can be caused by a cracked "A" clutch drum. Carefully inspect the area shown below for cracks.

Note: A common cause for this is high pressure during a 4-3 downshift—due to a worn pressure regulator valve. Always inspect the PR bore for excessive wear.

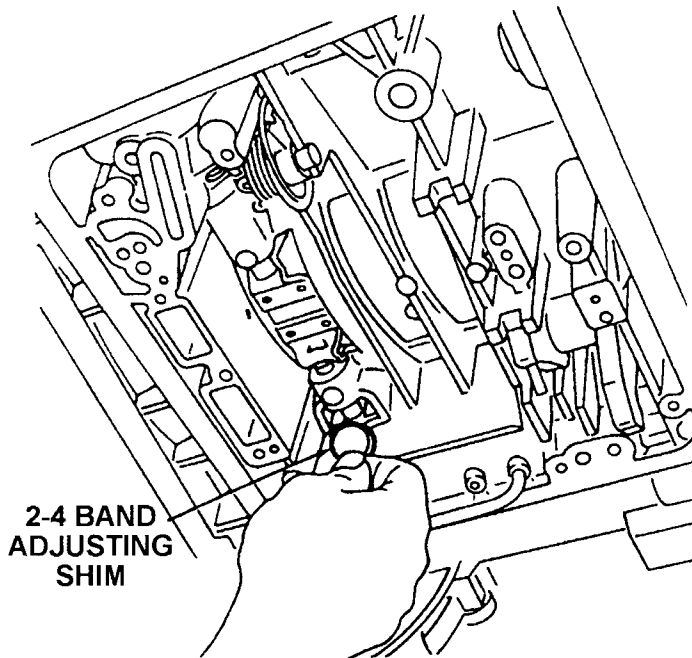


ZF PART NUMBER
FOR "A" CLUTCH
DRUM: 1050-302-023

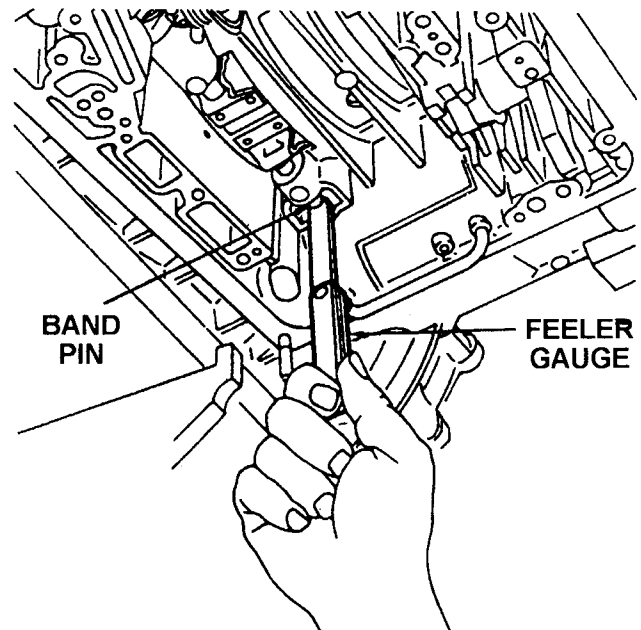
NOTE: Also check the internal splines for wear.

Band Adjustment

Servo travel is adjusted with a selective shim.



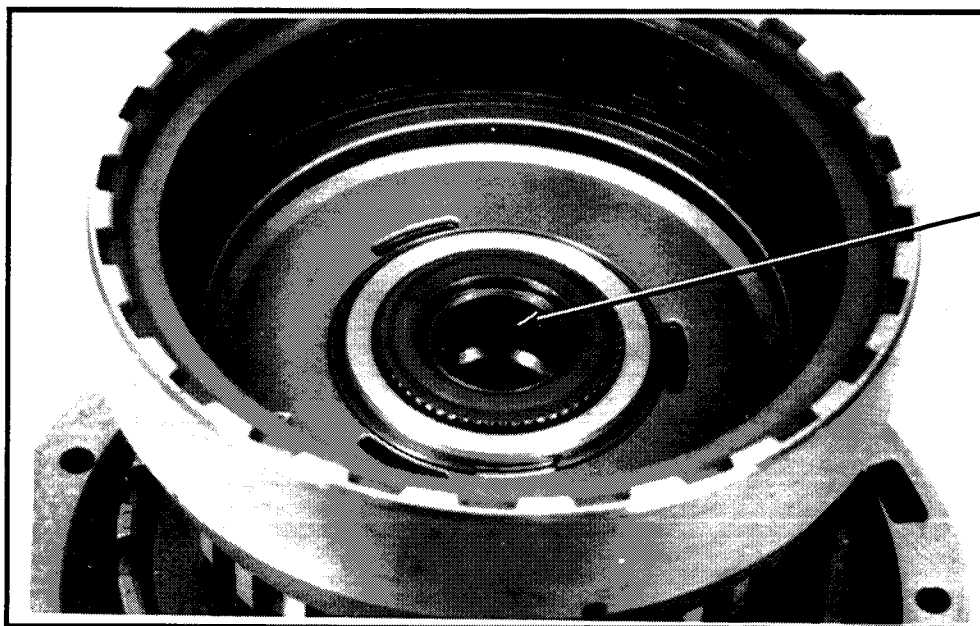
PART NUMBER	SHIM THICKNESS
1050 331 064	.256
1050 331 079	.246
1050 331 063	.236
1050 331 078	.226
1050 331 062	.217
1050 331 077	.207
1050 331 061	.197
1050 331 076	.187
1050 331 060	.177
1050 331 075	.167
1050 331 059	.157
1050 331 074	.148
1050 331 058	.138
1050 331 073	.128
1050 331 057	.118



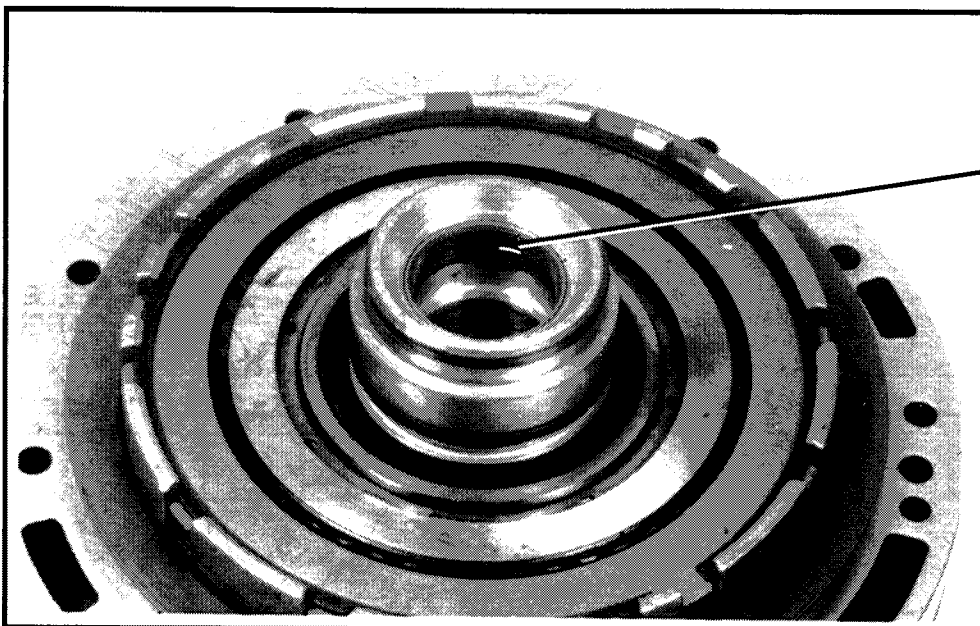
The clearance between the pin and the selective shim should be .049" - .059"

Slips Forward and on 2-3 Shift ("A" and "E" Clutch Failure)

Bushings are used in the pump stator as well as the "A" (forward) drum to provide the contact area for the sealing rings. These bushings should be replaced if there is any visible sign of wear at the sealing ring contact area.



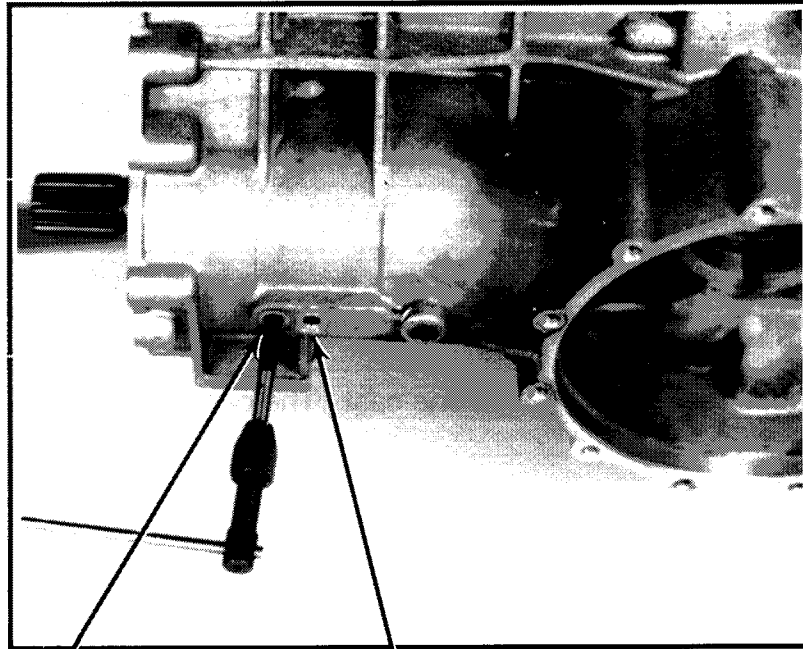
**"E" CLUTCH DRUM
SEALING RING
CONTACT AREA**



**"A" CLUTCH DRUM
SEALING RING
CONTACT AREA**

Line Pressure

The ZF4HP-18 that is used in the Premier and Monaco do not have pressure taps. However, there are two locations with plugs that can be removed—then tapped. This will offer a location for both line pressure and governor pressure.

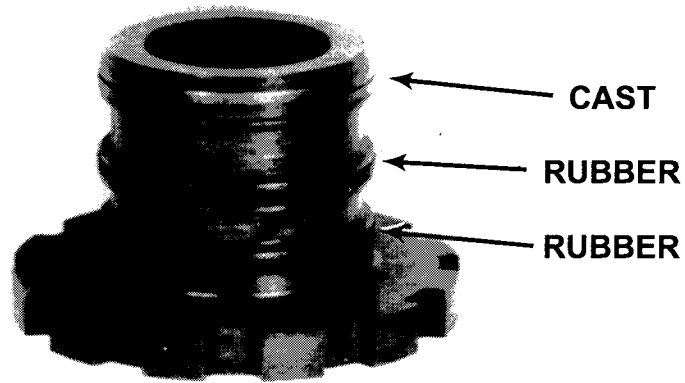


GOVERNOR
PRESSURE

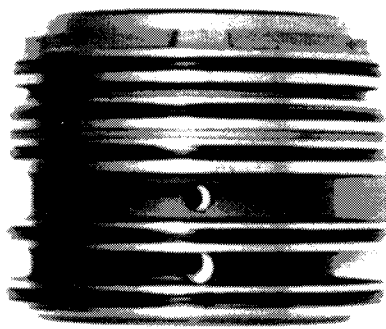
LINE
PRESSURE

NOTE: You need to be extremely careful when removing the plugs from the case. The holes should be tapped to 1/16 pipe thread.

Governor Distributor and Sleeve



The distributor uses two rubber sealing rings and one cast. The cast ring goes on the end closest to the pinion.



Always replace the five "O" rings of the governor sleeve.

Mazda

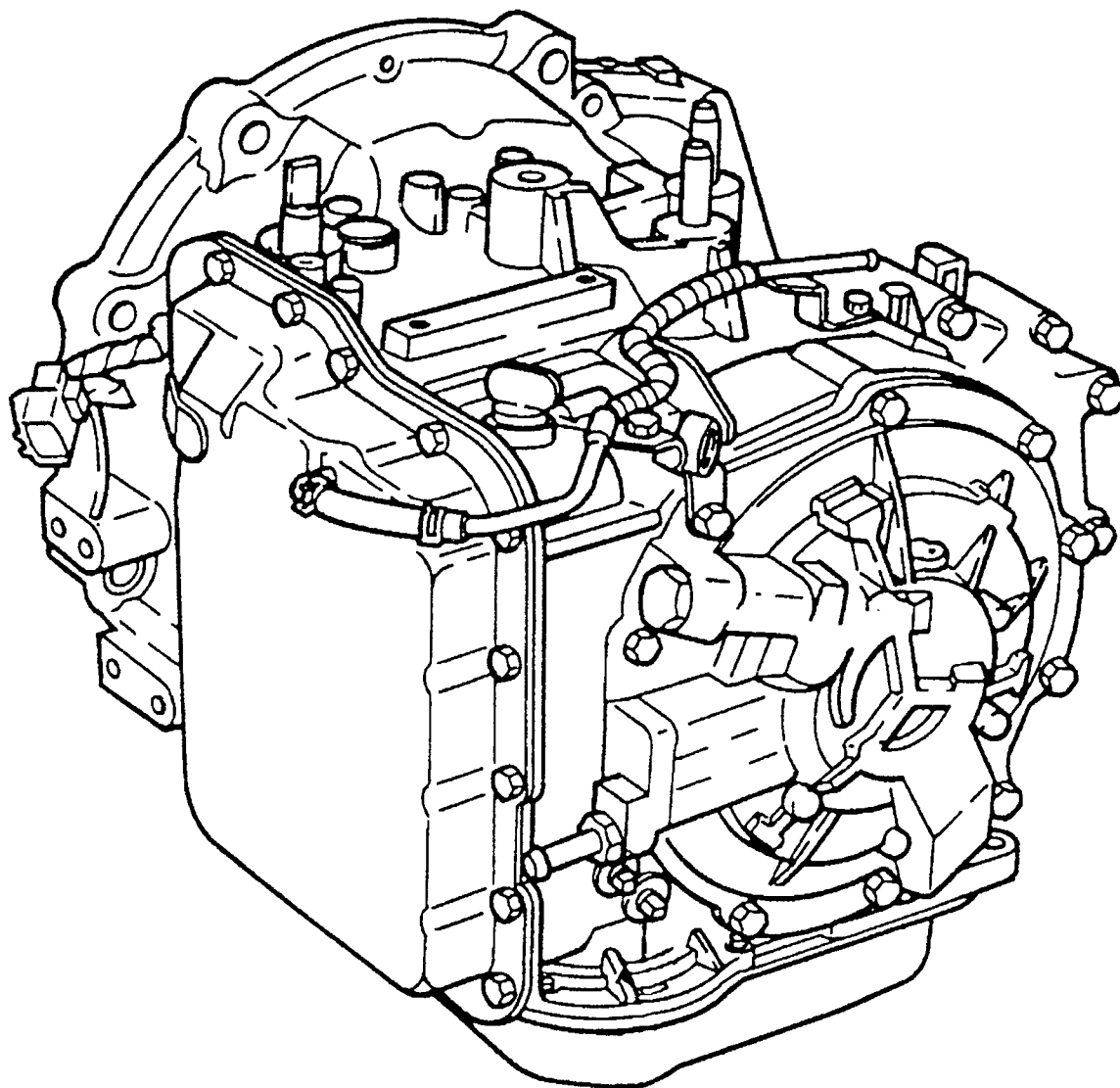
Description	138
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Mazda



GF4A-EL

The GF4A-EL was first introduced in 1993. It was used in the 2.0L and 2.5L Ford Probes and Mazda 626/MX6. In 1994 Ford and Mazda began using the CD4E with the 2.0L, while staying with the GF4AEL for the 2.5L V6. Although very similar to the G4AEL/4EAT some changes were made. This section will cover the major differences such as the seven solenoid valve body with computer controlled line pressure. We will also break down the different terminology used to describe sensors and switches.



Line Pressure Specs

Range	Idle	Full Stall
D, 2, 1	60-78 PSI	160-170 PSI
REV	110-146 PSI	270-290 PSI

Solenoid Reducing Pressure

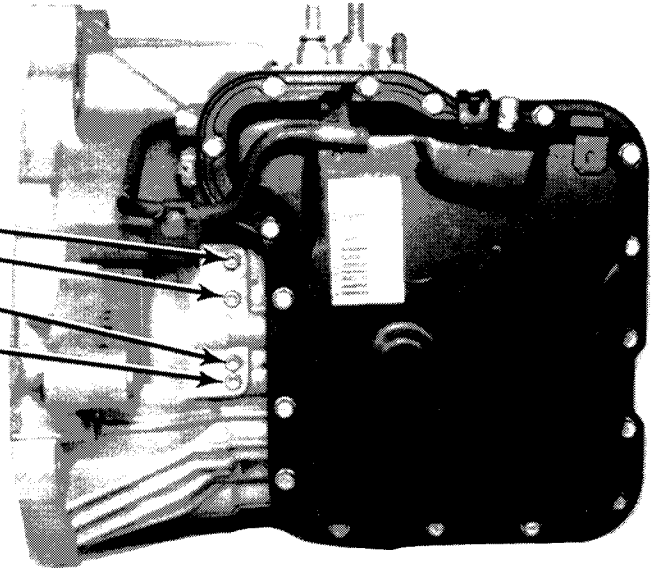
All	52-58 PSI
-----	-----------

Line Pressure

Converter Release

Converter Apply

3-4 Clutch



Gear Ratios

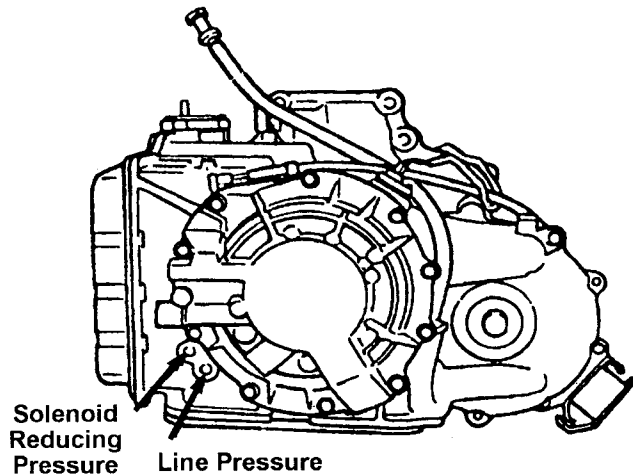
1st	2.80
2nd	1.54
3rd	1.00
4th	.70
Reverse	2.33

Final Drive Ratio

2.0L - 3.842
2.5L - 4.157

Failsafe Mode

D	3rd
2	3rd
1	1st

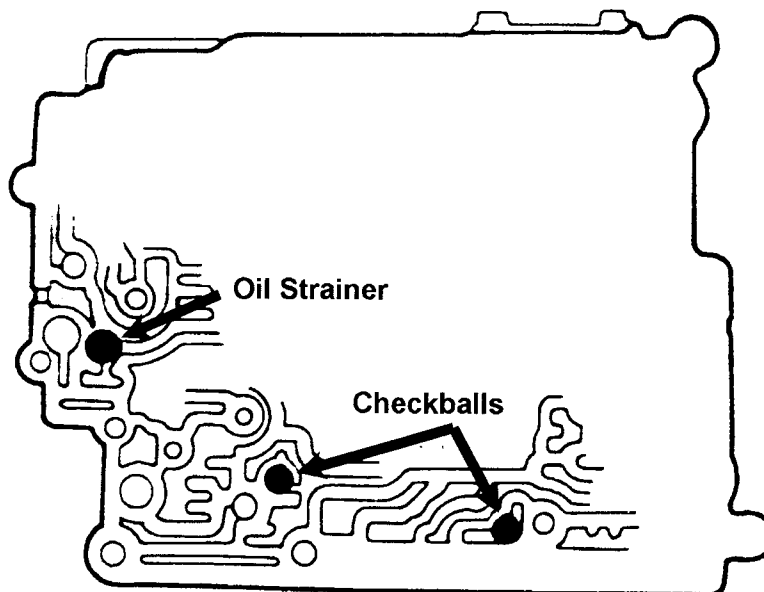
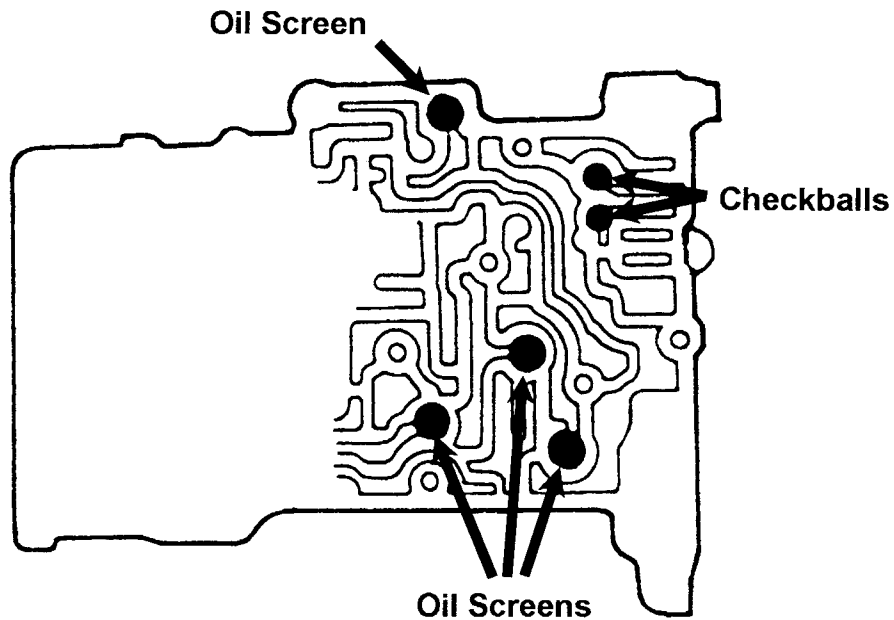
Solenoid
Reducing
Pressure

Line Pressure

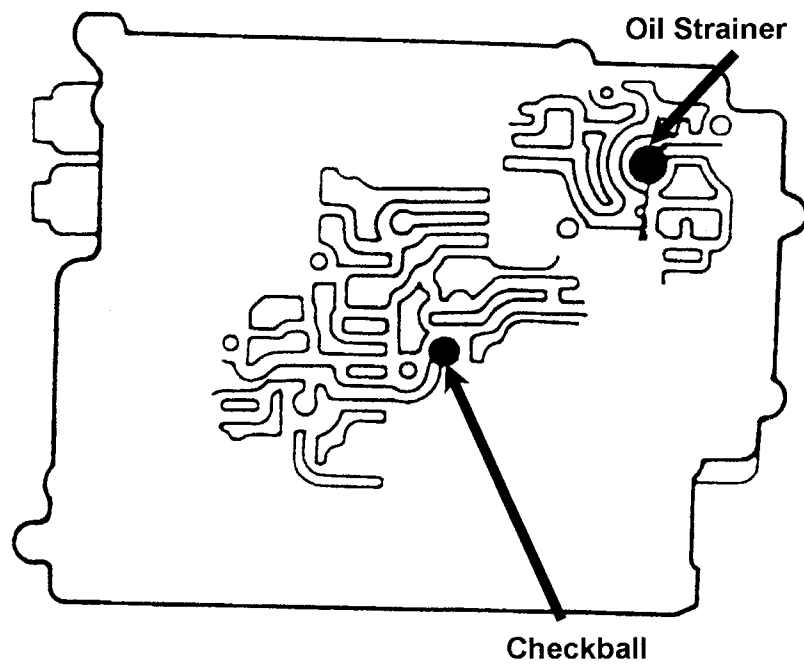
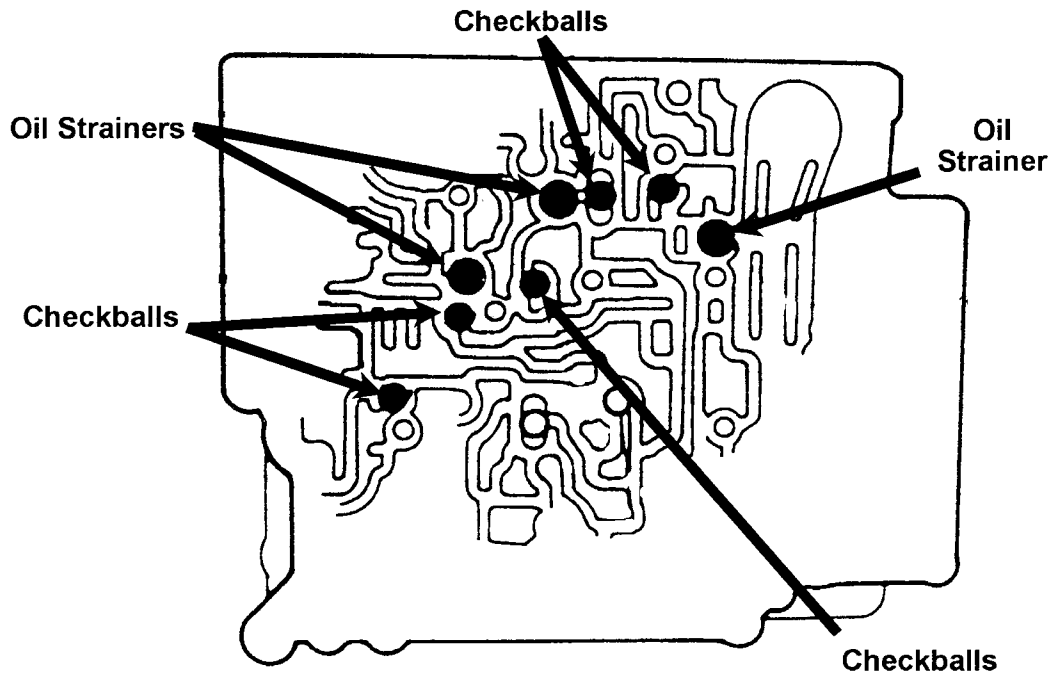
Range	Gear	1-2 Sol	2-3 Sol	3-4 Sol	Forward Clutch	Forward Sprag	Coast Clutch	2-4 Band	2-4 Servo Pressure		3-4 Clutch	Low Roller Clutch	Low Reverse Clutch	Reverse Clutch
									Apply	Release				
P														
R	Reverse													
N	<2mph													
N	>3mph													
D	1st													
	2nd													
	3rd													
	4th													
2	2nd													
	3rd													
1	1st											★		
	2nd													

★ = Holding but ineffective due to Low Reverse Clutch.

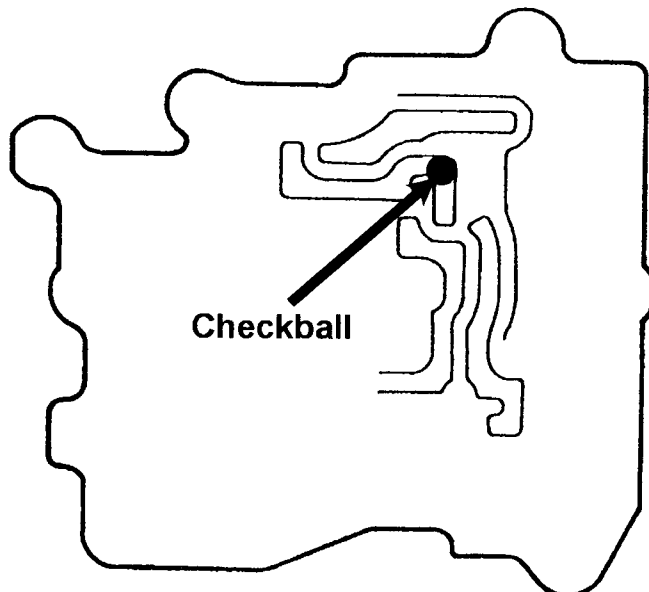
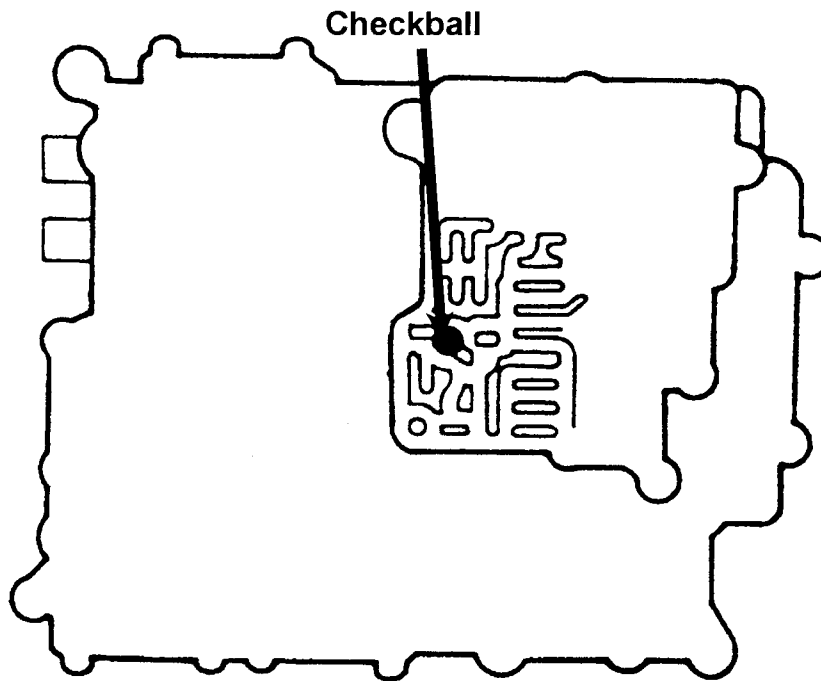
Check Ball and Screen Location



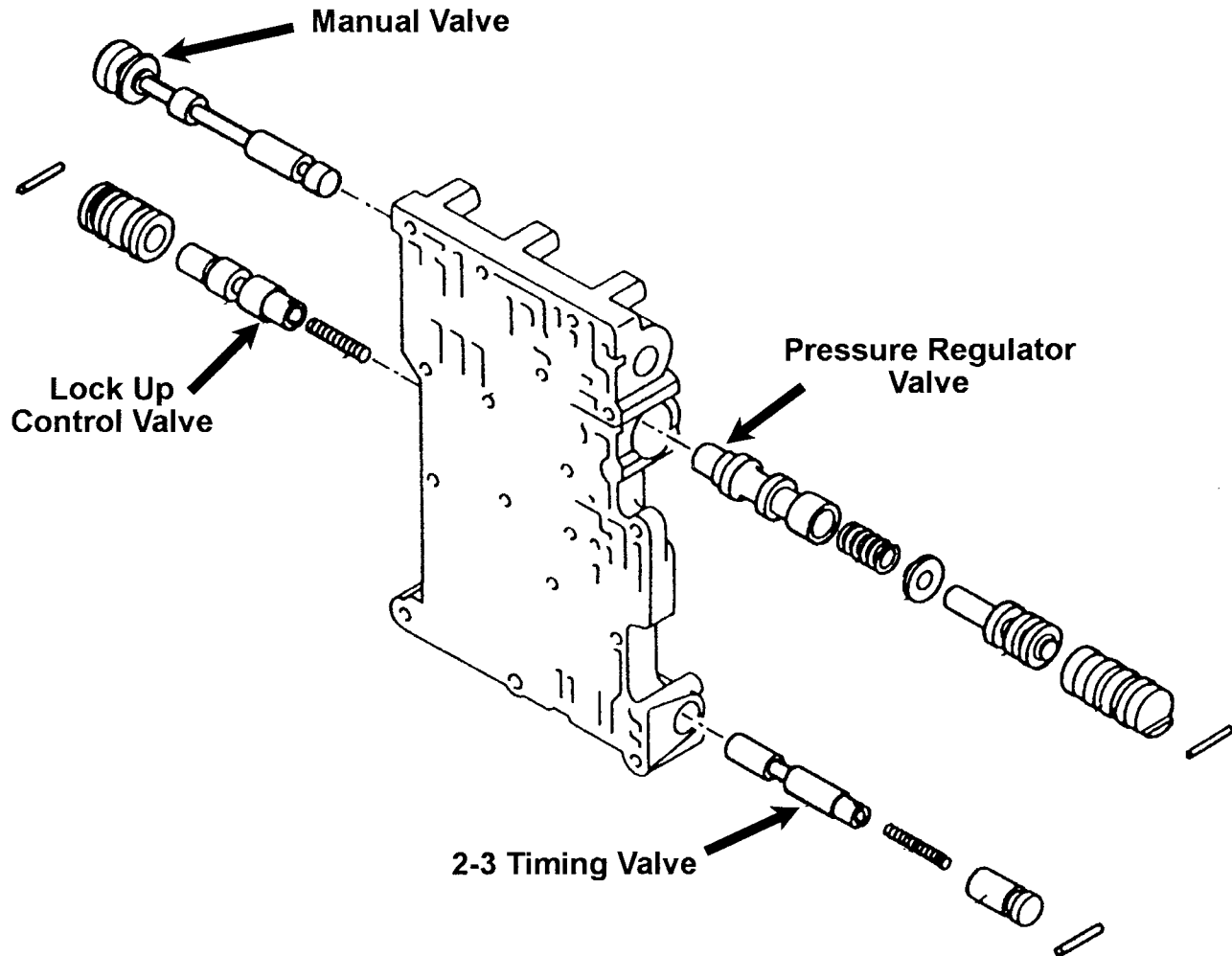
Check Ball and Screen Location



Check Ball and Screen Location

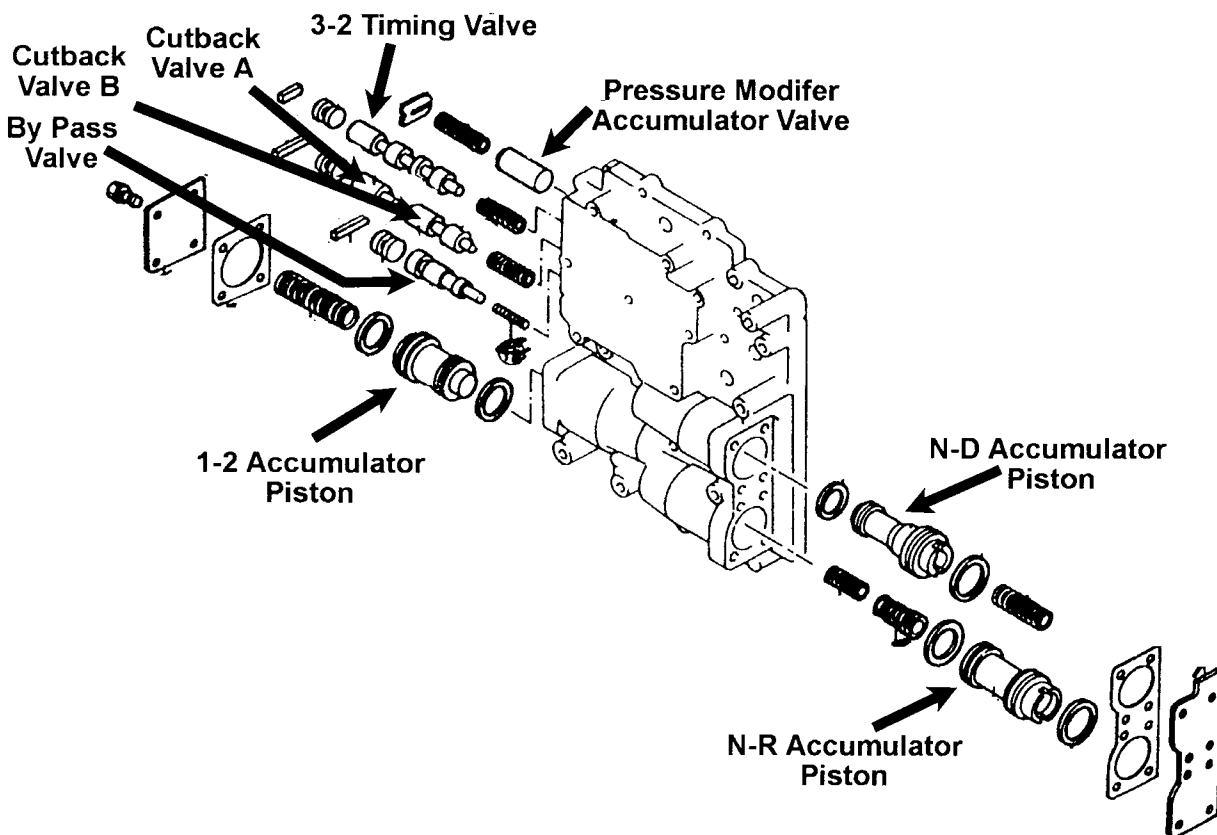


Valves and Springs



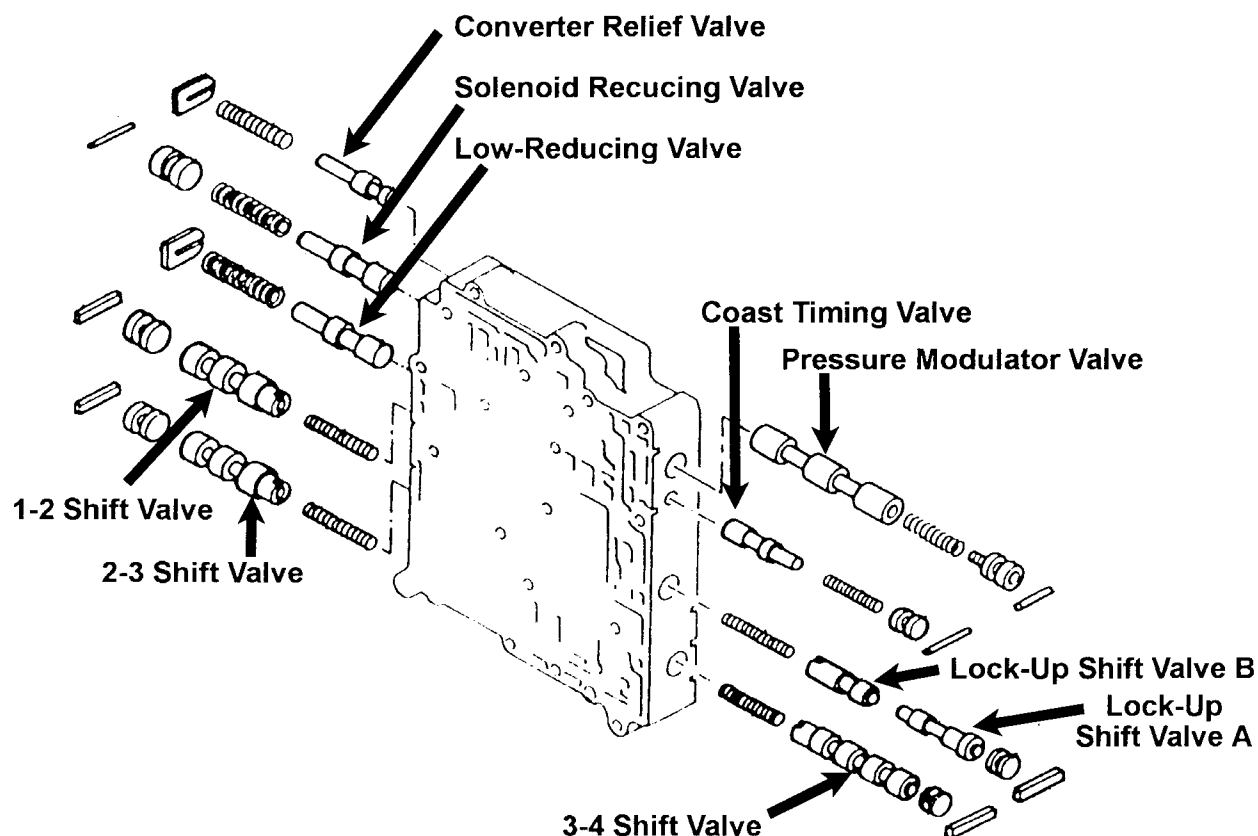
Spring \ Item	Outer Diameter mm (in)	Free Length mm (in)	No. of Coils	Wire Diameter mm (in.)	Identification Color
Pressure regulator Spring	12.0 (0.472)	33.9 (1.34)	7.0	1.1 (0.043)	Dark Blue
Lockup Control Spring	5.8 (0.23)	33.1 (1.30)	12.6	0.55 (0.022)	White
2-3 Timing Spring	4.7 (0.19)	22.3 (0.878)	14.0	0.65 (0.026)	White

Valves and Springs



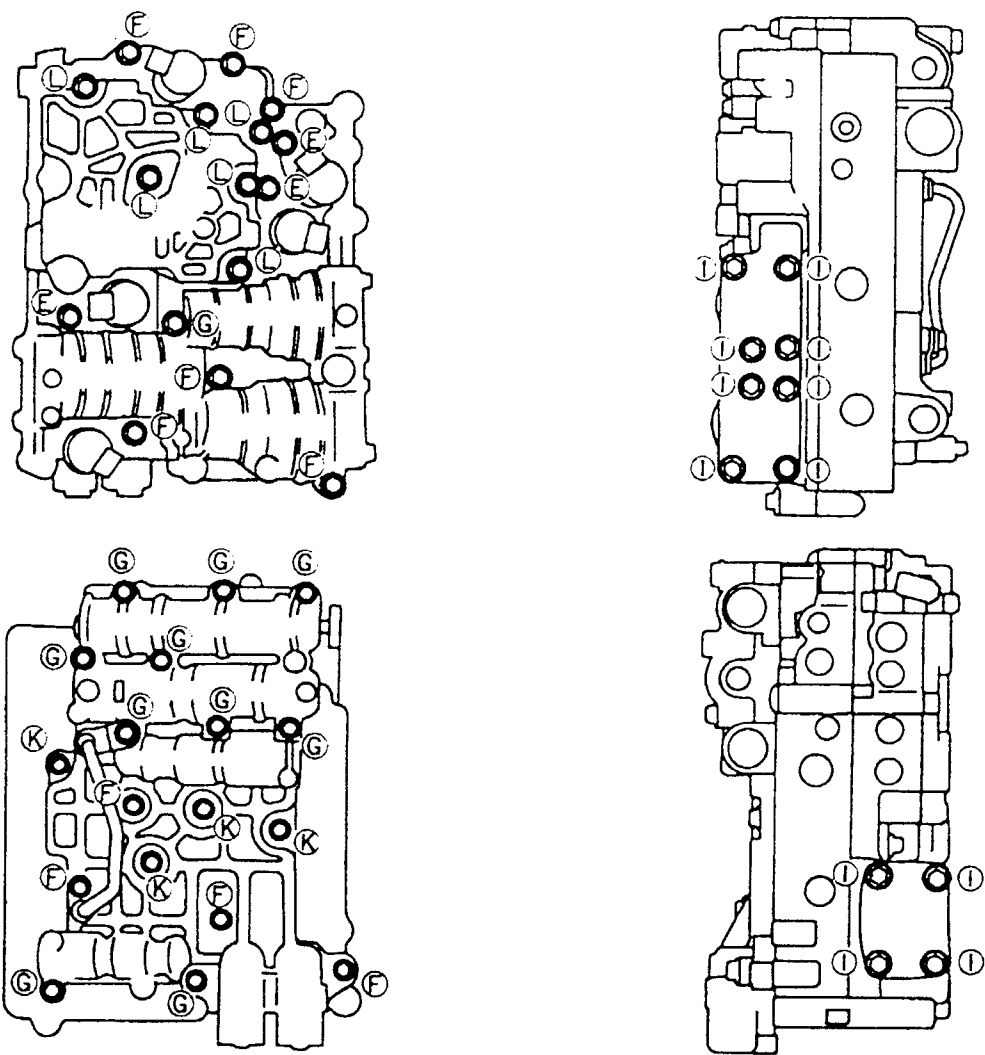
Spring \ Item			Outer Diameter mm (in)	Free Length mm (in)	No. of Coils	Wire Diameter mm (in.)	Identification Color
Pressure modifier accumulator spring			8.2 (0.32)	38.2 (1.50)	16.5	1.2 (0.047)	Light green
3-2 timing spring			8.25 (0.325)	35.4 (1.394)	12.5	0.85 (0.033)	Light blue
Cut back spring			8.2 (0.32)	29.8 (1.17)	7.4	0.6 (0.02)	Purple
Bypass spring			6.3 (0.25)	29.5 (1.16)	11.7	0.6 (0.02)	Dark green
1-2 accumulator spring	FS		20.2 (0.795)	74.6 (2.94)	11.7	2.5 (0.098)	Light blue
	KL	Small	14.8 (0.583)	81.6 (3.21)	17.7	1.7 (0.067)	Gray
		Large	20.2 (0.795)	81.6 (3.21)	12.5	2.3 (0.091)	Dark green
N-D accumulator spring			9.8 (0.39)	52.9 (2.08)	12.0	1.0 (0.039)	White
N-R accumulator spring		Small	7.2 (0.28)	60.1 (2.37)	26.2	1.0 (0.039)	Light blue
		Large	11.2 (0.441)	56.0 (2.20)	15.2	1.6 (0.063)	Red

Valves and Springs



Spring \ Item	Outer Diameter mm (in)	Free Length mm (in)	No. of Coils	Wire Diameter mm (in.)	Identification Color
Convertor relief spring	7.4 (0.29)	32.3 (1.27)	13.5	1.1 (0.043)	—
Solenoid reducing spring	8.0 (0.31)	39.7 (1.56)	12.0	0.9 (0.03)	Red
Low reducing spring	8.7 (0.34)	38.3 (1.51)	12.5	0.9 (0.03)	Yellow
1-2 shift spring	7.4 (0.29)	36.6 (1.44)	12.0	0.8 (0.031)	Purple
2-3 shift spring	7.4 (0.29)	36.6 (1.44)	12.0	0.8 (0.031)	Purple
Coast timing spring	6.2 (0.24)	28.0 (1.10)	16.0	0.6 (0.02)	Light blue
Torque converter clutch shift spring	6.0 (0.24)	40.0 (1.57)	13.8	0.5 (0.02)	White
3-4 shift spring	7.4 (0.29)	36.6 (1.44)	12.0	0.8 (0.031)	Purple
Pressure modifier spring	5.0 (0.20)	19.0 (0.75)	12.7	0.6 (0.02)	—

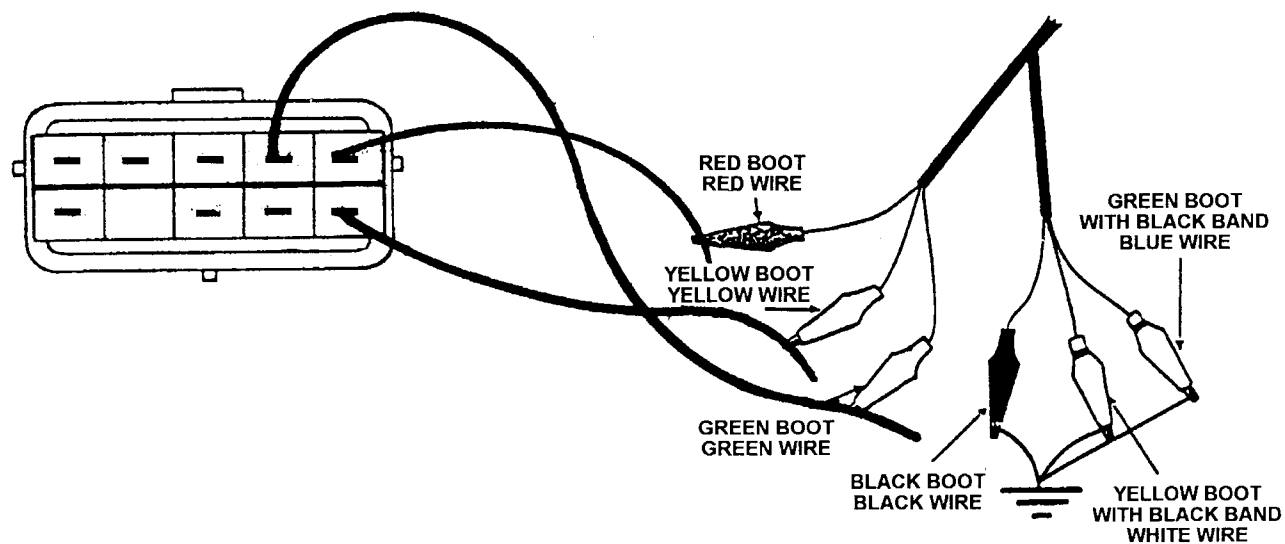
Valve Body Bolt ID and Torque Specifications



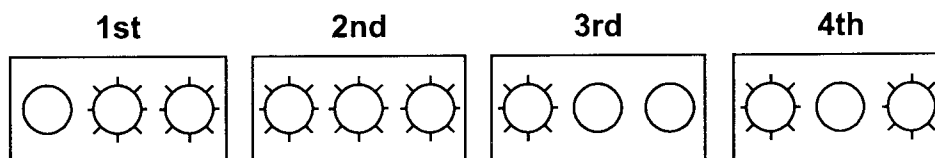
Identification Mark	Bolt	Length mm (in)	Tightening torque N-m (kgf-cm, iq-lb)
L		50 (2.0)	6.5—7.8 (66—80, 58—69)
G		40 (1.6)	
F		30 (1.2)	
K		20 (0.79)	
E		12 (0.47)	
I		16 (0.63)	

Mazda GF4A-EL

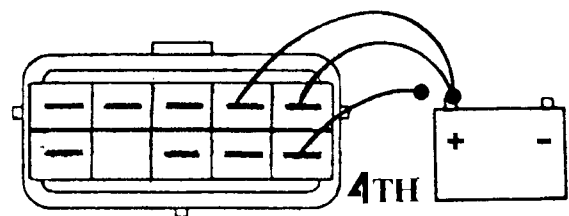
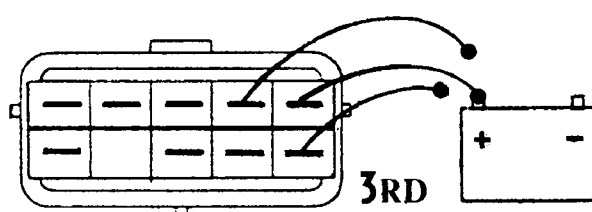
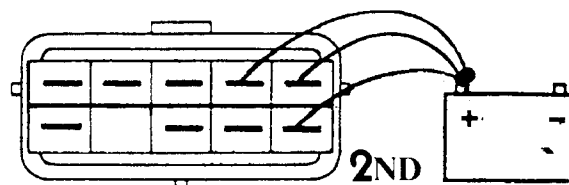
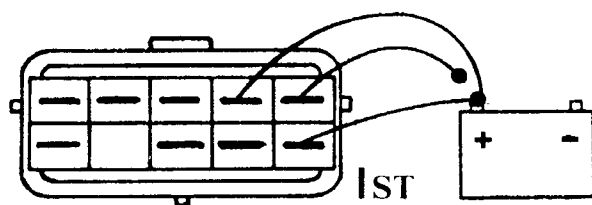
Signal Monitor



SOLENOID PATTERN	
GEAR	SOL 'ON'
1st	2-3 & 3-4
2nd	1-2, 2-3 & 3-4
3rd	1-2
4th	1-2 & 2-3



Making the Shifts



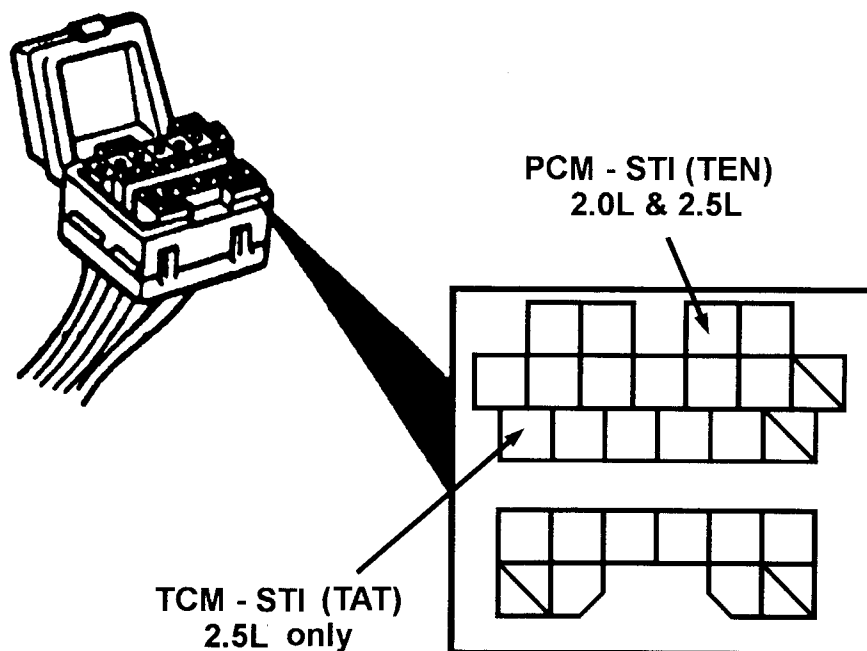
Diagnostic Trouble Code Retrieval

To retrieve trouble codes manually, ground the self test input (TEN or TAT) pin of the diagnostic connector. When the ignition is turned on, the check engine light or the hold light will begin blinking. A long flash represents the tens digits and a quick flash represents the ones digits. Two long flashes and four quick flashes for example would indicate a code 24.

Location: The diagnostic connector is located next to the battery.

1993 Vehicles equipped with a 2.0L use a PCM (Power Train Control Module) to control the engine and transmission.

Vehicles equipped with the 2.5L engine use a PCM to control the engine and a TCM (Transmission Control Module) to control the transmission. Both applications have the control modules located under the center console.



Codes

TCM Diagnostic Trouble Code	Diagnostic Trouble Code Definition
01*	Crankshaft Position Sensor #1 (CKP1)
02	Crankshaft Position Sensor #2 (CKP2)
03	Cylinder Identification (CID) Sensor
04	Crankshaft Position Sensor #1 (CKP1)
05	Knock Sensor (KS)
06*	Vehicle Speed (VSS) Sensor
08	Measuring Core Volume Air Flow (MC-VAF) Sensor
09	Engine Coolant Temperature (ECT) Sensor
10	Intake Air Temperature (IAT) Sensor
12*	Throttle Position (TP) Sensor
14*	Barometric Pressure (BARO) Sensor
15	Left Heated Oxygen Sensor (LHO2S) Voltage Always Below 0.55V
16	EGR Valve Position (EVP) Sensor
17	Left Heated Oxygen Sensor (LHO2S) Voltage Does Not Change
23	Right Heated Oxygen Sensor (RHO2S) Voltage Always Below 0.55V
24	Right Heated Oxygen Sensor (RHO2S) Voltage Does Not Change
25	Fuel Pressure Regulator Control (FPRC) Solenoid
26	Canister Purge (CANP) Solenoid
28	EGR Control (ECRC) Solenoid
29	EGR Vent (EGRV) Solenoid
34	Idle Air Control (IAC) Solenoid
41	Variable Resonance Induction System (VRIS) Solenoid #1
46	Variable Resonance Induction System (VRIS) Solenoid #2
55*	Pulse Signal Generator (PSG)
56*	Transaxle Oil Temperature (TOT) Sensor
57*	Reduce Torque Signal #1 (RTS1) (To PCM)
58*	Reduce Torque Signal #2 (RTS2) (To PCM)
59*	Torque Reduce / Engine Coolant Temperature Signal (TRS) (From PCM)
60*	1-2 Shift Solenoid (SS1)
61*	2-3 Shift Solenoid (SS2)
62*	3-4 Shift Solenoid (SS3)
63*	Torque Converter Clutch Control (TCCC) Solenoid
64*	Downshift Solenoid (DSS)
65*	Torque Converter Clutch (TCC) Solenoid
66*	Line Pressure Solenoid (LPS)
67	Low Cooling Fan (LFAN) Relay
69	Cooling Fan Engine Coolant Temperature

* Transmission Related

Terminology Ford vs. Mazda

Mazda and Ford have changed the names of many sensors. Although most sensors still operate the same way, the following information will help to minimize confusion.

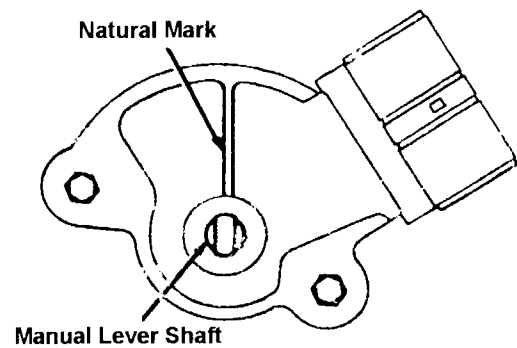
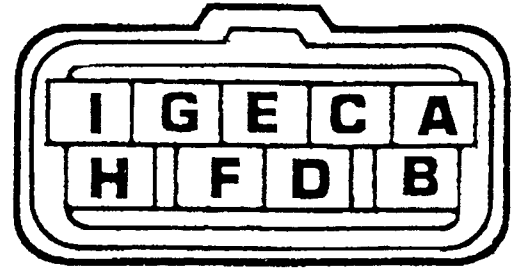
MAZDA	FORD
3-2 Control Solenoid	Downshift Solenoid
Inhibitor Switch (PRNDSL) Park/Neutral Switch (PRNDSL) Transaxle Range Switch (PRND21)	MLP (Manual Lever Position Sensor) (PRNOD1)
TPS (Throttle Position Sensor) TVO (Throttle Voltage Output)	TP Sensor
Pulse Generator Input/Turbine Speed Sensor	Pulse Signal Generator
Coolant Temperature Signal	Engine Coolant Temperature Signal
Brake Switch	BOO Switch
Hold Mode Switch O/D Off Switch	Hold Switch O/D Control Switch
Transaxle Fluid Temperature Sensor	TOT
1-2 Shift Solenoid Shift Solenoid A	1-2 Shift Solenoid
2-3 Shift Solenoid Shift Solenoid B	2-3 Shift Solenoid
3-4 Shift Solenoid Shift Solenoid C	3-4 Shift Solenoid

Inhibitor Switch

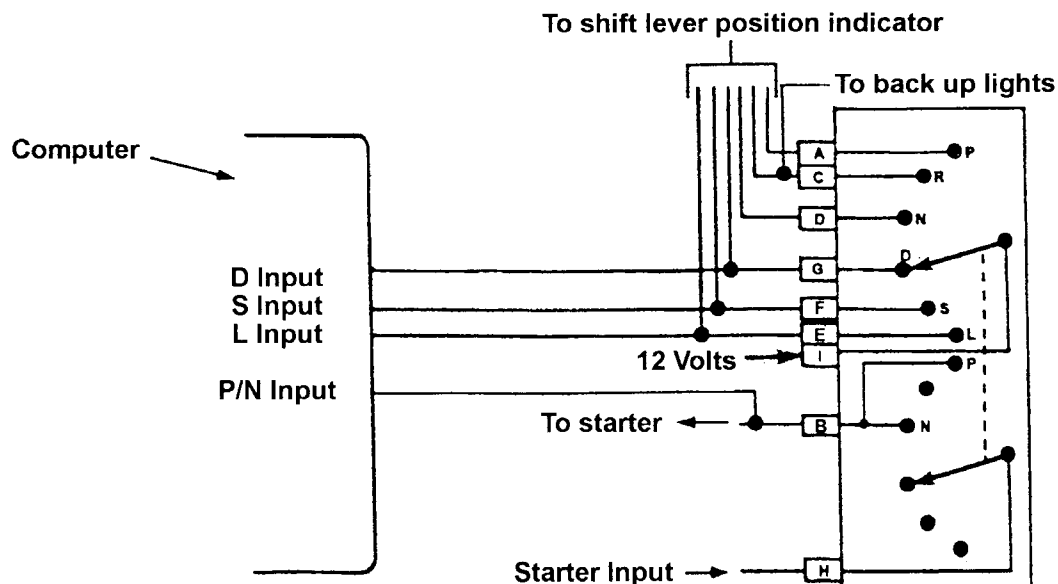
The computer uses information from the inhibitor switch to know what position the manual lever is in. There is no trouble code for the inhibitor switch however it may set a false code 6 (VSS). Other symptoms may include erratic shifts, 3rd gear starts, no third or fourth, and even no reverse.

	B	H	I	A	C	D	G	F	E
P			12	12	-	-	-	-	
R			12	-	12	-	-	-	-
N			12	-	-	12	-	-	-
D			12	-	-	-	12	-	-
S			12	-	-	-	-	12	-
L			12	-	-	-	-	-	12

	B	H	I	A	C	D	G	F	E
P	●	●	●	●					
R			●	●	●				
N	●	●	●	●	●	●			
D			●	●	●	●	●		
S			●	●	●	●	●	●	
L			●	●	●	●	●	●	●



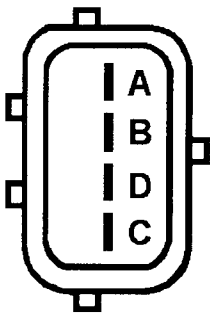
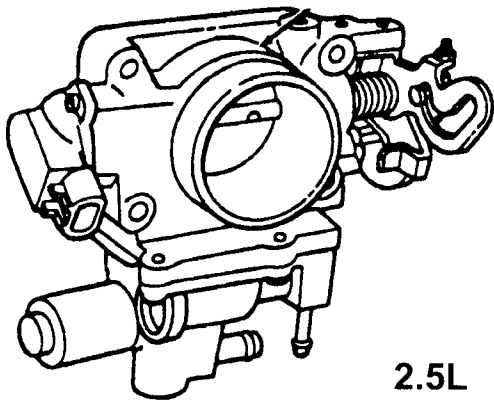
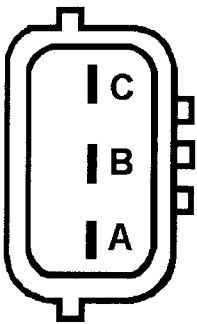
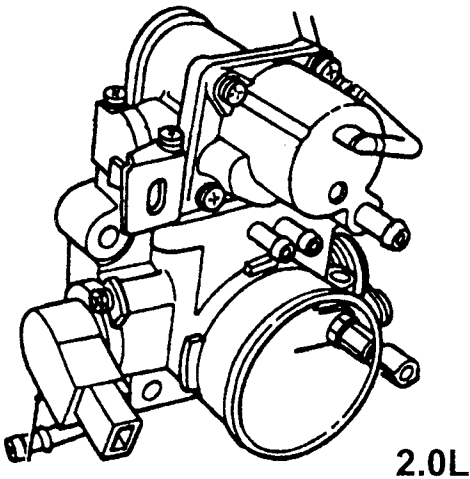
Wiring Schematic



TPS/Idle Switch

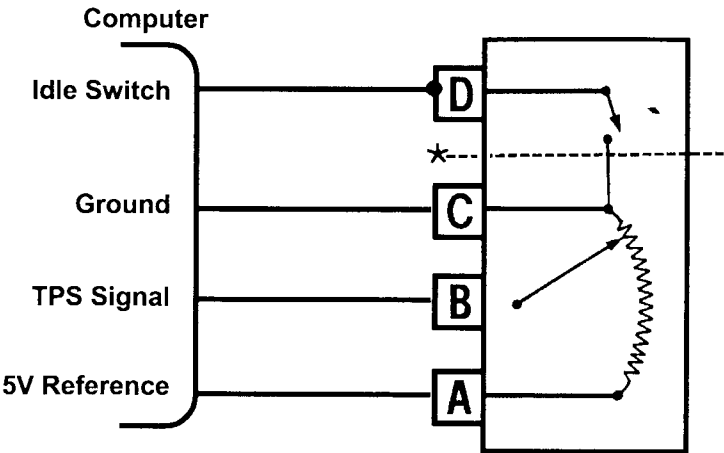
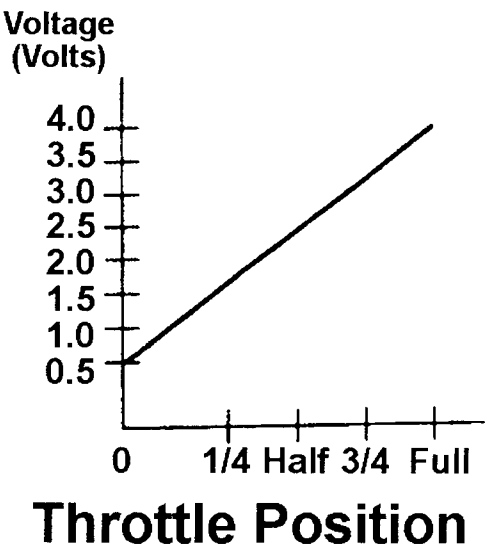
Signals from the TPS (Throttle Position Sensor) are sent to the computer. This information is used to influence shift timing and line pressure rise.

The signal from the idle switch is sent to the computer to cancel lock-up when the throttle is at idle position.



A	5V Reference
B	TPS Signal
C	TPS Ground
D	Idle Switch *

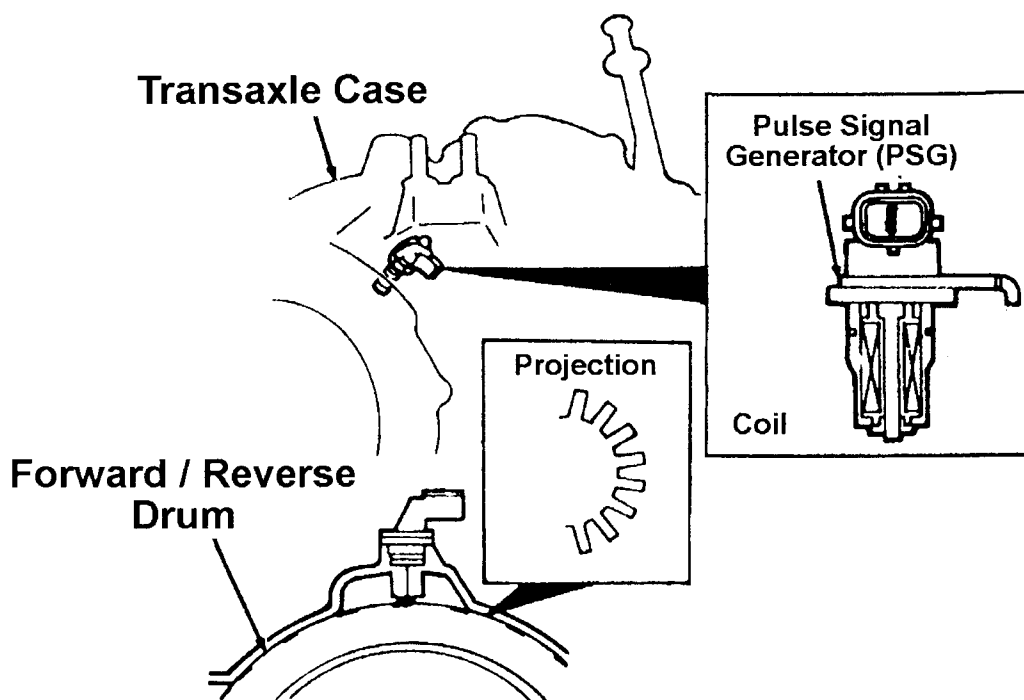
* = less than .10V at Idle



NOTE: The 2.0L uses an idle switch mounted separate from the TPS. The 2.5L idle switch is inside the TPS.

Pulse Generator

The pulse generator is a magnetic pickup located on the transaxle case to detect the Forward/Reverse drum speed. As the 32 projections, rotating around the drum, pass the tip of the pulse generator an A/C voltage is produced by the sensor. The pulse generator can be tested several ways. A/C voltage readings can be taken by probing the two wires with sensor connected or by unplugging and probing the two pins of the pulse generator. In neutral at Idle speed, voltage should be approximately 0.4 - 0.9 volts A/C with voltage rising with RPM. Although voltage is important, frequency (hertz) produced by the sensor is what is needed by the computer for accurate input speed readings.



Pulse Generator (cont'd)

The computer constantly monitors these frequencies and is programmed to calculate road speed by comparing them to the gear commanded much like the chart below.

Gear Commanded	RPM of Drum			
	1000	2000	3000	4000
1st	6 mph	12 mph	19 mph	25 mph
2nd	12 mph	23 mph	35 mph	46 mph
3rd	16 mph	33 mph	49 mph	65 mph
O/D	24 mph	47 mph	70 mph	93 mph

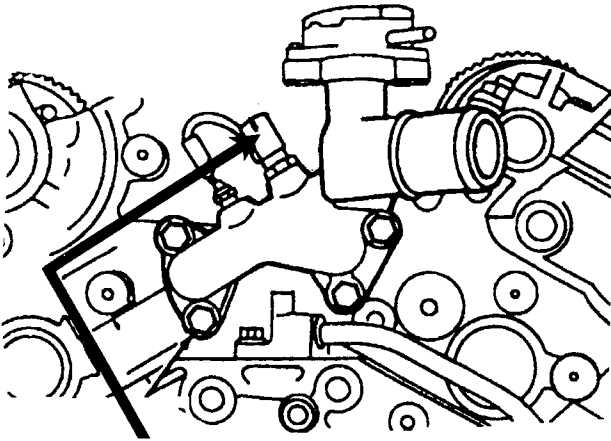
For Example: If input drum speed is 3000 RPM and the computer is currently commanding 2nd gear the computer calculates vehicle speed to be 35 mph. If the 2-4 band is broken the transaxle would stay in 1st gear. While the computer is assuming vehicle speed is 35 mph, actual vehicle speed is only 19 mph. When the computer commands 3rd gear and the transaxle makes a 1-3 upshift and input speed drops to approx 1200 rpm. Because the computer is not programmed to verify true speed by looking at the VSS it simply assumes the vehicle slowed to about 19 mph. When the computer commands the 3-2 down shift and input speed goes back to 3000 rpm in 1st gear repeating this scenario over and over again creating a symptom of a 1-3 shift hunt.

No codes will be set and if the solenoid signals are monitored by a technician it will appear to be an electrical problem. Many different internal transaxle failures can appear to be electrical. To help avoid hours of unnecessary electrical tests try unplugging the pulse generator. This will set a code 55. Now the computer will shift using the VSS which is not based on calculations. If the problem goes away one of two things are the cause. Either a pulse generator giving false information or there is a problem in the unit like shift solenoid, clutch slippage, sticky valves, etc.

NOTE: When code 55 is set, the computer is programmed to not command a 3-4 upshift or lock-up.

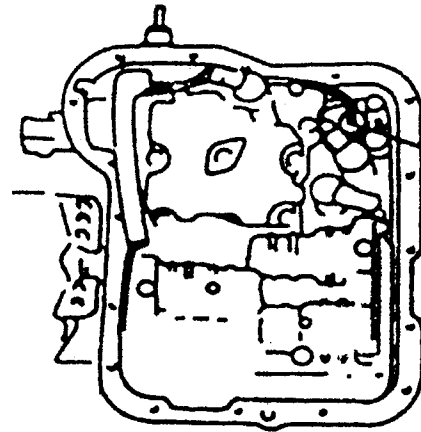
Temperature Sensors

The computer monitors temperature signals from the engine coolant sensor and the transaxle fluid temperature sensors to control many functions including line rise, torque converter clutch apply and 4th gear operations.



Engine Coolant Temperature Sensor

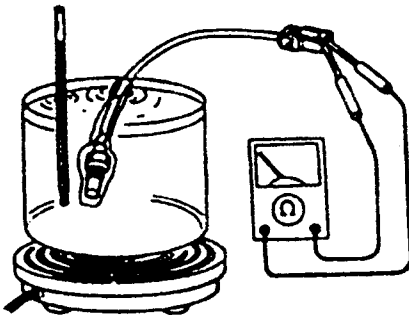
No Slip Lock-Up or Lock-Up below 60°C (140°F)



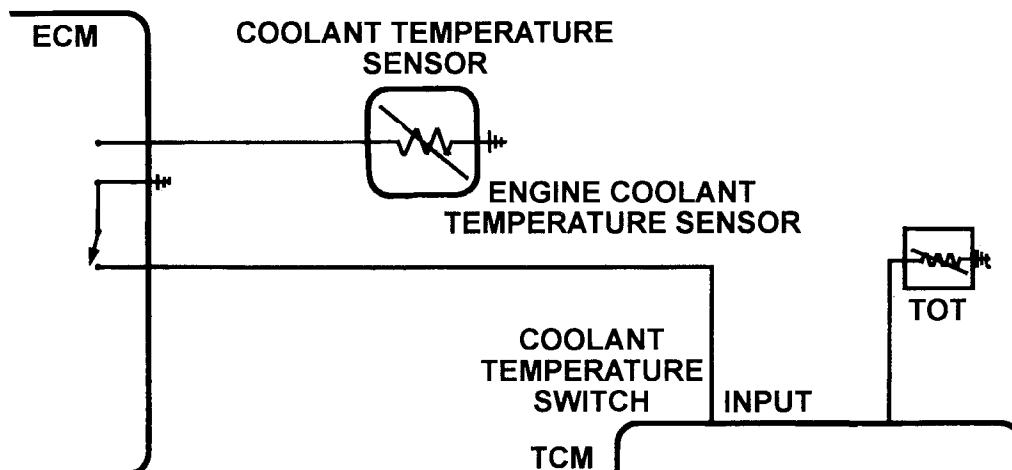
TRANSAXLE
FLUID
TEMPERATURE
SENSOR

No 4th gear below 10°C (50°F)

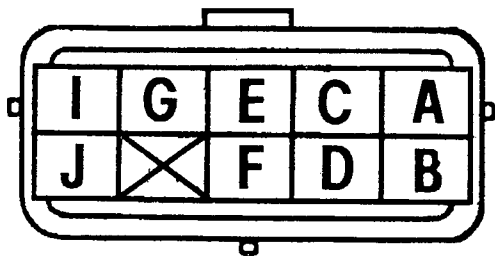
No slip lock-up below 20°C (68°F)



ATF Temperature °C (°F)	Resistance (k ohms)
-20 (-4)	13.47—17.17
0 (32)	5.445—6.678
20 (68)	2.441—2.894
40 (104)	1.193—1.374
60 (140)	0.6284—0.7048
80 (176)	0.3527—0.3865
100 (212)	0.2091—0.2245
120 (248)	0.1301—0.1372
130 (266)	0.1044—0.1090

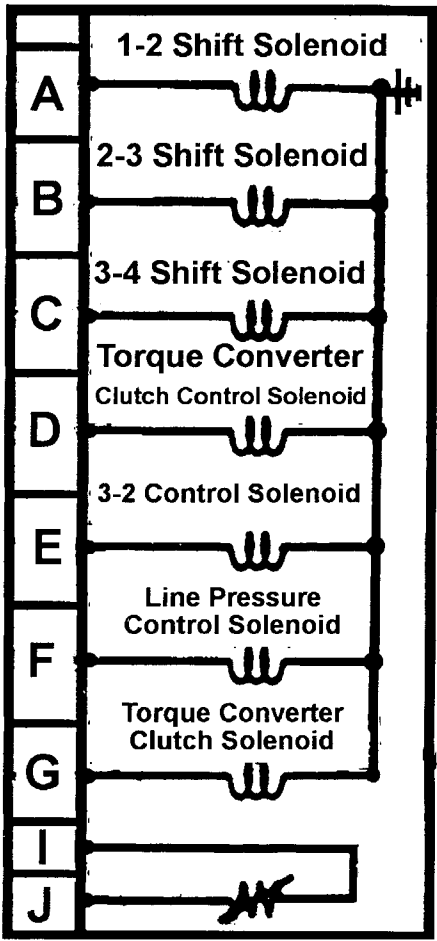


Solenoids



VIEW: Case Connector / Pin Side

Pin	Function	Trouble Code
A	1-2 Shift Solenoid	60
B	2-3 Shift Solenoid	61
C	3-4 Shift Solenoid	62
D	Torque Converter Clutch Control Solenoid	63
E	3-2 Control Solenoid	64
F	Line Pressure Control Solenoid	65
G	Torque Converter Clutch Solenoid	66
I	TOT	
J	TOT	



Pins “A” through “E”

Status: Normally Closed
Resistance: 11-27 ohms
Current: 0.5-1.2 amps @ 13.5 vdc
Signal: 12 volts

Line Pressure Control Solenoid

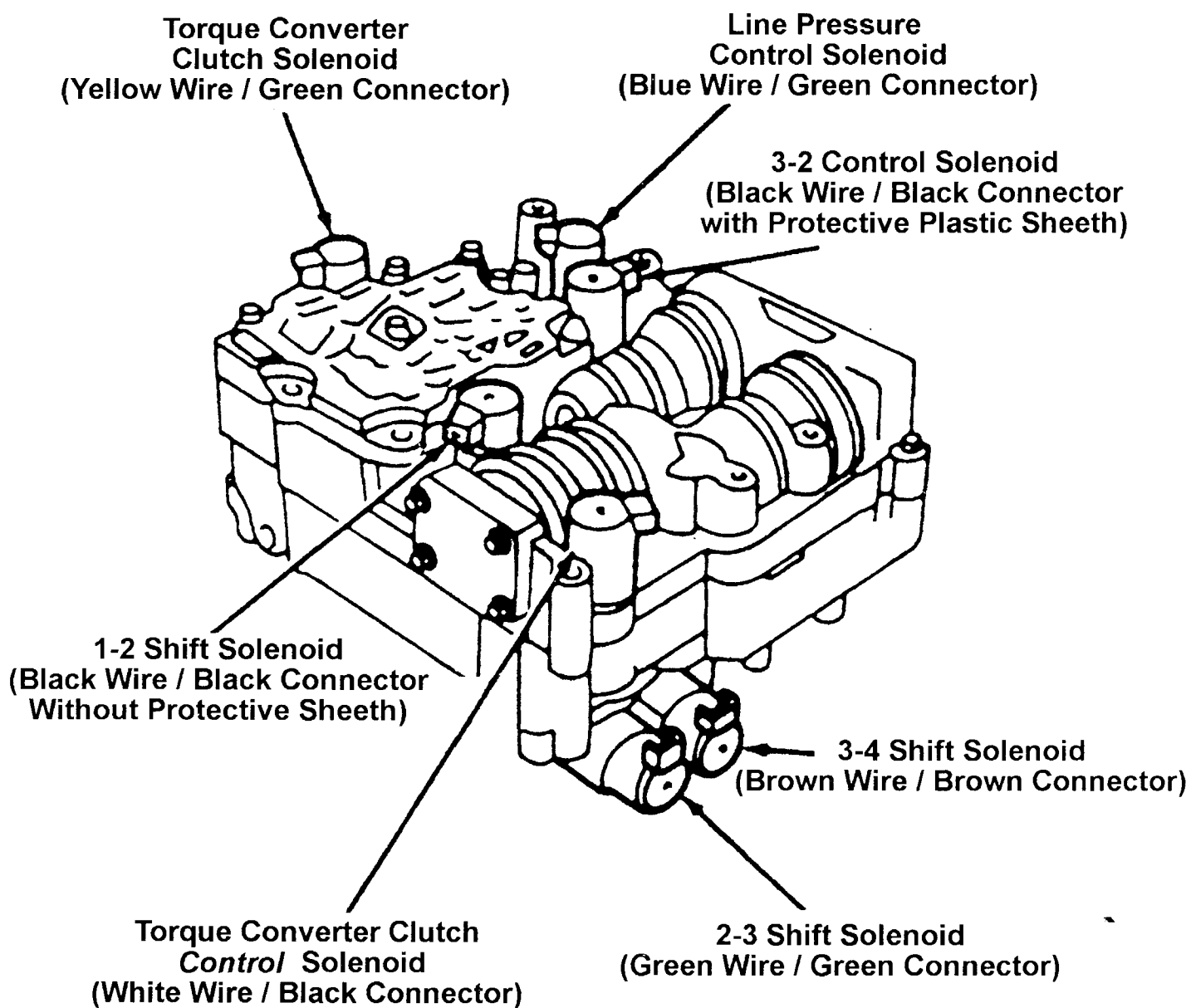
Status: Normally Closed
Resistance: 9-13 ohms
Signal: Idle-approx 8 volts / 67% duty cycle
Full Stall: Approx 1.6 volts / 0-10% duty cycle

TCC Solenoid (Torque Converter Clutch)

Status: Normally Closed
Resistance: 9-13 ohms
Signal: During slip TCC — 8-12 volts / 0-65% duty cycle
All other conditios: < 1.0 volts / 0% duty cycle

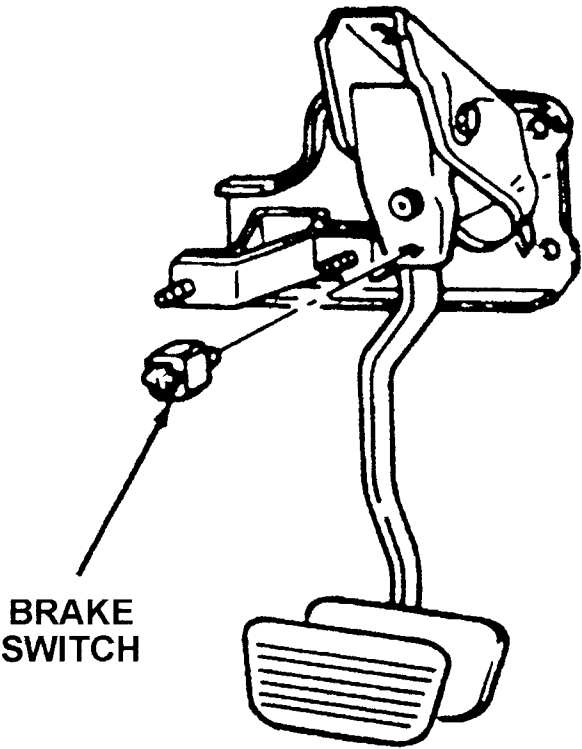
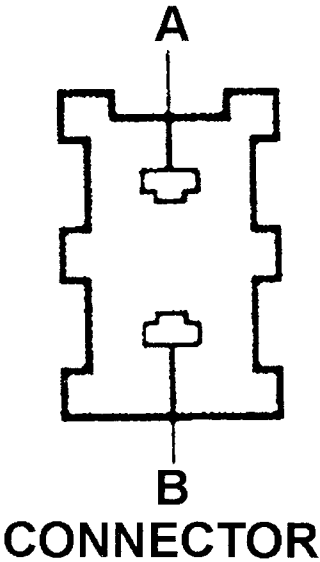
NOTE: Codes 60 through 66 are solenoid circuit errors.
Possible Causes: Bad solenoid, connection proglems, cut or shorted, wiring, low battery voltage, or computer.

Solenoids



Brake Switch

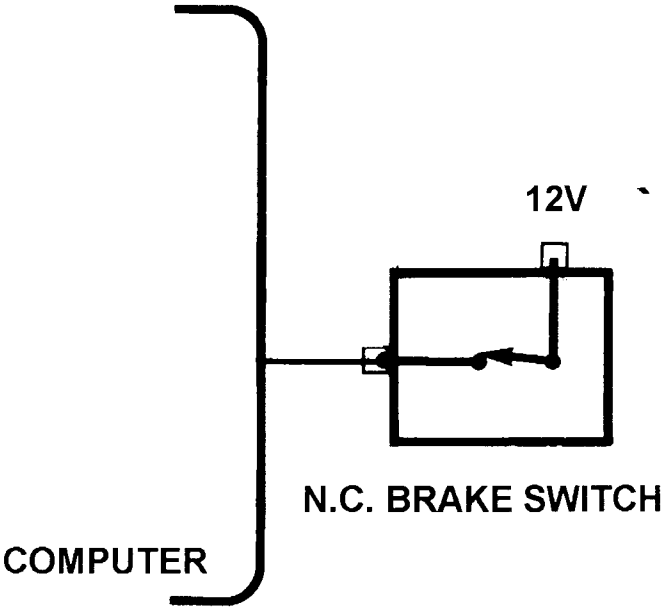
The computer uses data from the brake switch to cancel lock-up.



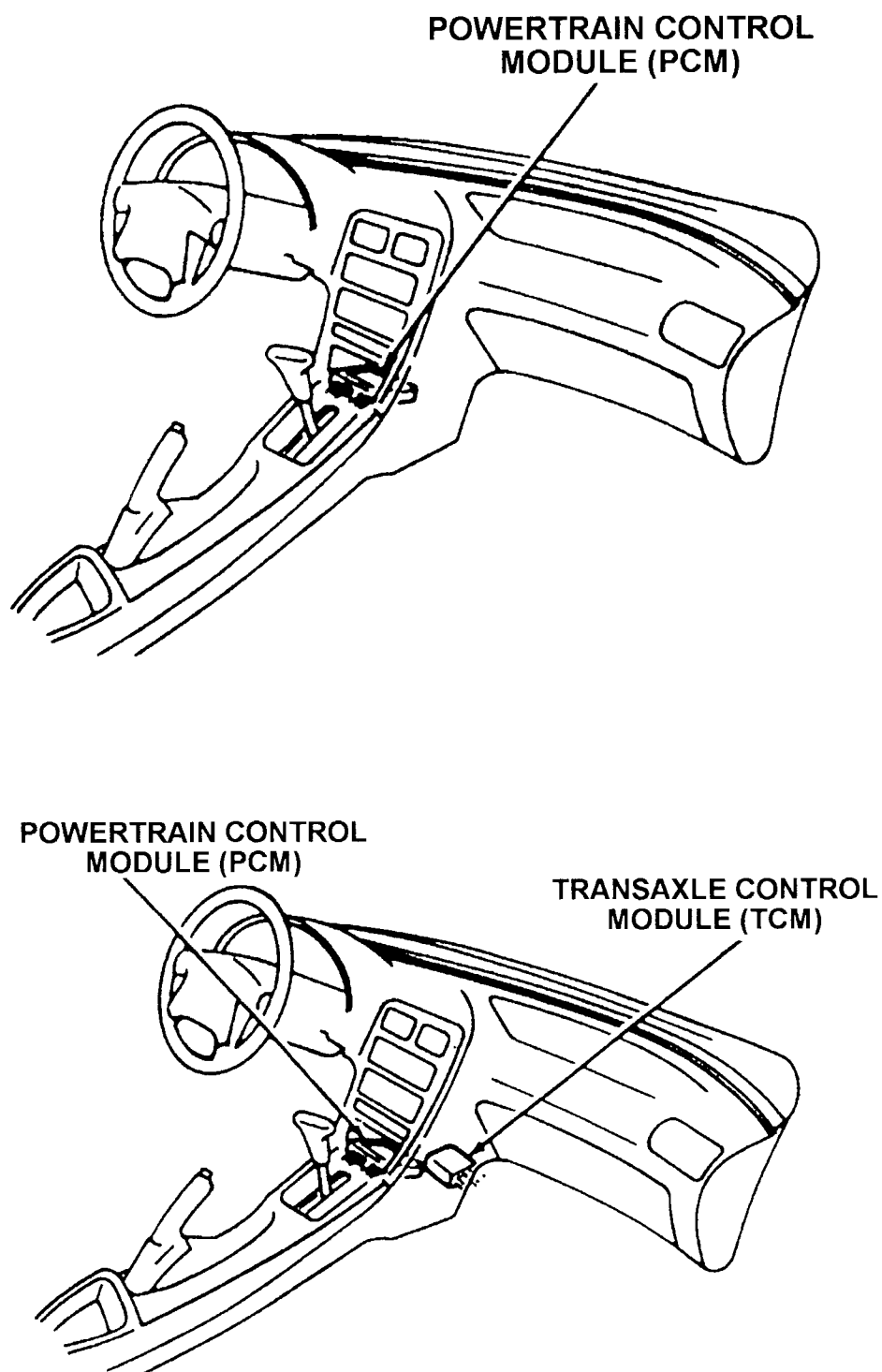
Brake	Continuity
Released	NO
Applied	YES

Brake	A	B
Released	12V	0V
Applied	12V	12V

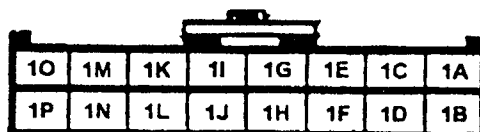
Voltage Chart



Computer Location



2.5L Pinout Chart



NOTE: < = Less Than

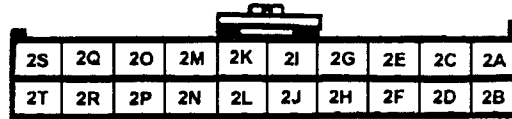
> = Greater Than

VOLTAGE

1A	AC Signal	AC Off AC On	12 < 1.0
1B	(93-94) Hold Indicator (95) O/D Off Indicator	In the Hold or O/D off mode All other	< 1.0 12
1C	STO (Diagnostics)		
1D	Inhibitor Switch (P/N)	In Park or Neutral Range All Other Ranges	< 1.0 12
1E	STI (Diagnostics)		
1F	Brake Switch	Brake Released Brake Depressed	0 12
1G	Fluid Temperature Sensor	3.5V at 68°F (20°C) 0.6V at 266°F (130°C)	Ranges 0.6 - 4.8
1H	(93-94) Hold Switch (95) O/D Off Switch	Switch Released Switch Depressed	12 < 1.0
1I	Inhibitor Switch (R) Torque Control	In Reverse Range In All Other Ranges	12 0
1J	Reduce Torque Signal 1	During a 1-2 or 2-3 Upshift Above ½ Throttle All Other Conditions	< 1.0 12
1K	Coolant Temperature Switch	Below 140°F (60°C) Above 140°F (60°C)	< 1.0 12
1L	Reduce Torque Signal 2	During All Downshifts Above 3/8 Throttle All Other Conditions	< 1.0 12
1M	Cruise Control	When Cruise Control is Accelerating All Other Conditions	< 1.0 12
1N	RPM Signal (engine)	Engine Running	2-3 Volts ★
1O	Idle Switch	Idle All Other Conditions	< 0.1 12
1P	VSS	Vehicle Stopped Vehicle Moving	0 or 5 2-3 ★

★ = Frequency varies with speed or RPM

2.5L Pinout Chart



20 PIN CONNECTOR

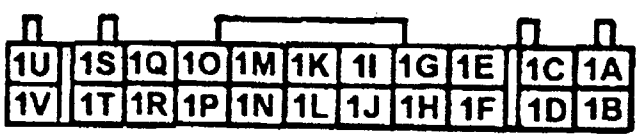
NOTE: < = Less Than

> = Greater Than

2A	TPS Reference	Key Off Key On	0 5
2B	Inhibitor Switch (P/N)	In Park or Neutral All Other Ranges	<1.0 12
2C	Converter Clutch Solenoid	During Slip TCC (Volts / + Duty Cycle) All Other Conditions (Volts/+ Duty Cycle)	8-12 / 65% <1.0 / 0%
2D	Inhibitor Switch (D)	In Drive Range All Other Ranges	12 0
2E	1-2 Shift Solenoid	Solenoid Off Solenoid On	<0.5 12
2F	Inhibitor Switch (S)	In "S" Range All Other Ranges	12 0
2G	2-3 Shift Solenoid	Solenoid Off Solenoid On	<0.5 12
2H	Inhibitor Switch (L)	In "L" Range All Other Ranges	12 0
2I	3-4 Shift Solenoid	Solenoid Off Solenoid On	<0.5 12
2J	Pulse Generator	Input Drum (Not Spinning) Input Drum (Spinning)	<0.1 ★ 0.5 - 4.0 (AC)
2K	Converter Clutch Control Solenoid	Solenoid Off Solenoid On	<0.5 12
2L	Pulse Generator Ground	Always	<0.1
2M	3-2 Timing Solenoid	Solenoid Off Solenoid On	<0.5 12
2N	Pressure Control Solenoid	Idle — 8.0 Volts / 67% + Duty Cycle Full Stall — 1.6 Volts / 0%	Ranges from 1.6V - 8.0V 0% - 67%
2O	Battery	Always	12
2P	Ground	Always	<0.1
2Q	Ignition	Key Off Key On	0 12
2R	Barometric Pressure Sensor		
2S	Ignition	Key Off Key On	0 12
2T	TPS	Idle Approx. 0.3 - 0.7 Full Throttle Approx. 4.0 - 4.4	0.3 - 4.4

★ = Frequency varies with speed or RPM

'93 2.0L Pinout Chart



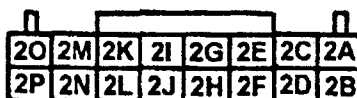
22 PIN CONNECTOR

NOTE: < = Less Than > = Greater Than

1A	Battery	Always	12
1B	Main Relay	Key Off Key On	0 12
1C			
1D	Start Signal	While Starting Engine All Other	12 < 1.0
1E	Not Used		
1F	Brake Switch	Brake Released Brake Applied	0 12
1G			
1H	Hold Mode Switch	Switch Released Switch Depressed	12 < 1.0
1I	Igniter (RPM Signal)	Engine Running	2.0 - 3.0 ★
1J	Headlight Switch	Head Lights Off Head Lights On	0 12
1K	Daytime Running Lights	Park Brake Released Park Brake Applied	12 0
1L			
1M	VSS	Vehicle Stopped Vehicle Moving	0.0 or 5.0 2.0 - 3.0 ★
1N	Power Steering Pressure Switch	While Steering Not Steering	< 1.0 12
1O	Rear Window Defrost Relay	Switch Off Switch On	12 < 1.5
1P	Blower Control Switch	In Off, 1st or 2nd Position In 3rd or 4th Position	12 < 1.0
1Q	Hold Indicator	In Hold Mode All Other	< 1.0 12
1R	AC Sensor	AC Off AC On	12 < 2.5
1S	AC Relay	AC Off AC On	12 < 2.5
1T	Idle Switch	Idle Above Idle	< 0.1 12

★ = Frequency varies with speed or RPM

'93 2.0L Pinout Chart



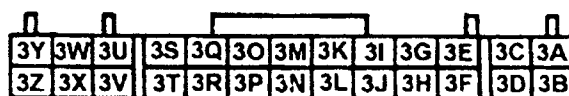
16 PIN CONNECTOR

NOTE: < = Less Than > = Greater Than

1U	Ignition	Key Off Key On	0 12
1V	Inhibitor Switch (P/N)	In Park or Neutral Range All Other Ranges	< 1.0 12
2A	Crankshaft Position Sensor	Engine Running	2.0 - 3.0 ★
2B	Cylinder Identification Sensor		
2C	Oxygen Sensor	Engine Running (After Warm Up)	0.5 - 1.5
2D	TPS	0.5 at Idle 4.2 at Full Throttle	(Ranges) 0.5 - 4.2
2E	Coolant Temperature Sensor		
2F	Intake Air Temperature Sensor	Approx 2.0V at 68°F (20°C)	Ranges
2G	Barometric Pressure Sensor	Sea Level Pressure Engine Off Sea Level	4.0
2H	Transaxle Oil Temperature Sensor	At 68°F (20°C) Approx 3.5 Volts At 266°F (130°C) Approx. 0.6 Volts	(Ranges) 0.6 - 3.5
2I	Reference Voltage	At Sea Level — Engine Off — Engine On	0.5 - 5.0
2J	EGR Temperature Sensor (California Only)		
2K			
2L	Mass Airflow Meter		Ranges 1.5 - 5.0
2M	Inhibitor Switch (R)	In Reverse Range All Other Ranges	12 0
2N	Inhibitor Switch (L)	In Low Range All Other Ranges	12 0
2O	Inhibitor Switch (S)	In "S" Range All Other Ranges	12 0
2P	Inhibitor Switch (D)	In "D" Range All Other Ranges	12 0

★ = Frequency varies with speed or RPM

'93 2.0L Pinout Chart



26 PIN CONNECTOR

NOTE: < = Less Than > = Greater Than

3A	Ground	Always	< 0.1
3B	Ground	Always	< 0.1
3C	Ground	Always	< 0.1
3D	Ground	Always	< 0.1
3E	Not Used		
3F	Pulse Generator	Input Drum (Not Spinning) Input Drum (Spinning)	0 0.5 - 4.0
3G	High Cooling Fan Relay		
3H	Pulse Generator Ground	Always	< 0.1
3I	Low Cooling Fan Relay		
3J	Not Used		
3K	EGR Vacuum Regulator Solenoid		
3L	Fuel Pump Relay	Key Off Key On	0 12
3M	Fuel Pressure Regulator Control Solenoid		
3N	Canister Purge Solenoid		
3O	Idle Air Control Solenoid		
3P	1-2 Shift Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3Q	2-3 Shift Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3R	3-4 Shift Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3S	Converter Clutch Control Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3T	3-2 Timing Solenoid		
3U	Converter Clutch Solenoid		
3V	Line Pressure Solenoid		
3W	Injector #1		
3X	Injector #2		
3Y	Injector #3		
3Z	Injector #4		

★ = Frequency varies with speed or RPM

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1998 **TECHNICAL SEMINAR**



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The Art of Diagnosing

What do you mean the transmission's on the bench
and you can't find anything wrong with it!...



Diagnosing, whether it be for a transmission, or any other any other component, is *the process of elimination*. Rarely will the diagnosis process lead directly to the failing component. True diagnosis is made by eliminating the components that *aren't causing the problem*. Once the these components are *proven* to be unrelated to the failure, the remaining components are then suspect.

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The Art of Diagnosing

Introduction

Diagnosing truly is an art: Today more than ever, it is vital that the person who *calls the shots*, as to whether the unit comes out or not, plays a much bigger role than in the past. Just a few years ago things like removing the valve body or replacing the transmission (because you've been working on it for two days and it still doesn't work) stopped being practical.

For example, no one would say to their installer "how about whipping the valve body out of that Probe for me?" Or, suppose you have a Nissan Pathfinder with an RE4R01A that won't shift. In the days of the 350s and C-4s, if the unit still wouldn't work after several hours of swapping parts, you'd just get another stock unit. If you didn't have one, you could get a unit from the core pile, or buy one from the wrecker for \$15, get it in the vehicle and move on to the next job.

Today, the unit *in the vehicle* is the one that has to be fixed. Now more than ever, knowing what's wrong with the unit *before it hits the bench*, is vital. Forget the idea that 'if we don't know where the problem is, rebuild it *again* and maybe it will go away.'

This program is designed for the person who drives the vehicle and determines whether or not the unit needs to come out. The following information will help you determine if the problem is internal. And if it is, this information will help you determine which component (or components) are the *root* of the problem. The first step is to learn to **diagnose**.

What is Diagnosis?

Diagnosis isn't the ability to know what is causing a problem. Doing so is usually nothing more than a guess. True diagnosis is knowing what *isn't* causing the problem. Then, after ruling out these components, you're left with the only component or components that can possibly be responsible for the complaint. This process usually seems less time efficient at first, but in the long run it is much more efficient.

Consider, for example, working on a part or component for two days that couldn't possibly be the cause of the problem in question. It should be no surprise that the problem won't get fixed. For example, a vehicle comes in with no reverse. The call is made that the problem might be with the torque converter; so the converter is replaced.

Lo and behold, the problem still exists. It should be no surprise that the unit will still have no reverse. After all, the torque converter isn't responsible for reverse.

The point is, it's important to know which components have the *potential* for causing the problem, and then have a method for ruling out each one until you've narrowed the problem down to one or two components.

To do this competently, you must be intimately familiar with the functions of the unit being diagnosed. This is more complex than most people think. This not only means knowing which elements are applied for each gear, but also knowing which *other* elements *can* be on without causing a problem, and knowing which other elements *can't* be on without causing a problem.

What is Diagnosis? (continued)

Another important fact to consider is the elements that are on but don't *need* to be on.

For example, the forward clutch of an AXODE is on in first, second, manual third and reverse. It *can* be on in automatic third gear. It *can't* be on in fourth gear. However, it is on in second gear but isn't part of the power flow, so it doesn't need to be on. That means that, even though the forward clutch is on in second gear, a forward clutch failure can't prevent an AXODE from moving in second gear. That's an important distinction when diagnosing a second gear failure.

True Diagnosis vs the Hit-n-Miss

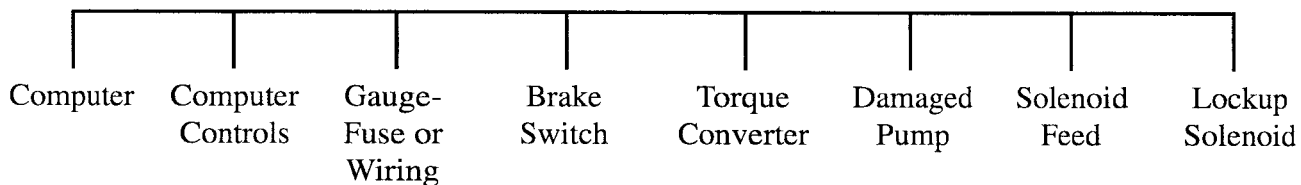
One of the most common methods for fixing a problem is the *hit-n-miss* approach. Common; but not very effective.

The reason it is so popular is that, on the surface, it seems to be the quickest way of getting the vehicle back on the road. The idea here is to identify as many items that can cause the failure, and then replace them one at a time until the failure is fixed. The problem is that this approach is unreliable, and in the long run costs more in both time and money.

For example, imagine that these eight possible problems are related to a 700-R4 that doesn't have lockup. The hit-n-miss approach would be to address each item, one at a time. Potentially, it would require eight steps to fix the problem. Meanwhile, those items that *weren't* the cause of the problem were paid for in time and money!

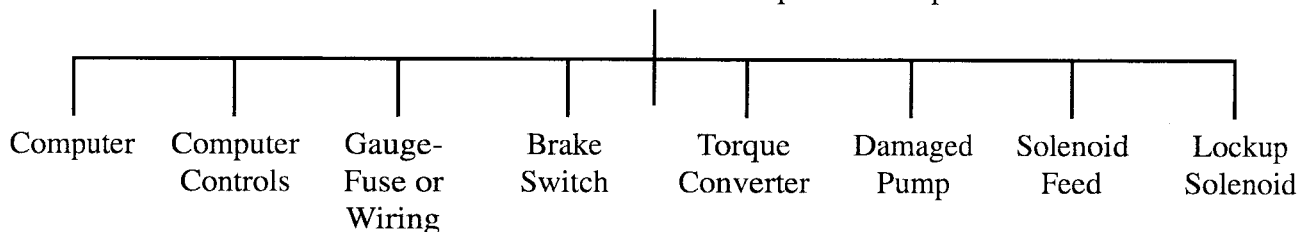
NOTE: One of the key elements in identifying the cause of a failure is to look for a *common denominator*. This is *one* item that can cause *all* of the failure.

The more you know, the *less* you have to work.



Now look at how much better it is to use true diagnosis. The key is to identify a test that will eliminate as many of the potential suspects as possible. In this example we might consider energizing the lockup solenoid manually and see if the transmission responds.

Perform a test that will eliminate possible suspects

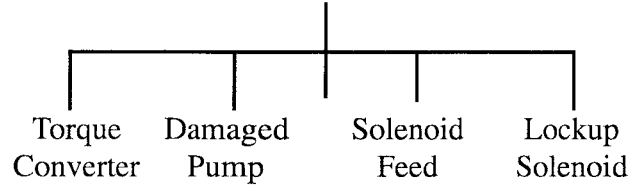


Suppose energizing the circuit didn't apply the converter clutch; your one check has virtually eliminated all of the possibilities on the left side of the list. The next step is to again, eliminate as many potential suspects as possible — with one test. In this example, that might be blocking the lockup apply valve in the lockup position and see if it kills the engine.

What is Diagnosis? (continued)

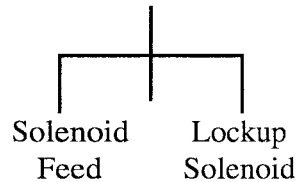
True Diagnosis vs the Hit-n-Miss (continued)

Once again, perform a test that will eliminate possible suspects



If the engine stalls, we're left with two possible suspects. A test that would work here might be putting a checkball down the snout of the lockup solenoid and see if the transmission locks up (on the road).

One last time, perform a test that will eliminate possible suspects



Using this procedure allowed us to find the culprit in only three moves. This is the basis of ***all*** true diagnoses — eliminate as much as possible through a planned series of tests, until you can identify the culprit.

Rules of Road Testing

There are several rules of road testing that often ignored. Following these simple rules will reduce the possibility of removing a unit unnecessarily.

When the vehicle first comes into the shop...

1. Make sure you experience the problem the customer is concerned with. Better yet, have the customer demonstrate the problem for you.
2. Depending on the problem, perform a pressure test and cooler flow test *before* removing the transmission.
3. Never remove a unit until you are fairly certain that you know what is wrong with it, and which component or components are responsible for the failure.

If the transmission is computer controlled, make certain the failure is in the unit before removing it. This may require checking the computer system for DTCs and monitoring the signal wires to the transmission.

Tips on Driving the Vehicle

There are many simple tests that take little extra time to perform — yet are often overlooked. The key to an effective road test is to try *anything* that might make the problem go away or change. These include:

1. Driving the vehicle in all ranges.
2. Adjust the TV cable — even to extremes.
3. Vary vacuum to the modulator.
4. Add a friction modifier.
5. Bypass the cooler.
6. Energize/monitor the shift solenoids.
7. Drive the vehicle with the solenoids disconnected.
8. Do all of the above at different throttle openings.

Some tests are better left for the lift

These are:

1. Push/pry on the servo covers.
2. Tighten the bands (all the way).
3. Run the vehicle with no oil. (5 – 10 seconds only — this is a good test for a movement in neutral condition)
4. Air-shift the transmission.

After you've repaired the transmission...

1. Always test the vehicle on the road; even if it appears as though the unit isn't operating properly and has to be removed again.
2. Never remove a unit until you are fairly certain that you know what is wrong with the transmission and which component or components are responsible for the failure.

If the transmission is computer controlled, make certain the failure is in the unit before removing it. This may require checking the computer system for DTCs and monitoring the signal wires to the transmission.

Just The Facts

There are only two reasons that a clutch or band will burn.

1. There isn't enough pressure to support the load (e.g. low line pressure, a leak in the circuit of the clutch or band that is burnt).
2. The unit is shifting into a bindup (a clutch or band is coming on when it shouldn't; such as a cross leak).

When two transmissions have the same failure, the problem is usually with technique or parts. For example, a procedure that is thought to be a good thing to do (something you read in a magazine or heard mentioned by someone), is causing the problem. Using the same faulty procedure will result in the same failure: This is a problem with technique.

If a part causes the failure (such as valve body gaskets that are wrong for the application), using the same incorrect part will result in the same failure.

No Movement

A *no movement* condition can be related to forward, reverse or both ranges. As always, look for common denominators (if any) and then determine what components aren't related to the problem.

No Movement both Forward and Reverse

A vehicle that won't move forward or reverse is commonly caused by:

1. No line pressure.
2. No torque converter charge.
3. Converter drainback.
4. Mechanical failure.

The simple tests that will help rule out components that *aren't* the cause include:

1. Move the shifter to all ranges.
2. Remove the modulator hose (if equipped).
3. Pull the TV cable to maximum (if TV increases line pressure).
4. Check cooler flow (this will confirm torque converter charge).
5. Put a gauge on the transmission and test for proper line pressure.

Torque Converter Drainback

Torque converter drainback is often blamed for transmissions that won't move. The most important fact to understand is that when a transmission doesn't move — and it's caused by converter drawback — the engagement will *improve gradually* as the engine runs. If the transmission won't engage, but then, as you move the shifter repeatedly from neutral to drive or neutral to reverse, it suddenly engages, the problem isn't torque converter drainback.

No Movement Forward, or No Movement Reverse

If the vehicle will move either forward *or* reverse, several items can be eliminated:

1. Line pressure — it may be low, but there is at least enough pressure to make it move in one direction.
2. Torque converter charge — torque converters don't discriminate between reverse and forward.

Usually if the unit won't move in only one direction, the problem is a mechanical failure or a leak in the applying component(s). Methods that will isolate these two possibilities are:

1. Drive the vehicle in *all* shifter positions.
2. Remove the modulator hose.
3. Pull the TV cable to maximum (if TV controls line pressure)
4. Tighten all accessible band adjustments, or pry on all servos that are secured by snap rings. This is an easy way to overrun a defective sprag or leaking servos (model specific).

No Upshifts

A unit that won't upshift can be caused by a variety of components, including stuck shift valves, leaking apply circuits, mechanical failure, and in some cases the torque converter (split torque or damper types only). Anyone who intends to drive the vehicle and isolate the problem *must* be familiar with the clutch-and-band application of the unit being tested. Here are a few simple tests that will help isolate the problem.

Hydraulically-Shifted Units

1. Drive the vehicle in *all* ranges — this will help verify the operation of friction elements that serve more than one function.
2. Drive the vehicle at full throttle — this will help rule out the TV system.
3. Remove the modulator hose (on units where the modulator controls line pressure *only*).
4. Tighten all accessible band adjustments, or pry on all servos that are secured by snap rings. This is an easy way to overrun a defective sprag or leaking servos (model specific).

Electronically-Shifted Units

1. Drive the vehicle in *all* ranges — this will help verify the operation of friction elements that serve more than one function.
2. Remove the modulator hose (on units where the modulator controls line pressure *only*).
3. Tighten all accessible band adjustments, or pry on all servos that are secured by snap rings. This is an easy way to overrun a defective sprag or leaking servos (model specific).
4. Unplug the case connector that contains the shift solenoid wires — all electronically-shifted units will shift to at least second gear (some will shift to third, and some will shift to fourth).
5. Use a transmission tester to command each gear.

Bindups

Mechanical Bindups

You'll usually first notice a mechanical bindup while the vehicle is still on the lift, after a rebuild. The most common type of bindup is on the 1 – 2 shift as a result of a sprag or roller clutch installed backward. Often, when a unit has a sprag or roller clutch installed backward, the unit will shuttle-shift on the lift. When the vehicle is on the ground, the bindup will usually get worse. Also, in the case of a low sprag or roller clutch, the unit won't engage forward but may engage in manual low.

A simple test to confirm whether the low sprag or roller clutch is installed backward is to turn the both drive wheels, by hand, forward and then backward. The wheels should offer more resistance to turning backward. If the wheels have more resistance to turning forward, the sprag or roller clutch is backward. This test works with all units with a Simpson (e.g. C-4, 350, A-140E) or Ravaneaux (FMX, AOD, KM175-5) gear train. It will work on many other units; however, some units like the AXOD and 4T60 won't offer a difference in resistance.

Sometimes a mechanical bindup is caused by a misassembly such as clutch pack that is improperly indexed or a washer mislocated. An example is a Honda that binds in reverse and drives forward in neutral. This is usually caused by misassembling the first-gear clutch. Drain the sump and the start the engine. If the drive wheels start turning, the bindup is mechanical. If not, the bindup is hydraulic.

A mechanical bindup can also be caused by a broken park mechanism. For example, a vehicle with a KM-175-5 binds in reverse. The best test here is to first get the unit to bind up. Now, without touching the shifter, turn the engine off. If the vehicle won't roll (the drive wheels are stuck), the park mechanism is stuck.

Summary

1. Check the drive wheels for proper rotation. The low sprag or roller clutch may be in backward.
2. See if the condition goes away with the engine off. This is for units that *move in neutral*.
3. See if the vehicle will roll with the engine off. This for units that *won't move*.

Hydraulic Bindup

A hydraulic bindup is usually caused by cross leaks and are very difficult to isolate. Most of the time they'll be worse hot or during heavy throttle conditions. The best test to confirm a hydraulic bindup is to induce high line pressure. The method for doing this will vary from unit to unit: On a 4T60, remove the modulator hose. On a 4L60, pull the TV cable.

Once you've confirmed the condition is a hydraulic bindup, you must isolate the responsible component. If the unit has pressure taps for the individual components (e.g. intermediate clutch tap, direct clutch tap, etc.), see if there's any pressure where it doesn't belong. Another method for isolating the components is to rule them out by preventing them from functioning. For example, if an A4LD has a bindup in reverse, try loosening the overdrive and intermediate bands. Then see if the bindup goes away.

Once the component is isolated, consider how it is fed and whether it can be isolated further. For example, a 4L60 has a bindup in reverse. Pulling the TV cable makes it worse, so the problem is hydraulic. By checking the pressure on the second, third and fourth gear taps, you'll know if they are the components responsible. Let's say they aren't: Knowing the reverse clutch and low-reverse clutch are on in reverse, and the band and 3 – 4 clutch aren't responsible, you have now isolated the problem to be in the forward or overrun clutch. The question now is 'where did the foreign oil come from?'

Bindups (continued)

Summary

- Hydraulic cross leaks are made worse by increasing line pressure. Use this fact for testing.
- Hydraulic cross leaks are often caused by missing checkballs, wrong valve body gaskets and sealing rings that are undersized.

Kills The Engine

A unit that *kills the engine* is usually caused by a torque converter clutch that is always applied. However, this isn't always the case. Sometimes, an engine problem or some other condition unrelated to the transmission will cause the engine to stall with the added load of engaging the transmission. For this reason, never remove a transmission before conducting these tests:

1. Disconnect *all* electrical connections to the transmission. Retest.
Increase line pressure by removing modulator hose or pulling the TV cable (model specific). Retest
2. Drive the vehicle on the *lift* (with your foot *off* the brake). Gradually apply the brake. As the wheels slow down, it will be clear whether the engine is running poorly, or the torque converter clutch is applied (dragging the engine down). If the converter clutch is applied, it will feel as though you are running a standard transmission and not releasing the clutch; as the engine drags down, it will begin to buck — violently.

Special Note

- **Kills the engine only forward** — This is usually caused by external electrical, engine-related problems (cracked MAF hose etc.). It can also be caused by a leaking lockup solenoid or a solenoid with insufficient feed: This is only for units with a normally closed solenoid that opens for lockup (e.g. G4A-EL).
- **Kills the engine only in reverse** — This is usually caused by a worn pump (excessive side clearance), or a clogged cooler.

Downshift (Coastdown) Clunks

Most transmissions, regardless of whether they have three or four speeds, use some type of one-way clutch for first gear. For models that do this, it is important to check whether it clunks on the 2 – 1 downshift. That's because there are *no friction elements that apply* for the 2 – 1 downshift (e.g. on the 700-R4, the 2 – 4 band *releases* during the 2 – 1 downshift).

If no friction element is applying, how can there be a clunk? The reason is simple. If the transmission doesn't downshift to first gear *before* the engine drops normal idle RPM, the engine will be *under a load*, in second gear, as the vehicle approaches a stop. When the second gear friction element releases (clutch or band), the engine RPM rises and *clunks* the low one-way clutch. Here are the most common reasons for a 2 – 1 clunk:

1. The engine idle is too high.
2. The governor is stuck (valve type governor, such as a 700-R4 or C-6).
3. Line pressure is too high. This affects transmissions with checkball type governors (e.g. 125C, 440-T4, AXOD). When line pressure is above normal (usually 50 – 75 PSI in drive at an idle), the governor will be unable to exhaust the oil it's receiving. The result is that the transmission doesn't downshift until the vehicle comes to (or almost comes to) a stop. **This is the most common cause for a downshift clunk.**

If the unit doesn't clunk on the 2 – 1 downshift, but clunks on other downshifts, the problem is *unit-specific*. However, high line pressure is a good suspect for all clunks.

Downshifts at Closed (or Light) Throttle

(Hydraulically-shifted units only)

A *downshift at closed (or light) throttle* will often feel as though the transmission fell out of gear (or shifted to neutral). When the throttle is opened slowly, the transmission will shift back to high gear. Usually this condition only affects four speed units and only fourth gear. However, three-speed units can also suffer this condition. To verify that the unit isn't *falling out of gear*, manually downshift the transmission to the next lowest gear. If the transmission is still in gear, the problem is a downshift and is usually caused by one of these conditions:

1. If shift timing is controlled by a vacuum modulator (e.g. THM350, THM400), the modulator line may be attached to *ported* vacuum. Ported vacuum will be *low* (usually zero Hg) at closed throttle, and go up as the throttle opens. At about $\frac{1}{3}$ throttle, ported vacuum will behave like manifold vacuum.
2. The governor circuit has a leak. At light or closed throttle, line pressure is low and may not provide enough oil to feed the governor circuit *and* the leak. Then, during light throttle, governor pressure drops below the value needed to keep the transmission upshifted. This may feel as though the transmission fell out of gear.
3. Line pressure is too low at closed throttle. This is similar to item two, but the leak is in the mainline circuit rather than the governor circuit.

Neutrals at a Stop

Neutraling at a stop is usually caused by a sprag or roller clutch failure, or a leak in an apply member or circuit. Once again, an intimate understanding of the clutch and band application is crucial. Many items shown in a clutch-and-band application chart aren't used for takeoff, even though they are applied in manual low. This can be extremely deceptive when diagnosing a sprag or roller clutch failure. For example, the third clutch of the AXOD is applied in manual low. However, it doesn't offer any aid to the forward sprag for takeoff. This doesn't mean that it is a poor test. Moving the shifter to manual low increases line pressure. If the transmission engages when the shifter is in manual low, it indicates a leak in either the forward clutch or low/intermediate servo. Now, those who do have an understanding of this unit's powerflow will use the shifter for another test — they'll drive it in manual third.

In the OD position, the forward clutch is released during the 3 – 4 shift. However, when the shifter is in D3, the forward clutch isn't released. Now, if the transmission doesn't go to neutral during the stop, the problem is in the forward clutch. Why? Because once the clutch applies, it is easier to keep it applied than it is to apply it during the coast-downshift. Driving the vehicle with the shifter in the D3 range doesn't allow the forward clutch to release, so it doesn't have to reapply.

This is an example of a simple test that can be performed from the driver's seat. Although problems like this are unit specific, here are a few measures you can take to isolate the cause on other units.

1. Drive the vehicle with the shifter in all ranges.
2. If the unit has a vacuum modulator, apply different levels of vacuum with a handheld vacuum pump. This is an important test — sprags aren't affected by line pressure and will never respond to an increase in line pressure. If the unit engages, the problem is hydraulic — guaranteed.
3. If the condition can be duplicated on the lift, pry on the servo covers or tighten any bands that are accessible (unit specific).
4. Use a pressure gauge to verify whether line pressure is normal when the vehicle comes to a stop. If the pressure falls off, but returns after a few seconds, the pump is drawing air. Try overfilling the transmission.

Skips a Gear

A unit that *skips a gear* is usually experiencing a single friction element failure or stuck valve (such as a shift valve). For testing this type of problem, it is extremely important that you understand the power flow and oil circuitry of the unit. This problem is probably one of the best examples of using a true diagnostic technique, since being able to find the *cause* isn't very easy. However, finding out what *isn't* the cause (true diagnosis) isn't so difficult... if you have a complete understanding of the unit.

Example 1: A THM 400 transmission has a 1 – 3 shift. Right away we know that it can't be the modulator (or modulator vacuum), the governor, or the kickdown solenoid. This leaves — as the possible causes — the intermediate clutch, a stuck 1 – 2 shift valve, the intermediate sprag or a leak in the second gear circuit. Without going any further, we can eliminate a stuck shift valve. Why? Because the shift valves of the 400 transmission are *series* fed. This means that the 2 – 3 shift valve is fed by the 1 – 2 shift valve. If the 1 – 2 shift valve were stuck, the transmission wouldn't shift to third gear.

Example 2: An E4OD shifts 1 – 2 – 4. The first thought might be that the problem is in the direct clutch. However, after studying the power flow it's easy to see that this couldn't be the case. The direct clutch is used in fourth gear. This can be tricky, but it's important to realize that this transmission is really capable of six speeds forward, and two in reverse. Why? Because this transmission is really two transmissions housed within a single case. There is a two-speed unit in the front (the overdrive section) and a three-speed unit in the back (the C-6 section). The two speeds in the front, multiplied by the three speeds in the back offer six gear ratios. Here is where true road-testing savvy comes into the picture: Is the unit really shifting into fourth gear, or is it overdriving second?

There are many transmissions that have this capability: 200-4R, 325-4L, A4LD, 4N71B, A40D and the A340, just to name a few. If the overdrive unit is connected to the output shaft, it will still have six speeds forward but only one reverse. Some examples of this are the A-500, ZF4HP-22 and A140.

The best methods for isolating the components that are working is to:

1. Drive the vehicle in *all* ranges — this will help verify the operation of friction elements that serve more than one function.
2. Drive the vehicle at *full* throttle — this will help rule out the TV system.
3. Remove the modulator hose (on units where the modulator controls line pressure *only*).
4. Tighten all accessible band adjustments, or pry on all servos that are secured by snap rings. This is an easy way to overrun a bad sprag or leaking servo (model specific).
5. On electronically shifted units, use a transmission tester (or use jumper leads) to electrically shift the unit.

Wrong Gear Starts

A *wrong gear start* condition is when the transmission starts in a gear other than first and then shifts through the rest of the gears normally; for example 2 – 3 – 4 or 3 – 4. A transmission that stays in one gear has an entirely different condition. Never confuse the two complaints. Identifying the cause of the problem depends on whether the unit is hydraulically or electrically shifted.

Hydraulically-Shifted Units

An important concept to realize is that **governor pressure** is the only force that has the ability to move a shift valve into the *shifted* position. Also, the most common condition of this type is *second gear starts*. With that in mind, there two possibilities for the 1 – 2 shift valve to be in the shifted position at a stop.

1. The shift valve is stuck.
2. The governor circuit has too much pressure.

Testing for this is simple: Drive the vehicle until the condition occurs. With the vehicle stationary, move the shifter to neutral. Now move the shifter back into drive. If the transmission is in first gear, suspect governor pressure is too high. Here's why: governor pressure (on most vehicles; ZF and Mercedes excluded) isn't present in neutral. If the valve were stuck, it would remain in the shifted position in neutral. Then, you shifted back into drive, the transmission would still be in second. Also, by design it takes more governor pressure to *move* a shift valve than it does to *hold it* in place. So even a couple of extra pounds of governor pressure could prevent the valve from downshifting.

IMPORTANT: Governor pressure doesn't have to come from the governor. Any pressure that enters the governor circuit *becomes* governor pressure. Because of this, there is no guarantee that working on the governor will fix a governor-related problem. For example, an A4LD with a damaged center sealing ring on the governor distributor will more than likely have second or third gear starts. This is a governor pressure problem but working on the governor won't fix it.

Another way a unit can have wrong gear starts is by a leak in an accumulator. For example, if the large sealing ring of the intermediate accumulator of a 350 leaks, the result will usually be second gear starts. The test here is to move the shifter to manual low. If the unit binds up, the problem isn't caused by a shift valve in the second gear position; only a cross leak will cause a bind up like this.

Summary

1. Move the shifter to manual low. This will verify that the problem is due to a cross leak.
2. While the unit is stuck in second gear, move the shifter to neutral and then back to drive. This will show whether the 1 – 2 shift valve is stuck, or the problem is governor related.

Wrong Gear Starts (continued)

Electronically-Shifted Units (continued)

Electronically-Shifted Units

Other than first gear starts on an electrically-shifted transmission is usually the result of:

1. External electrical malfunctions.
2. Stuck shift valves.
3. A leaking or clogged shift solenoid.

NOTE: Usually, if a shift solenoid is clogged or stuck open, it will affect more than one gear.

4. A leaking accumulator for the gear in question (see the hydraulic section).

Start by monitoring the shift solenoid wires. This will show you whether the computer commanded the wrong gear start, or if the cause is in the transmission itself. If the problem seems to be internal, and there is more than one missing gear, see if one solenoid could be responsible. For example, an A140E has second gear starts. It also has no fourth gear. Shift solenoid #2 must be closed for both first and fourth gear. A stuck-open #2 shift solenoid could cause both conditions. It is a high possibility that is the cause of this problem.

Summary

1. Always verify that the computer did, or didn't, send the proper shift signal.
2. See if there is more than one problem, and determine if those problems could be caused by one component.

Shift Feel

Shift feel, whether it is concerning a harsh or soft shift, is controlled by the same (or similar) variables—regardless of the type of transmission. The common variables are:

1. Line Pressure — The *higher* the line pressure, the *firmer* the shift.
2. Flow rate — The *faster* the oil moves, the *firmer* the shift.
3. Accumulator rate — The *slower* the accumulator strokes, the *firmer* the shift.
4. Cushion springs and wave plates — The more *time* that is consumed by a cushion before the clutch or band applies, the *softer* the shift.
5. Steel plate or drum surface — The *smoother* the surface, the *firmer* the shift.
6. Friction plate composition — For our purposes, this won't be defined, however, some friction compositions offer a more aggressive shift than others.
7. Fluid (ATF) type — For our purposes, this won't be defined, however, some types of ATF will offer a more aggressive shift than others.

The variables that affect *all* of the shifts are line pressure and fluid type. The other variables control an individual shift. Although this area of diagnosis doesn't offer measures that a driver can take to isolate the problem, it is important for the driver to understand these variables. This will help avoid an unnecessary pull, or a pull when not enough is known about the behavior of the unit. Here is a brief explanation of each variable and the systems that control them.

1. **Line pressure** — Line pressure affects all shifts and is one of the most often overlooked items for shift feel complaints. Most units will operate at 50 – 70 PSI at an idle (in drive) and rise to 130 – 200 PSI at a stall. The controls for line rise vary from unit to unit. These include TV pressure, modulator pressure and EPC pressure. As the driver of the vehicle, it is important to be able to interpret good pressure rise from bad. One of the most effective ways to learn is to observe the pressure behavior (with a gauge) of vehicles that are working properly. Once you've experienced line rise on several vehicles that are working properly, it will be easy to recognize a poor pressure response.
2. **Flow rate** — Flow rate controls how *fast* the oil is delivered to a shifting element. The most common device for controlling flow rate is an orifice in the separator plate. Often there will be a checkball that works with the orifice, so that flow rate is controlled in one direction only. Another type of flow control device works as a regulator *during* the shift. When the shift is completed (or enough time has passed), the regulator is forced open (full flow). An example of this type of device is a 1 – 2 capacity modulator valve on an AXOD.

NOTE: Some vehicles use a controlled backpressure system (in conjunction with an accumulator) with these regulators. Because of this, these systems can influence more than one shift. An example of this is the line modulator valve in an E4OD.

Shift Feel (continued)

3. **Accumulator rate** — The accumulator cushions the shift by consuming oil that would otherwise go to the shifting element (e.g. clutch drum or servo). When the accumulator reaches the end of its travel, the shifting element receives *all* of the oil delivered from the system. This can be demonstrated easily by monitoring a pressure gauge attached to a shifting element's pressure port. During the shift (and while the accumulator is stroking), the pressure will be below line pressure. Shortly after the shift is completed, the pressure will spike up to the mainline value. The *spike* occurred when the accumulator stopped moving. There is one important rule regarding accumulator travel, and the spike that is created when it stops. The shift must be completed *before* the accumulator stops moving. A slide-bump shift is the result of an accumulator that has bottomed out before the shift was complete.
4. **Cushion springs and waved plates** — These are self explanatory. The cushion provides a gradual apply of a clutch or band.
5. **Steel plate and drum surface** — It is a common fallacy that the rougher the steel plate (or drum) surface, the firmer the shift. Unfortunately, this isn't the case. A rough surface has a tendency to cause the clutch or band to begin its work earlier, so the time from the start to finish of the apply process is actually longer, and the shift is slower. A good example of this is the reverse engagement of a 440-T4. Sooner or later (as the drum gets smoother and smoother) virtually all of these units will have a chatter-bang engagement into reverse. One of the measures taken to correct this is to sand the drum (to provide a rough surface). This will offer a smoother engagement.
6. **Friction plate composition** — The type of friction plate (or band) composition will, in some cases, make a huge difference in shift quality. One way to spot a friction materials problem a unit that comes in with *one* failure and then *after rebuild* the unit has an entirely different shift-feel problem — one that it didn't have when it came in. For example, a 1991 Mitsubishi Galant comes in with a 1 – 2 – 3 – neutral complaint. After rebuild, it has all of the gears but now has a 2 – 3 flare: All other shifts are fine. The chances are good that the root cause of the problem is related to the composition of the friction plates in the front clutch.
7. **Fluid (ATF) type** — The most common type of ATF currently in use by the aftermarket is Dexron III and Mercon compatible. This type of oil is compatible with most friction materials. However, some units, like those manufactured by Honda, may chatter or shift aggressively with anything other than Honda ATF. Another example is the 41TE: It isn't uncommon to get a 1 – 2 chatter when using ATF other than Chrysler's 7176.

Chatters

Chatter complaints are most often caused by problems with fluid type (ATF), friction type (clutch plates), or the surface of the steel plates (or clutch drum). A common misconception is that a chatter is caused by some type of calibration problem (e.g. low line pressure, accumulator springs that are too weak etc.).

Just the Facts

There are only *two* variables concerning clutch (or band) operation:

1. **The apply rate can vary** — The best example of this is a standard transmission clutch. With a standard transmission, the apply rate of the clutch is controlled by the rate that the clutch pedal moves.
Moving the clutch pedal faster or slower won't — in itself — cause the clutch to chatter. But, if the clutch is chattering, moving the pedal faster (applying the clutch faster) can reduce the chatter by reducing the *time* that the clutch can chatter. But, applying the clutch faster isn't a fix for the chatter, it simply is *masking* the chatter.
2. **The torque capacity can vary** — This is how much torque the friction element can transfer without breaking loose. The standard transmission clutch will also work for this example. Once the clutch is released fully, the tension of the springs holds the clutch applied. The heavier the springs, the more torque the clutch can transfer before it breaks loose. Once the clutch is applied, as long as the torque doesn't exceed the capacity of the springs, increasing the spring force will have *no* effect. If the spring tension is insufficient, the clutch will slip, not chatter.
An automatic transmission uses the same principles. Regardless of how many control systems there are they can only control the apply *rate* and *torque* capacity.

NOTE: A converter clutch that is slipping can glaze the clutch and *then* cause it to chatter. In this way calibration has an *indirect* effect on clutch chatter.

More Facts

1. If the chatter is only during the apply, the problem is strictly related to fluid type, friction material and the steel surface.
2. If the chatter happens during and after the apply, there is a calibration problem allowing the clutch to slip. The slip may have damaged the friction material, causing it to chatter.

One of the best — and most often overlooked — approach to chatters that occur during the shift is using the proper friction plates and ATF. Some of the best examples of this are the Honda and 41TE transmissions. It is very common to get shifting chatters where the root cause is nothing more than the wrong type of friction plates and ATF.

Special Note on TCC Chatter — Torque converter clutch chatter is caused by the same factors as any other clutch. However, sometimes what feels like a converter clutch chatter is really engine related. Methods the driver can use to isolate these differences are:

1. Use a friction modifier. If the problem is engine related, the modifier will have no effect.
2. Increase line pressure during the chatter. If the transmission uses a vacuum modulator for line rise (e.g. 440-T4, 4T60-E), change the vacuum at the modulator while the chatter is occurring. If the chatter goes away, it is converter related.
3. Disconnect items like the MAF sensor or MAP sensor. Many systems will still operate the converter clutch with these devices disconnected. However, disconnecting them will make the engine run differently and may eliminate the chatter. If so, the problem is engine related.
4. Don't use the brake pedal as a method of confirming converter clutch failure: It isn't a reliable method of isolating the cause.

Noise

Diagnosing a noise can be one of the greatest challenges of transmission repair. One reason for this is that a component that creates a noise doesn't always look damaged. There are many types of noises that are transmission related: Pump, hydraulic (valve buzz), planetary, bearing, final drive and isolation (caused by bad mounts), to name a few.

There are several rules which will help isolate which component is causing the problem. First, a component can't generate a noise if it isn't moving. This sounds straightforward enough but is often over looked. Next, if the noise is pressure related, the noise will change when the demand for pressure changes. A word of caution: all transmissions make a certain degree of noise. One of the primary reasons for using rubber mounts is that they isolate the noise from the rest of the vehicle. A broken mount can amplify a normal noise. The engine and transmission mounts should be checked carefully first. Also, some mounts can be in good shape but improperly installed. This can also cause excessive amplification of a normal noise.

Here is a list of common *noise generators*, and simple methods of diagnosing them:

Torque Converter Noises

Most torque converters consist of a pump, turbine and stator. Many also use some type of clutch, which can be hydraulically or centrifugally applied. A *split-torque* converter, like the one used in the ATX, has a planetary gear set. Still others, like those used in the AOD and ZF4HP-18, have a damper assembly which is physically connected to the main housing. The damper assembly, being connected to the main housing, always turns with the engine (this will be important later).

A torque converter noise is easy to isolate. Since the *entire* converter (pump, turbine and stator) turns while the transmission is in park and neutral, a converter noise will go away in those ranges. When the transmission is in gear — and the drive wheels are held stationary — the turbine in the torque converter will stop rotating (this is because the turbine shaft is stationary). This is when the bearing between the turbine and main housing of the converter is working. If the noise is only there in gear, with the drive-wheels stationary, and goes away in neutral, suspect the torque converter.

There are, however, a few exceptions. Remember the spit-torque, and damper-assembly converters? When the transmission is in gear, and the drive wheels are stopped, there is always something in the transmission which is turning. For example, the direct drum of an AOD is *always* turning while the engine is running. For this reason, a torque converter noise can easily be confused with the noise made by one of the direct clutch bearings. The intermediate drum used in the ATX also turns any time the engine is running, regardless of whether the transmission is or isn't in gear. Here's another tip. A torque converter noise will *slowly* get quieter as the drive wheels begin rolling from a stop.

Noise (continued)

Pump Noises

Pump noises are simple. They change when the demand for pressure changes. For example, a 4T60 has a noise whether it is in or out of gear. Because of this, the torque converter can be ruled out. Putting the transmission in gear will stop the *entire* gear train from turning. This rules out the entire gear train (see how easy this is?). At this point, the only suspect is the pump (or some other hydraulic component, like the pressure regulator valve). The test here is to vary the vacuum to the modulator which will vary line pressure. If the noise varies with a change in pressure, it's time to look at the pump (including the pump driveshaft). If this were a 4L60, pulling the TV cable would do the trick. With an E4OD, disconnecting the solenoid wire harness will work.

NOTE: Pump noises can also be caused by a restricted filter. This can be checked with a pressure gauge. If the noise is caused by a clogged filter, the needle will fluctuate when the demand for pressure increases.

Final Drive Noises

Final drive noises are perhaps the easiest noises of all to diagnose. The diagnosis is simple: The noise will increase in *pitch* as the speed of the vehicle increases. The important point is that it won't change with engine RPM or with gear the transmission is in... only vehicle speed. However, it is easy to mistake a bad mount for a final drive noise. Here again, check the mounts carefully first.

Planetary and Bearing Noises

Planetary and bearing noises are by far the most difficult noises to diagnose. This is where the first rule is important to remember: A component can't make a noise if it isn't moving. The trick here is to remember that when two components are rotating in the same direction, *at the same speed*, they are, in effect, not moving in relationship to each other. This is the most important point to keep in mind.

For example, a 4T60 has a noise in neutral and while driving down the road. The noise goes away when the transmission is in gear and the vehicle is stopped. Right away, the torque converter can be ruled out (when the torque converter makes a noise, it does so with the transmission in gear and the drive wheels stopped). Because the pump is producing the same pressure in neutral as it is in drive, it can be ruled out as well. The final drive can't be the culprit because the noise is there when the vehicle isn't moving.

Now is where you must exercise careful scrutiny. We already stated that a component can't make a noise if it isn't moving. Also, two components that are rotating in the same direction, at the same speed are considered *not moving* in relation to each other. Knowing that third gear has a one-to-one ratio means that the planetaries aren't rotating in *relation to each other* in third gear. This means that if the noise is caused by either planet, it will go away when the transmission shifts to third gear. Unfortunately, although the noise is quieter in third gear, it is still there. Further diagnosis requires a thorough knowledge of the unit being tested.

In this case, the noise didn't go away in third gear, but it did change in *pitch* as the unit shifted from one gear to the next. If the noise isn't coming from a planet, and it changes pitch as the transmission shifts from one gear to the next, it *must* be a component that is connected to the turbine shaft. This leaves the two sprockets and their related bearings; all other components have been eliminated.

Unit-Specific Examples

The next few pages provide examples of specific problems, and methods to diagnose them. Remember, the methods used here can, in most cases, be used on other transmissions with similar problems. The key to using these examples effectively is *thinking* about how these testing methods provide the solutions to the problems, and how these methods can be used to diagnose other units.

No Movement

All units: Remove one of the cooler lines, If there's no oil flow, suspect either *no* line pressure or *very high* line pressure; check the line pressure with a gauge.

All units; stops moving after transmission gets hot: Shut the engine off, and let it sit for 3 – 5 minutes. Then restart the engine, and see if it goes into gear. If it moves a little way and then stops, shut the engine off again; this time let it sit for 10 minutes. If it drives longer than before, look for a clogged filter.

440-T4: Remove the modulator hose, and put the selector in manual second. The high line caused by no vacuum will flood the governor and cause a second gear start. If so, there's a problem with the input clutch or sprag.

700-R4; no forward in OD, moves in D3 (auxiliary VB units): Move the shifter quickly from D3 to neutral. If the vehicle seems to want to continue moving, the valve body gaskets are wrong: They're for a unit without an auxiliary valve body. If it doesn't seem to want to move when you shift the selector into neutral, look for a failed forward clutch or sprag. Drop the pan and remove the forward feed tube. With the shifter in *neutral*, start the engine and blow air into the forward feed hole in the pump. If the wheels move, the sprag is okay: Check for leaks in the forward accumulator.

AXOD: Block the governor weights out with pieces of rubber hose, and put the shifter in manual low. If the vehicle moves, the problem is in the forward clutch or sprag.

A4LD; no forward in OD range: Tighten the overdrive band all the way. If the vehicle moves with the shifter in the overdrive range, problem is the overdrive sprag. If the unit binds, the sprag is in backward.

E4OD; no forward unless OD button canceled: Let the unit upshift to third then press the OD button. If the unit binds up, the overdrive sprag is in backward. If it goes to 4th, the sprag is no good.

A604; drives from stop in first then neutrals and won't move: Turn the engine off and then restart it; if the unit works okay, look for a stripped 2-4 sun gear shell.

KM-175; feels like it's in gear: Experience the condition, then, *without moving the shifter*, turn the engine off. Try to push the vehicle. If the vehicle won't roll, the park mechanism is broken.

Unit-Specific Examples (continued)

No Upshifts

All electronically-shifted units: Remove the solenoid harness connector. *All* computer-shifted transmissions will *failsafe* (no power to the shift solenoids) into a gear *higher* than first.

200-R4 (also has no reverse): Pry on the servo cover. If it *pops* out (at about the time the unit should go into second) the problem is a stripped sun gear shell.

440-T4: See if the TV cable is loose while the engine is running. If so, the throttle valve is binding hydraulically. If the TV cable isn't loose, remove the modulator hose. If the unit shifts with the modulator hose disconnected, the problem is a leaking governor circuit or a restricted governor feed.

AXOD: Drive the vehicle at *very light throttle*. If the transmission shifts to neutral, the problem isn't a *no upshift*. The problem is second clutch failure (The second clutch must apply for the unit to go beyond first gear. The *neutral shift* is actually a shift to third. Other transmissions that work like this are the AXODE, ATX, 440-T4 and the 4T60E.).

ATX: Put a pressure gauge on the servo release tap (located next to the servo). Drive the vehicle on the lift to at least 30 MPH. If pressure shows on the gauge, the valve body has shifted into *third gear*. This rules out the governor and throttle valve. The most common reason for this problem is a broken or stripped planet in the torque converter.

A4LD: Try shifting the unit manually into second gear. Does it shift hard into second? If so, the problem is in the modulator circuit. If shift feel is normal (or even a little soft), the problem is in the governor.

Bind-ups

Most units; binds on the 1 – 2 shift: Does it move forward in drive, with the drive wheels *on* the ground? If it *doesn't*, the low sprag is in backward.

THM 350 and 400; binds in manual low: Does the transmission start in second gear? If so, the problem is probably mechanical (e.g. 2nd clutch is stuck on because of too many frictions, cocked piston, etc.). If the transmission starts in 1st gear and shifts normally, try pulling the modulator hose. Does the transmission start in second gear now? If so, the problem is a cross leak in the intermediate accumulator; usually the large sealing ring.

440-T4; binds on the 2 – 3 shift: Unfortunately, there is no really good test for this. The problem is usually a leak in the servo release circuit (e.g. 3rd accumulator checkball capsule, servo release seal, etc.).

AXOD; binds in reverse: Does it get worse when you step down harder on the gas? This is usually caused by missing checkballs, or the wrong valve body gaskets.

A404, 413, 470 and 670; binds in manual low: Does it start in 1st gear in the drive range? If so, the problem is hydraulic. When the bind-up occurs, try turning the kickdown band adjusting screw. If it won't turn, the problem is the band is being applied due to a cross leak, usually at the accumulator.

Honda four speeds; binds in reverse: Does it move in neutral? If so, drain the oil in the sump and try neutral again. If it still turns the wheels (and it usually does), the problem is an assembly area in the forward clutch (e.g. clutch not indexed, misplaced thrust washer, etc.).

Unit-Specific Examples (continued)

Kills the Engine

Most units; Kills the engine in reverse: In most cases this problem is caused by excessive clearance between the inner pump gear or rotor. This clearance allows line pressure to enter the converter hub and pressurize the apply side of the converter clutch. This can also be compounded by having too much restriction in the cooler circuit. Bypass the cooler to verify this problem. In all cases, remove any electrical wiring to rule out the possibility of outside electrical causes.

G4A-EL; Kills the engine in drive: Drive the vehicle on the lift to see if the problem is the converter clutch or an engine problem (see section on "Kills the Engine"). If the problem is TCC engagement, it's usually caused by a leaking lockup solenoid or a restricted solenoid feed. To verify this, try checking the unit with the TV cable pulled to maximum throttle (the problem should go away).

Neutrals at a Stop

All units: Does the problem get worse the *faster* you stop the vehicle? Try overfilling the transmission: you may have the wrong dipstick in it.

AXODE, 440-T4: Drive the vehicle with the shifter in the D3 position. If the problem goes away, the forward clutch circuit is leaking (e.g. cracked forward piston, leaking sealing rings, etc.). If the problem is still present, look for a problem in the forward sprag or a stuck 2 – 3 servo release valve. The only effective way to continue testing is to put a pressure gauge onto the 1 – 2 servo (you'll have to drill and tap a hole in the servo cover). If servo pressure is equal to line when the problem occurs, the forward sprag is the culprit. If servo pressure is low, the problem is a stuck 2 – 3 servo regulator valve.

NOTE: On the 440-T4, the components in question are the input clutch circuit, input sprag, and 2 – 3 accumulator valve.

KM-175: Drive the vehicle with the OD cancel button depressed, so the unit won't shift into overdrive. Does the symptom go away? If so, look for the problem in the forward clutch circuit (e.g. leaking rear clutch, misaligned rear clutch drum and input shaft, sticking rear clutch exhaust valve, etc.).

Skips a Gear

A4LD; shifts 1st, 2nd to 4th: This unit is actually capable of *six* speeds forward and *two* speeds in reverse. It's impossible to get overdrive without achieving third gear as well. In most cases the unit is shifting from second to an *overdriven second*. To test for this, disable the overdrive band; here's how: Loosen the overdrive band so it can't come on, or unplug the solenoid connector (only on units with a 3 – 4 shift solenoid). If the unit now shifts 1st to 2nd, but no further, the problem is with the direct clutch (including its feed circuit, or the 2 – 3 shift valve). If the unit shifts 1st to 2nd to 3rd, the problem is with *shift timing*: The 2 – 3 and 3 – 4 shift are occurring at the same time (extremely rare).

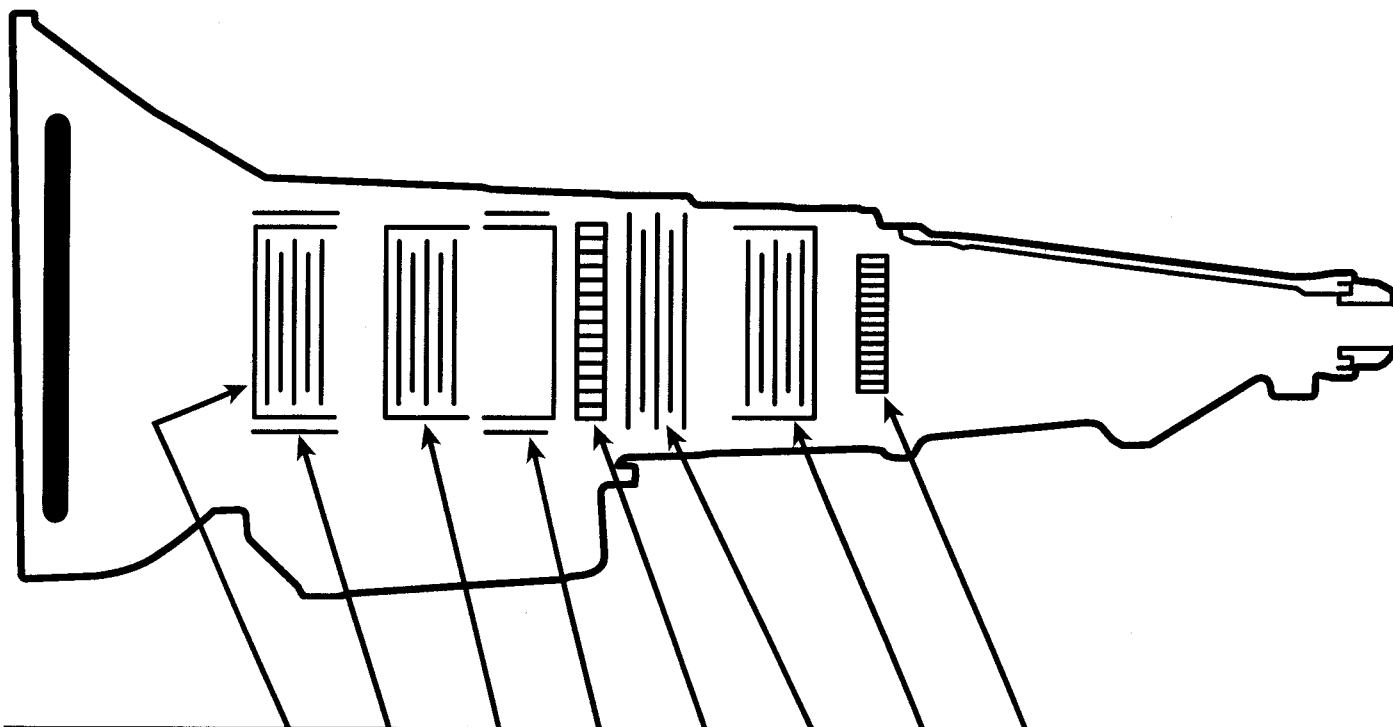
TF6 or TF8, A500, 518; shifts from 1st to 3rd: These are series-fed units; meaning that the 1 – 2 shift valve feeds the 2 – 3 shift valve. The problem *can't* be a stuck 1 – 2 shift valve. Either the servo is leaking (really bad) or the band isn't able to grab the drum (e.g. broken band, missing strut, etc.).

Chrysler 42RH, 46RH, 47RH

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Clutch and Band Application



Selector Position	Gear	Direct (Front) Clutch	Kick-down Band	Forward (Rear) Clutch	Low/Reverse Band	One-Way Clutch	Over-drive Clutch	Direct Clutch	One-Way Clutch	Gear Ratio (42RH)	Gear Ratio (46RH/47RH)
Reverse	R									2.21	2.21
Overdrive	1 st									2.74	2.45
	2 nd									1.54	1.45
	3 rd									1.00	1.00
	4 th									0.69	0.69
D2	1 st									2.74	2.45
	2 nd									1.54	1.45
D1	1 st									2.74	2.45

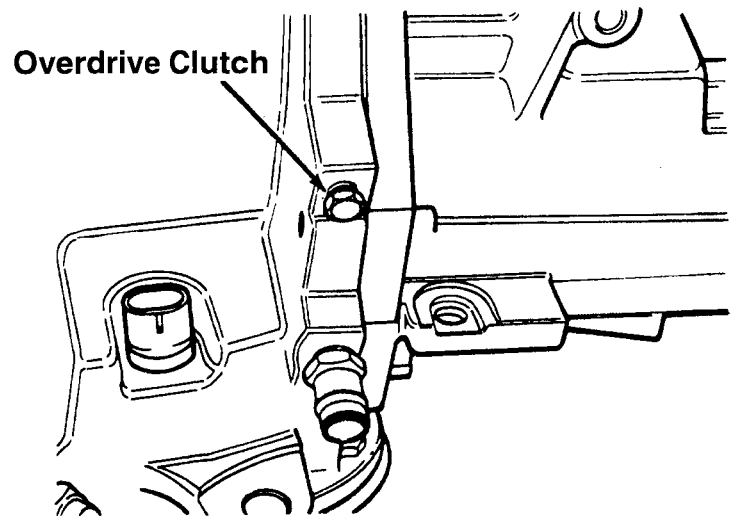
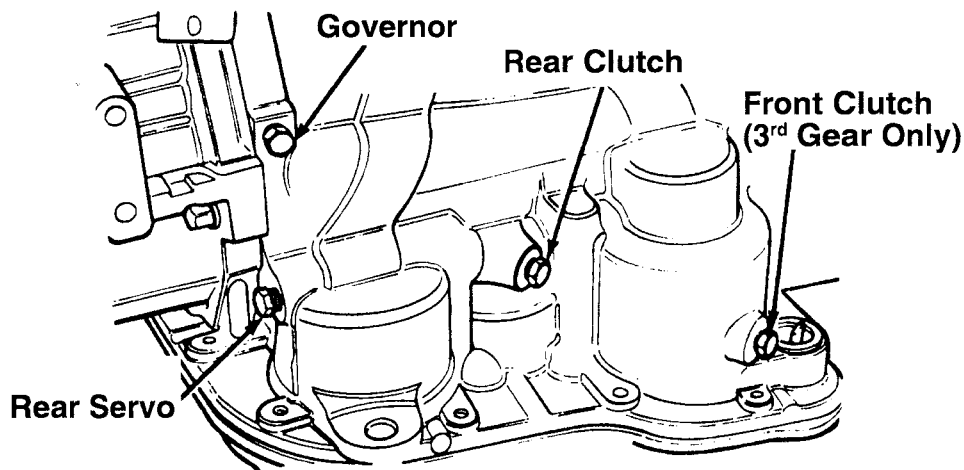


Clutch Applied

Pressure Testing

Pressure Specifications

Gear Range	Idle (PSI)	Stall (PSI)
Drive	54 – 60	80 – 100
D2	54 – 60	80 – 100
Low	54 – 60	80 – 100
Reverse	145 – 175	230 – 280



Electrical Systems

System Operation

The A500 series of transmission is primarily a hydraulically-controlled unit. First through third gear operation is controlled by a valve body and governor. The transmission uses a TV system to provide a load signal for the operation of these three gears.

The only electrically-controlled systems are fourth gear and lockup. The ignition switch provides voltage and the vehicle computer (SMEC or SBEC, depending on vehicle and year) develops the signal to operate the solenoids that control fourth gear and lockup.

The computer controls the ground signal to the lockup solenoid directly, based on a number of computer system inputs, including:

- Throttle position
- Gear selector position
- Coolant temperature
- Transmission fluid temperature
- Engine RPM
- Vehicle speed
- Overdrive switch position

The computer also uses these sensor signals to provide a signal to the overdrive module, which in turn provides the ground to energize the overdrive solenoid.

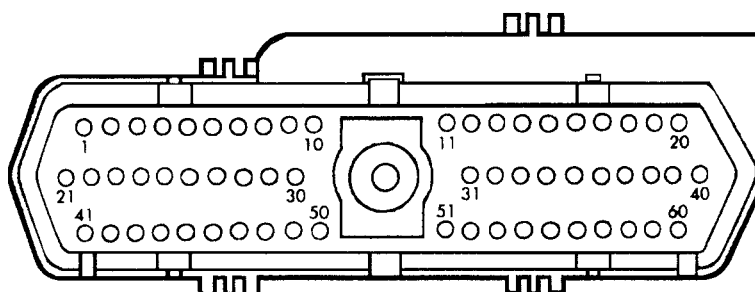
Always begin any diagnosis by checking system voltage. Voltages lower than about 12 volts or above 16 volts will affect transmission operation.

Electrical Systems (continued)

Computer (SMEC)

The computer supplies a ground signal to energize the overdrive solenoid to control lockup, and a signal to the overdrive module to control fourth gear operation. It bases these signals on the input signals it receives.

Look for the computer in the fenderwell in the engine compartment on all vehicles except vans. On vans, look for the computer mounted to the firewall, above the engine.



Chrysler's Computer Connector

Electrical Systems (continued)

Temperature Sensors

The Chrysler systems use two temperature sensors to control transmission operation:

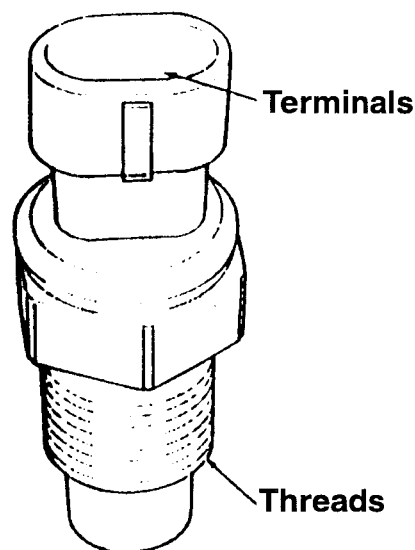
- Engine coolant temperature sensor (ECT)
- Transmission fluid temperature sensor (TFT)

These are thermistors: semiconductors that change resistance as their temperature changes.

Like most automotive thermistors, these are negative temperature coefficient thermistors: The resistance goes down as the temperature goes up.

To check either sensor, you can compare the sensor resistance to the temperature, and then check the chart.

Engine Coolant Sensor Resistance			
Temperature		Resistance (Ohms)	
°C	°F	Minimum	Maximum
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9120	10,880
30	86	7370	8750
40	104	4900	5750
50	122	3330	3880
60	140	2310	2670
70	158	1630	1870
80	176	1170	1340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410



Dual Range Circuits

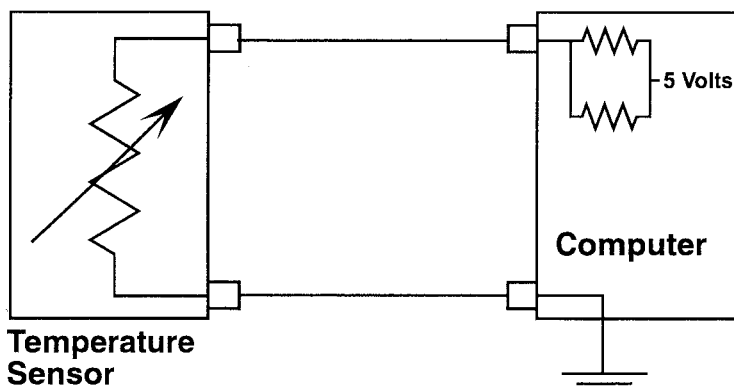
Many Chrysler products use dual range temperature sensor circuits. To develop a more accurate temperature signal, the computer switches a second resistor into the circuit when the temperature signal reaches about 40° C (104° F). This second resistor changes the voltage signal to the computer, to provide a wider range of signals. This increases signal accuracy.

The additional resistor is inside the computer, so it won't affect a resistance check of the temperature sensor. However, it will affect its voltage signal.

Continued...

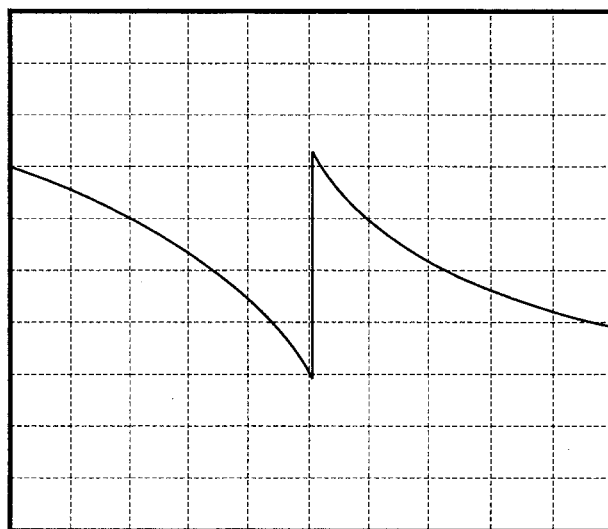
Electrical Systems (continued)

Temperature Sensors (continued)



When the engine's cold, the computer only uses one resistor in the temperature sensor circuit. But when the temperature reaches about 104° F, it switches in a second sensor, to provide greater accuracy.

If you connect a scope to the temperature sensor circuit, you'll see the voltage drop slowly as the temperature increases. Then, when the temperature reaches about 40° C (104° F), the voltage will jump as the second resistor switches in. From there, the voltage will continue to drop as the temperature increases to normal ranges.



Here's how the voltage waveform looks on a system that uses a dual curve temperature sensor system.

Temperature Sensor Locations

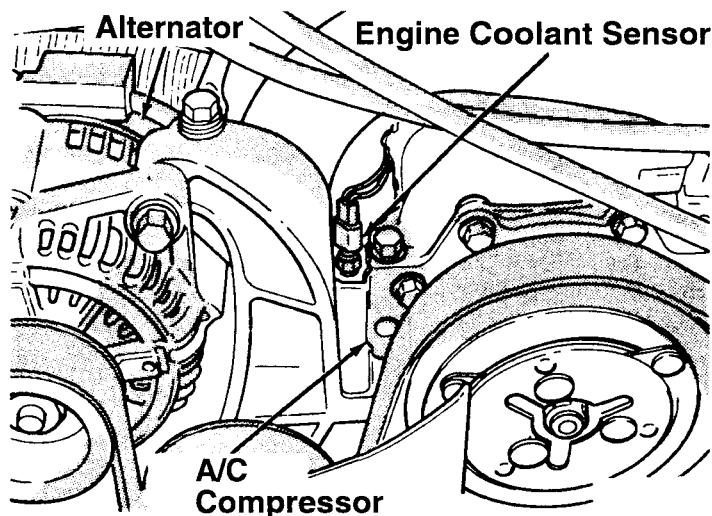
Look for the engine coolant temperature sensor (ECT) mounted in the cylinder head or intake manifold, threaded into the water jacket.

To allow the transmission to shift into fourth gear, the coolant temperature must be above 65° F.

Look for the transmission fluid temperature sensor (TFT) on the left side of the transmission case.

If the transmission fluid temperature exceeds 270° F, the overdrive module prevents the transmission from shifting into fourth gear.

Typical location and installation for an engine coolant temperature sensor.



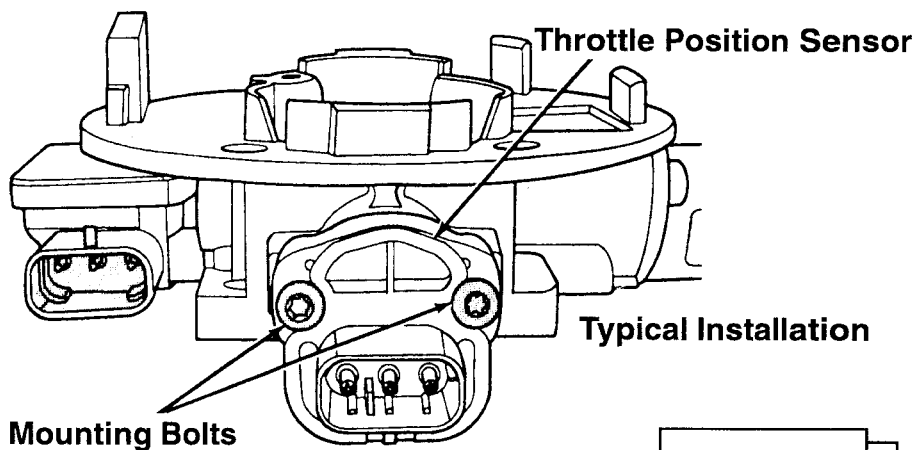
Electrical Systems (continued)

Throttle Position Sensor (TPS)

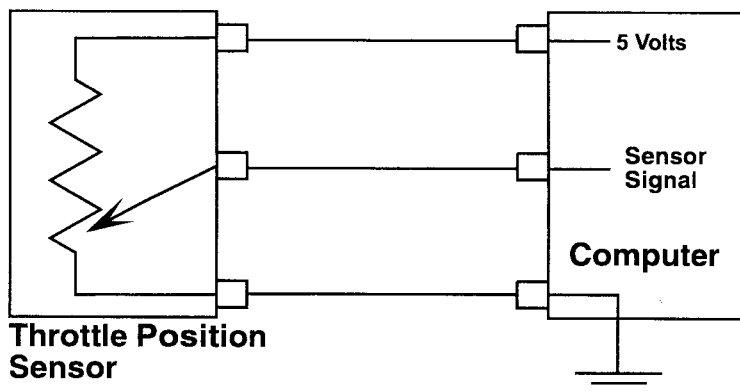
The throttle position sensor is a potentiometer. This is a type of variable resistor with three wires:

- Reference voltage
- Ground
- Sensor signal

A potentiometer uses a wiper that slides along a fixed resistor. The closer the wiper is to the ground side of the resistor, the lower the voltage signal. As the wiper approaches the reference voltage side of the resistor, the signal voltage rises to maximum.



As the wiper moves up and down along the resistor, the voltage signal varies: The closer it gets to the positive side of the resistor, the higher the voltage.



The wiper on the throttle position sensor connects to the throttle: The voltage signal provides the computer with a way to determine throttle position. From that, the computer interprets the load on the engine.

Here's the throttle position sensor signals you should receive from a Chrysler throttle position sensor:

Gas engine: Closed throttle – less than 1 volt
Wide-open throttle – 4.0 to 4.5 volts

Diesel engine: Closed throttle – about 1 volt
Wide-open throttle – about 3.5 volts

Look for the throttle position mounted to the air horn, near the throttle plate.

To enable fourth gear and lockup, the throttle must be above idle, but less than 70% of wide open throttle.

Electrical Systems (continued)

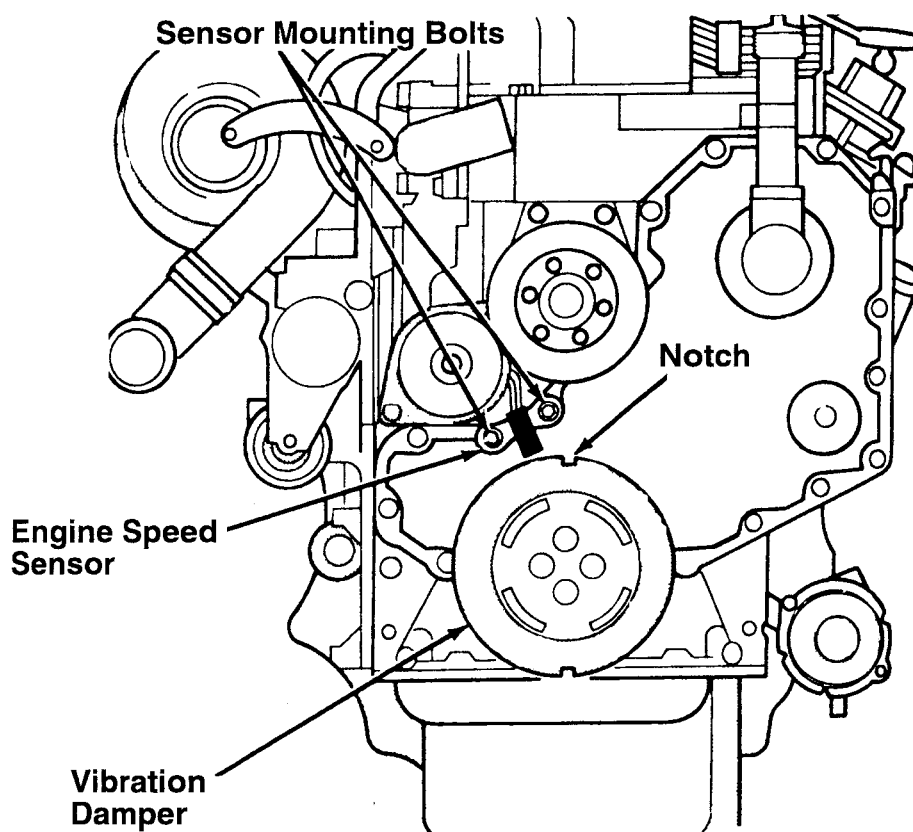
RPM Sensor

The computer requires an RPM signal, to help determine when to shift the transmission into lockup or overdrive.

On gasoline-powered engines, the computer determines engine RPM from the crankshaft sensor: As long as the engine starts and runs, you know the computer's getting the signal it needs to determine engine RPM.

But diesel engines don't require an RPM signal to run. On diesel engines, the computer requires an additional input to control overdrive and lockup. For that, diesel engines include an RPM sensor.

The RPM sensor is an AC-generating sensor. This is a two-wire sensor that develops an AC signal whenever a notch in the front pulley passes the sensor. From this, the computer determines engine RPM.



Gasoline engine computer systems can take the engine RPM signal right from the crankshaft sensor: If the engine's running, you know the sensor's okay. But diesel engines require a separate RPM sensor, bolted to the front of the engine.

Electrical Systems (continued)

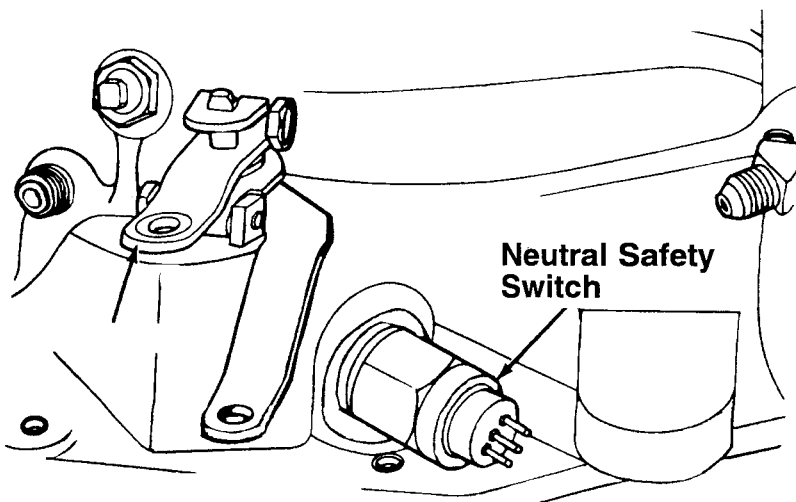
Neutral Safety Switch

The neutral safety switch is an on/off switch, designed to indicate the manual gear selector position. When the selector is in park or neutral, the neutral safety switch provides zero volts to the computer.

But in reverse or drive positions, the neutral safety switch provides a 9-volt signal to the computer.

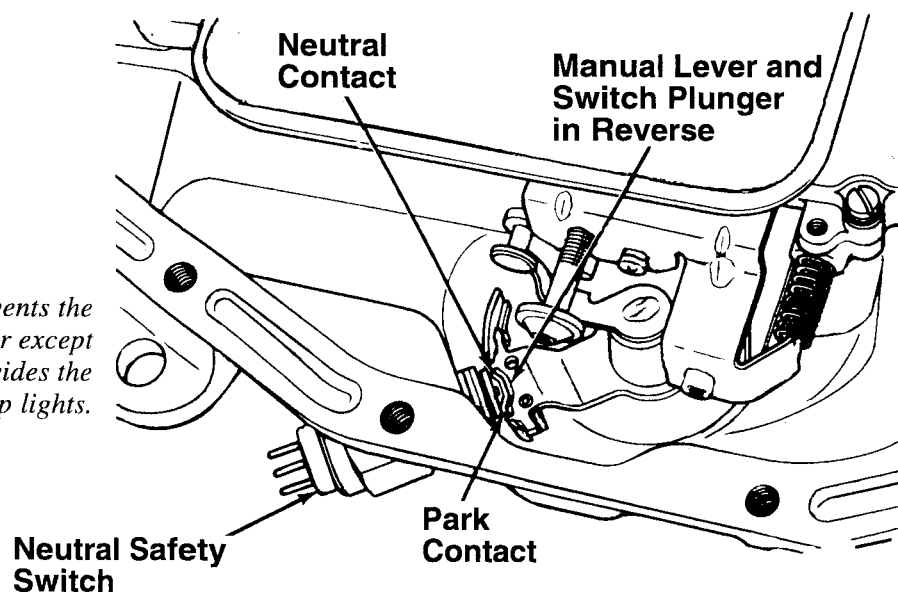
The neutral safety switch isn't adjustable: If the switch signal isn't correct, replace the switch and recheck it.

Look for the neutral safety switch threaded into the left side of the transmission case.



The neutral safety switch threads into the left side of the transmission case, right behind the manual lever.

The neutral safety switch prevents the starter from cranking in any gear except park and neutral, and it provides the signal to light the backup lights.



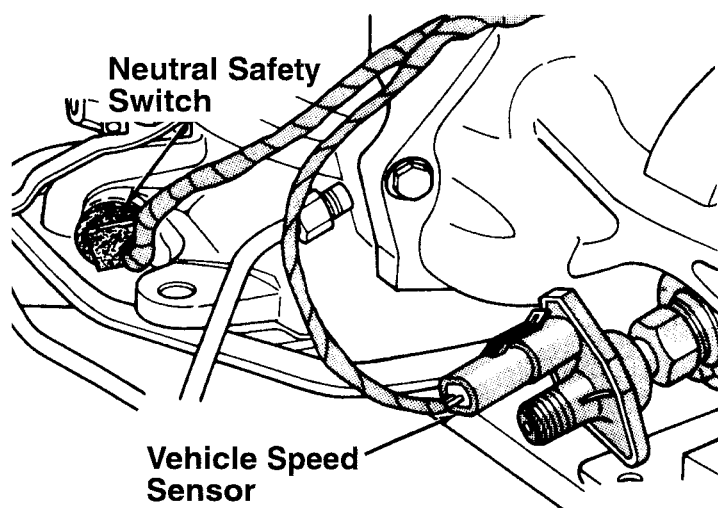
Electrical Systems (continued)

Vehicle Speed Sensor (VSS)

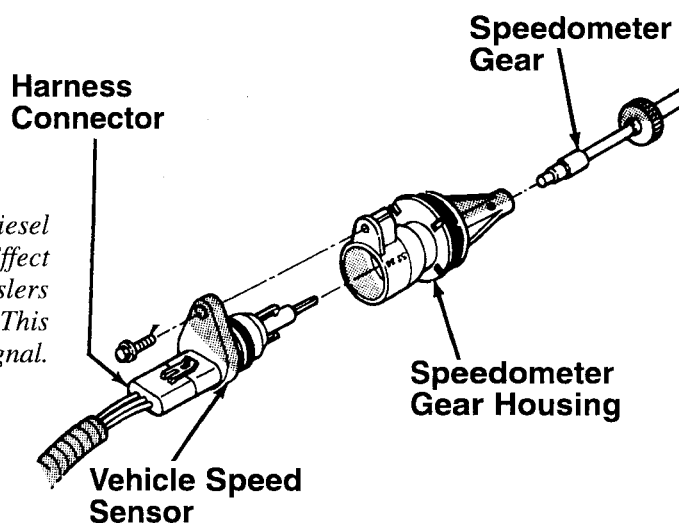
To enable fourth gear and lockup, the vehicle must be moving at least 25 MPH. To monitor vehicle speed, Chrysler vehicles use a vehicle speed sensor.

The vehicle speed sensor mounts in the extension housing, threaded onto the speedometer gear output housing on most vehicles. On "B" vans, the vehicle speed sensor mounts in the speedometer cable, between the transmission and the speedometer.

These vehicle speed sensors are rotating contact reed sensors: The sensor opens and closes the circuit four times per revolution of the speedometer cable. From that pulsing signal, the computer monitors vehicle speed.



In 1993, all Chryslers except Dakota and diesel went from a rotating switch sensor to a Hall Effect vehicle speed sensor. In 1994, all Chryslers switched to the Hall Effect speed sensor. This sensor uses an 8-volt reference signal.



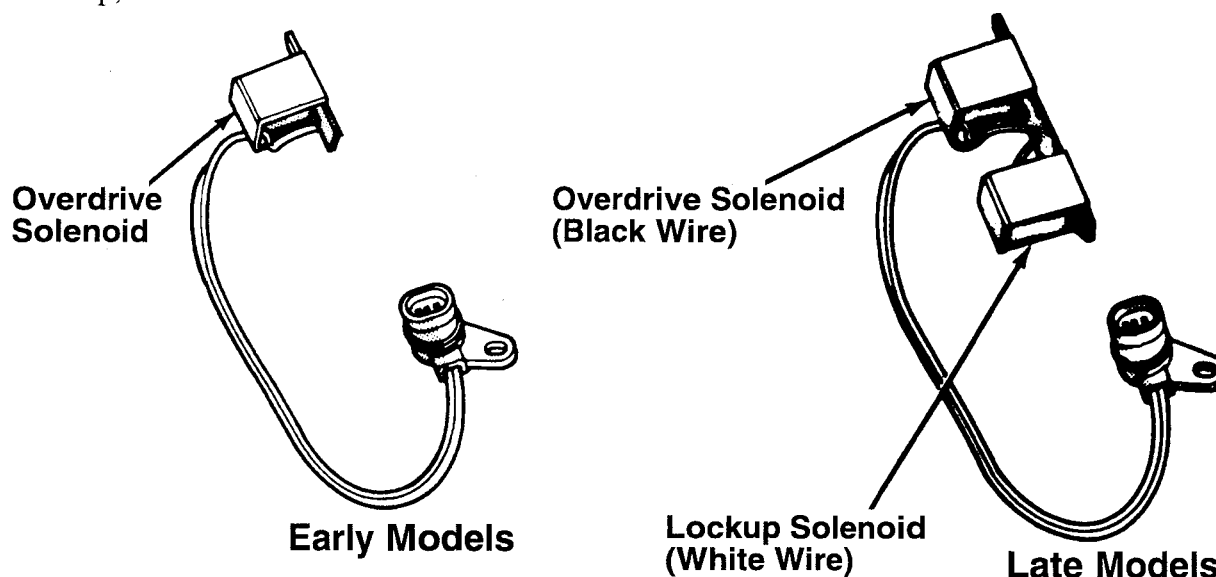
Electrical Systems (continued)

Transmission Solenoids

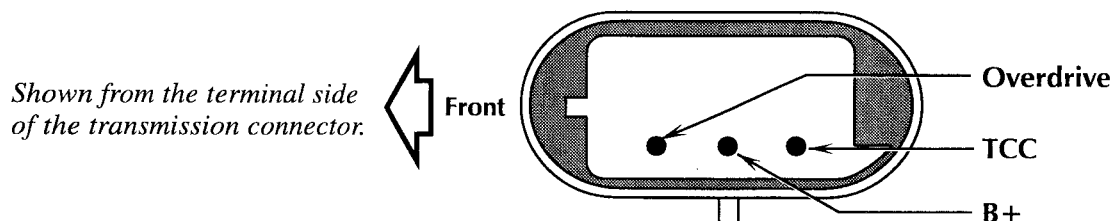
The A500-series transmissions only control overdrive and lockup electrically, so they won't have more than two solenoids.

Early units didn't offer lockup; they only provided overdrive. Those units used a single solenoid.

Later units provide both overdrive and lockup. Those transmissions use two solenoids in a single block: one for lockup, the other for overdrive.

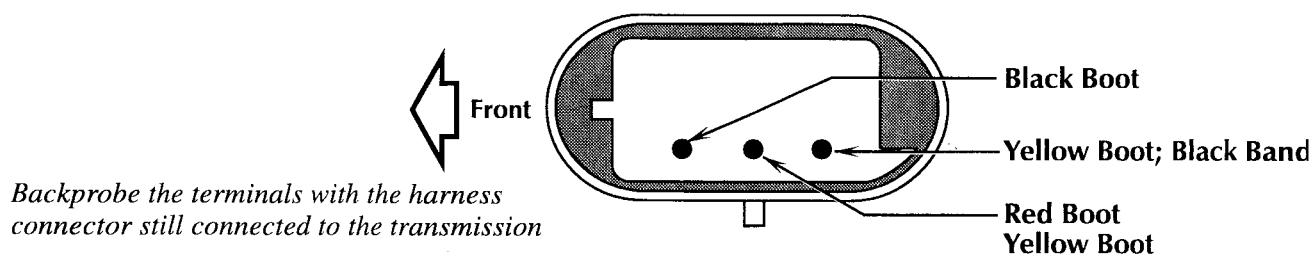


The solenoids receive system voltage right from the ignition switch, whenever the key is on. The computer provides the signals to operate the solenoids, and control lockup and overdrive.



If you've built the shift signal monitor from earlier ATRA bulletins, you can use it to check the signals from the computer.

Here's how to connect your signal monitor to the transmission solenoid connector.



Continued...

Electrical Systems (continued)

Transmission Solenoids (continued)

And here's the signals you should see with your signal monitor:

Transmission Shift Pattern			
First Gear			
Second Gear			
Third Gear			
Fourth Gear w/Lockup			

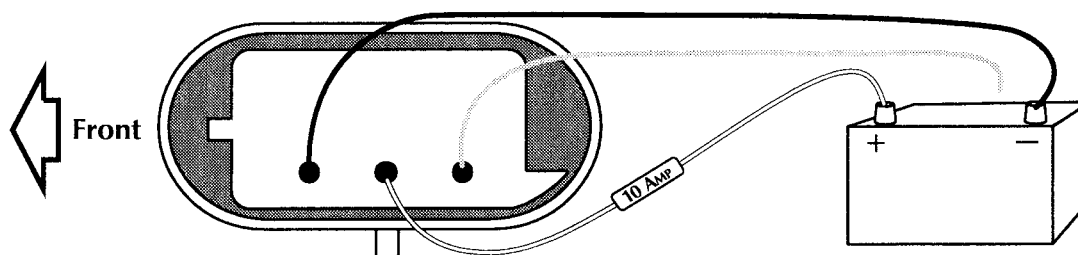
The middle LED indicates the signal to the converter clutch (TCC) solenoid.

You can also force the transmission to shift into overdrive and lockup by energizing the appropriate solenoids. Here's how:

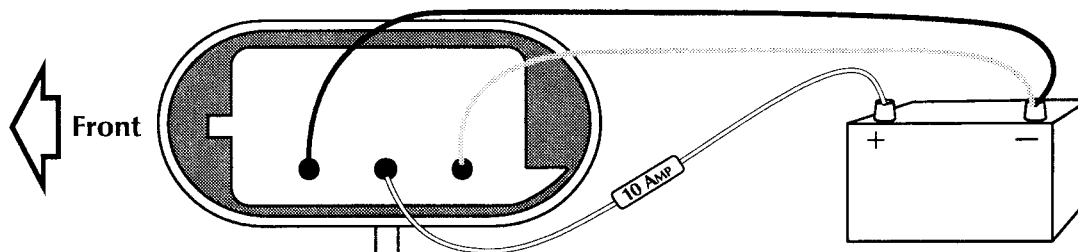
- Put the vehicle on a lift, and raise the drive wheels off the ground.
- Start the engine.
- Put the transmission in gear.
- Give the vehicle gas, and let it shift into 3rd gear.

Now apply power and ground to the appropriate terminals, as shown in these graphics. If the transmission doesn't provide lockup, the back terminal won't be in the connector.

Overdrive Only

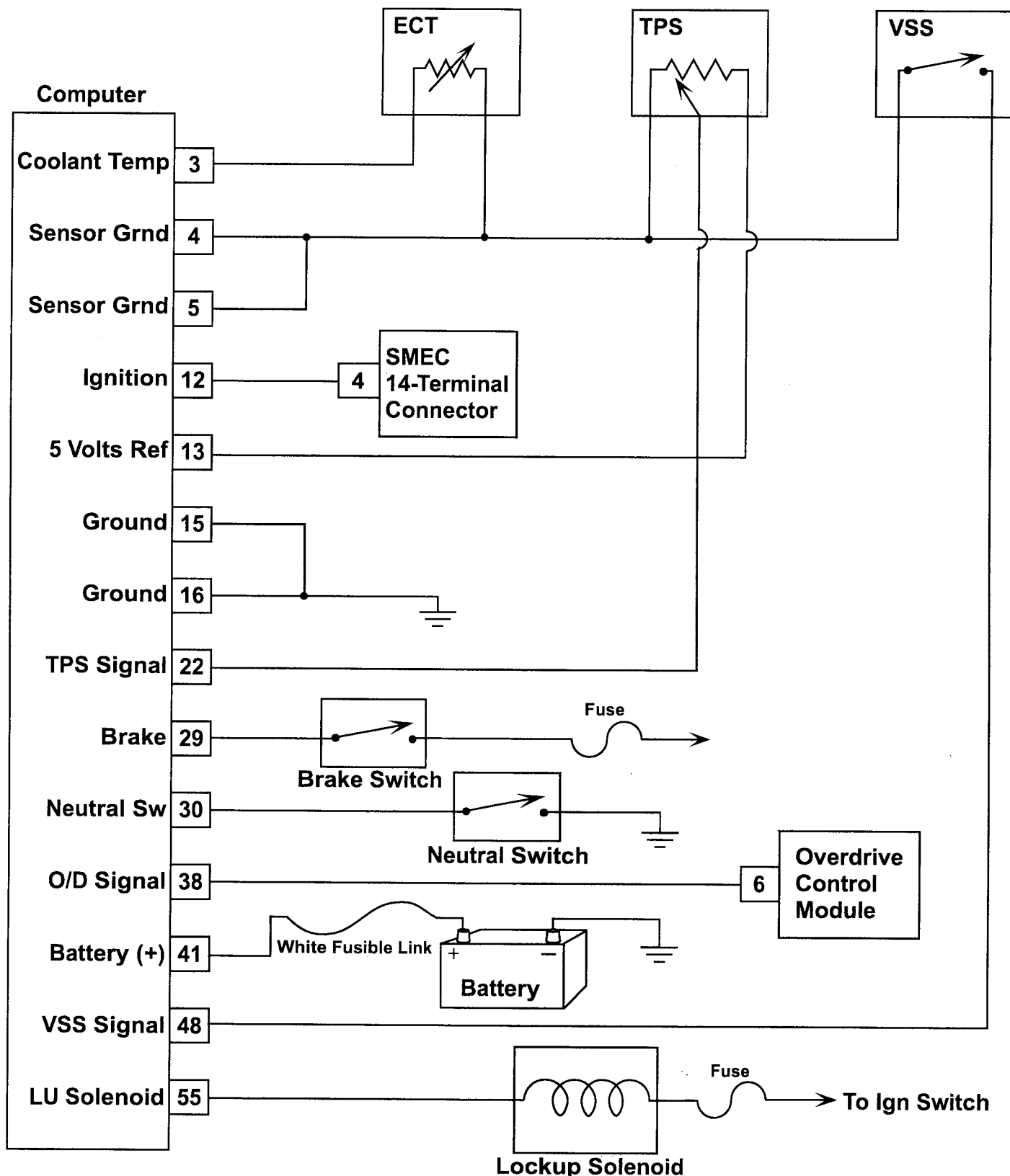


Overdrive and Lockup



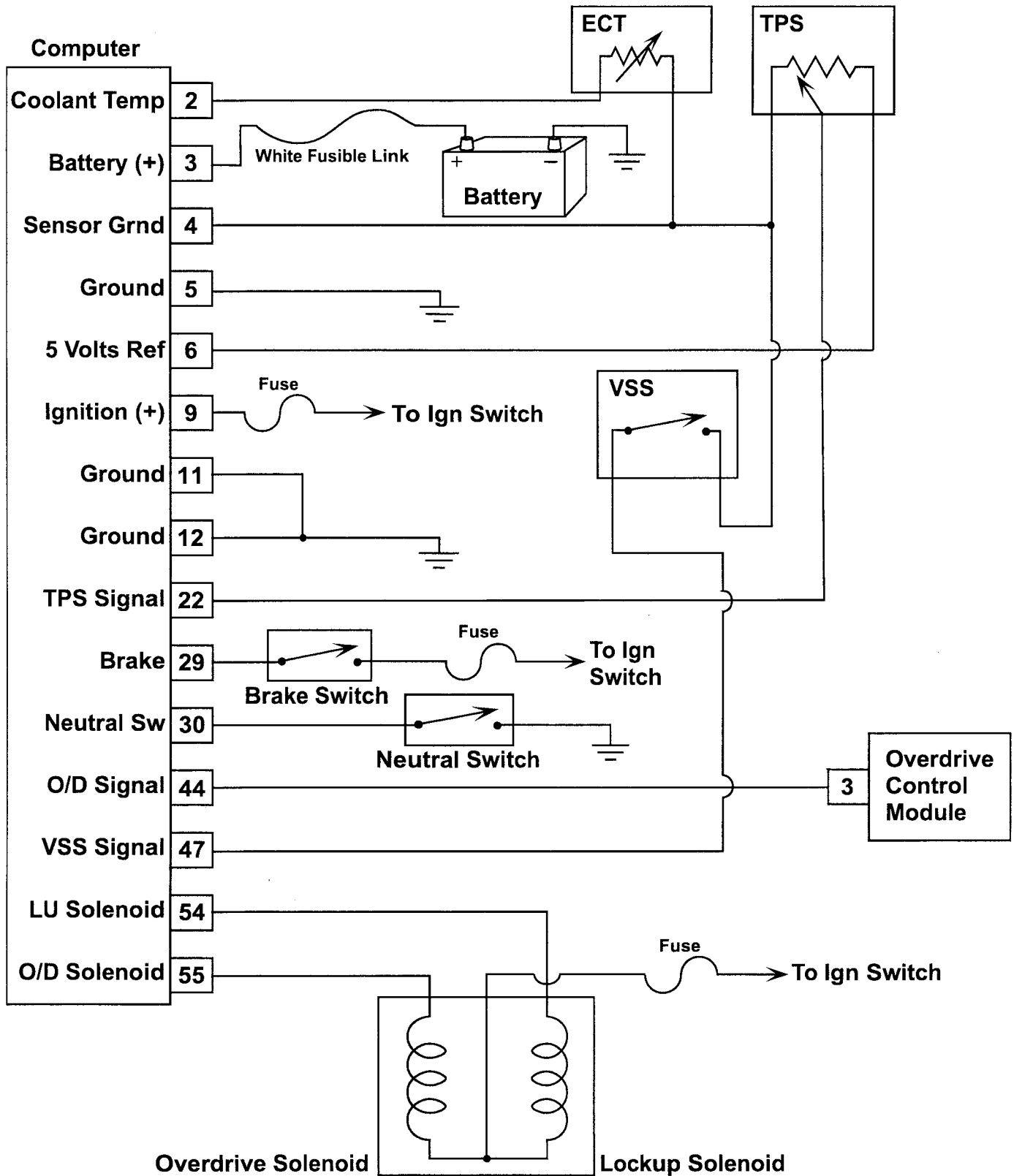
Electrical Systems (continued)

Type 1 Schematic: 1988 – 89



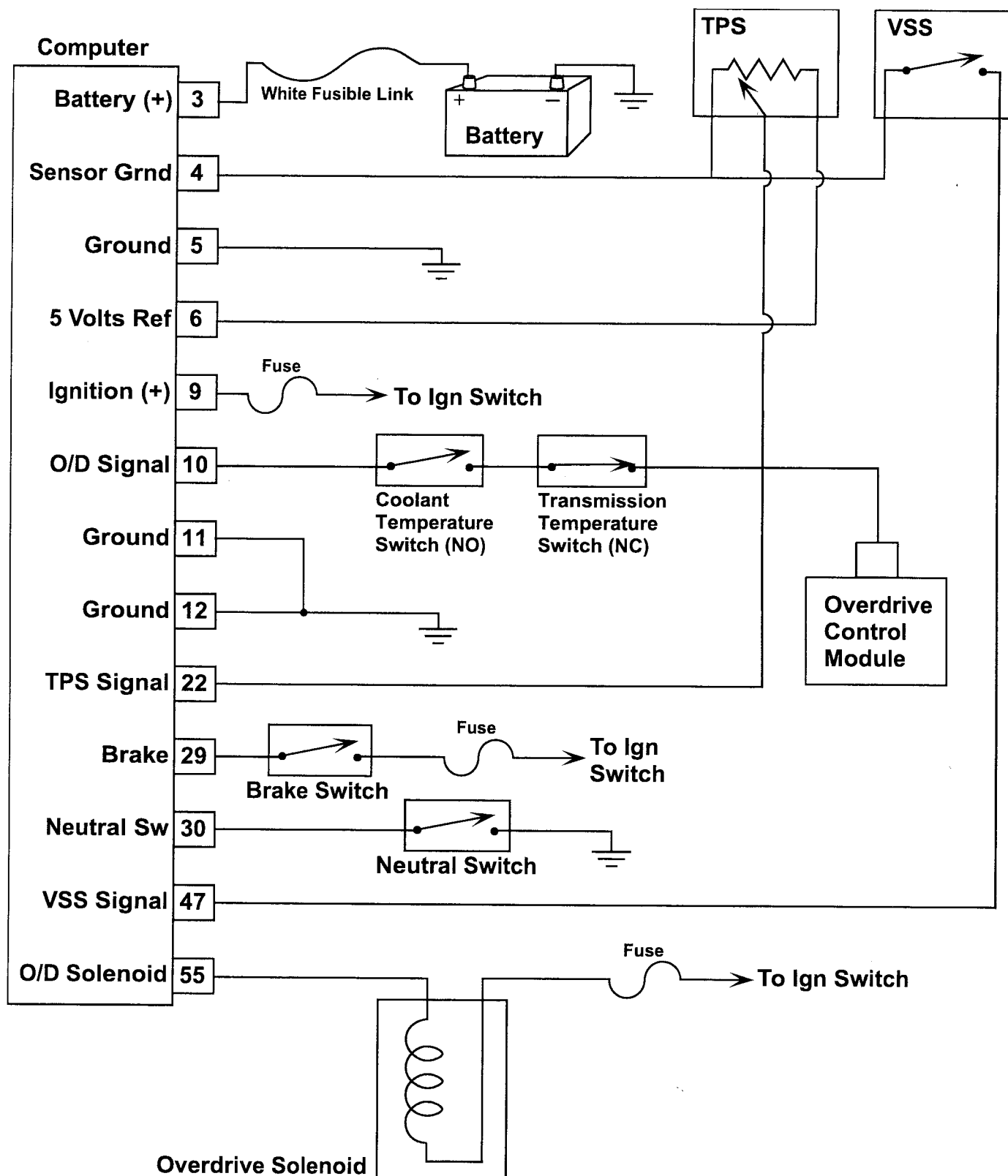
Electrical Systems (continued)

Type 2a Schematic: 1990 – 91, 1992 Pickup and Ramcharger w/5.9L Gas Engine, 1992 Vans



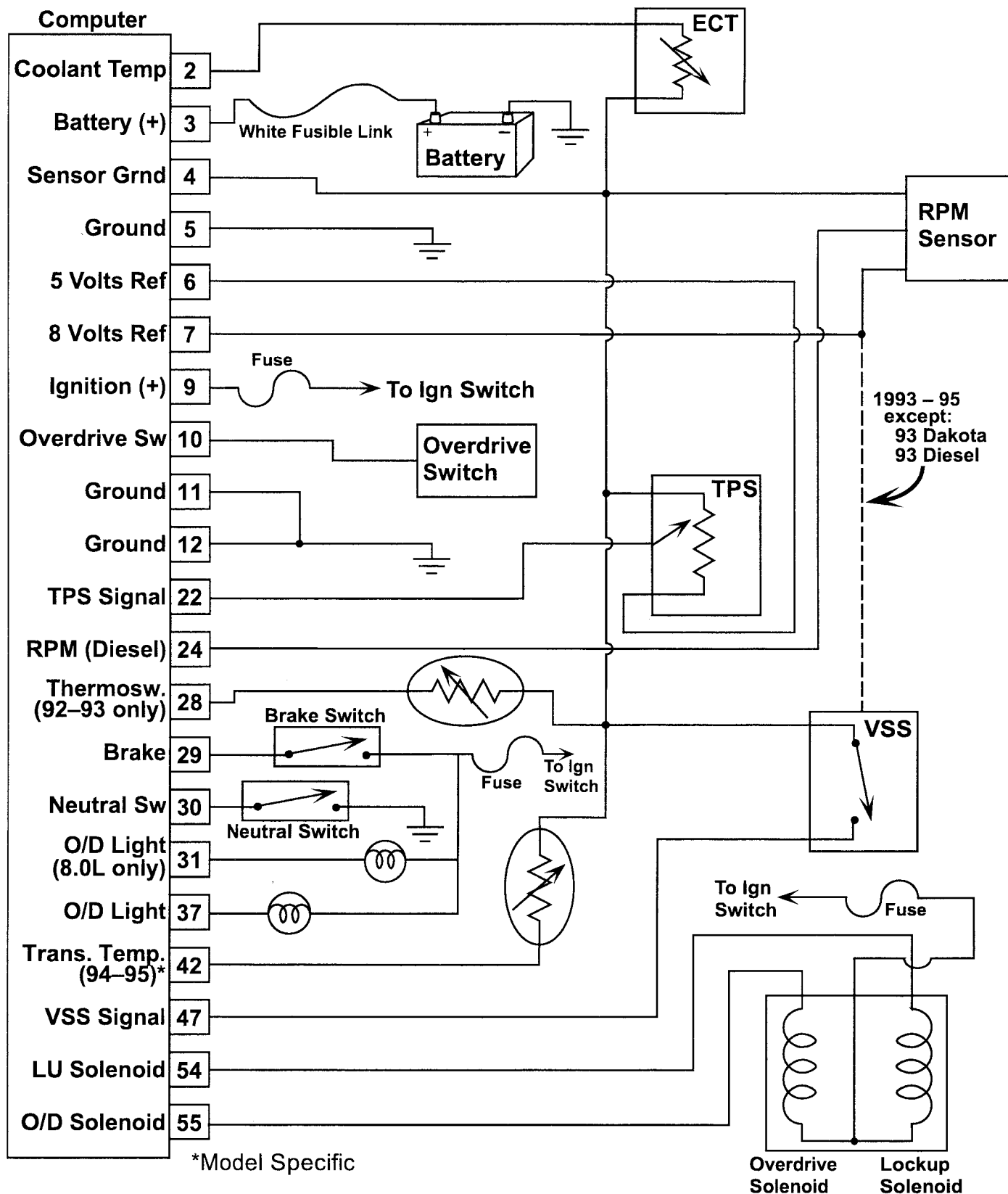
Electrical Systems (continued)

Type 2b Schematic: 1991 w/Diesel Engine



Electrical Systems (continued)

Type 3 Schematic: 1992 (exc. Pickup, Ramcharger w/5.9L Gas Engine, and Vans), 1993 – 95



Electrical Systems (continued)

Overdrive Cancel Switch and Module

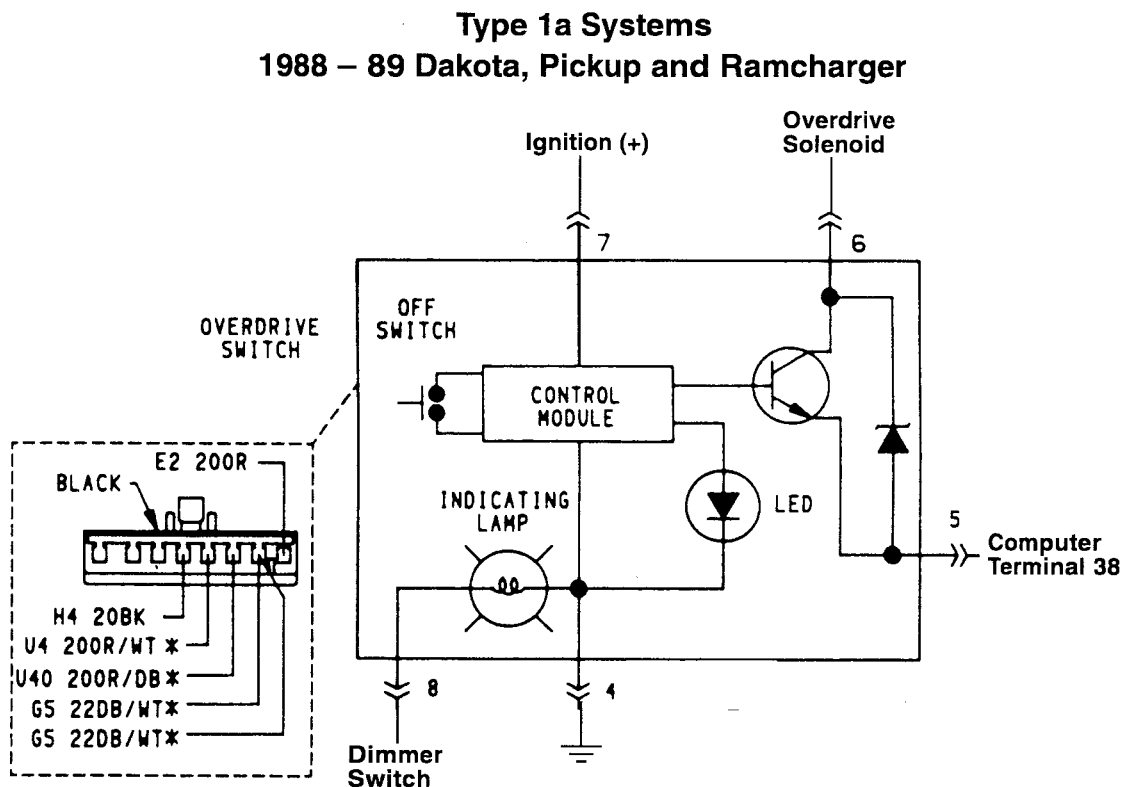
The overdrive cancel switch is an on/off switch that allows the driver to disable fourth gear.

There are four different style systems in use today. The system in use depends on the computer system:

Type 1a, b systems: The computer provides the overdrive signal to the module. The module provides that signal to the solenoid when the switch is enabled. Type 1 systems are used with the Type 1 computer.

Type 2a, b systems: The module is an input to the computer. The computer uses the input from the module, along with the other inputs, and provides the signal to energize the overdrive solenoid. Type 2 systems work with the Type 2 computer systems.

Type 3a, b and 4a, b systems: The module is gone; now the switch provides the signal directly to the computer. The computer still provides the signal to energize the overdrive solenoid. All four systems appear with the Type 3 computer.

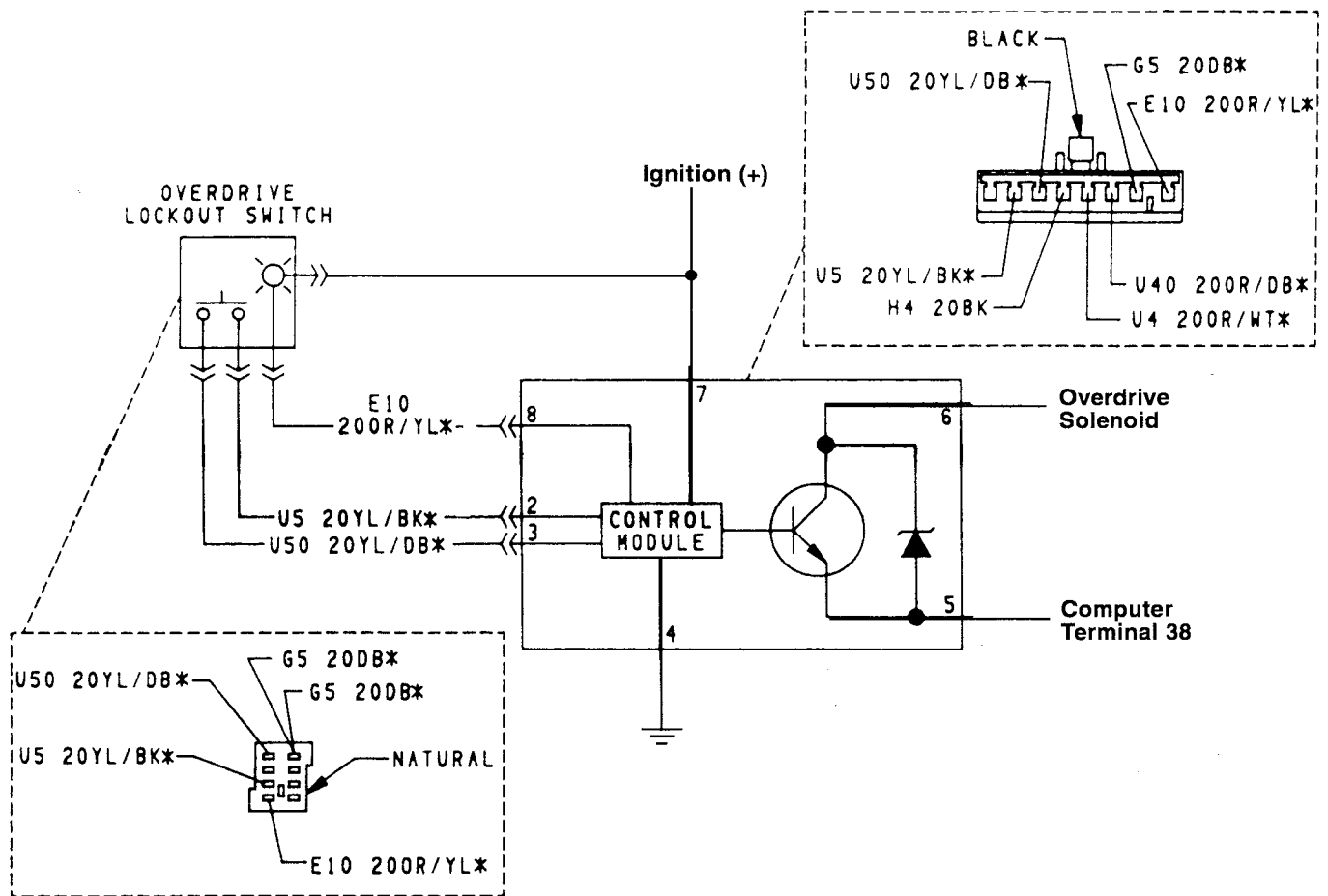


Continued...

Electrical Systems (continued)

Overdrive Cancel Switch and Module (continued)

Type 1b Systems
1988 - 89 Vans

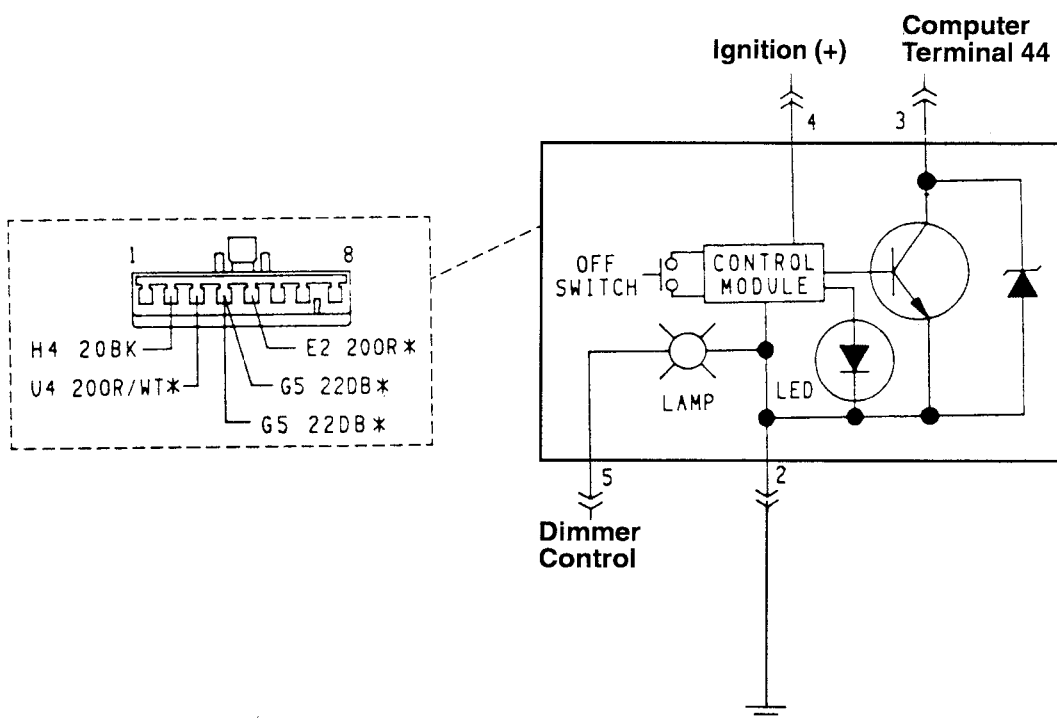


Continued...

Electrical Systems (continued)

Overdrive Cancel Switch and Module (continued)

Type 2a Systems
1990 – 91 Dakota, Pickup and Ramcharger



Continued...

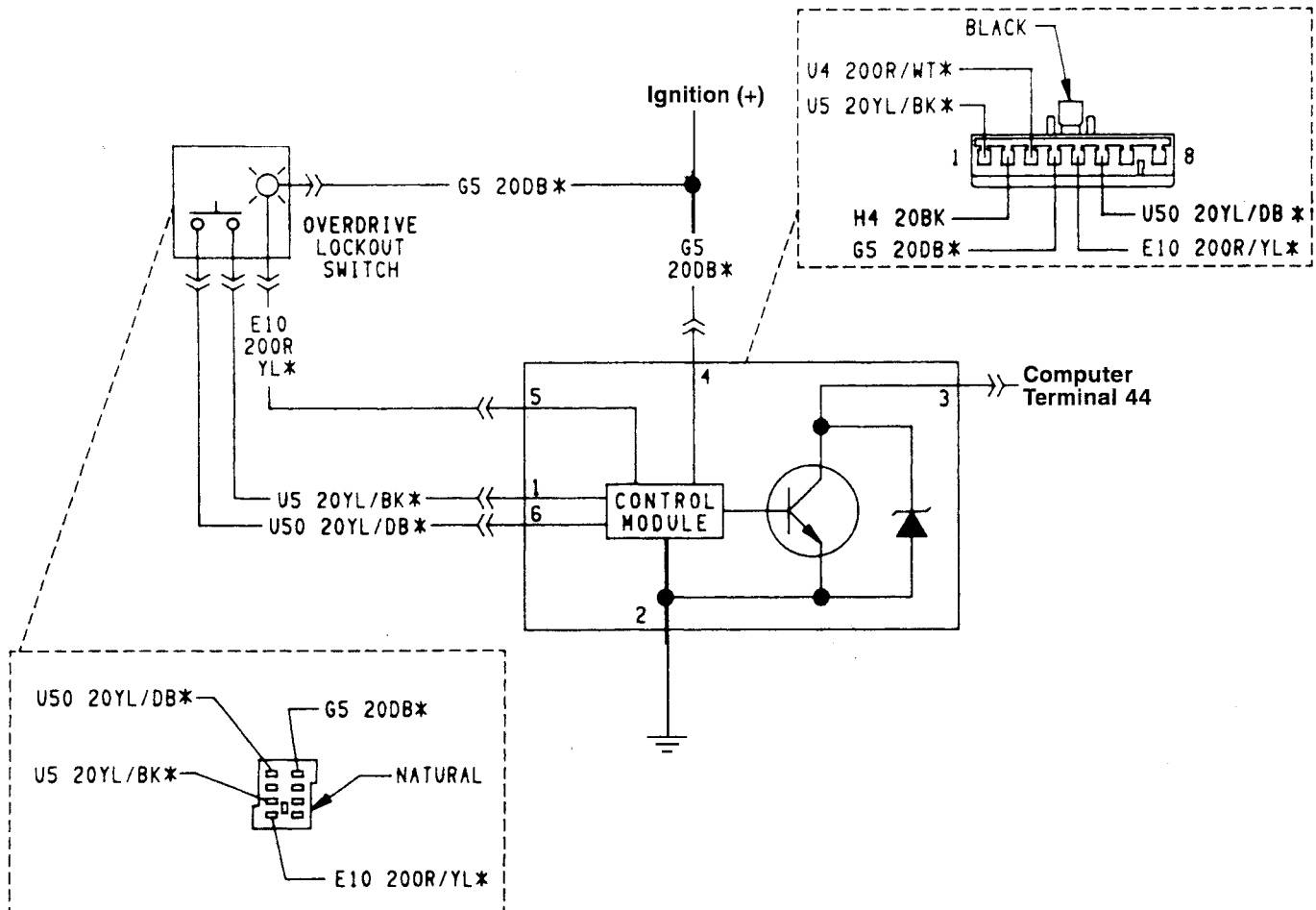
Electrical Systems (continued)

Overdrive Cancel Switch and Module (continued)

Type 2b Systems

1990 – 91 Truck w/Diesel Engine; 1990 – 92 Vans

1992 Truck w/5.9L Gas Engine



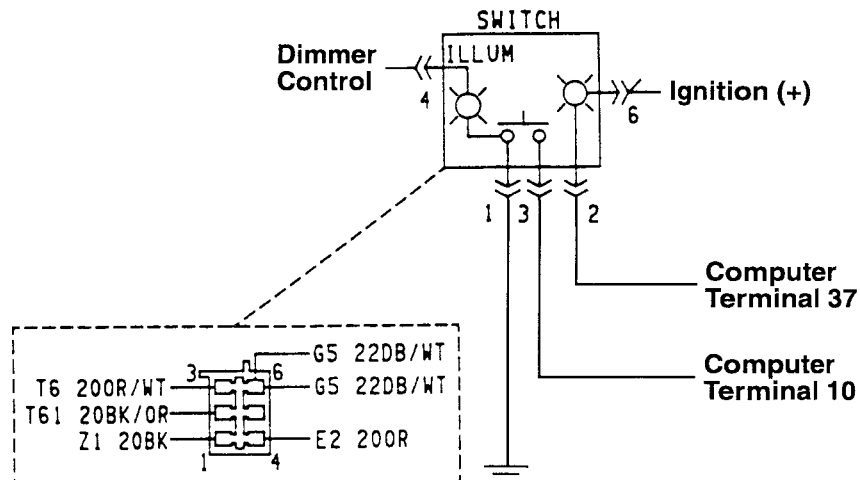
Continued...

Electrical Systems (continued)

Overdrive Cancel Switch and Module (continued)

Type 3a Systems

1992 – 95 Dakota, 1992 Pickup and Ramcharger w/3.9L, 5.2L Engine
1993 Pickup and Ramcharger (All)

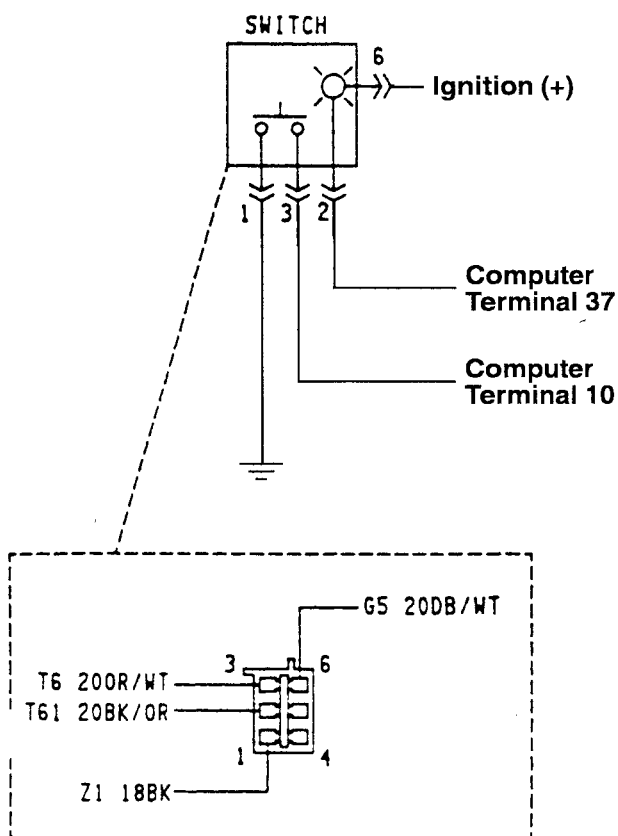


Continued...

Electrical Systems (continued)

Overdrive Cancel Switch and Module (continued)

Type 3b Systems
1992 – 93 Diesel Truck, 1993 – 94 Van

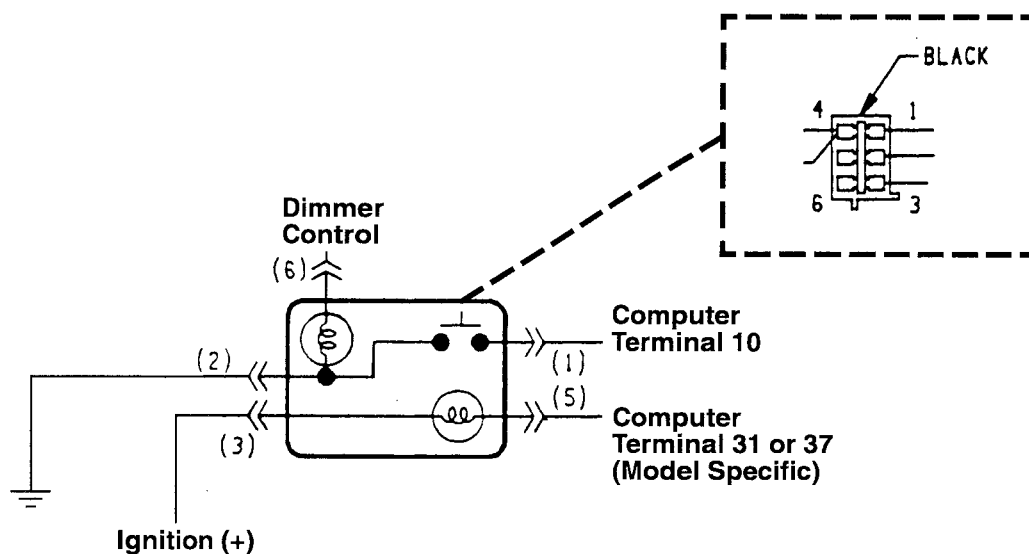


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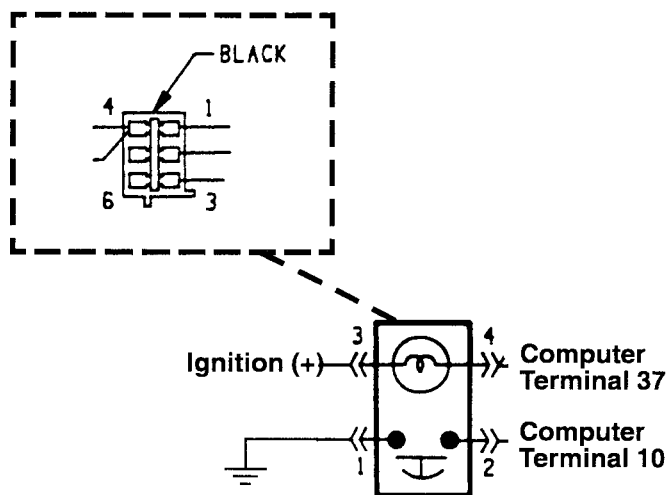
Electrical Systems (continued)

Overdrive Cancel Switch and Module (continued)

Type 4a Systems
1995 Pickup and Ramcharger



Type 4b Systems
1994 Truck and Ramcharger; 1995 Vans



Rebuild Adjustments

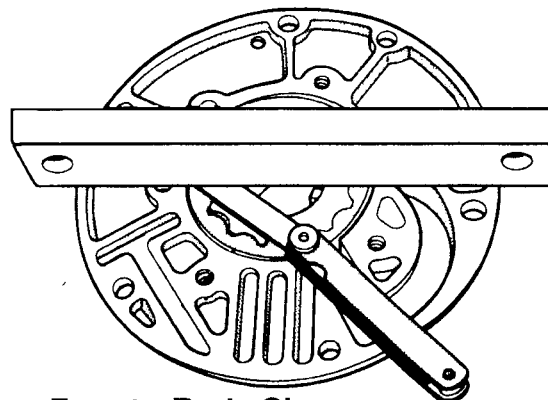
Pump Clearances

There are several pump clearance checks necessary on A500-series transmissions. These include:

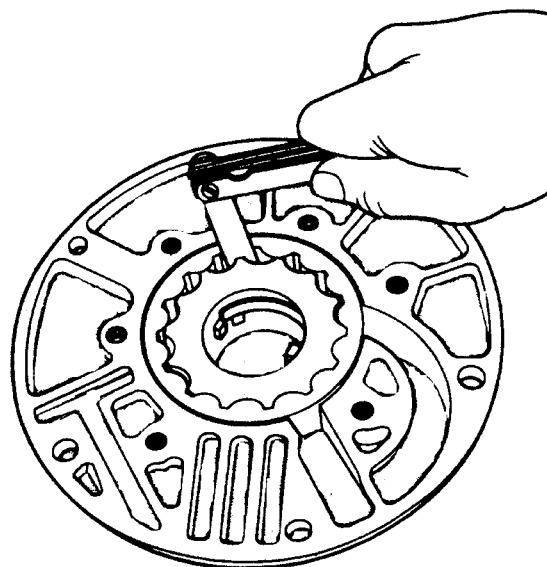
- Pump gear-to-body side clearance
- Pump gear-to-gear clearance
- Outer gear face-to-body clearance
- Inner gear face-to-body clearance

The procedure for checking these clearances is identical for all A500-series units, but the clearance specifications are slightly different, based on the transmission you're working on.

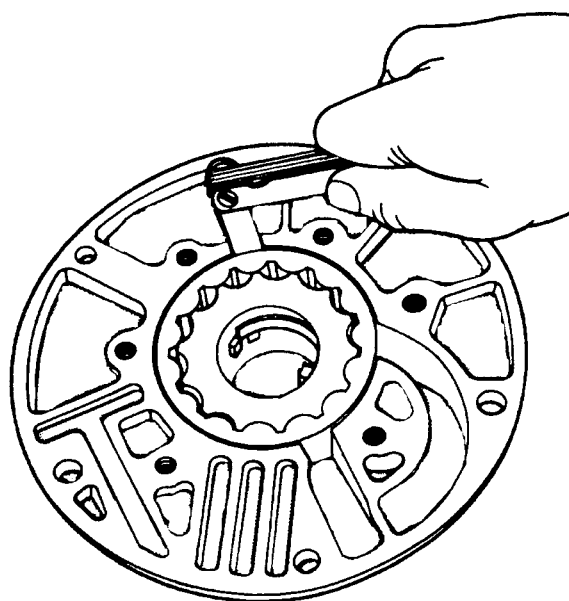
Pump Clearance Adjustments		
Clearance	42RH	46RH/47RH
Gear-to-body side	0.0025" – 0.004" (0.06mm – 0.004mm)	0.0035" – 0.0075" (0.010mm – 0.190mm)
Gear-to-gear	0.0035" – 0.0075" (0.010mm – 0.190mm)	0.0035" – 0.0075" (0.010mm – 0.190mm)
Outer gear face-to-body	0.0035" – 0.0075" (0.010mm – 0.190mm)	0.0035" – 0.0075" (0.010mm – 0.190mm)
Inner gear face-to-body	0.0035" – 0.0075" (0.010mm – 0.190mm)	0.0035" – 0.0075" (0.010mm – 0.190mm)



Face-to-Body Clearance



Gear-to-Gear Clearance



Gear-to-Body Side Clearance

Rebuild Adjustments (continued)

Geartrain Clearance

When assembled, the planetary geartrain clearance must be within specifications, to provide adequate lubrication and prevent gear noise.

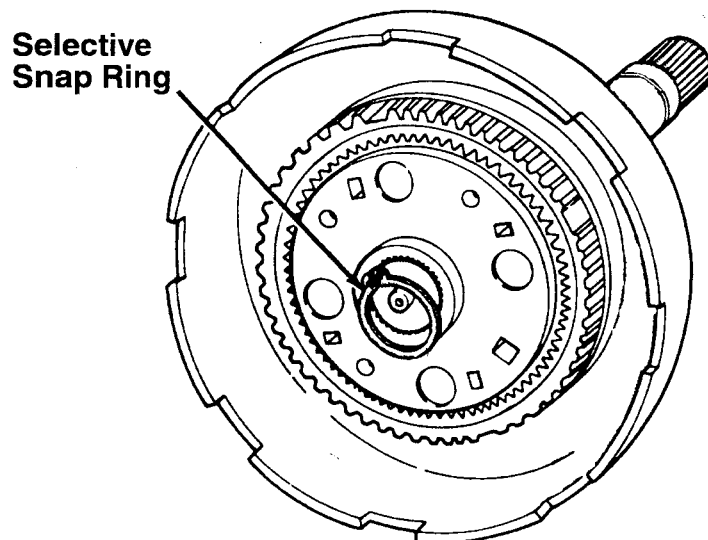
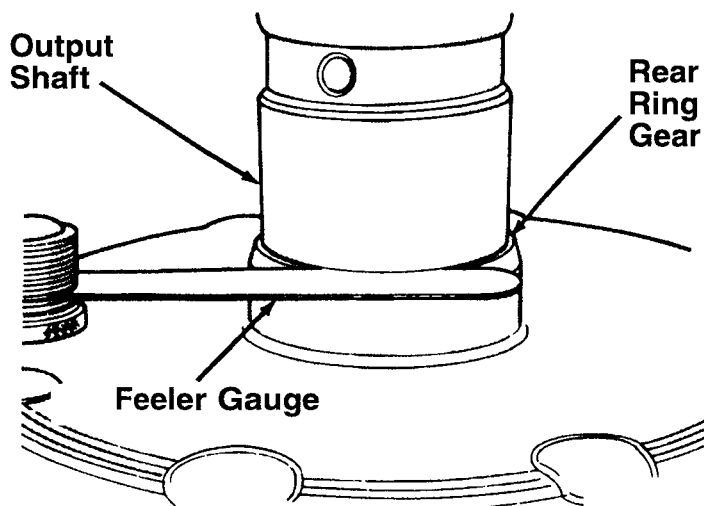
42RH 0.005" – 0.048" (0.12 – 1.22 mm)

46RH/47RH 0.006" – 0.048" (0.15 – 1.22 mm)

If the clearance is outside of specifications, there are three different selective snap rings available:

Replace the snap ring with the right one to bring the geartrain clearance into specs.

Geartrain Snap Ring Thickness		
Snap Ring	42RH	46RH/47RH
Thin	0.042" (1.07 mm)	0.048" (1.22 mm)
Medium	0.064" (1.63 mm)	0.055" (1.40 mm)
Thick	0.084" (2.13 mm)	0.062" (1.58 mm)



Rebuild Adjustments (continued)

Overdrive Assembly Endplays

There are two different endplay adjustments required in the overdrive assembly:

- Overdrive piston endplay
- Intermediate shaft endplay

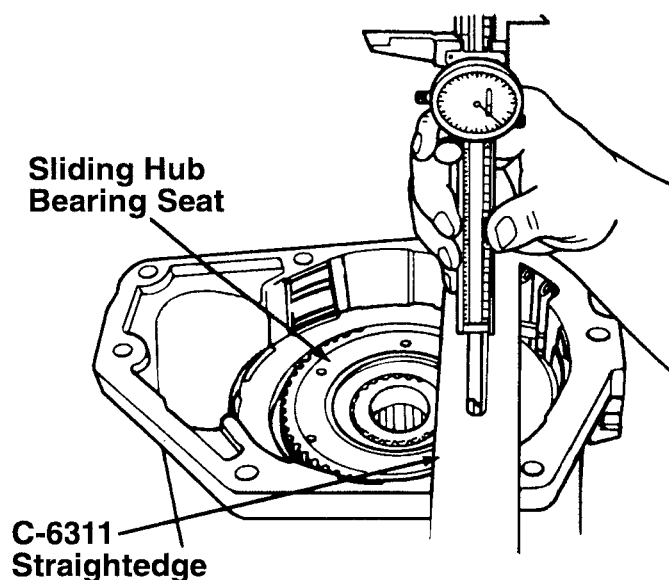
These adjustments are critical for proper operation of the overdrive section of the transmission.

Overdrive Piston Endplay

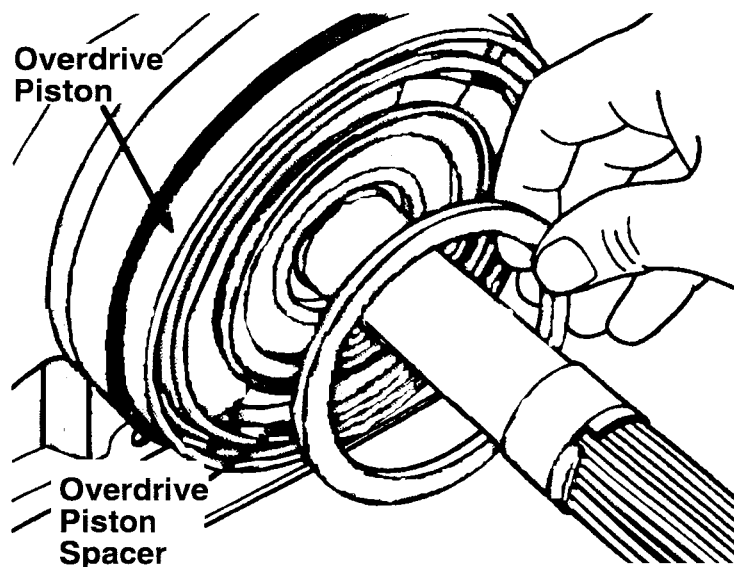
The overdrive piston endplay adjustment coordinates the direct clutch release with the overdrive brake apply. If there's too little endplay, the transmission will bind going into overdrive; too much endplay, and the transmission will destroy the direct clutches. You'll usually notice this first as a slip in reverse.

One way to check the overdrive piston clearance is with Chrysler's straightedge (P/N 6311). If you don't have that straightedge, any good straightedge will do. Just measure the clearance in four places, as shown in the diagram, and determine the average clearance measurement.

Then subtract the straightedge thickness – if you're using the Chrysler tool, subtract 0.500" (12.700 mm) – from your measurement to get the clearance. Then compare your measurement to the chart, and use the spacer listed in the chart.



Overdrive Piston Thrust Plate Spacers		
Endplay Measurement	Spacer Thickness	Chrysler P/N
1.250" – 1.265" (31.750 – 32.130 mm)	0.110" (2.800 mm)	4431730
1.266" – 1.280" (32.155 – 32.510 mm)	0.125" (3.175 mm)	4431585
1.281" – 1.295" (32.540 – 32.890 mm)	0.140" (3.555 mm)	4431731
1.296" – 1.310" (32.920 – 33.275 mm)	0.155" (3.940 mm)	4431586
1.311" – 1.325" (33.300 – 33.655 mm)	0.170" (4.320 mm)	4431732
1.326" – 1.340" (33.680 – 34.035 mm)	0.185" (4.700 mm)	4431587
1.341" – 1.355" (34.060 – 34.420 mm)	0.200" (5.100 mm)	4431733
1.356" – 1.370" (34.440 – 34.800 mm)	0.215" (5.460 mm)	4431588
1.371" – 1.385" (34.825 – 35.180 mm)	0.230" (5.840 mm)	4431734
1.386" – 1.400" (35.200 – 35.560 mm)	0.245" (6.225 mm)	4431590



Rebuild Adjustments (continued)

Overdrive Assembly Endplays (continued)

Intermediate Shaft Endplay

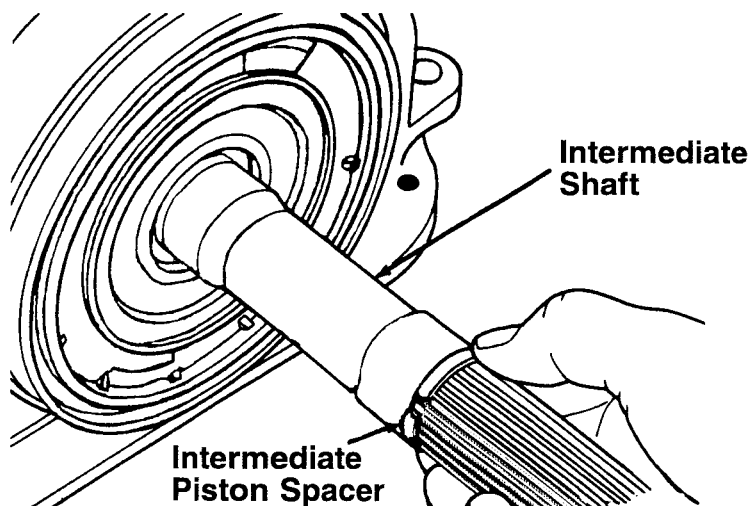
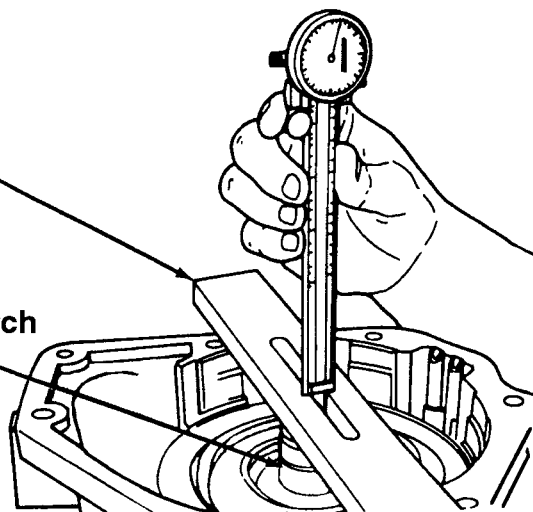
The intermediate shaft endplay check requires a special tool that slides into the end of the direct clutch hub. Slide Chrysler tool 6312 into the direct clutch hub, and measure the clearance between the gasket surface and the end of the tool, as shown in the graphic.

One way to measure this clearance is with a straightedge, such as the Chrysler straightedge, P/N 6311. Then subtract the straightedge thickness from your measurement to determine the clearance. If you're using the Chrysler straightedge, subtract 0.500" (12.700 mm) from your measurement. Then compare the clearance to the chart, and use the spacer listed in the chart.

Intermediate Piston Thrust Plate Spacers		
Endplay Measurement	Spacer Thickness	Chrysler P/N
0.2336" – 0.2505" (5.933 – 6.363 mm)	0.160" (4.065 mm)	4431916
0.2506" – 0.2675" (6.365 – 6.795 mm)	0.175" (4.445 mm)	4431917
0.2676" – 0.2855" (6.797 – 7.252 mm)	0.195" (4.955 mm)	4431918
0.2856" – 0.3011" (7.254 – 7.648 mm)	0.210" (5.335 mm)	4431919

**C-6311
Straightedge**

**C-6312
Direct Clutch
Hub Tool**



Rebuild Adjustments (continued)

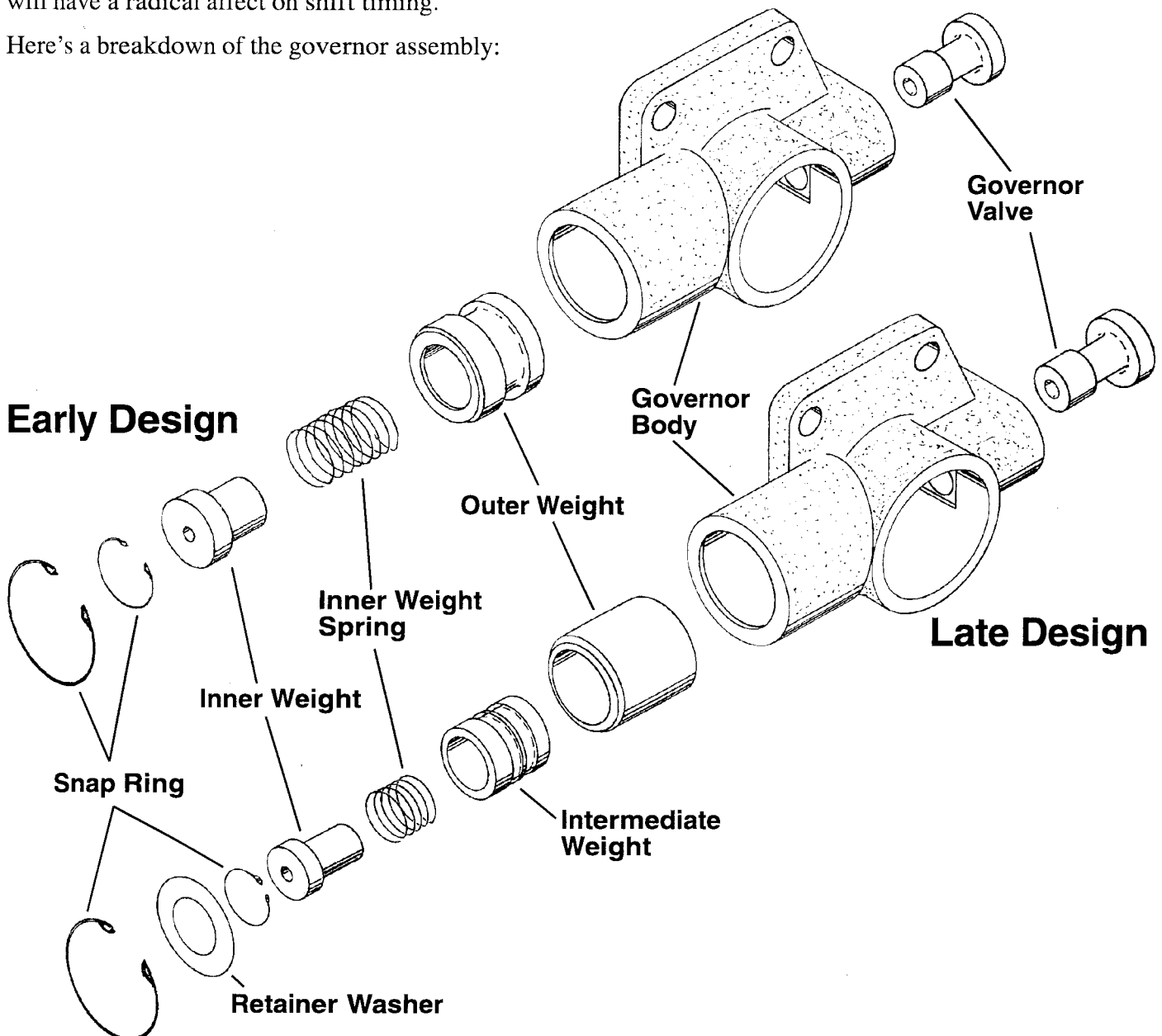
Governor

There are two different design governors used on A500-series transmissions. The most obvious difference is that the later design governor includes an intermediate weight. This weight didn't appear on earlier models.

Never interchange early and late governors; they could cause shift problems.

When replacing governors, always make sure the weights in the new governor are the same as the weights in the old governor. Differences in size or weight will affect shift timing. A less obvious difference is in the governor valve: Some are aluminum, others are steel. Never interchange the two: The difference in weight will have a radical affect on shift timing.

Here's a breakdown of the governor assembly:



Technical Bulletins

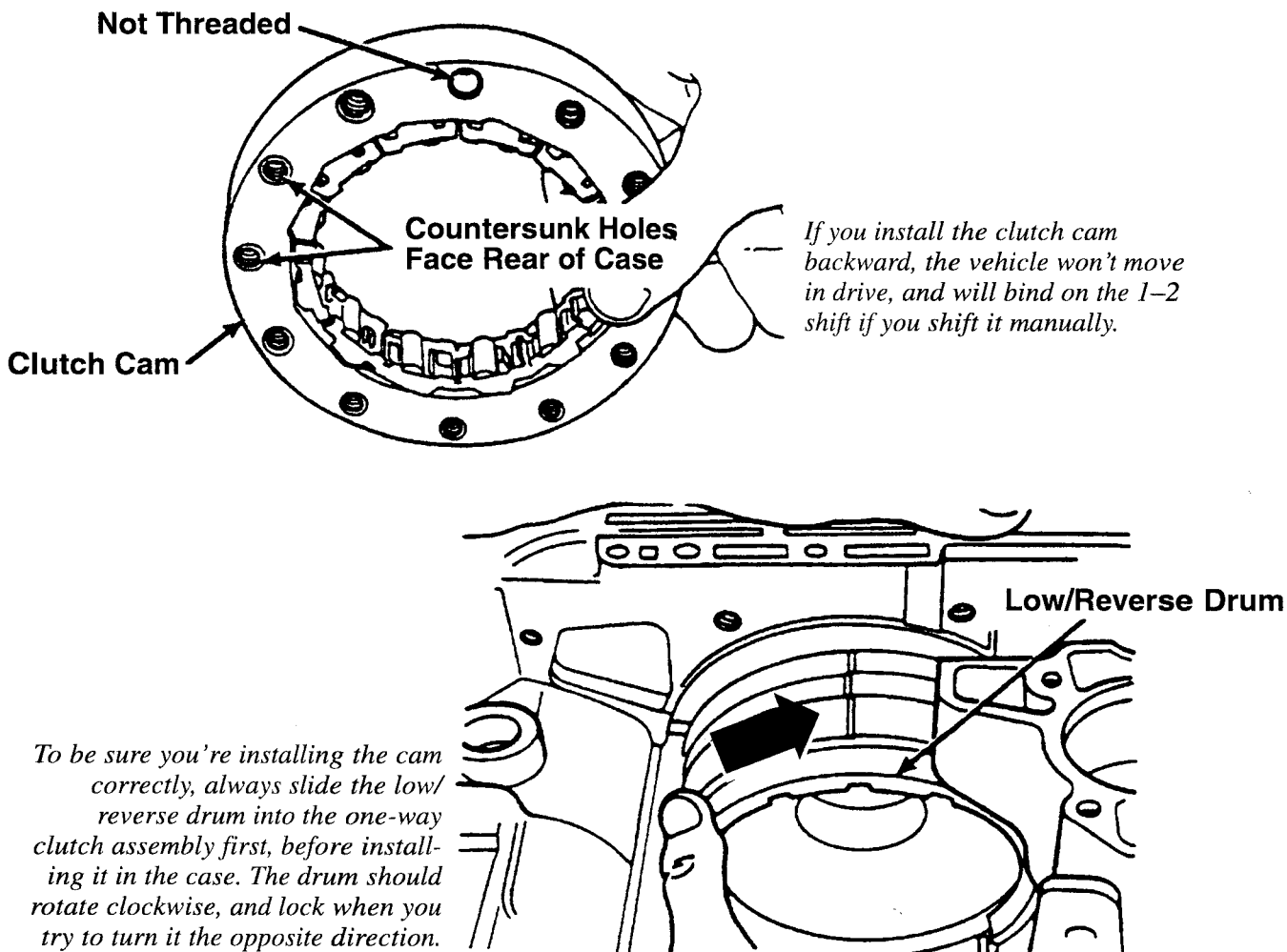
No Forward in Drive; Binds on Manual Upshift from Low

This is an after-rebuild failure: The transmission won't go into gear when you put the selector in drive. Then, when you put the selector into low, it moves in first gear, but binds when you upshift the unit manually.

The problem is usually caused when the low overrun clutch cam is mounted backward in the back of the transmission case. The only way to determine which way the cam faces is by the bolt holes: The countersunk holes side of the holes must face out toward the bell housing.

However, there's an easy way to make sure you're installing the cam correctly: Just assemble the cam, overrunning clutch and low/reverse drum outside the transmission. When you're holding the cam, the drum should rotate clockwise, but lock when you try to turn the drum in the opposite direction.

Once you've determined which way the cam should face, install it into the case.

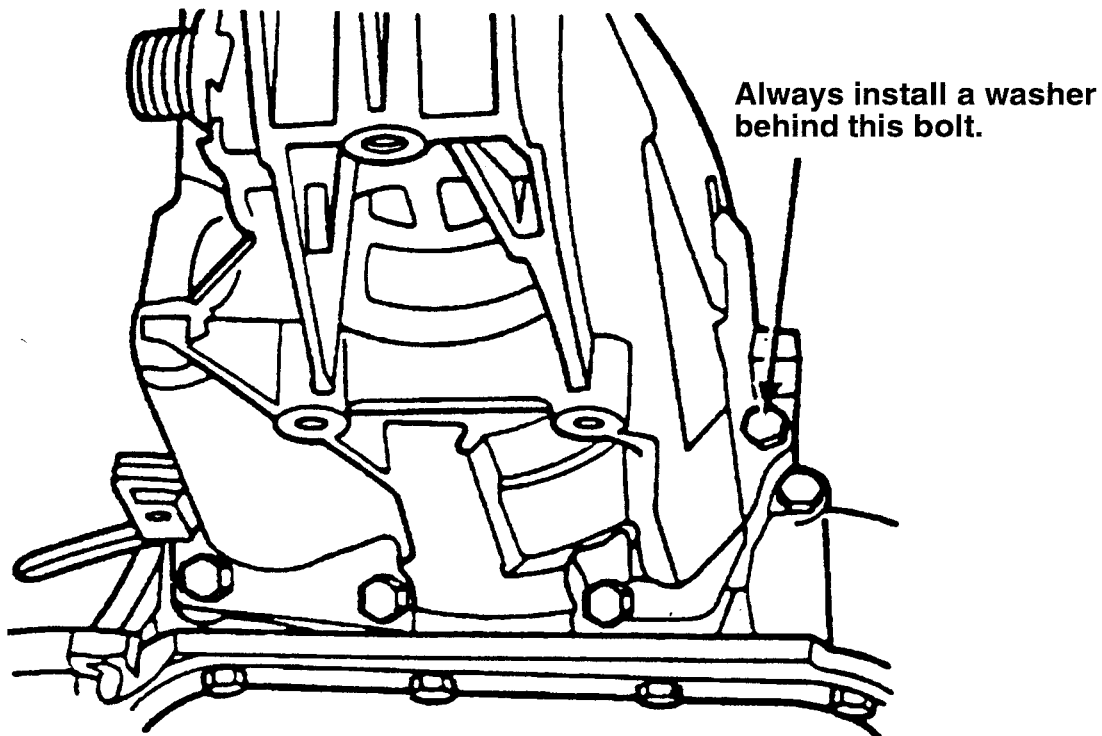


Technical Bulletins (continued)

Low/Reverse Band Failure

In some cases, the overdrive housing bolt indicated can interfere with the low/reverse band strut. This can cause the band to fail prematurely.

Always check this bolt for any sign of wear or damage, and always install a washer on the bolt, to keep it from threading too deeply into the case.



Technical Bulletins (continued)

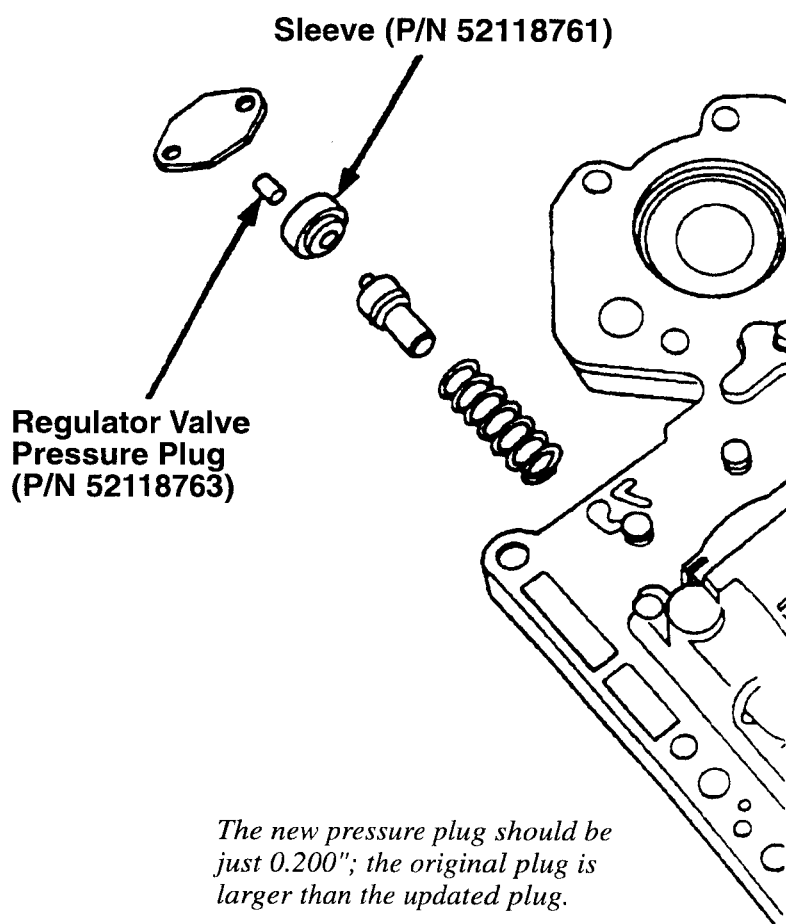
Slips in Reverse

Low reverse boost pressure can cause the transmission to slip in reverse under heavy loads. This is most common on vehicles that undergo overloading or extreme use.

To increase reverse boost pressure, Chrysler now offers a replacement regulator valve pressure plug and sleeve:

- Regulator Valve Pressure Plug, P/N 52118763
- Regulator Valve Sleeve, P/N 52118761

You can identify the new components by the pressure plug: The pressure plug is 0.200" in diameter; the original plug is larger than 0.200".

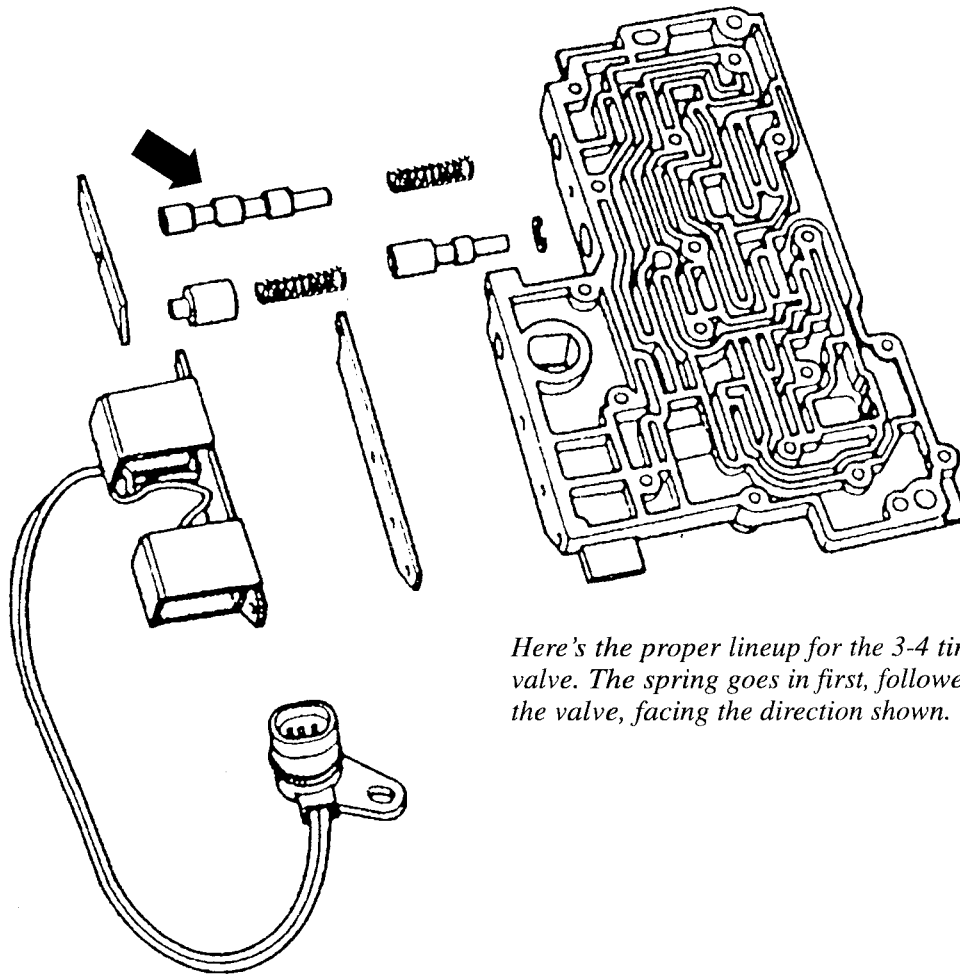


Technical Bulletins (continued)

No 4th Gear After Rebuild

Many repair manuals show the 3-4 timing valve installed backward. If installed backward, the transmission won't shift into fourth gear, even though the computer is supplying the proper signals.

The graphic shows the proper order and direction for the 3-4 timing valve. Always install the spring first in the bore, then the valve, facing the direction shown.



Here's the proper lineup for the 3-4 timing valve. The spring goes in first, followed by the valve, facing the direction shown.

Specifications

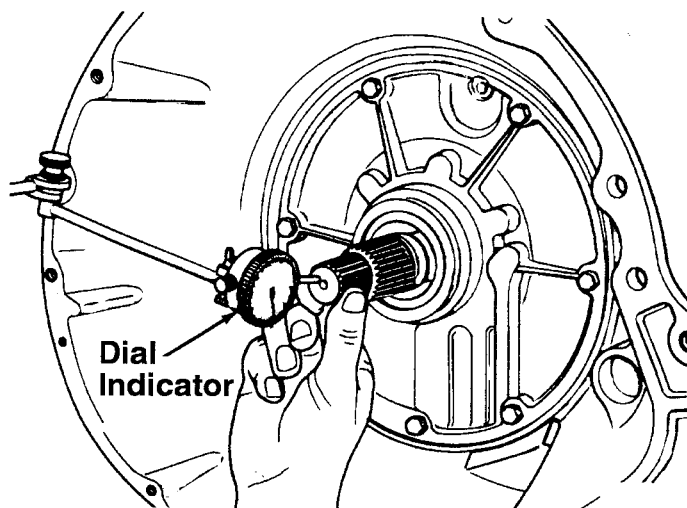
Torque Specifications

Bolt Description	ft-lbs	(Nm)
Bell housing	30	(41)
Extension housing to case	32	(43)
Extension housing to mount	50	(68)
Flex plate to crankshaft.....	55	(75)
Kickdown band adjustment locknut	30	(41)
Neutral safety switch	25	(34)
Reverse band adjustment locknut	25	(34)

Bolt Description	in-lbs	(Nm)
Converter to flex plate	270	(31)
Cooler line fitting.....	155	(18)
Cooler line nut	85	(10)
Front pump to case	175	(20)
Governor body to support	95	(13)
Kickdown lever shaft plug	150	(17)
Oil pan	150	(17)
Output shaft support	150	(17)
Overrun clutch cam set screw	40	(5)
Pressure taps	120	(14)
Pump body to stator support	175	(20)
Solenoid case connector	150	(17)
Speedometer drive housing clamp.....	100	(11)
Valve body screw	35	(4)
Valve body to case	105	(12)

Input Shaft Endplay

42RH	0.022" – 0.090" (0.55 – 2.30 mm)
46RH/47RH	0.034" – 0.084" (0.85 – 2.15 mm)



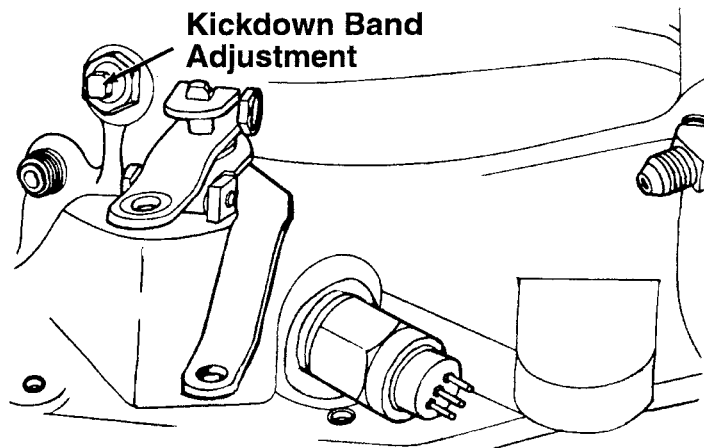
Continued...

Specifications (continued)

Kickdown Band Adjustment

Tighten adjustment screw to 72 ft-lbs

Back off adjustment screw 2 – 2½ turns



Low/Reverse Band Adjustment

42RH

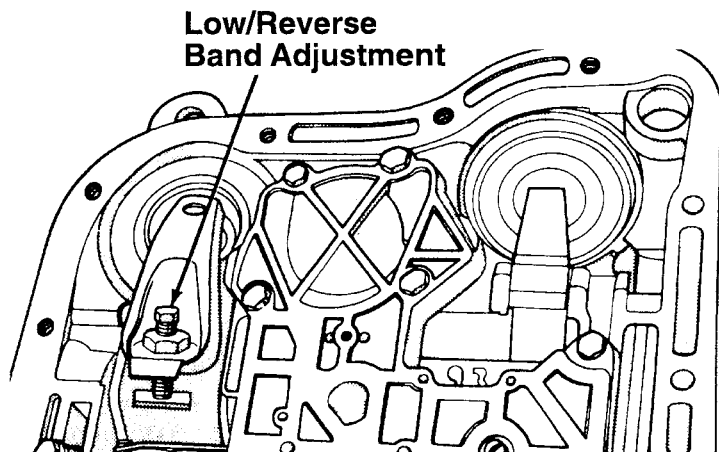
Tighten adjustment screw to 72 ft-lbs

Back off adjustment screw 4 turns

46RH/47RH

Tighten adjustment screw to 72 ft-lbs

Back off adjustment screw 2 turns



Chrysler 41TE

Contents

41TE Diagnosis	C2
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PRNODL and Neutral Start Switches (1989 – 95)	C13
Transmission Range Sensor; 1996 – on	C15
Solenoid Switch Valve	C17
Shift Solenoids	C19
Gear Ratio Errors	C21
Clutch Volume	C23

41TE Diagnosis

The Chrysler 41TE, or A604, is a common electronic transaxle that operates in an uncommon manner.

Unlike most other transmissions and transaxles on the road today, the 41TE doesn't control line pressure separately, or use a series of valves to control clutch apply.

Instead, the 41TE runs on full line pressure all the time, and controls the clutch apply through a series of pulse width modulated solenoids, in a single solenoid block.

Because of these control differences, the 41TE is susceptible to a whole series of faults and failures that you won't see on any other unit.

For example, many technicians mistake 2nd gear starts for failsafe on this unit. Both are likely symptoms, but each symptom indicates a different root failure. That's the main goal of this section: to help you identify the most common symptoms, and determine the most likely cause for those symptoms.

In this section, we're going to look at some of the more common failures that plague the 41TE transaxle. We'll examine some of the common causes for these failures, and you'll learn which causes technicians often overlook during a typical diagnosis.

We'll start by looking at the diagnostic trouble codes associated with these units, and then look at some of the more common codes, and see what causes them to set in the first place.

Diagnostic Trouble Codes

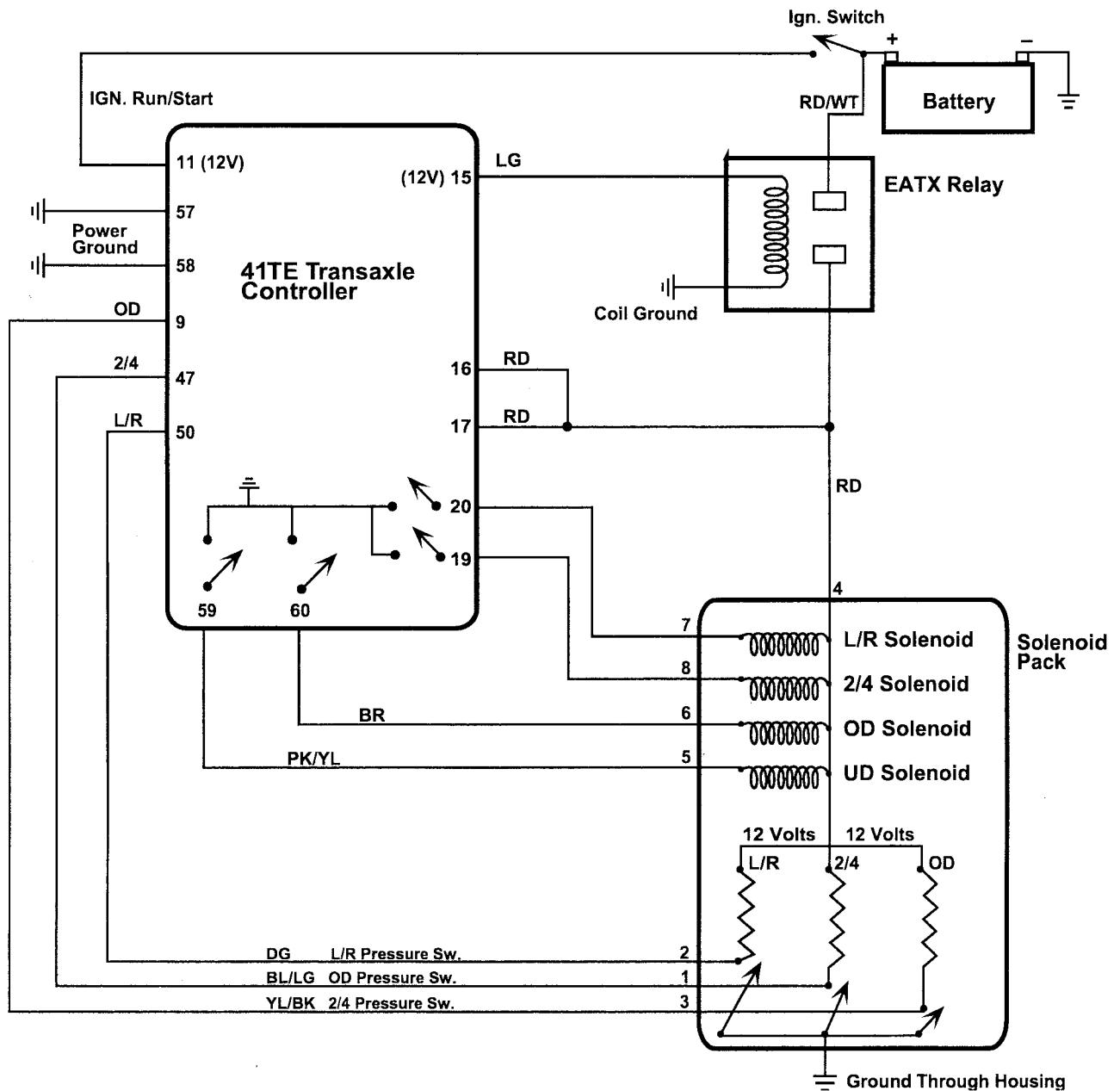
Code	Description	Limp-In
11	Internal 41TE controller error (watchdog circuit test)	Yes
12	Battery was disconnected	No
13	Internal 41TE controller error (watchdog circuit shutdown)	Yes
14	EATX (main power) relay is always on	Yes
15	EATX (main power) relay is always off	Yes
16	Internal 41TE controller error (ROM check failure)	Yes
17	Internal 41TE controller error (RAM check failure)	Yes
18	Engine speed signal circuit failure	Yes
19	Chrysler Collision Detection (CCD) bus communication error	No
20	Switched battery (the computer sees voltage at the pressure switches, while the relay contacts are open)	Yes
21	OD pressure switch circuit problem	Yes
22	2/4 pressure switch circuit problem	Yes
23	2/4 and OD pressure switch circuits have a problem	Yes
24	LR pressure switch circuit problem	Yes
25	LR and OD pressure switch circuit problem	Yes
26	LR and 2/4 pressure switch circuit problem	Yes
27	All pressure switch circuits have a problem	Yes
28	PRNODL signal has a problem	No
29	Throttle position sensor signal is out of range	No
31	OD hydraulic pressure switch circuit problem	Yes
32	2/4 hydraulic pressure switch circuit problem	Yes
33	OD and 2/4 hydraulic pressure switch circuits have a problem	Yes
35	Loss of hydraulic prime (pump is drawing air into the system)	No
36	Fault immediately after a shift (slipping clutch, gear ratio error, etc.)	Yes
37	Solenoid switch valve stuck in lockup position	No
38	Lockup solenoid circuit is either open or shorted	No
39	Gear ratio error	Yes
41	LR solenoid circuit is either open or shorted	Yes
42	2/4 solenoid circuit is either open or shorted	Yes
43	OD solenoid circuit is either open or shorted	Yes

Continued...

Diagnostic Trouble Codes (continued)

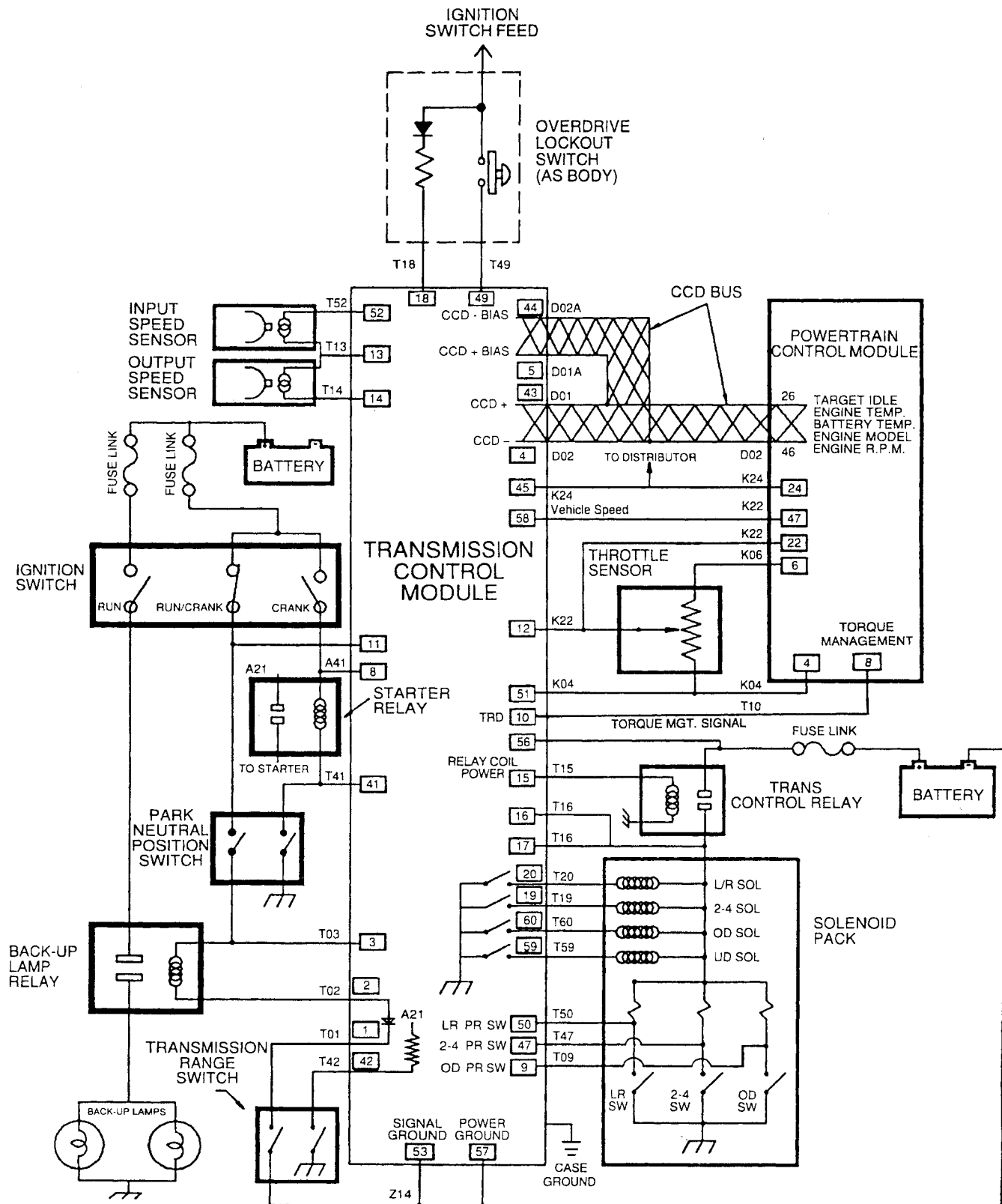
Code	Description	Limp-In
44	UD solenoid circuit is either open or shorted	Yes
45	Internal 41TE controller error (E2 memory failure)	No
46	3 -- 4 shift abort	No
47	Solenoid switch valve stuck in LR position	Yes
48	Torque reduction data (TRD) link communication error	No
50	Gear ratio error in reverse	Yes
51	Gear ratio error in 1 st gear	Yes
52	Gear ratio error in 2 nd gear	Yes
53	Gear ratio error in 3 rd gear	Yes
54	Gear ratio error in 4 th gear	Yes
56	Turbine shaft sensor error	Yes
57	Output shaft sensor error	Yes
58	Sensor ground is loose or damaged	Yes
60	LR clutch volume too low	No
61	2/4 clutch volume too low	No
62	OD clutch volume too low	No
63	UD clutch volume too low	No
70	Autostick input circuit failure	No
71	Manual shift overheat	No
72	Thermistor input circuit open or shorted	No
73	Worn out or burnt transaxle fluid	No
74	Calculated oil temperature in use (thermistor voltage is out of range)	No

Solenoids and Pressure Switches



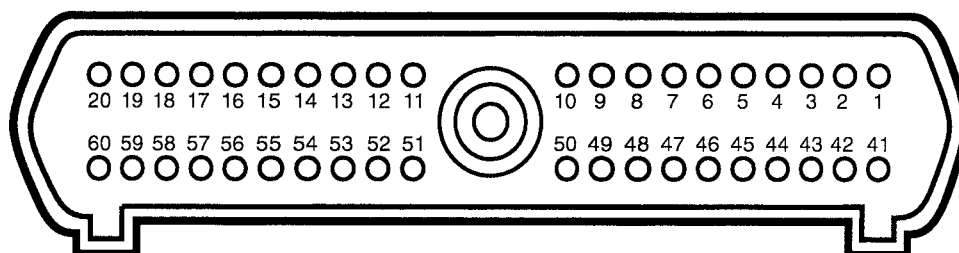
41TE Electrical Schematics (continued)

Main Schematic, 1989 – 95



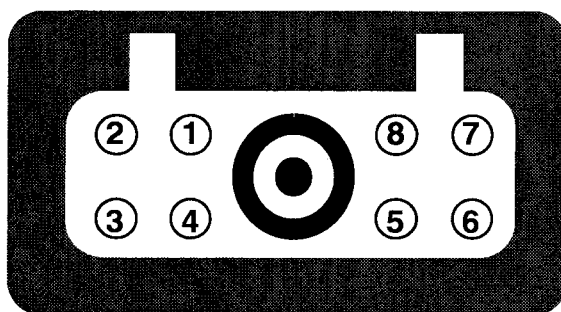
41TE Electrical Schematics (continued)

Terminal Identification, 1989 – 95



1	Transmission Range; B+	41	Park/Neutral Position Sense
2	Transmission Range; B+	42	Reverse Position Sense
3	Transmission Gear Range Sense	43	CCD +
4	CCD –	44	CCD – Bias
5	CCD + Bias	45	Engine RPM Signal
6	Not Used	46	Not Used
7	Not Used	47	2/4 Pressure Switch Signal
8	Ignition Switch; Start	48	Not Used
9	OD Pressure Switch Signal	49	OD Off Switch Signal
10	Torque Management Request (TRD) Link	50	Low/Reverse Pressure Switch Signal
11	Ignition Switch (B+)	51	Sensor Ground
12	Throttle Position Sensor Signal	52	Input Shaft Speed Sensor Signal
13	Sensor Ground	53	Signal Ground
14	Output Shaft Speed Sensor Signal	54	Not Used
15	Transmission Control Relay Power	55	Not Used
16	Switched Battery Power (B+)	56	Fused Battery (B+)
17	Switched Battery Power (B+)	57	Ground
18	Ignition Feed; Overdrive Lockout	58	Vehicle Speed Signal to the PCM
19	2/4 Solenoid Control	59	UD Solenoid Control
20	Low/Reverse Solenoid Control	60	OD Solenoid Control

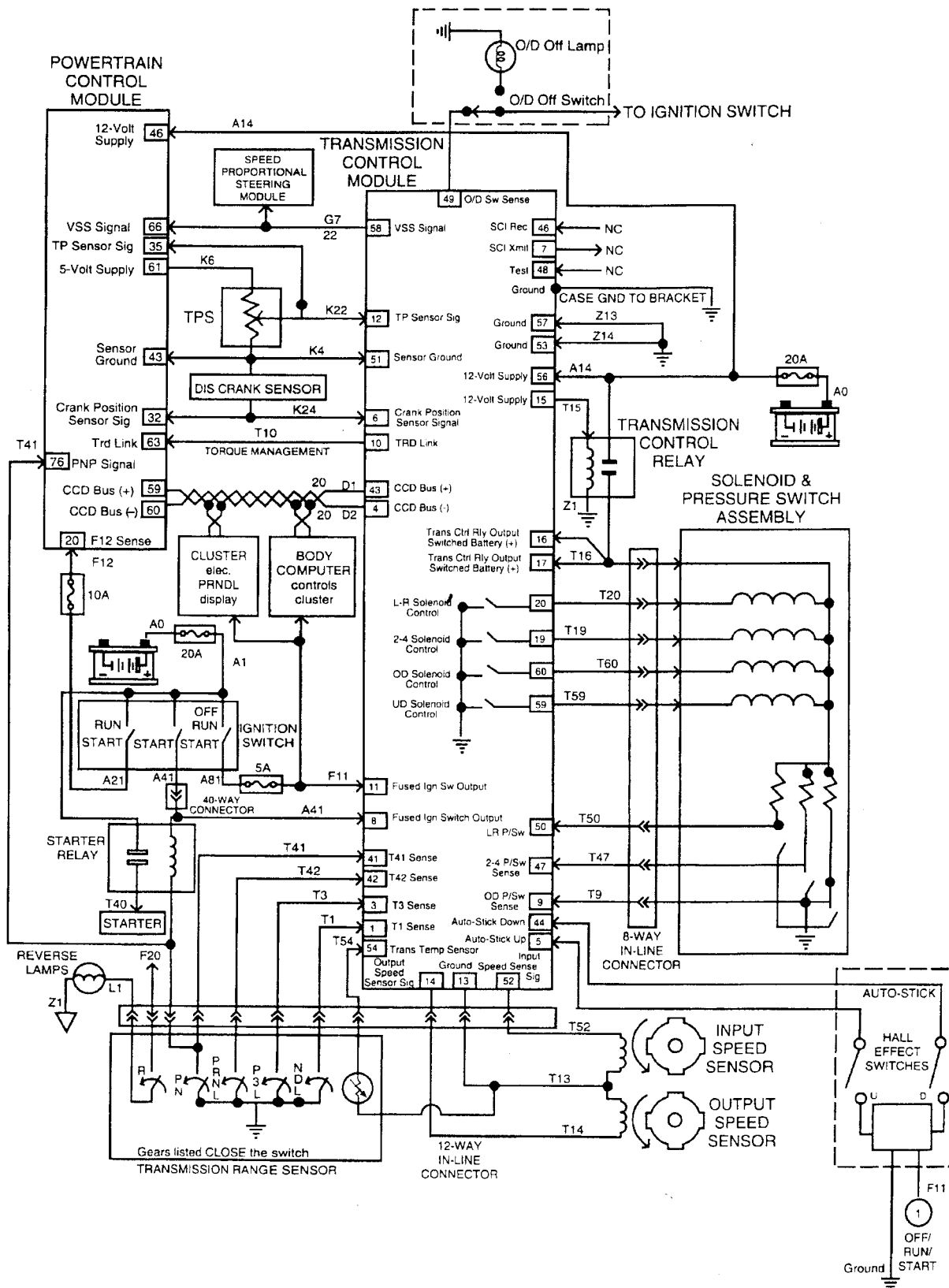
Solenoid Pack Connector Terminal Identification



1	2/4 Pressure Switch Signal	5	UD Solenoid Ground
2	Low/Reverse Pressure Switch Signal	6	OD Solenoid Ground
3	OD Pressure Switch Signal	7	Low/Reverse Solenoid Ground
4	12 Volt Power Supply from EATX Relay	8	2/4 Solenoid Ground

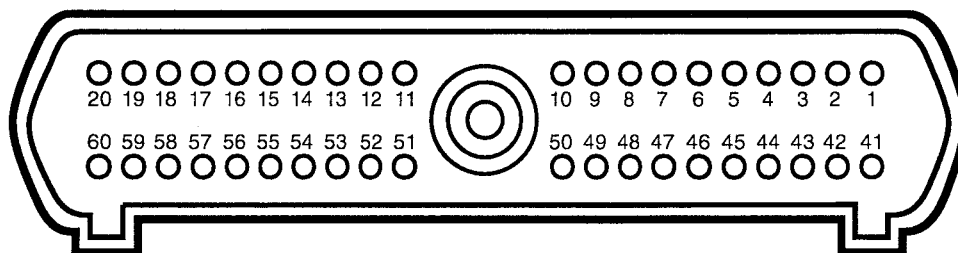
41TE Electrical Schematics (continued)

Main Schematic, 1996 – on



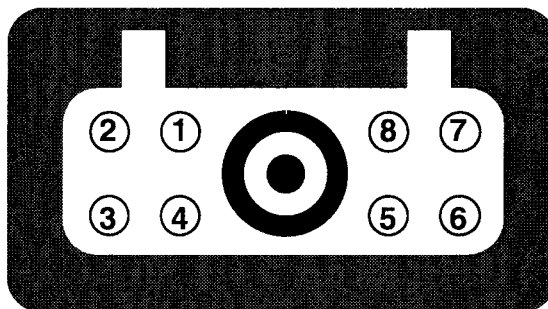
41TE Electrical Schematics (continued)

Terminal Identification, 1996 – on



1	Transmission Gear Range Sensor T1 Sense	41	Transmission Gear Range Sensor T41 Sense
2	Not Used	42	Transmission Gear Range Sensor T42 Sense
3	Transmission Gear Range Sensor T3 Sense	43	CCD –
4	CCD +	44	Autostick Down
5	Autostick Up	45	Not Used
6	Engine RPM Signal	46	SCI Receive
7	SCI Transmit	47	2/4 Pressure Switch Signal
8	Ignition Switch (B+)	48	Test Terminal
9	OD Pressure Switch Signal	49	OD Off Switch Signal
10	Torque Management Request (TRD) Link	50	Low/Reverse Pressure Switch Signal
11	Ignition Switch (B+)	51	Sensor Ground
12	Throttle Position Sensor Signal	52	Input Shaft Speed Sensor Signal
13	Sensor Ground	53	Ground
14	Output Shaft Speed Sensor Signal	54	Transmission Temperature Sensor
15	Transmission Control Relay Power	55	Not Used
16	Switched Battery Power (B+)	56	Fused Battery (B+)
17	Switched Battery Power (B+)	57	Ground
18	Not Used	58	Vehicle Speed Signal to the PCM
19	2/4 Solenoid Control	59	UD Solenoid Control
20	Low/Reverse Solenoid Control	60	OD Solenoid Control

Solenoid Pack Connector Terminal Identification



1	2/4 Pressure Switch Signal	5	UD Solenoid Ground
2	Low/Reverse Pressure Switch Signal	6	OD Solenoid Ground
3	OD Pressure Switch Signal	7	Low/Reverse Solenoid Ground
4	12 Volt Power Supply from EATX Relay	8	2/4 Solenoid Ground

Clutch and Solenoid Application Chart

This chart is a little different from other clutch application charts you may be familiar with. Most clutch applications charts use the darkened boxes to indicate which clutches are applied.

The darkened boxes on this chart indicate which solenoid is energized. The clutches are indicated with the initials of each specific clutch pack. And, as you can see, energizing a solenoid doesn't necessarily apply a specific clutch pack. In fact, as the chart indicates, the underdrive clutch comes on when the S1 solenoid is off; to apply the underdrive clutch, the computer turns the S1 solenoid off.

Use this chart to identify when the individual solenoids energize, and to determine which clutches apply for each individual gear range.

Gear	Solenoids				Manual Valve
	S1	S2	S3	S4	
	UD	OD	LR/CC	24/LR	
Park/Neutral Under 8 MPH			LR		
Neutral Over 8 MPH					
Reverse Under 8 MPH				LR	R
Reverse Over 8 MPH					R
1 st Gear	UD		LR		
2 nd Gear	UD			24	
2 nd Gear EMCC	UD		CC	24	
3 rd Gear	UD	OD			
3 rd Gear EMCC	UD	OD	CC		
4 th Gear		OD		24	
4 th Gear EMCC		OD	CC	24	



– Solenoid Energized

OD – Overdrive Clutch

LR – Low/Reverse Clutch

CC – Converter Clutch

2/4 – 2/4 Clutch

R – Reverse Clutch

EMCC – Electronically-Modulated Converter Clutch

Pressure Switch Circuits

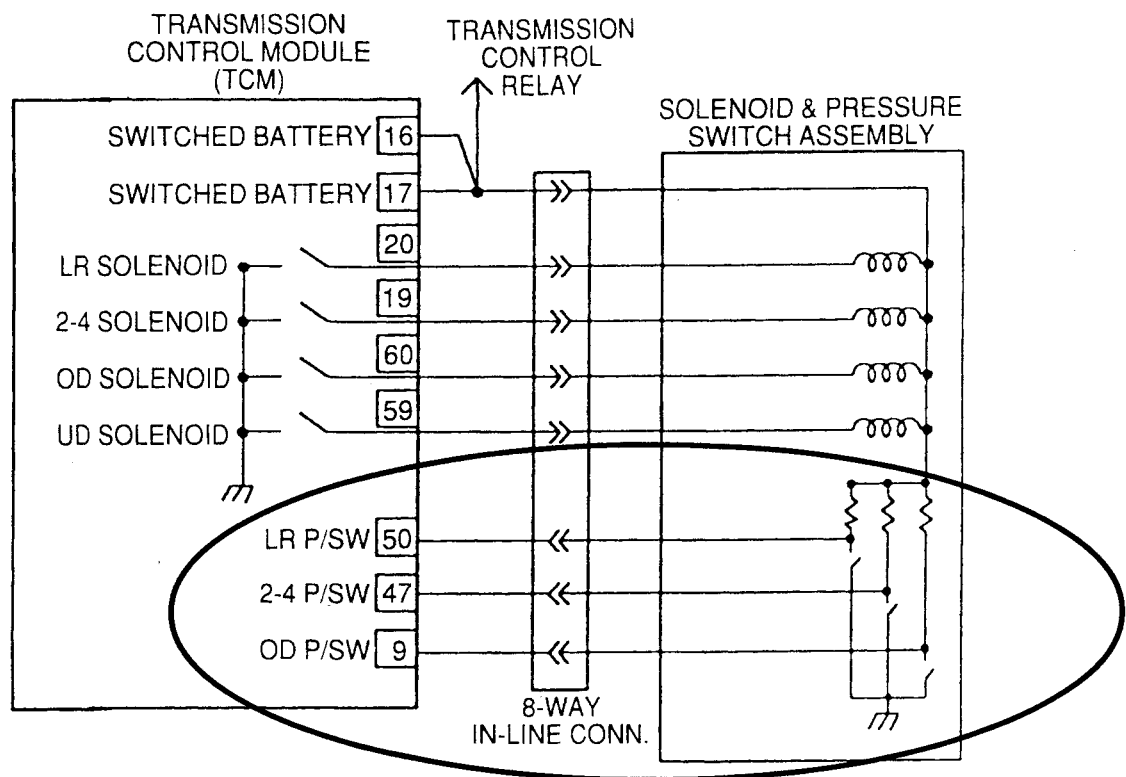
Related Diagnostic Trouble Codes

Code 21	OD pressure switch circuit problem
Code 22	2/4 pressure switch circuit problem
Code 23	2/4 and OD pressure switch circuits have a problem
Code 24	LR pressure switch circuit problem
Code 27	All pressure switch circuits have a problem
Code 25	LR and OD pressure switch circuit problem
Code 26	LR and 2/4 pressure switch circuit problem

System Description and Operation

The 41TE transaxle uses a series of three pressure switches, designed to confirm solenoid operation. When the computer energizes or de-energizes a solenoid, it looks for the appropriate pressure switch to open or close, to determine whether the fluid pressure is applying the clutch pack.

These are on-off switches: The switch closes when the pressure in the circuit reaches 23 PSI, and opens when the pressure drops back below 11 PSI. The computer can't determine actual circuit pressure from these switches; it can only determine whether the pressure reached the circuit.



The computer uses the solenoid switches monitor pressure in each clutch circuit, and compares that pressure to the solenoid commands. If the switch position doesn't match the solenoid command, the computer checks for a solenoid problem; if it doesn't detect a problem, the computer sets a switch code.

Continued...

Pressure Switch Circuits (continued)

System Description and Operation (continued)

The computer compares the switch condition to the solenoid signals about every 7 milliseconds, or about 143 times every second. If the switch condition doesn't match the solenoid command, the computer tests the solenoid circuit for continuity. If the solenoids check out okay, the computer assumes a switch problem, and sets one of these switch codes.

These codes don't necessarily indicate a bad switch; they simply indicate there's no pressure to the clutch circuit when it's supposed to be there. A large leak in the clutch circuit could also set one of these codes, because the pressure would be too low to close the switch, but the solenoid would check out okay.

Code 27 is a good example of a code that probably doesn't indicate a bad switch. What are the odds of all of the switches being faulty? Not very likely. More likely, there's a problem in the circuit feeding the switches, or in the computer sensing circuit itself.

For any of these codes to set:

- the vehicle must have been running for at least 2 seconds
- the engine must reach at least 500 RPM
- the transmission must have adequate line pressure
- the unit can't be shifting
- the switch condition must differ from the signal operating the solenoids.

These codes will set within 1 – 3 seconds of the failure occurring, depending on the transmission operating temperature.

PRNODL and Neutral Start Switches (1989 – 95)

Related Diagnostic Trouble Codes

Code 28 PRNODL signal has a problem

System Description and Operation

These early 41TEs used two separate switches — the PRNODL switch and the neutral start switch — to determine shift lever position.

This is an important consideration on these units, because the manual valve actually has only 3 positions: neutral, reverse and drive. All of the other control positions take place in the computer, based on the signals from these two switches. A failure in one of these switches is a common reason for a delayed reverse engagement, or will prevent the transmission from dropping into the manual gear ranges.

Switch operation is so important that the computer examines more than just the actual switch signals; it also watches for the transitions — from open to closed or closed to open — in these switches. By monitoring the transitions, the computer is able to anticipate changes in shift lever position, make the necessary command changes quickly enough to operate the transmission properly.

The computer uses the switch pattern to determine the shift lever position. A switch or circuit failure will set a code almost instantly, and the computer monitors these circuits constantly. If you see a code 28 on one of these systems, check the switch signals with your scan tool.

Here's a chart of the scan tool displays you can expect, based on the switch patterns:

Switches	Switch Position							
NS1								
RL1								
NS2								
RL2								
Scan Tool Display	P	R	N	OD	D	L	T1	T2

 Switch Closed

And here's how those patterns indicate the shift lever position:

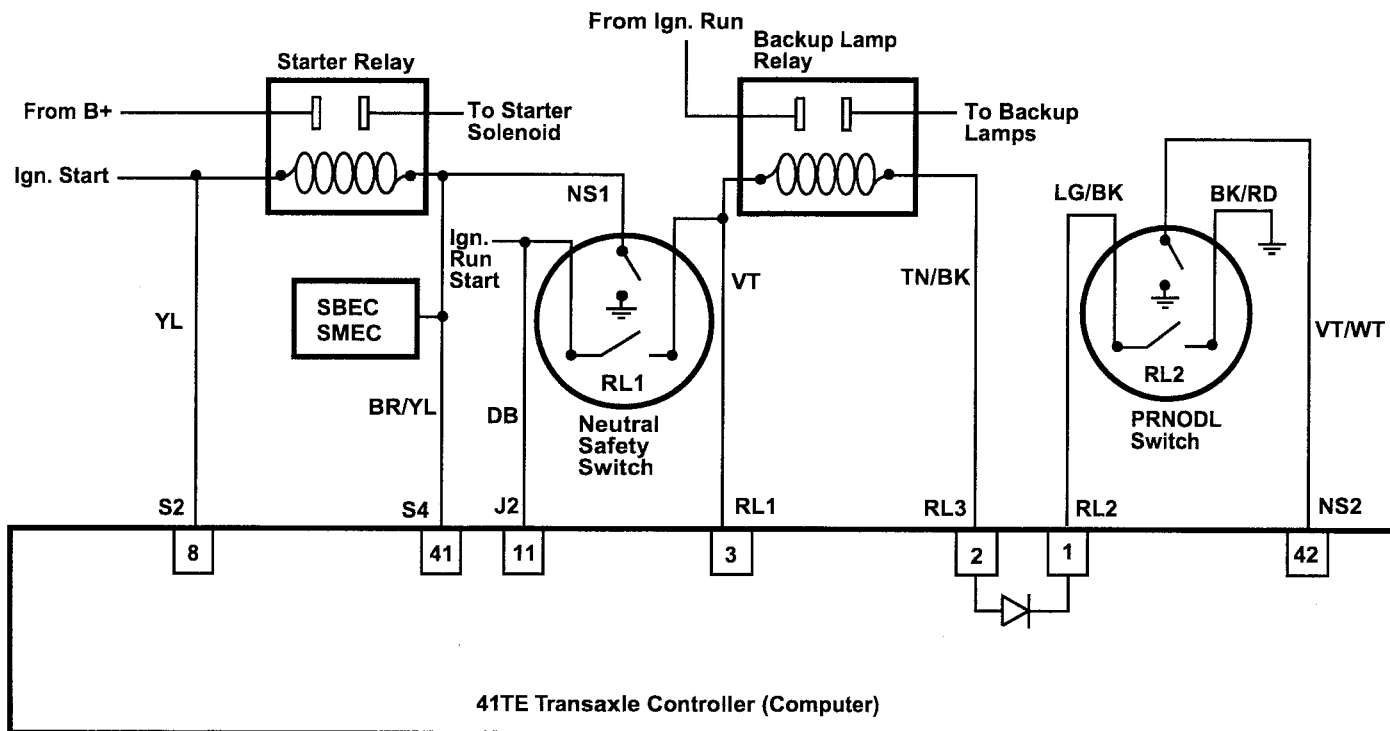
Switches	Shift Lever Position													
	P	Transition P – R			R	Trans R–N	N	Transition N–OD		OD	Trans OD–D	D	Trans D–L	L
NS1														
RL1														
NS2														
RL2														
Scan Tool Display	P	T1	T2	D	R	D	N	T1	T2	OD	T2	D	T2	L

Continued...

PRNODL and Neutral Start Switches (continued)

System Description and Operation (continued)

If the unit you're checking doesn't match this switch pattern, use the schematic to check for individual switch operation. These switch signals depend on more than just the actual switch operation: Loose connections, bad grounds or broken wires can all affect the signals making their way back to the computer.



If the voltage and ground circuits to the PRNODL and neutral start switches are all okay, any discrepancy in the switch signals are probably due to a switch failure.

Transmission Range Sensor; 1996 – on

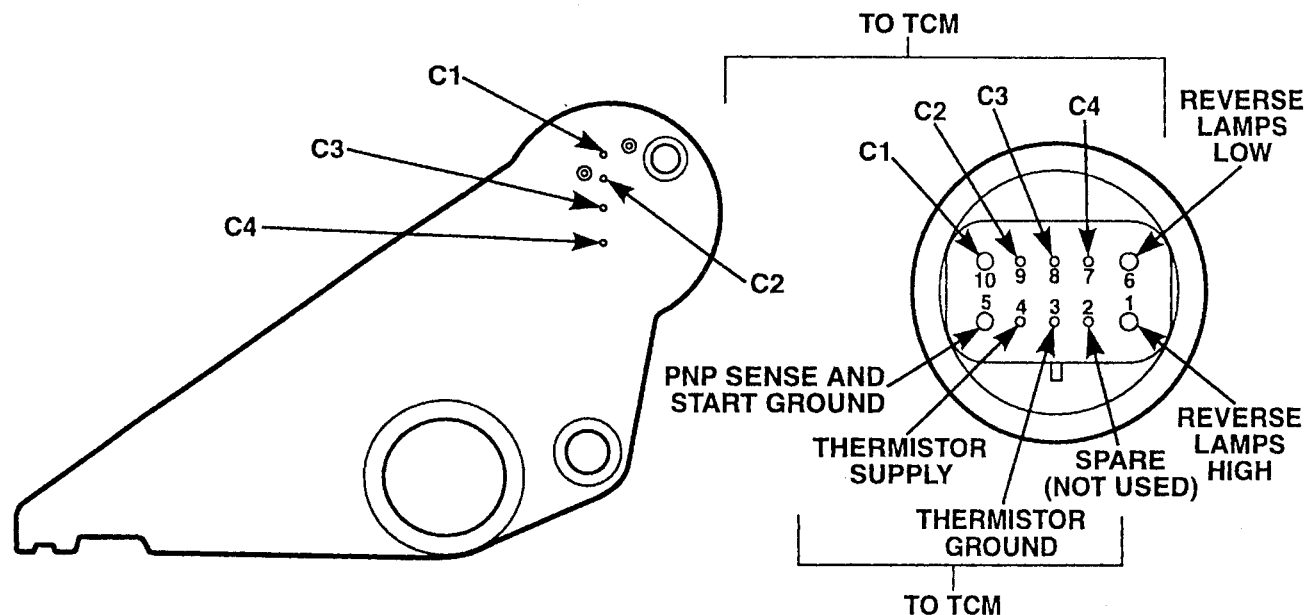
Related Diagnostic Trouble Codes

Code 28	Transmission range sensor signal has a problem
Code 72	Thermistor input circuit open or shorted
Code 74	Calculated oil temperature in use (thermistor voltage is out of range)

System Description and Operation

In 1996, Chrysler eliminated the PRNODL and neutral start switches, replacing them with a single transmission range sensor. This sensor provides all of the functions of the earlier switches, plus adds a thermistor, to monitor transmission oil temperature.

Here's a list of the transmission range sensor terminals, and the signals you can expect from them:



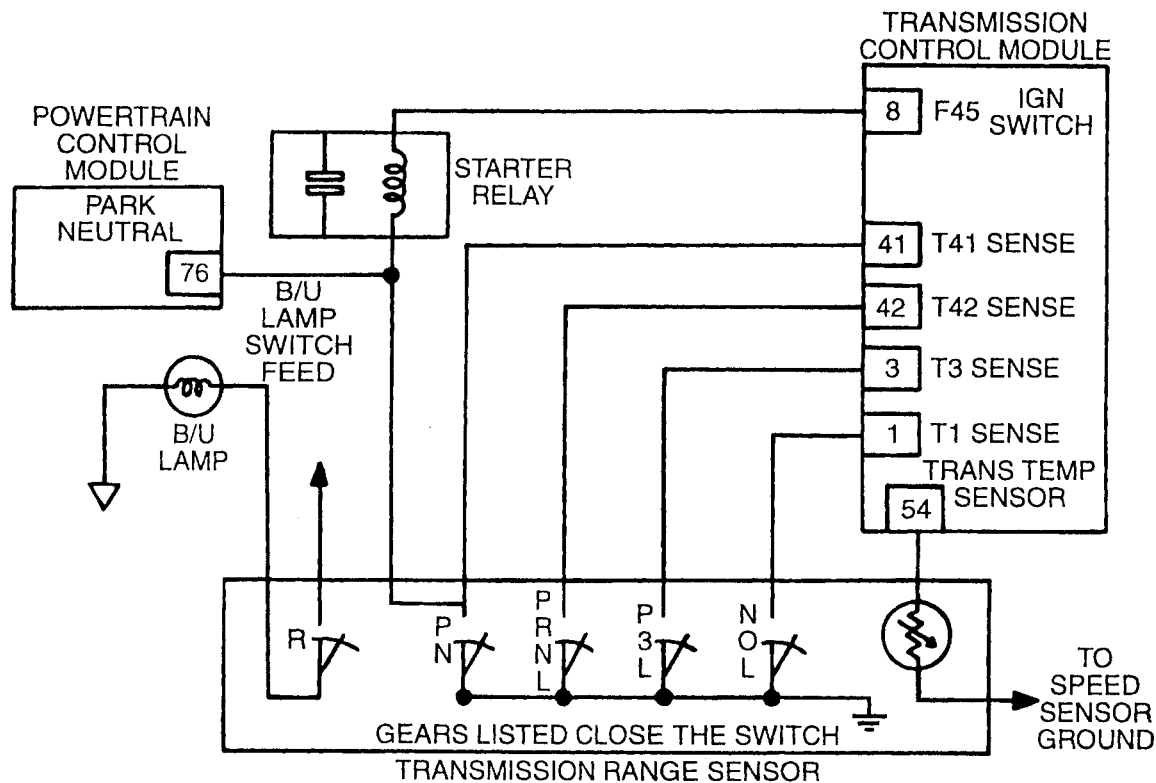
Terminal	Function
1	F20 — Fused power input to power the backup lights
2	Not used
3	T13 — Thermistor ground
4	T54 — Thermistor sensor signal
5	T41 — Park/neutral ground for the starter solenoid
6	L1 — Power signal to operate the backup lights
7	T1 (C4 switch) — Range sensor position switch, grounded in neutral, overdrive and low
8	T3 (C3 switch) — Range sensor position switch, grounded in park, manual 3 and low
9	T42 (C2 switch) — Range sensor position switch, grounded in park, reverse, neutral and low
10	T41 (C1 switch) — Range sensor position switch, grounded in park and neutral

Continued...

Transmission Range Sensor (continued)

System Description and Operation (continued)

Here's a schematic of the transmission range sensor, and a chart that indicates the switch status in each gear range:



Selector Position		T41 (C1)	T42 (C2)	T3 (C3)	T1 (C4)
P	P				
R	R				
N	N				
OD	D				
3	2				
L	1				

 Switch Closed

Solenoid Switch Valve

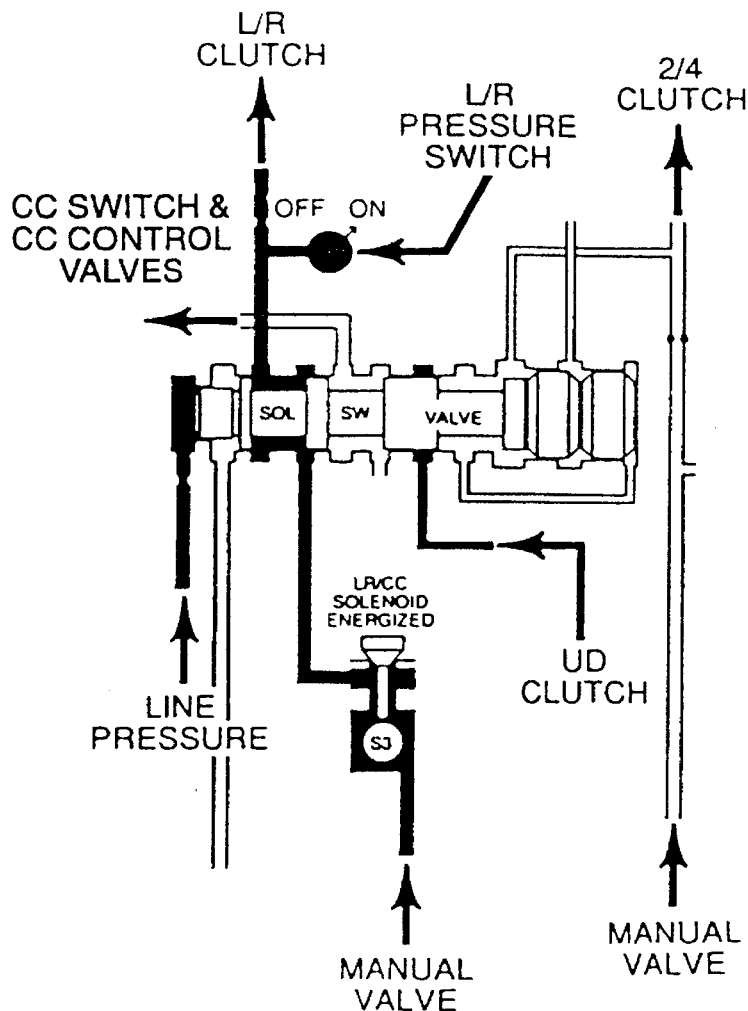
Related Diagnostic Trouble Codes

Code 37	Solenoid switch valve stuck in lockup position
Code 47	Solenoid switch valve stuck in LR position

System Description and Operation

Solenoid S3 has two completely different functions in operating the 41TE transaxle: In reverse and first gears, energizing solenoid S3 applies the low/reverse clutch pack. But after the 1 – 2 shift, the S3 solenoid controls the converter clutch apply circuit. Here's how the same solenoid can be used to control two completely different circuits:

41TEs have a solenoid switch valve, that diverts apply oil, depending on the transmission gear range. In first or reverse, the solenoid switch valve provides a clear path between the S3 solenoid and the low/reverse clutch.



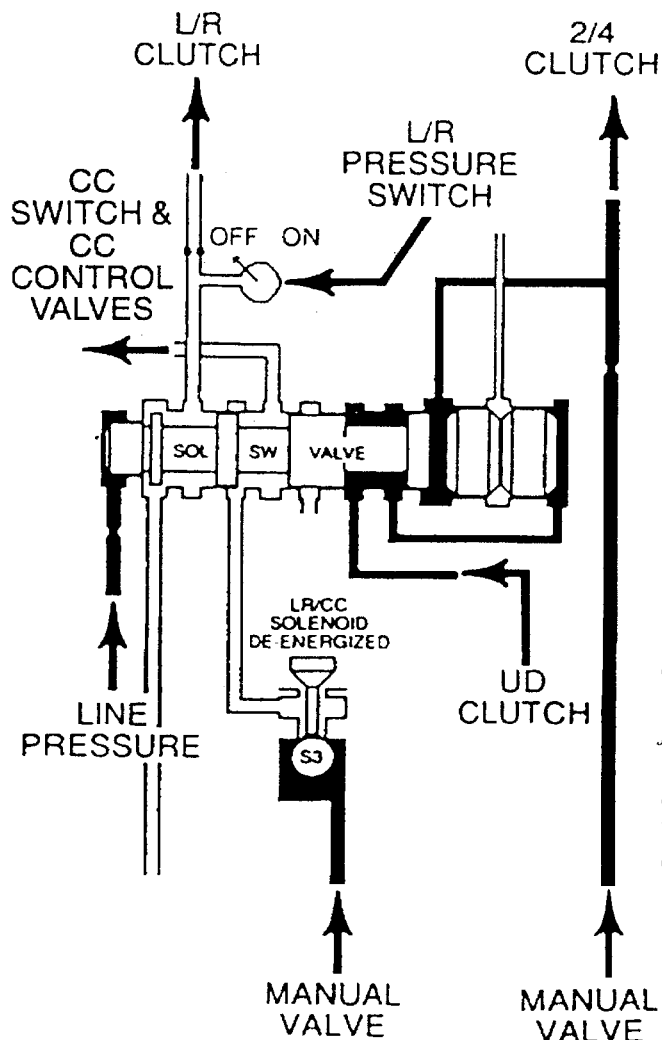
With the solenoid switch valve in the low/reverse position, it provides a clear path between the S3 solenoid and the low/reverse clutch.

But once the 2/4 clutch applies, 2/4 apply oil strokes the solenoid switch valve. This redirects the path of oil from the S3 solenoid to the converter clutch apply circuit. Now energizing the S3 solenoid supplies oil to apply the converter clutch.

Continued...

Solenoid Switch Valve (continued)

System Description and Operation (continued)



When the 2/4 clutch applies, 2/4 apply oil strokes the solenoid switch valve, which redirects the path of oil from the S3 solenoid to the converter clutch apply circuit. Energizing the S3 solenoid with the solenoid switch valve in this position supplies oil to apply the converter clutch.

Once the solenoid shift valve strokes, either 2/4 apply oil, underdrive apply oil, or overdrive apply oil will hold it in this shifted position. The valve won't release until the underdrive solenoid comes on for a second, to relieve pressure to the solenoid shift valve. This allows line pressure to shift the solenoid shift valve back into its original position.

If the solenoid shift valve sticks in the low/reverse position, it will keep the passage open to the low/reverse clutch pack. This can cause a bindup when the unit attempts to upshift, and will set a code 47.

A second, more common problem is if the valve sticks in the lockup position. This prevents the unit from downshifting into first gear — it actually downshifts into neutral. Then the unit goes into failsafe (limp-in) mode, and operates in second gear. The computer sets code 37, and disables converter clutch operation.

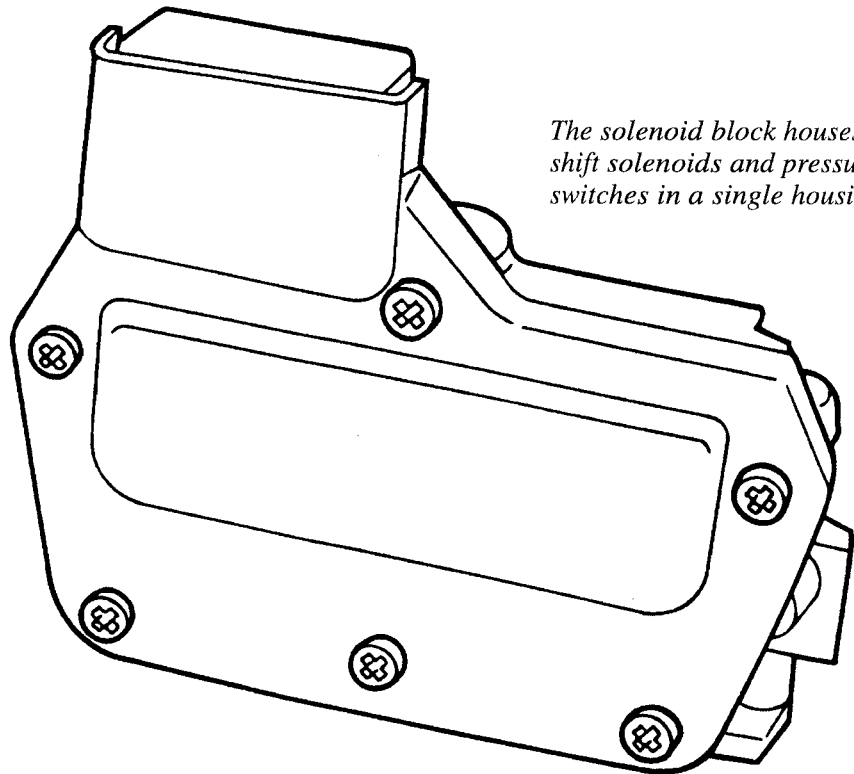
This problem can be due to a sticking valve, but is more likely caused by the underdrive circuit failing to vent, keeping the valve shifted. Putting the unit into reverse raises line pressure, which can overcome the residual oil. This forces the solenoid shift valve to downshift temporarily, so the unit will operate in reverse, and may even go into first gear the first time you shift back into OD.

Shift Solenoids

Related Diagnostic Trouble Codes

Code 41	LR solenoid circuit is either open or shorted
Code 42	24 solenoid circuit is either open or shorted
Code 43	OD solenoid circuit is either open or shorted
Code 44	UD solenoid circuit is either open or shorted

System Description and Operation



The solenoid block houses the shift solenoids and pressure switches in a single housing.

The 41TE uses four solenoids to control transaxle operation. The computer tests these solenoid circuits roughly every ten seconds, and immediately after a gear ratio error or pressure switch error sets a code. This test enables the computer to determine whether there's a problem in any of the solenoid circuits. Here's how the computer tests these circuits:

Whenever an electrical solenoid turns off, it develops a spike as the magnetic field breaks down. This process is similar to the way the ignition coil develops a spark to run the engine.

The voltage of the spike is based directly on the condition of the circuit. If the solenoid windings are shorted, or there's a loose ground in the circuit, the spike will be lower.

To test the solenoid circuits, the computer turns the solenoids off, and measures the voltage spike. If the spike doesn't reach a predetermined voltage level, the computer determines there's a problem in the circuit, and sets a diagnostic trouble code for that circuit.

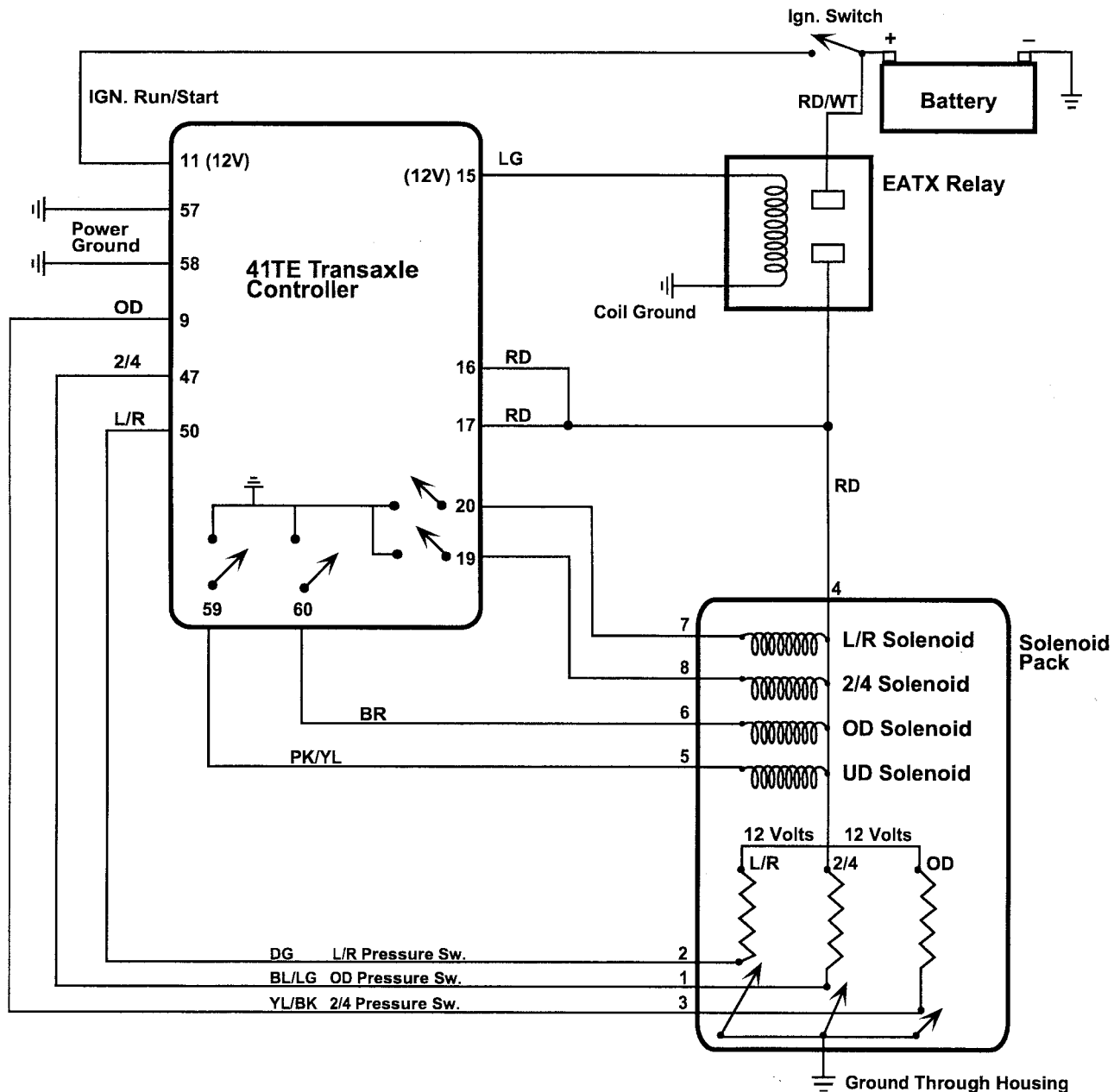
Continued...

Shift Solenoids (continued)

System Description and Operation (continued)

The important point here is that the problem isn't necessarily due to a damaged or worn out solenoid. Remember, these are electrical circuits: Problems anywhere in the circuit will affect the voltage spike, and cause a code to set. Electrical circuit problems that will set a solenoid code include:

- Low battery voltage
- Loose electrical connections
- Bad ground for the solenoid circuits



The computer will set a code after three failed continuity tests, or after one failed test that occurs immediately after a pressure switch or gear ratio problem.

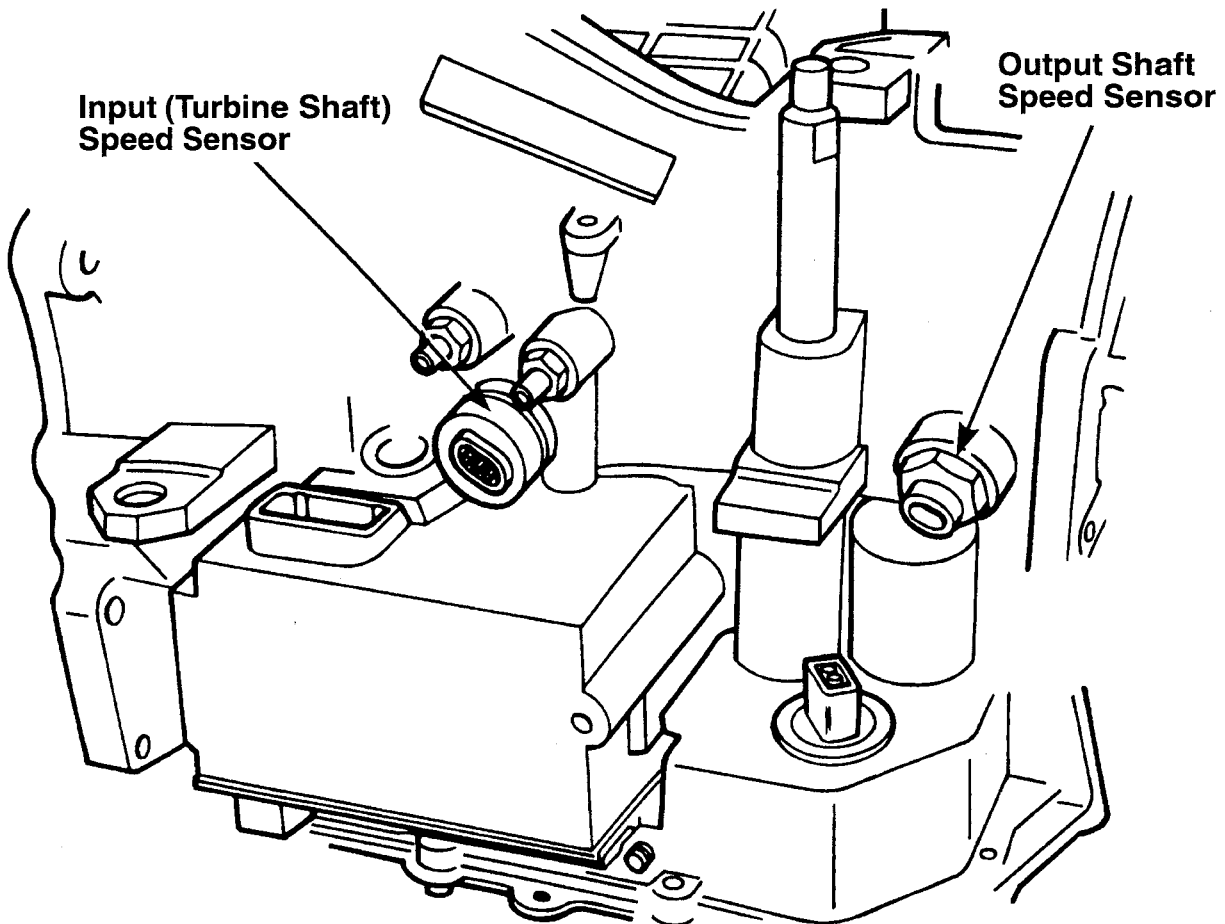
Gear Ratio Errors

Related Diagnostic Trouble Codes

Code 39	Gear ratio error (pre-1991 only)
Code 50	Gear ratio error in reverse
Code 51	Gear ratio error in 1 st gear
Code 52	Gear ratio error in 2 nd gear
Code 53	Gear ratio error in 3 rd gear
Code 54	Gear ratio error in 4 th gear
Code 56	Turbine shaft sensor error
Code 57	Output shaft sensor error
Code 58	Sensor ground is loose or damaged

System Description and Operation

Whenever a 41TE is on the road, it's constantly comparing the signals from the two speed sensors, to monitor gear ratios. If at any time during normal operation, the ratio the computer calculates doesn't match the gear ratio it's signaled, the computer sets a gear ratio error code.



Continued...

Gear Ratio Errors (continued)

System Description and Operation (continued)

If the computer notices a major change in the signal from one of the sensors while it's operating, it sets a code for that individual sensor.

Before 1991, there was only one code available to indicate a problem in these sensors: code 39. If you experience a code 39, it's important to find out as much as possible about the transaxle's operating conditions that occurred right before the unit went into limp-in mode. Those conditions are the only clues you have to identify the specific cause of the failure, and the source of the code.

But on 1991-and-later models, the computer sets a specific code for the gear range or sensor involved. This makes isolating and identifying the problem much easier.

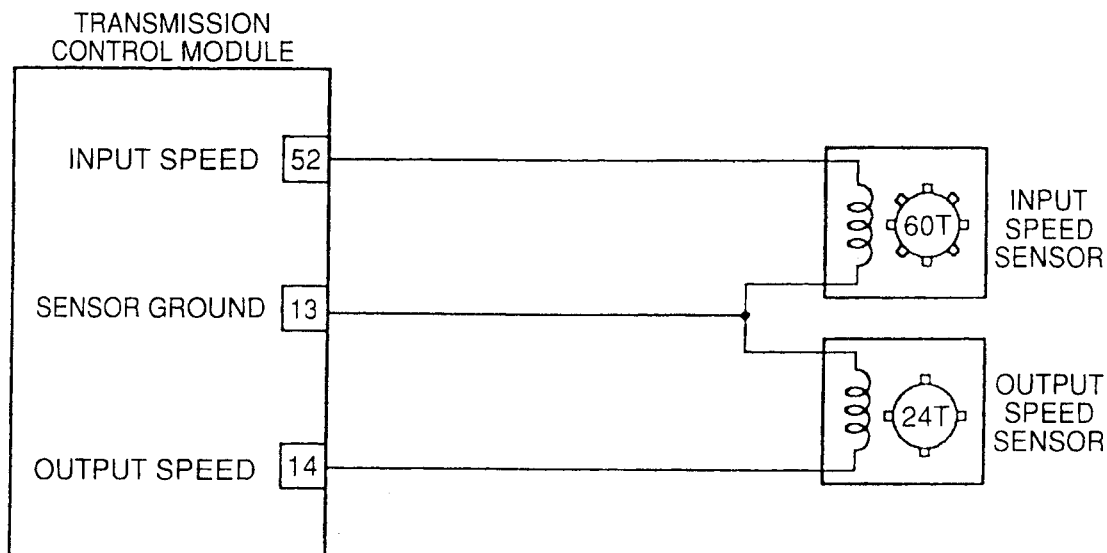
One common cause for gear ratio codes is electrical interference in the sensor circuits. Electromagnetic interference (EMI) often bleeds over from the ignition system, or through a motor circuit.

One easy way to identify this type of electrical "bleed-over" is to check the speed sensor signals with your scan tool, while the vehicle is in gear, and fully stopped. If you see any signal other than zero at either sensor, suspect electrical interference.

Very often, correcting electrical interference is simply a matter of rerouting the wires away from the source the interference. Another way to reduce this interference is to route the wires directly parallel to one another.

If the interference seems to relate to an electric motor, make sure the motor ground is good, and check the motor itself; a bad motor can send electrical interference through the entire electrical system. If the motor and grounds are okay, you may have to look into adding a capacitor to the circuit, to reduce the interference.

Additional sources of gear ratio errors can be caused by a damaged sensor ring, reducing the number of pulses the sensor can develop, or a bad sensor itself.



These are permanent magnet speed sensors: They should have between 300 and 1200 ohms resistance, and should develop a magnetic field around the sensor all the time.

Clutch Volume

Related Diagnostic Trouble Codes

Code 60	LR clutch volume too low
Code 61	24 clutch volume too low
Code 62	OD clutch volume too low
Code 63	UD clutch volume too low

System Description and Operation

41TEs control clutch apply rate and feel by monitoring adjusting the amount of time it takes for each clutch circuit to reach apply pressure. This is called the “clutch volume index,” or CVI. The clutch volume index is based on a scale of 255.

Fill Volume

L/R	Low 0 – 34	Normal 35 – 83	High 84 – 255
2/4	Low 0 – 19	Normal 20 – 77	High 78 – 255
OD	Low 0 – 74	Normal 75 – 150	High 151 – 255
UD	Low 0 – 23	Normal 24 – 70	High 71 – 255

Each clutch circuit has an optimum range for filling: If the clutch pack takes too long, the clutches could be worn or there could be a leak in the circuit.

But if the clutches fill too quickly, it could be caused by a broken clutch return spring, a misplaced snap ring, a leak into the clutch circuit, a warped clutch disk and so on. If the clutch volume appears too low right after a rebuild, chances are that clutch was stacked too tight.

Here's when the computer tests the clutch volume index for each clutch circuit:

- Low/reverse — during a 2 – 1 or 3 – 1 shift, and the transmission fluid is between 70° – 100° F.
- 2/4 — during a 1 – 2 shift, and the transmission fluid is above 80° F.
- OD — during a 2 – 3 shift, and the transmission fluid is above 80° F.
- UD — during a 4 – 3 or 4 – 2 shift, and the transmission fluid is above 80° F.

General Motors

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4L80E Modifications

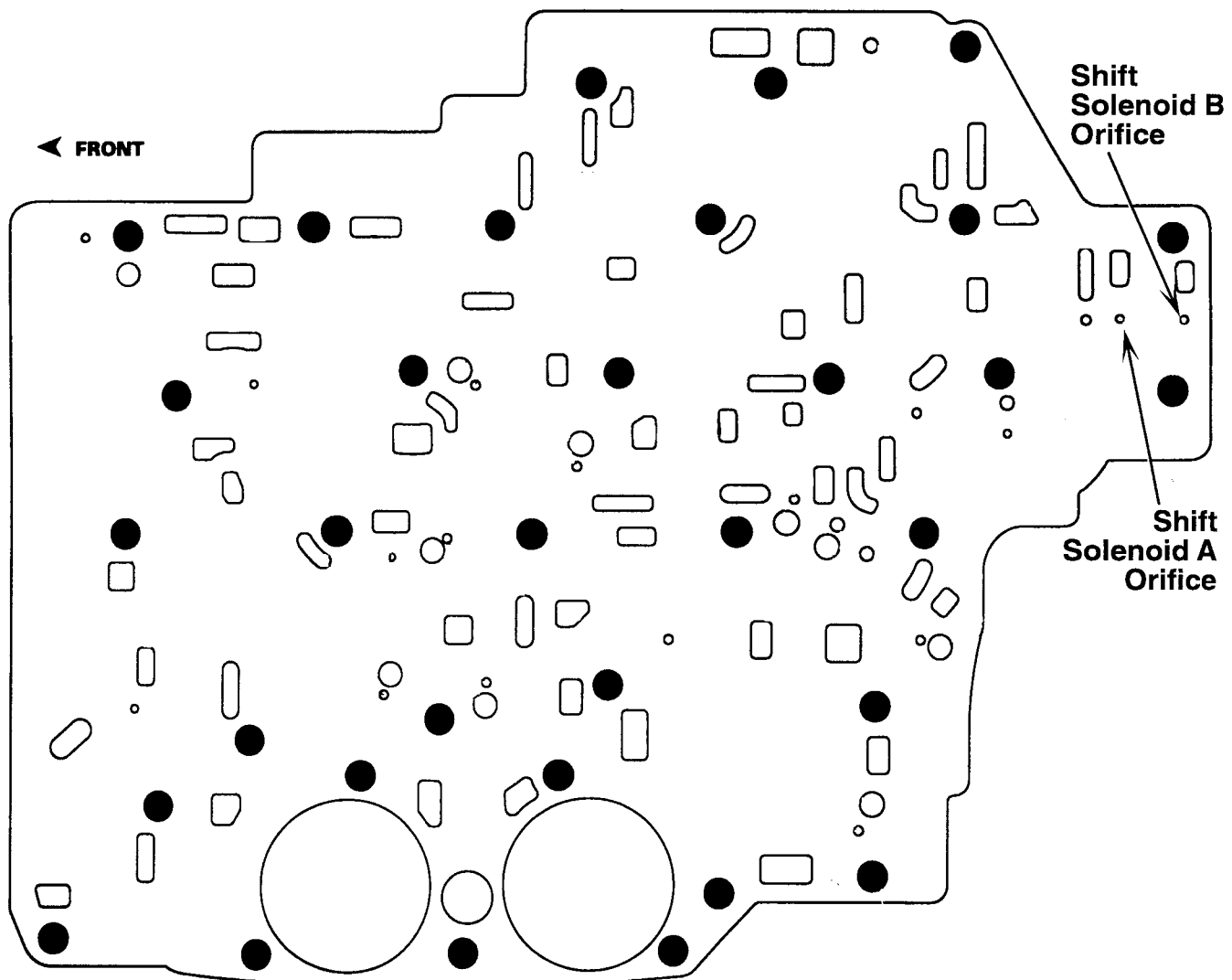
Neutrals on 3 – 4 Shift Wrong Gear Starts Shifts Out of Sequence

A leak in either solenoid circuit can cause a 4L80E to experience any of these problems:

- Shifts into neutral on the 3 – 4 shift.
- Wrong gear starts
- Shifts out of sequence

To correct these problems, look for signs of leaks in the solenoid circuits, such as a damaged solenoid O-ring or a solenoid that isn't closing all the way. Correcting that condition should take care of the shift problem.

But whether you find the problem or not, a good rebuild procedure is to drill both solenoid orifices to 0.035" – 0.040"; do this during every rebuild or valve body service.



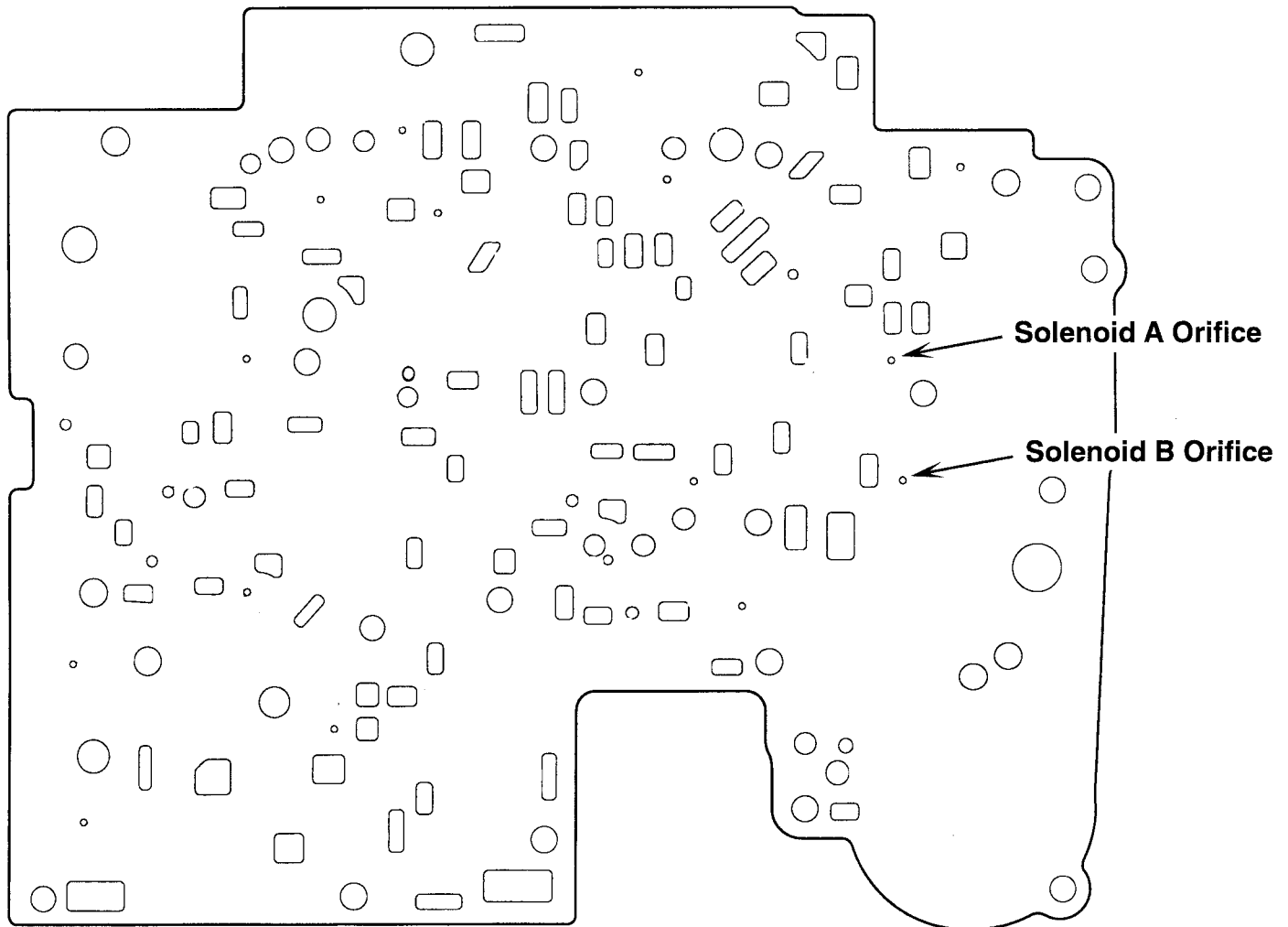
4L60E Modifications

No 4th Gear Wrong Gear Starts Shifts Out of Sequence

Leaks in the shift solenoids or low solenoid feed oil can cause any or all of these problems:

- No 4th gear
- Wrong gear starts
- Shifts out of sequence

To combat these problems, always drill the solenoid feed holes in the separator plate to between 0.035" – 0.040" during every rebuild or valve body service.



4L60E Valve Body Interchange

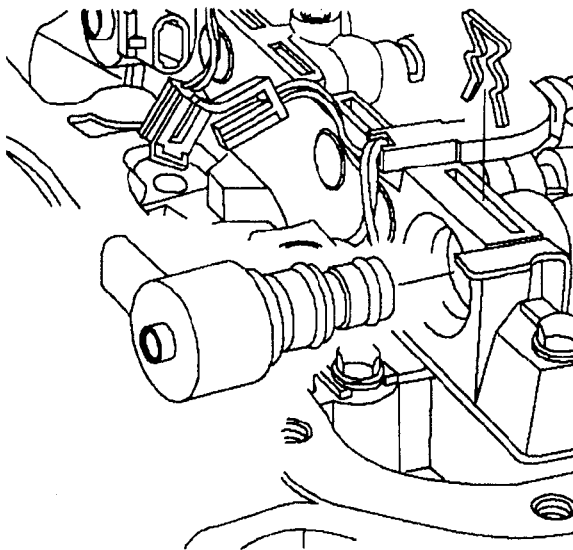
In 1993 and 94, the 4L60E controlled lockup with a simple on/off solenoid. In 1995, GM added a pulse width modulated solenoid, to control TCC apply. While there are slight differences in these valve bodies, they are interchangeable, provided you remember one basic rule: Always keep the separator plate that came with the transmission.

For example, to use a 1995 valve body on a 1993 or 94 transmission, always use the original separator plate. Then you can remove the solenoid (or not; it doesn't really matter), and install the valve body on the transmission.

To install a 1993 or 94 valve body on a 1995 transmission, again, keep the original separator plate, and install a PWM solenoid on the valve body. Use the original wiring to connect the solenoid, and you're in business.

IMPORTANT: Some early 1993 valve bodies won't have a machined bore to accomodate the PWM solenoid. If not, you can't use that valve body in a 1995 transmission.

You can identify which separator plate you have by the holes identified in the graphic. The extra holes provide a passage for the solenoid to work.

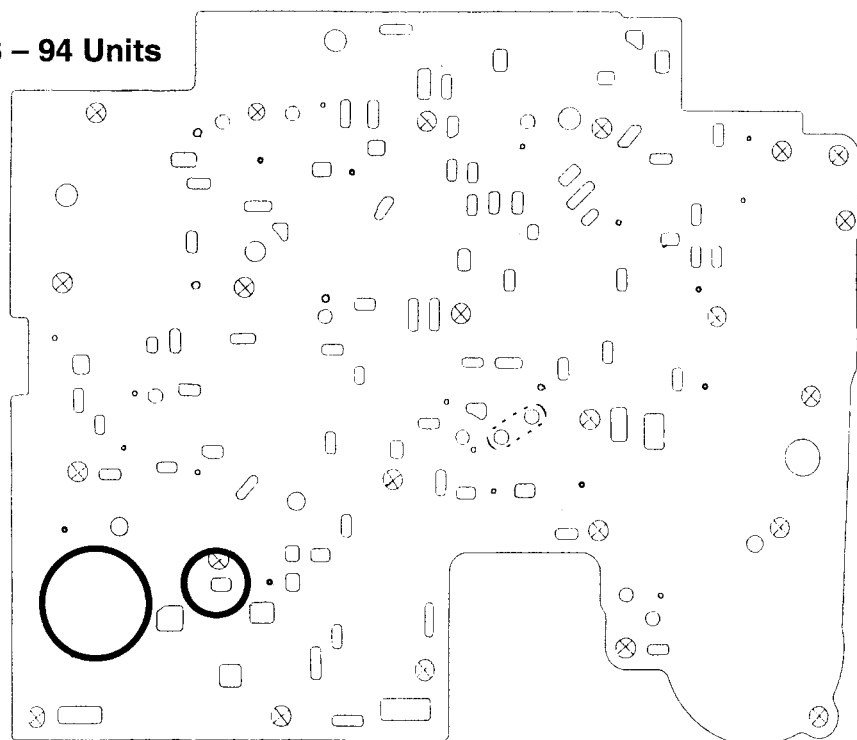


To use a 1993 or 94 valve body in a 1995 vehicle, you must install a PWM solenoid in the valve body. But for the solenoid to provide oil pressure in the proper locations, you must use the separator plate that came with the transmission.

Continued...

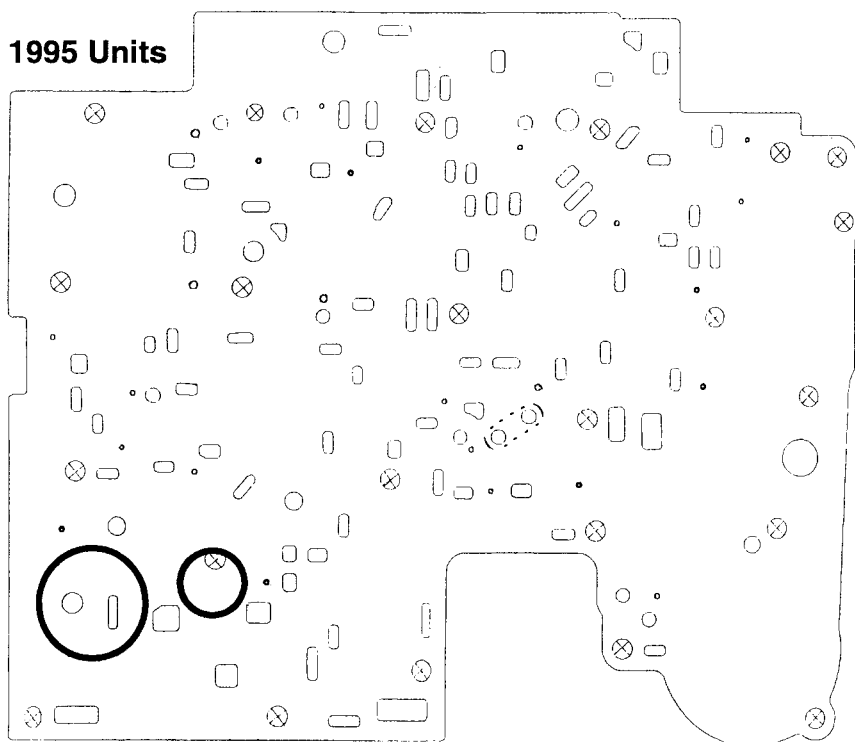
4L60E Valve Body Interchange (cont)

1993 – 94 Units



The early design separator plate bypassed the PWM circuit in the valve body.

1995 Units



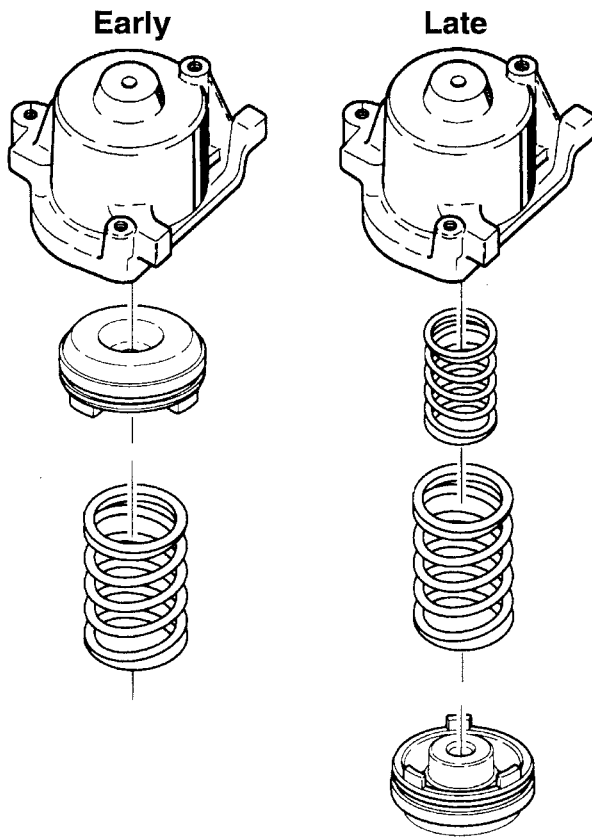
Later separator plates had these holes changed to allow fluid to reach the PWM solenoid.

4L60E with Harsh 1 – 2 Shift

In 1994 GM changed the configuration of the 1 – 2 and 3 – 4 accumulators. Now, instead of a spring between the accumulator piston and the separator plate, these units use two springs... on the opposite side of the accumulator.

If you have a late accumulator, installing the piston first, then the spring (using the early configuration) will cause a harsh 1 – 2 shift.

The chart provides a listing of the springs used in each vehicle, by color.



1 – 2 Accumulator Springs

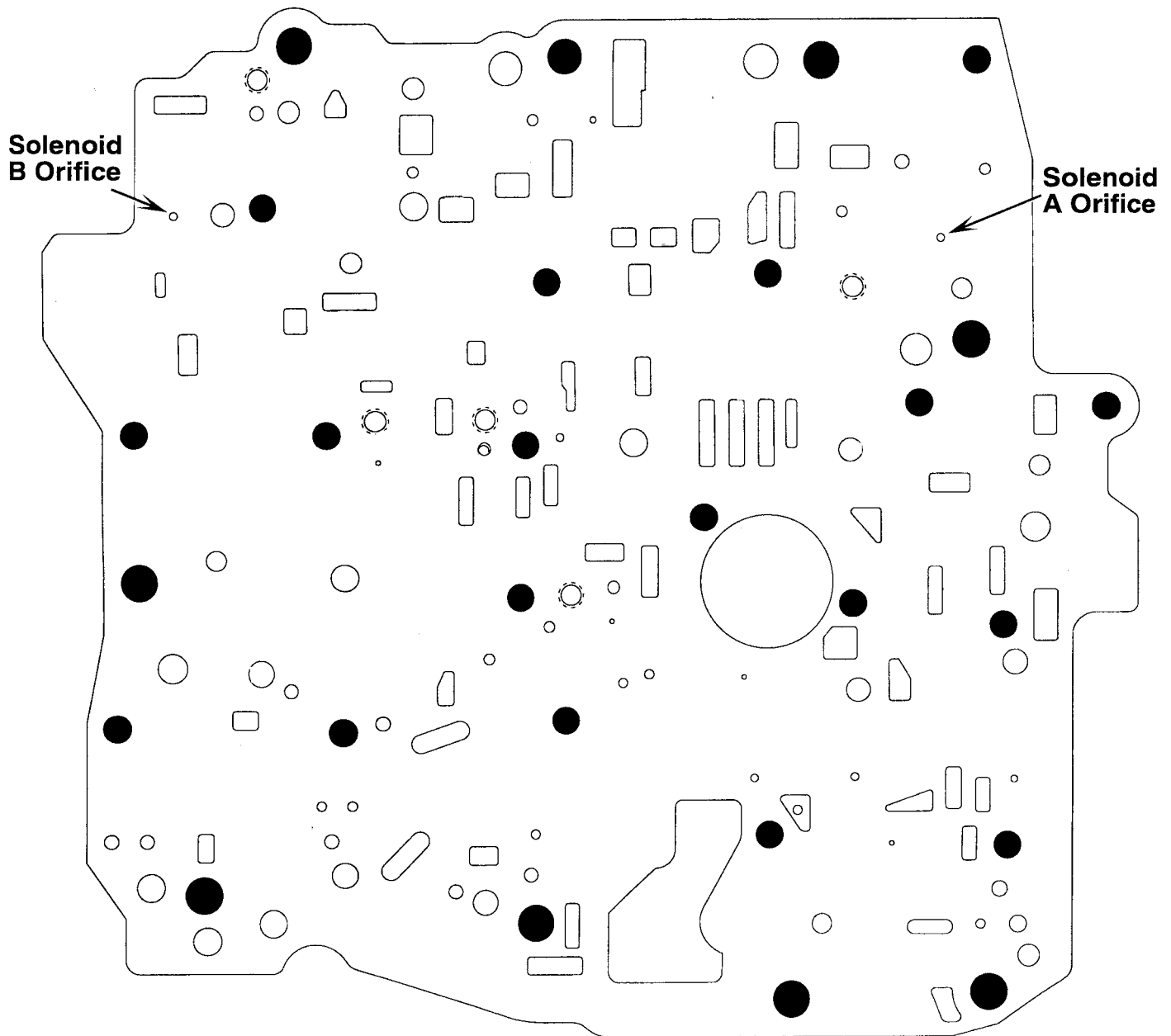
1994 Transmission	Inner Spring	Outer Spring
CA, CB, CH, CJ, CP, FD, KA, KC, MD, MJ, MN, MS, SF, SH, TA, TB, TL, TW	Natural	Yellow
CC, CF, CM, CU, KB, KP	Pink	Yellow
HD, SA	Natural	Violet
HB	White	Violet
BB, BC	Orange	Violet
AH, BF, BW	Orange	Yellow
FF, YD	White	Dark Green

4T60E 2nd Gear Starts; Shifts 1 – 3

Leaks in the shift solenoids or low solenoid feed oil can cause either of these problems in a 4T60E:

- 2nd gear starts
- 1 – 3 shifts

To combat these problems, always drill the solenoid feed holes in the separator plate to between 0.035" – 0.040" during every rebuild or valve body service.

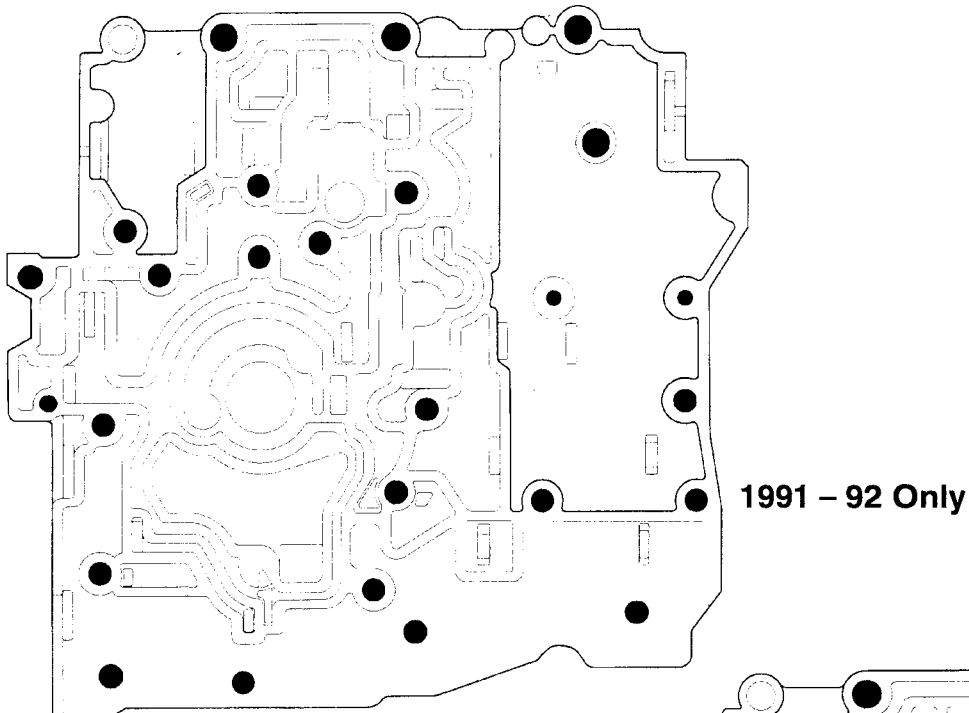


4T60E Casting Changes

There were a number of changes to the valve body, pump body and channel casting for 1993-and-later 4T60E transaxles. These components can be interchanged from one unit to another, but only as a complete assembly.

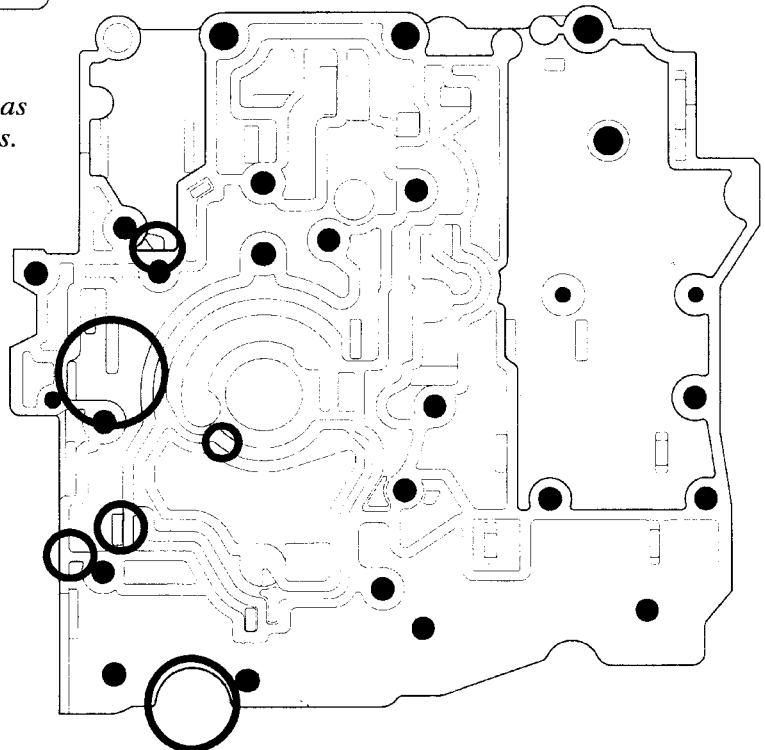
Use the drawings on the next few pages to identify the castings you're working with.

Valve Body Pump



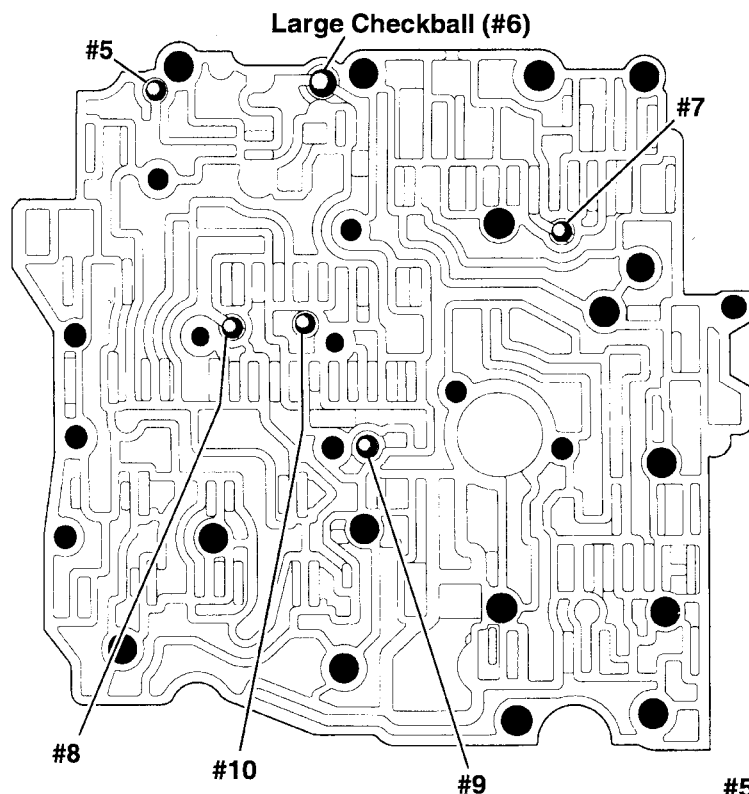
The circles indicate the areas that changed in the castings.

1993-on



4T60E Casting Changes (continued)

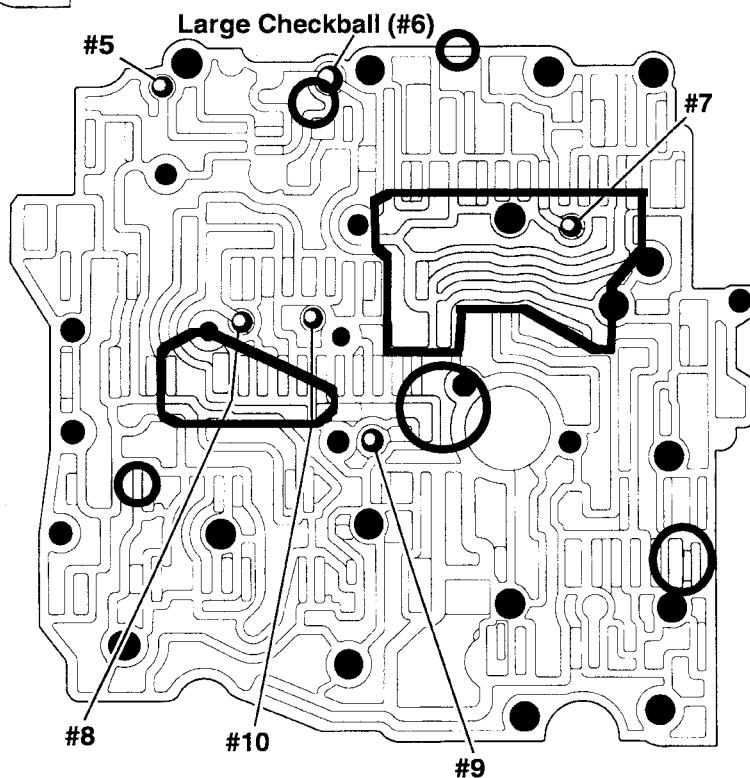
Valve Body (Channel Plate Side)



1991 – 92 Only

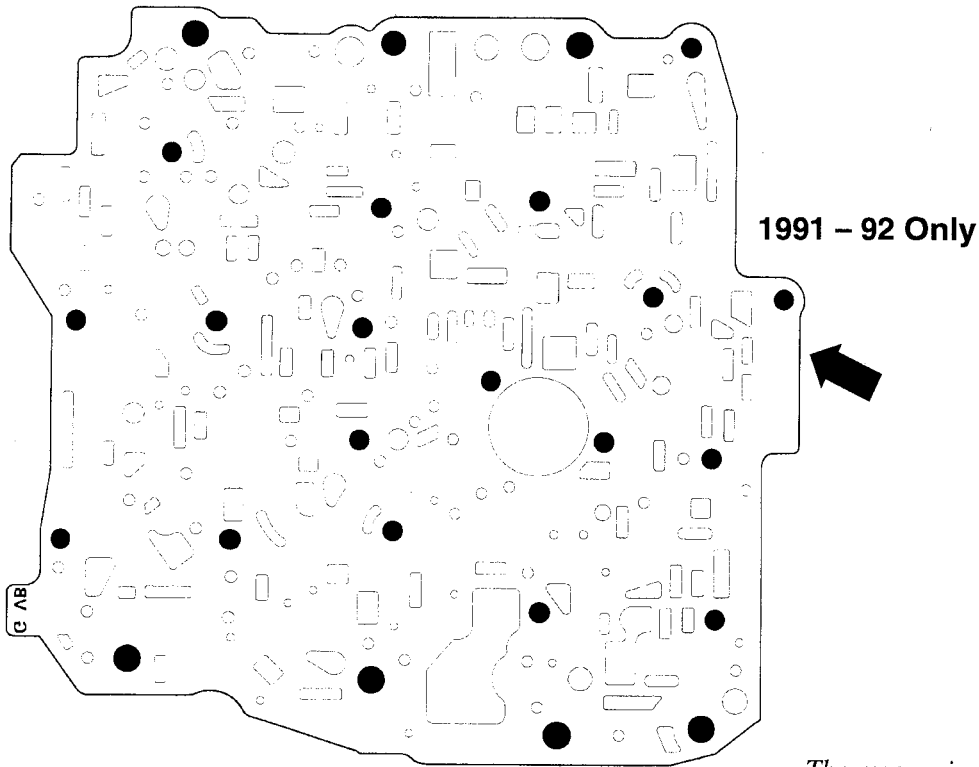
The circles and dark boxes indicate the areas that changed in the castings.

1993-on

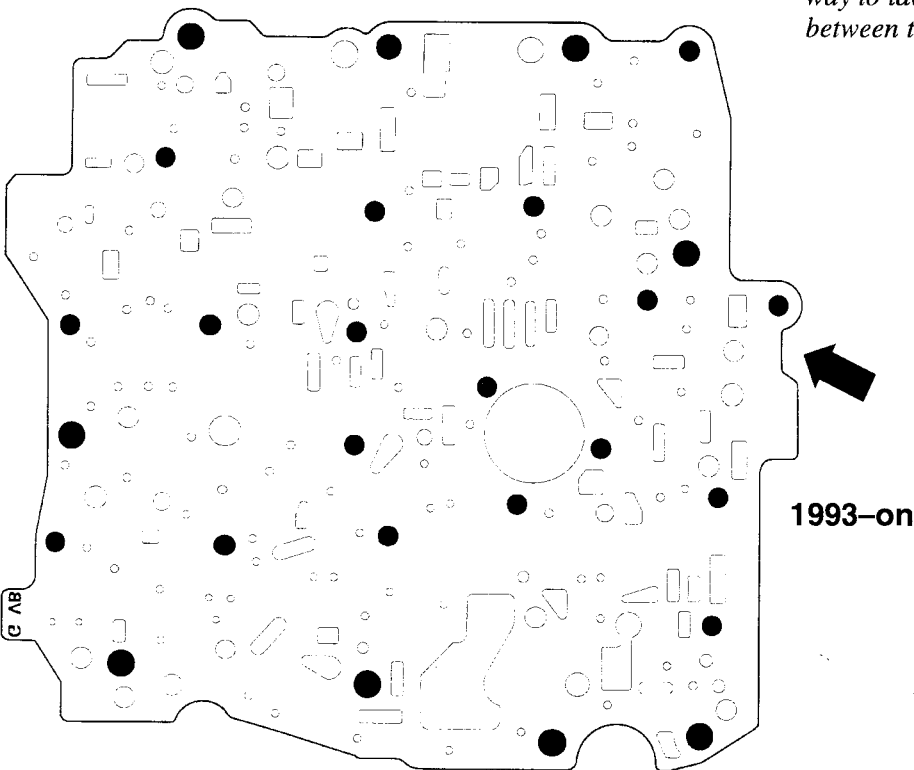


4T60E Casting Changes (continued)

Gasket (Valve Body-to-Separator Plate)

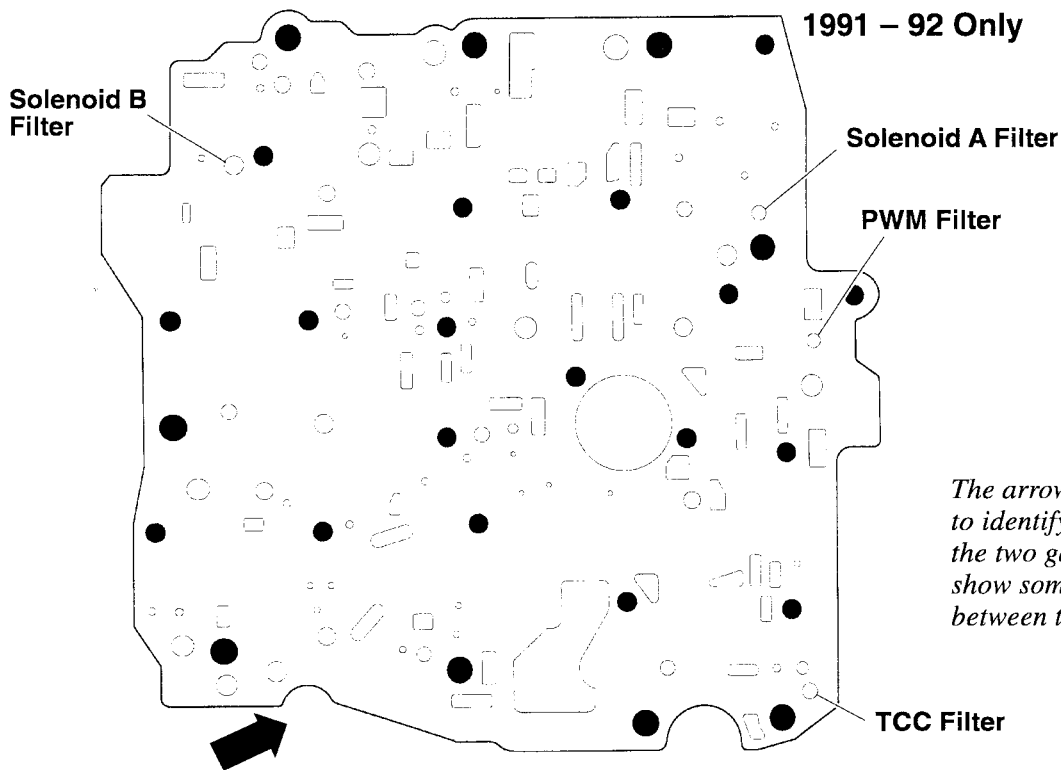


The arrows indicate an easy way to identify the difference between the two gaskets.

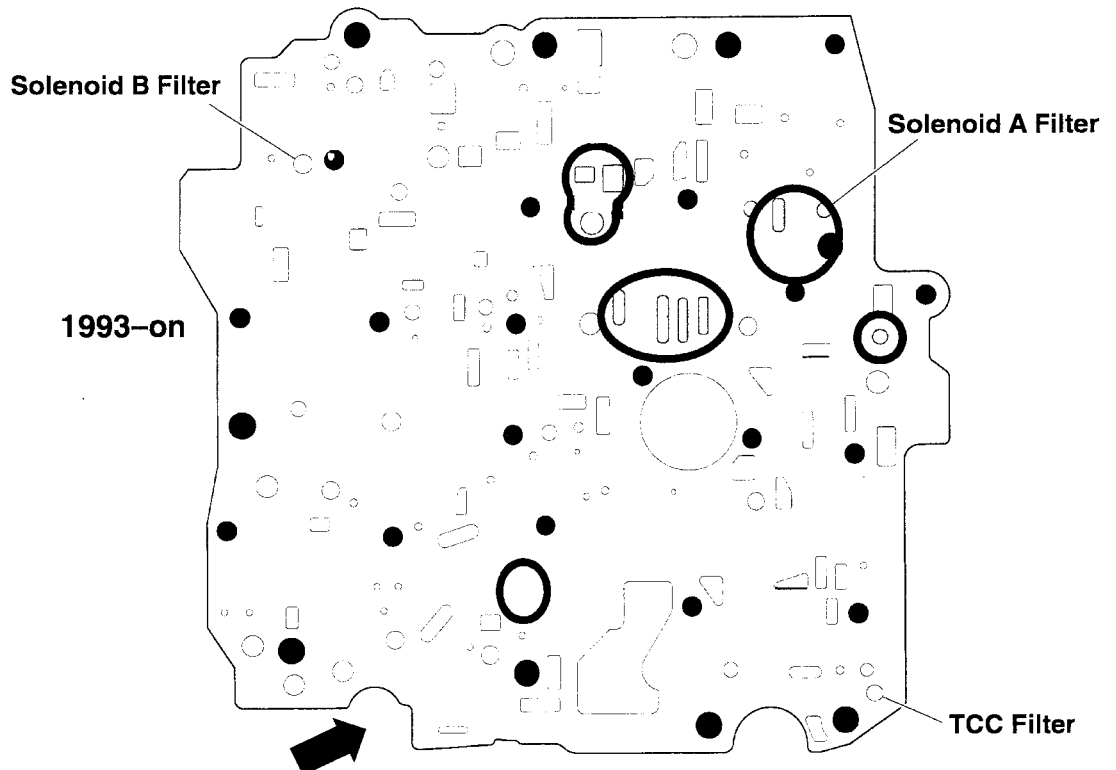


4T60E Casting Changes (continued)

Separator Plate

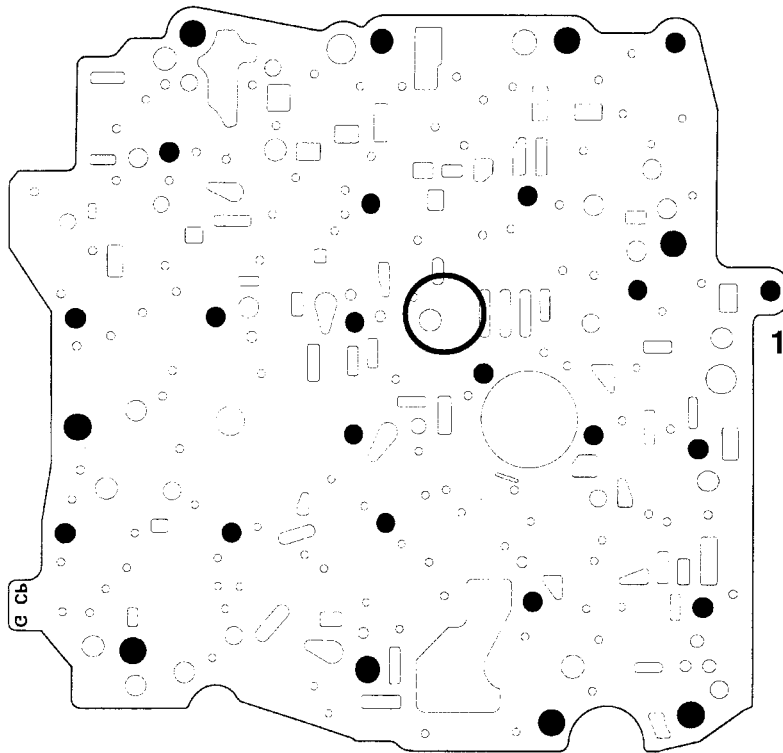


The arrows indicate an easy way to identify the difference between the two gaskets. The dark circles show some of the differences between the two plates.

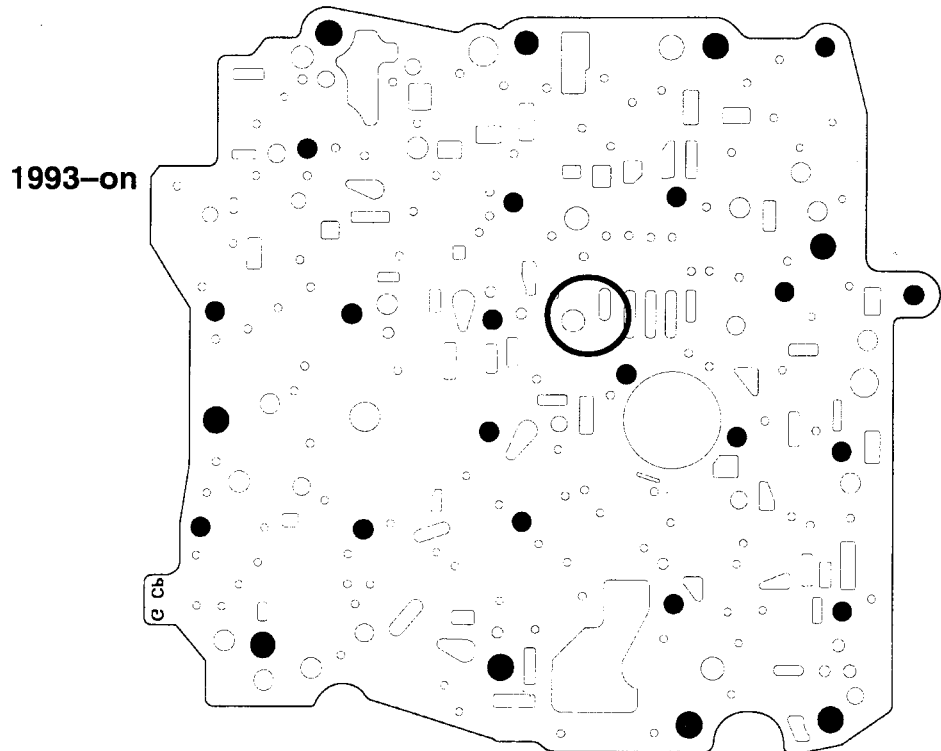


4T60E Casting Changes (continued)

Gasket (Separator Plate-to-Channel Plate)



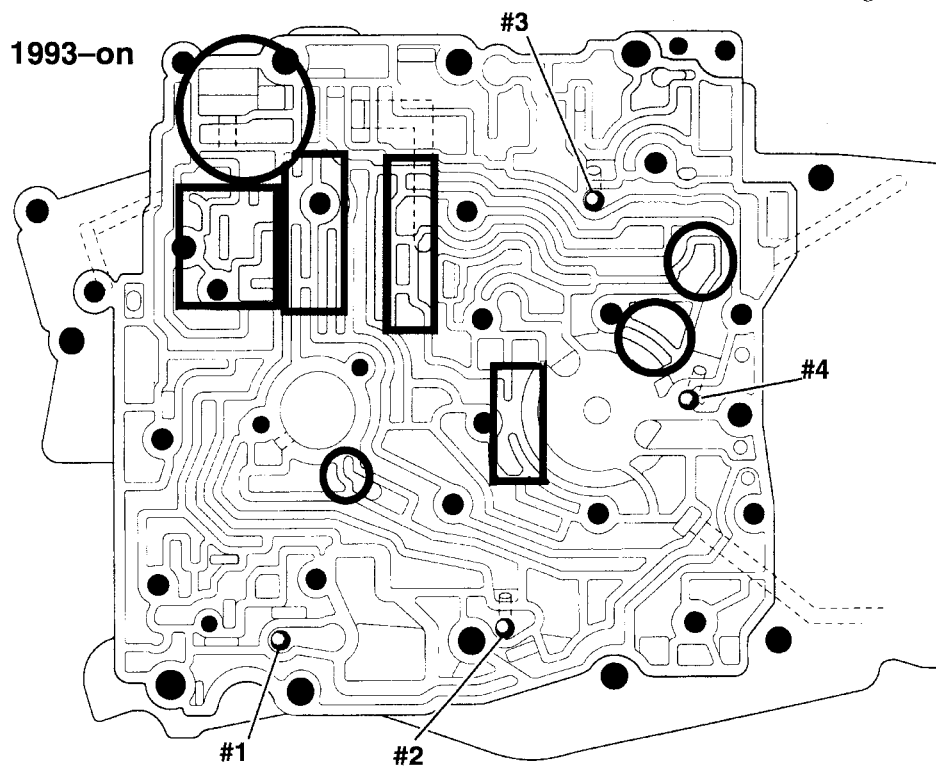
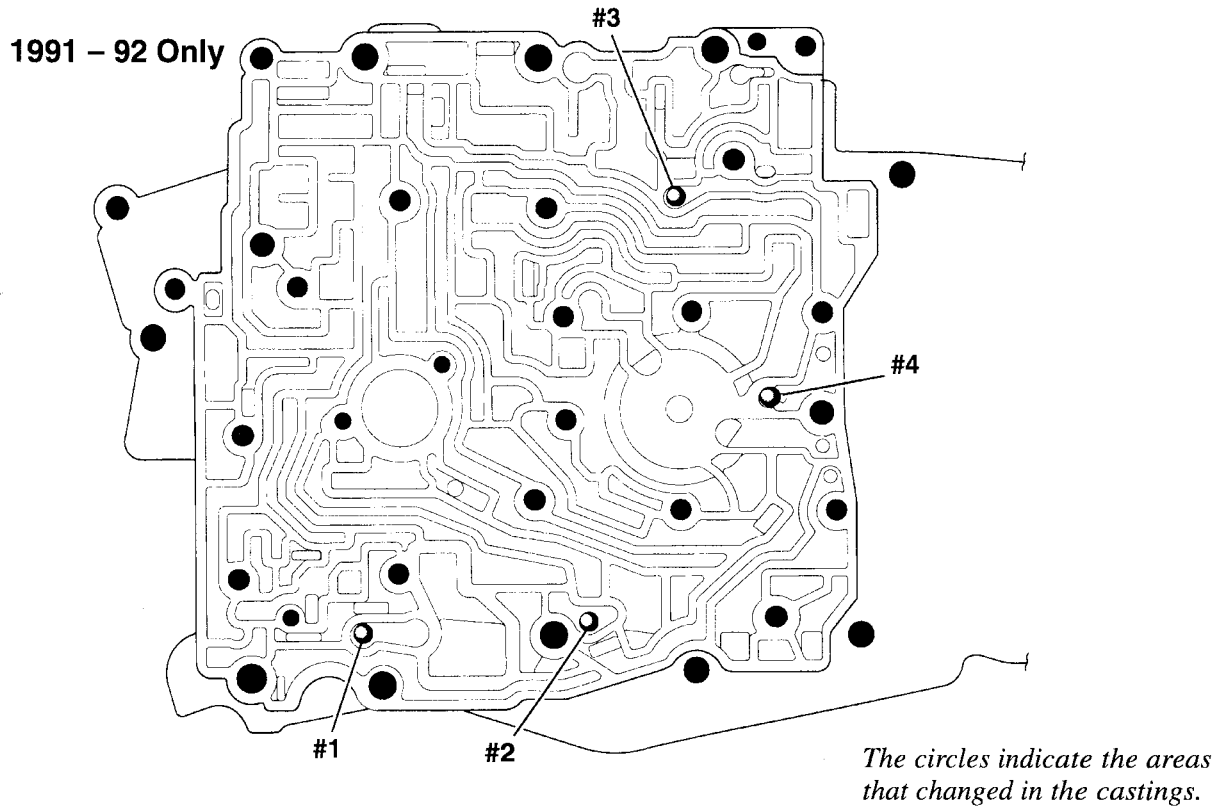
1991 - 92 Only



1993-on

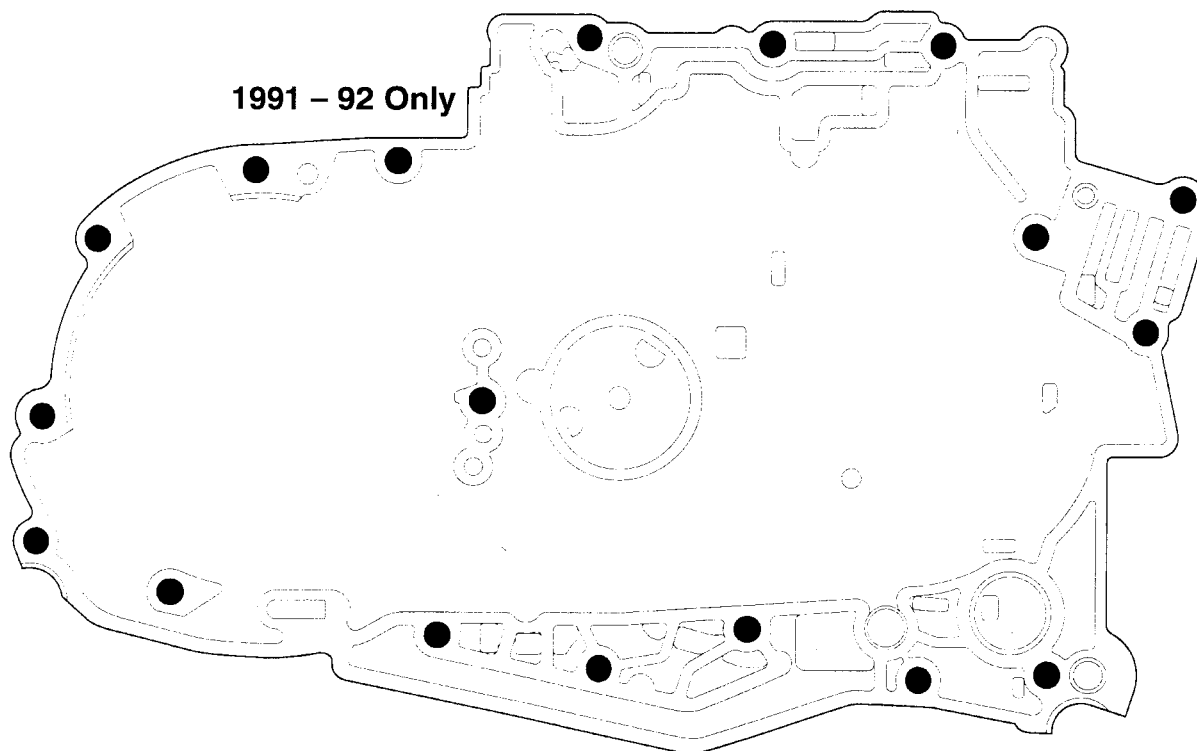
4T60E Casting Changes (continued)

Channel Plate (Valve Body Side)

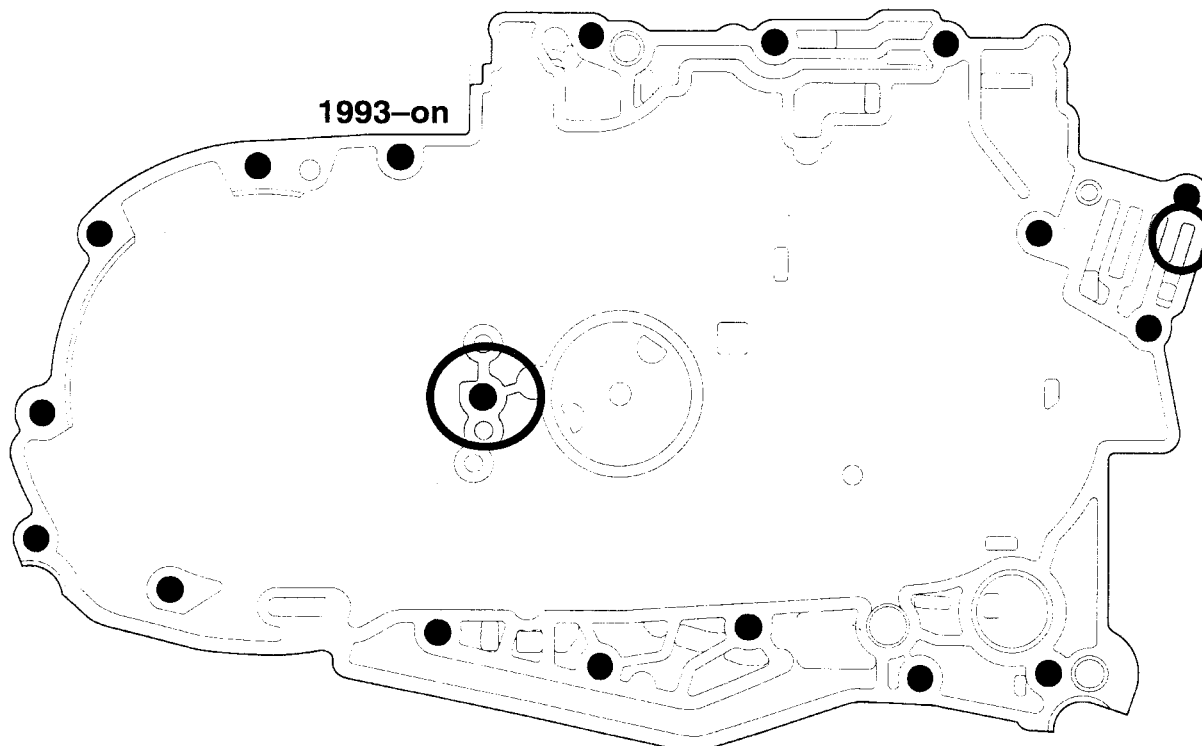


4T60E Casting Changes (continued)

Channel Plate (Case Side)



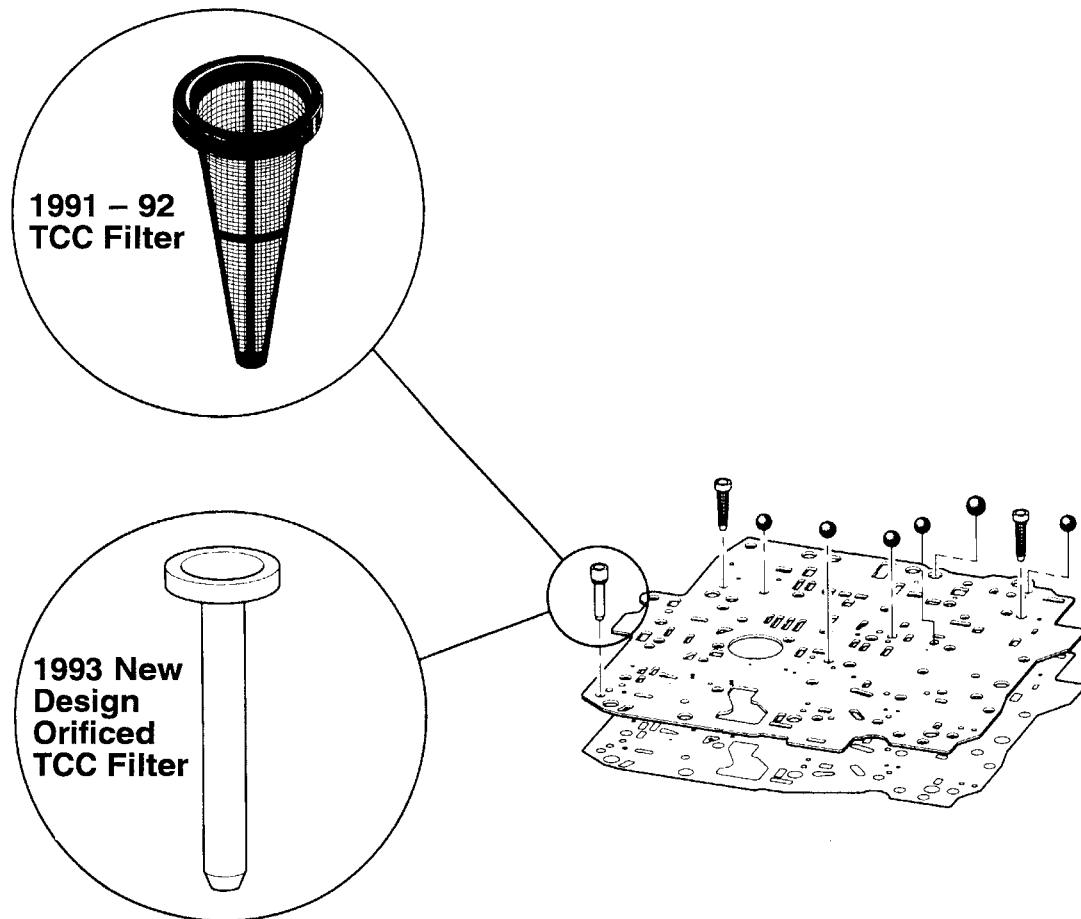
The circles indicate the areas that changed in the castings.



4T60E Locks Up On 1 – 2 Shift

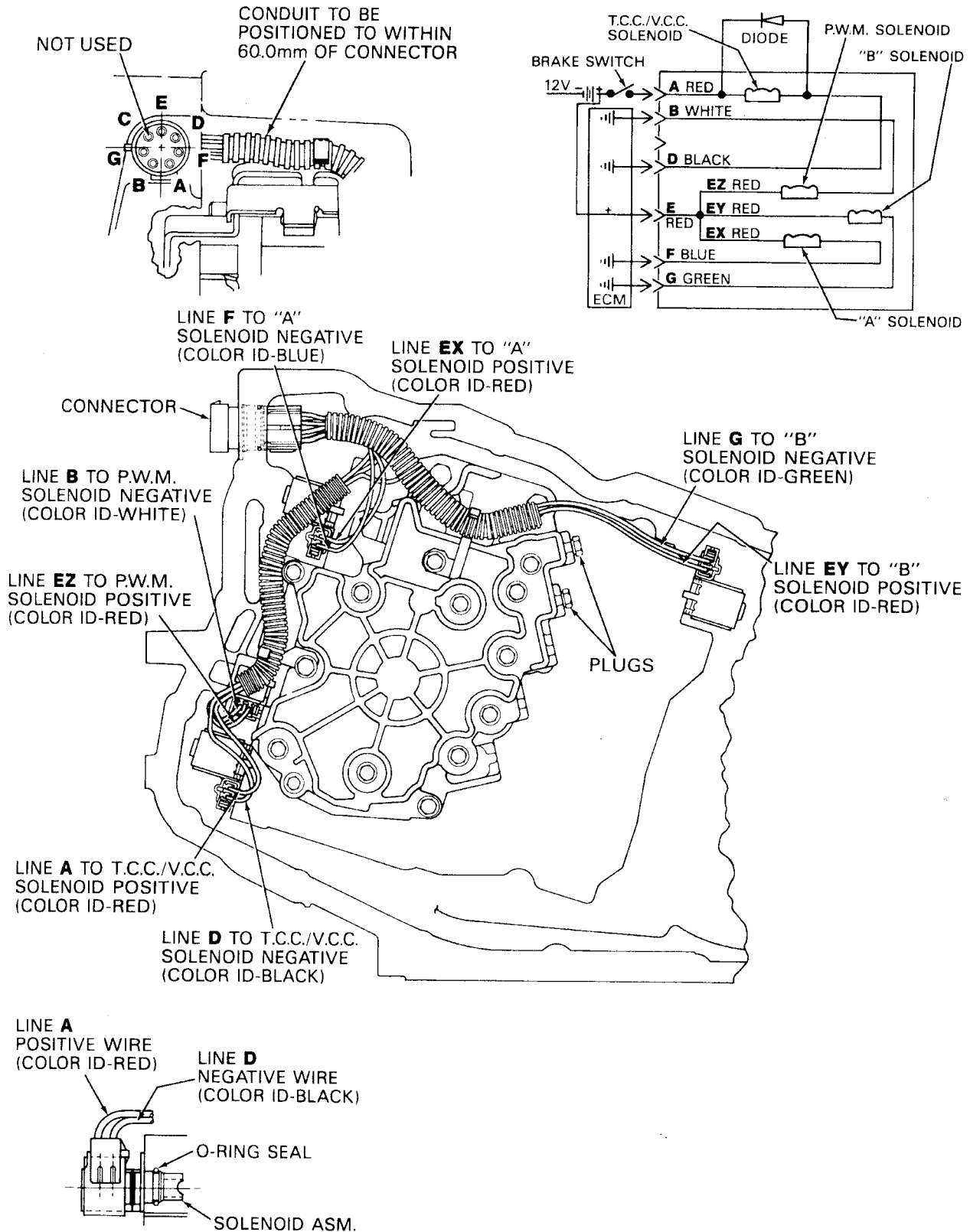
In 1993, the TCC screen began including a feed orifice. If you forget this screen, or use an earlier-design screen, the converter clutch will lock up right on top of the 1 – 2 shift, and won't release until the unit downshifts into 1st gear.

- Screen w/Orifice – 8658060
- O-Ring – 8658109



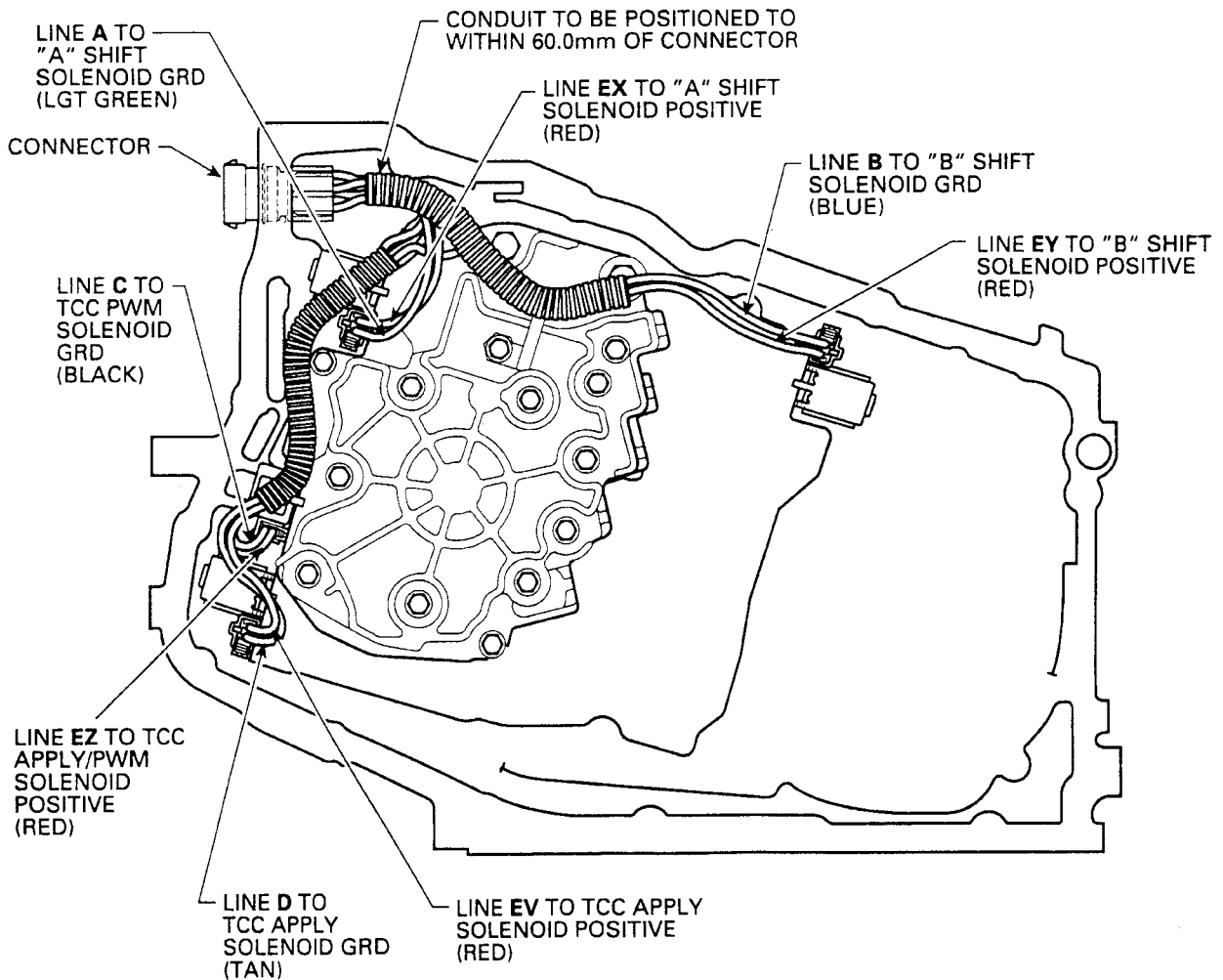
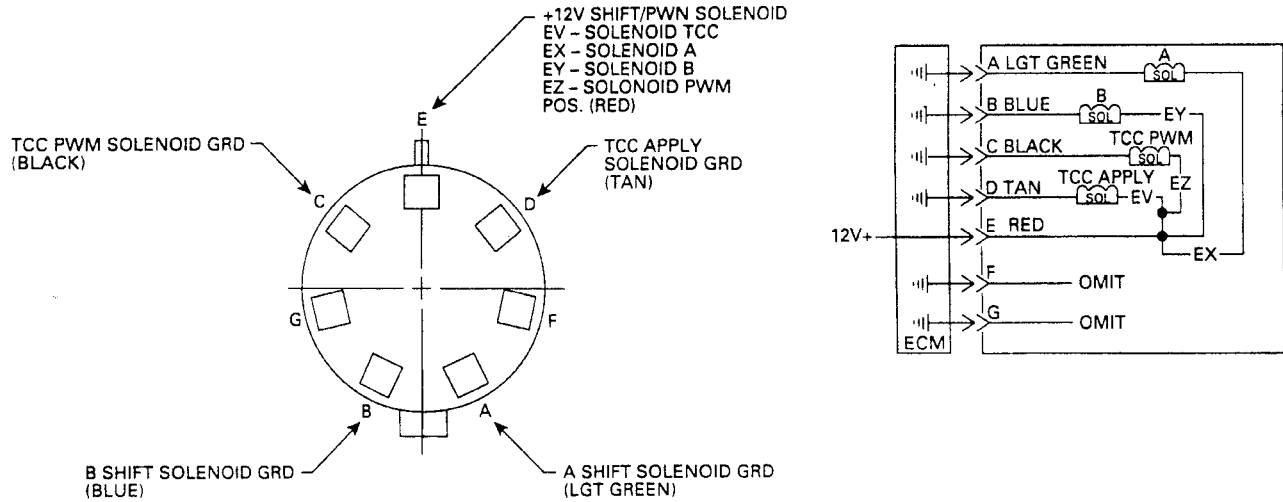
4T60E Wiring Changes

1991 – 93; No Switches



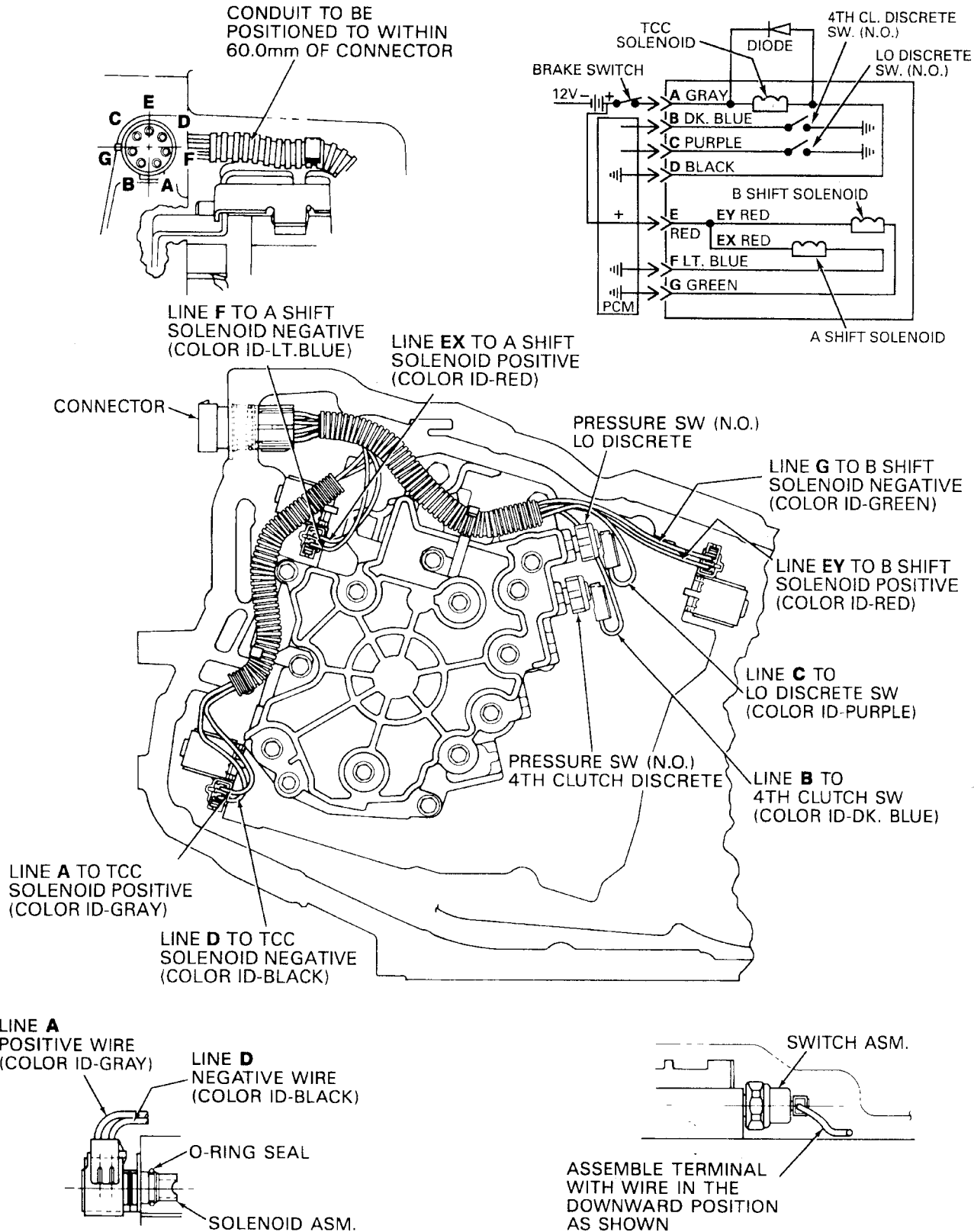
4T60E Wiring Changes (cont)

1994-on; No Switches



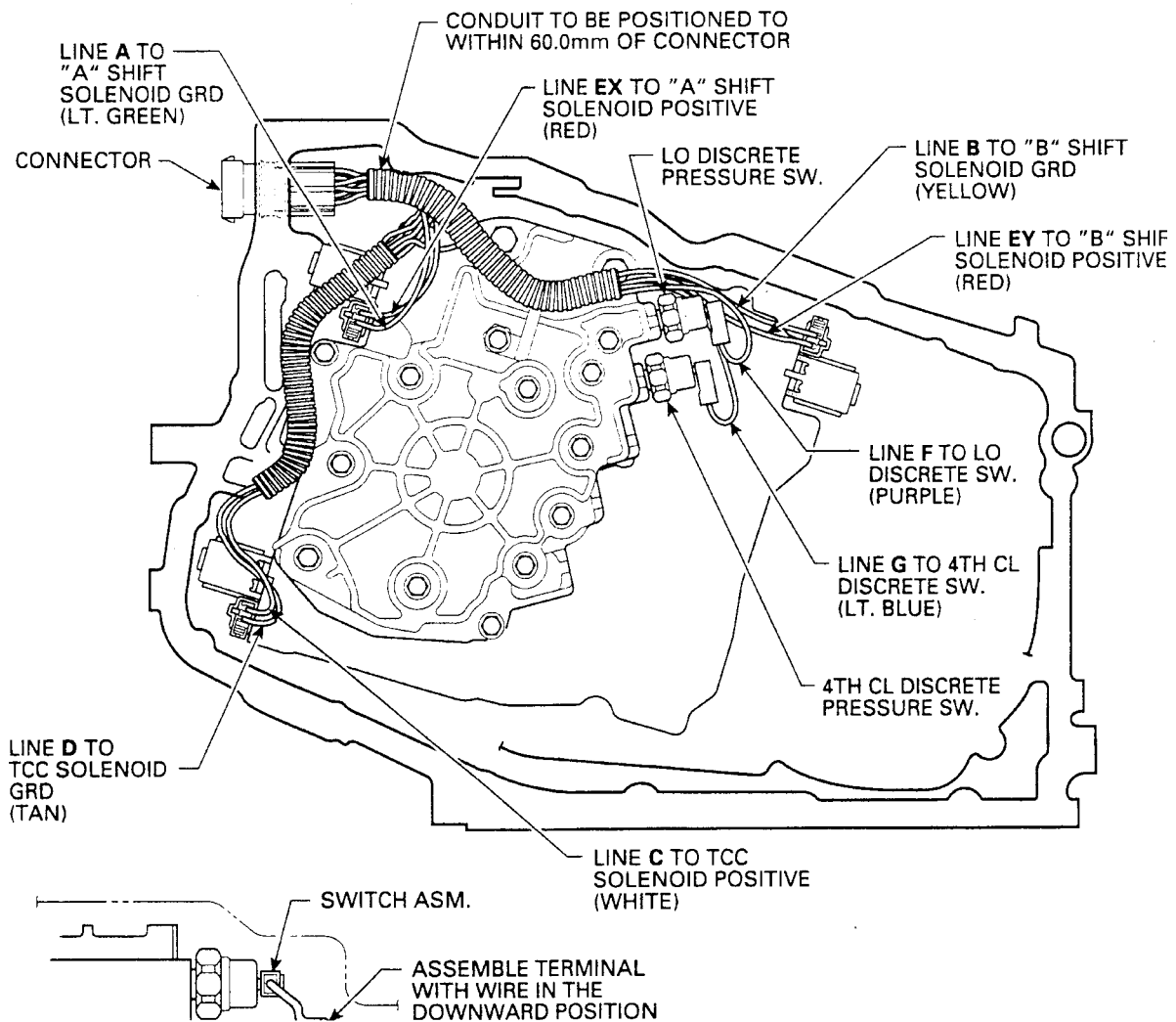
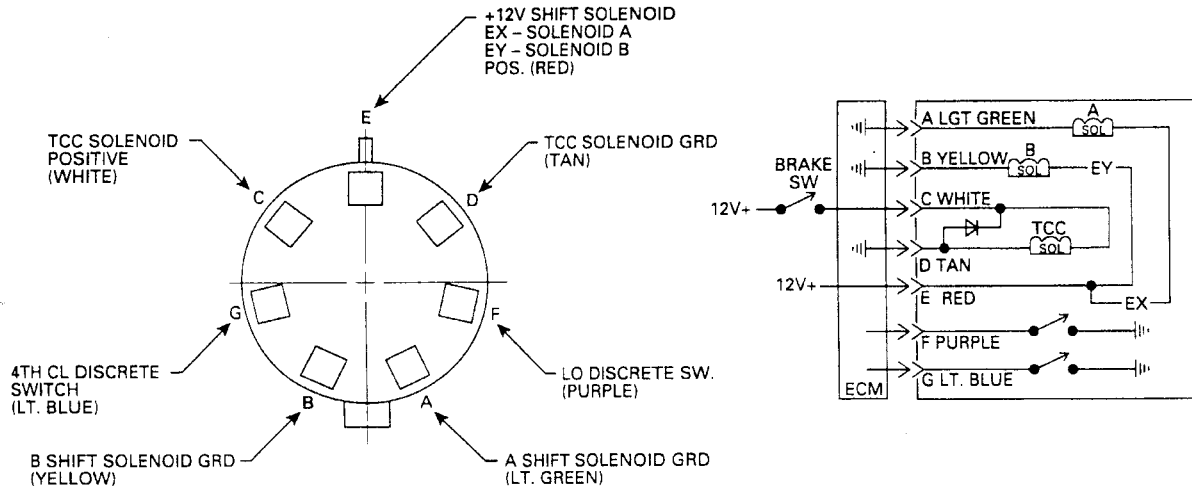
4T60E Wiring Changes (cont)

1991 – 93; w/Pressure Switches



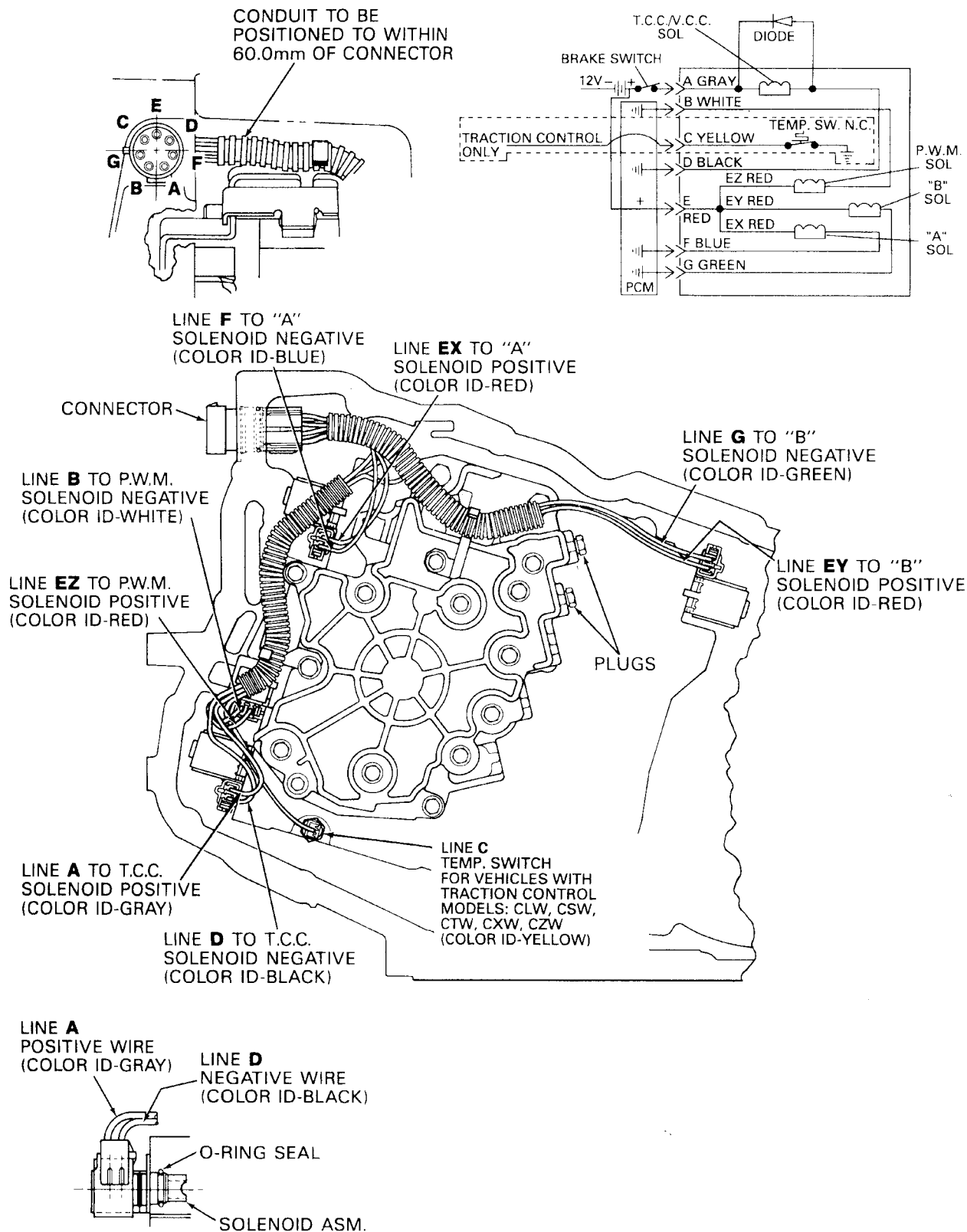
4T60E Wiring Changes (cont)

1994-on; w/Pressure Switches



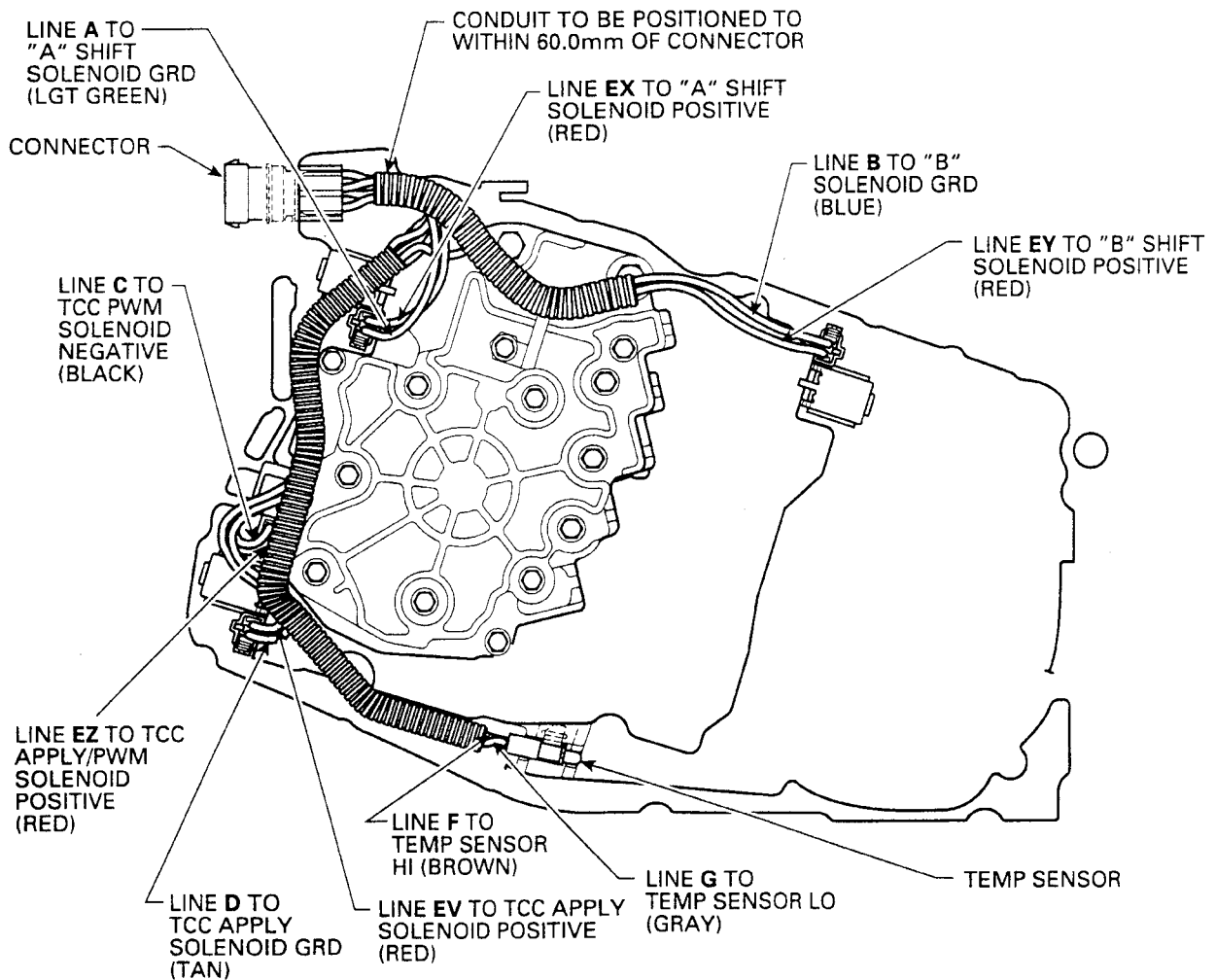
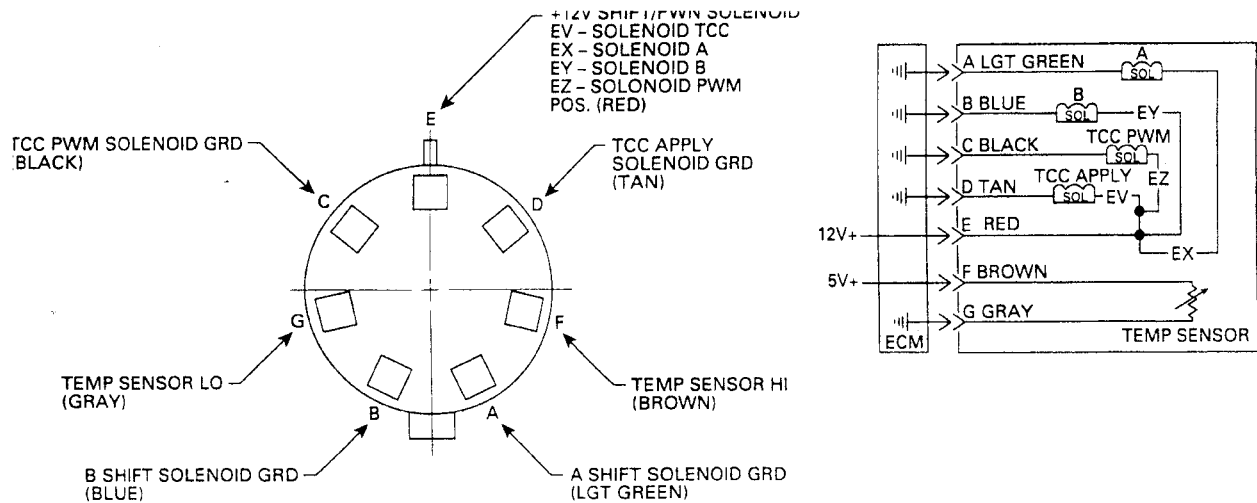
4T60E Wiring Changes (cont)

1991 – 93; w/Temperature Switches



4T60E Wiring Changes (cont)

1994-on; w/Temperature Switches



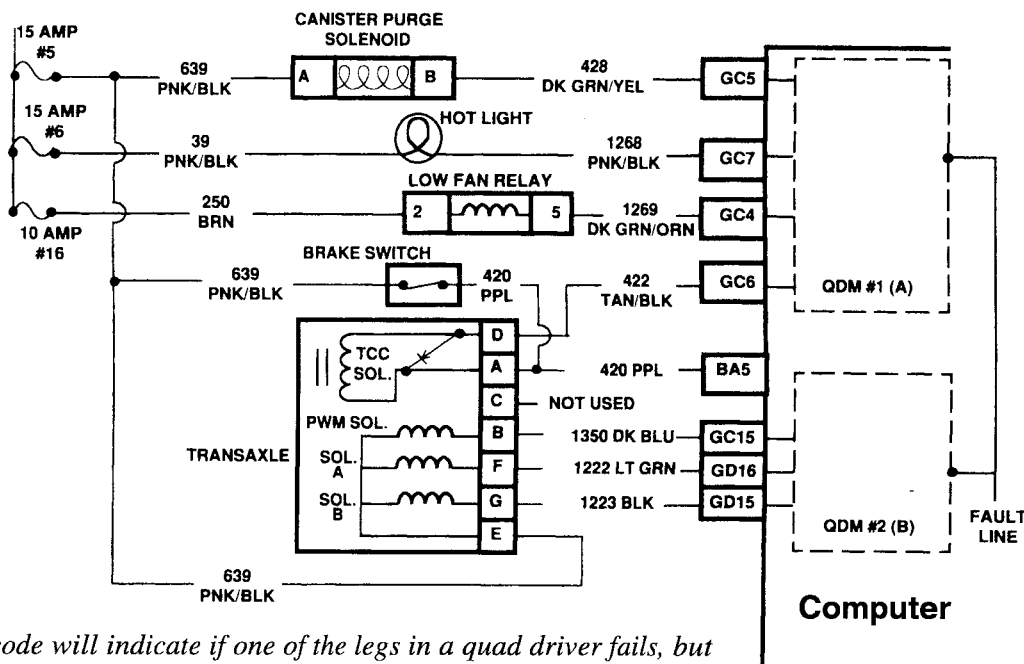
4T60E Quad Driver Diagnosis

GM computers use a device called a "quad driver" to control output devices, such as solenoids and motors. These quad drivers are actually four transistors, combined into one single device. In most cases, these quad drivers provide a ground path for these output devices. In general, these quad drivers will handle anywhere from a half amp all the way to a couple amps of draw.

The problem comes in when one of the four transistors in a quad driver becomes damaged. In most cases, there's only one code to identify a problem with the entire quad driver. In some cases, another code or the vehicle operating conditions will indicate which circuit is faulty. But in other cases, you may not know which circuit caused the quad driver to fail.

That's why it's important to check all of the circuits the quad driver controls, before replacing the computer. Installing a new computer without correcting the circuit problem is a sure way to damage your new computer.

Here's how to check the quad driver circuits: Refer to a detailed schematic, to see which output circuits are controlled by the quad driver. In the example shown, quad driver 1 controls the canister purge solenoid, the temperature light, the low fan relay and the TCC solenoid. Quad driver 2 controls the other transmission solenoids.



A code will indicate if one of the legs in a quad driver fails, but it won't indicate which leg failed. The key to a successful repair is to check all four circuits before replacing the computer.

Now use your ammeter to energize each circuit, one at a time, from the computer connector. Most on/off solenoids have 20 ohms resistance, so they should draw about 0.75 amps. Use Ohm's Law to determine the proper circuit draw. If any of the circuits draws higher than it should, check and repair that problem before installing a new computer. Look for low solenoid resistance or a short in the wiring harness. Never replace the computer until you're sure all of the circuits are working properly.

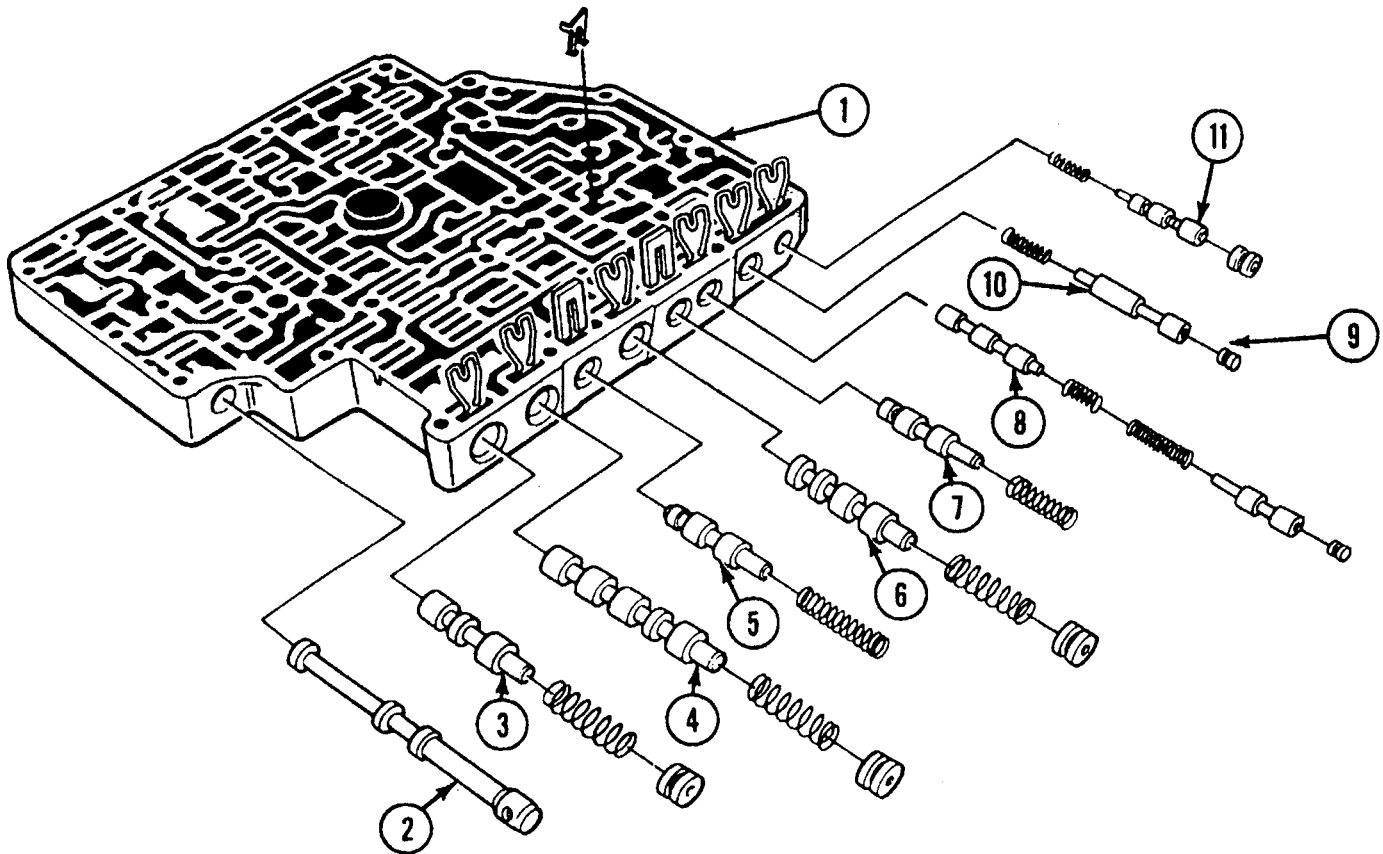
Ford

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AX4S (AXODE) Valve Train ID

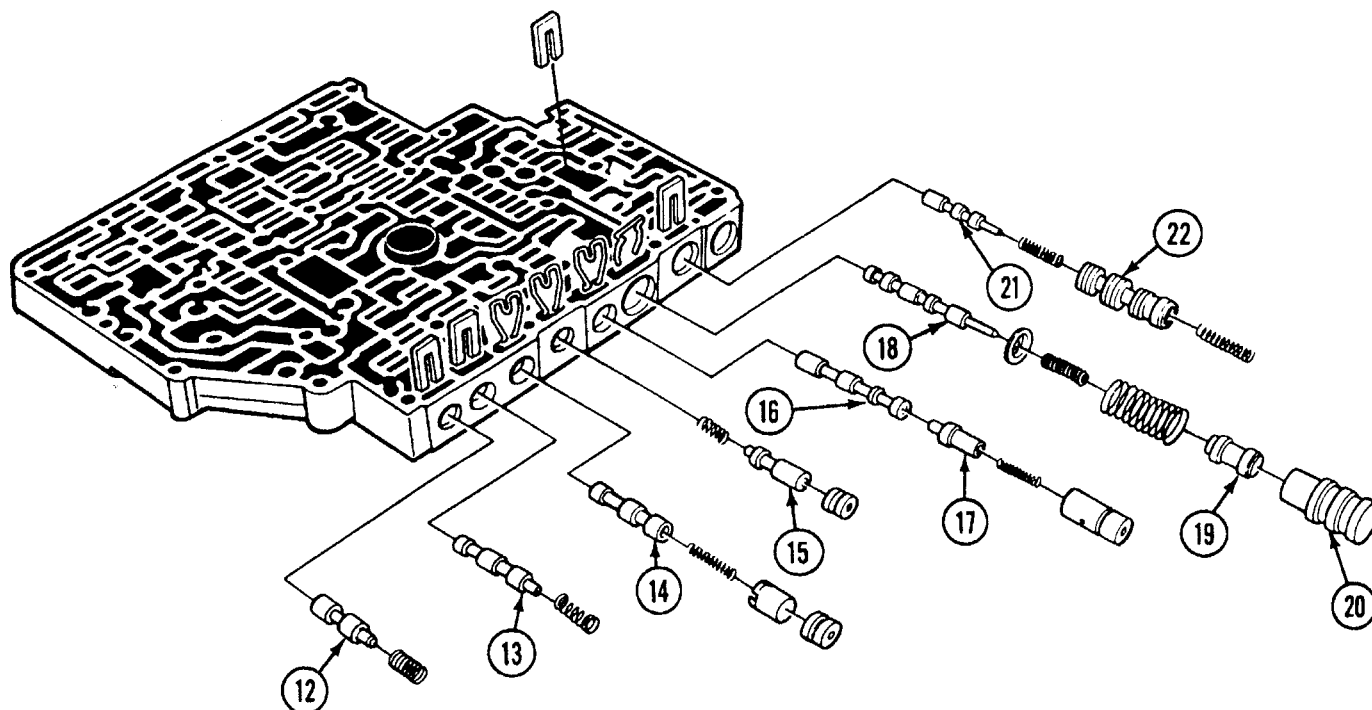
Many service manuals list the valves for the AXODE and AX4S incorrectly. Always refer to these illustrations to identify the valves for these units.



Item	Description
1	Valve Body
2	Manual Control Valve
3	2-3 Shift Valve
4	1-2 Shift Valve
5	Pull-In Valve
6	3-4 Shift Valve
7	Forward Clutch Valve
8	3-2 Shift Timing
9	Pull-In Control Valve
10	Engagement Valve
11	2-3 Servo Regulator Valve

Continued...

AX4S (AXODE) Valve Train ID (cont)

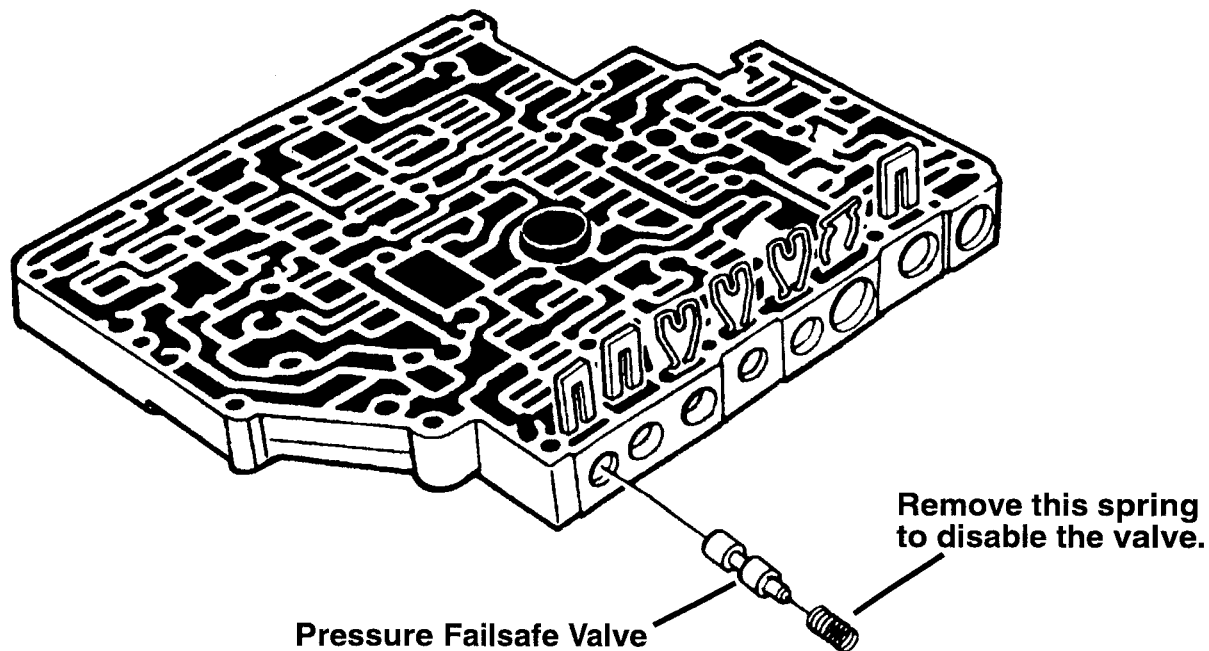


Item	Description
12	Pressure Failsafe Valve
13	Backout Valve
14	Accumulator Regulator
15	1-2 Capacity Modulator
16	Bypass Clutch Control Valve
17	Bypass Clutch Control Valve Plunger
18	Main Regulator
19	Main Regulator Boost Plunger
20	Main Regulator Boost Sleeve
21	Solenoid Regulator Valve
22	Converter Regulator Valve

AX4S (AXODE) Erratic or High Line Pressure

Erratic or high line pressure, especially at idle, can be caused by a problem in the pressure failsafe valve.

The best way to prevent this problem is to disable the pressure failsafe valve during any valve body repair or service. Simply remove the spring to disable the valve.

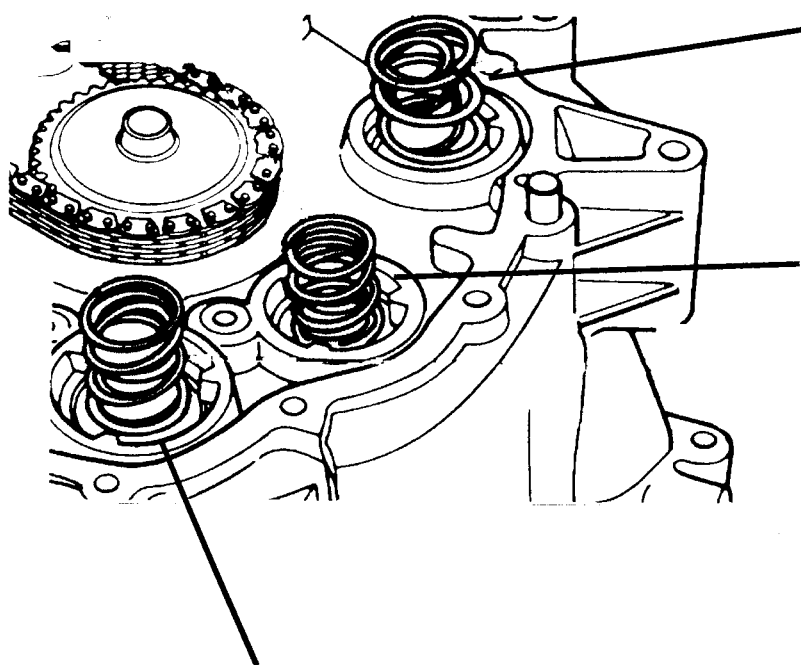


AXOD/AX4S (AXODE) Accumulator Springs

The accumulator springs for the AXOD and AXODE have changed from year to year, and engine to engine. One easy way to identify the springs is by spring color.

NOTICE: The springs for the 1991 – 95, 1 – 2 accumulator are the same as those for the 1988 – 90, 3.8L engine, although the spring colors have changed.

Of course, there's no guarantee the springs will still have their original paint. That's okay: You can identify the springs by their sizes, using the chart, or you can identify them through the process of elimination.



N-D Accumulator Springs

Vehicle	Inner	Outer
All Models	Blue E6DZ-7G301-A	Orange E6DZ-7D300-A

3-4 Accumulator Springs

Vehicle	Inner	Outer
1986 – 90 3.0L	Green E6DZ-7F288-A	Green E6DZ-7G266-A
1988 3.8L Continental	Green E6DZ-7F288-A	Green E6DZ-7G266-A
1988 3.8L exc. Continental	Green E6DZ-7F288-A	Plain E8DZ-7G266-A
1989 – 95 3.8L 1991 – 95 3.0L	*Green E6DZ-7F288-A	White E9DZ-7G266-A

* Some models will use a white spring. It has the same part number as the green spring.

1 – 2 Accumulator Springs

Vehicle	Inner	Middle	Outer
1986 – 90 3.0L	Yellow E6DZ-7G326-A	—	Yellow E6DZ-7G267-A
1988 – 90 3.8L	Brown E8DZ-7G326-A	Brown E8DZ-7G358-A	Brown E8DZ-7G267-A
1991 – 95 All	Purple E8DZ-7G326-A	Pink E8DZ-7G358-A	Brown E8DZ-7G267-A

Continued...

AXOD/AX4S Acc. Springs (cont)

If the paint was washed off of the accumulator springs, you can use the spring measurement to identify which spring goes where:

Accumulator Spring Identification			
Color	Diameter	Length	Wire Diameter
N-D Accumulator			
Blue (Outer)	1.485"	1.790"	0.135"
Orange (Inner)	1.020"	1.725"	0.099"
1 – 2 Accumulator			
Yellow (Outer)	1.565"	1.462"	0.125"
Brown (Outer)	1.575"	1.435"	0.125"
Brown/Pink (Middle)	1.200"	1.460"	0.099"
Yellow (Inner)	1.180"	1.525"	0.091"
Brown/Purple (Inner)	0.905"	1.620"	0.075"
3 – 4 Accumulator			
Green (Outer)	1.190"	1.515"	0.091"
Plain (Outer)	1.175"	1.690"	0.098"
White (Outer)	1.175"	1.760"	0.099"
Green/White (Inner)	0.875"	1.450"	0.080"

Elimination Process

Identifying the accumulator springs through the process of elimination is fairly easy, and is very accurate. Once you become familiar with the procedure, you'll find it easier than digging through charts or measuring spring sizes. There are a couple of points to remember:

- Most units will have seven springs; the 1986 – 90 3.0L will have six springs.
- Springs must coil in the opposite direction of the spring they fit into.

Here's how to identify these springs properly.

Step 1: The two largest springs are for the 1 – 2 and N – D accumulators. Both springs should be able to wiggle in their seats. If one spring fits tightly in its seat, switch the springs.

Step 2: Of the springs that are left, choose the two with the largest diameter. Use the shorter spring in the 1 – 2 accumulator; the other spring goes in the N – D accumulator.

Step 3: If there are three springs left, put the largest one that will fit in the 1 – 2 accumulator. If only two springs are left, go on to step 4.

Step 4: Use the two springs left in the 3 – 4 accumulator.

AX4S (AXODE) 3 – 2 Flare

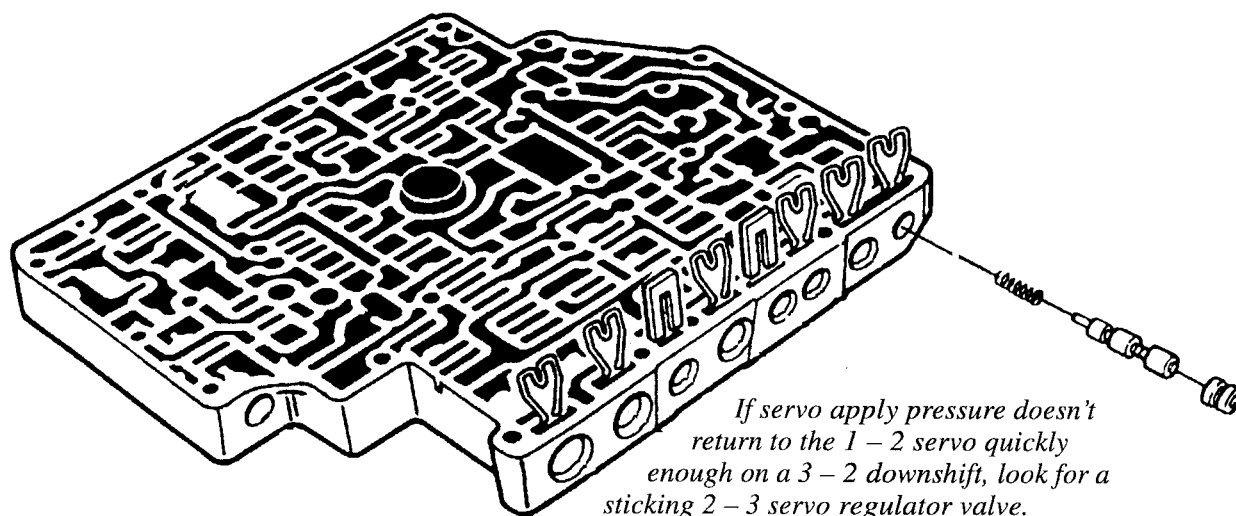
There are several possibilities for a 3 – 2 flare on an AXODE. Here's how to isolate the source of the problem, in 4 easy steps:

Step 1: Check mainline pressure; at idle you should have between 48 and 77 PSI. At stall, mainline pressure should be between 168 and 217 PSI. If mainline pressure is low, take care of that problem before going on.

Step 2: Drill and tap the 1 – 2 servo cover to monitor servo apply pressure.

- In 1st and 2nd gears, servo pressure should equal mainline pressure.
- In 3rd and 4th gears, the 2 – 3 servo regulator valve should hold servo pressure between 25 – 35 PSI. Pressure must return to mainline during a 3 – 2 downshift. If servo pressure doesn't return quickly enough, look for a sticky 2 – 3 servo regulator valve.

Step 3: If line pressure and servo apply pressure are okay during the 3 – 2 flare, try a lighter 1 – 2 servo return spring. This may allow the servo to apply faster, and prevent a downshift flare.



Step 4: If the flare still occurs, try changing all of the checkballs with new ones, and install a set of metal oil control rings on the sprocket support. Always perform this step as a normal part of any AXODE rebuild.

If this condition is more pronounced around corners, check for a clogged filter, and try overfilling the transmission. This condition could indicate the system is drawing air past the filter.

AX4S (AXODE) 3 – 2 Flare (continued)

1991 Modifications

There's a specific problem causing 3 – 2 flare shifts on 1991 AXODEs. To correct this, Ford developed a new design backout valve kit. The backout valve that comes with this kit changes the valve body circuitry to be more like the 1992 systems. You should update the backout valve to the second design whenever possible.

The kit also includes a replacement retainer to fit between the springs for the pull-in control valve and the 3 – 2 shift timing valve. If you don't need the complete kit, you can order the retainer separately.

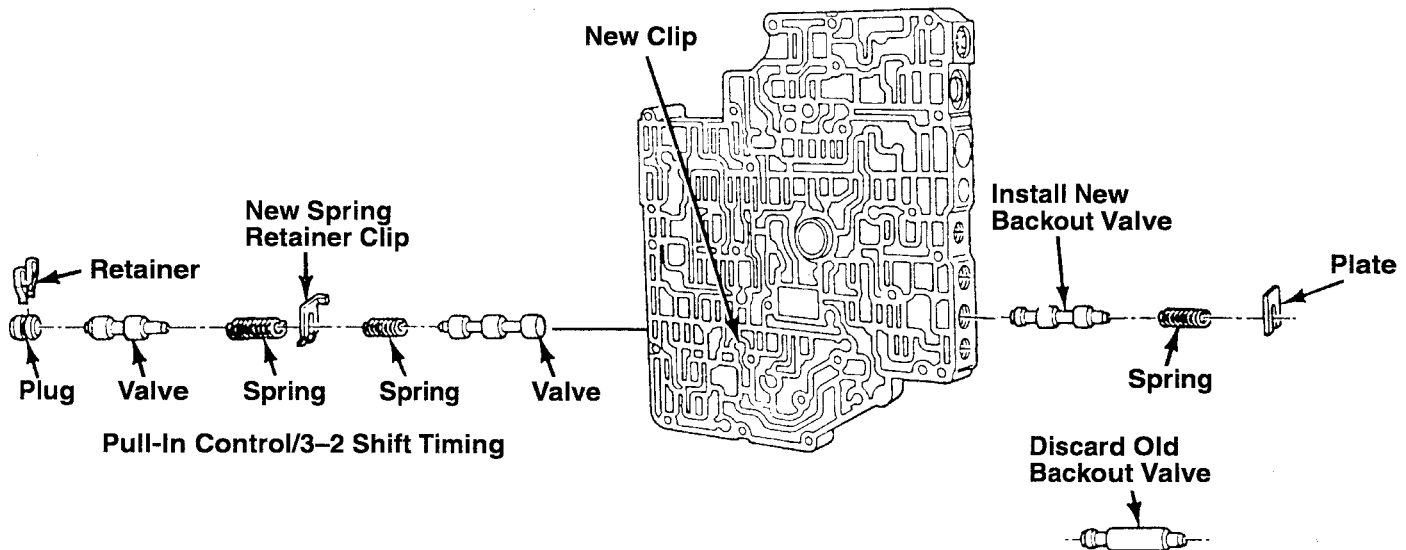
F1DZ-7A142-B — 3.0L Taurus/Sable

F1DZ-7A142-C — 3.8L Taurus/Sable

F1DZ-7A142-D — 3.8L Police

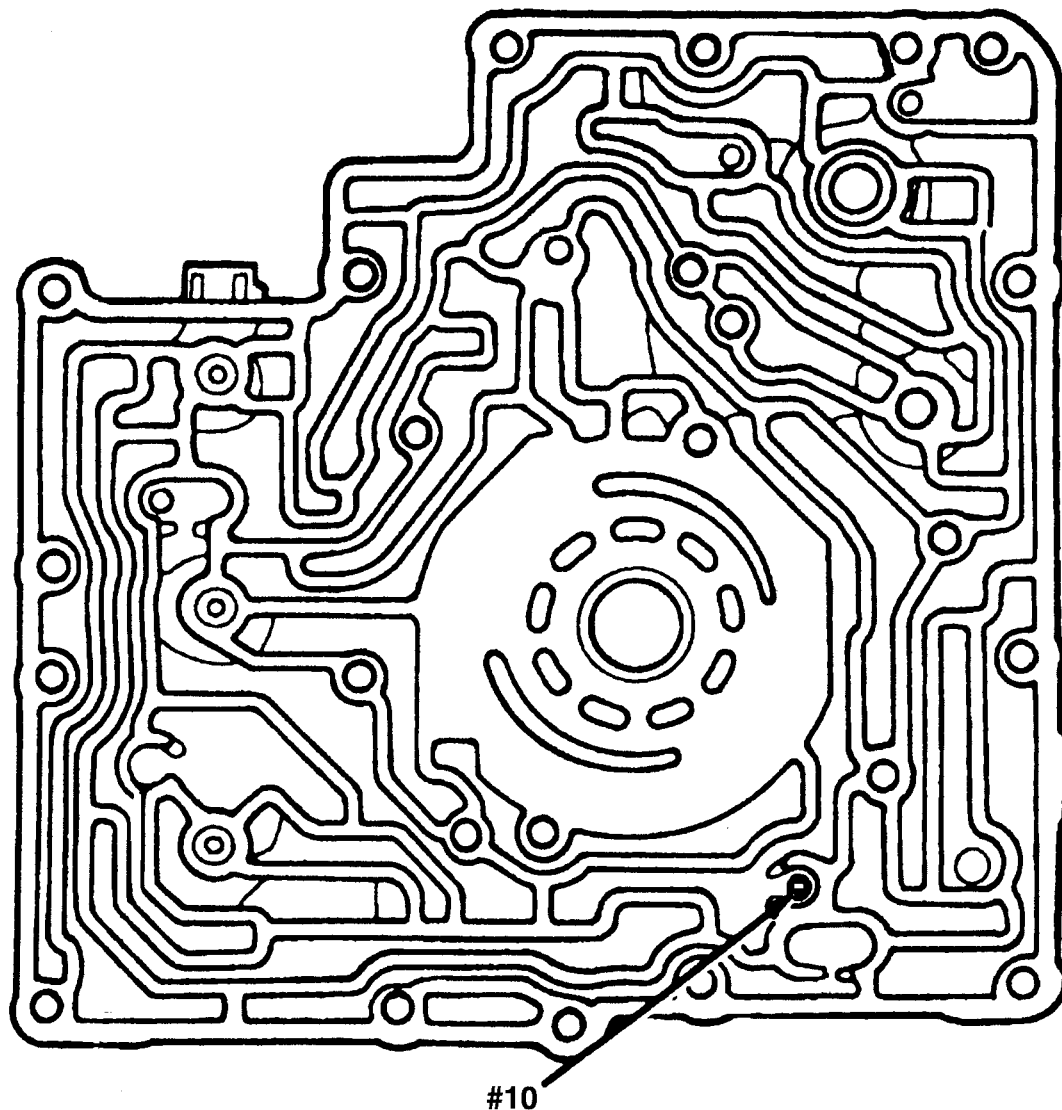
F1OY-7A142-B — 3.8L Continental

F1DZ-7F194-A — Retainer Only

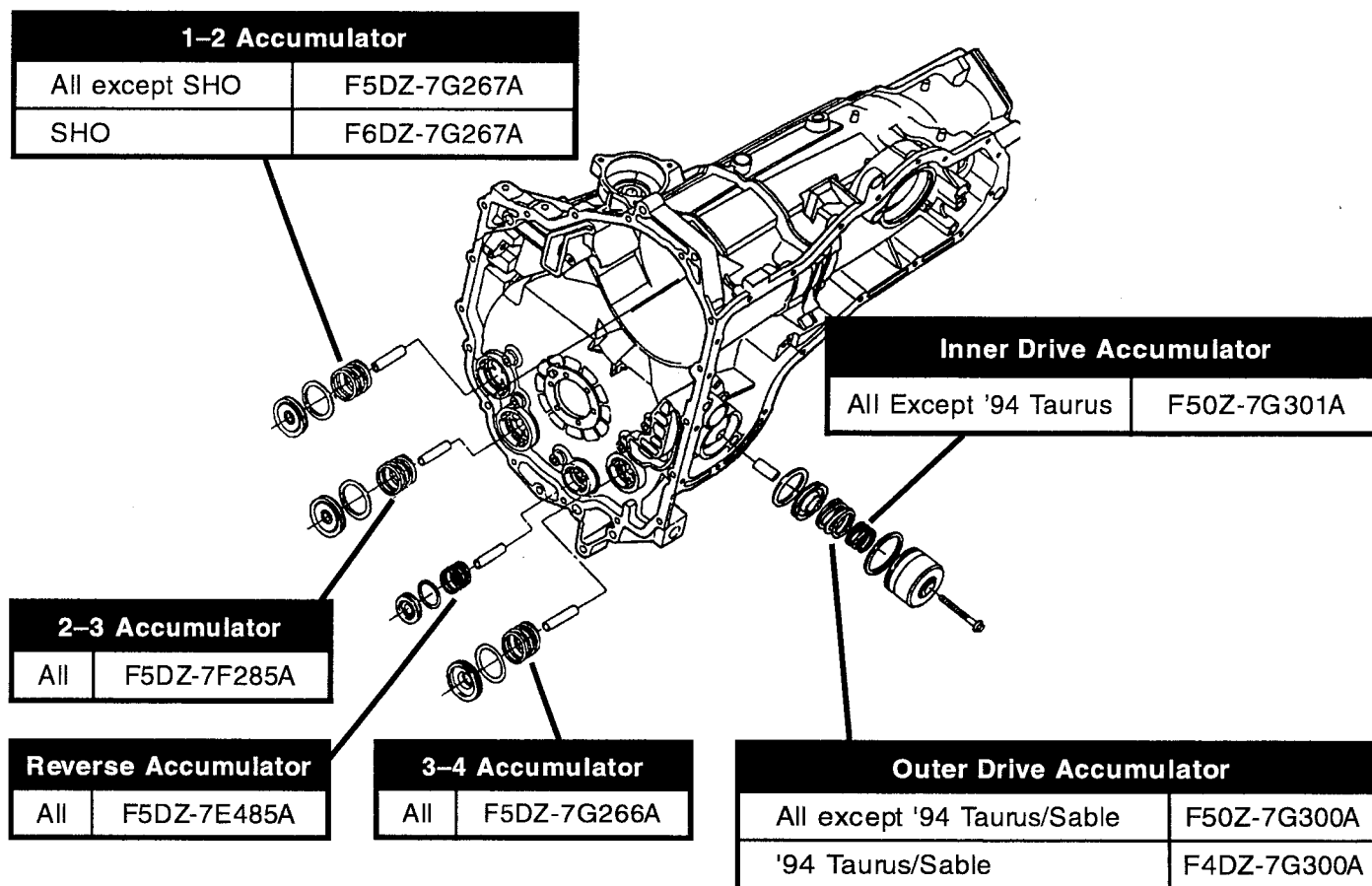


AX4S (AXODE) Shifts 1 – Neutral

An AXODE that shifts from first gear into neutral is usually caused by a leak in the #10 checkball. To prevent checkball leaks, replace all of the checkballs during every rebuild or valve body service.



AX4N Accumulator Spring Locations



Accumulator Springs			
Part Number	Color	Wire Diameter	Coil Diameter
F5DZ-7G266A	Blue	0.112"	1.312"
F5DZ-7G267A	Plain	0.112"	1.324"
F6DZ-7G267A	Purple	0.120"	1.510"
F5DZ-7F285A	Orange	0.110"	1.300"
F5DZ-7E485A	Green	0.091"	0.965"
F4DZ-7G300A	Plain	0.091"	1.369"
F50Z-7G300A	Green	0.102"	1.471"
F50Z-7G301A	Brown	0.083"	1.172"

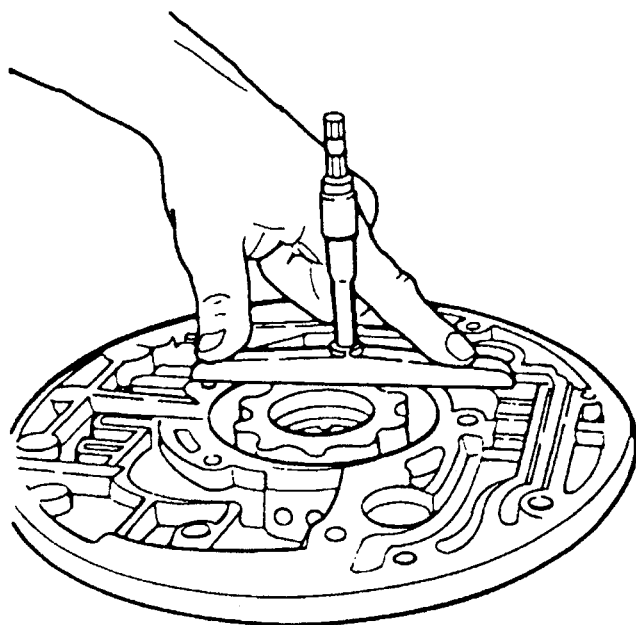
E4OD Kills the Engine When You Put It in Reverse

Since the lockup valve is blocked hydraulically when the transmission selector's in reverse, there's no way this problem could be due to a solenoid or sticking shift valve. Either of these problems would affect the transmission in both forward and reverse.

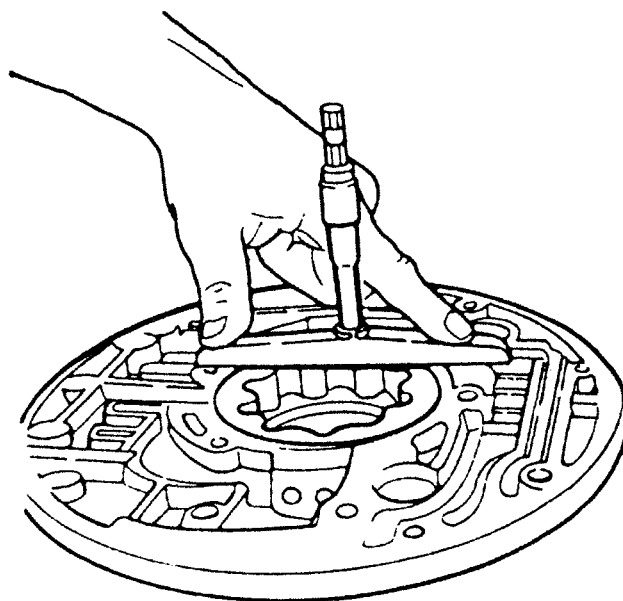
This specific complaint indicates too much clearance on the inner pump gear. The pressure bypasses the gear, and pressurizes the converter housing. Fluid can't exhaust from the back of the converter clutch, so the clutch drags and stalls the engine.

This problem tends to get worse as the vehicle heats up, and can be compounded by a clogged cooler. To see if the cooler is involved, bypass the cooler, and try putting the transmission in reverse. If the engine doesn't stall this time, replace the cooler.

To correct this problem before it occurs, always check the pump gear clearance during every rebuild. The pump gears should have between 0.0015" and 0.0020" clearance.



Inner Gear Clearance Check



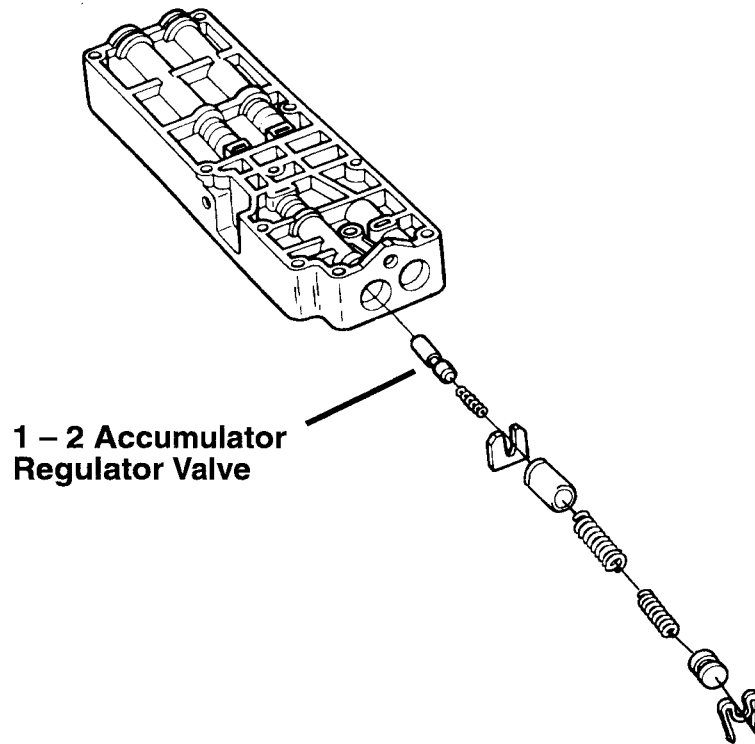
Outer Gear Clearance Check

E4OD Harsh 1 – 2 Upshift

The first step in diagnosing a harsh 1 – 2 upshift on an E4OD is to determine whether the clutches are coming on too quickly... or too slowly. Too quickly is obvious, but too slowly can also cause this type of problem. What happens is the accumulator bottoms before the clutches apply, causing a slide-bump shift that customers often mistake for a harsh shift.

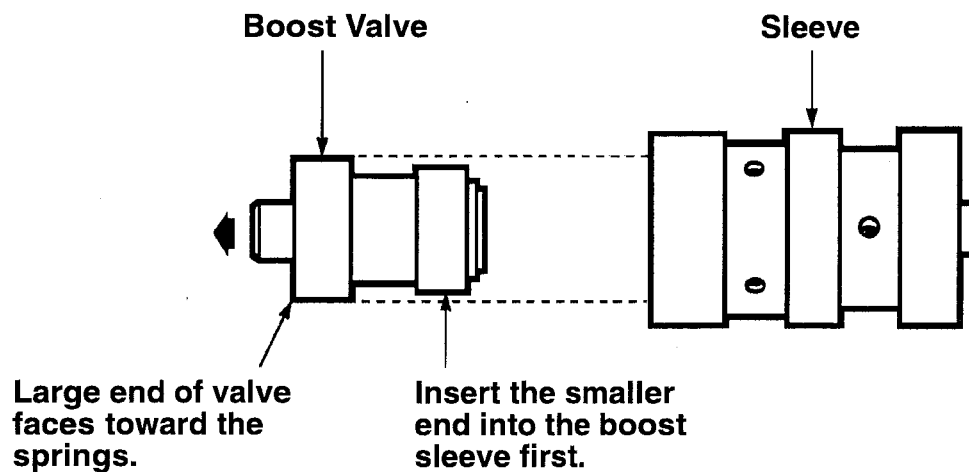
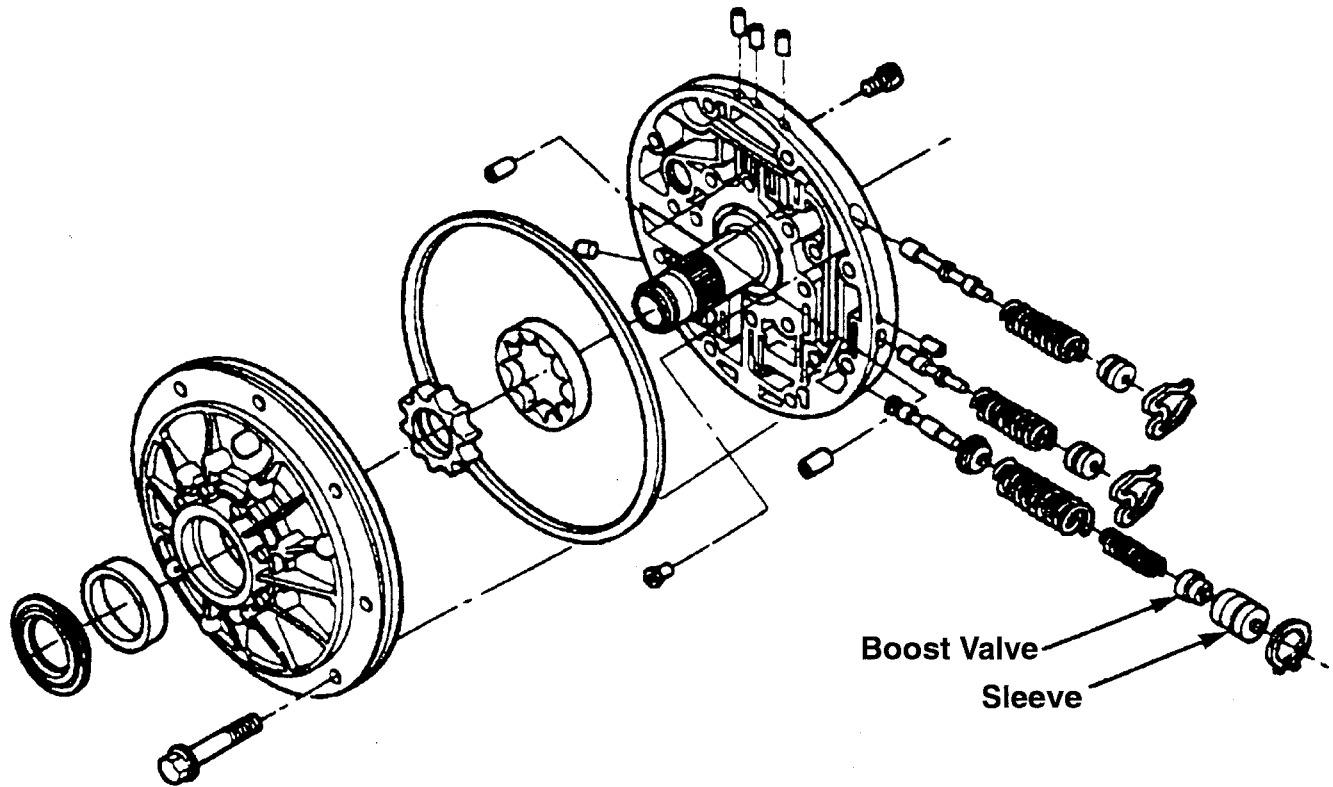
An easy check for this problem is to monitor the shift signals, from the computer to the transmission. If the shift takes place immediately after the signal for 2nd gear, you're probably looking at clutches that are applying too quickly. But if there's a short lag between the signal and the shift, you're probably looking at a slide-bump shift.

Assuming the rest of the unit is in good shape, you can probably fix this problem by changing the spring for the 1 – 2 accumulator regulator valve. Install a stronger spring to speed up the shift; a softer spring will slow it down a bit.



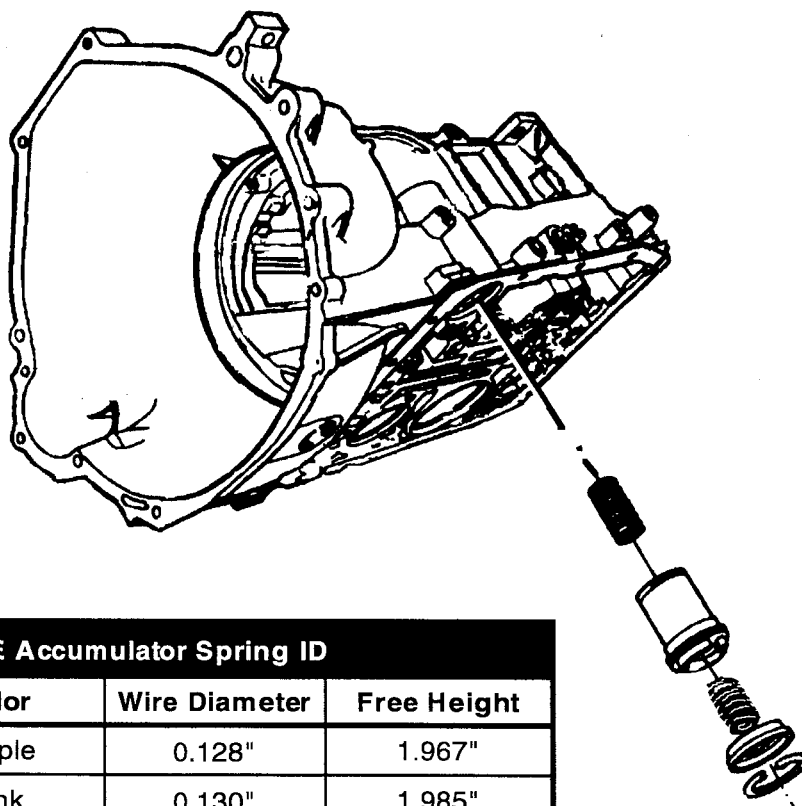
E4OD Boost Valve Affects Line Rise

A worn boost valve or boost valve sleeve can have a drastic effect on line rise. If you have a problem with line rise on an E4OD, or you find any sign of wear on the boost valve or sleeve, always replace both parts. Ford now offers a kit that includes both the boost valve and sleeve, P/N E9TZ-7D03-AA.



AODE (4R70W) Has Soft or Slide-Bump 1 – 2 Shift

A wrong or missing 1 – 2 accumulator spring is a likely source of a soft 1 – 2 shift or a slide-bump 1 – 2 shift. This page provides a chart to identify each accumulator spring. Compare that to the chart on the next page, which provides the application for each spring, based on vehicle and engine size.



4R70W/AODE Accumulator Spring ID

Part Number	Color	Wire Diameter	Free Height
F3LY-7F284-A	Purple	0.128"	1.967"
F4UZ-7F284-A	Pink	0.130"	1.985"
F7AZ-7F284-AA	White	0.114"	2.600"
F7AZ-7F284-BA	Violet	0.118"	1.955"
F7AZ-7F284-CA	Blue	0.118"	2.480"
F75Z-7F284-AA	Lt. Blue	0.130"	2.546"
F75Z-7F284-BA	Brown	0.140"	2.292"

Continued...

AODE (4R70W) Has Soft or Slide-Bump 1 – 2 Shift (continued)

4R70W/AODE Accumulators							
Vehicle	Spring	1992	1993	1994	1995	1996	1997
Crown Victoria 4.6L/ Grand Marquis 4.6L	Top	None	None	Dk.Blue	White	White	White
	Bottom	Violet	Violet	Violet	Purple	Purple	Purple
Mark VIII 4.6L 4V	Top	NA	Lt. Blue	Lt. Blue	Lt. Blue	Lt. Blue	Lt. Blue
	Bottom	NA	Purple	Purple	Purple	Purple	Pink
Mustang 3.8L	Top	NA	NA	None	None	White	White
	Bottom	NA	NA	Purple	Purple	Pink	Pink
Mustang 4.6L	Top	NA	NA	None	None	Lt. Blue	Lt. Blue
	Bottom	NA	NA	Purple	Purple	Purple	Purple
Mustang 5.0L	Top	NA	NA	None	None	NA	NA
	Bottom	NA	NA	Purple	Purple	NA	NA
Thunderbird 3.8L / Cougar 3.8L	Top	NA	NA	None	None	White	White
	Bottom	NA	NA	Purple	Purple	Pink	Pink
Thunderbird 4.6L / Cougar 4.6L	Top	NA	NA	None	None	Lt. Blue	Lt. Blue
	Bottom	NA	NA	Purple	Purple	Purple	Purple
Town Car 4.6L	Top	None	None	Dk.Blue	White	White	White
	Bottom	Violet	Violet	Violet	Purple	Purple	Purple
Econoline 4.2L and 4.6L	Top	NA	NA	NA	NA	NA	Brown
	Bottom	NA	NA	NA	NA	NA	Pink
Econoline 5.0L	Top	NA	NA	White	White	White	NA
	Bottom	NA	NA	Pink	Pink	Pink	NA
Expedition 4.6L	Top	NA	NA	NA	NA	NA	Lt. Blue
	Bottom	NA	NA	NA	NA	NA	Pink
Explorer 5.0L / Mountaineer	Top	NA	NA	NA	NA	White	White
	Bottom	NA	NA	NA	NA	Pink	Pink
F-150 4.2L	Top	NA	NA	NA	NA	White	White
	Bottom	NA	NA	NA	NA	Pink	Pink
F-150 4.6L	Top	NA	NA	NA	NA	Lt. Blue	Lt. Blue
	Bottom	NA	NA	NA	NA	Pink	Pink
F-150 5.0L	Top	NA	NA	White	White	White	NA
	Bottom	NA	NA	Pink	Pink	Pink	NA
F-250 LD 4.6L	Top	NA	NA	NA	NA	NA	Brown
	Bottom	NA	NA	NA	NA	NA	Pink

Honda / Acura

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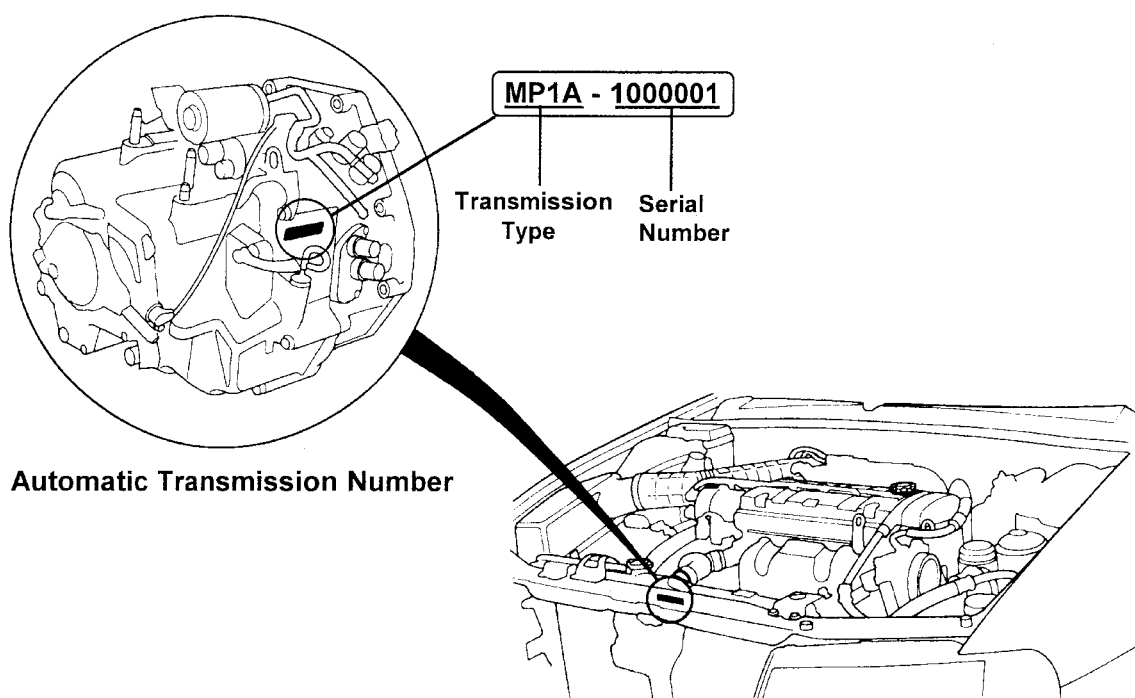
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Honda, Acura

Transmission Identification

Each of these transmissions has a small tag on the side of the case, that carries the transmission identification number. This number is made up of two parts: the transmission type (or model number), and the transmission serial number.

The graphic shows where this tag appears on the transmission case, and where it sits in relation to the engine compartment. Always use this number to identify the transmission you're working on.



The next two pages provide a listing of the transaxles available, based on the vehicle manufacturer and model, and on the transaxles model number. These charts provide a lot of information about the control systems involved in each type of unit, including the number of clutch packs the transaxle has, and the devices it uses to control lockup, shift timing, and shift feel.

In addition, we've cross-referenced the transaxle listings by the transaxle model number — if you know the transaxle model number, you can use this information to determine what vehicle the unit was designed for.

Transaxle Application Charts

Year	Transaxle Number	Number of Clutch Packs	Lockup Control		Shift Timing Control		Shift Feel Control		
			Governor & TV Cable	Solenoids	Governor & TV Cable	Solenoids	TV Cable	Vacuum Modulator	Solenoid
Accord									
1983	AK	4	N/A	N/A	X		X		
1984 – 85	AS	4	X		X		X		
1986 – 89	F4	4	X		X		X		
1990	PX4B	5		2		2	X		
1991 (USA)	APX4	5		2		2	X		
1991 (Japan)	MPXA	5		2		2	X		
1992 (USA)	APX4	5		2		2	X		
1992 (Japan)	MPWA	5		2		2	X		
1993	MPXA	5		2		2	X		
1994	MP0A	5		2		2	X		
1995 – 96 (USA)	A0YA	5		2		2		X	
1995 – 96 (Japan)	MP0A	5		2		2	X		
1995 – 96 (6-cyl)	MPZA	5		2		2			X
Prelude									
1983	AK	4	N/A	N/A	X		X		
1984 – 87 w/carb	AS	4	X		X		X		
1985 – 87 w/FI	F4	4	X		X		X		
1988 – 89	K4	4		2	2		X		
1990	PY8A	4		2	2		X		
1991	MY8A	4		2	2		X		
1992 – 96	MP1A	5		2	2		X		
Civic									
1986 – 87	CA	4	X		X		X		
1988 – 90 2WD	L4	4	X	1	X		X		
1989 – 1990 4WD	S5	5		2		2	X		
1991 2WD	ML4A	4	X	1	X		X		
1991 4WD	MPSA	5		2		2	X		
1992 – 95	M24A	5		2	X		X		
1996	A4RA	4		2		2			X

NOTE: Models with two lockup solenoids and a TV cable use TV pressure to control the degree of partial lockup.

Transaxle Application Charts (continued)

Year	Transaxle Number	Number of Clutch Packs	Lockup Control		Shift Timing Control		Shift Feel Control		
			Governor & TV Cable	Solenoids	Governor & TV Cable	Solenoids	TV Cable	Vacuum Modulator	Solenoid
Integra									
1986 – 87	CA	4	X		X		X		
1988 – 89	P1	4	X	1	X		X		
1990	RO	4		2		2		X	
1991 – 93	MPRA	4		2		2		X	
1994	MP7A	5		2		2	X		
1995	SP7A	5		2		2	X		
1996	S4XA	5		2		2	X		
Legend									
1986 and 1987 4-door	G4	4	X	1	X		X		
1987 2-door, and 1988 – 89	L5	4		2		X	X		
1990	PL5X	4		2		2	X		
1991 – 95	MPYA	6		2		2			X
1992 – 94 Vigor	MPWA	5		2		2			X
1995 – 96 2.5TL	M1WA	5		2		2			X
1996 3.2TL	M5HA	6		2		2			X
1996 3.5RL	M5DA	6		2		2			X

NOTE: Models with two lockup solenoids and a TV cable use TV pressure to control the degree of partial lockup.

Transaxle Application by Transaxle Model Number

Transaxle	Vehicle	Transaxle	Vehicle	Transaxle	Vehicle
AK	1983 Prelude; Accord	ML4A	1991 Civic (2WD)	M1WA	1995 – 96 2.5TL
APX4	1991 – 92 Accord (USA)	MPRA	1991 – 93 Integra	M5DA	1996 3.5RL
AS	1984 – 85 Accord	MPSA	1991 Civic (4WD)	M5HA	1996 3.2TL
	1984 – 87 Prelude w/Carb	MPWA*	1992 Accord (Japan built)	M24A	1992 – 95 Civic
A0YA	1995 – 96 Accord 4-cyl (USA)	MPWA*	1992 – 94 Vigor	PL5X	1990 Legend
A4RA	1996 Civic	MPXA	1991, 93 Accord (Japan built)	PX4B	1990 Accord
CA	1986 – 87 Civic, Integra	MPYA	1991 – 95 Legend	PY8A	1990 Prelude
F4	1986 – 89 Accord	MPZA	1995 – 96 Accord (6-cyl)	P1	1988 – 89 Integra
	1985 – 87 Prelude w/FI	MP0A	1994 Accord	RO	1990 Integra
G4	1986 Legend (87 4-door)		1995 – 96 Accord (Japan built)	SP7A	1995 Integra
K4	1988 – 89 Prelude	MP1A	1992 – 96 Prelude	S4XA	1996 Integra
L4	1988 – 90 Civic (2WD)	MP7A	1994 Integra	S5	1989 – 90 Civic (4WD)
L5	1988 – 89 Legend (87 2-door)	MY8A	1981 Prelude		

* These transaxles aren't the same unit.

Diagnostic Trouble Code Retrieval

When the computer detects a problem in the transmission control system, it stores a diagnostic trouble code in memory, to indicate the general area where the problem appears. This is designed to help you identify and find problems in the computer control system.

When a diagnostic trouble code first sets in memory, all Honda and Acura vehicles flash a shift status light on the dash. This isn't a trouble code: It's just the computer's way of telling you to check for codes.

Honda and Acuras provide their diagnostic trouble codes one of two ways: Some vehicles flash an LED on the transmission computer, whenever the key is on. Others deliver codes by flashing the S or D4 light on the dash, whenever you connects the wires in a service connector.

In this section, we'll look at both procedures, to see how to retrieve the codes, how to translate those codes, and how to clear those codes from memory after you've completed your repairs.

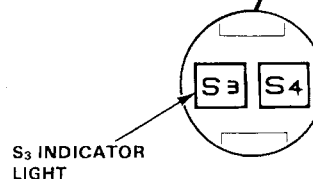
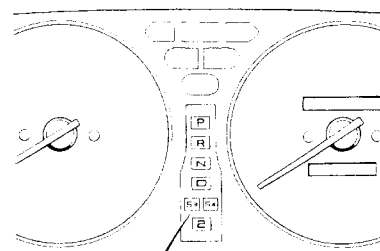
Displays from the LED on the Computer

Several of the early Hondas and Accords display diagnostic trouble codes by flashing an LED on the computer itself. The LED continues flashing whenever the key is on, as long as the codes remain in memory.

When a code sets in memory, the computer lights the S3 indicator light in the dash. The S3 indicator remains on all the time, regardless of gear range; this indicates a problem in the computer system that needs attention.

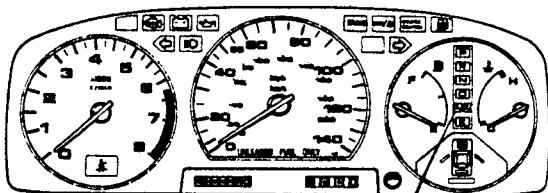
Here's a list of the vehicles that use an LED on the transmission computer to

1990 – 93 Integra



S3 INDICATOR
LIGHT

1988 – 91 Prelude



S3 INDICATOR
LIGHT

Diagnostic Trouble Code Retrieval (continued)

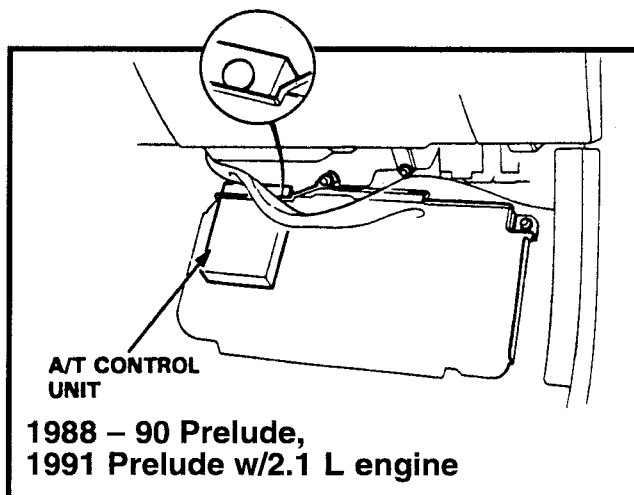
Displays from the LED on the Computer (continued)

flash out the codes, and where to look for the computer.

Honda

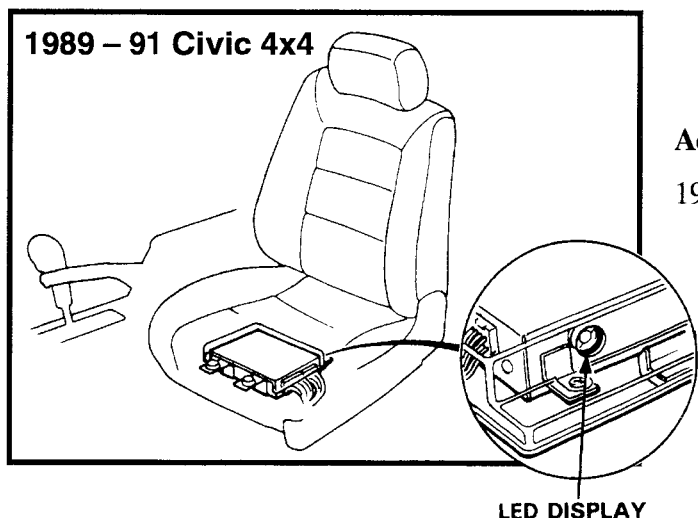
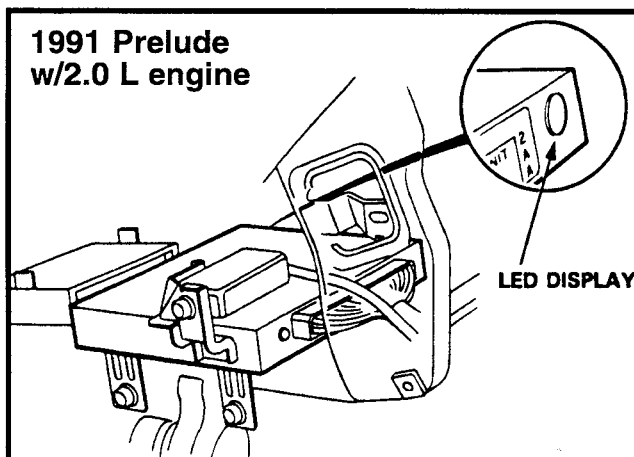
1988 – 90 Prelude, 1991 All w/2.1 L engine —
Look for the computer under the front of
the carpet, on the passenger's side. Remove
the passenger's door sill and kick panel to
make it easier to access the computer.

1991 Prelude w/2.0 L engine — Look for the
computer behind the center console.



The computer is just visible from the
passenger's side floor.

1989 – 91 Civic 4x4 — Look for the computer
under the driver's seat.



Acura

1990 – 93 Integra — Look for the computer behind the left

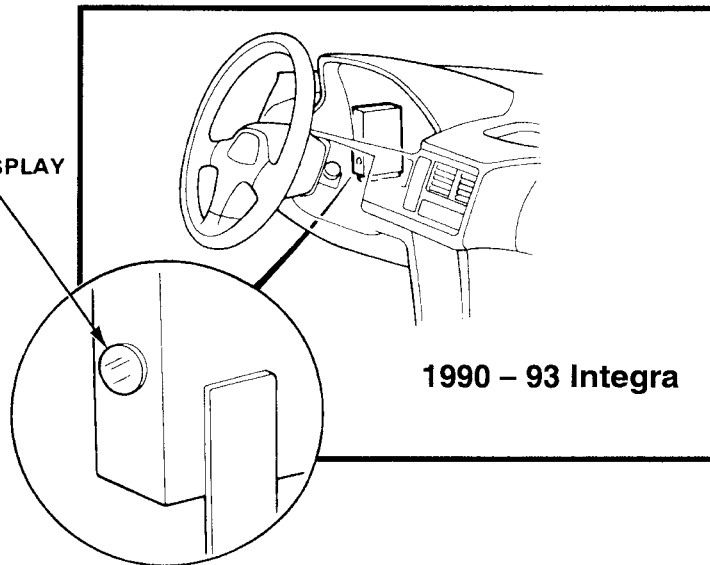
Diagnostic Trouble Code Retrieval (continued)

Displays from the LED on the Computer (continued)

side of the dashboard, next to the inner fender. The computer is just visible from the driver's side floor.

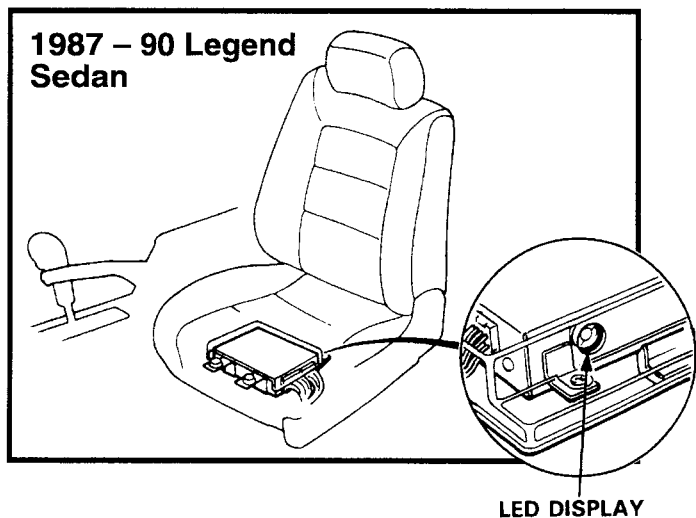
1987 – 90 Legend Sedan — Look for the computer under the driver's seat.

LED DISPLAY



1990 – 93 Integra

1987 – 90 Legend Sedan

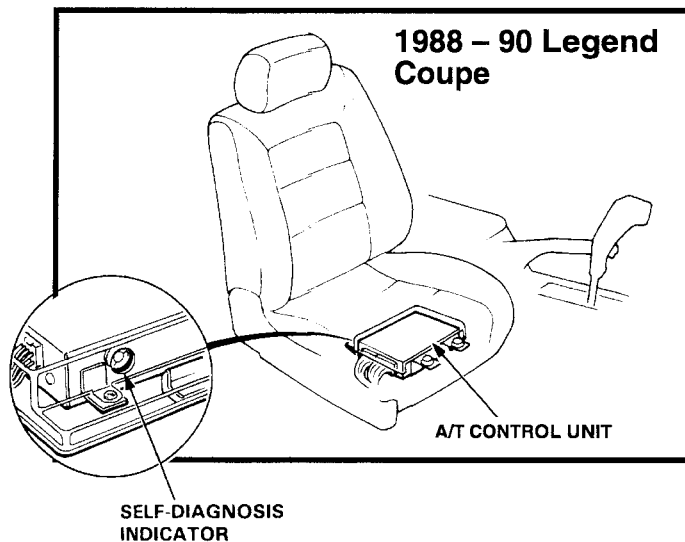


LED DISPLAY

1988 – 90 Legend Coupe — Look for the computer under the passenger's seat.

Displays from the S or D4 Light

1988 – 90 Legend Coupe



A/T CONTROL UNIT

SELF-DIAGNOSIS
INDICATOR

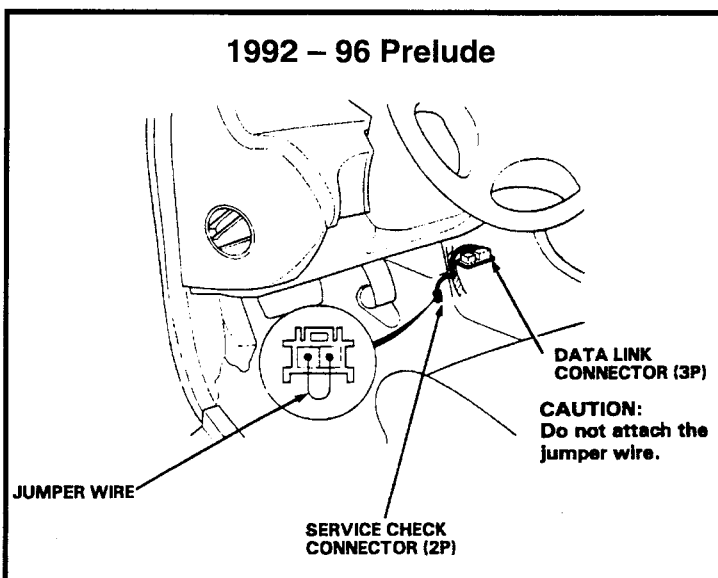
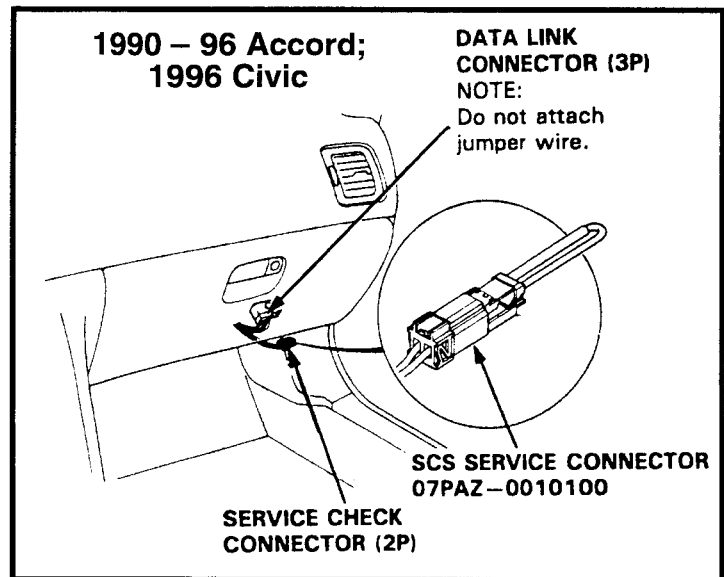
Diagnostic Trouble Code Retrieval (continued)

Here's a list of the cars that deliver diagnostic trouble codes through the S or D4 light on the dash. These vehicles have a "service check" connector; to read any trouble codes in memory, you have to jump to terminals of the service check connector together, and turn the ignition key on. The "service check" connector is either a single connector with two wires, or two separate connectors in a single harness. In either case, these wires aren't connected to anything; the connector (or connectors) sits open.

Honda

IMPORTANT: The data link connector (DLC) sits right next to the "service check" connector on these Hondas. Don't confuse the two, and never jump the wires on the data link connector; jumping the data link connector will damage the computer.

1990 – 96 Accord; 1996 Civic — Look for the "service check" connector tucked under the far right edge of the dashboard, either below the right bottom edge of the glove box, or behind the top edge of the passenger's side carpet, on top of the computer.



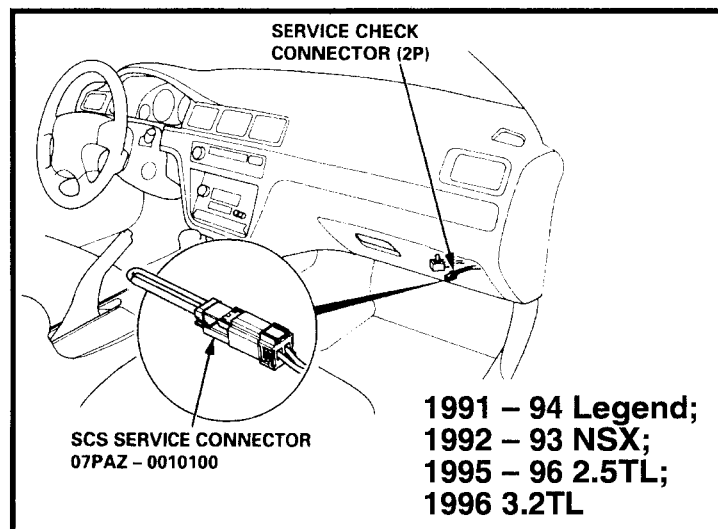
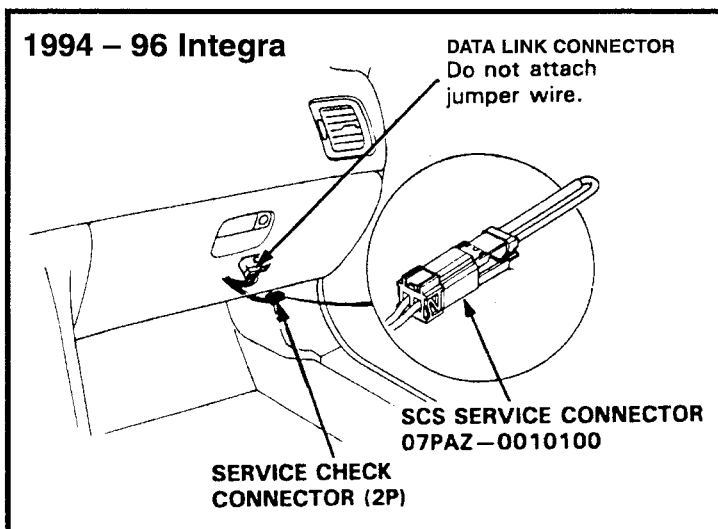
1992 – 96 Prelude — Look for the "service check" connector behind the center console.

Diagnostic Trouble Code Retrieval (continued)

Displays from the S or D4 Light (continued)

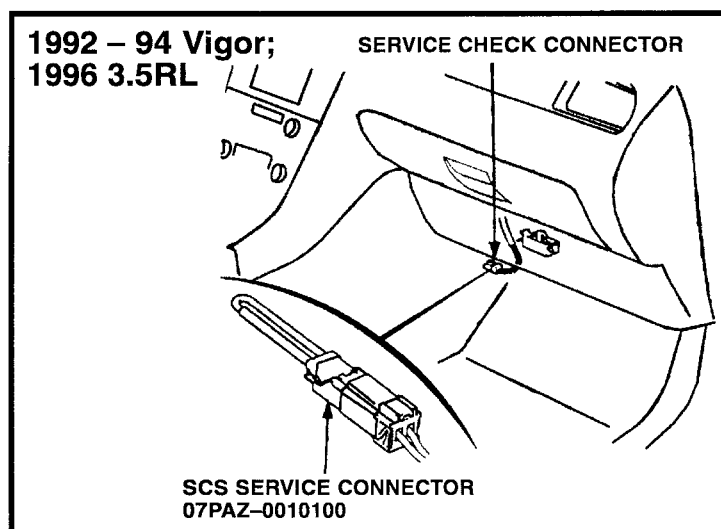
Acura

1994 – 96 Integra — Look for the “service check” connector tucked under the far right edge of the dashboard, either below the right bottom edge of the glove box, or behind the top edge of the passenger’s side carpet, on top of the computer.



1991 – 94 Legend; 1992 – 93 NSX; 1995 – 96 2.5TL; 1996 3.2TL — Look for the “service check” connector tucked under the far right edge of the dashboard, either below the right bottom edge of the glove box, or behind the top edge of the passenger’s side carpet, on top of the computer.

1992 – 94 Vigor; 1996 3.5RL — Look for the “service check” connector under the left front edge of the passenger’s carpet, up against the firewall. Be careful adjusting the carpet, or you’ll never get it back in place afterward.



Diagnostic Trouble Code Format

Hondas and Acuras display diagnostic trouble codes in one of two formats: as single- and two-digit codes.

Single-Digit Codes

Single-digit codes are just what their name implies: The computer displays each code by flashing the light a number of times to match the code number. So code 5 is five flashes; code 10 is ten flashes, and so on. If there's only one code in memory, the computer displays that code, pauses, then displays the code again. If there's more than one code in memory, the computer displays the codes in order, from lowest to highest.

All of the systems that use an LED on the computer to display codes use single-digit codes.

Two-Digit Codes

Systems that use two-digit codes display diagnostic trouble codes as two separate digits; that is, they display the tens using one set of flashes, and the ones as another set of flashes.

The tens flashes are long flashes — they are usually about 1 1/2 seconds long. The ones flashes are much shorter; only about a half a second long. So code 14 would be one long flash, a short pause, and four short flashes. Zero is no flashes, so code ten would just be a long flash, followed by a long pause, to indicate that code is over, and the system is ready to move on to the next code.

Here's how the "S" or "D4" light would flash out diagnostic trouble codes 10 and 14.



All of the systems that use the "S" or "D4" light to display diagnostic trouble codes use two-digit codes. The system will display the codes in order, from the lowest to the highest number, and then repeat itself as long as you have the "service check" connector jumped and the key on.

Clearing the Diagnostic Trouble Codes

IMPORTANT: Never disconnect the battery to clear diagnostic trouble codes from memory. While this will erase the codes, it also erases all other memories in the vehicle, including the radio presets and the engine computer's learned parameters. This will affect the vehicle's operation, and can easily lead to a dissatisfied customer.

To clear any diagnostic trouble codes from memory, remove the fuse listed for the vehicle you're working on, and leave it out for at least a minute. Then reinstall the fuse, and drive the vehicle. After a thorough road test, recheck for any codes in memory. If there are no further codes in memory, your repairs were successful; if the codes return, or new codes appear, always check those problems before delivering the vehicle.

Vehicle Model	Year	Fuse to Erase Codes
Honda		
Accord	1990 – 96	Backup Fuse
Civic 4x4	1989 – 91	#34 Fuse
Civic	1996	Backup Fuse
Prelude	1989 – 91	#35 Fuse
	1992 – 96	Clock Radio Fuse
Acura		
Integra	1991 – 93	#34 Fuse
	1994 – 96	Backup Fuse
Legend	1988 – 90	#22 Fuse
	1991 – 95	#15 Fuse (in Underdash Fusebox)
Vigor	1992 – 94	Backup Fuse
2.5TL	1995 – 96	Backup Fuse
3.2TL	1996	Backup Fuse
3.5RL	1996	Backup Fuse

Depending upon the fuse that you remove, you may still have to reset the clock, radio presets, etc.

NOTE: All fuses are in the engine compartment fuse box except the 1991 – 94 Legend.

Diagnostic Trouble Codes

Here is a list of the diagnostic trouble codes that apply to Honda and Acura vehicles. Remember, never condemn a component based solely on a code; always check the circuit and component before replacing any parts.

Code	Description
------	-------------

- | | |
|----|--|
| 1 | Open or Shorted Lockup Solenoid A |
| 2 | Open or Shorted Lockup Solenoid B |
| 3 | Open or Shorted Throttle Position Sensor |
| 4 | Open or Shorted Vehicle Speed Sensor |
| 5 | Faulty Shifter Position Switch Circuit |
| 6 | Faulty Shifter Position Switch Circuit |
| 7 | Open or Shorted Shift Solenoid A |
| 8 | Open or Shorted Shift Solenoid B |
| 9 | Open or Shorted Countershaft Speed Sensor (Reed Type on Some Models) |
| 10 | Open or Shorted Coolant Temperature Sensor |
| 11 | Open or Shorted Tach Signal Lead |
| 12 | Faulty Cooling Fan Control Unit Lead (Legend w/Type 1 Control Unit) |
| 13 | Open or Shorted PA (Baro) Sensor (1990 – 93 Integra) |
| 14 | Open or Shorted FAS Lead |
| 15 | Open or Shorted Mainshaft Speed Sensor |
| 16 | Open or Shorted Pressure Control Solenoid |
| 17 | Open or Shorted Kickdown Solenoid (Legend) |
| 40 | Lockup Control System |
| 41 | Shift Control System |

Transaxle Computer Types

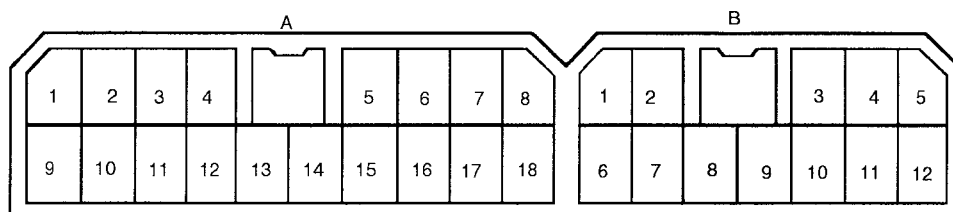
Over the years, Honda and Acura have used five different types of computers in their vehicles. Each of these computers has its own terminal configuration, and provides its own level of system control.

Here's a list of the different transmission computers, and the vehicles that each type of computer appears in.

Computer System	Manufacturer	Vehicle
Type 1	Honda	1989 – 91 Civic 4WD
		1989 – 91 Prelude
	Acura	1990 – 93 Integra
		1987 – 89 Legend
Type 2	Honda	1990 – 95 Accord
		1995 – 96 Accord V6
		1992 – 95 Prelude
	Acura	1994 – 96 Integra
		1990 Legend
		1992 – 94 Vigor
		1995 – 96 2.5TL
Type 3	Acura	1991 – 95 Legend
Type 4	Honda	1996 Accord 4-cyl
		1996 Civic
		1996 Prelude
Type 5	Acura	1996 3.2TL
		1996 3.5RL

The next few pages provide a listing of each type of computer's terminal connectors, along with an identification listing for each terminal. Use these pages as a reference to diagnose computer system problems on these systems.

Transaxle Computer Type 1



Connector A

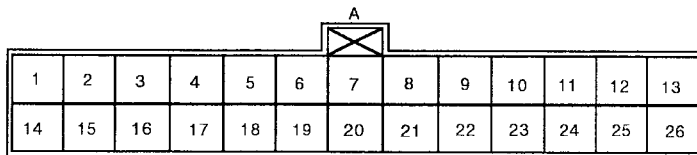
1. Interlock Control Unit (Prelude, Integra)
Cooling Fan Control Unit (Legend)
Shift Position Switch; Low (Civic)
2. VSS+ (on Transmission)
3. VSS+ (Speedometer)
4. Shift Position Switch (2)
5. Shift Position Switch (S)
6. Shift Position Switch (D)
7. Shift Position Switch (P/N)
8. Shift Position Switch (R)
9. S4 Light (on Switch)
10. PA (Baro) Sensor
11. TPS
12. PGM-FI
13. VSS
14. S4 Switch
15. Brake Switch
16. Coolant Temperature Sensor
17. Tach Signal
18. A/C Switch

Connector B

1. Shift Solenoid B
2. Shift Solenoid A
3. Lockup Solenoid A
4. Ignition Switch (+)
5. Ground
6. Battery
7. Not Used
8. Low Indicator Light
9. Not Used
10. Lockup Solenoid B
11. Ignition Switch (+)
12. Ground

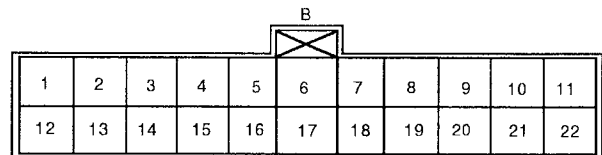
NOTE: Not all terminals appear on all models.

Transaxle Computer Type 2



Connector A

1. Pressure Control Solenoid (-)
2. Shift Solenoid B
3. Shift Solenoid A
4. Park Signal
5. Tach Signal
6. Shift Position Switch (1)
7. Shift Position Switch (2)
8. Shift Position Switch (D3)
9. Shift Position Switch (D4)
10. Shift Position Switch (P/N)
11. Shift Position Switch (R)
12. Ignition
13. Ground
14. Ground*
15. Lockup Solenoid B
16. Lockup Solenoid A
17. S or D4 Light
18. Brightness Reduction Circuit
19. Brightness Reduction Circuit (Legend)
20. PGM-FI (AT.CHK) Cooling Fan Control Unit (Legend)
21. PFM-FI
22. Interlock Control Unit
23. Battery (+)
24. A/C Switch
25. Ignition
26. Ground

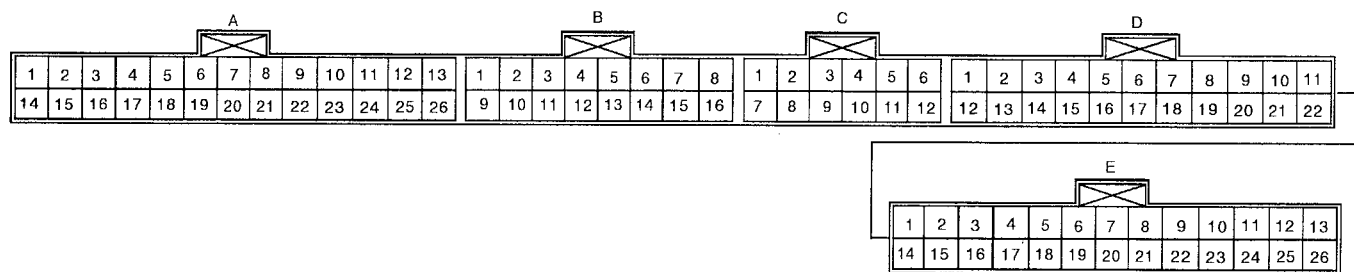


Connector B

1. Pressure Control Solenoid (+)
2. PA (Baro) Sensor
3. Coolant Temperature Sensor
4. TPS
5. VSS
6. PGM-FI (AFSB)
7. PGM-FI (AFSA)
8. NC Speed Sensor (Counter Shaft)
9. NC Speed Sensor (Counter Shaft)
10. NM Speed Sensor (Mainshaft)
11. Not Used
12. Brake Switch
13. Not Used
14. SCS (Service Check Switch)
15. Not Used
16. Not Used
17. NM Speed Sensor (Main shaft)
18. Not Used
19. PGM-FI (FAS)
20. PGM-FI (VREF)
21. 'S' Switch
22. Not Used

NOTE: Not all terminals appear on all models.

Transaxle Computer Type 3



Connector A

- 13. Main Relay
- 26. Ground

Connector B

- 4. Shifter Position Switch (Park)
- 9. Ground

Connector C

- 1. Main Relay
- 2. Cooling Fan Control Module
- 5. SCS (Service Check Switch)
- 7. VSS

Connector D

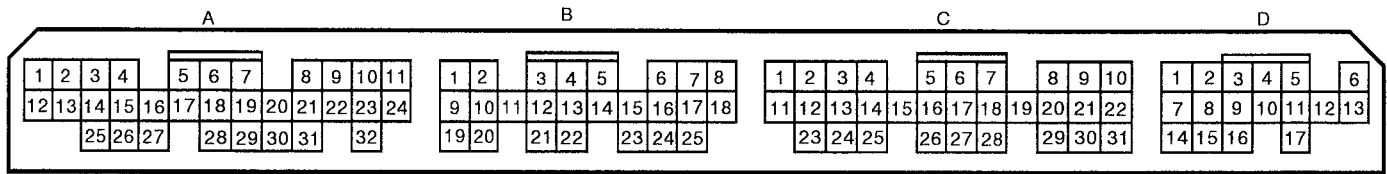
- 1. Battery
- 6. TPS
- 7. Coolant Temperature Sensor
- 11. TPS/Coolant Temperature Sensor Ground
- 12. Brake Switch
- 21. TPS Power
- 22. TPS/Coolant Temperature Sensor Ground

Connector E

- 1. Ignition Switch
- 2. Ground
- 3. Pressure Control Solenoid (+)
- 4. NM Speed Sensor Ground (Mainshaft)
- 5. NC Speed Sensor Ground (Countershaft)
- 6. Not Used
- 7. Shifter Position Switch (R)
- 8. Shifter Position Switch (D4)
- 9. Shifter Position Switch (D3)
- 10. Shifter Position Switch (2)
- 11. Shifter Position Switch (1)
- 12. Shift Solenoid A
- 13. Lockup Solenoid A
- 14. Ignition Switch
- 15. Ground
- 16. Pressure Control Solenoid (–)
- 17. NM Speed Sensor (Mainshaft)
- 18. NC Speed Sensor (Countershaft)
- 19. Dimmer Cancel Circuit
- 20. Not Used
- 21. Kickdown Switch
- 22. Interlock Control Unit
- 23. D4 Light
- 24. Not Used
- 25. Shift Solenoid B
- 26. Lockup Solenoid B

NOTE: Not all terminals appear on all models.

Transaxle Computer Type 4



Connector A

- 10. Ground
- 11. Main Relay
- 23. Ground
- 24. Main Relay

Connector C

- 7. SCS (Service Check Switch)
- 10. Battery
- 18. VSS

Connector B

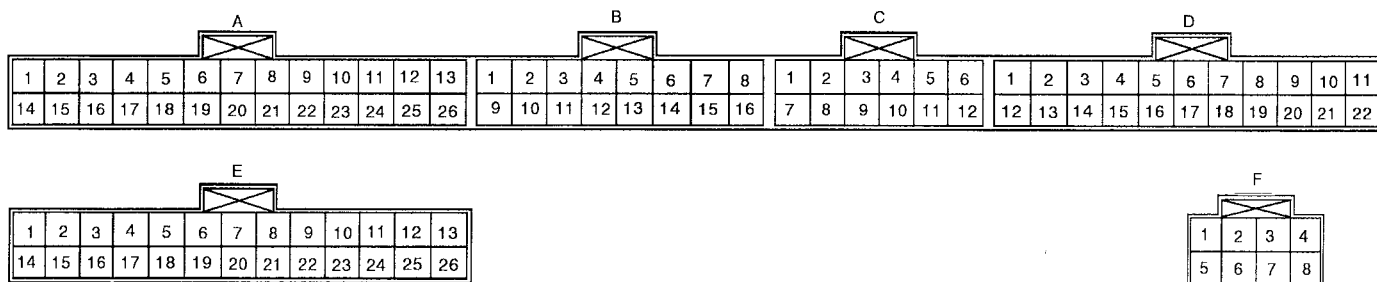
- 1. Pressure Control Solenoid (−)
- 2. Pressure Control Solenoid (+)
- 3. Shift Solenoid A
- 4. Lockup Solenoid B
- 5. Lockup Solenoid A
- 6. Not Used
- 7. Not Used
- 8. Shifter Position Switch (D³)
- 9. Not Used
- 10. Not Used
- 11. Shift Solenoid B
- 12. Interlock Control Unit
- 13. D4 Light
- 14. MN Speed Sensor Ground (Mainshaft)
- 15. MN Speed Sensor Ground (Mainshaft)
- 16. Shifter Position Switch (R)
- 17. Shifter Position Switch (2)
- 18. Shifter Position Switch (1)
- 19. Not Used
- 20. Not Used
- 21. Not Used
- 22. NC Speed Sensor Ground (Countershaft)
- 23. NC Speed Sensor Ground (Countershaft)
- 24. Shifter Position Sensor (D4)
- 25. Shifter Position Sensor (P/N)

Connector D

- 1. TPS
- 2. Coolant Temperature Sensor
- 5. Brake Switch
- 10. TPS Power
- 11. Signal Ground

NOTE: Not all terminals appear on all models.

Transaxle Computer Type 5



Connector A

- 12. Ground
- 13. PGM-FI Main Relay
- 25. Ground

Connector B

- 1. PGM-FI Main Relay
- 13. VSS

Connector C

- 5. SCS (Service Check Switch)

Connector D

- 1. Battery
- 6. TPS
- 7. (ETC) Coolant Temperature Sensor
- 21. TPS-Power
- 22. Sensor Ground (TPS, ECT, SCS)

Connector E

Not used for transmission operation.

NOTE: Not all terminals appear on all models.

Connector E

- 1. Ignition Switch
- 2. Brake Switch
- 3. Pressure Control Solenoid
- 4. NM Speed Sensor (Mainshaft)
- 5. NC Speed Sensor (Countershaft)
- 6. TCS Control Unit
- 7. Shifter Position Switch (R)
- 8. Shifter Position Switch (D4)
- 9. Shifter Position Switch (D3)
- 10. Shifter Position Switch (2)
- 11. Shifter Position Switch (1)
- 12. Shift Solenoid A
- 13. Lockup Solenoid A
- 14. Not Used
- 15. Not Used
- 16. Pressure Control Solenoid (—)
- 17. NM Speed Sensor Ground (Mainshaft)
- 18. NC Speed Sensor Ground (Countershaft)
- 19. Not Used
- 20. Not Used
- 21. Not Used
- 22. Multiplex Dr Unit or Interlock Control Unit (Model Dependent)
- 23. D4 Light
- 24. Shifter Position Switch (P/N)
- 25. Shift Solenoid B
- 26. Lockup Solenoid B

Transaxle Computer Testing

Transaxle Computer Terminal Number					Item Being Checked	Specifications	Conditions
Type 1	Type 2	Type 3	Type 4	Type 5			
Power and Ground							
B4, B11	A12, A25	E1, E14	—	E1	Ignition Switch	System (Battery) Voltage	Ignition On
B6	A23	D1	C10	D1	Battery	System (Battery) Voltage	Always
—	—	A13, C1	A11, A24	B1, A13	PGM-FI Main Relay	System (Battery) Voltage	Ignition On
B5, B12	A26, A13, A14	A26, B9, E2, E15	A10, A23	A12, A25	Ground	Less than 0.1 V	Always
A13	—	D11, D22	D11	D22	Sensor Ground (TPS, ECT, SCS, etc.)	Less than 0.1 V	Always
Vehicle Speed							
A3	B5	C7	C18	B13	Vehicle Speed Sensor (Speedometer)	5 Volts; Pulsing	Drive Wheels Turning
A2	—	—	—	—	Vehicle Speed Sensor (Transaxle)	5 Volts; Pulsing	Drive Wheels Turning
—	—	E17	B15	E4	NM Speed Sensor (Mainshaft)	AC Voltage	Zero at a Stop; Voltage Increases with Drive Wheel RPM
—	—	E4	B14	E17	NM Speed Sensor Ground (Mainshaft)		
—	—	E18	B23	E5	NC Speed Sensor (Countershaft)	AC Voltage	Zero at a Stop; Voltage Increases with Drive Wheel RPM
—	—	E5	B22	E18	NC Speed Sensor Ground (Countershaft)		
Shifter Position							
—	A4	—	—	—	Park Switch	System (Battery) Voltage	Shift Selector in Park
A7	A4, A10	B4	B25	E24	Shifter Position Switch (P/N)	System (Battery) Voltage	Shift Selector in Neutral or Park
A8	A11	E7	B16	E7	Shifter Position Switch (R)	System (Battery) Voltage	Shift Selector in Reverse
A6	A9	E8	B24	E8	Shifter Position Switch (D4 or D)	System (Battery) Voltage	Shift Selector in D or D4
A5	A8	E9	B8	E9	Shifter Position Switch (D3 or S)	System (Battery) Voltage	Shift Selector in S or D3
A4	A7	E10	B17	E10	Shifter Position Switch (2)	System (Battery) Voltage	Shift Selector in 2
—	A6	E11	B18	E11	Shifter Position Switch (1)	System (Battery) Voltage	Shift Selector in 1

Continued...

Transaxle Computer Testing (continued)

Transaxle Computer Terminal Number					Item Being Checked	Specifications	Conditions
Type 1	Type 2	Type 3	Type 4	Type 5			
Throttle Position Sensor							
—	—	D21	D10	D21	TPS Power	4.75 – 5.25 Volts	Ignition On
A11	B4	D6	D1	D6	TPS Signal	0.5 Volts 4.7 Volts	Closed Throttle Open Throttle
—	—	D11, D22	D11	D22	TPS Ground	Less than 0.1 Volt	Always
—	—	E21	—	—	Kickdown Switch	System (Battery) Voltage	Switch open (Less than wide-open throttle)
Other Inputs							
A15	B12	D12	D5	E2	Brake Switch	System (Battery) Voltage	Ignition On
A16	B3	D7	D2	D7	Coolant Temp. Sensor	0.5 – 4.5 Volts	Increases with coolant temperature
A10	B2	E17	B15	E4	PA Sensor	0.25 Volts 3.0 Volts	28" of vacuum 0" of vacuum
A17	A5	—	—	—	Tach Signal	Engine RPM	Check with Tach/Dwellmeter
Solenoids							
B2	A3	E12	B3	E12	Shift Solenoid A	System (Battery) Voltage	Transmission in 2 nd and 3 rd gear ranges
B1	A2	E25	B11	E25	Shift Solenoid B	System (Battery) Voltage	Transmission in 1 st and 2 nd gear ranges
B3	A16	E13	B5	E13	Lockup Solenoid A	System (Battery) Voltage	Transmission in lockup
B10	A15	E26	B4	E26	Lockup Solenoid B	System (Battery) Voltage	Transmission locked up half way or more
—	B1	E3	B1	E3	Pressure Control Sol. (+)	System (Battery) Voltage	Ignition On
—	A1	E16	B2	E16	Pressure Control Sol. (–)	Duty Cycled	Engine Running
Diagnostics							
—	B14	C5	C7	C5	Service Check Switch (SCS)	No Voltage Spec Available	

Pressure Specifications

IMPORTANT: All TV pressures will be zero PSI at closed throttle, and will rise to the specification shown at wide-open throttle.

All governor pressure specifications were recorded at 38 MPH.

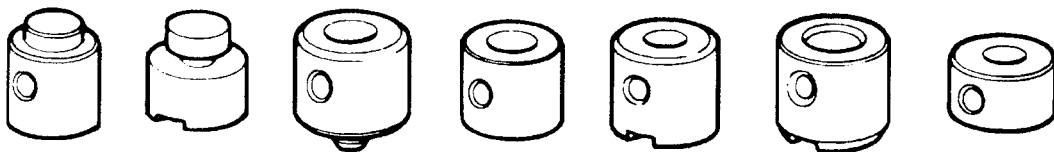
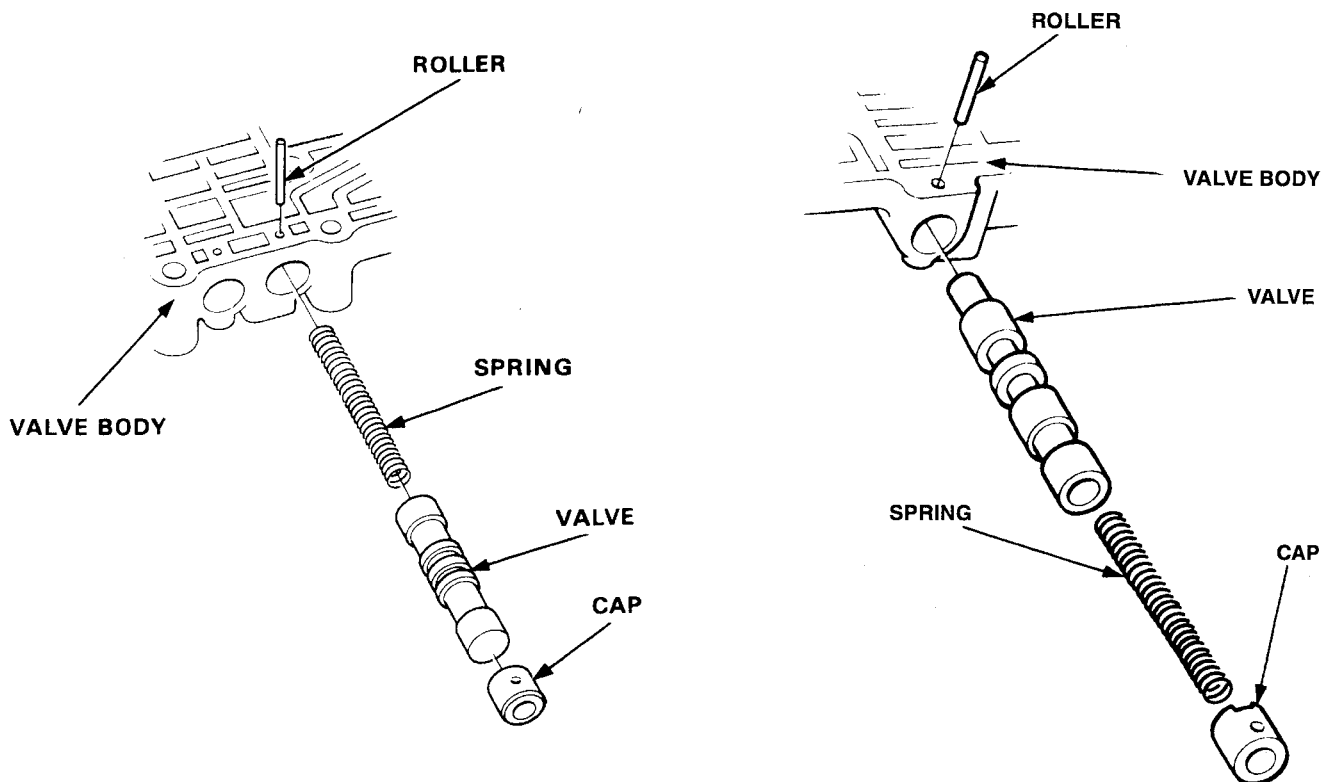
Transaxle	Mainline	TV A	TV B	Governor	Special Instructions
AK	107 – 114	78 – 80	107 – 114	31 – 33	
APX4	114 – 121	N/A	114 – 121	N/A	
AS	114 – 121	73 – 75	114 – 121	31 – 33	
A0YA	120 – 130	N/A	120 – 130	N/A	
A4RA	120 – 130	N/A	N/A	N/A	
CA	121 – 128	79 – 81	121 – 128	31 – 32	Use the L4 specifications for CA units in Civics
F4	114 – 121	73 – 75	114 – 121	31 – 32	
G4	114 – 121	67 – 69	114 – 121	26 – 28	
K4	121 – 128	N/A	121 – 128	N/A	
L4	114 – 121	73 – 75	114 – 121	30 – 31	
L5	114 – 121	N/A	114 – 121	N/A	
ML4A	114 – 121	73 – 75	114 – 121	30 – 31	
MPRA	111 – 118	N/A	111 – 118	N/A	With vacuum modulator disconnected
	71 – 85	N/A	111 – 118	N/A	At 19" to 23" of vacuum to the modulator
MPSA	114 – 121	N/A	114 – 121	N/A	
MPWA Honda	114 – 121	N/A	114 – 121	N/A	
MPWA Acura	121 – 128	N/A	71 – 75	N/A	
MPXA	114 – 121	N/A	114 – 121	N/A	
MPYA	114 – 122	N/A	84 – 91	N/A	
MPZA	71 / 120	N/A	78 – 85	N/A	Mainline varies with throttle opening: Closed / WOT
MP0A	120 – 130	N/A	120 – 130	N/A	
MP1A	114 – 121	N/A	114 – 121	N/A	
MP7A	120 – 130	N/A	120 – 130	N/A	
MY8A	121 – 128	N/A	121 – 128	N/A	
M1WA	85 / 130	N/A	81 – 87	N/A	Mainline varies with throttle opening: Closed / WOT
M24A	114 – 121	69 – 71	114 – 121	26 – 27	All except 1993 – 95 w/1.5L engine
	121 – 128	69 – 71	121 – 128	26 – 27	1993 – 95 w/1.5L engine only
M5DA	75 / 130	N/A	80 – 85	N/A	Mainline varies with throttle opening: Closed / WOT
M5HA	118 – 120	N/A	84 – 91	N/A	
PL5X	114 – 121	N/A	114 – 121	N/A	
PX4B	114 – 121	N/A	114 – 121	N/A	
PY8A	121 – 128	N/A	121 – 128	N/A	
P1	121 – 128	79 – 81	121 – 128	31 – 32	
RO	111 – 118	N/A	111 – 118	N/A	With vacuum modulator disconnected
RO	71 – 85	N/A	111 – 118	N/A	At 19" to 23" of vacuum to the modulator
SP7A	120 – 130	N/A	120 – 130	N/A	
S4XA	120 – 130	N/A	120 – 130	N/A	
S5	114 – 121	N/A	114 – 121	N/A	

Valve Body Caps

One of the most common causes for after-rebuild failures is the valve body caps. These caps are directional; installing them facing the wrong way will cause any number of problems with transaxle operation.

In addition, many of these caps are hollow; that is, they have a hole drilled straight through them. These hollow caps always seat against a spring; never a valve. For a valve to stroke, pressure has to build up on the end opposite the spring. If there's a hole in the cap, pressure can't build up, so the valve never operates.

Always be careful to install the valve body caps in the correct bores, facing the proper direction.



This side of the cap always faces away from the valve body

Clutch Pack Cushions

Another common source of after-rebuild failures has to do with clutch cushions. These cushions are easy to install incorrectly, or to swap from one clutch pack to another.

These clutch cushions are specifically matched to the clutch pack they belong in. Any mistake in installation can cause a harsh apply, or can burn up a clutch pack, due to reduced clutch clearance.

Use these charts to identify the type of clutch cushion each transmission uses, and use the pictures to identify the proper way to install those cushions.

**A****B****C**
Honda 4 Clutch Pak Units

Model	1st Clutch	2nd Clutch	3rd Clutch	4th Clutch
AK	A	A	A	A
AS	A	A	A	A
A4RA	A	N/A	A	A
CA	B	A	A	A
F4	B	A	A	A
G4	B	C	A	A
K4	A	C	A	A
L4	A	C	A	A
L5	A	C	A	A
ML4A	A	C	A	A
MPRA	C	A	A	A
MY8A	C	C	A	A
PL5X	A	C	A	A
PY8A	C	C	A	A
P1	A	C	A	A
RO	A	C	A	A

Honda 5 Clutch Pak Units

Model	1st	1st Hold	2nd	3rd	4th
APX4	A	C	C	A	A
A0YA	C	C	C	C	C
MPSA	A	A	C	A	A
MPWA Honda	A	C	C	A	A
MPWA Acura	A	C	C	A	A
MPXA	A	C	C	A	A
MPZA	C	N/A	C	C	C
MP0A	C	C	C	C	C
MP1A	A	C	C	A	A
MP7A	A	A	C	A	A
M1WA	A	N/A	C	C	A
M24A	A	A	C	A	A
PX4B	A	C	C	A	A
SP7A	A	A	C	A	A
S4XA	A	A	C	A	A
S5	A	A	C	A	A

Honda 6 Clutch Pak Units

Model	1st	1st Hold	2nd	3rd	4th	Rev
MPYA	A	C	C	C	C	A
M5DA	A	C	C	N/A	N/A	A
M5HA	A	C	C	C	C	A

Clutch Pack Clearances

Proper clutch clearance adjustment is critical for proper transaxle operation; too tight, and the clutch can drag and burn up; too loose, and you could end up with a flare or shift timing problem.

The next two pages list all of the Honda and Acura transaxles, and provide the clutch clearances specifications for each clutch pack. We've separated these units by the number of clutch packs in the transaxle: 4-, 5- and 6-clutch units. Find the unit you're working on, and set the clutch clearances carefully, to make sure your rebuilds work — and last — the way they're supposed to.

4-Clutch Model Clearance Specifications				
Model	1 st Clutch	2 nd Clutch	3 rd Clutch	4 th Clutch
AK	0.016" – 0.028"	0.016" – 0.028"	0.016" – 0.028"	0.016" – 0.028"
AS	0.016" – 0.028"	0.026" – 0.031"	0.016" – 0.023"	0.016" – 0.023"
A4RA	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
CA	0.026" – 0.033"	0.026" – 0.031"	0.016" – 0.023"	0.016" – 0.023"
F4	0.026" – 0.033"	0.020" – 0.028"	0.016" – 0.024"	0.016" – 0.024"
G4	0.026" – 0.033"	0.020" – 0.028"	0.020" – 0.028"	0.016" – 0.024"
K4	0.030" – 0.037"	0.016" – 0.024"	0.016" – 0.024"	0.016" – 0.024"
L4	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
L5	0.026" – 0.033"	0.020" – 0.028"	0.020" – 0.028"	0.016" – 0.024"
ML4A	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
MPRA	0.026" – 0.033"	0.020" – 0.028"	0.016" – 0.024"	0.016" – 0.024"
MY8A	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"	0.016" – 0.024"
PL5X	0.026" – 0.033"	0.020" – 0.028"	0.020" – 0.028"	0.016" – 0.024"
PY8A	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"	0.016" – 0.024"
P1	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
RO	0.026" – 0.033"	0.020" – 0.028"	0.016" – 0.024"	0.016" – 0.024"

Continued...

Clutch Pack Clearances

5-Clutch Model Clearance Specifications					
Model	1 st Clutch	1 st Hold	2 nd Clutch	3 rd Clutch	4 th Clutch
APX4	0.026" – 0.033"	0.028" – 0.035"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
A0YA	0.026" – 0.033"	0.031" – 0.039"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
MPSA	0.026" – 0.033"	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
MPWA Honda	0.026" – 0.033"	0.028" – 0.035"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
MPWA Acura	0.026" – 0.033"	0.031" – 0.039"	0.022" – 0.030"	0.022" – 0.030"	0.022" – 0.030"
MPXA	0.026" – 0.033"	0.028" – 0.035"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
MPZA	0.030" – 0.037"	0.024" – 0.039"	0.028" – 0.035"	0.026" – 0.033"	0.022" – 0.030"
MP0A	0.026" – 0.033"	0.031" – 0.039"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
MP1A	0.026" – 0.033"	0.031" – 0.039"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
MP7A	0.026" – 0.033"	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
M1WA	0.026" – 0.033"	0.031" – 0.039"	0.022" – 0.030"	0.022" – 0.030"	0.022" – 0.030"
M24A	0.026" – 0.033"	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
PX4B	0.026" – 0.033"	0.031" – 0.039"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
SP7A	0.026" – 0.033"	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
S4XA	0.026" – 0.033"	0.026" – 0.033"	0.026" – 0.033"	0.016" – 0.024"	0.016" – 0.024"
S5	0.026" – 0.033"	0.026" – 0.033"	0.026" – 0.032"	0.016" – 0.024"	0.016" – 0.024"

6-Clutch Model Clearance Specifications						
Model	1 st Clutch	1 st Hold	2 nd Clutch	3 rd Clutch	4 th Clutch	Reverse
MPYA	0.026" – 0.033"	0.028" – 0.035"	0.024" – 0.031"	0.024" – 0.031"	0.020" – 0.028"	0.030" – 0.037"
M5DA	0.026" – 0.033"	0.028" – 0.035"	0.024" – 0.031"	0.024" – 0.031"	0.020" – 0.028"	0.030" – 0.037"
M5HA	0.026" – 0.033"	0.028" – 0.035"	0.024" – 0.031"	0.024" – 0.031"	0.020" – 0.028"	0.030" – 0.037"

Adjusting Transaxle Clearances

Honda and Acura transaxles are rather unique as automatic transmissions go. They look and operate very much like a manual transmission. Because of this unique design, they require specific attention to the clearances between the shafts and hubs. Improper clearance settings can affect transmission operation and reduce its operating life.

There are three main methods for adjusting Honda and Acura transaxle geartrain clearances:

- Selective bearing races
- Distance collars
- Selective cotters

To check these adjustments, you must assemble all of the components, including the shaft bearings, onto the shaft. Torque the assembly nut to about 50 in. lbs., and then check the clearance as shown in the procedures.

In this section, we'll look at typical examples of each type of adjustment. Using those examples, you should be able to adjust any Honda or Acura transaxle geartrain clearance.

Selective Bearing Races

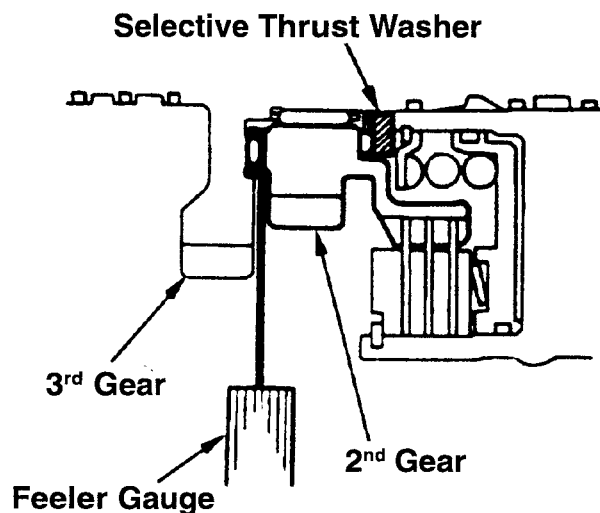
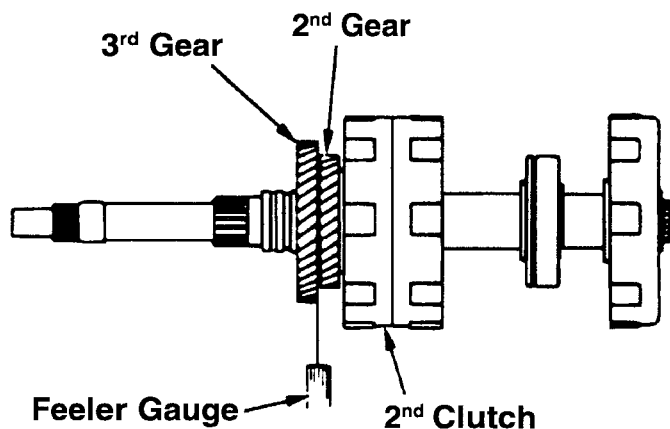
In general, the procedure for checking the clearance on the geartrain is always the same: You're checking the freeplay in the gear, and adjusting the clearance by adjusting the selective component. However, in practice, the procedure for checking that clearance may vary, depending on the component configuration, and how much room you have to check them.

There are three basic ways of checking the clearance for selective bearing races:

1. Check the clearance directly with a feeler gauge.
2. Check the component endplay with a feeler gauge.
3. Check the component endplay with a dial indicator.

We'll look at all three methods — you'll have to choose the method you need, depending on how accessible the components are.

- 1. Checking the clearance directly with a feeler gauge:** Some components provide enough clearance for you to slide a feeler gauge in between two of the mating components. If you have that access, great; just slide a feeler gauge into place, and check the clearance. Then add or subtract the proper thickness to the selective bearing race, to bring the component into specs.



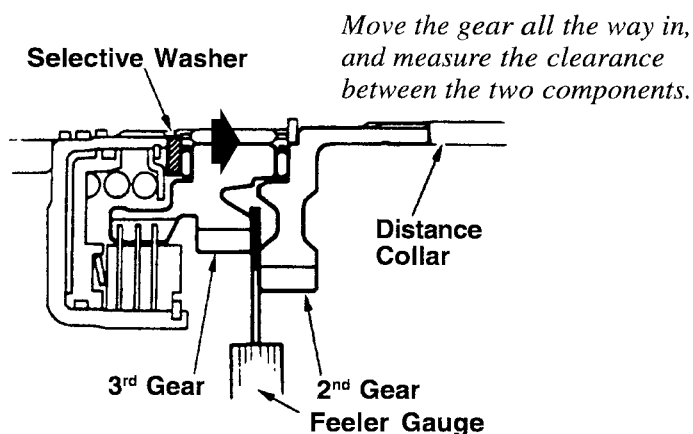
Adjusting Transaxle Clearances (continued)

Selective Bearing Races

- 2. Checking the component endplay with a feeler gauge:** In some cases, there won't be any way to reach into the selective washer or race with a feeler gauge. In that case, you can still use a feeler gauge to check the endplay; here's how:

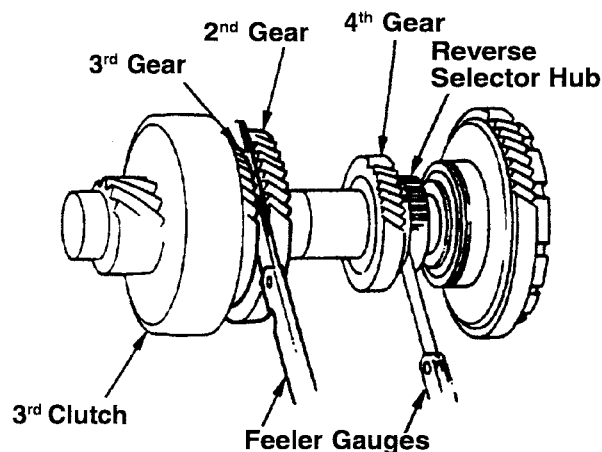
IMPORTANT: If the component you're checking shares the same shaft as a distance collar adjustment, use a feeler gauge to eliminate all of the freeplay from the distance collar before checking the selective bearing race clearance.

Step 1: Hold the gear all the way in, away from the selective bearing race.

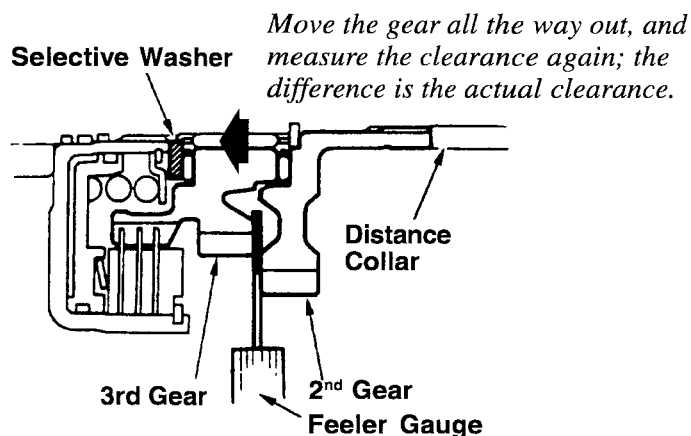


Step 2: Slide the feeler gauge (or gauges; you'll probably need several of them stacked together for this check) between the two components that require adjustment, and measure the clearance.

Step 3: Move the gear out, all the way against the selective bearing race.



Step 4: Use your feeler gauge to measure the new clearance between the two components.



Step 5: Subtract your second measurement from your first measurement. The difference is the clearance between the two components. Then add or subtract the proper thickness to the selective bearing race, to bring the component into specs.

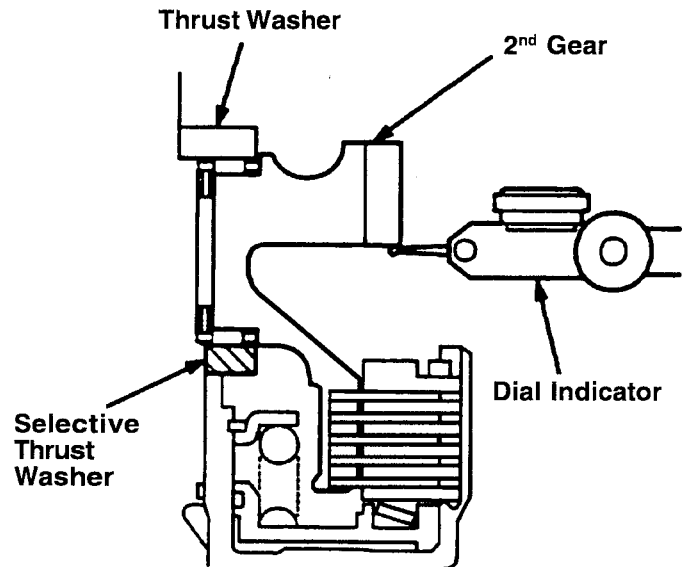
Adjusting Transaxle Clearances (continued)

Selective Bearing Races

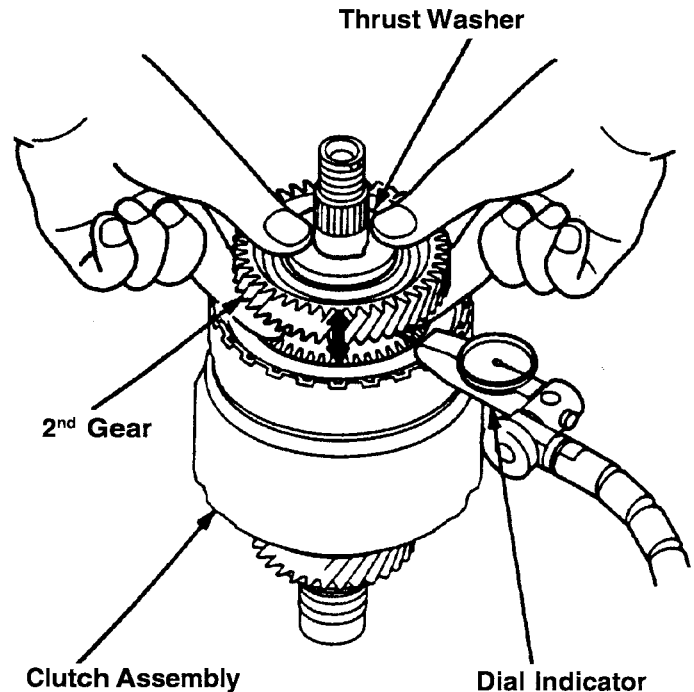
- 3. Checking the component with a dial indicator:** If you have room, you may be able to use a dial indicator against the moveable gear to measure the clearance; here's how:

Step 1: Attach the dial indicator to the component, and set the needle against the moveable gear.

Step 2: Hold the outer gear all the way in against the selective bearing race, and zero the needle on your dial indicator.



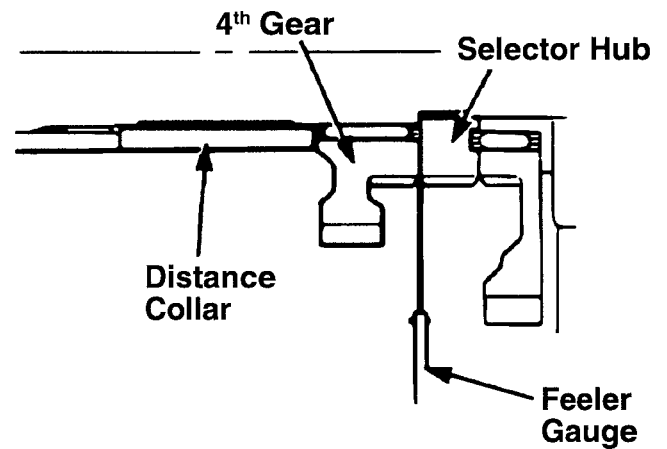
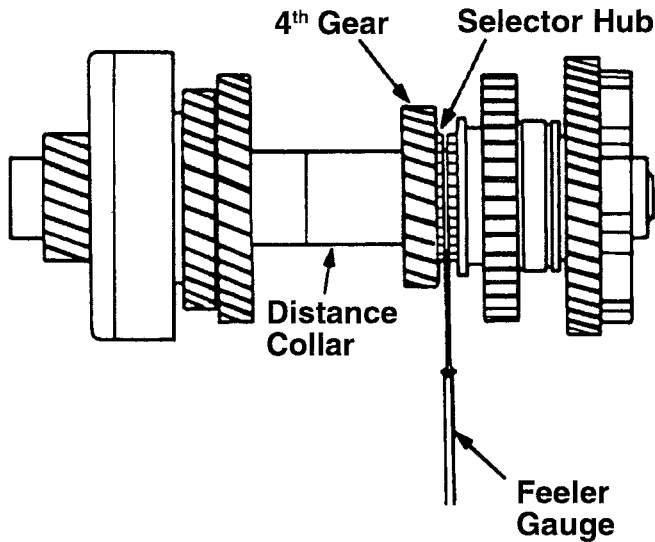
Step 3: Move the outer gear back, as far as it will go away from the selective bearing race; the dial indicator should provide the total clearance between the components. Add or subtract the proper thickness to the selective bearing race, to bring the component into specs.



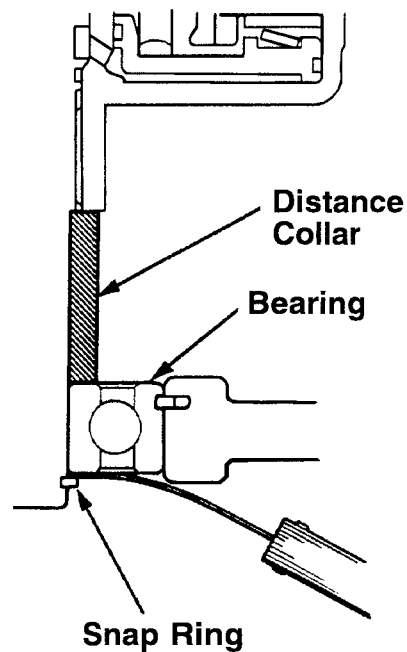
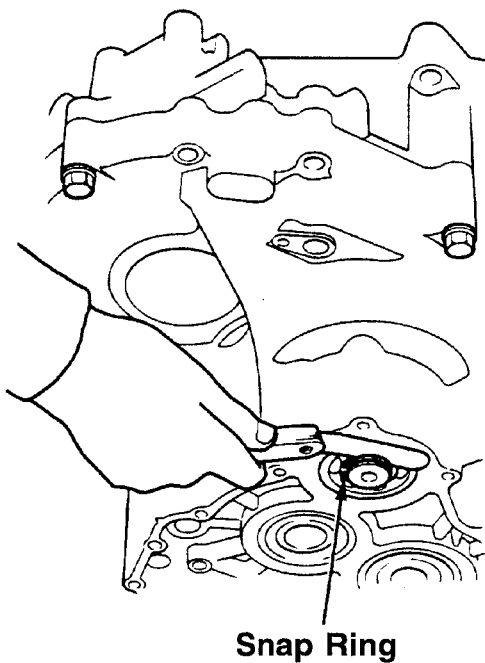
Adjusting Transaxle Clearances (continued)

Distance Collars

Checking the adjustment on a distance collar is fairly easy: Just slip a feeler gauge between two of the components in the gear stack, and measure the clearance. If the clearance is outside of specs, replace the distance collar with a taller or shorter one, to bring the clearance into specs.



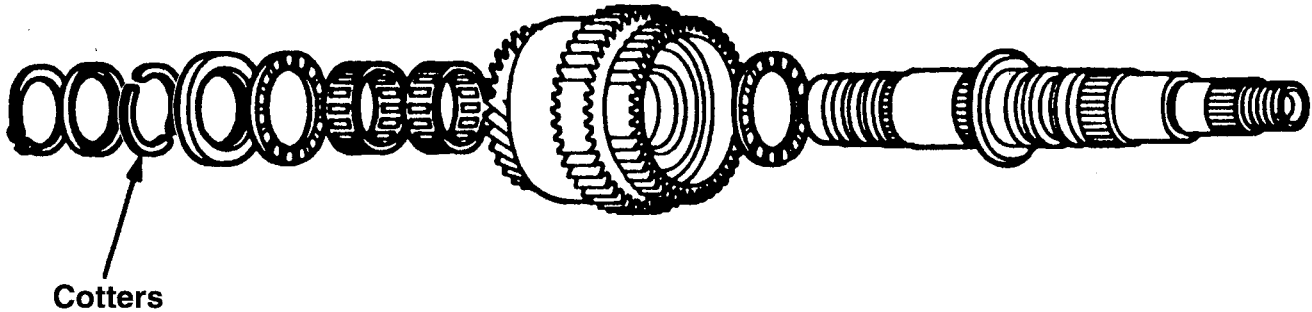
Depending on the specific unit or component you're measuring, you may even be able to measure the clearance between the case and a snap ring, such as on the 1990 – 93 Integra, shown here.



Adjusting Transaxle Clearances (continued)

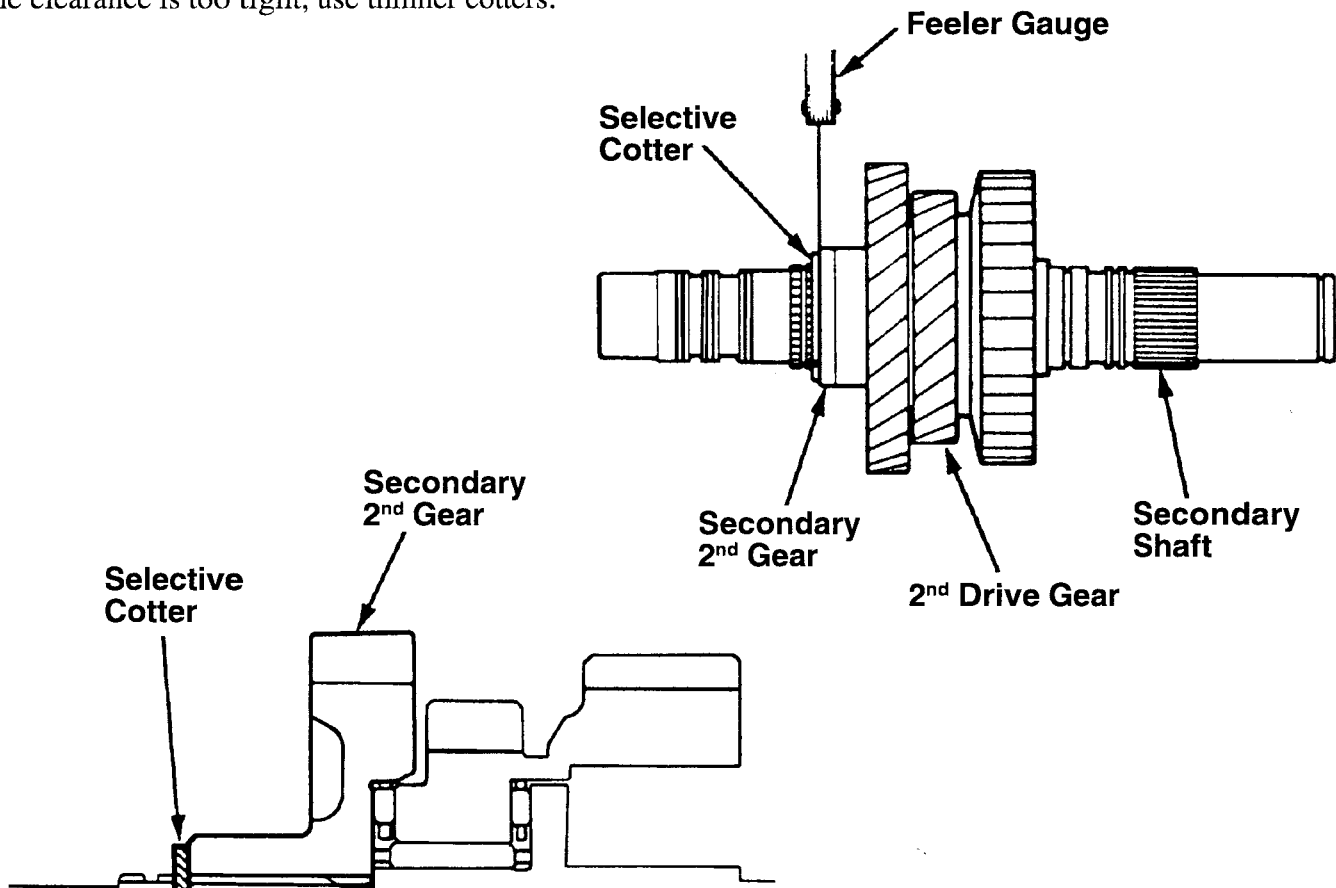
Selective Cotters

A cotter is a type of split thrust washer, with two, U-shaped halves. When placed together, the two halves form a circle, just like any other thrust washer.



Honda and Acura use cotters in several locations throughout the transmission; but only one — the 1990 – 93 Integra — uses selective cotters to adjust a clearance.

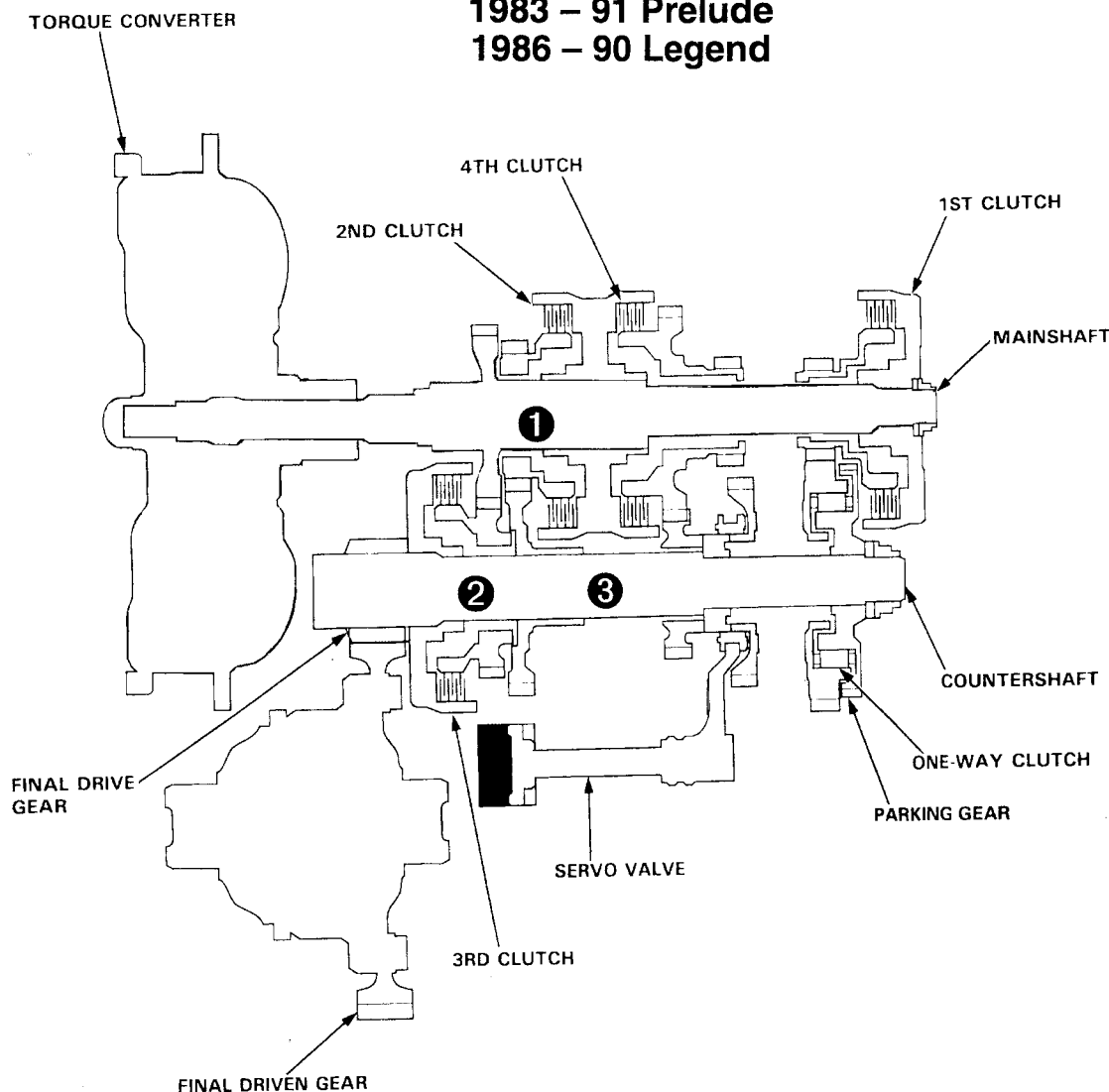
To check the clearance on these units, slip a feeler gauge between the cotters, and the secondary shaft second gear hub. Compare that clearance to the specifications: If there's too much clearance, use thicker cotters; if the clearance is too tight, use thinner cotters.



Transaxle Clearances

These next few pages cover the main transmission shaft clearances for each type of transaxle, and provide the clearance specifications for each system.

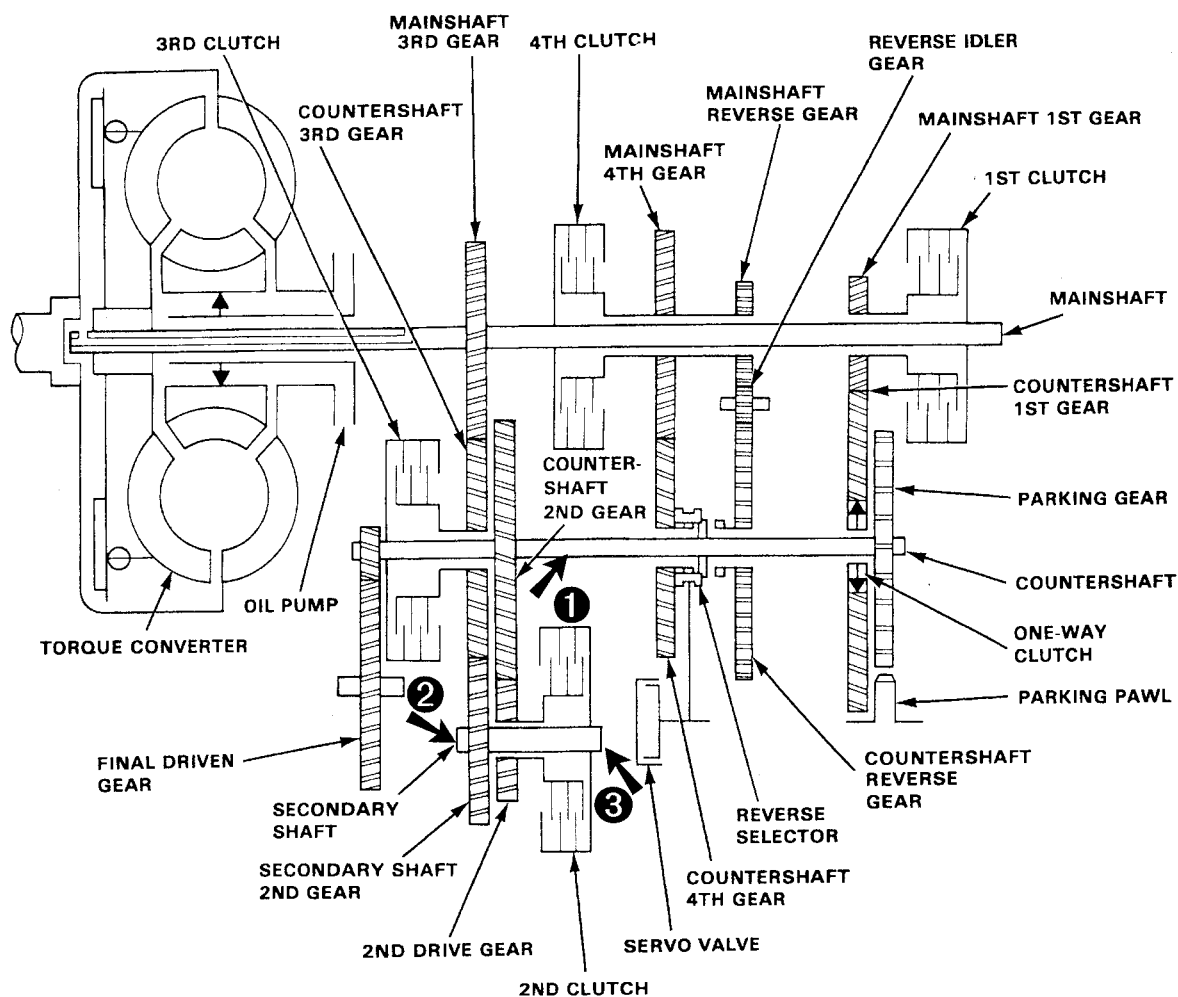
1983 – 89 Accord
1986 – 91 and 1996 Civic
1983 – 91 Prelude
1986 – 90 Legend



Setting	Measure the clearance between...	Specification
①	Bearing race between the 2 nd /4 th clutch drum and 2 nd gear	0.003" – 0.006"
②	Bearing race between 3 rd clutch and 3 rd gear (exc. Legend)	0.003" – 0.006"
③	Distance collar between 2 nd and 4 th gears	0.003" – 0.006"

Transaxle Clearances (continued)

1990 - 93 Integra

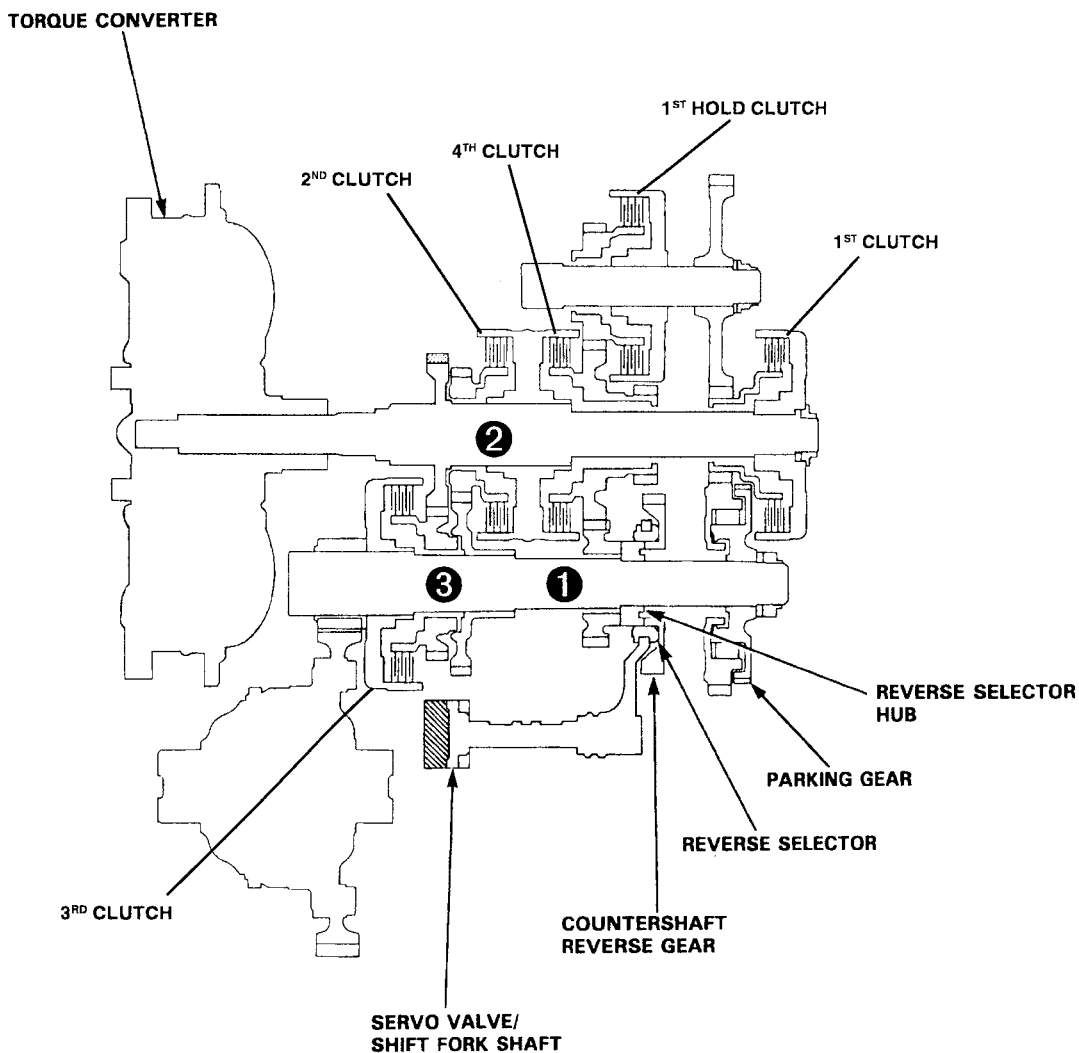


Setting	Measure the clearance between...	Specification
①	Distance collar between the 2 nd gear and 4 th gear	less than 0.0016"
NOTE: Wedge a feeler gauge between the reverse gear and the selector hub to take measurement ①.		
②	Cotters between the secondary shaft 2 nd gear and snap ring	less than 0.003"
③	Distance collar on the secondary shaft	less than 0.003"

Transaxle Clearances (continued)

1989 – 91 Civic 4WD

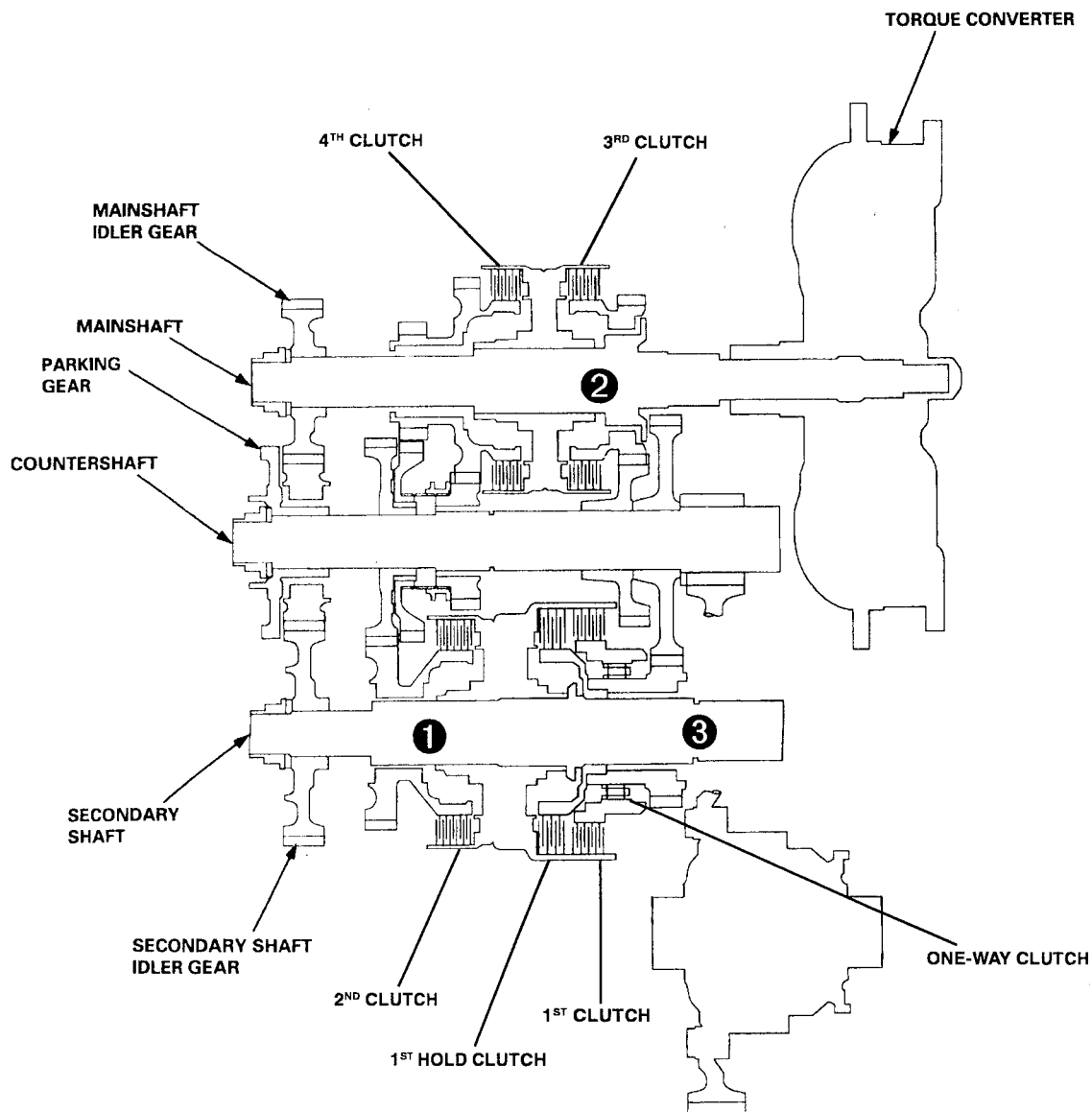
1992 – 95 Civic



Setting	Measure the clearance between...	Specification
①	Distance collar between the 4 th gear and 2 nd gear	0.002" – 0.005"
②	Bearing race between the 2 nd /4 th clutch drum and 2 nd gear	0.002" – 0.005"
③	Bearing race between the 3 rd clutch drum and 3 rd gear	0.002" – 0.005"

Transaxle Clearances (continued)

1995 – 96 Accord V6

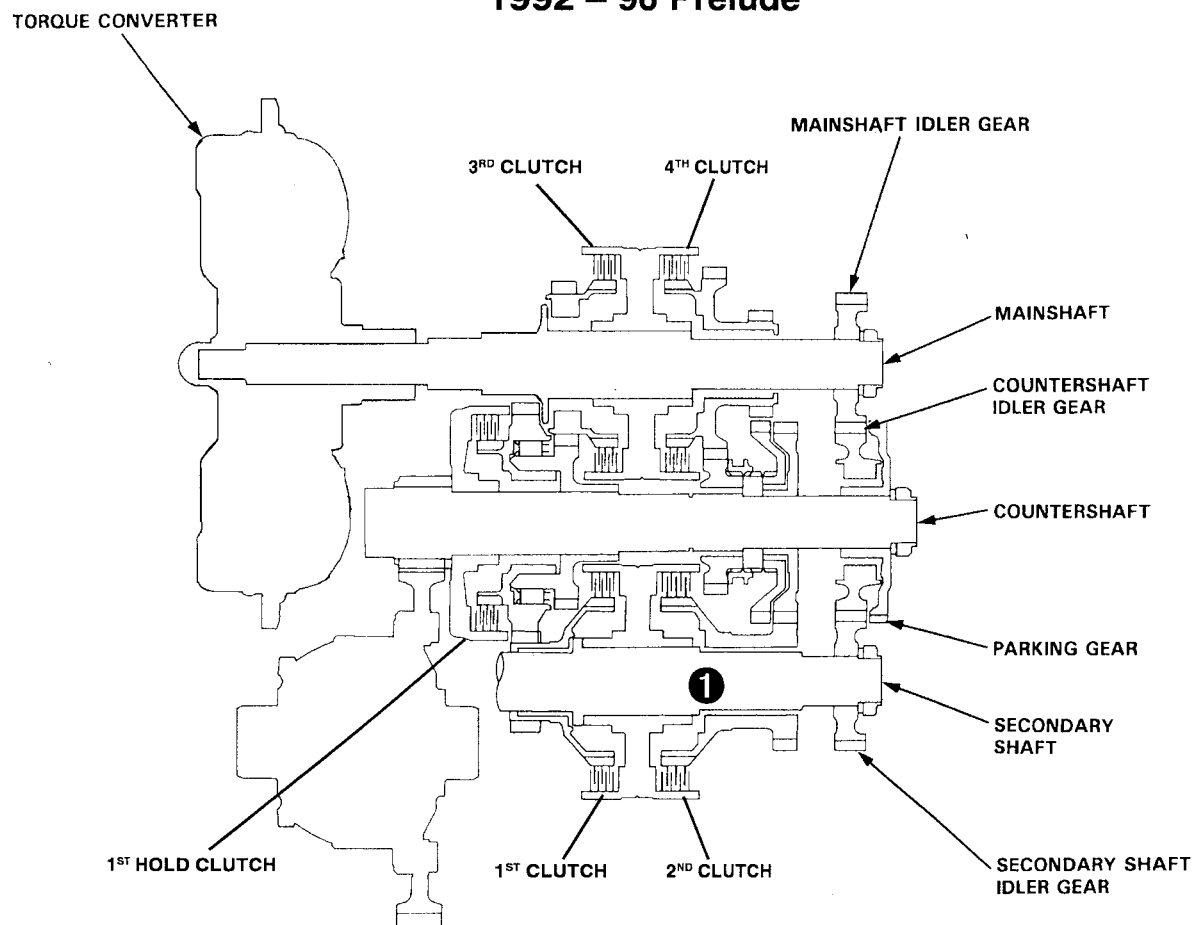


Setting	Measure the clearance between...	Specification
①	Bearing race between 1 st /1 st hold/2 nd clutch drum and 2 nd gear	0.003" – 0.006"
②	Bearing race between the 3 rd /4 th clutch drum and 3 rd gear	0.001" – 0.004"
③	Bearing race between the collars and 1 st gear one-way clutch assembly	0.003" – 0.006"

Transaxle Clearances (continued)

1990 – 96 Accord

1992 – 96 Prelude



Setting **Measure the clearance between...**

1

Bearing race between 1st/2nd clutch drum and 2nd gear

Specification

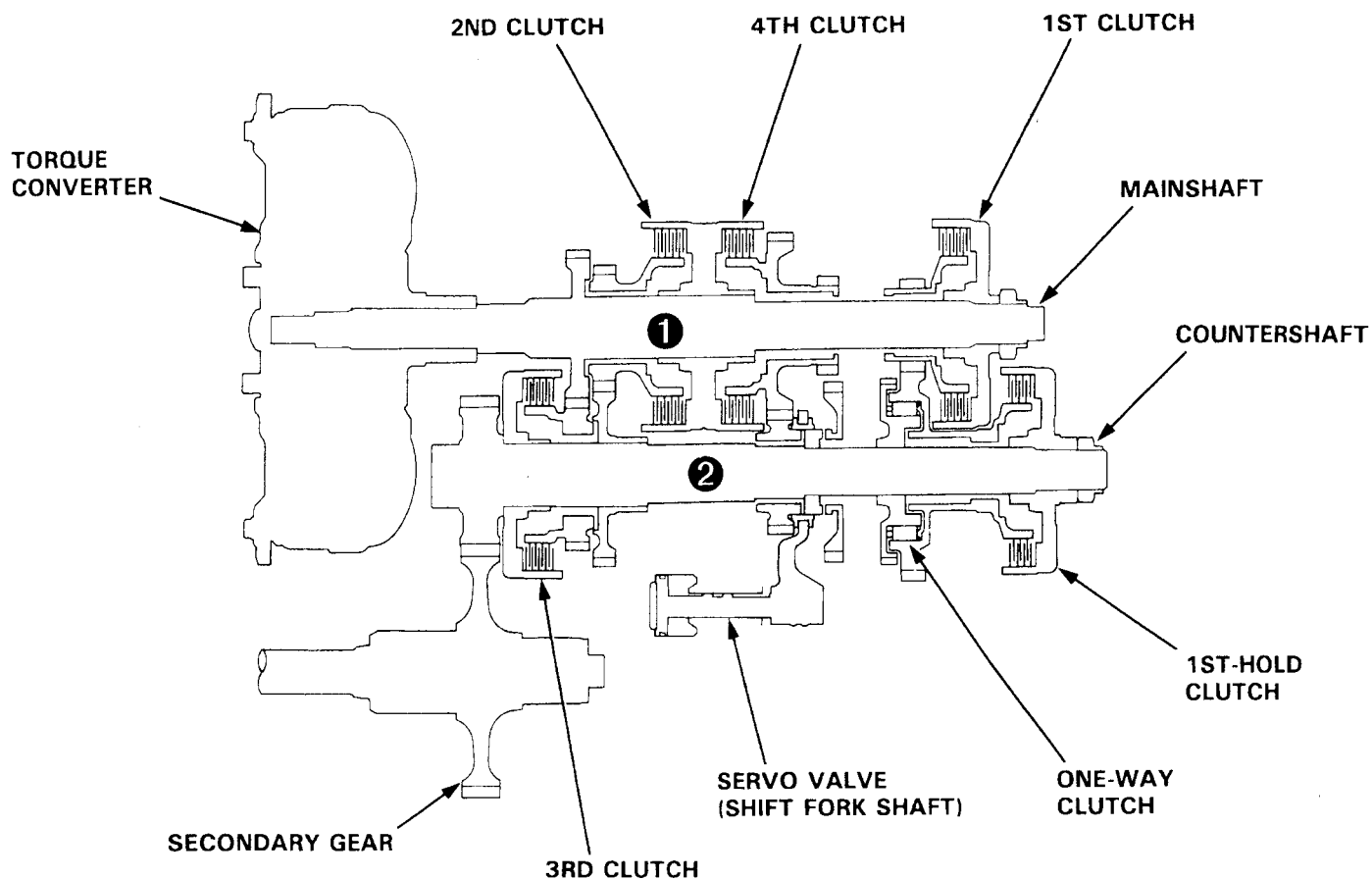
0.003" – 0.006"

NOTE: 1990 – 91 Accords contain no selective parts; if the clearance is out of specs, look for worn components.

Transaxle Clearances (continued)

1992 – 94 Vigor

1995 – 96 2.5TL



Setting	Measure the clearance between...	Specification
①	Bearing race between the 2 nd /4 th clutch drum and 2 nd gear	0.003" – 0.006"
②	Distance collar between the 4 th gear and 2 nd gear	0.003" – 0.006"

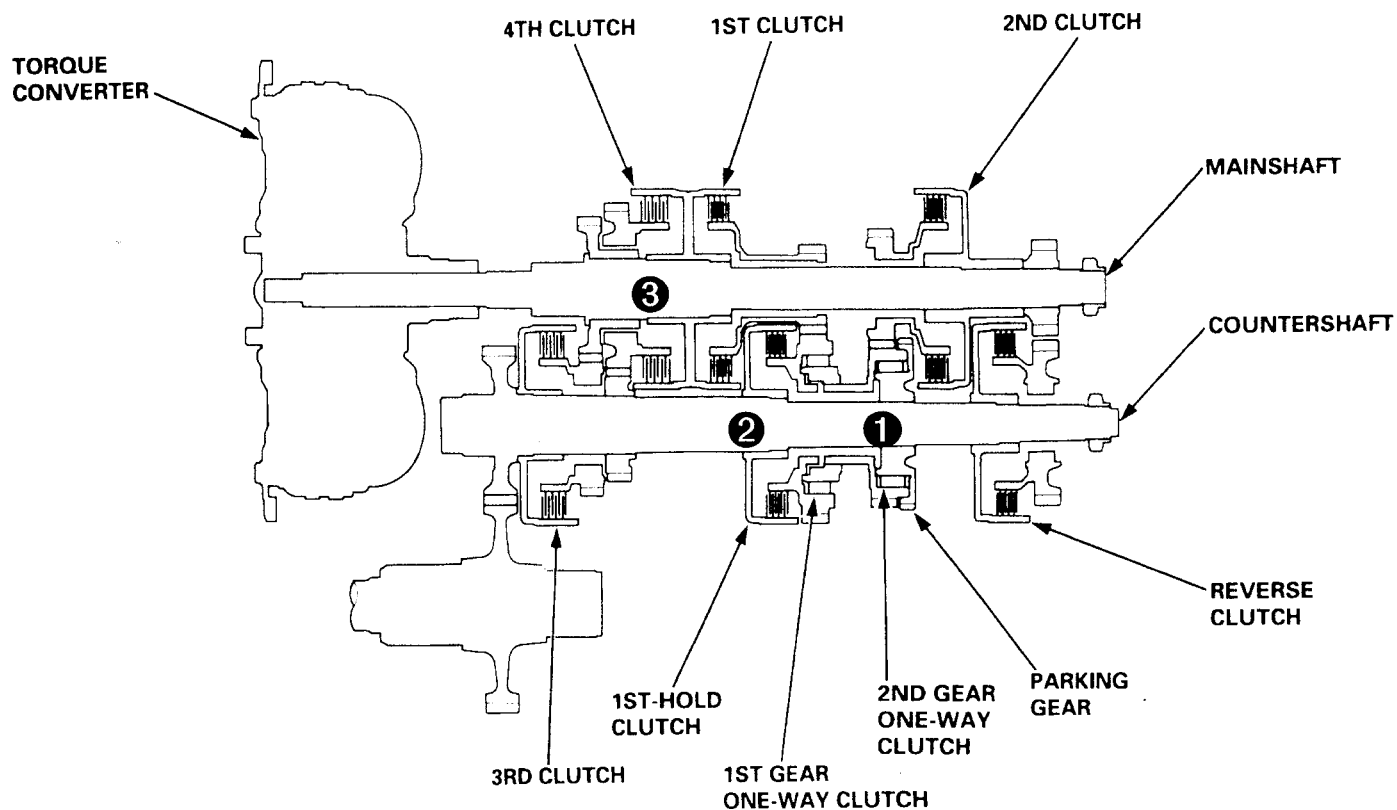
NOTE: Measure between the 4th gear and reverse hub.

Transaxle Clearances (continued)

1991 – 94 Legend

3.5RL

3.2TL



Setting	Measure the clearance between...	Specification
①	Bearing race between the parking gear and 2 nd gear	0.003" – 0.006"
②	Distance collar between the 1 st hold clutch and 3 rd gear	0.003" – 0.006"
③	Bearing race between 1 st /4 th drum and 1 st gear	less than 0.003"

Grinds Going Into or Out of Reverse

4-Speed Automatics

One of the more common failures on a Honda or Acura transaxle is a grind that appears while shifting into or out of reverse. The reason this is such a common failure becomes more obvious as you understand how these transaxles apply reverse.

In all other gear ranges (except reverse), the reverse/4th gearset remains in the position shown, with the selector locked to the 4th gear. In this position, the 4th gear and selector hub spin freely with the countershaft, until the 4th clutch applies to engage the transaxle into 4th gear.

To shift the unit into reverse, two things must occur: First, the reverse gear selector must slide down the selector hub and engage the reverse gear. Second, the 4th clutch must engage, to complete the power flow through the reverse gears. Here's how the system's supposed to work:

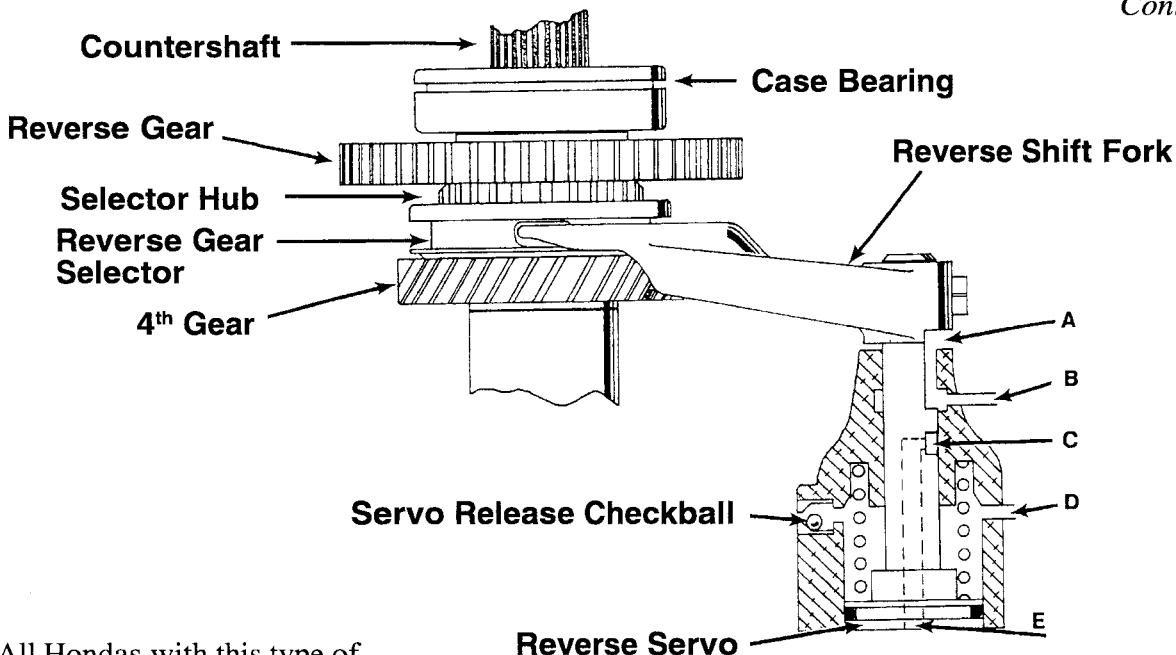
When you put the selector into reverse, the manual valve applies oil pressure to the reverse servo piston. This oil begins to force the servo to shift the reverse gear selector, and it allows pressure into the port inside the servo, through port E.

As the servo reaches the end of its travel, the reverse gear selector engages with the reverse gear. At the same time, port C in the servo aligns with port B, which sends apply oil to the 4th clutch. This apply oil applies the 4th clutch, just as the reverse gear engages fully with the reverse gear selector. The combination of engaging the reverse gear and applying the 4th clutch puts the transaxle into reverse.

When you move the selector out of reverse, the manual valve redirects apply oil, from the back of the servo to the front of the servo, through port D. This begins to force the servo off, to release the reverse gear.

As soon as the servo begins moving, the servo moves port C away from port B, and opens port B to exhaust through port A. This allows the 4th clutch to release, just as the servo moves the shift fork, to disengage the reverse gear selector from the reverse gear.

Continued...



NOTE: All Hondas with this type of gear set will clunk going into and coming out of reverse.

Grinds Going Into or Out of Reverse (continued)

At least, that's how it's supposed to work, when it's working properly. But any kind of a slowdown or mismatch at the reverse gear, or any drag at the 4th clutch, and you're likely to be faced with a grind. Depending on the specific failure, that grind could take place as the unit's going into reverse, coming out of reverse, or both.

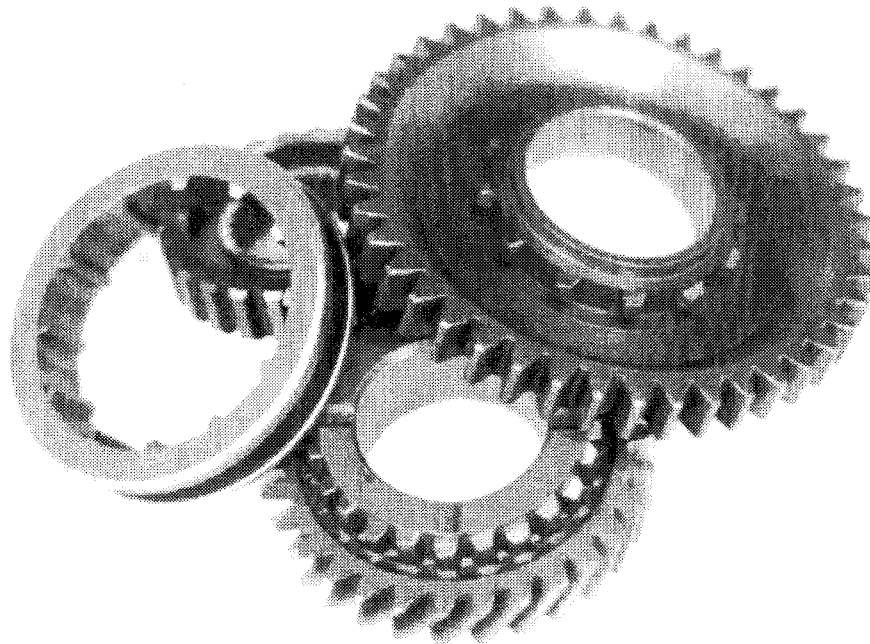
CAUTION: Never shift a Honda or Acura transaxle into or out of reverse while the vehicle's moving. This could cause serious damage to the unit.

So, now that we know what can cause a grind, let's look at how to find the problem, and correct it.

Perform These Checks Before You Remove the Unit...

- **CHECK LINE PRESSURE:** Low line pressure will allow the servo to move too slowly; this gives the gears a chance to begin turning before the selector's engaged with the reverse gear. To prevent a grind, the servo should "snap" into reverse, and "snap" back out of reverse.
- **CHECK THE OIL TYPE:** Some oils, such as type F, can cause the 4th clutch to drag. That can cause a grind going into reverse. If the transmission fluid was changed recently, suspect an oil problem. Honda's own transmission fluid works best in these units.
- **CHECK FOR PRESSURE AT THE 4TH CLUTCH:** If the 4th clutch feed pipe bushing is worn, it can allow 1st clutch oil to leak into the 4th clutch circuit when you put the selector in gear. This can partially apply the 4th clutch, and allow the clutches to drag. There shouldn't be any pressure at the 4th clutch tap with the unit in gear, and the wheels stopped. If you find pressure at the 4th clutch tap, look for a cross leak in the unit.

Continued...



Grinds Going Into or Out of Reverse (continued)

Perform These Checks During a Rebuild...

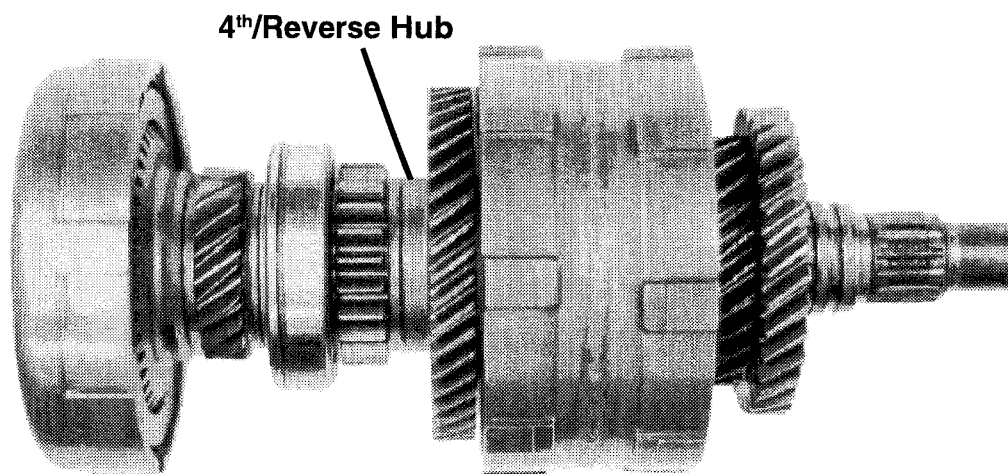
- **CHECK THE 4TH/REVERSE GEAR SET FOR WEAR:** While wear on the gear teeth doesn't normally *cause* a grind, it's often the *result* of a grinding problem. For smooth reverse engagement and release, the teeth on these components have to be clean, without any sign of wear. If any of these components exhibits wear, replace the complete set.
- **CHECK THE 4TH CLUTCH CLEARANCE:** A tight 4th clutch pack will drag, and allow the gears to spin during engagement. This is a common source of a grind going into reverse. Here's the adjustment for the 4th clutch clearance:

AK transaxles:	0.016" – 0.028"
AS transaxles:	0.016" – 0.023"
All others:	0.016" – 0.024"

To prevent the clutches from dragging, set the clearance to the high end of the specs.

- **CHECK THE FRICTION MATERIAL:** The friction material can make a big difference on how the clutch releases reverse. If the clutch doesn't break loose, or if it drags, the transaxle will grind. Always use top-quality friction plates. When in doubt about the quality of the plates, use the factory friction plates. And don't forget to make sure the clutch plates are absolutely flat: Warped plates will drag and cause a grind, too.
- **CHECK THE 4TH/REVERSE HUB CLEARANCE:** Assemble the mainshaft (including the case bearing), and tighten the nut to 25 ft. lbs. Then check the 4th/reverse hub clearance; it should have between 0.003" – 0.006" of clearance. If the clearance is too tight, look for an assembly problem, or replace the 4th/reverse bearing collar.

NOTE: The 4th/reverse bearing collar is the part that the needle bearing rides on.



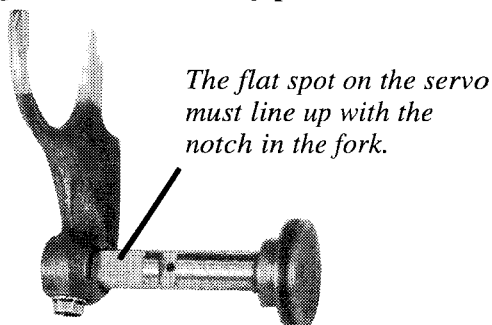
- **CHECK THE MAINSHAFT AND COUNTERSHAFT FOR STRAIGHTNESS:** While less likely than some other problems, a bent or damaged shaft can cause the reverse gear selector to bind. This can prevent the reverse gear selector from applying or releasing properly, causing a grind.

Continued...

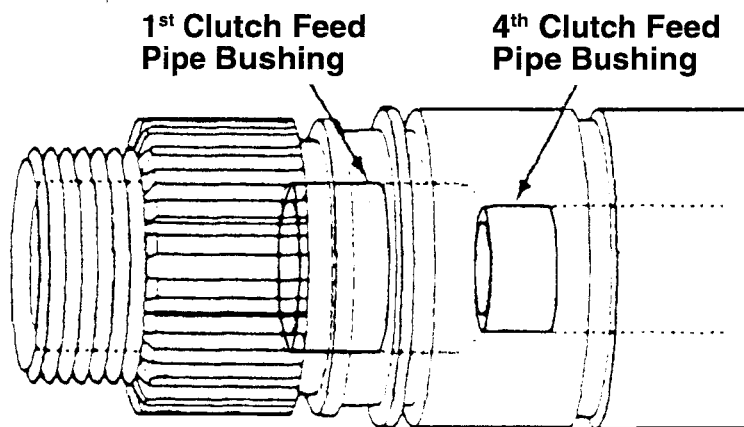
Grinds Going Into or Out of Reverse (continued)

Perform These Checks During a Rebuild... (continued)

- **CHECK THE SERVO SHAFT AND BORE:** Make sure the servo shaft and bore are smooth, without any sign of scoring. Damage on the shaft or bore can cause the servo to bind, and prevent the servo from shifting the reverse selector properly. To operate without grinding, the reverse servo has to be able to slide quickly from one end of its bore to the other, and back again.
- **CHECK THE SERVO SHAFT BOLT:** The bolt that holds the shift fork to the servo is a shouldered bolt, that will sit flush against the fork when installed properly. Using another bolt can allow you to install the fork backward: If the servo's backward, the grooves that control oil flow to the 4th clutch will face the wrong way, shutting off apply and release oil to the 4th clutch. To be sure you've installed the fork properly, make sure the flat spot on the servo lines up with the notch on the shift fork. While this probably won't cause a grind going into reverse, it may prevent reverse altogether: an important consideration during a rebuild.



- **CHECK FOR A STICKING SERVO CONTROL VALVE:** Some models use a servo control valve to control the rate of servo apply and release. If the unit you're working on has a servo control valve, make sure it's free and working properly. Models without a servo control valve use an orificing checkball to control servo operation.
- **CHECK THE SERVO RELEASE CHECKBALL:** This checkball holds release pressure at the back of the servo. If the checkball leaks, the servo won't release quickly enough, and can cause a grind when shifting out of reverse.
- **CHECK THE 4TH CLUTCH FEED PIPE BUSHING:** If the 4th clutch feed pipe bushing is worn, it can allow 1st clutch oil to bypass the bushing, and apply oil pressure to the 4th clutch whenever the unit's in drive. This can cause the 4th clutch to drag, causing a reverse grind, and possibly burning up the 4th clutch. To check for this problem, check for pressure at the 4th clutch tap, with the unit in gear, wheels stopped. There shouldn't be any pressure; if there is, suspect a worn 4th clutch bushing.



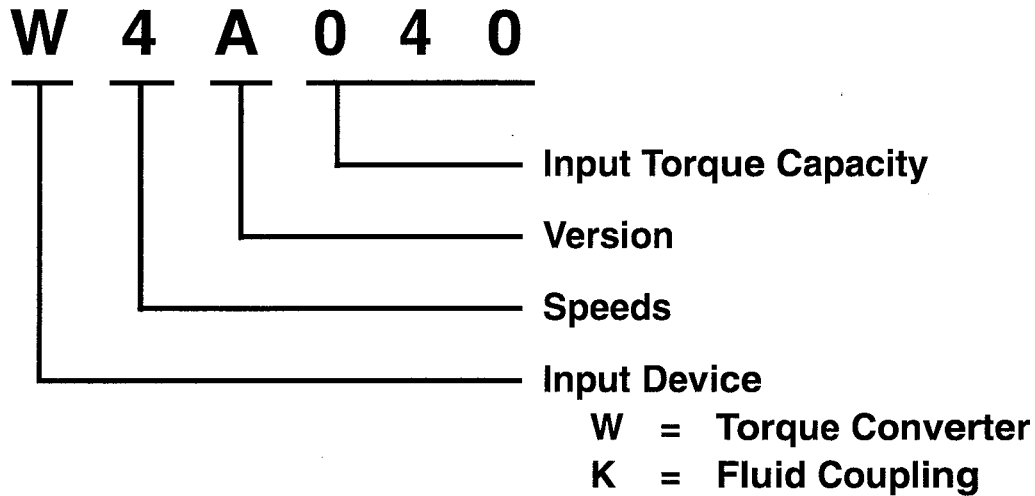
Mercedes

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Mercedes Transmission Identification

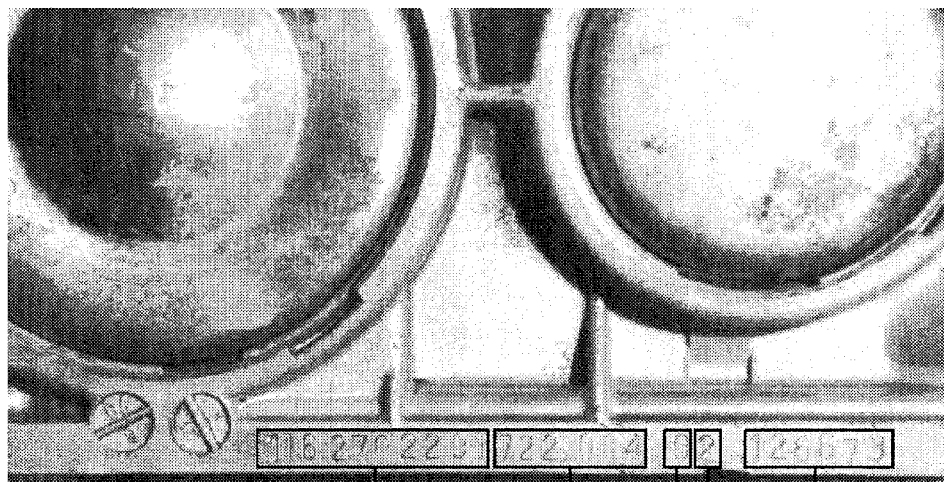
There are two ways to identify Mercedes transmissions: The first is a general ID that shows how many gears it has, its torque capacity, etc. Here's how to identify the transmission using this method:



The second method of identification references the specific car the transmission was originally installed in. This number is stamped into the right hand side pan rail.

Mercedes Transmission Identification (continued)

To identify Mercedes transmissions, look at the number stamped on the right side pan rail.



Transmission Part Number

Transmission Type

Production Number

Automatic Transmission

0 = Left Hand Steering
1 = Right Hand Steering

The number we're most interested in is the transmission type, which can be broken down even further.

The version is used to identify the specific model of transmission, e.g. what car it's used in, shift speeds, pressures, etc.

Here's how to identify the transmission types, based on the transmission number:

722.004

Version

- 0 = 3 speed
- 1 = 4 speed (with 4 bolt pan
- 3 = 4 speed (with 6 bolt pan — large trans)
- 4 = 4 speed (with 6 bolt pan — small trans)
- 5 = 5 speed overdrive
- 6 = 5 speed overdrive (fully computer controlled)

The next few pages provide the transmission identification charts for cars that were imported into the United States, from 1974 – 1990. These charts don't include "gray market" cars; cars that were imported illegally, or weren't designed for import.

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts

These charts provide transmission identification information, based on the chassis number. Look for the chassis number stamped into the radiator support.

The chassis number is based on the vehicle body style; so all vehicles with chassis number that begins with "107" have a similar body style and design.

These listings are in numerical order, beginning with the lowest chassis number. To determine which unit you're working on, compare the chassis number with the listing on these pages. They should provide you with the transmission type number for the unit that was originally installed in the vehicle.

Chassis Style 107			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
107.02	107.022	280SLC	722.103, 112, 306
	107.023	350SLC	722.002
	107.024	450SLC	722.001
			722.004 (USA)
	107.025	380SLC	722.304
	107.026	450SLC 5.0	722.006, 305
107.04	107.041	300SL	722.322
	107.042	280SL	722.103, 112, 306
	107.043	350SL	722.002
	107.044	450SL	722.001
			722.004 (USA)
	107.045	380SL	722.304, 312
	107.046	500SL	722.305, 313
	107.047	420SL	722.325
	107.048	560SL	722.313

Chassis Style 114			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
114.01	114.011	250	722.104
	114.015	230.6	722.105
114.02	114.023	250C	722.104
114.06	114.060	280	722.102
	114.062	280E	722.103
114.07	114.072	280CE	722.103
	114.073	280C	722.102

¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts (continued)

Chassis Style 115			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
115.01	115.015	200	722.106
	115.017	230.4	722.110
115.11	115.110	220D	722.107
	115.114	240D 3.0	722.109
	115.115	200D	722.107
	115.117	240D	722.108

Chassis Style 116			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
116.02	116.020	280S	722.100, 102, 111
	116.024	280SE	722.101, 103, 112
	116.025	280SEL	722.103, 112
	116.028	350SE	722.002
	116.029	350SEL	722.002
116.03	116.032	450SE	722.001
			722.004 (USA)
	116.033	450SEL	722.001
			722.004 (USA)
	116.036	450SEL 6.9	722.003
116.12	116.120	300SD	722.120

¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts (continued)

Chassis Style 123			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
123.00	123.000	230 ¹	722.119
	123.003	250 ¹	722.113, 308
	123.007	280E ¹	722.112, 309
123.02	123.020	200	722.115
	123.023	230	722.119
	123.026	250	722.113, 308
	123.028	250 ²	
123.03	123.030	280	722.111
	123.033	280E	722.112, 300, 309
123.04	123.043	230C	722.119
123.05	123.050	280C	722.111
	123.053	280CE	722.112, 300, 309
123.08	123.083	230T	722.117, 308
	123.086	250T	722.113, 308
123.09	123.093	280TE	722.112, 303, 309
123.10	123.102	240D	722.117
	123.103	240D	
	123.105	300D	722.118
123.12	123.120	200D	722.116
	123.123	240D	722.117
	123.125	240D ¹	
	123.126	220D	722.116
123.13	123.130	300D	722.118
	123.132	300D ¹	
	123.133	300D Turbo Diesel	722.315, 416 ⁴
123.15	123.150	300CD	722.118
	123.153	300CD Turbo Diesel	722.345, 416 ⁴
123.18	123.183	240TD	722.117
123.19	123.190	300TD	722.118
	123.193	300TD Turbo Diesel	722.120, 303, 315, 416 ⁴
123.20	123.200	230E ¹	722.122, 401
123.22	123.220	200	722.121, 406
	123.223	230E	722.122, 401
123.24	123.243	230CE	722.122, 401
123.28	123.280	200T	722.121, 406
	123.283	230TE	722.122, 401

¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts (continued)

Chassis Style 124			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
124.00	124.003	230E ¹	722.408
	124.004	250E ¹	
	124.007	260E ¹	722.409
	124.008	280E ¹	722.433
124.01	124.019	200E (E200) ³	722.431
124.02	124.020	200	722.411
	124.021	200E	722.400
	124.022	220CE (E220) ³	722.428
	124.023	230E	722.408
	124.026	260E	722.409
	124.027	260E ¹	
	124.028	280E (E280) ³	722.433, 504
	124.029	280TE (E280) ³	722.433
124.03	124.030	300E	722.320, 358
	124.031	300E-24	722.359, 501
	124.032	320E	722.369, 503
	124.034	400E	722.354
	124.036	500E	722.365
124.04	124.040	200CE (E200) ³	722.431
	124.041		722.400
	124.042	220CE (E220) ³	722.428
	124.043	230CE	722.408
124.05	124.050	300CE	722.320, 358
	124.051	300CE-24	722.359, 501
	124.052	320CE	722.369, 503
124.06	124.060	200CE	722.431
	124.061	300CE-24 ²	722.259, 501
	124.062	E220 ²	722.428
	124.066	320CE ²	722.369, 503
124.07	124.079	200TE (E200) ³	722.431

¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts (continued)

Chassis Style 124 (continued)			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
124.08	124.080	200T	722.411
	124.081	200TE	722.400
	124.082	220TE	722.428
	124.083	230TE	722.408
	124.088	280TE	722.433, 504
124.09	124.090	300TE	722.320, 588
	124.091	300TE-24	722.359, 501
	124.092	320TE	722.369, 503
124.10	124.104	E250 Diesel ¹	722.434
	124.105	250D ¹	722.414
	124.106		
	124.107	E250 Diesel ¹	722.434
124.12	124.120	200D (E200) ³	722.403
	124.125	250D	722.414
	124.126	E250 Diesel	722.434
	124.127	250D ¹	722.414
	124.128	250D (E250) ³	722.418
	124.129	E250 Diesel ¹	722.434
124.13	124.130	300D	722.415
	124.131	E300 Diesel	722.435
	124.133	300D Turbo (E300) ³	722.317, 357
124.18	124.180	200TD	722.403
	124.185	250TD	722.414
	124.186	E250 Diesel ¹	722.434
	124.188	250TD Turbo (E250) ³	722.418
124.19	124.190	300TD	722.415
	124.191	E350 Diesel	722.335
	124.193	300TD Turbo (E300) ³	722.317, 357
124.22	124.226	260E 4MATIC	722.335, 341
124.23	124.230	300E 4MATIC (E300) ³	722.346, 342
124.29	124.290	300TE 4MATIC (E300) ³	722.346, 342
124.33	124.330	300D 4MATIC	722.347, 343
	124.333	300TD Turbo ¹ (E300) ³	722.348, 344
124.39	124.393	300TD Turbo ¹ (E300) ³	722.348, 344

¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts (continued)

Chassis Style 126			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
126.02	126.020	260SE	722.412
	126.021	280S	722.307
	126.022	280SE	722.300
	126.023	280SEL	
	126.024	300SE	722.319, 351
	126.025	300SEL	
126.03	126.032	380SE	722.301, 310
	126.033	380SEL	
	126.034	420SE	722.324, 355
	126.035	420SEL	
	126.036	500SE	722.302, 311, 356
	126.037	500SEL	
	126.038	560SE	722.311, 350
	126.039	560SEL	722.323, 350
126.04	126.043	380SEC	722.310
	126.044	500SEC	722.311, 356
	126.045	560SEC	722.323, 350
	126.046	420SEC	722.324, 355
126.12	126.120	300SD	722.303, 416 ⁴
	126.125	300SDL	722.321
126.13	126.134	350SD Turbo	722.361
	126.135	350SDL Turbo	

Chassis Style 129			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
129.05	129.058	SL280	722.437, 506
129.06	129.060	300SL	722.363
	129.061	300SL-24	722.352, 500
	129.063	SL320	722.507
	129.066	500SL (SL500) ³	722.353
	129.067		722.364
129.07	129.076	600SL (SL600) ³	722.362

¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts (continued)

Chassis Style 140			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
140.02	140.028	300SE 2.8 (E280) ³	722.419, 505
140.03	140.032	300SE 3.2 (S320) ³	722.368, 371, 502, 508
	140.033	300SEL 3.2 (S320) ³	722.368, 371, 502, 508
140.04	140.042	400SE (S420) ³	722.366
	140.043	400SEL (S420) ³	
140.05	140.050	500SE (S500) ³	722.370
	140.051	500SEL (S500) ³	
	140.056	600SE V12 (S600) ³	722.362
	140.057	600SEL V12 (S600) ³	
140.07	140.070	500SEC (S500) ³	722.370
	140.076	600SEC (S600) ³	722.362
140.13	140.134	300SD Turbo Diesel (S350) ³	722.367

Chassis Style 201			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
201.01	201.018	190E 1.8	722.420
201.02	201.022	190	722.402
	201.023	190	722.411
	201.024	190E 2.0	722.400
		190E 2.3	722.400 (USA)
	201.028	190E 2.3	722.408
	201.029	190LE 2.6	722.409
201.03	201.034	190E 2.3-16	722.410
	201.035	190E 2.5-16	722.417
201.12	201.122	190D	722.403
	201.126	190D 2.5	722.414
	201.128	190D 2.5 Turbo	722.413

¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Transmission Identification (continued)

Vehicle and Transmission Identification Charts (continued)

Chassis Style 202			
Vehicle Type	Chassis Number	Vehicle Model	Trans Number
202.01	202.018	C180	722.421
202.02	202.022	C220	722.423
	202.028	C280	722.424
202.12	202.120	C200 Diesel	722.425
	202.121	C220 Diesel	722.426
	202.125	C250 Diesel	722.427

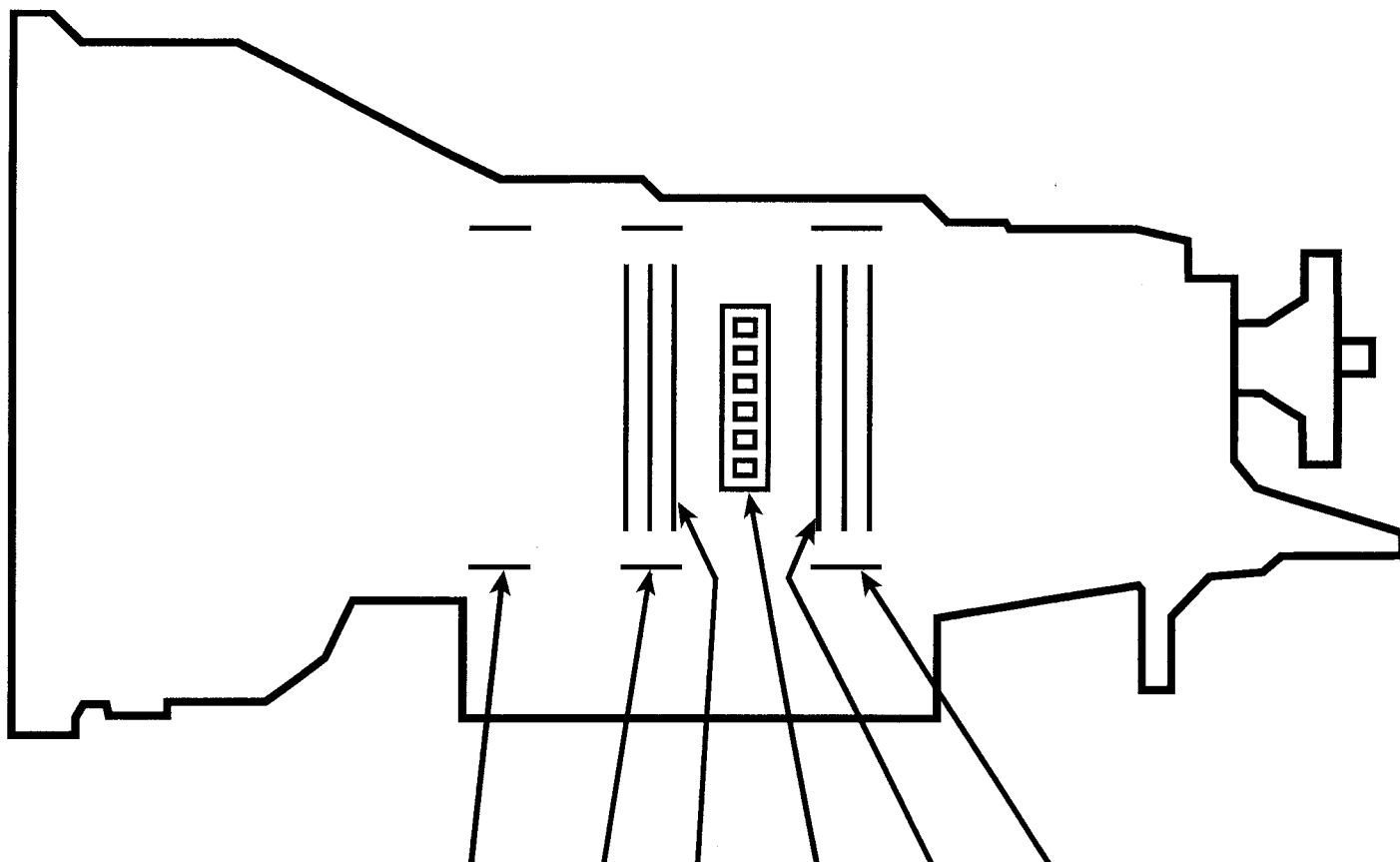
¹ Special Body ² Convertible

³ Body style changed 6/93; new body style appears in parentheses.

⁴ 1985 California

Mercedes Clutch and Band Application

722.0 / 722.1 / 722.2



Selector Position	722.0	722.1 722.2	B3 Brake	B1 Brake	K1 Clutch	F1 Freewheel	K2 Clutch	B2 Brake	722.0	722.1 722.2
R	R	R					★		1.84:1	5.47:1
D	—	1 st							—	3.98:1
	1 st	2 nd							2.31:1	2.39:1
	2 nd	3 rd							1.46:1	1.46:1
	3 rd	4 th							1.00:1	1.00:1
S	—	1 st							—	3.98:1
	1 st	2 nd							2.31:1	2.39:1
	2 nd	3 rd							1.46:1	1.46:1
L	—	1 st					★		—	3.98:1
L	1 st	—							2.31:1	—

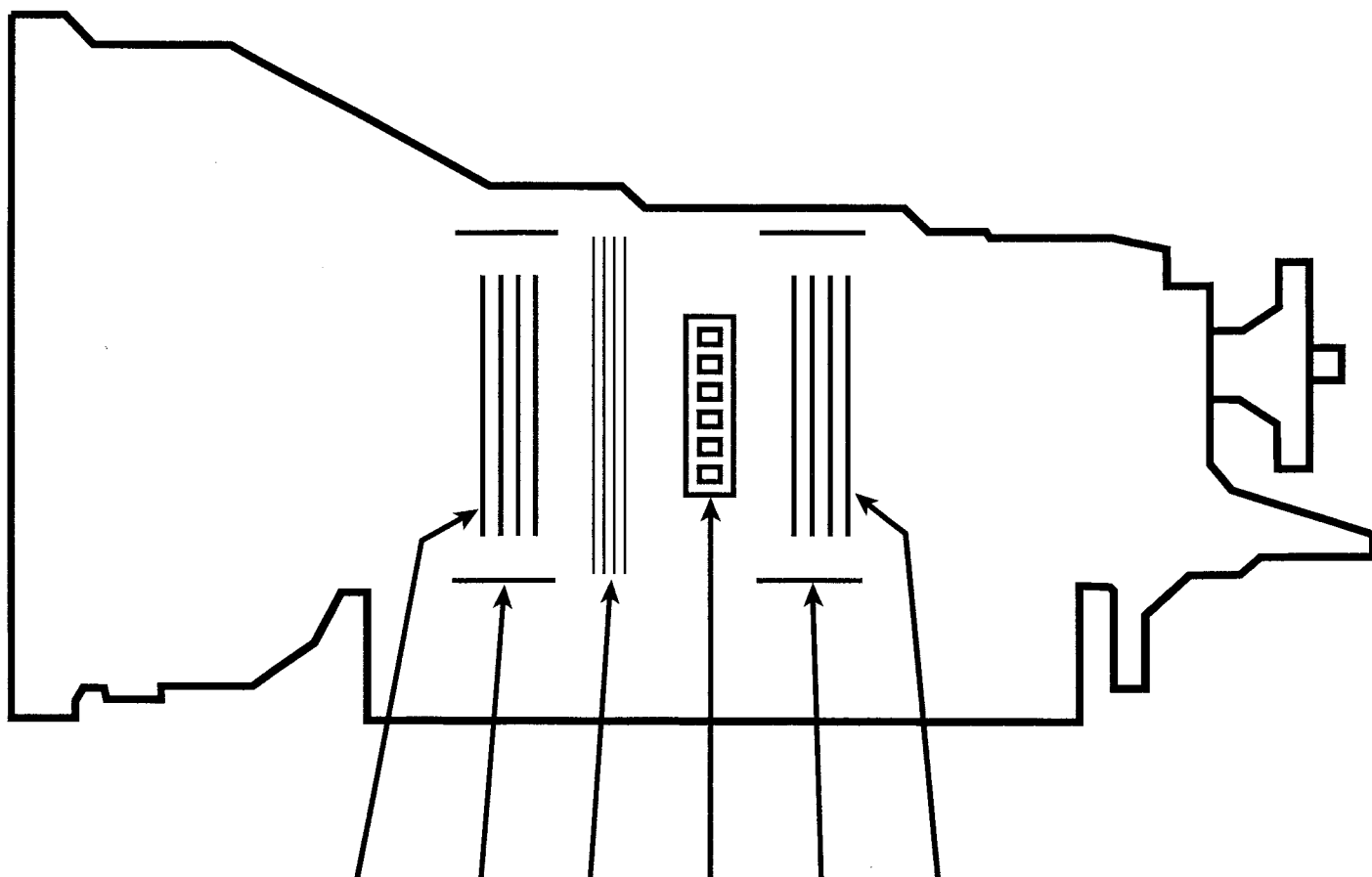


Clutch or brake applied

★ Not used on 722.0 — used for engine braking.

Mercedes Clutch and Band Application (cont)

722.3 / 722.4



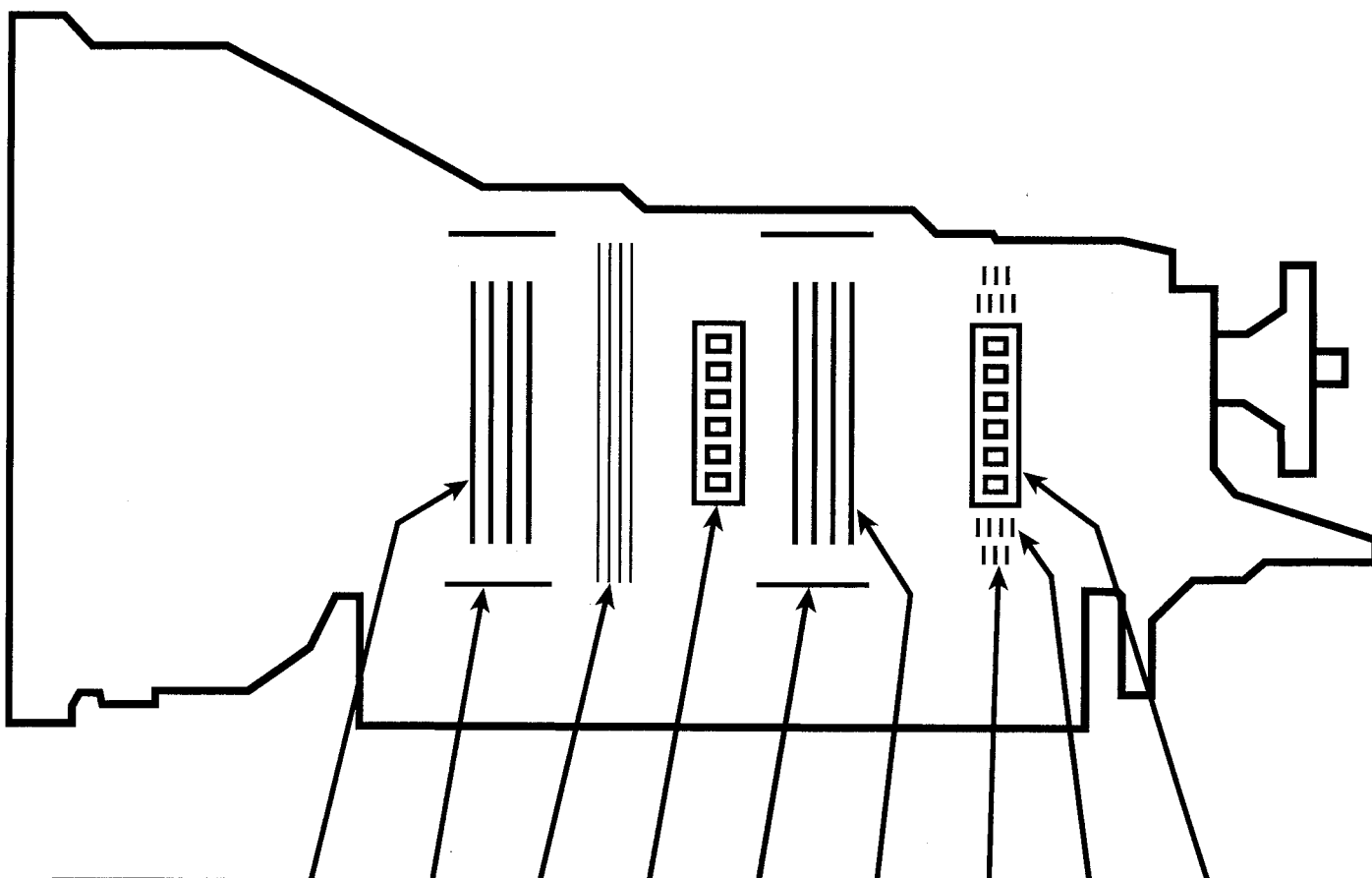
Selector Position	Gear Engaged	K1 Clutch	B1 Brake	B3 Brake	F1 Freewheel	B2 Brake	K2 Clutch	722.3	722.4
R	R						★	5.14:1	5.14:1
D	1 st							3.68:1	4.25:1
	2 nd							2.41:1	2.40:1
	3 rd							1.44:1	1.48:1
	4 th							1.00:1	1.00:1
3	1 st							3.68:1	4.25:1
	2 nd							2.41:1	2.40:1
	3 rd							1.44:1	1.48:1
2	1 st						★	3.68:1	4.25:1
	2 nd							2.41:1	2.40:1

Clutch or brake applied

★ Used for engine braking.

Mercedes Clutch and Band Application (cont)

722.5



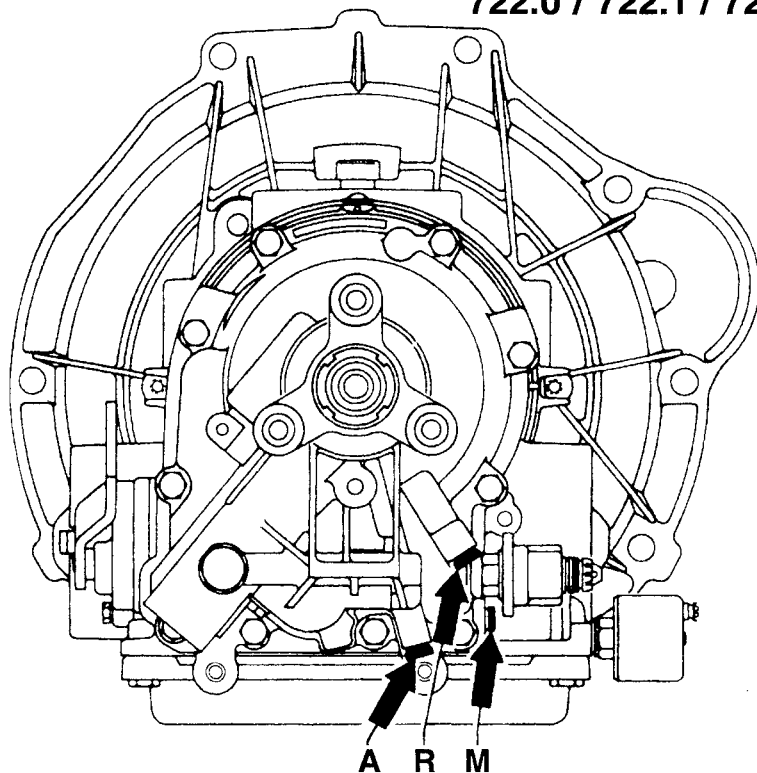
Selector Position	Gear Engaged	K1 Clutch	B1 Brake	B3 Brake	F1 Freewheel	B2 Brake	K2 Clutch	BS	KS	F2	Gear Ratios
R	R						★				5.58:1
D	1 st										3.87:1
	2 nd										2.24:1
	3 rd										1.44:1
	4 th										1.00:1
	5 th										0.75:1

 Clutch or brake applied

★ Used for engine braking.

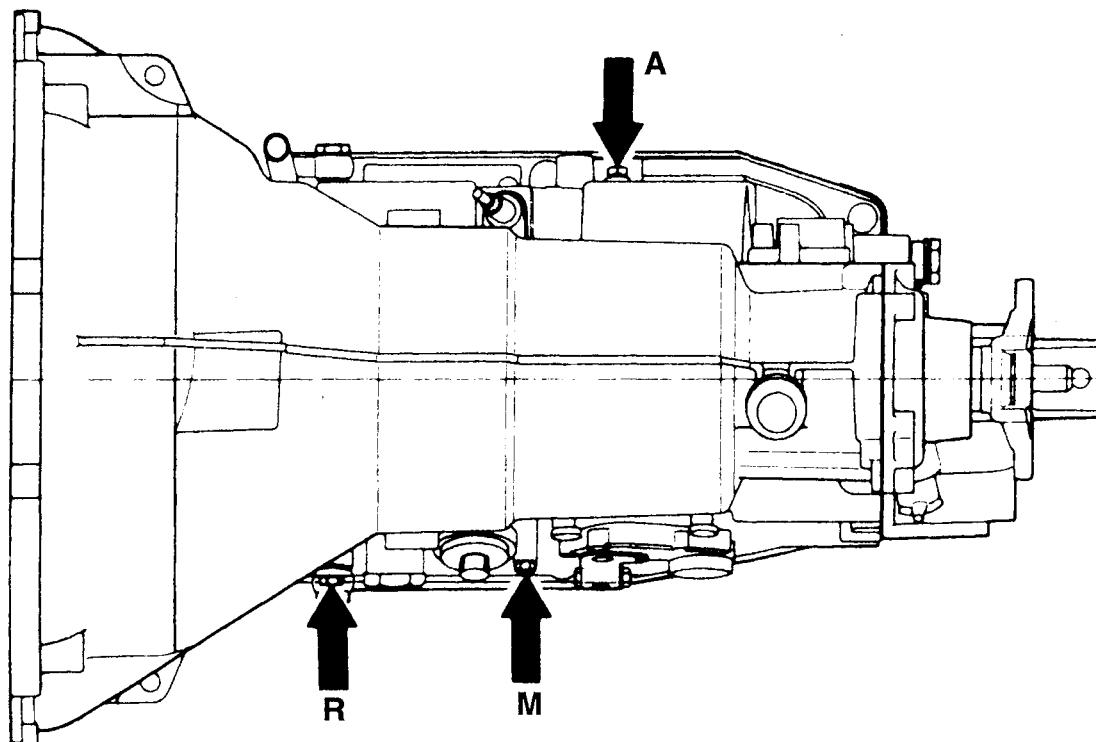
Pressure Tap Locations

722.0 / 722.1 / 722.2



A – Working Pressure (Mainline)
R – Governor Pressure
M – Modulating Pressure

722.3 / 722.4



Pressure Specifications

IMPORTANT: Modulator pressure specifications for 722.0 and 722.1 transmissions are based on measurements taken with the vehicle moving at 40 MPH (65 KPH) at full throttle.

Mainline pressure specifications are based on measurements taken with the vehicle at stall, with the modulator vacuum line disconnected.

722.0 Transmissions					
Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)	Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)
722.001	171	45	722.004	161	45
722.002	167	45	722.006	178	45
722.003	155	45			
722.1 Transmissions					
Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)	Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)
722.102	154	55	722.112	155	55
722.103	155	55	722.113	136	55
722.104	141	55	722.115	136	55
722.105	155	55	722.116	119* (N/A**)	41* (44**)
722.106	136	55	722.117	126* (N/A**)	41* (44**)
722.107	119	41	722.118	129* (N/A**)	41* (44**)
722.108	126	41	722.119	148	55
722.109	129	41	722.120	155	41
722.110	148	55	722.121	145	55
722.111	154	55	722.122	138	55

* Pressures for units with a mechanical modulator

** Pressures for units with a vacuum modulator

Pressure Specifications (continued)

IMPORTANT: Modulator pressure specifications for 722.3 transmissions are based on measurements taken with the vehicle moving at 31 MPH (50 KPH) at full throttle.

Mainline pressure specifications are based on measurements taken with the vehicle at stall, with the modulator vacuum line disconnected.

722.3 Transmissions					
Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)	Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)
722.300	141	41	722.343	177	54
722.301	177	50	722.344	218	46
722.302	199	55	722.345	180	45
722.303	213	44	722.346	184	57
722.304	177	50	722.347	194	44
722.305	199	55	722.348	213	46
722.306	141	41	722.350	203	55
722.307	141	41	722.351	189	58
722.308	187	52	722.352	184	55
722.309	141	41	722.353	193	58
722.310	191	58	722.355	203	55
722.311	199	58	722.356	186	50
722.312	191	58	722.357	218	46
722.313	209	58	722.358	189	58
722.315	181	42	722.359	184	55
722.317	184	54	722.361	228	46
722.319	184	57	722.362	210	62
722.320	184	57	722.363	189	58
722.321	209	46	722.364	N/A	58
722.322	184	57	722.365	200	58
722.323	209	58	722.366	174	55
722.324	199	53	722.367	N/A	45
722.325	199	52	722.368	183	58
722.341	160	46	722.368	N/A	58
722.342	189	46	722.370	200	58

Pressure Specifications (continued)

IMPORTANT: Modulator pressure specifications for 722.4 and 722.5 transmissions are based on measurements taken with the vehicle moving at 31 MPH (50 KPH) at full throttle.

Mainline pressure specifications are based on measurements taken with the vehicle at stall, with the modulator vacuum line disconnected.

722.4 Transmissions					
Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)	Transmission Number	Mainline Pressure (PSI)	Modulator Pressure (PSI)
722.400	213*	46	722.417	186	41
722.401	212	57	722.418	226	47
722.402	157	33	722.420	131	35
722.403	194	44	722.421	N/A	48
722.404	203	46	722.423	N/A	54
722.405	213	46	722.424	N/A	55
722.406	164	38	722.425	N/A	44
722.407	142	29	722.426	N/A	39
722.408	211	57	722.427	N/A	42
722.409	158	48	722.428	N/A	54
722.410	193	50	722.429	N/A	44
722.411	173	38	722.431	N/A	52
722.412	158	48	722.433	N/A	55
722.415	226	47	722.434	N/A	44
722.414	183	41	722.435	N/A	44
722.415	209	48	722.437	N/A	55
722.416	205	44			
722.5 Transmissions					
Transmission Number	Mainline Pressure	Modulator Pressure	Transmission Number	Mainline Pressure	Modulator Pressure
722.500	200	55	722.505	N/A	55
722.501	200	55	722.506	N/A	55
722.502	209	59	722.507	N/A	58
722.503	N/A	58	722.508	N/A	58
722.504	N/A	55			

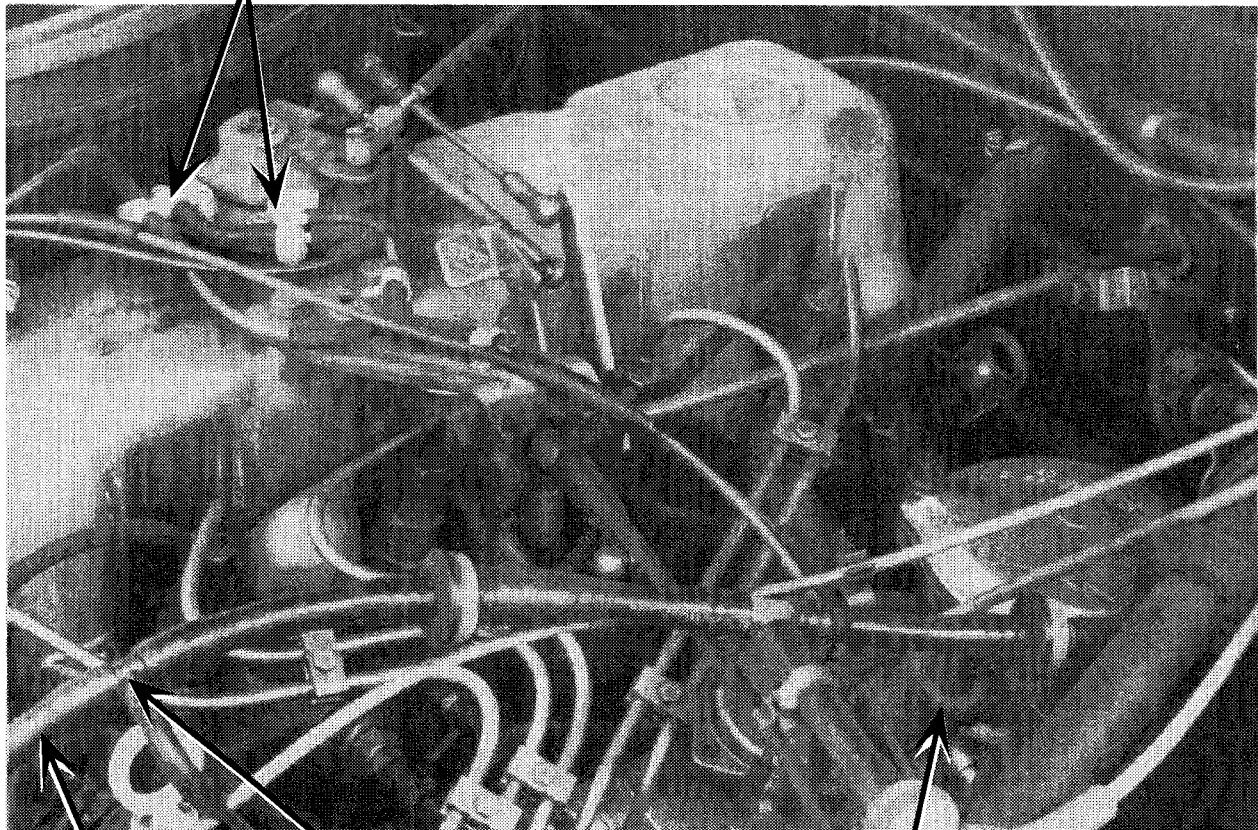
* 1985 USA vehicle pressure is 176 PSI

Diesel Vacuum System Overview

Mercedes began using a vacuum modulator on their diesel automatic transmissions in 1989 (USA versions).

While these systems varied from year to year (and model to model), most of the systems consisted of a vacuum pump, vacuum regulator, and switchover valves.

Switchover Valves



This hose leads to the vacuum pump.

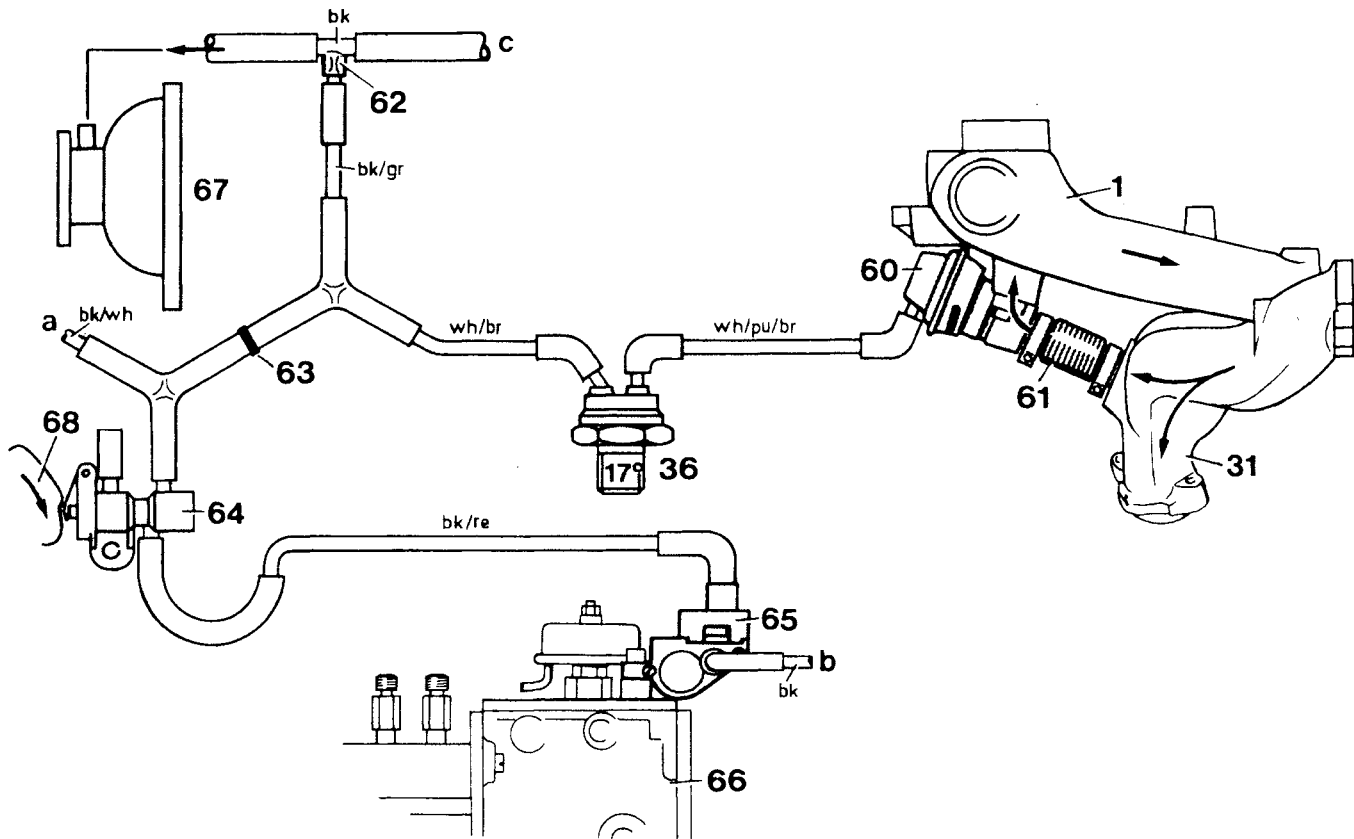
Orifice #62

Vacuum Regulator

The vacuum pump is similar to other diesel vacuum pumps: Its normal capacity is 21" – 23" Hg. The regulator and switchover valves control the level of vacuum at the modulator. Although the vacuum systems appear to be vastly different, there are actually just two basic system designs.

Diesel Vacuum System Overview (continued)

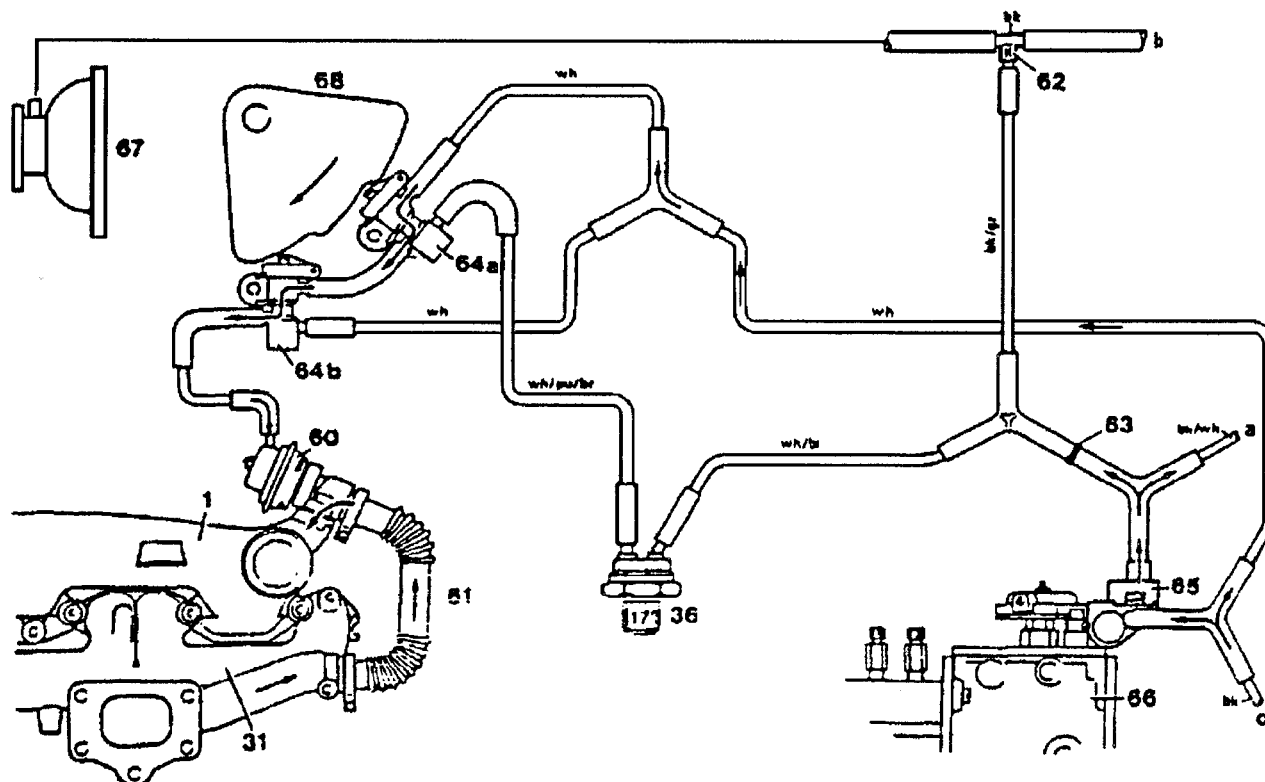
The first type draws full pump vacuum to the modulator at an idle. When you take up the slack in the throttle linkage, the vacuum drops to about 11" – 15" Hg. The vacuum continues to drop gradually as the throttle opens, until it reaches 0" – 3" Hg at full throttle. Here's an example of this type of system:



- | | | | |
|----|---------------------------|----|-------------------------------|
| 1 | Intake Manifold | 65 | Vacuum Modulating Valve |
| 31 | Exhaust Manifold | 66 | Injection Pump |
| 36 | Therموvalve 17° C / 63° F | 67 | Vacuum Pump |
| 60 | EGR Valve | 68 | Bell Crank with Cam |
| 61 | Bellows | a | Automatic Transmission |
| 62 | Orifice | b | Vent to Passenger Compartment |
| 63 | Orifice | c | Brake Booster |
| 64 | Switchover Valve | | |

Diesel Vacuum System Overview (continued)

The second type of system draws regulated vacuum of 11" – 15" Hg at idle, and gradually drops to 0" – 3" Hg at full throttle. This system doesn't have the initial vacuum of 21" – 23" Hg at closed throttle. Here's an example of this type of system:



- 1 Intake Manifold
- 31 Exhaust Manifold
- 36 Therموvalve 17° C / 63° F
- 60 EGR Valve
- 61 Corrugated Tube
- 62 Orifice
- 63 Orifice
- 64a Switchover Valve; Idle Shutoff EGR
- 64b Switchover Valve; Full Throttle Shutoff EGR

- 65 Vacuum Modulating Valve
- 66 Fuel Injection Pump
- 67 Vacuum Pump
- 68 Lever with Cam
- a Automatic Transmission
- b To additional vacuum consumers
- c Vent to passenger compartment

These systems may have anywhere from zero to three switchover valves. Don't use the number of switchover valves to determine the type of system you're working on; instead, look at the location of the transmission vacuum takeoff:

If the vacuum originates from a switchover valve, you're working on the first type system; if the vacuum comes directly from the regulator, it's the second type.

In 1984, Mercedes replaced the mechanical switchover valve with an electric version; but these switchover valves were only used to control the EGR. A vacuum amplifier now controls the vacuum to the modulator.

NOTE: Always check the vacuum system first when diagnosing a transmission problem. There are many variations to this system and factory vacuum specifications vary slightly from model to model. These specifications offer the best overall performance. If you need to see a vacuum diagram for a specific model car, look under the hood, in front of the radiator. Most cars have a sticker that provides the vacuum routing.

Vacuum Test

Step 1: Check the vacuum at the "T" connector (#62) at an idle.

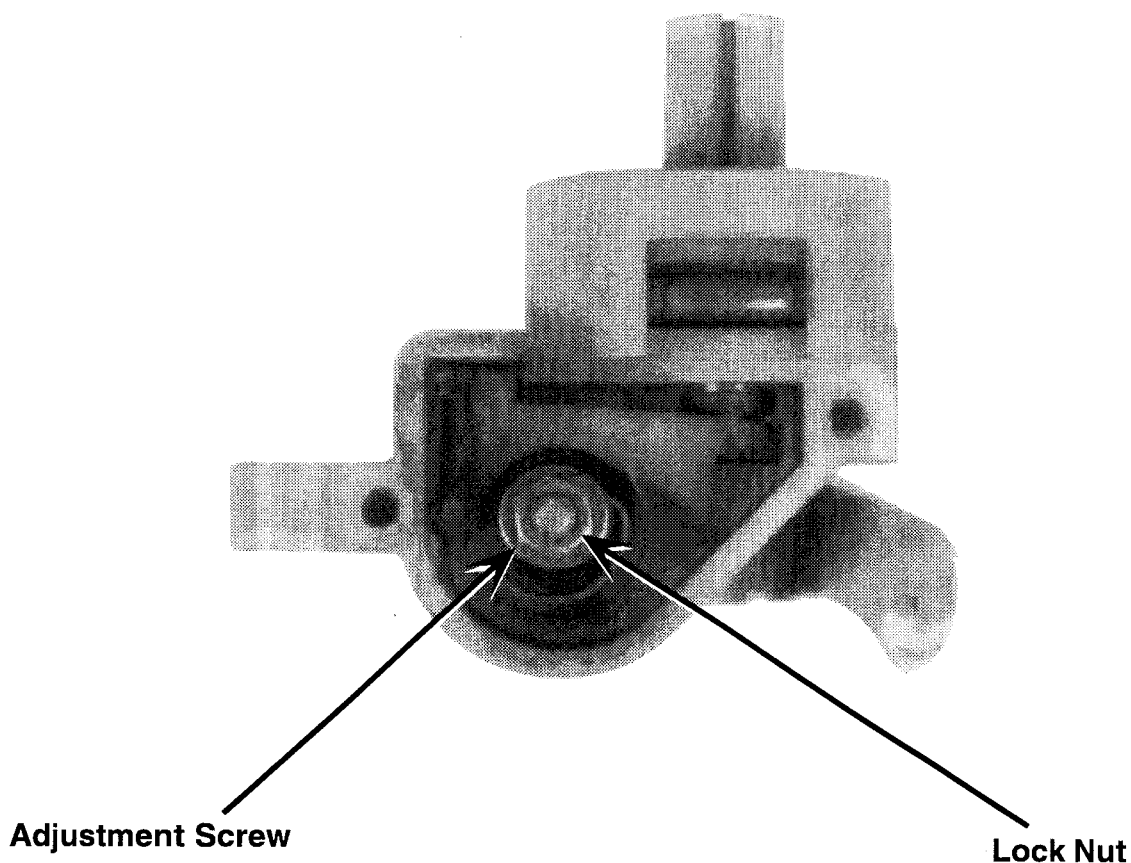
The vacuum should rise quickly to 21" – 23" Hg. If the gauge moves slowly, check for a plugged orifice at #62. Use a small wire to clean it out. Be careful: the orifice is only 0.023" in diameter. If the orifice becomes enlarged, the vacuum regulator may not be able to control the vacuum properly.

Step 2: Check the vacuum at the modulator takeoff.

The vacuum will vary based on the type of system you're working on. See the overview for the specifications on your system. If vacuum appears low, check for worn switchover valves, cracked hoses, etc.

If everything appears okay, but vacuum is still low, you can adjust the regulator. Remove the two screws that secure the cover. That gives you access to the adjustment screw.

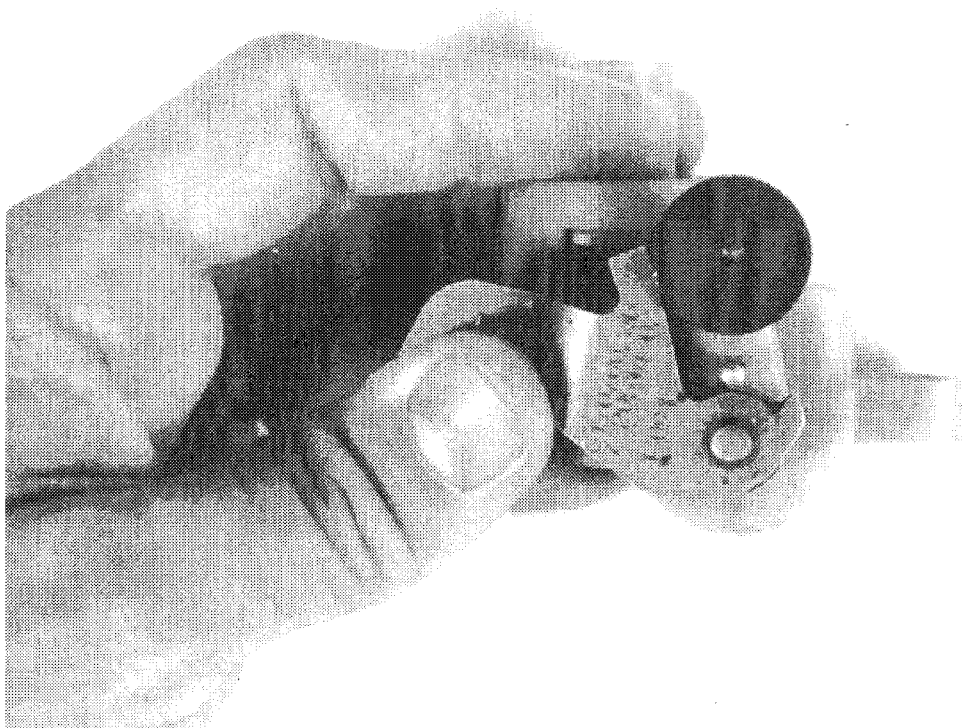
Turning the adjustment screw clockwise will increase vacuum, turning it counterclockwise will decrease vacuum. If the regulator won't adjust, replace it.



Vacuum Test (continued)

Step 3: With the gauging tool in place, you should have 5" – 6" Hg vacuum. This is a secondary step to confirm regulator adjustment.

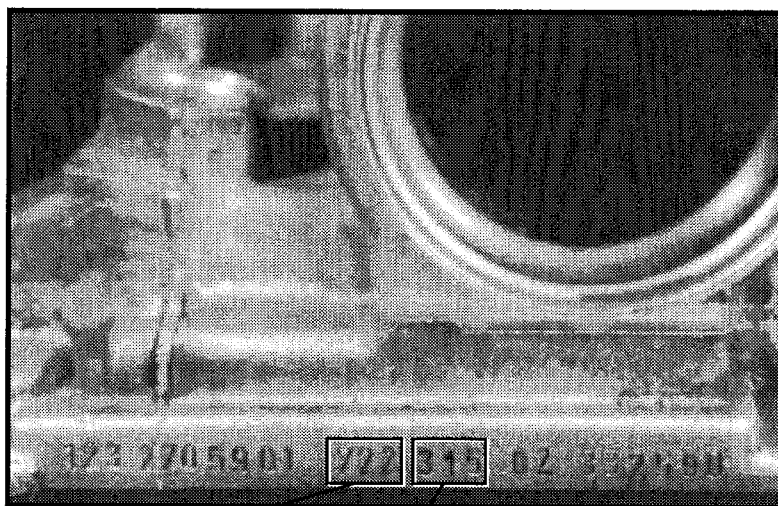
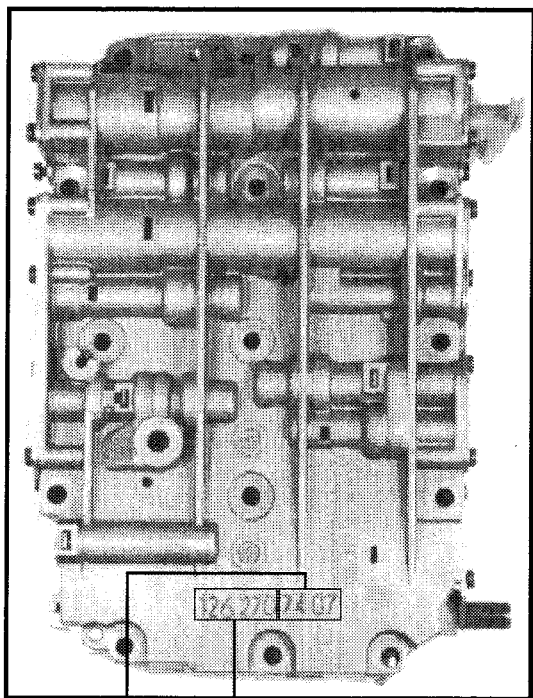
NOTE: The gauging tool is 0.786" diameter, 0.198" thick, with an 0.122" hole.



Mercedes Valve Body Identification

Mercedes transmissions have a part number ink stamped on the valve body for identification purposes. The following chart list the valve bodies used from 1974 – 1990. This list doesn't cover "gray market" cars.

Example of how to use the chart:



722.3, 722.4 and 722.5

Valve Body ID	Year	Transmission	Car Model
Valve Body Style 126 270			
73 15	86 – 87	317	300D Turbo
			300TD Turbo
74 07	81	321	300SDL Turbo
		303	300SD
	82 – 83	315	300D Turbo
			300CD Turbo
79 15	81	313	560SL
	86 – 87	323	560SEL
			560SEC
83 15	86 – 87	320	300E

NOTE: Some early units (74 – 80) don't have a model number stamped on the case. In that event you'll need to rely on the year and model of the car.

Mercedes Valve Body Identification (continued)

722.0 and 722.1

Valve Body	Year	Transmission	Car Model	Valve Body	Year	Transmission	Car Model
Chassis 100 270				Chassis 116 270 (continued)			
36 07	77 – 79	003	450SEL 6.9	34 07	78 – 79	004	450SEL
Chassis 114 270							450SLC
52 07	74 – 76	102	280				450SL
			280C	44 07	81	112	280E
			280S				280CE
54 07	74	102	280	59 07	79	120	300SD
			280C	61 07	80	004	450SEL
57 07	75 – 76	102	280				450SLC
			280C				450SL
			280S	79 07	79	120	300SD
Chassis 115 270				Chassis 123 270			
61 07	74 – 76	108	240D	00 07	77 – 78	119	230
7307	74 – 76	110	230.4	02 07	77 – 79	112	280E
75 07	74 – 75	109	300D				280SE
	76 – 79	118	300D		78 – 79		280CE
	78 – 79		300CD	05 07	77 – 79	117	240D
	79		300TD	27 07	80	120	300SD
85 07	75 – 76	110	230.4	42 07	80	112	280E
Chassis 116 270							280SE
22 07	74 – 76	004	450SE				280CE
			450SEL	51 07	80 – 81	117	240D
			450SLC	53 07	80 – 81	118	300D
			450SL				300CD
24 02	74	102	280S				300TD
35 07	74 – 76	004	450SE	61 07	81 – 83	117	240D
			450SEL	62 07	81	118	300D
			450SLC				300CD
			450SL				300TD
38 07	77 – 79	004	450SEL				
			450SLC				
			450SL				

Mercedes Valve Body Identification (continued)

722.3, 722.4 and 722.5

Valve Body ID	Year	Transmission	Car Model	Valve Body ID	Year	Transmission	Car Model
Valve Body Style 107 270				Valve Body Style 126 270 (continued)			
08 07	87	320	300E	55 07	81 – 82	309	300SD
14 07	86	313	560SL	58 71	89 – 90	355	420SEL
	86 – 87	323	560SEL 560SEC	58 71	89 – 90	350	560SEL 560SEC
Valve Body Style 124 270				60 15	83 – 84	315	300D* 300CD* 300TD*
00 07	88	409	190E 2.6	62 15	85	315	300D* 300CD* 300TD*
12 07	88	409	190E 2.6				300D* 300CD* 300TD*
42 07	90	352 359	300SL-24 300CE-24				300D* 300CD* 300TD*
64 07	90	409	190E 2.6 260E			303	300SD*
Valve Body Style 126 270				67 15	86 – 87	324	420SEL
08 71	87	324	420SEL	71 07	82	309	300SD
14 15	83	310	380SEL 380SEC	71 71	90	361	350SD Turbo
		312	380SL	73 15	86 – 87	317	300D Turbo 300TD Turbo
20 71	87 – 89	313	560SL	74 07	81 82 – 83	321	300SDL Turbo
	88	323	560SEL 560SEC			303	300SD
21 71	88	324	420SEL			315	300D Turbo 300CD Turbo 300TD Turbo
22 15	84	311	500SEL 500SEC				
28 15	83 – 84	303	300SD*	79 15	86	313	560SL
	83	315	300D* 300CD* 300TD*	86 – 87	323	560SEL 560SEC	
				83 15	86 – 87	320	300E
36 07	81	303	300TD*	86 07	82	310	380SEL 380SEC
	81 – 82		300SD*	Valve Body Style 129 270			
	82		300D* 300CD* 300TD*	07 07	88 – 90	358	300E 300CE 300TE
37 15	83	310	380SEL 380SEC 380SE			351	300SEL
					90	342	300E-4MATIC 300TE-4MATIC
	84 – 85	312	380SL			351	300SE 300SEL
38 15	84 – 85	311	500SEL 500SEC	16 07	90	500	300SL-24
46 07	81	301	380SEL			501	300CE-24
		304	380SLC 380SE	20 07	90	353	500SL
	81 – 82						

MERCEDES

Mercedes Valve Body Identification (continued)

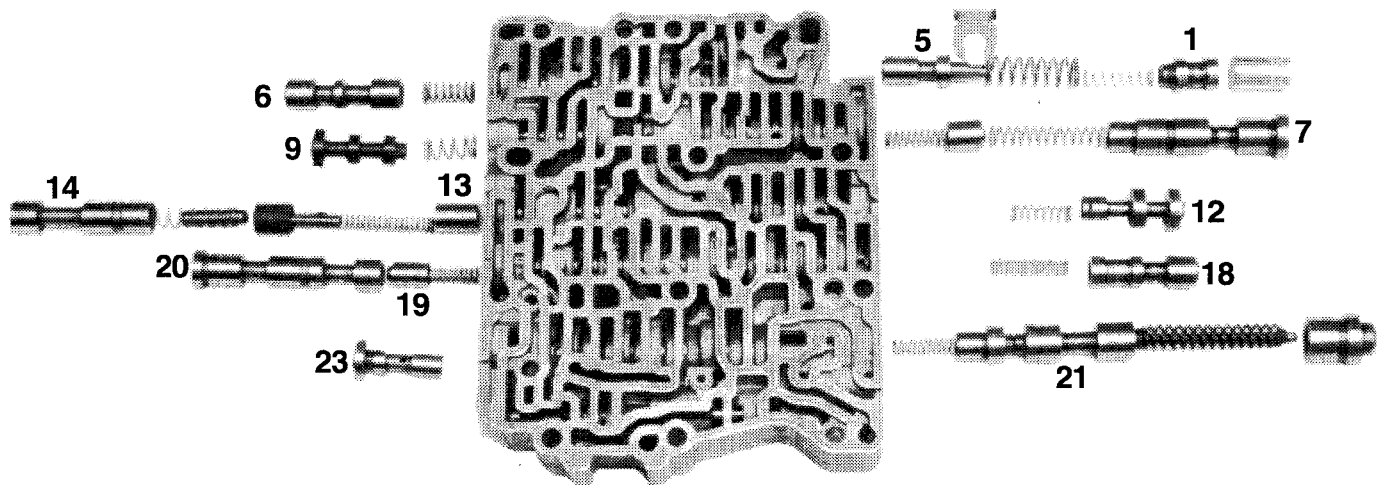
722.3, 722.4 and 722.5 (continued)

Valve Body ID	Year	Transmission	Car Model	Valve Body ID	Year	Transmission	Car Model
Valve Body Style 201 270				Valve Body Style 201 270 (continued)			
00 07	87 – 88	409	260E	56 07	84	400	190E 2.3
	87		190E 2.6	70 07	84 – 85	403	190D 2.2
00 15	87 – 88	408	190E 2.3	74 15	89 – 90	409	190E 2.6
02 15	86 – 88	414	190D 2.5				260E
12 07	87	409	190E 2.6	76 07	85	416	300D
13 53	90	418	250D Turbo				300CD
18 15	90	413	190D 2.5 Turbo				300TD
21 07	84	403	190D 2.2	76 15	90	418	250D Turbo
29 15	87	413	190D 2.5 Turbo	81 15	88	408	190E 2.3
32 15	87	408	190E 2.3	85 07	85 – 86	400	190E 2.3
35 15	87	414	190D 2.5	85 15	89	414	290D 2.5
41 07	84	400	190E 2.3	90 07	86 – 87	410	190E 2.3-16
51 07	84	403	190D 2.2	91 07	88	414	190D 2.5

Mercedes 722.1 Valve Body

Shift Valve Housing

The valve body used for these pictures was valve body number 123 270 6207.

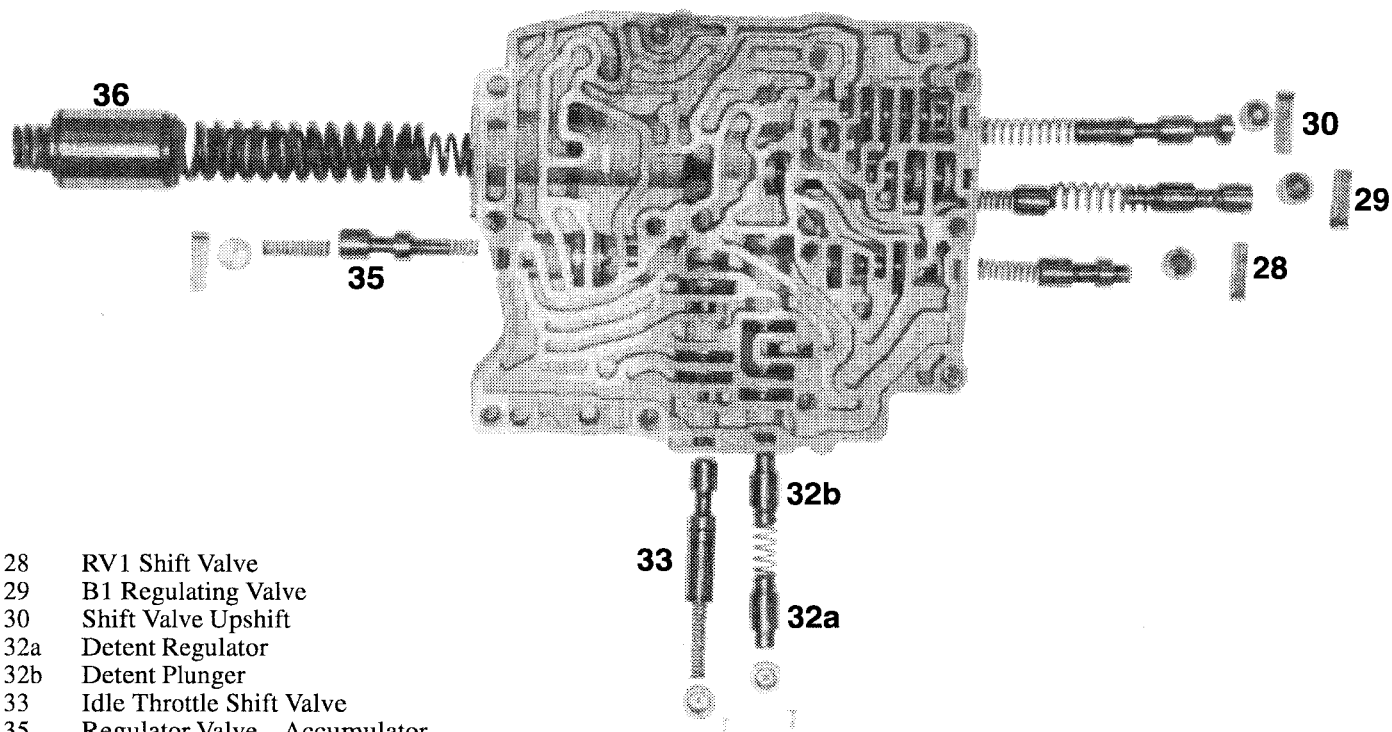


- | | | | |
|----|-----------------------------------|----|-------------------------------|
| 1 | TV Plunger | 14 | 3-4 Command Valve |
| 5 | Throttle Valve (Control Pressure) | 18 | 3-2 Downshift Valve |
| 6 | B2 Release Valve | 19 | 2-1 Kickdown Piston |
| 7 | 2-3 Command Valve | 20 | 1-2 Command Valve |
| 9 | B2 Shift Valve | 21 | Pressure Regulator Valve |
| 12 | B1 Shift Valve | 23 | Governor Pressure Boost Valve |
| 13 | 4-3 Downshift Piston | | |

NOTE: The numbers listed for these valves are the numbers assigned by Mercedes.

Mercedes 722.1 Valve Body (continued)

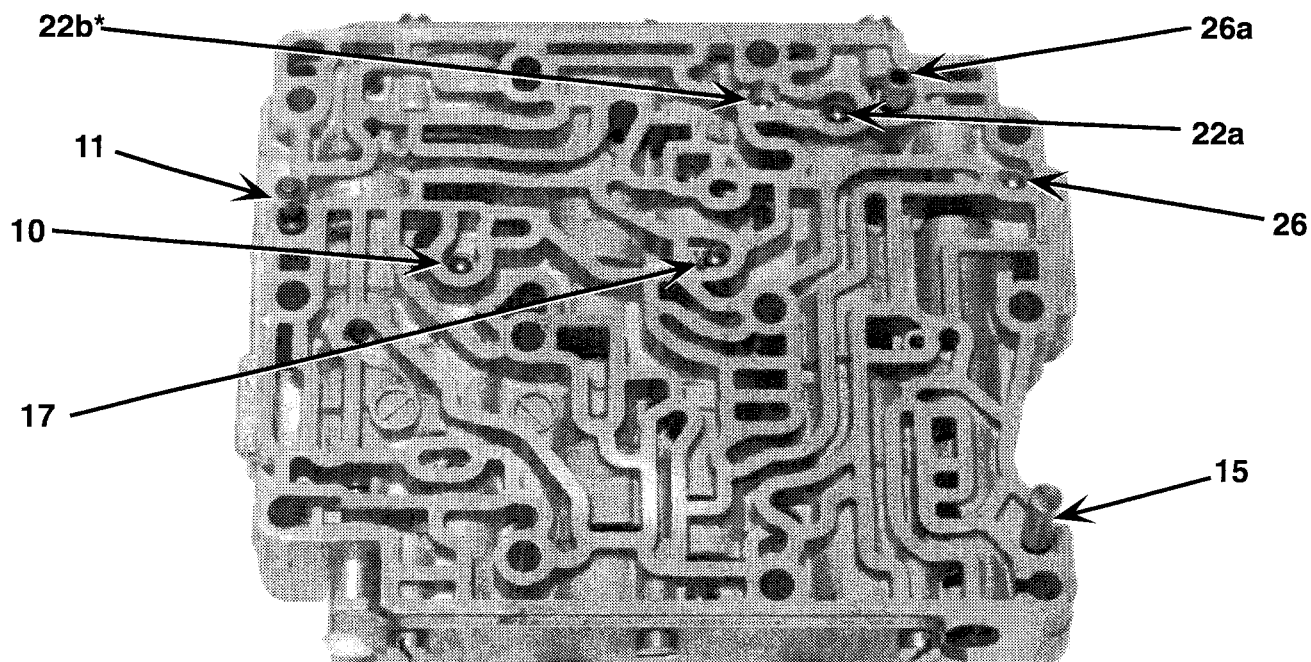
Lower Housing



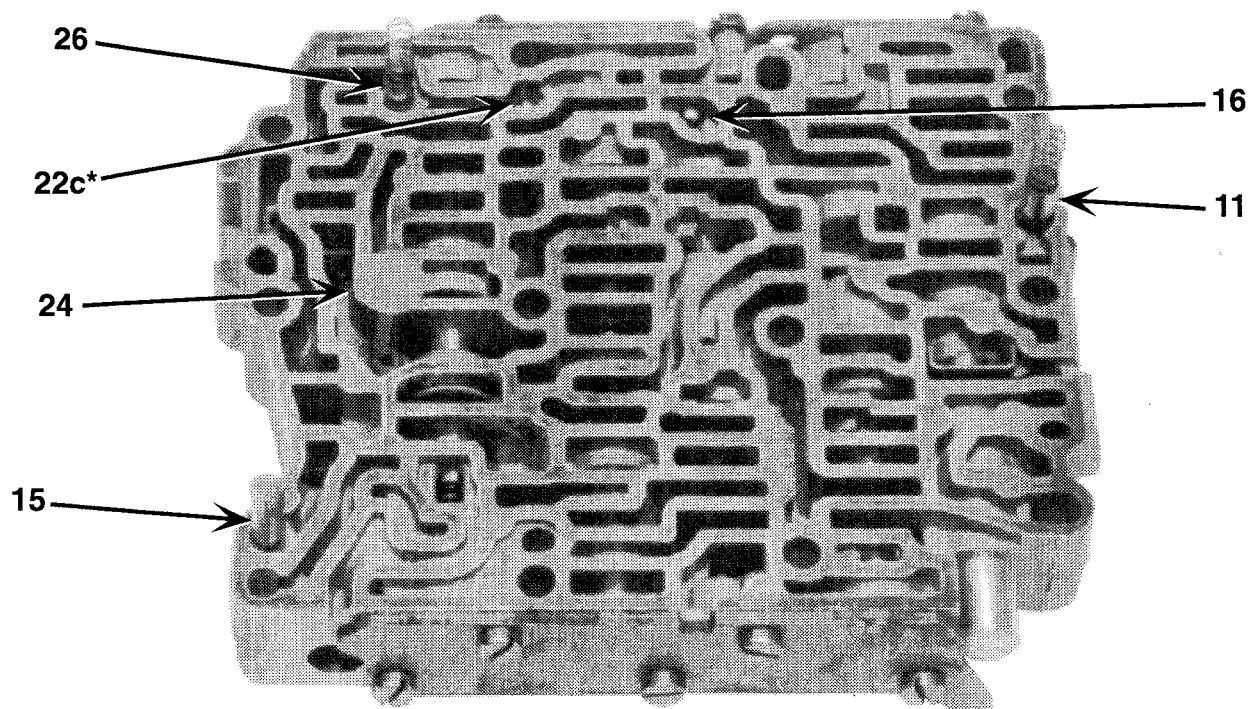
- 28 RV1 Shift Valve
- 29 B1 Regulating Valve
- 30 Shift Valve Upshift
- 32a Detent Regulator
- 32b Detent Plunger
- 33 Idle Throttle Shift Valve
- 35 Regulator Valve – Accumulator
- 36 Accumulator

Mercedes 722.1 Valve Body (continued)

Valve and Checkball Locations



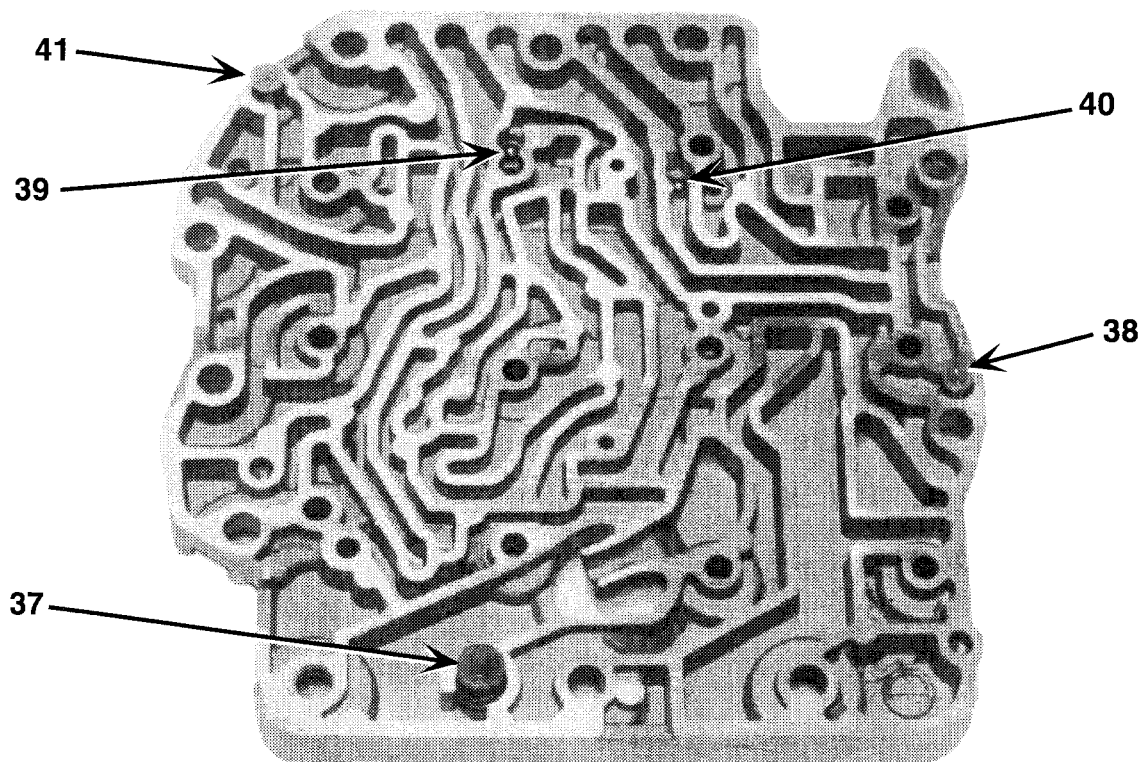
- 11 B2 Release Valve
- 15 RV2 Shutoff Valve
- 24 Front Pump Check Valve
- 26 K2 Detent Valve



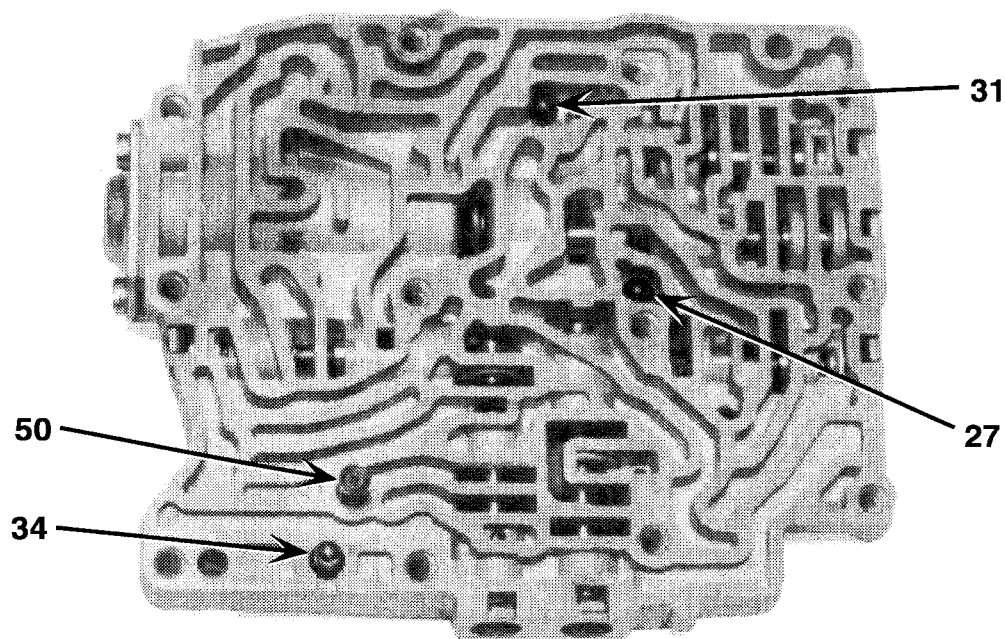
* There's a 13.2 mm (0.520") rod between checkballs 22b and 22c.

Mercedes 722.1 Valve Body (continued)

Valve and Checkball Locations (continued)

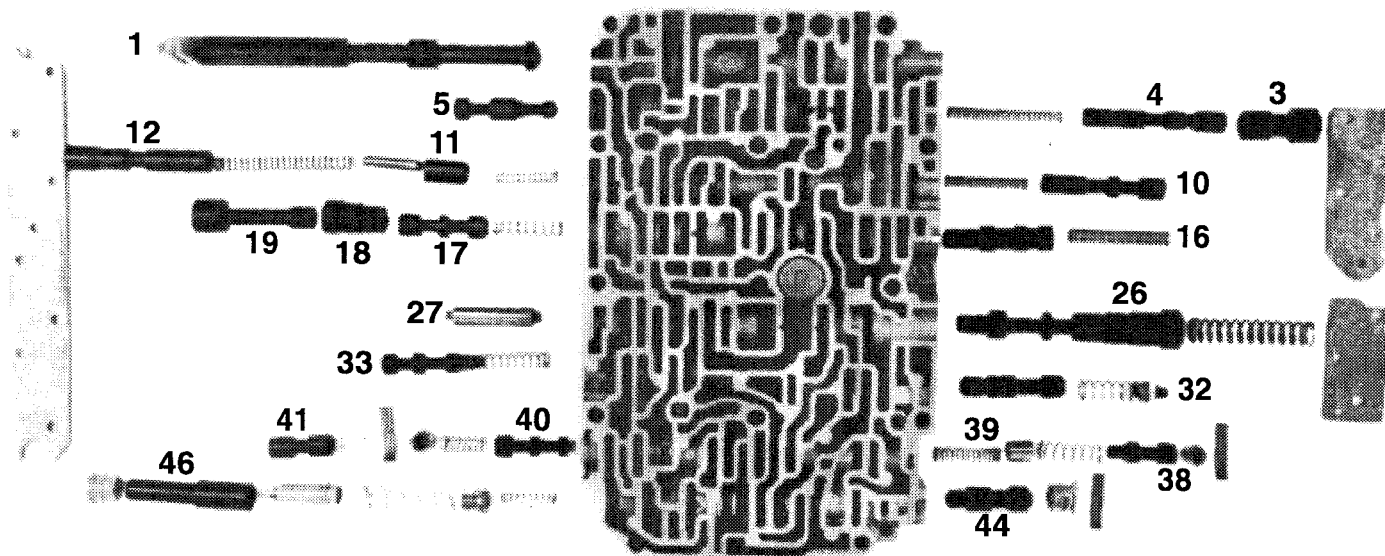


- 34 Modulator Relief Valve
- 37 Lube Valve
- 38 B3 One-Way Throttle Valve
- 41 B2 Release – One-Way Throttle Valve
- 50 Screen for #34



Mercedes 722.3 Valve Body

Shift Valve Housing



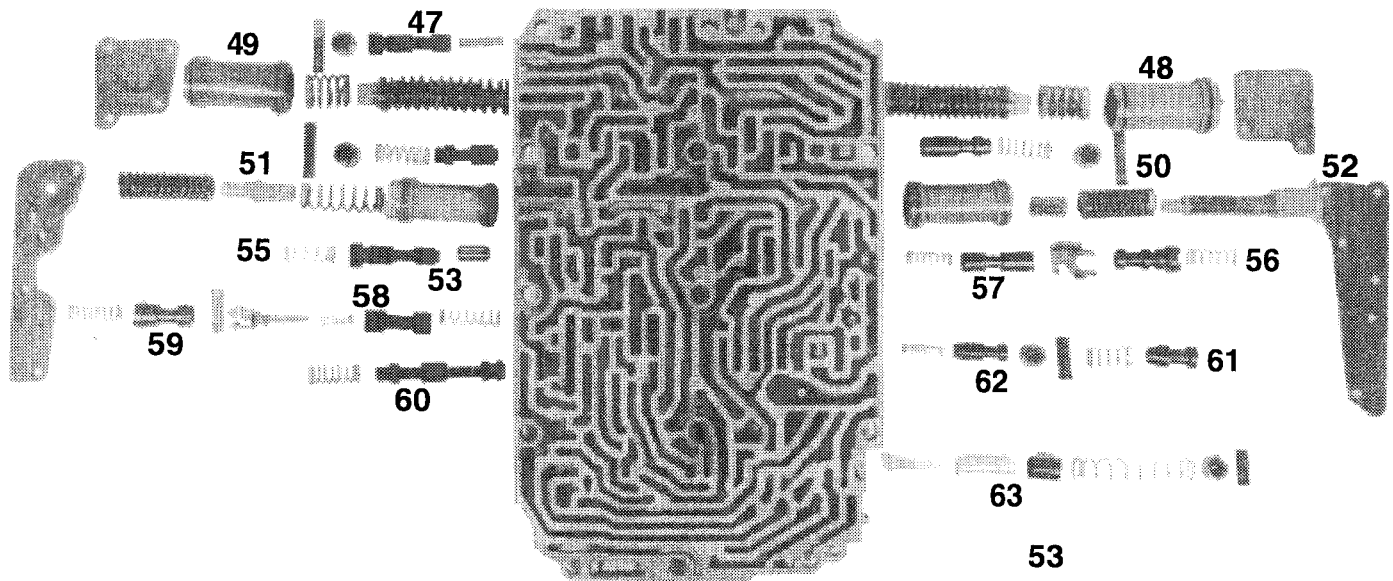
NOTE: If the throttle valve is free, don't remove it; the retainer may break when you try to remove it.

1	Manual Control Valve	26	Pressure Regulator Valve
3	2-3 Command Valve Plunger	27	Plug
4	2-3 Command Valve	32	Full Throttle Control Valve
5	Converter Adaptation Valve	33	B2 Shift Valve
10	B1 Shift Valve	38	B1 Control Valve
11	3-4 Command Valve Plunger	39	B1 Control Valve Plunger
12	3-4 Command Valve	40	Kickdown Shift Valve
16	Basic Pressure Control Valve	41	Governor Pressure Shift Valve
17	1-2 Command Valve	44	Governor Boost Valve
18	1-2 Command Valve Sleeve	45	Throttle Valve
19	1-2 Command Valve Plunger	46	Throttle Plunger

NOTE: The numbers listed for these valves are the numbers assigned by Mercedes.

Mercedes 722.3 Valve Body (continued)

Accumulator Housing

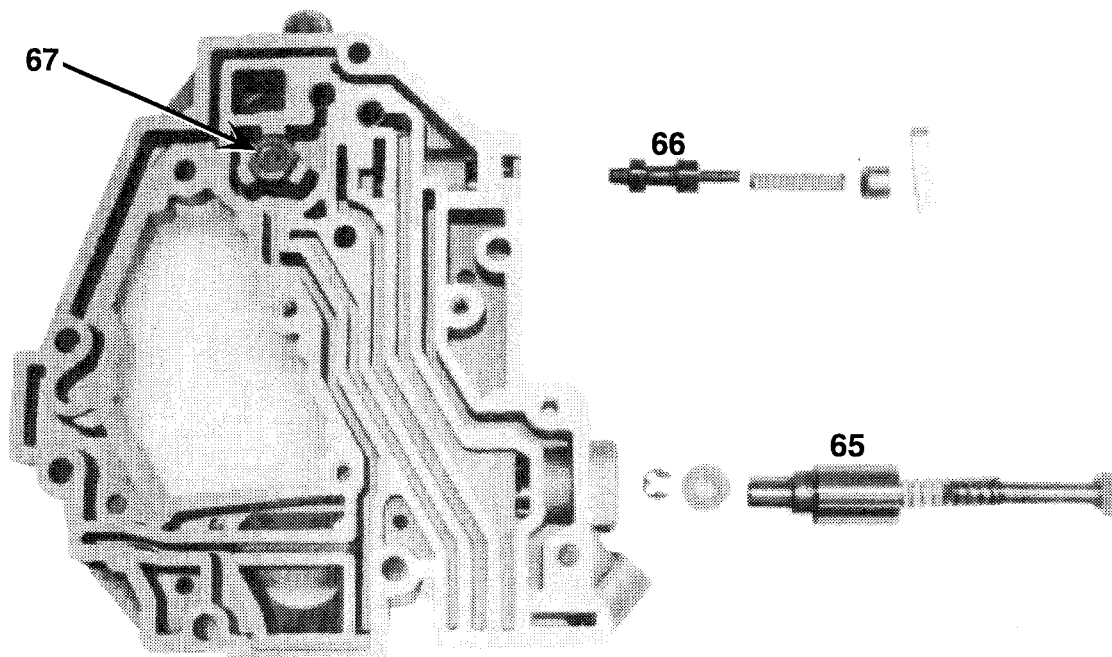


- 47 Shift Pressure Control Valve
- 48 K1 Accumulator
- 49 K2 Accumulator
- 50 K1 Accumulator Control Valve
- 51 K2 Accumulator Control Valve
- 52 B1 Accumulator
- 53 Switching-On Accumulator
- 55 RV2 Shutoff Valve

- 56 Deceleration Shift Valve
- 57 B1 Accumulator Control Valve
- 58 Switching-On Accumulator Control Valve
- 59 K2 Shift Valve
- 60 B2 Detent Valve
- 61 Brake Circuit Shutoff Valve
- 62 RV1 Shutoff Valve
- 63 Kickdown Accumulator

Mercedes 722.3 Valve Body (continued)

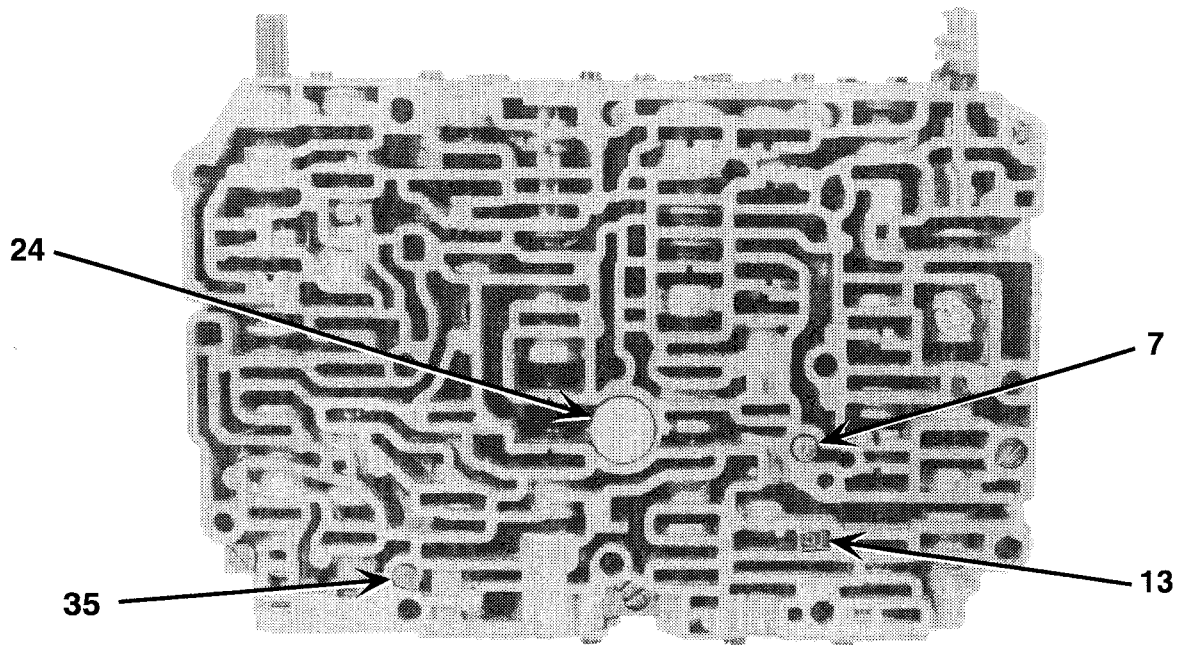
Lower Cover



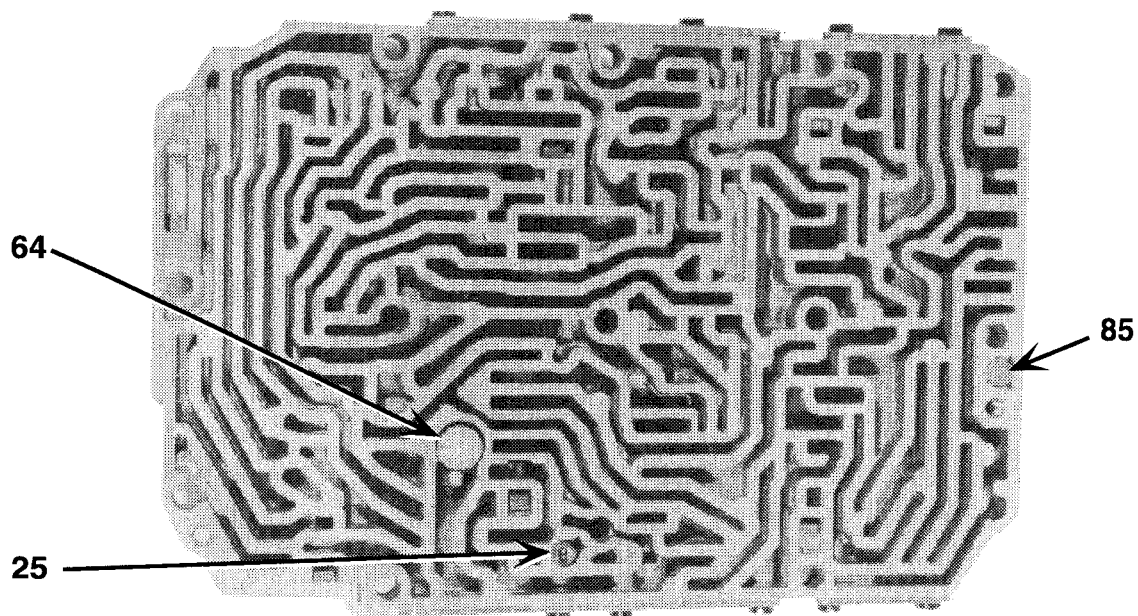
- 65 Reverse Gear Shutoff Plunger
- 66 Secondary Pump Shift Valve
- 67 Secondary Pump Check Valve

Mercedes 722.3 Valve Body (continued)

Valve and Checkball Locations



- 7 K1 Shutoff Valve
- 13 B1 Check Valve
- 24 Primary Pump Check Valve
- 35 Lube Oil Shift Pin

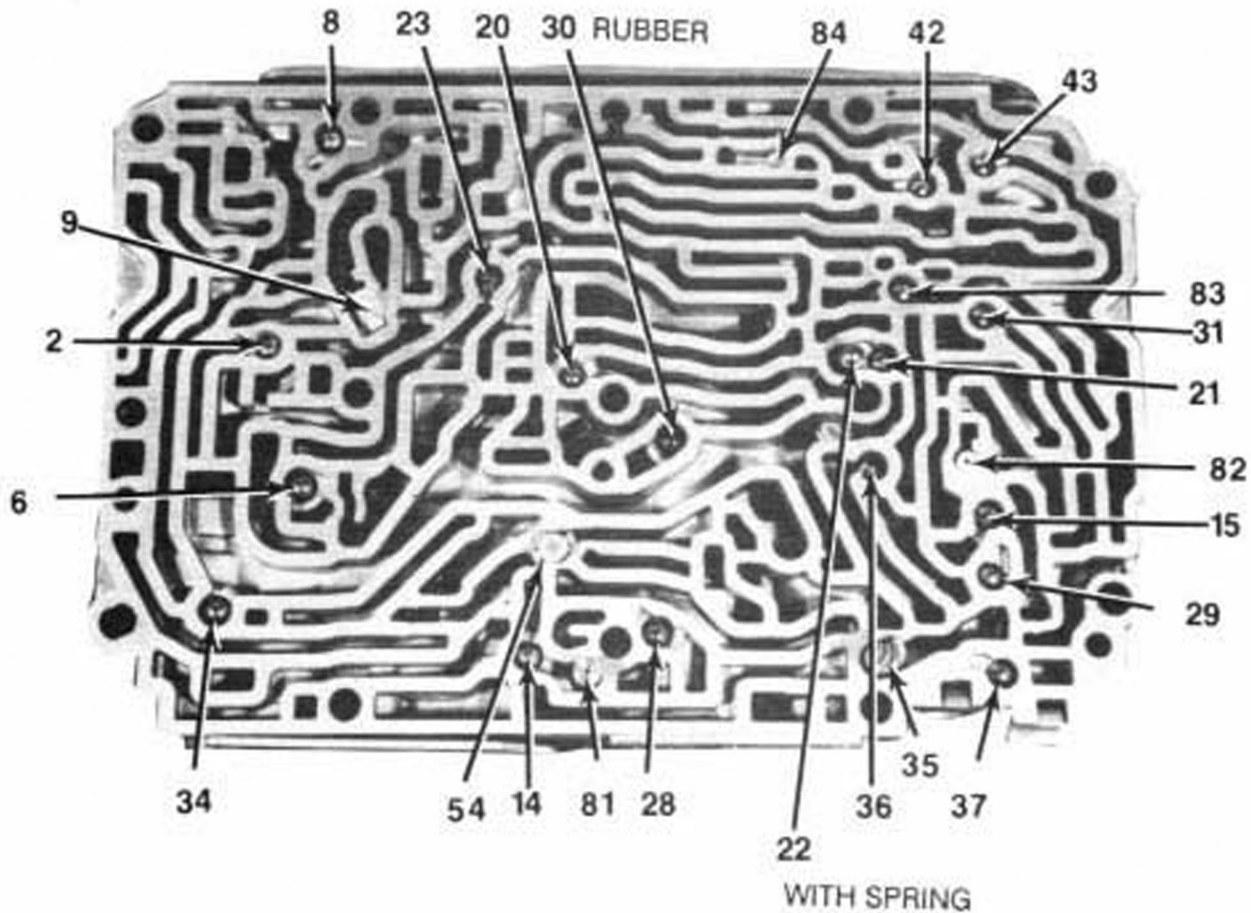


- 25 Modulating Pressure Relief Valve
- 64 Lube Oil Relief Valve
- 85 Pressure Relief Valve (K1 Dribble Circuit)

Mercedes 722.3 Valve Body (continued)

Valve and Checkball Locations (continued)

NOTE: The #83 checkball isn't used on all models. Use the separator plate (shown on the next page) to determine whether to use this checkball or not.

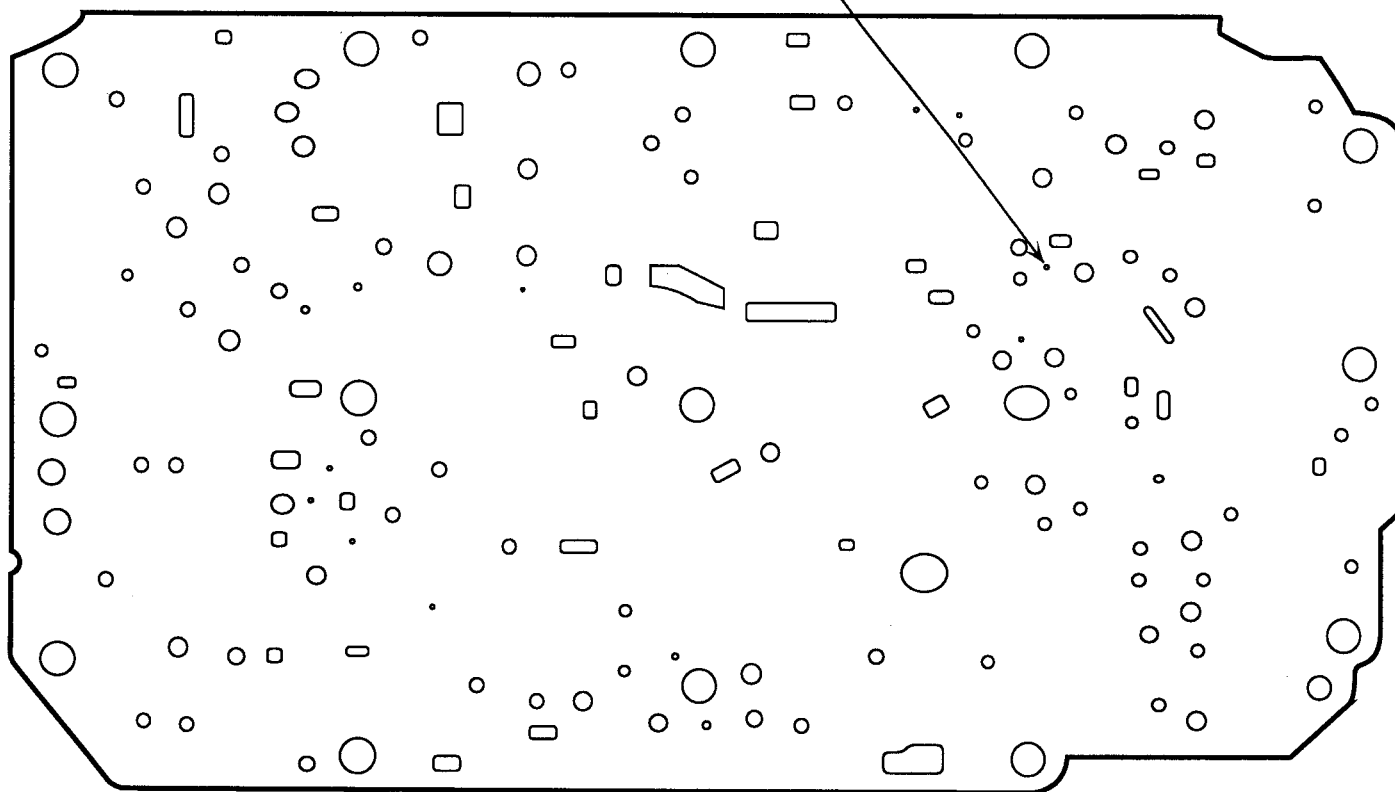


- 9 K2 Check Valve
- 35 Lube oil Shift Pin
- 54 B1 Accumulator Check Valve
- 81 Modulator Check Valve
- 82 TV Check Valve
- 84 K2 Check Valve

Mercedes 722.3 Valve Body (continued)

Valve and Checkball Locations (continued)

If the separator plate has this hole, the valve body takes checkball #83; if this hole isn't there, don't install a #83 checkball.

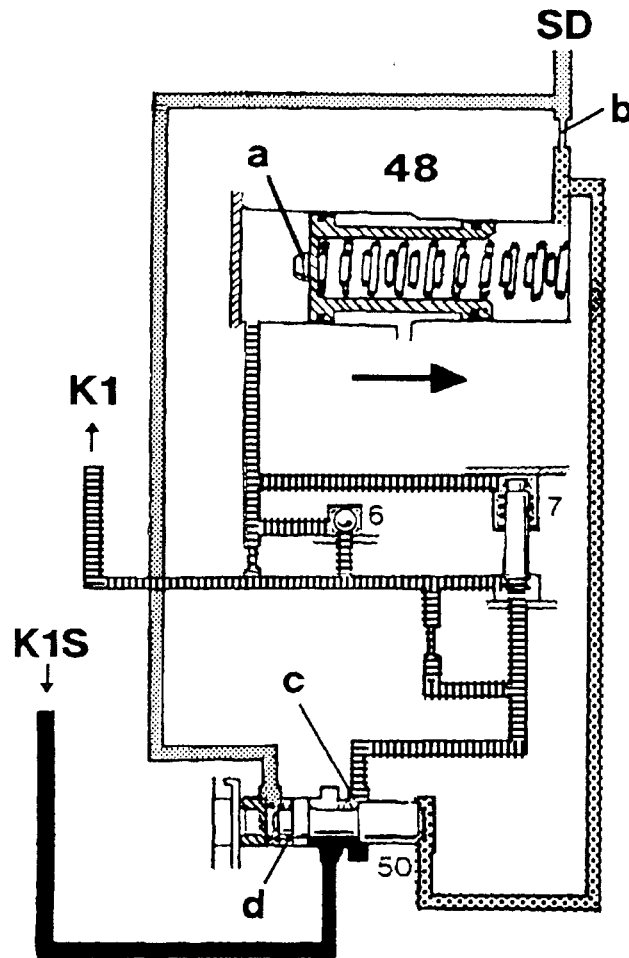


Accumulator System

722.3 and 722.4

There are four accumulators in Mercedes 722.3 and 722.4 transmissions: One for reverse and forward engagements (switching-on), one for the 1 – 2 shift (B2), one for the 2 – 3 shift (K1), and one for the 3 – 4 shift (K2). The figure below is an example of an accumulator system. The example here is for the K1 clutch (2 – 3 shift).

- K1S = K1 Shift Oil
- K1 = K1 Feed
- SD = Control (Accumulator) Pressure
- 7 = K1 Shutoff Valve
- 48 = K1 Accumulator
- 50 = K1 Accumulator Control Valve



ACCUMULATOR FUNCTION

With the engine running, “SD” oil applies to the spring side of the accumulator, and both sides of the K1 accumulator control valve (#50). Because the pressure is equal on both sides of #50, spring force at “d” moves the accumulator control valve to the right (open position).

When the 2 – 3 command valve (2-3 shift valve) initiates the 2 – 3 shift, it sends “K1S” oil to #50. “K1S” oil moves through #50, past #7, and tees off to the K1 clutch and accumulator (#48). K1S oil, working on the left side of the accumulator (a), opposes the lower “SD” pressure, and moves the piston to the right.

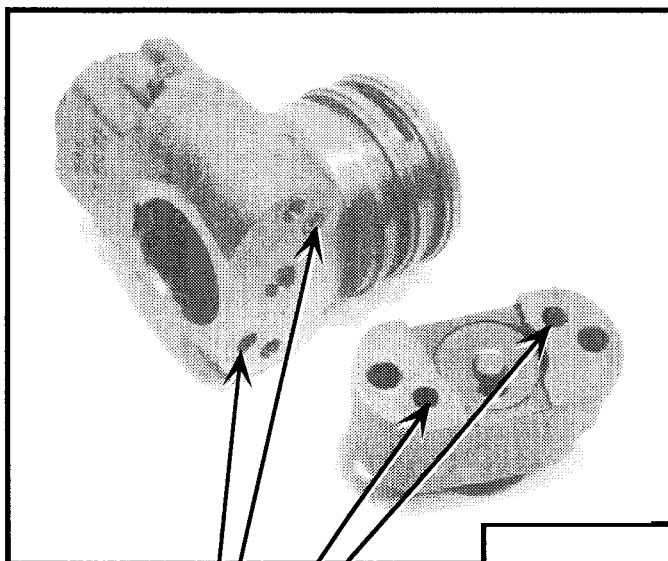
Because of orifice “b,” the oil exiting the spring side of the accumulator increases in pressure while the piston is moving. This pressure, working on the right side of #50, moves the K1 accumulator control valve to the left. The controlling edge (c) of #50 now reduces the flow of oil to the K1 clutch.

When the accumulator bottoms out, pressure is once again equal on both sides of #50, so the accumulator control valve moves to the right.

No Shifts/Late Shifts

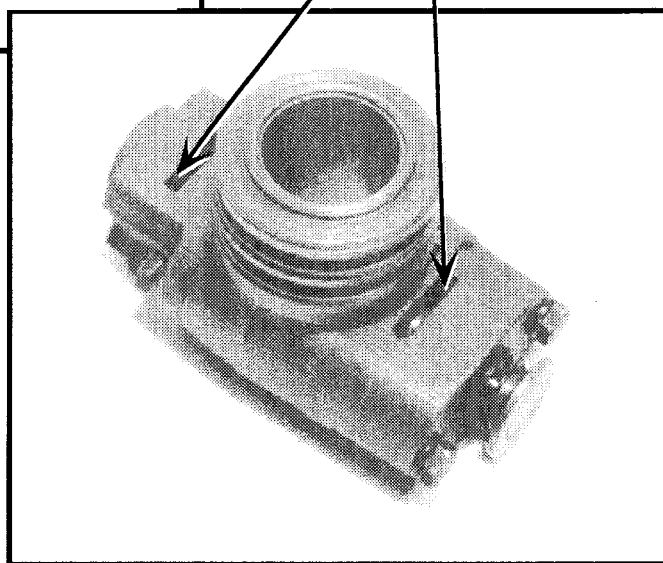
Mercedes 722.0,.1,.2

No shifts or late shifts can occur if the secondary governor weight isn't assembled properly to the governor body. There are vents on both sides of the governor weights: The large vents must face the sealing rings.



There are vents on both sides of the governor weights: The large vents must face the sealing rings.

CAUTION: Never use the feed holes to indicate proper governor assembly. The feed holes will always line up, regardless of proper indexing.

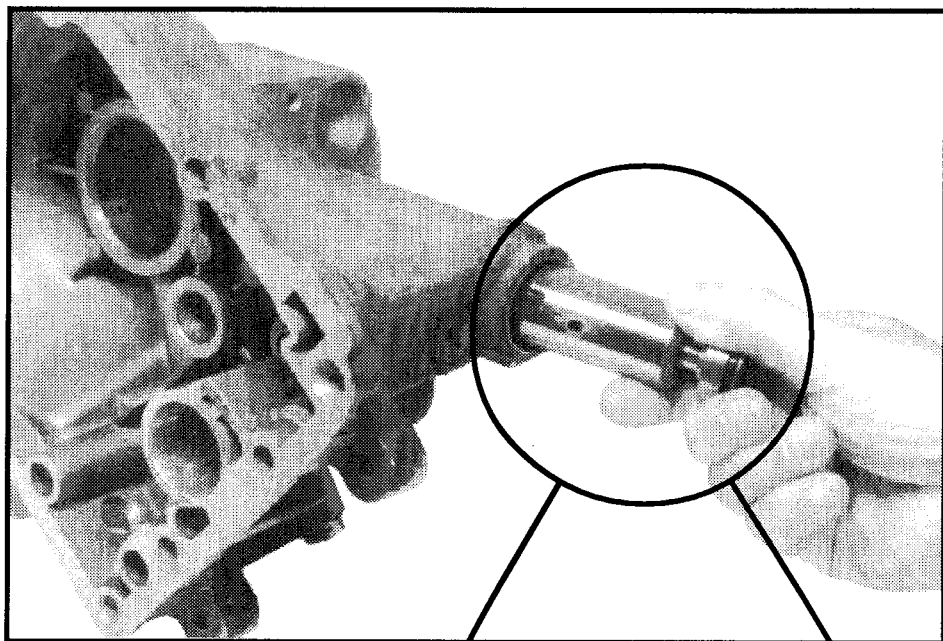


NOTE: There are smaller vents on the other side of the governor (not shown).

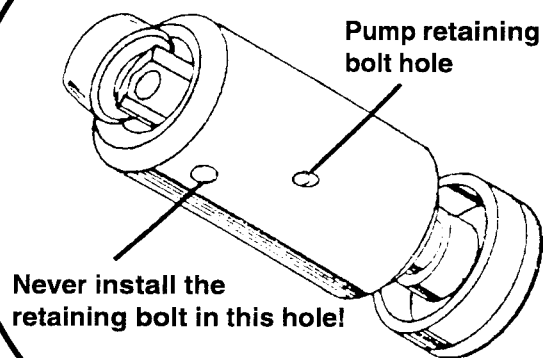
Rear Seal Blowout

Mercedes 722.0, .1, .2

Rear seal blowout is usually caused by installing the rear pump backward. Use these illustrations to see the proper way to install the rear pump.

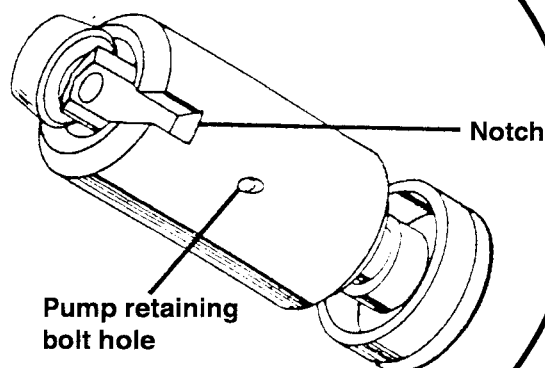


Two holes to the front
(Notch to the rear, not pictured)



First Design

Notch to the front
(One hole to the rear, not pictured)

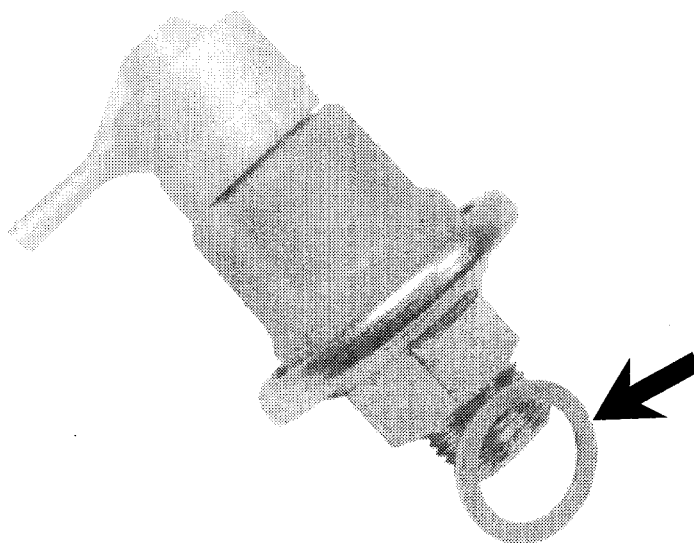


Second Design

Slips on Shifts or No Kickdown

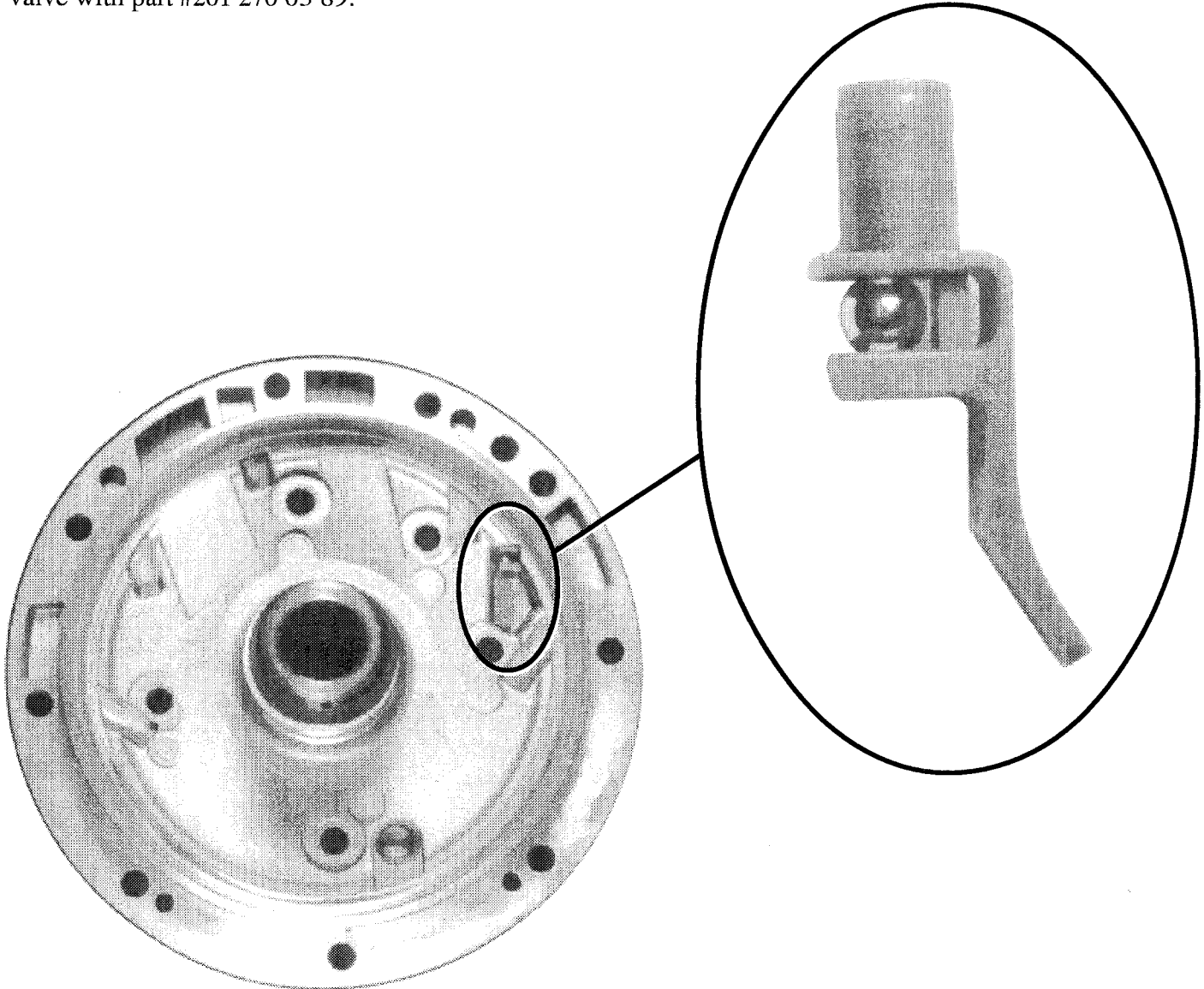
722.0, 722.1, 722.2

These conditions can be caused by using an aluminum sealing washer on the vacuum modulator. If the transmission is equipped with a modulator, never install a washer between the case and modulator; always use a thread sealant to seal the modulator to the case.



Rough Reverse Release

Rough release of the B3 (reverse) brake may be caused by a missing or broken exhaust check valve. When the check valve breaks, you'll usually find pieces of green plastic under the B3 piston. Replace the check valve with part #201 270 03 89.

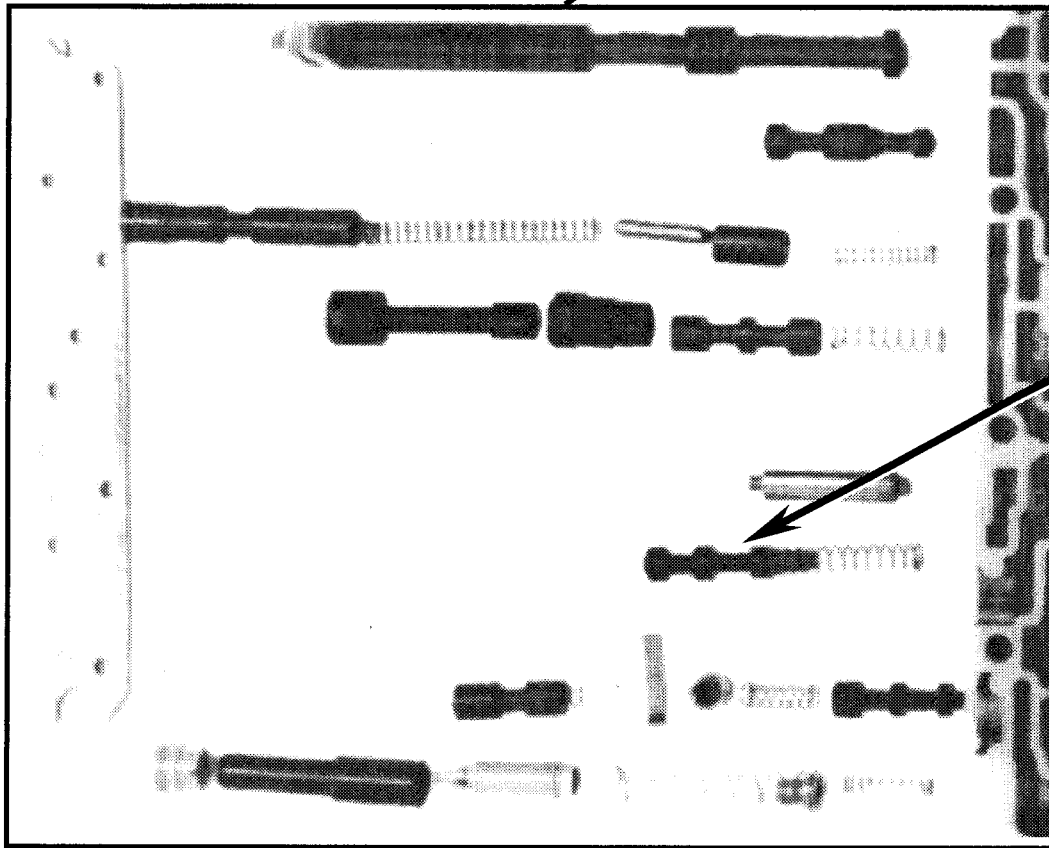
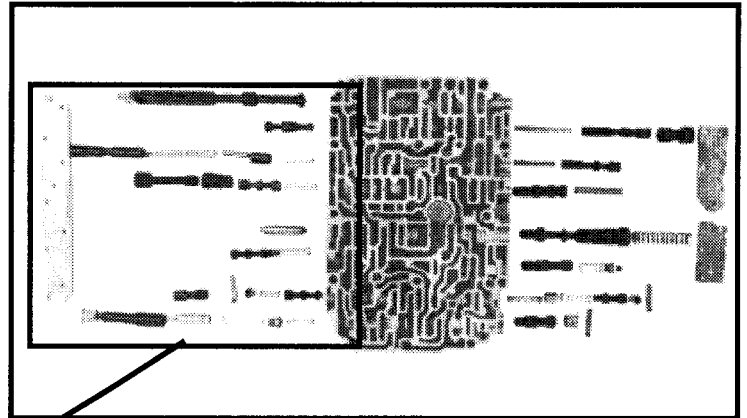


NOTE: This check valve wasn't used in 722.418 models, and was omitted on 722.408, 409 and 414 models after production #673440.

No Forward

Mercedes 722.3 and 722.4

The most common reason for a Mercedes 722.3 or 722.4 not to move forward is a stuck B2 shift valve. Check line pressure in drive before you disassemble the valve body; pressure should be at least 60 PSI.



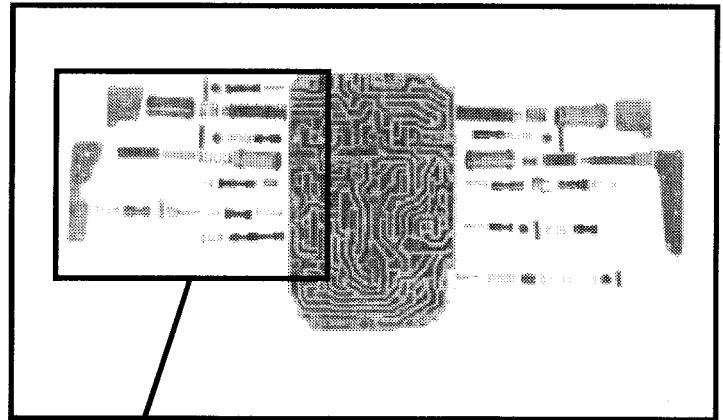
B2 Shift Valve

No Forward or Reverse

Mercedes 722.3 and 722.4

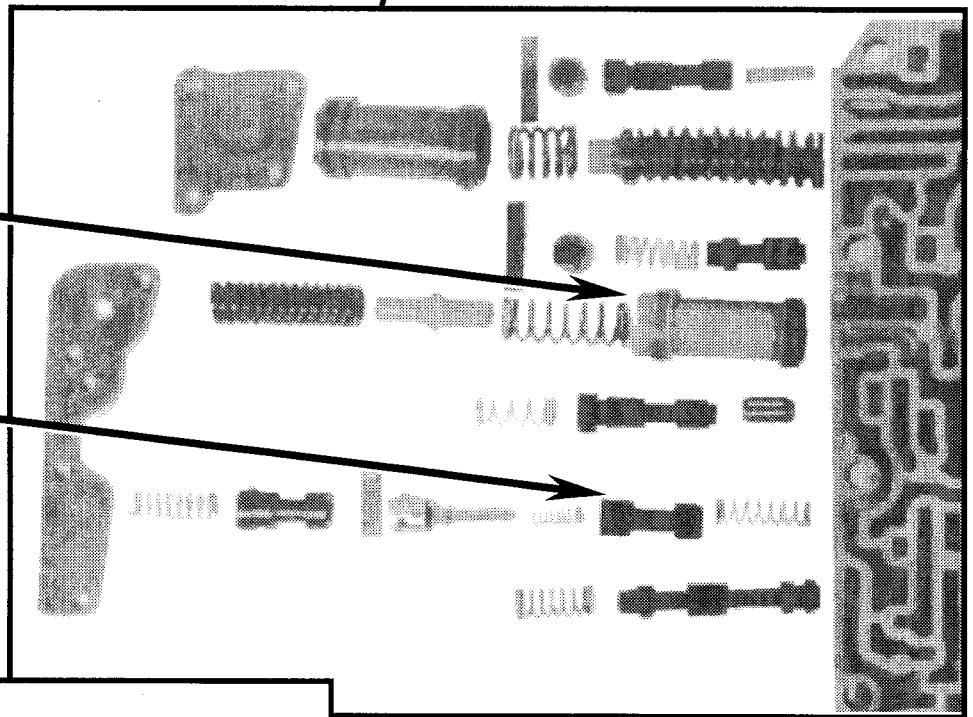
The most common reason for a Mercedes 722.3 or 722.4 to have no forward and no reverse is a sticking switching-on accumulator control valve, or leaking rings on the switching-on accumulator.

There are slightly different versions of the switching-on accumulator control valve and valve train. Yours may look different than the illustration. Before disassembling the valve body, always check line pressure and cooler flow. Line pressure should be at least 60 PSI.

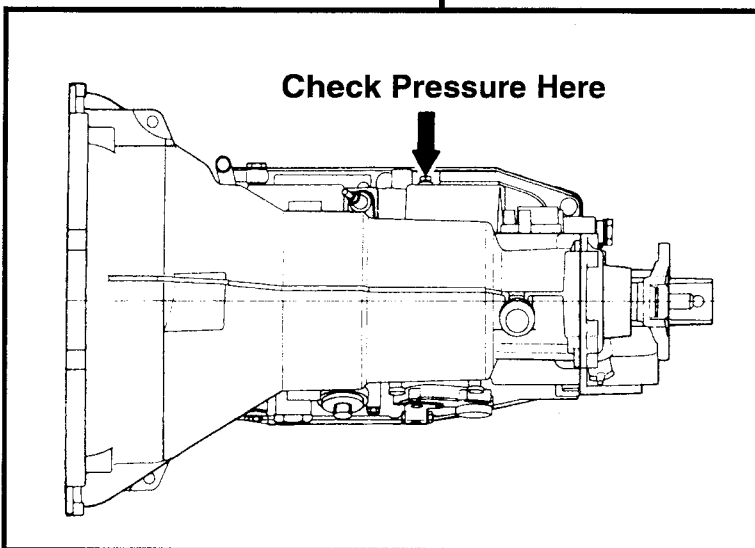


**Switching-on
Accumulator**

**Switching-on
Accumulator
Control Valve**



Check Pressure Here



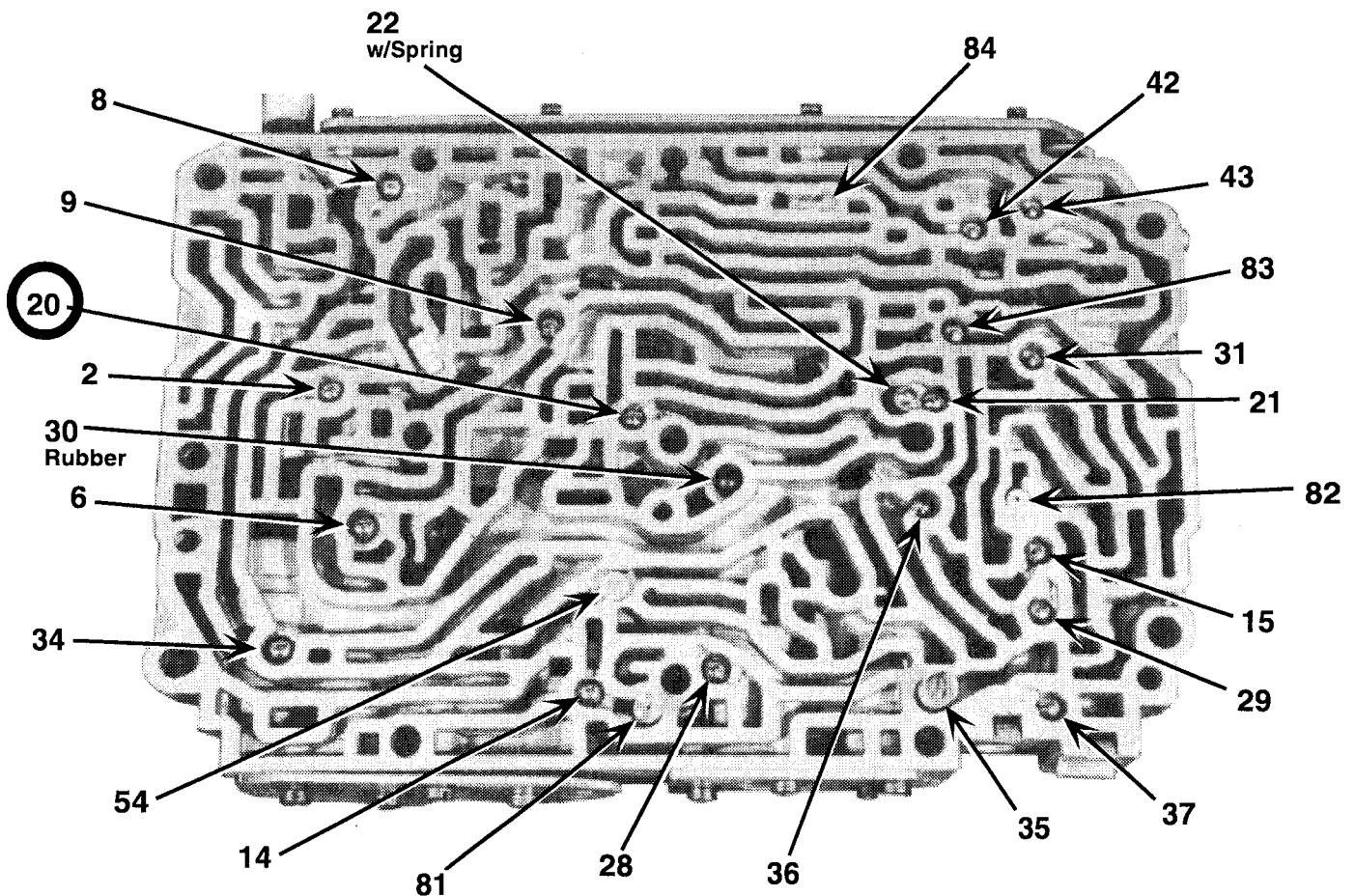
No Forward / Slips Forward (until 1-2 shift is completed) / Slips in Reverse (usually worse hot)

Mercedes 722.3

One or more of these complaints may be caused by a damaged #20 checkball or checkball seat. The exact complaints will vary, depending on how badly damaged the ball or plate becomes.

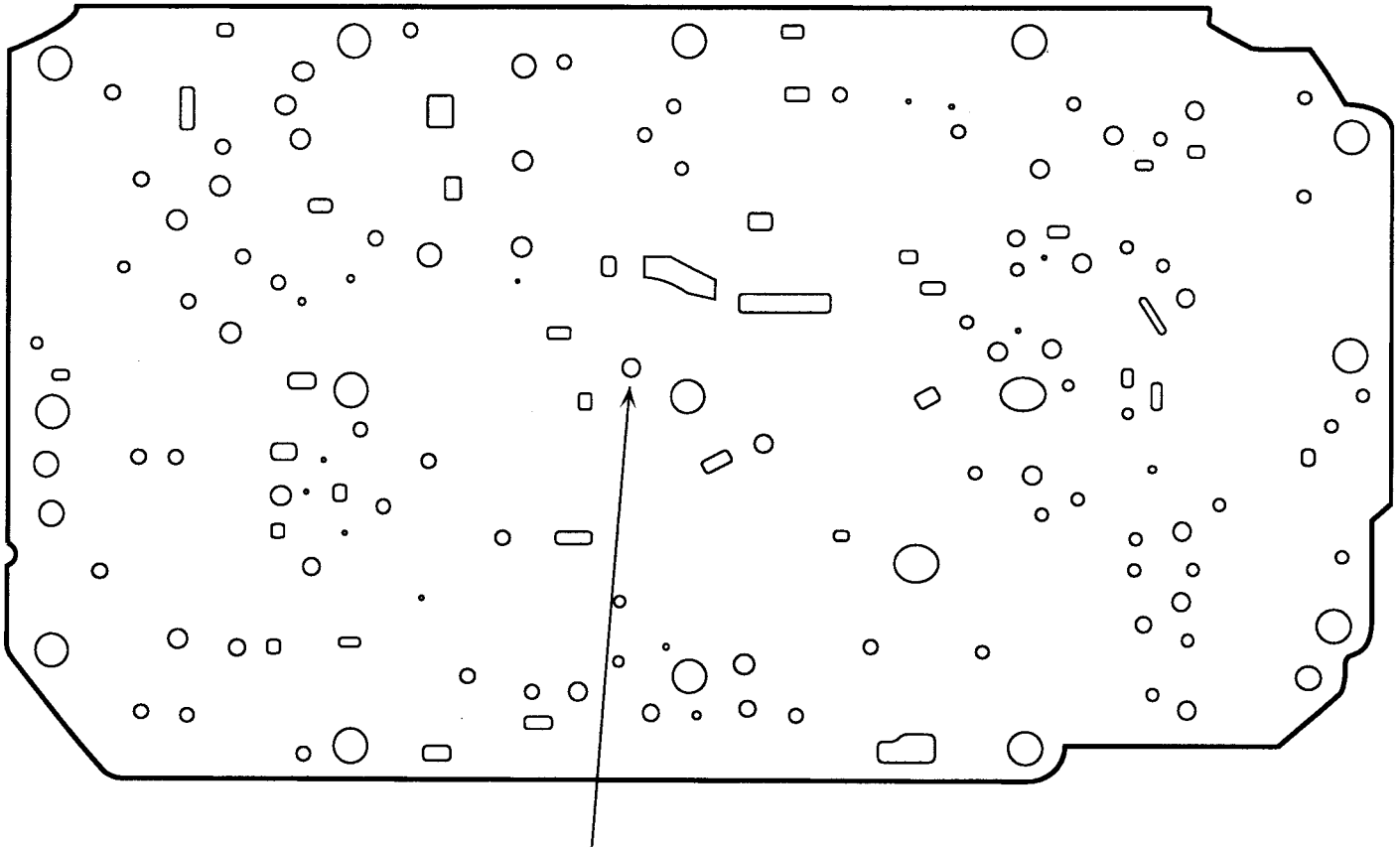
Replace the #20 steel checkball with an 0.218" diameter rubber checkball (part # 116 991 0029).

If the separator plate is damaged, look for a good used plate; new plates aren't available separately. Before installing any replacement plate, make sure it matches the original plate exactly.



**No Forward /
Slips Forward (until 1-2 shift is completed) /
Slips in Reverse (usually worse hot) (cont)**

Mercedes 722.3



#20 Checkball Seat

Mercedes Transmission Parts

Transmission	Part	Part Number
All	Switchover Valve (1980 – 83)	002 997 53 36
All	Vacuum Regulator (1980 – 83)	123 070 00 46
All	Vacuum Regulator Adjustment Tool	916 589 00 21 00
All	Output Shaft Nut Spanner	123 990 00 60
All	Output Shaft Nut Socket (30 mm, 12-point)	124 270 13 05
722.0, 1	Modulator Pin Adjusting Tool	115 589 11 21 00
722.1, 2	Mechanical Modulator Spring	115 993 56 03
722.0, 1	Modulators	
	All Steel	000 270 01 79
	Red Screw-In	123 270 06 79
	White Screw-In	123 270 99 79
722.3, 4, 5	Modulators	
	Black	126 270 43 79
	Brown	126 270 27 79
	Green	126 270 26 79
	Red	126 270 25 79
	White	126 270 24 79
722.3	B3 Frictions	126 272 09 25
722.3	B2 Piston	107 270 04 32
722.3	“T” Seal for the B2 Servo	126 277 24 55
722.3	Rear Valve Body Gasket	124 277 02 80
722.3	K1, K2 Sealing Rings	126 272 09 55
722.3, 4	Modulator Pin	126 272 20 74
722.3, 4	Accumulator Sealing Rings	126 586 01 27
722.4	ATF (For Harsh Shifts)	001 989 07 03

Engine or Transmission?

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Engine vs Transmission Problems

Some transmission problems are easy to find and fix. For example, the vehicle won't shift at all, and the transmission oil is burnt black: In this case, you know the transmission has to come out for a rebuilt.

But some problems aren't so cut and dried: chatters, no power, slipping in gear... all problems that could be caused by a transmission problem... or maybe not.

For example, a complaint of no power on acceleration could indicate a bad torque converter, but it could just as easily be caused by a clogged exhaust system. You could rebuild the transmission, replace the converter... and end up right where you started.

And in recent years, determining whether a problem was in the transmission or not has only become worse. Lockup converters were the first problem: When the converter locks, it puts a greater load on the engine. This can increase the likelihood of ignition breakup or misfire. At the same time, the converter no longer provides a hydraulic cushion between the engine and transmission. This allows the system to transmit engine conditions more readily, magnifying the effects of a misfire or engine roughness.

What's more, now that transmission operation has become a function of the powertrain control module (computer), problems totally unrelated to the transmission can prevent the transmission from operating entirely.

5 Basic Problem Areas

There are a number of different conditions that could be confused with a transmission failure. These problems fall into 5 basic categories:

- Shudder/chatter
- Surge
- Power loss/drag
- Stalls
- No shifts – Failsafe

We're going to look at each of these categories, and see how to isolate each of these conditions, to determine whether the problem is in the transmission, or somewhere else in the vehicle.

Shudder/Chatter

This is one of the more common engine problems that's often confused with a transmission problem. A shudder or chatter usually takes place during or right after a shift.

If the problem occurs during a specific shift, such as the shift from 2nd to 3rd gear, suspect a transmission problem. In the transmission, a shudder or chatter can indicate slipping or burnt clutches, a restriction in the apply circuit, or a pressure problem.

If it only occurs after the shift is complete, suspect an engine problem. In the engine, a shudder or chatter usually indicates a misfire or vibration. If the problem only takes place with the converter clutch applied, you're probably looking at a secondary ignition misfire.

There are a few simple tests you can use to identify an engine problem that could cause a shudder or chatter:

- Engine vacuum
- Ignition secondary waveform
- Oxygen sensor waveform

Continued...

5 Basic Problem Areas (continued)

Surge

A surge is when the vehicle tends to accelerate and decelerate momentarily, causing a rocking or jerking condition.

In the transmission, a surge could be caused by a slipping or burnt clutch, or by shuttling back and forth between two gears.

In the engine, a surge can indicate an air/fuel mixture problem, a vacuum leak, or an EGR problem.

There are a few simple tests you can use to identify an engine problem that's causing a surge:

- Engine vacuum
- EGR system
- Oxygen sensor waveform

Power Loss/Drag

You'll usually recognize a power loss or drag by the amount of throttle necessary: You'll have to press down more on the throttle to get the same level of acceleration as you would on a similar vehicle.

In the transmission, a power loss or drag will usually be caused by a dragging clutch or band, or a slipping one-way clutch in the torque converter.

Elsewhere in the vehicle, a power loss or drag can be due to an engine, ignition or fuel problem, a clogged exhaust, or by a dragging brake.

There are a few tests you can use to identify a problem that's causing a power loss or drag:

- Engine vacuum
- Exhaust backpressure
- Fuel pressure
- Ignition waveforms
- Oxygen sensor waveform
- Brake operation

Stalls

There are two main stalling conditions that can be either a transmission problem or an engine control system problem: stalling going into gear, or stalling while coming to a stop.

In the transmission, both of these problems are usually caused by the converter clutch remaining on when it should be released.

In the engine control system, stalling problems can be due to a number of problems, including:

- Idle speed control system isn't working properly
- Engine torque is opening an air duct (mass airflow sensor systems only)
- Engine torque is opening or shorting an electrical circuit

Continued...

5 Basic Problem Areas (continued)

No Shifts – Failsafe

These vehicles won't shift at all, or have severely limited shifts. In the transmission, this could be due to a major failure, such as burnt clutches.

But with the introduction of computer controls, more and more vehicles are finding their way into the shop that won't shift, but have nothing at all wrong with the transmission itself. Further investigation reveals the "transmission" problem is caused by a problem in one of the computer system sensors or circuits.

One of the first tests you should perform on any vehicle with this type of problem is to check for diagnostic trouble codes. Not just transmission codes: Check the engine codes too. Remember, many vehicle systems share sensors between the engine and transmission. So the throttle position sensor and MAP sensor provide the load signals for both the engine and transmission computer.

Once you've determined you're looking at a computer system problem, and you've identified the system or circuit that's probably involved, you can isolate the problem by taking advantage of a computer system characteristic known as "substitution."

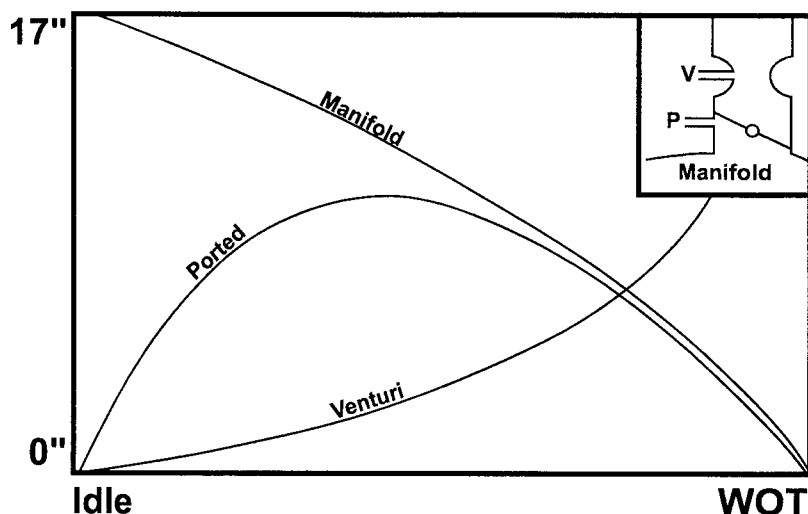
Diagnostic Procedures

Vacuum Testing

There are three main types of engine vacuum:

- Manifold
- Ported
- Venturi

Ported and venturi vacuum both originate after the throttle plate, and tend to rise with throttle opening. These types of vacuum are used to control various devices, including EGRs, vacuum advances and some modulators.

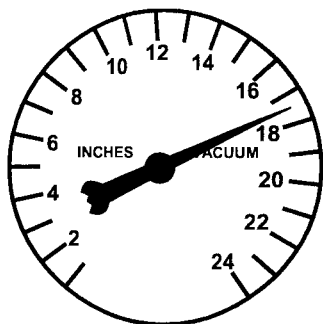


This chart shows the relationship between the three main types of vacuum: manifold, ported and venturi. When testing for an engine performance problem, always check the manifold vacuum.

The vacuum we're most concerned with is manifold vacuum, which originates below the throttle plate. The engine develops manifold vacuum through cylinder suction. Manifold vacuum is high during closed throttle; opening the throttle lowers the vacuum.

In most engines, normal manifold vacuum will around 18" at idle, and will drop off as the throttle opens. On a full throttle, hard acceleration, manifold vacuum will drop near zero (atmospheric pressure). If the engine is working properly, the vacuum should be fairly smooth and steady.

Here's what different vacuum conditions can indicate:



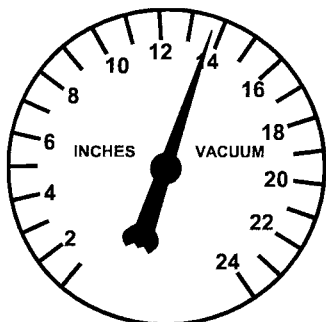
Conditions: 18" vacuum at idle. Drops off as throttle opens. Rises above 18" during closed throttle deceleration. Holds fairly steady at all throttle openings.

Indicates: Normal operation

Continued...

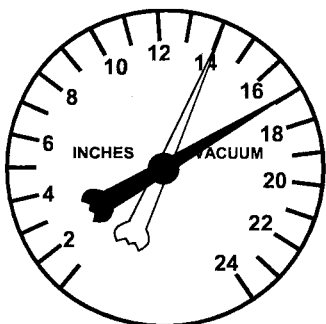
Diagnostic Procedures (continued)

Vacuum Testing (continued)



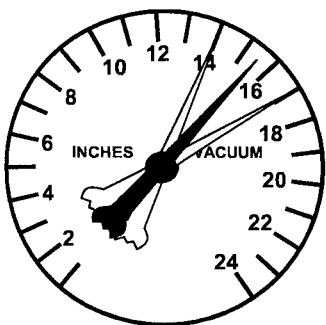
Conditions: Low vacuum at idle. Drops off as throttle opens. May rise above 18" during closed throttle deceleration. Holds fairly steady at all throttle openings.

Indicates: Vacuum leaks, valve timing retarded, or engine wear



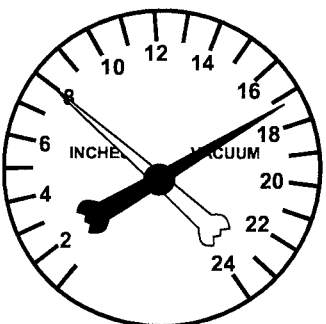
Conditions: 14" – 17" vacuum at idle; surging up and down.

Indicates: Air/fuel problem



Conditions: 14" – 17" vacuum at idle; pulsing rapidly.

Indicates: Engine problem: Burnt valve, worn valve guides, worn camshaft



Conditions: 18" vacuum at idle. Drops off below 16" at 2000 RPM, with the EGR disconnected.

Indicates: Exhaust restriction (backpressure)

IMPORTANT: Never use engine vacuum as your final diagnostic source. Always confirm any conditions indicated by engine vacuum.

Diagnostic Procedures (continued)

Exhaust Backpressure Testing

Backpressure is a term used to describe the level of restriction in the exhaust system. The greater the restriction, the more backpressure the exhaust develops.

A certain amount of backpressure is expected... even necessary. Without any backpressure, the exhaust system wouldn't reduce the noise from combustion. And on some vehicles, the EGR won't operate without some level of backpressure.

The problem comes when backpressure becomes too high. High backpressure prevents the exhaust from flowing freely, restricting the engine's ability to "breathe." This can reduce the engine's power, making it feel like the engine's "holding back."

One way to check for excess backpressure is by checking manifold vacuum: It stands to reason if the engine can't exhaust properly, it won't draw properly either.

But a vacuum check has its limits: To begin with, it won't show a marginal exhaust restriction – one that's right on the edge of being a problem.

For a more accurate test, you're better off checking the actual exhaust backpressure, using a low pressure gauge. Installing the gauge is easy. There are a number of places you can access the exhaust system:

- Oxygen sensor opening – there are adapters available to screw into the oxygen sensor hole to provide an access port for measuring backpressure.
- Air injection port – You can remove the one-way check valve, and use threaded adapters to connect your gauge to measure exhaust backpressure.
- EGR exhaust port – You can make your own adapter with a flat metal plate. Drill the bolt holes and an exhaust port, and mount the plate in place of the EGR.

...or you can drill a small access hole in the exhaust.

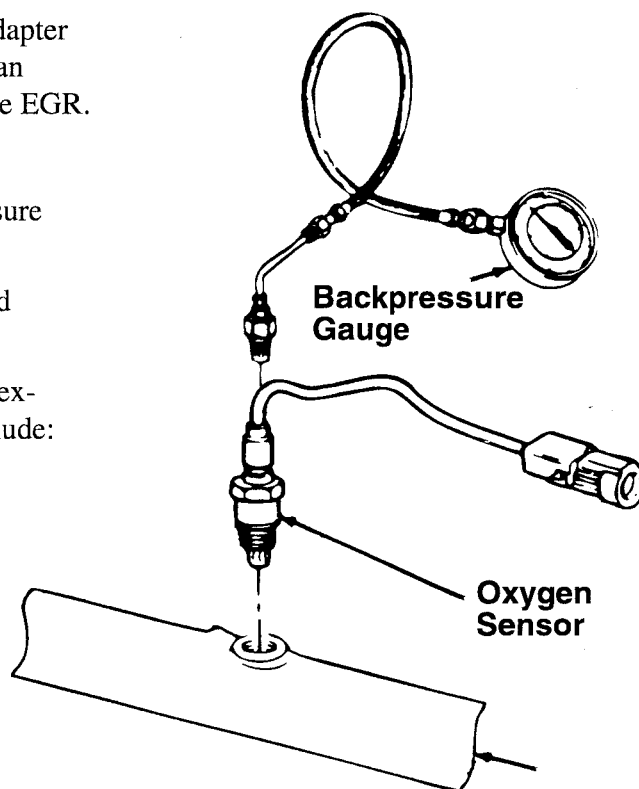
Once you've accessed the exhaust, connect a low pressure gauge to the exhaust and run the vehicle.

A good exhaust should display 2 PSI or less at idle, and shouldn't exceed 3 PSI at 2000 RPM.

If exhaust backpressure is too high, the vehicle has an exhaust restriction. Likely sources for that restriction include:

- Catalytic converter
- Muffler
- Collapsed pipe

Watch out for double-walled pipes: Some exhaust pipes have an inner and outer wall. The outside of the pipe will look just fine, but the inside pipe will have collapsed, causing an exhaust restriction.



Diagnostic Procedures (continued)

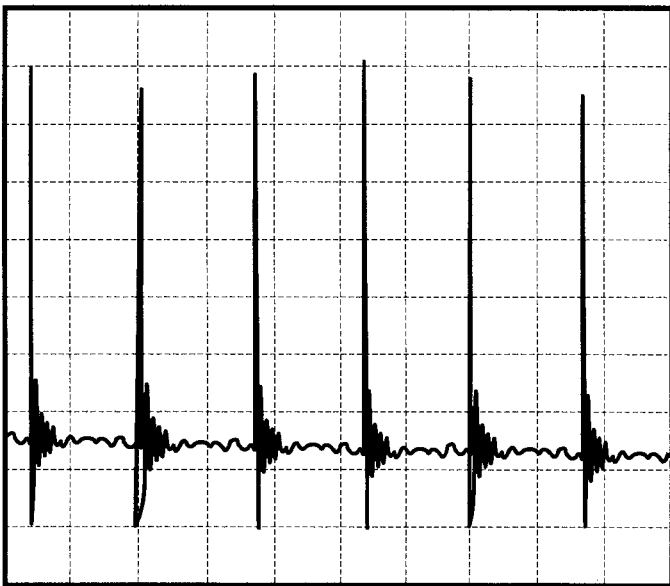
Ignition Tests

One of the most common failures to be mistaken for a transmission problem is a secondary ignition breakdown. This is where the bypasses the spark plug, making its way to ground through another path. This fails to fire the mixture, causing a misfire.

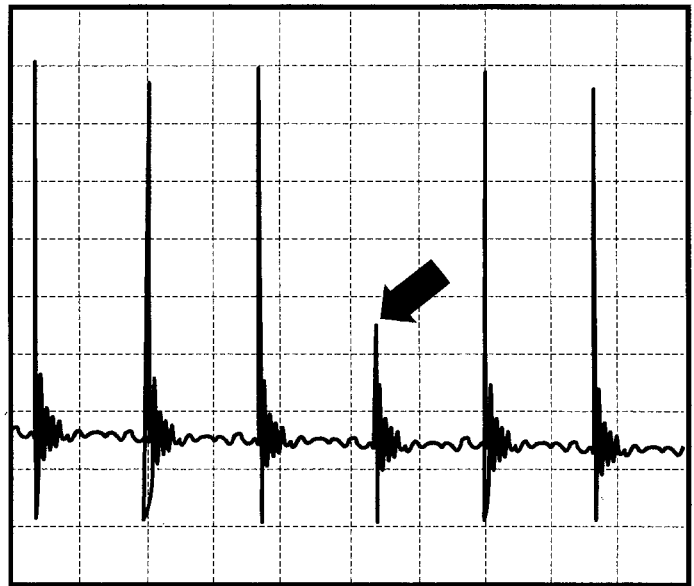
Secondary ignition breakdown is most common under load, so it often shows up during lockup. This is why many technicians mistake an ignition breakdown for a converter clutch chatter.

One of the best ways to find a secondary ignition problem is with an oscilloscope, especially configured to read the secondary waveform. This may require special probes and settings. Most general repair shops have engine analyzers that include these scopes.

But many digital oscilloscopes designed for today's automotive market now offer the necessary probes and setups for checking secondary ignition waveforms. These will provide a great way to look for ignition problems: Just connect the scope, and go for a drive. If the ignition waveform indicates a problem that corresponds with the shudder or chatter, you've found the problem.



If the ignition system's working properly, all of the voltage spikes should be relatively even, and each spike should exhibit roughly the same number of oscillations.



If one spike drops off or jumps off screen while the problem occurs, you've found an ignition problem. Short spikes indicate a shorted cylinder; long spikes indicate an open cylinder.

Continued...

Diagnostic Procedures (continued)

Ignition Tests (continued)

One of the difficulties in diagnosing today's ignition systems is identifying which cylinders are misfiring. Years ago, you could simply pull the wires from the distributor cap, one at a time, until one didn't change how the engine ran: That was the one that was misfiring.

But today's ignition systems are high energy systems: Pulling the wires out of the cap could damage the ignition system.

In addition, many of today's cars and trucks no longer use a standard ignition system. These vehicles have distributorless ignition systems, that use wastespark technology to operate. Each cylinder fires directly from a coil, and each coil fires two cylinders at the same time. Pulling a single plug wire would disable two cylinders. So you need a different technique for isolating individual cylinder problems; here's how:

- You'll need a piece of solid copper wire: The type of wire used to wire a house electrical circuit.
- Cut it into 1" pieces, one for each cylinder.
- Pull the plug wires off of the coils, one at a time.
- Slip a piece of copper wire into the coil boot, and slide the wire and boot assembly back onto the coil.
- Repeat the procedure until all the coil towers have a small piece of copper wire protruding from the boot.
- Start the engine.

Now you're ready to short the cylinders:

- Connect a standard test light to a good engine ground.
- Hold the test light carefully, so you don't touch any metal parts.
- Slowly touch the copper wire to the first cylinder.

Touching the copper wire should short the cylinder through the test light. If you feel the engine change when you short the cylinder, you know the cylinder's firing.

Continued...

Diagnostic Procedures (continued)

Ignition Tests (continued)

Now slowly move the test light probe away from the copper wire, and watch how far the spark jumps. If the ignition system is working properly, the spark should follow the test light for up to about $\frac{3}{4}$ ". Compare the distance the spark follows the test light with the other cylinders.

If the spark doesn't follow the test light as far as the other cylinders, suspect some type of short in the circuit: a fouled plug or a carbon track in the coil.

If the spark follows the test light further than the rest of the cylinders, suspect an open in the circuit: an open wire or plug.

If the engine changes properly when you short each cylinder, and the sparks all follow the test light the same distance, the ignition system is probably okay.

A common cause for ignition breakdown occurs when the insulation on the plug wires or boots wears out. This allows the spark to leak out, and go to ground. One of the clues to this condition is a series of burn spots or carbon tracks on the plug wires.

If the ignition breakdown is caused by worn plug wires, it usually occurs during wet conditions. You can duplicate these conditions with a simple spray bottle filled with plain water. Spray a fine mist along the wires and boots, and watch for an arc from the wires. If the wires begin arcing, they're worn out: replace them and recheck the vehicle.

Diagnostic Procedures (continued)

Oxygen Sensor Tests

Most vehicles built over the last 10-or-so years is of the “closed loop feedback” variety. That is, they use an oxygen sensor to monitor the exhaust. From the oxygen sensor signal, the computer can then modify the air/fuel ratio, to maintain efficient operation and low emission levels.

One of the big advantages of an oxygen sensor is you can use its signal to identify a number of engine operating problems. To do so, you must first make sure the oxygen sensor is working properly. If not, the feedback information to the computer won't be accurate, and neither will the engine's operation.

Checking the Oxygen Sensor

The best way to check the oxygen sensor signal is with a digital oscilloscope. Connect your scope's positive lead to the oxygen sensor signal wire, and the negative lead to the oxygen sensor ground.

CAUTION: It's very important to use the right ground for reading the oxygen sensor signal. Failure to do so will affect your results. One- and three-wire sensors use the engine as a ground. Two- and four-wire sensors use the sensor ground circuit for the oxygen sensor ground.

Here's how to adjust your scope:

Voltage Scale – about 0.2 volts per division

Time Base – between 0.1 and 1 second per division

Free Run or Auto Trigger on

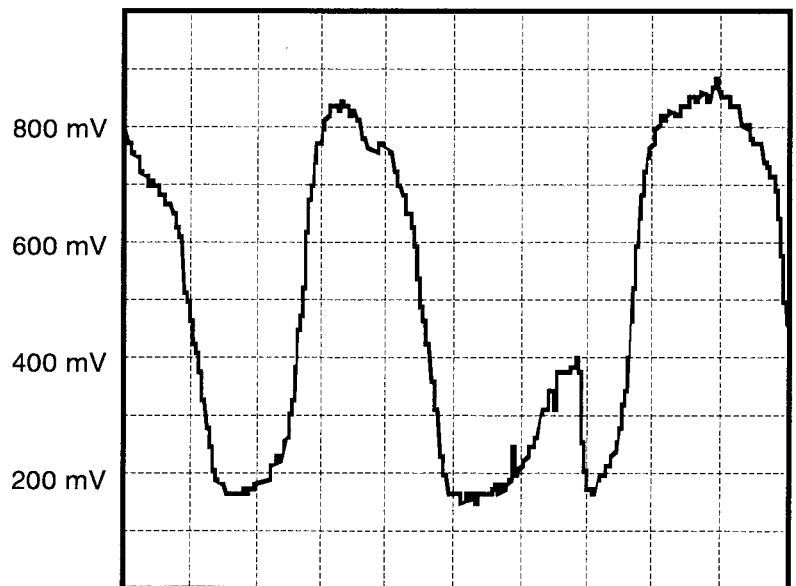
Start the engine, and hold it at 2000 RPM until the oxygen sensor begins switching. Then rev the throttle a few times.

A good oxygen sensor should meet these requirements:

- The signal should rise to at least 850 mV
- The signal should drop below 150 mV
- The signal should switch in less than about 80 to 100 ms

If the oxygen sensor meets these requirements, it's okay. Go ahead and begin checking system operation. If not, replace the sensor, and then check the new sensor operation.

One final point: If the oxygen sensor voltage ever drops below zero volts, the sensor is bad – replace it.



A good oxygen sensor should be able to rise above 850 mV, drop below 150 mV, and should switch in less than about 100 ms. If the voltage drops below zero, always replace the sensor.

Diagnostic Procedures (continued)

Checking the Oxygen Sensor (continued)

Testing System Operation through the Oxygen Sensor Signal

Once you're sure the oxygen sensor is okay, you're ready to check the signal, to determine whether the computer system is in control of the engine.

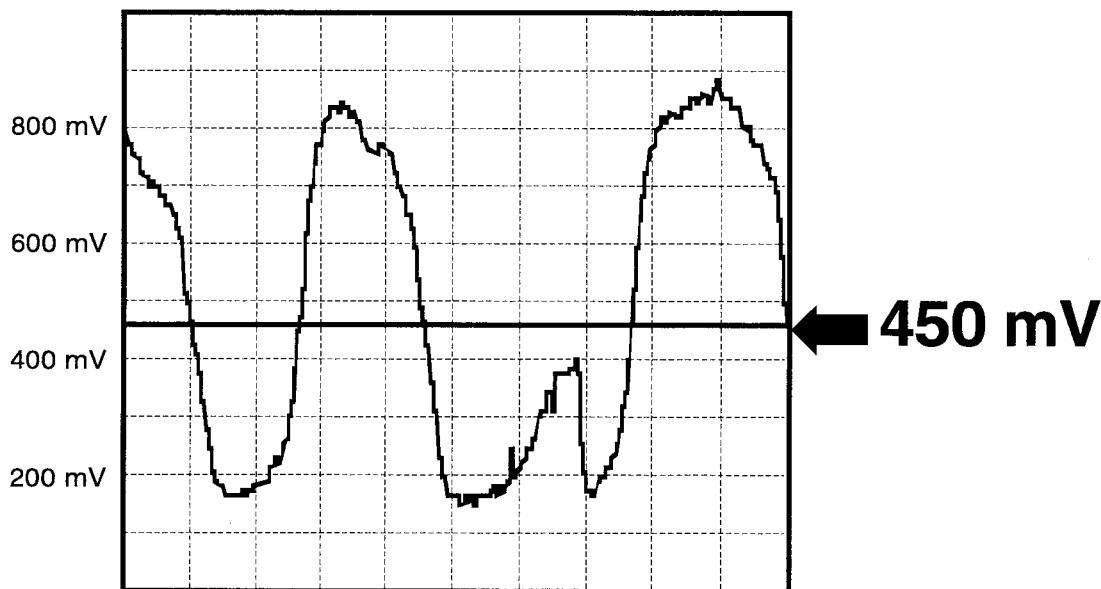
If the system is working properly, the oxygen sensor should switch between once every two seconds (carbureted vehicles), to as fast as five times per second (sequential fuel injection systems). In addition, during normal operation, the sensor should average right around 450 mV.

This is where your scope's MinMax function is useful. It provides the minimum, maximum, and average voltage reading the scope sees while active. Choose MinMax, and take the vehicle for a drive.

IMPORTANT: Always make sure the oxygen sensor is in good shape before performing this test: If the oxygen sensor isn't working properly, the average voltage is meaningless.

- If the oxygen sensor voltage averages right around 450 mV, the system is in proper control of the air/fuel mixture.
- If the oxygen sensor voltage averages below 450 mV, the system is tending toward the rich side.
- If the oxygen sensor voltage averages above 450 mV, the system is tending toward the lean side.

So your oxygen sensor signal can indicate whether the mixture is within normal operation, or if there's a problem in the fuel delivery system.



The oxygen sensor voltage should average right around 450 mV. Below 450 mV indicates too much fuel entering the engine, so the system's trying to force the engine lean. Above 450 mV indicates not enough fuel, so the system's trying to force the engine rich.

Diagnostic Procedures (continued)

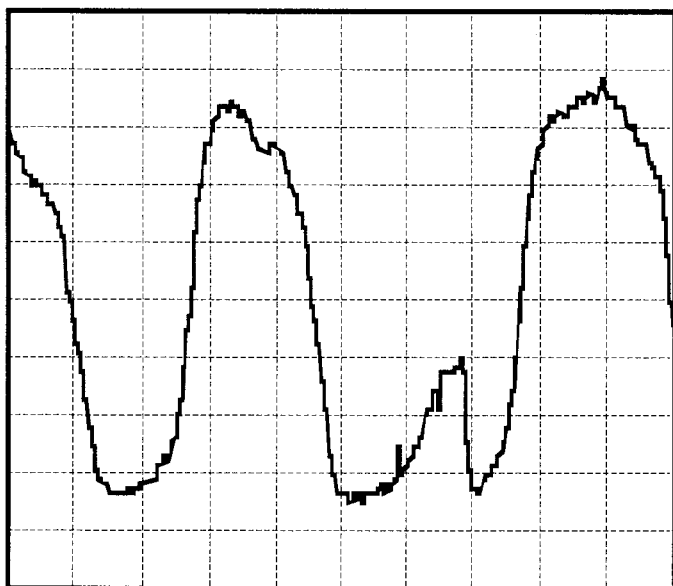
Checking the Oxygen Sensor (continued)

Identifying a Misfire

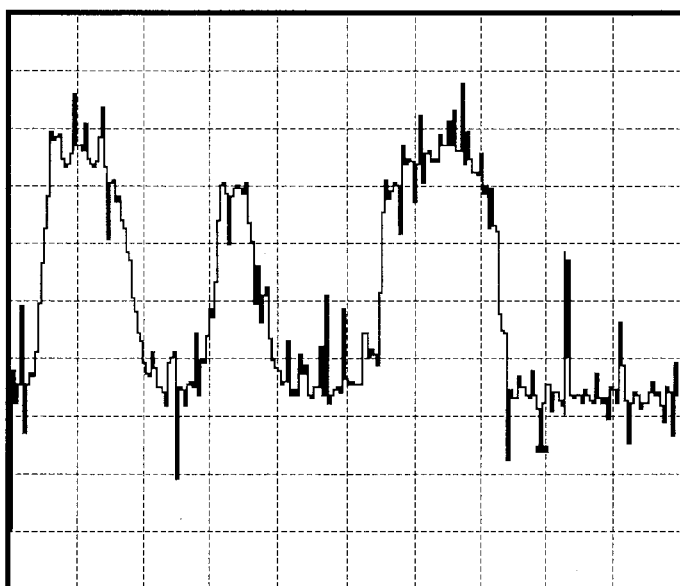
The oxygen sensor is also a good way to identify a misfire in the engine.

Most oxygen sensor signals should be fairly smooth, with very little roughness in the waveform. Some systems have more roughness than others, but in general, the oxygen sensor should be fairly smooth.

But if there's a misfire in the engine, that misfire forces a disruption of air and fuel past the oxygen sensor. This creates a high frequency signal in the oxygen sensor signal.



This is how a good oxygen sensor waveform should look, with the computer system in proper control of the air/fuel mixture.



The high frequency breakup in this signal indicates the roughness in the powertrain is due to a misfire in the engine. A clutch chatter won't show up on the oxygen sensor waveform.

If you suspect a misfire in the engine, check the oxygen sensor signal: If the misfire is accompanied by a roughness in the oxygen sensor signal, there's a cylinder misfiring. Check for ignition, air/fuel or compression problems.

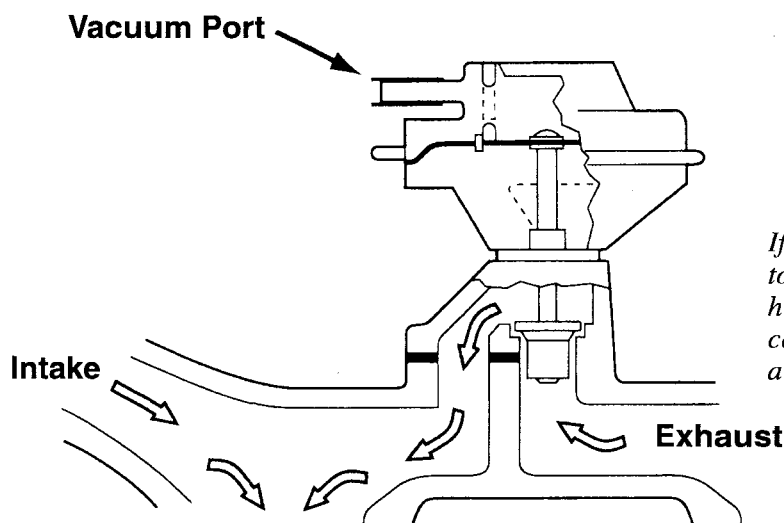
CAUTION: Some oxygen sensor waveforms are much "noisier" than others; this is normal. Never assume high frequency noise in the oxygen sensor waveform indicates a misfire unless the high frequency signal is taking place only when you feel the miss.

Using the wrong ground to test the sensor can also cause a noisy oxygen sensor waveform; however, the noise won't correspond to any particular driveability complaint.

Diagnostic Procedures (continued)

EGR Testing

The EGR, or exhaust valve recirculation valve, bleeds a small amount of exhaust gas back into the intake manifold. This reduces the volatility of the mixture entering the combustion chamber, to slow the burn, and reduce combustion temperatures. This prevents engine ping, and reduces NOx formation.



If the EGR opens too far, or too easily, you can expect a hesitation or surge, which could easily be mistaken for a transmission problem.

- If the EGR isn't opening at all, you can expect a severe ping from the engine, and high NOx levels. While this is a problem, it's unlikely to be mistaken for a transmission problem.
- If the EGR remains open all the time, you can expect a rough idle and stalling: again, not a problem that can be mistaken for a transmission problem.

But there are two types of EGR problems that could look like a transmission problem:

- If the EGR opens too far, you can expect a hesitation on moderate accelerations.
- If the EGR is leaking, the valve position will wander, and cause a surge at steady throttle openings.

If you're experiencing either of these problems, there's an easy way to check whether the EGR is causing the problem: Disconnect it. If the problem goes away with the EGR disconnected, the problem is probably in the EGR system. Have that fixed before continuing your diagnosis.

Diagnostic Procedures (continued)

Fuel System Testing

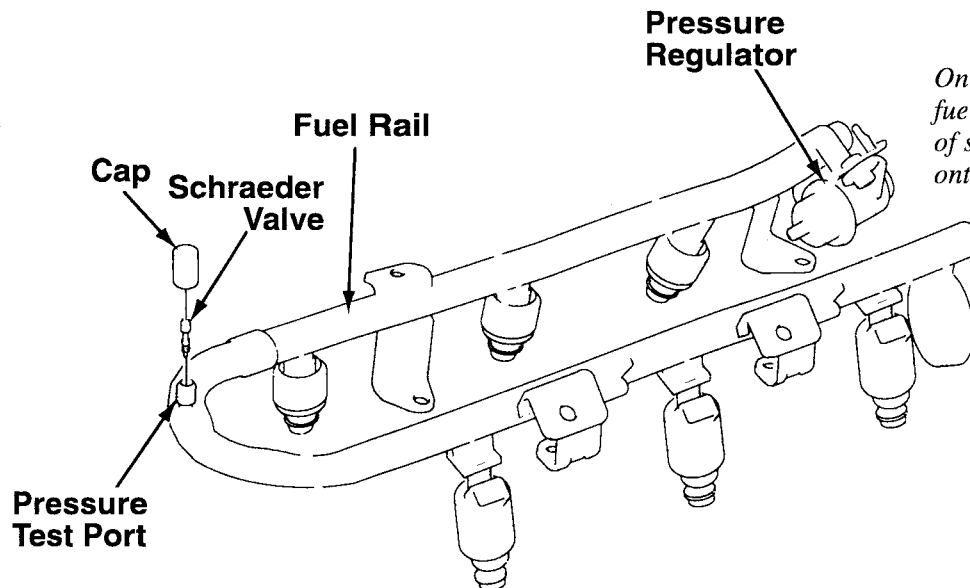
Fuel system problems can cause the widest range of problems, and can be the most difficult to diagnose. That's because there are so many different areas that can cause problems in the fuel system. Problems such as:

- Low or high fuel pressure
- Restricted fuel flow
- Bad (contaminated) gas
- Clogged or damaged injectors
- Clogged or damaged carburetor ports
- Leaks in the fuel system

...and more.

A few basic checks you can perform include fuel pressure and injector operation.

To check fuel pressure, you'll need to connect a pressure gauge to the system. On some vehicles, that's simply a matter of threading the gauge onto a test port. On others, the procedure may include disconnecting the fuel line, and connecting a gauge in series with the system.



On many systems, checking the fuel pressure is a simple matter of screwing a pressure gauge onto the pressure test port.

Run the engine with the pressure gauge installed, and compare the system pressure with specifications. If the pressure's low on a carbureted system, the fuel pump is probably the cause.

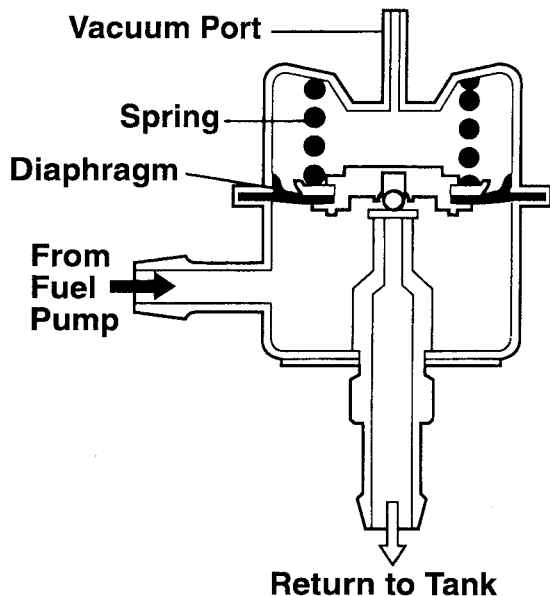
On a fuel injected system, try pinching the fuel return line for a second. If the pressure jumps, you know there's a problem with the pressure regulator.

If the pressure regulator uses a vacuum line to monitor engine load, always pull the vacuum line: If you see fuel in the vacuum line, the regulator diaphragm is leaking, and the pressure regulator will need to be replaced.

Continued...

Diagnostic Procedures (continued)

Fuel System Testing (continued)

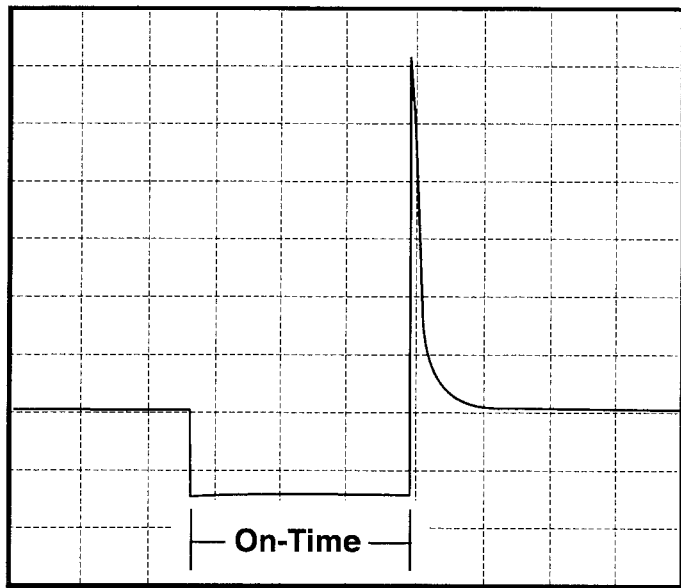


The pressure regulator compensates for changes to engine load by monitoring manifold vacuum. A leak in the diaphragm will allow raw fuel to enter the engine through the vacuum port.

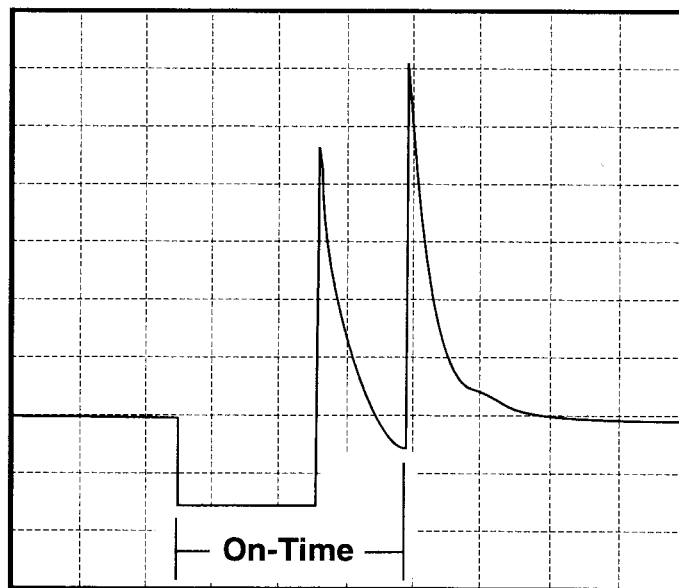
Another fuel system check you can perform is to check the injector operation. Start by disconnecting the injector electrical connectors, one at a time, with the engine running. Each time you disconnect an injector, the cylinder should stop firing. If disconnecting an injector doesn't affect engine operation, the injector is probably damaged or clogged.

If you have a scope, you can check the injector waveform. Connect your scope positive lead to the control side (the pulsing signal) of the injector connector, and the negative lead to ground. Adjust your scope to display the firing waveform.

The injector waveform will depend on the system you're checking. Some will have a single spike. Current limiting injectors will have a second spike. Bosch-style current limiting injectors will have a high frequency pulsed signal attached to the waveform.



A conventional (saturated driver) injector turns on when the driver grounds, pulling the voltage to zero; on-time ends when the driver releases, creating the voltage spike.

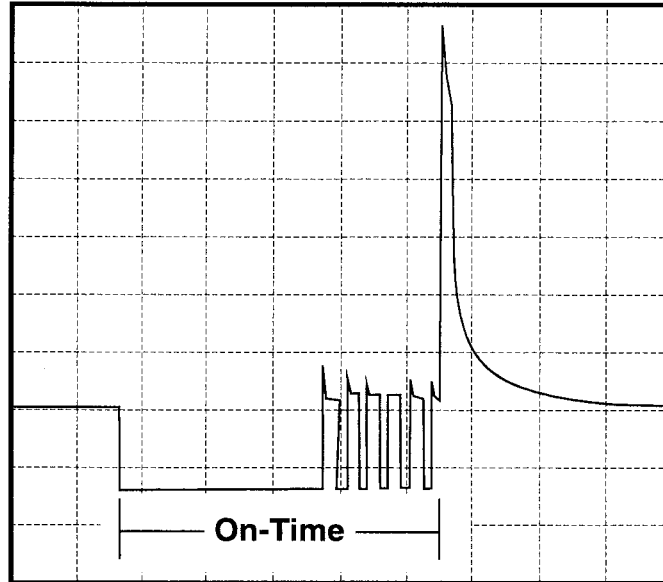


A peak-and-hold injector displays a double spike: the first indicates the end of the peak voltage cycle. The second indicates the end of the injector on-time.

Continued...

Diagnostic Procedures (continued)

Fuel System Testing (continued)



On a Bosch-style, or pulsed modulated injector, injector on-time is from the initial drop to zero volts, until the end of the pulses.

Always compare the waveforms from all of the injectors on the vehicle. A short spike indicates a shorted winding in the injector. Curved vertical lines indicate excess resistance in the injector.

You can also compare the injector on-time to the engine running conditions:

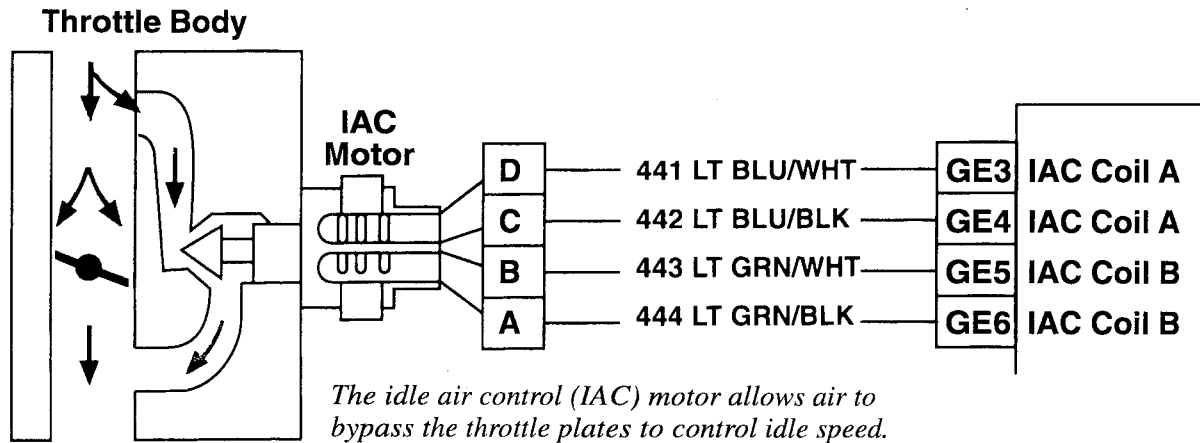
- If the injector on-time is long, but the engine is lean, suspect low fuel pressure or a clogged injector.
- If the injector on-time is long, and the engine is rich, suspect a computer system problem.
- If the injector on-time is short, but the engine is rich, suspect unwanted fuel entering the engine, such as a leak at the fuel pressure regulator vacuum port.
- If the injector on-time is short, and the engine is lean, suspect a computer system problem.

If you suspect clogged injectors, have the injectors cleaned professionally: The injector cleaners that pour into the gas tank won't help at this point. But keep in mind, even professional cleaning won't help severely clogged injectors: They'll have to be replaced.

Diagnostic Procedures (continued)

Idle Control System Testing

Most computer-controlled vehicles include some form of idle control system, designed to provide the computer with control of idle speed. These systems allow idle speed to remain as low as possible, while providing adequate idle speed under all load conditions.



If the idle control system isn't working properly, you could experience a number of problems, including stalling when you put the transmission in gear, or stalling when you come to a stop.

If you suspect a problem in the idle control system, there's a simple check you can use on most vehicles: Check the idle speed when you start the engine cold.

On most vehicles, the idle control system also provides fast idle under cold operating conditions. If the engine has no fast idle cold, suspect a problem with the idle control system.

But if the idle speed rises normally when cold, the idle control system is probably working properly. You'll need to look elsewhere for stalling problems.

Idle control problems could indicate a defective idle control component, or it could simply be caused by carbon plugging the idle air circuit. Before attempting to clean any carbon from the idle air circuit, check for tags on or around the air horn: Some air horns are coated, and aren't supposed to be cleaned. Cleaning these air horns will remove the protective coating, causing the air horn to require regular cleaning in the future. Always check for factory recommendations before cleaning any air horns or throttle plates.

Diagnostic Procedures (continued)

Torque Conditions

Every time you move the transmission selector into gear, the engine and transmission torque to one side or the other. This torquing condition is normal, caused by the load the geartrain placing torque between the wheels and the road.

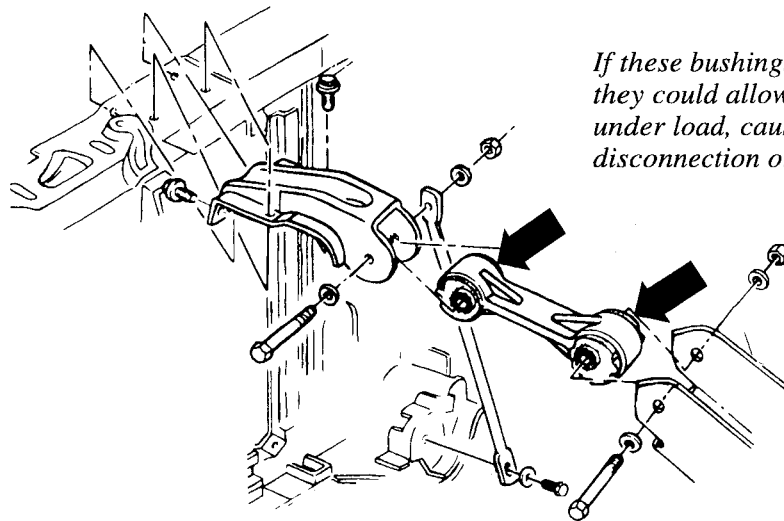
However, this movement can cause other problems:

The torquing motion can pull against the air inlet, opening a vacuum leak when you put the vehicle in gear.

The torquing motion can pull against the wiring harness, causing connectors to disconnect or wires to short momentarily.

The torquing motion can allow the engine or transmission to contact the vehicle body, allowing vibrations to transmit through the rest of the vehicle.

The first thing to check is the torque struts on the engine. If they're worn, they'll allow the engine to torque too far, and cause any number of problems in the engine. Replacing the struts may be all that's necessary to eliminate certain problems.



If these bushings are worn or damaged, they could allow the engine to shift under load, causing an electrical disconnection or a vacuum leak.

But even if the torque struts are fine, you can still experience any of these problems.

The best way to identify any type of torquing problem is to perform a "wiggle" test: Wiggle the wires or pull gently against the air inlet, and see whether the problem occurs. If the problem takes place during a wiggle test, examine the area thoroughly: A good visual inspection should reveal the cause of the problem.

Diagnostic Procedures (continued)

Brake Checks

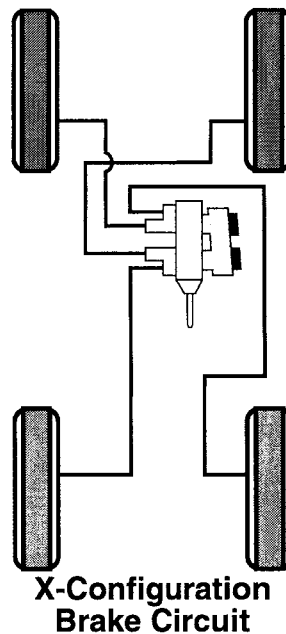
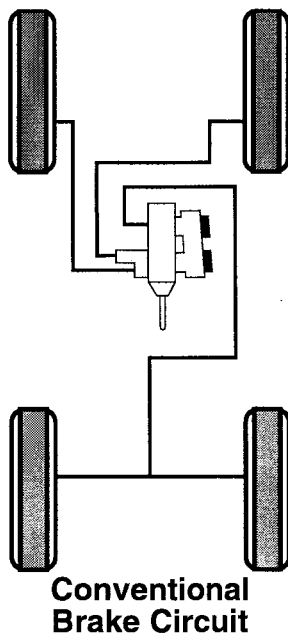
Dragging brakes can cause any vehicle to feel like it's holding back, requiring more gas than normal to keep moving.

An easy way to check for dragging brakes is to raise the vehicle off the ground, and try rotating the wheels by hand. Most wheels should rotate fairly easily.

Depending on the condition, the brakes may not drag cold: You may have to drive the vehicle for a few miles, to warm the system up before the brakes will start to grab.

If only one wheel is grabbing, suspect a problem in the wheel. Conditions like a rusted caliper or wheel cylinder, or a mechanical failure in the wheel are likely candidates.

If two wheels are binding, check to see whether both wheels are on the same hydraulic circuit. On some vehicles, one circuit controls one axle, the other controls the other axle. Other vehicles use an "X" configuration, controlling the right front and left rear wheel from one circuit, the left front and right rear from the other circuit.



Conventional brake circuit configuration allows one circuit to control the front brakes, while the other circuit controls the rears. X-configuration has one circuit to control the left front and right rear, while the other circuit controls the right front and left rear.

If both wheels on a circuit are binding, suspect a problem in the master cylinder or control systems. A common cause for this is a misadjustment in the master cylinder apply rod. If the rod is adjusted too long, it won't allow pressure to relieve when you release the brake pedal. As the fluid heats up, the system puts pressure on the brakes, and causes the brakes to drag.

Many vehicles today are equipped with traction control systems. This is an addition to antilock brake systems: Most traction control systems apply a small amount of drag to the spinning wheel. This slows the wheel, and distributes more of the torque to the opposite wheel. The result is the vehicle can accelerate normally.

However, a problem in the traction control system can allow the brakes to apply, and cause a drag in the system. The best way to eliminate this as a possibility is to turn the traction control system off. If the drag goes away, look for a problem in the traction control system.

Diagnostic Procedures (continued)

Computer Sensor Substitution

Most of today's vehicles are controlled by computer system. These systems use sensor signals to determine the operating conditions, to control engine and transmission operation.

When one of these sensors fails, the computer usually provides a diagnostic trouble code, to help point you in the direction of the failure. In addition, the computer usually provides a substitute signal, to enable the system to continue operating, in a somewhat less-accurate mode.

But that's only for complete sensor failures. More often than not, sensors don't fail completely. Instead, they go out of adjustment, or develop momentary glitches that are hard to find, but can affect engine or transmission operation.

So the problem becomes identifying those less-than-complete failures in the computer system. Fortunately, it's easier than you might think.

The first step is to check for codes: Even though the failure may not be complete, it still may have set a code. That code will point you toward a likely source of the problem.

If there are no codes, think about the problem, and the sensors that are most likely to cause the problem. Check bulletins, hotlines, and repair manuals for suggestions.

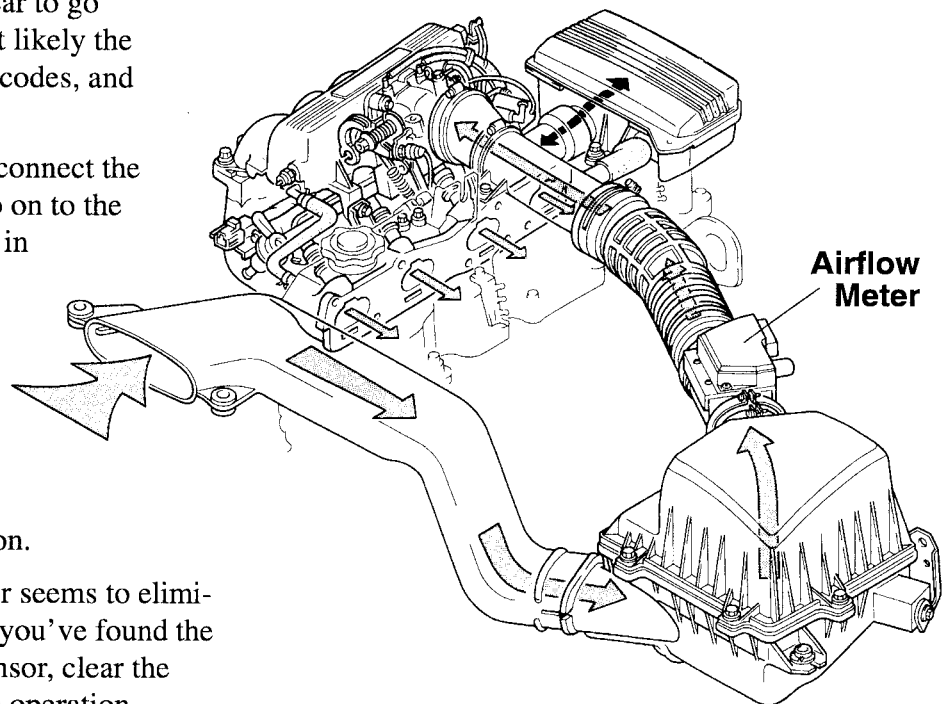
Once you've determined which sensors are likely sources of the problem, pick one and disconnect it. Then go for a drive.

Remember what we said about complete failures: The computer provides a substitute signal to replace complete sensor signal failures. By disconnecting the sensor, you've created a complete sensor failure. The computer will now provide a substitute signal, to enable the vehicle to continue operating.

With the sensor disconnected, drive the vehicle. Did the problem appear to go away? If so, the sensor is most likely the problem. Replace it, clear the codes, and recheck the vehicle operation.

If the problem is still there, reconnect the sensor, clear the codes, and go on to the next sensor on your list. Keep in mind, the sensors that could affect – or seem to affect – transmission operation are limited: You should be looking at load sensors and speed sensors. Anything else won't have much of an effect on transmission operation.

When disconnecting the sensor seems to eliminate the problem, chances are you've found the sensor at fault. Replace the sensor, clear the codes, and recheck the vehicle operation.



VSS Programming

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Speedometer Calibrators

GM's Digital Ratio Adapter Calibrator (DRAC)

The computer determines vehicle speed from the vehicle speed sensor signal. But to convert that signal accurately, the computer needs to compensate for tire size and axle ratio. That's the purpose of the digital ratio adapter calibrator, or DRAC. The DRAC adjusts the signal from the vehicle speed sensor into a consistent signal that compensates for variations in axle ratio or tire size.

These are known quantities when the vehicle is first built, but as soon as someone changes the tires or differential ratio, those specifications are no longer valid. When the tire size or axle ratio changes, you must adjust the DRAC.

On 1991 vehicles, the process for reprogramming the DRAC is fairly complex, involving removing certain pins from a calibrator clip, and installing it in the DRAC.

But on 1992-and-later vehicles, the calibrator includes a series of jumpers. There's no way to recalibrate the unit once it's been calibrated. Whether the unit's damaged or you've just changed the axle ratio, you'll still need a new calibrator.

If you've changed the axle ratio or tire size, take the new specifications along with you to the dealer: They'll be able to provide you with a DRAC that's been calibrated to the vehicle's specific configuration.

But in most cases, the reason you'll be replacing the DRAC is because the old one was damaged or stopped working. In that case, programming the new DRAC is easy:

Start by getting a new DRAC from your AC/Delco dealer: They handle the programmable DRACs, in two different styles. Use the electrical connector to determine which DRAC you need:

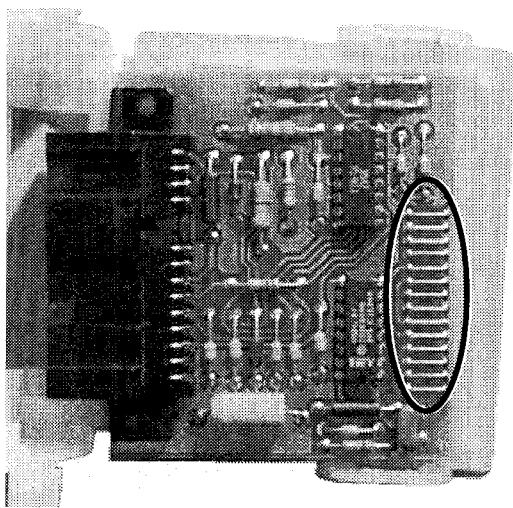
Black Connector — Type 1 — P/N 16202915

Gray Connector — Type 2 — P/N 16149365

How you program the DRAC depends on which one you needed.

Type 1 DRAC; Black Connector

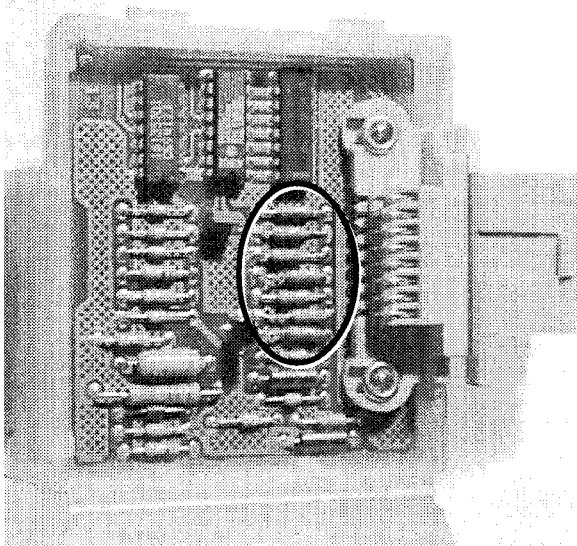
The 14 jumpers on the left of the circuit board are the programming jumpers. Just refer to the jumper terminals on the old DRAC. Use the jumpers as a guide for how to configure the new DRAC: Clip the jumpers to match the old DRAC exactly. That's all there is to it: Your DRAC is calibrated to match the original one.



Continued...

Speedometer Calibrators (cont)

GM's Digital Ratio Adapter Calibrator (cont)



Type 2 DRAC; Gray Connector

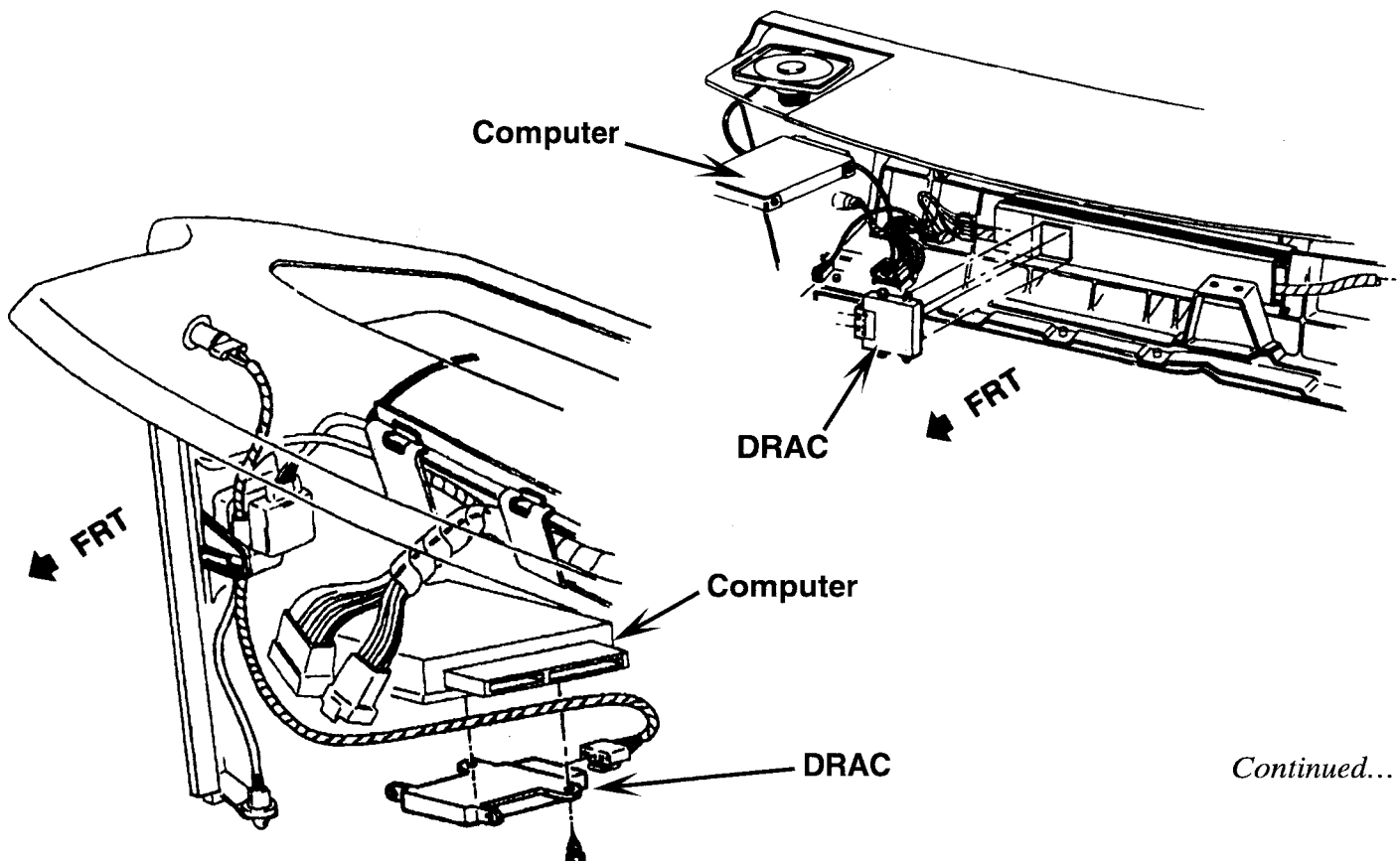
See those seven green things that look like resistors? Actually, they're a type of fuse, and on this DRAC they act like jumpers. In the factory, there's a special tool for burning the individual fuses out to program the DRAC. Unfortunately, a good fuse looks the same as a burnt fuse. Here's how you can tell which fuses should be open:

Use your ohmmeter to measure the resistance across each fuse. A good fuse will have only about 1 Ω resistance; a burnt fuse will have about 10 k Ω .

Once you know which fuse should be burned out, you know how to program the DRAC. But instead of trying to burn the fuses out, use a cutter to clip the fuses necessary. That'll work just as well, and you'll have less of a chance of damaging the new DRAC.

DRAC Locations

On C- and K-series trucks, look for the DRAC near the computer, on the right side of the passenger compartment. Here are a couple of typical views of where you'll find the DRAC on these vehicles:



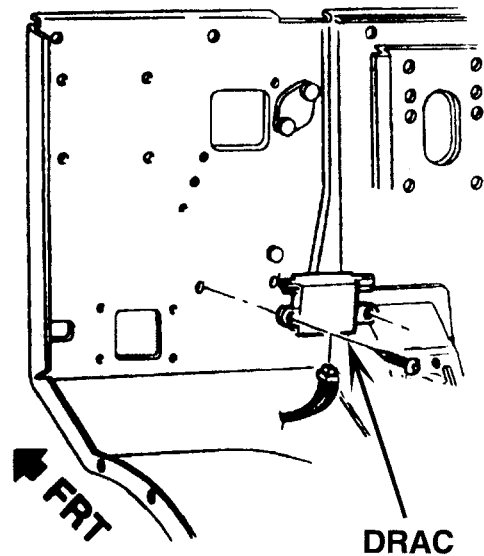
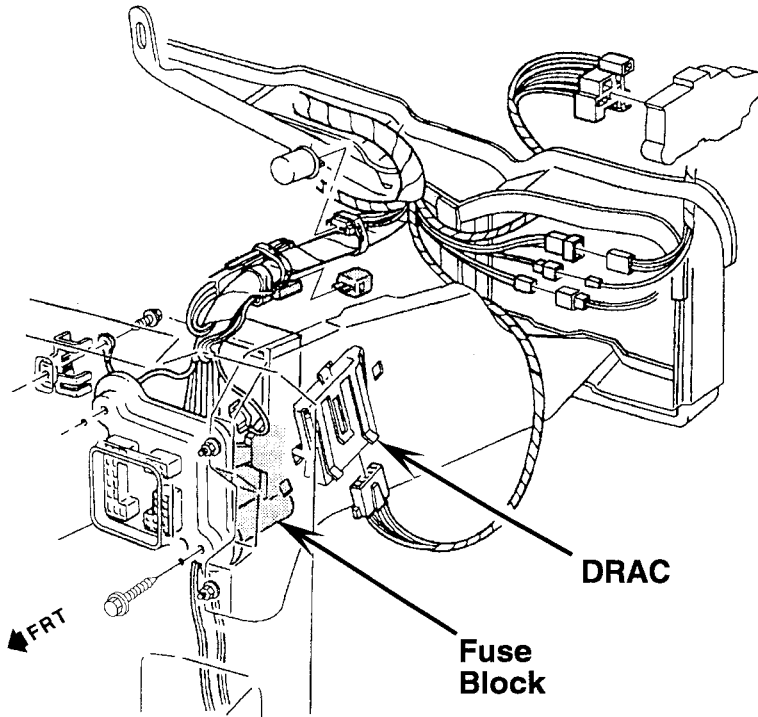
Continued...

Speedometer Calibrators (cont)

GM's Digital Ratio Adapter Calibrator (cont)

DRAC Locations

On G- and P-series vans, look for the DRAC on the left side of the passenger compartment, near the fuse panel or the instrument cluster. Here are a couple of typical views of where you'll find the DRAC on these vehicles:



Speedometer Calibrators (continued)

Ford's Programmable Speedometer/Odometer Module (PSOM)

To read vehicle speed accurately, many 1992-and-later Ford utility vehicles, such as the Aerostar, use a programmable speedometer/odometer module. This module converts the vehicle speed sensor signal into the proper signal to the computer, based on tire size and axle ratio.

Any time tire size or axle ratio changes, you must recalibrate the module to maintain an accurate vehicle speed reading. Here's how to recalibrate the programmable speedometer/odometer module:

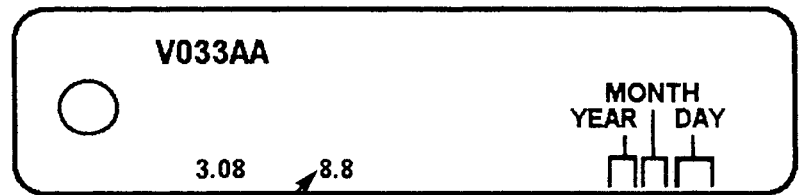
Step 1: Determine the number of times the tire rotates each mile

You can determine the tire rotations by dividing 63,360 by the tire's circumference in inches. For example, a P235/75R15 tire has a circumference of 88 inches. So $63,360 \div 88 = 720$ revolutions per mile.

Step 2: Determine the number of teeth on the differential ring gear exciter ring

One way to determine the number of teeth is to count them. Another way is to check the ID tag on the differential. This provides the ring gear diameter. Here's the number of exciter ring teeth each ring gear has:

Ring Gear	Exciter Teeth
7.5"	102
8.8"	108
9.75" – 11.25"	120



Ring Gear Size

The differential ID tag provides the size of the ring gear, so you can use it to determine how many exciter teeth are on the ring gear.

Step 3: Calculate the conversion constant

This is the number you're going to input into the programmable speedometer/odometer module. Here's how to determine the conversion constant.

$$\frac{\text{Tire Revolutions per Mile} \times \text{Exciter Ring Teeth}}{8000} = \text{Conversion Constant}$$

For example, let's assume the vehicle we're working on has an 8.7" ring gear. In the first step we calculated a tire that rotated 720 times per mile. To calculate the conversion constant:

$$\frac{720 \times 108}{8000} = 9.72$$

So the conversion constant is 9.72. Always round your calculation to two decimal places.

Continued...

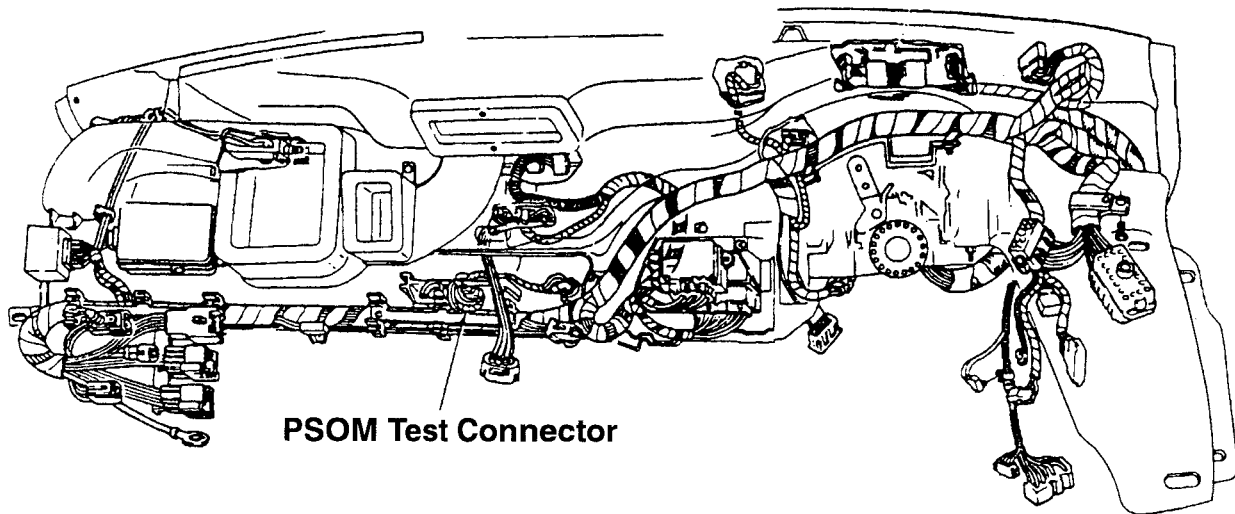
Speedometer Calibrators (continued)

Ford's PSOM (continued)

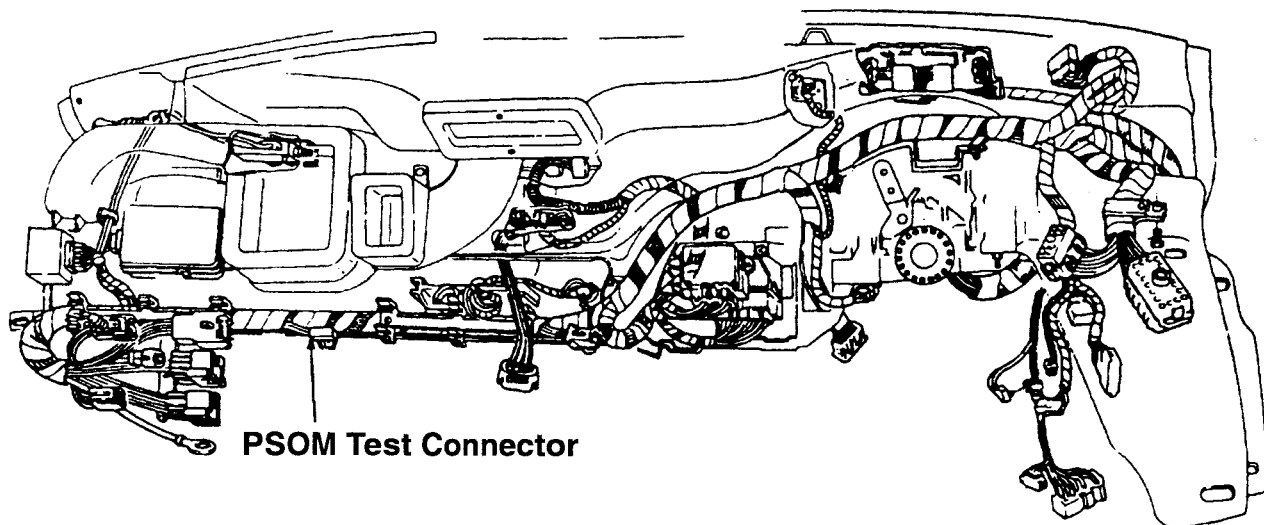
Step 4: Recalibrate the PSOM

Locate the PSOM test connector: It's a two-wire connector under the dashboard. Use the pictures to help locate the connector.

F-Series and Bronco with Gas Engine



F-Series with Diesel Engine

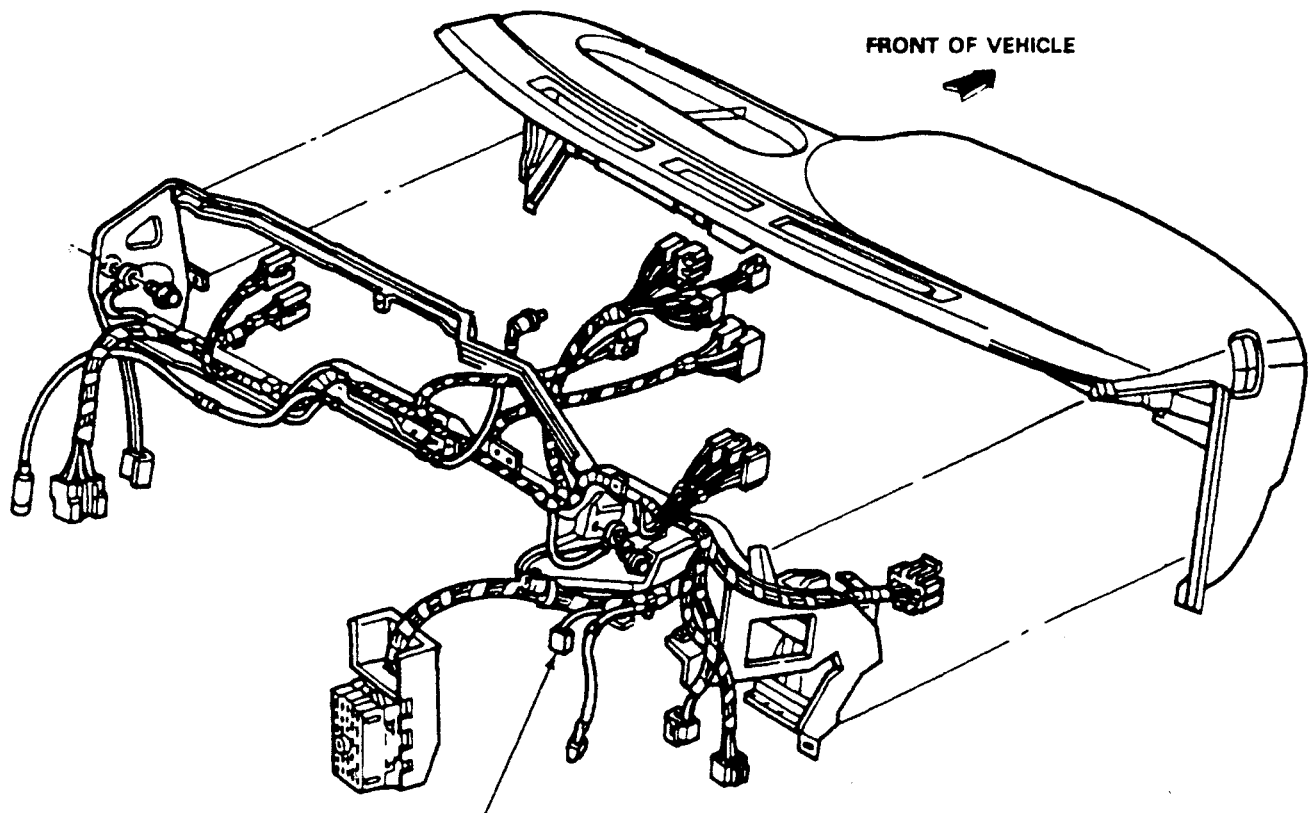


Continued...

Speedometer Calibrators (continued)

Ford's PSOM (continued)

Econoline



PSOM Test Connector

Continued...

Speedometer Calibrators (continued)

Ford's PSOM (continued)

Now you're ready to reprogram the PSOM:



Use the programming buttons by the odometer to program changes into the PSOM.

- Ground the PSOM test wire. On most vehicles, it's the black/orange wire; on Econolines, it's the light blue/yellow wire.
- Press and hold the odometer reset button.
- Turn the key on, engine off while holding the reset button down.
- Release the reset button.

The speedometer will go through a series of tests. Then it will display a two-digit software revision number.

- Press and release the reset button again; the speedometer will display the present conversion constant.

If the constant is correct, turn the key off: There's no reason to continue. But if the conversion constant isn't right for the vehicle specifications, go on to the next step.

- Press the select button to scroll through the available conversion constant values, until you reach the value you're looking for. The PSOM range is from 5.00 to 12.00, in 0.01 increments.
- When you find the correct conversion constant, press and release the reset button.
- Turn the key off, and unground the PSOM test terminal.

IMPORTANT If you want to discontinue the reset procedure at any point without saving a new constant, just turn the key off before pressing the reset button.

On vehicles built before 1995, the PSOM can only be reset three times; on later vehicles, the PSOM can be reset six times. If you reach the limit without calibrating the system accurately, you must replace the PSOM to change the calibration again.

Speedometer Calibrators (continued)

Chrysler's Electronic Pinion Factor

Until 1993, Chrysler vehicles use two separate speed sensors to monitor vehicle speed: One sensor in the transmission extension housing provided the signal for all of the systems except the transmission computer. The transmission computer received its vehicle speed signal from the transmission output speed sensor.

Beginning in 1993, Chrysler consolidated its vehicle speed signals: Now all controllers except the ABS computer take a vehicle speed signal from the transmission output speed sensor.

In addition, Chrysler also reduced the number of computers it used for its vehicles. The problem here was vehicle speed: The computer had to be able to compensate for tire size and axle ratios to determine vehicle speed accurately.

To do so, Chrysler transmission computers now must be programmed with a pinion factor and tire size number when they're first installed. This allows the computer to convert the output speed sensor signal into 8000 pulses per mile. The transmission computer then passes this signal along to the other computers in the vehicle.

If the transmission computer isn't programmed with the pinion factor and tire size, it won't provide a vehicle speed signal, so the speedometer won't operate.

Improper calibration or switching computers from one vehicle to another can cause inaccuracies in vehicle speed readings. You can verify the computer programming with a DRB scan tool.

If you don't have a DRB scan tool, you can determine where the problem is by checking the speedometer signal frequency against actual vehicle speed. To do so, connect your digital multimeter to one of these computer terminals:

- Transmission computer terminal 58
- Powertrain control module terminal 47

Set your meter to read DC frequency. Now operate the vehicle at exactly 60 MPH – not 60 MPH indicated on the speedometer. There are a few ways to be sure you're driving at exactly 60 MPH:

- Drive the vehicle on a calibrated dynamometer.
- Have someone drive along side of you, in a vehicle with a known-accurate speedometer.
- Use a stopwatch and a measured mile to maintain an accurate 60 MPH (1 mile every 60 seconds).

At exactly 60 MPH, the speedometer speed signal should be 133 Hz. Compare the actual vehicle speed to the speed indicated on the vehicle speedometer.

- If the signal is 133 Hz at the indicated speed of 60 MPH on the speedometer, but the vehicle speed doesn't match the indicated speed, the pinion factor or tire size is calibrated improperly.
- If the signal is 133 Hz at the actual speed of 60 MPH, but the indicated speed is off, the programming is correct. Look for a problem in the powertrain control module or the speedometer head in the dashboard.

JR403E – Isuzu Truck

Contents

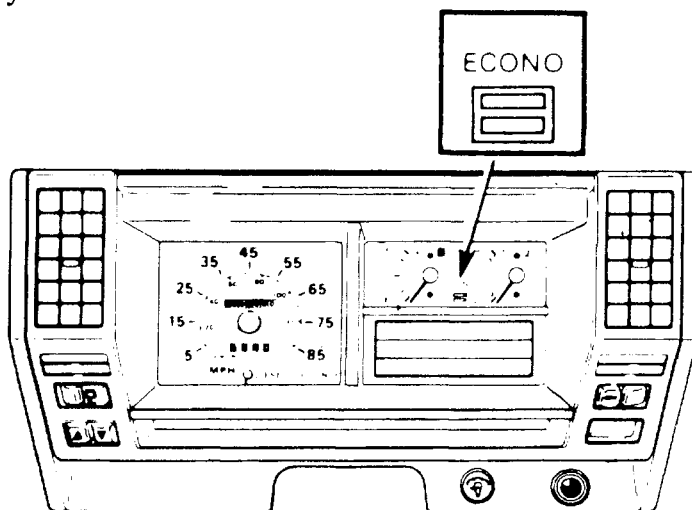
JR403E System Diagnosis	K2
Diagnostic Trouble Codes	K2
Problem Indication	K2
Retrieving the Codes; Early Systems	K2
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JR403E System Diagnosis

Diagnostic Trouble Codes

Problem Indication

The JR403E control system indicates problems in the computer system through the Economy light on the dash. When you first turn the key on, the light will flash 16 times, to indicate a diagnostic trouble code stored in memory.



To indicate a computer system problem or display diagnostic trouble codes, Isuzu trucks flash the Economy light on the dash.

Once you know there's a code in memory, there are two different procedures for retrieving and reading the codes, depending on vehicle year. The easiest way to determine which procedure to follow is to try the procedure for early systems: If the system displays codes, you chose correctly; if not, look for the diagnostic link connector, required for the second procedure.

On each system, the computer displays the codes by flashing the Economy light on the dash.

Retrieving the Codes; Early Systems

To retrieve the codes on early vehicles, set the parking brake. You'll have to put the vehicle in gear during the procedure, and this will prevent it from rolling.

To prepare to retrieve the codes:

- Turn the ignition key off.
- Put the shift selector in D.
- Set the Economy/Drive switch to "normal."

Now you're ready to begin the procedure to display diagnostic trouble codes:

Continued...

JR403E System Diagnosis (continued)

Diagnostic Trouble Codes (continued)

Problem Indication (continued)

Step 1: Turn the key on, engine off.

Step 2: Move the shift selector to 2.

Step 3: Move the Economy/Drive switch to "economy."

Step 4: Move the shift selector to 1.

Step 5: Move the Economy/Drive switch back to "normal."

Step 6: Hold the throttle all the way to the floor.

The computer will begin displaying diagnostic codes by flashing the Economy light on the dash.

Reading the Codes; Early Systems

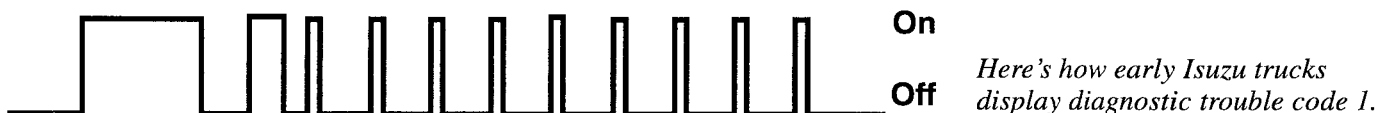
Isuzu trucks display diagnostic trouble codes using an 11-flash sequence. The light flashes 11 times in a row; the sequence always starts with a long flash — about two seconds long. It's followed by 10 shorter flashes.

If there are no problems in the system, all ten flashes will be very short — about 0.1 seconds each.



But if the computer identifies a problem in the system, one of those 10 flashes will be longer — nearly a half second long. Count the flashes: The long flash identifies the code in memory.

For example, if the first flash after the two second flash is the long one, you're looking at code 1.



If the fourth flash is the longer one, you're looking at code 4.



If there's more than one code in memory, the computer displays all of the codes in the same pass. Here's how a system would display codes 1, 4 and 8 at the same time:



Continued...

JR403E System Diagnosis (continued)

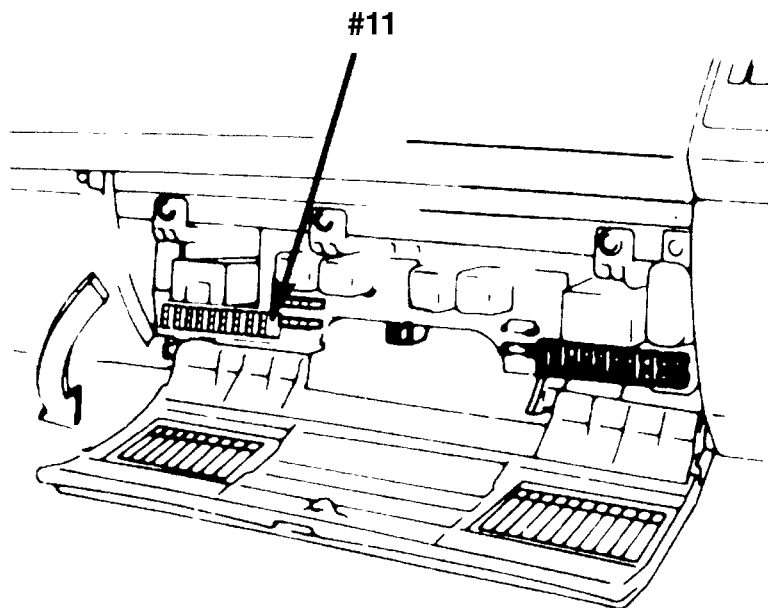
Diagnostic Trouble Codes (continued)

Code Definitions; Early Vehicles

Code	Definition
1	Vehicle speed sensor — transmission circuit open or shorted.
2	Vehicle speed sensor — speedometer circuit open or shorted.
3	Throttle position sensor circuit open or shorted.
4	Shift solenoid A circuit open or shorted.
5	Shift solenoid B circuit open or shorted.
6	Overrun clutch solenoid open or shorted.
7	Lockup clutch solenoid open or shorted.
8	ATF temperature sensor circuit is open or the computer power source is insufficient.
9	Engine RPM signal circuit open or shorted.
10	Line pressure solenoid open or shorted.

Clearing the Codes

Once you've repaired any problems in the system, you can clear the codes from memory by disconnecting the #11 fuse for at least 10 seconds. Then replace the fuse.

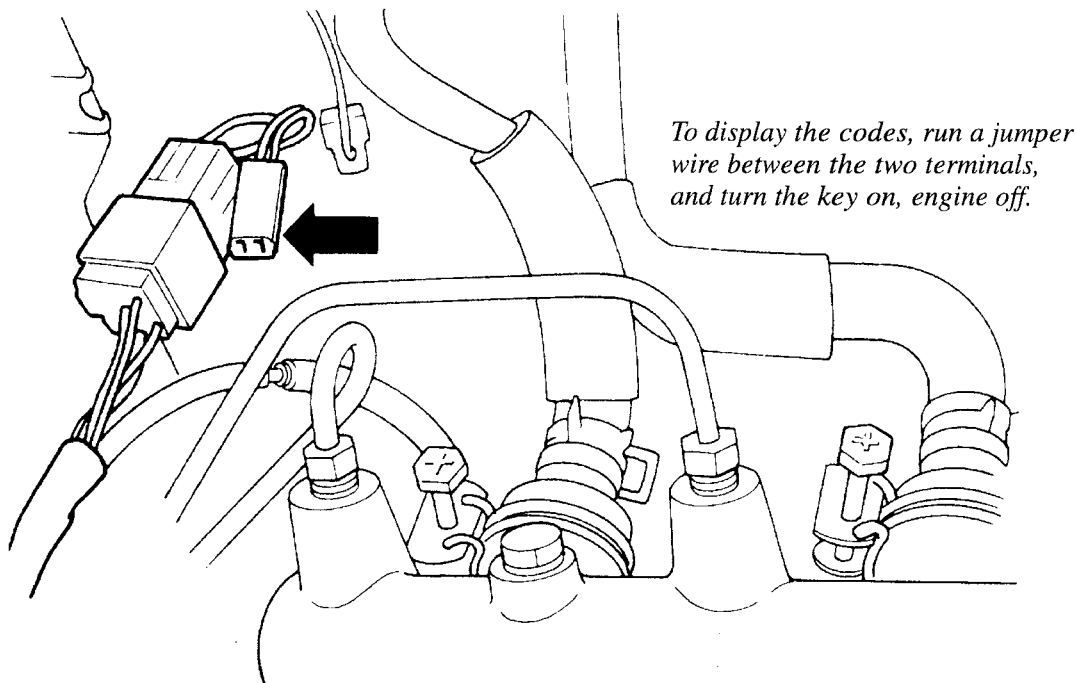


JR403E System Diagnosis (continued)

Diagnostic Trouble Codes (continued)

Retrieving the Codes; Late Systems

The procedure for retrieving codes on late model Isuzu trucks involves jumping between the two terminals on the diagnostic link connector. Look for the connector just below the brake fluid reservoir, in the engine compartment.



Connect a jumper between the two terminals on the connector, and turn the key on, engine off. The computer will begin flashing the Economy light on and off to display the codes.

Reading the Codes; Late Systems

Late model Isuzu trucks display codes using a two digit format: The first series of flashes indicates the tens digit, and the second series indicates the ones digit. Here's how code 32 would appear:



If there is more than one code in memory, the codes will display in order, from lowest number to highest. Each code will display three times, then the system goes on to the next code in memory.

If there are no codes, the computer will flash the Economy light on and off, in a regular, even pattern.

Continued...

JR403E System Diagnosis (continued)

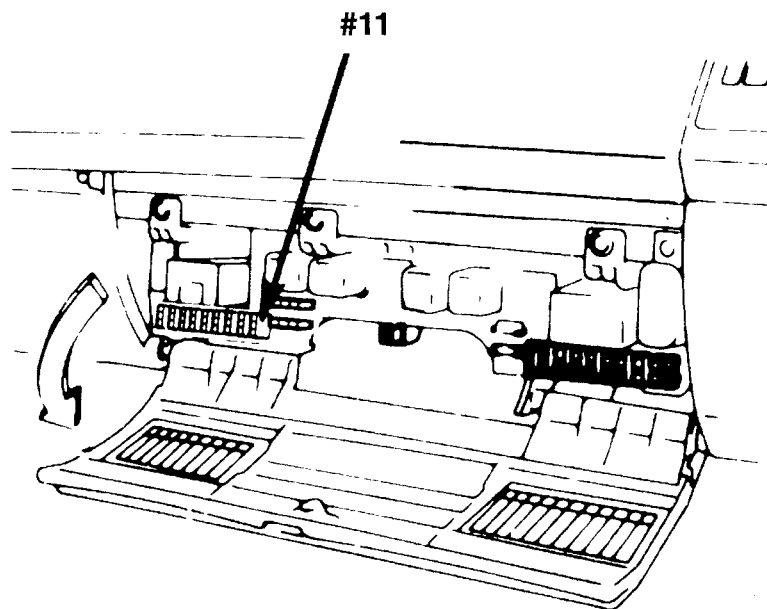
Diagnostic Trouble Codes (continued)

Code Definitions; Late Vehicles

Code	Definition
11	Vehicle speed sensor — transmission circuit open or shorted.
13	Engine RPM signal circuit open or shorted.
15	ATF temperature sensor circuit is open or the computer power source is insufficient.
17	Inhibitor switch circuit is open or shorted.
21	Throttle position sensor circuit open or shorted.
24	Vehicle speed sensor — speedometer circuit open or shorted.
31	Shift solenoid A circuit open or shorted.
32	Shift solenoid B circuit open or shorted.
33	Overrun clutch solenoid open or shorted.
34	Lockup clutch solenoid open or shorted.
35	Line pressure solenoid open or shorted.

Clearing the Codes

Once you've repaired any problems in the system, you can clear the codes from memory by disconnecting the #11 fuse for at least 10 seconds. Then replace the fuse.



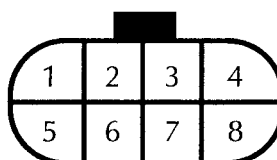
JR403E System Diagnosis (continued)

Testing Transmission Operation

Terminal Identification

Here's a breakdown of the individual connector terminals:

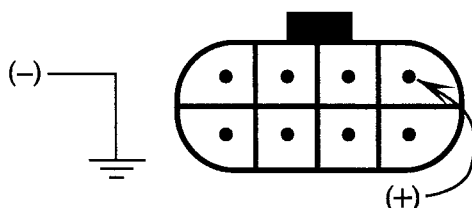
Transmission Connector Identification			
ID	Function	ID	Function
1	Shift Solenoid B	5	TCC Solenoid
2	Shift Solenoid A	6	TOT Sensor
3	Overrun Solenoid	7	TOT Sensor
4	EPC (+)	8	Temperature Switch



Shown from the terminal side of the transmission connector.

Electronic Pressure Control

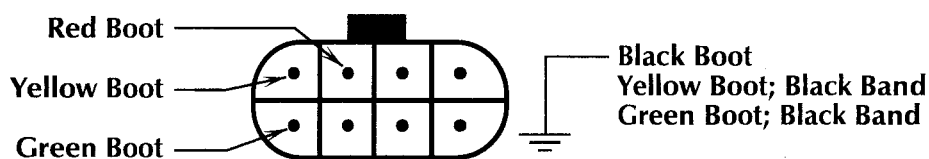
To check the electronic pressure control signal, connect your high-impedance voltmeter to the terminals shown.



Signal voltage should increase as the computer commands line pressure to decrease.

Checking the Shift Pattern

Here's how to connect your signal monitor to the transaxle diagnostic connector, to check the signals from the computer to the transaxle:



Backprobe the terminals with the harness connector still connected to the transmission.

This is the shift pattern you should see with your signal monitor:

Transmission Shift Pattern			
First Gear			
Second Gear			
Third Gear			
Fourth Gear w/Lockup			

The far right LED indicates the signal to the converter clutch (TCC) solenoid.

Diagnostic Tip: These systems can command lockup in 2nd, 3rd and 4th gears.

Continued...

JR403E System Diagnosis (continued)

Testing Transmission Operation (continued)

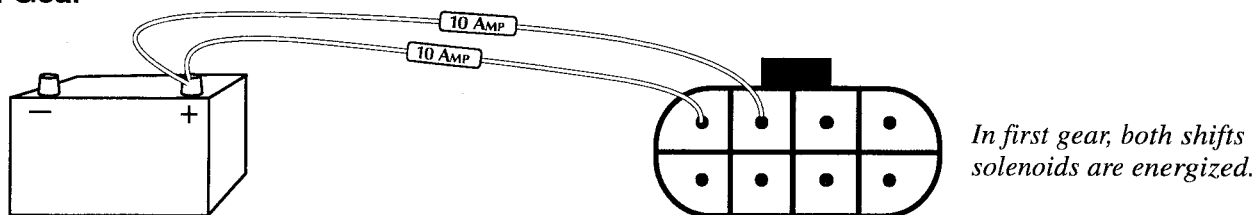
Forcing the Shift

Here's the manual shift pattern you can expect with the transaxle in failsafe:

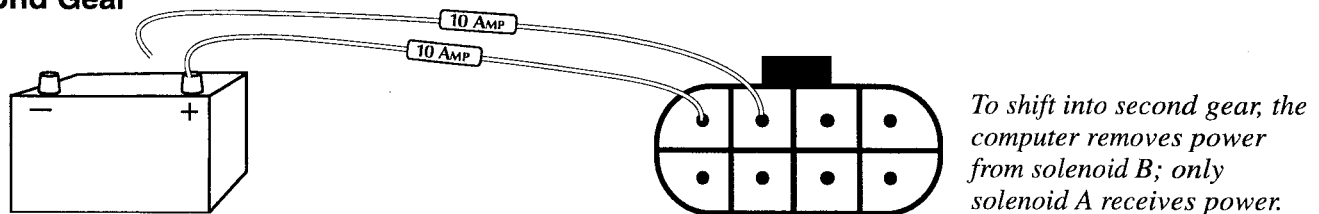
Manual Gear Ranges in Failsafe						
Selector Position	Park	Reverse	Neutral	D or 3	S or 2	L or 1
Gear Range	Park	Reverse	Neutral	3 rd	3 rd	2 nd

Here's how to force the transaxle to shift electrically:

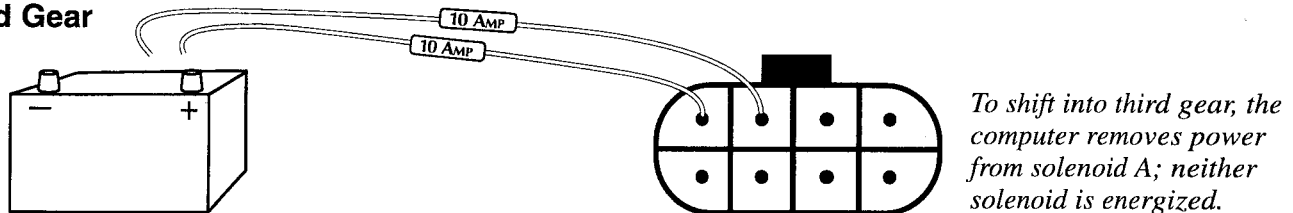
First Gear



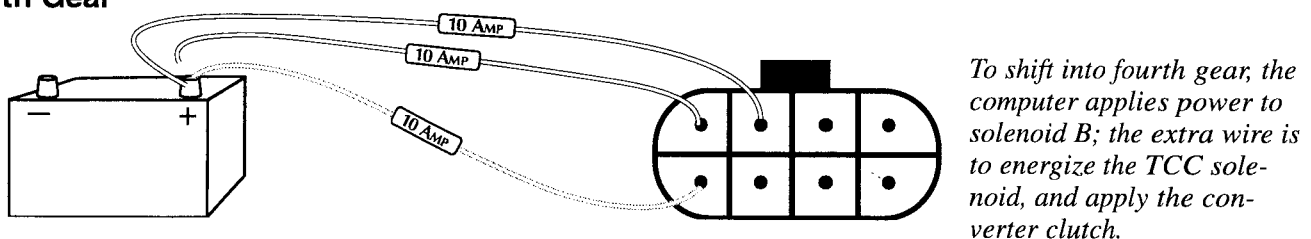
Second Gear



Third Gear



Fourth Gear



JR403E System Diagnosis (continued)

Computer Terminal Identification

Early Systems

1	2	3	4		6	7	X	9	10	21	22	23	24	25	26	X	28
11	12	X	14	15	16	17	X	19	20	29	30	31	32	33	34	35	36

Pin No. Function

1. 2 range switch
2. 1 range switch
3. Exhaust brake signal
4. Idle switch
5. —
6. Overdrive switch
7. Kick-down switch
8. —
9. Economy drive switch
10. Throttle sensor voltage (5V out)
11. Throttle sensor
12. ATF Thermosensor
13. —
14. Idle switch voltage
15. Throttle sensor ground
16. Vehicle speed sensor 1
17. Full throttle switch
18. —

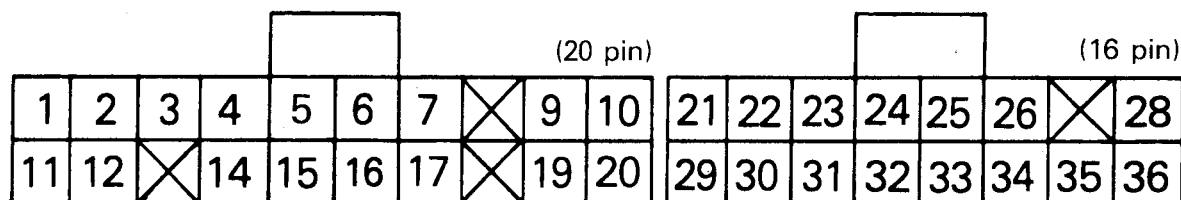
Pin No. Function

19. Neutral range switch
20. D range switch
21. Overrun clutch solenoid
22. Lock-up duty solenoid
23. Economy drive indicator
24. Vehicle speed sensor 2
25. Engine revolution sensor
26. Reverse range switch
27. —
28. Battery back-up voltage
29. Ignition voltage
30. Ignition voltage
31. Ground
32. Ground
33. Duty solenoid (Dropping register)
34. Duty solenoid (Line pressure)
35. Shift solenoid A
36. Shift solenoid B

JR403E System Diagnosis (continued)

Computer Terminal Identification (continued)

Late Systems



Pin No. Function

1. 2 range switch
2. 1 range switch
3. Exhaust brake signal
4. Idle switch
5. Diagnosis terminal
6. Overdrive switch
7. Kick-down switch
8. —
9. Economy drive switch
10. Throttle sensor voltage (5V out)
11. Throttle sensor
12. ATF Thermosensor
13. —
14. Idle switch voltage
15. Throttle sensor ground
16. Vehicle speed sensor 1
17. Full throttle switch
18. —

Pin No. Function

19. Neutral range switch
20. D range switch
21. Overrun clutch solenoid
22. Lock-up duty solenoid
23. Economy drive indicator
24. Vehicle speed sensor 2
25. Engine revolution sensor
26. Reverse range switch
27. —
28. Battery back-up voltage
29. Ignition voltage
30. Ignition voltage
31. Ground
32. Ground
33. Duty solenoid (Dropping register)
34. Duty solenoid (Line pressure)
35. Shift solenoid A
36. Shift solenoid B

JR403E System Diagnosis (continued)

Circuit Testing

Pin	Function	Operating Conditions	Measurement
1	Inhibitor Switch; Manual 2 Input	In Manual 2	Battery Voltage
		All ranges except Manual 2	Zero Volts
2	Inhibitor Switch; Manual L Input	In Manual L	Battery Voltage
		All ranges except Manual L	Zero Volts
3	Brake Switch	Brake pedal applied	Battery Voltage
		Brake pedal released	Zero Volts
4	Idle Switch	Accelerator pedal applied	Less than 1.0 Volt
		Accelerator pedal released	8 – 15 Volts
5	Early — N/A		
	Late — Diagnostic Link		
6	Overdrive Switch	Overdrive switch off	Battery Voltage
		Overdrive switch on	Less than 1.0 Volt
7	Kickdown Switch	Accelerator pedal applied	Less than 1.0 Volt
		Accelerator pedal released	3 – 8 Volts
8	N/A		
9	Economy Switch	Switch set to Normal	3 – 8 Volts
		Switch set to Economy	Less than 1.0 Volt
10	TPS Reference	Key on	4.5 – 5.5 Volts
11	TPS Signal	Idle	4.0 – 4.9 Volts*
		Wide-open throttle	0.1 – 1.8 Volts*
12	ATF Temperature Sensor	At 50° F (10° C)	About 1.8 Volts
		At 104° F (40° C)	About 1.1 Volts
13	N/A		
14	Idle/Full Throttle Ref.	Key on	8 – 15 Volts
15	Sensor Ground	Always	Less than 0.1 Volts
16	VSS1 (at Transmission)	With output shaft rotating	Square Wave DC Signal
17	Full Throttle Switch	Idle	Less than 1 Volt
		Accelerator more than halfway down	8 – 15 Volts

* On some models TPS voltage is low at idle and increases with throttle opening.

Continued...

JR403E System Diagnosis (continued)

Circuit Testing (continued)

Pin	Function	Operating Conditions	Measurement
18	N/A		
19	Inhibitor Switch; Neutral Input	In Neutral	Battery Voltage
		All ranges except Neutral	Zero Volts
20	Inhibitor Switch; Drive Input	In Drive	Battery Voltage
		All ranges except Drive	Zero Volts
21	Overrun Clutch Solenoid	Solenoid on	Battery Voltage
		Solenoid off	Zero Volts
22	Lockup Solenoid	Converter clutch applied	8 – 15 Volts
		Converter clutch released	Less than 1.0 Volt
23	Economy Switch	Switch in normal position; key on	Battery Voltage
		Switch in economy position; key on	Less than 1.0 Volt
24	VSS2 (in Speedometer)	With speedometer cable rotating	Square Wave DC Signal
25	Engine RPM Sensor	Engine off	Zero Volts AC
		Engine running	Varying Volts AC
26	Inhibitor Switch; Reverse Input	In Reverse	Battery Voltage
		All ranges except Reverse	Zero Volts
27	N/A		
28	Keep-Alive Power	Always	Battery Voltage
29	Ignition	Key on	Battery Voltage
30	Ignition	Key on	Battery Voltage
31	Ground	Always	Less than 0.1 Volt
32	Ground	Always	Less than 0.1 Volt
33	Line Pressure Control Solenoid	Idle	1.5 – 2.5 Volts
		Full throttle	Less than 0.5 Volts
34	Line Press. Control Sol. w/Dropping Resistor	Idle	5 – 14 Volts
		Full throttle	Less than 0.5 Volts
35	Shift Solenoid A	Solenoid on	Battery Voltage
		Solenoid off	Zero Volts
36	Shift Solenoid B	Solenoid on	Battery Voltage
		Solenoid off	Zero Volts

Reference

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Conversion Tables

Area		
Multiply	By	To Obtain
in ²	645.2	mm ²
in ²	6.452	cm ²
in ²	0.0069	Ft ²
Ft ²	0.0929	m ²
Ft ²	144.0	in ²
m ²	10.764	Ft ²
cm ²	0.155	in ²
mm ²	0.00155	in ²
area of a circle = πr^2 area of a cylinder = $\pi r^2 h$		
$\pi = 3.14$ r = Radius h = Height		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Continued...

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

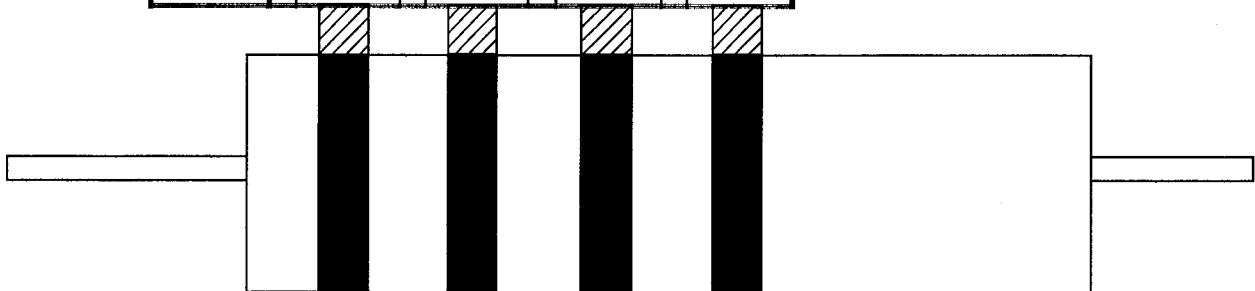
*The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the multiplier.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	1	—
Brown	1	1	10	—
Red	2	2	100	—
Orange	3	3	1k	—
Yellow	4	4	10k	—
Green	5	5	100k	—
Blue	6	6	1M	—
Violet	7	7	10M	—
Gray	8	8	100M	—
White	9	9	—	—
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%



So if the bands are:

Blue Green Yellow Silver
6 5 x 10,000 ±10%

Red Violet Brown Gold
6 5 x 10 ±5%

White Orange Violet Plain
9 3 x 10,000,000 ±20%

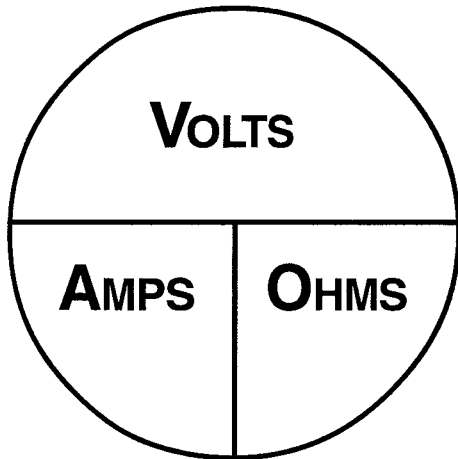
The resistor value is:

= 650 kΩ, ±10%

= 270 Ω, ±5%

= 930 MΩ, ±20%

Ohm's Law



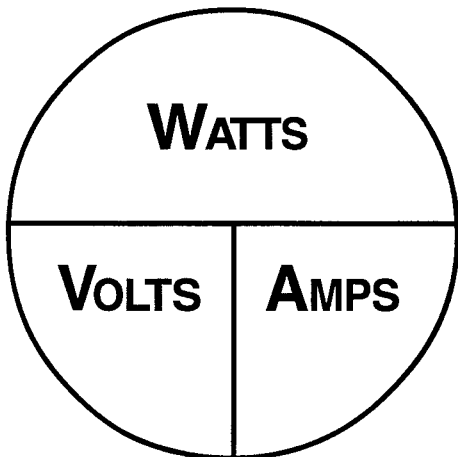
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

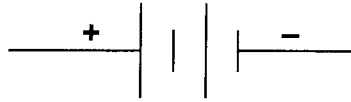
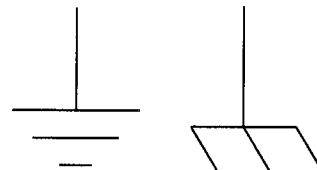
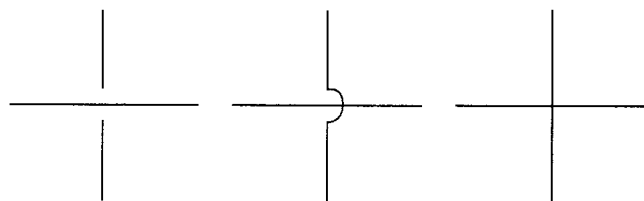
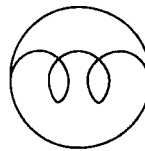
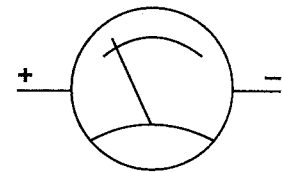
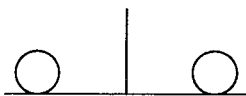
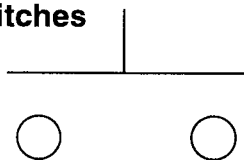
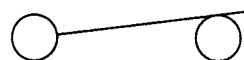
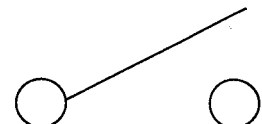
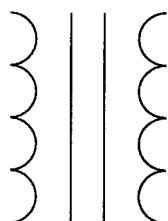
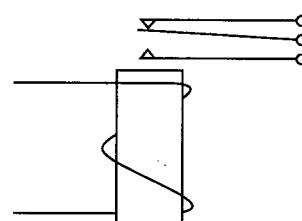
Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

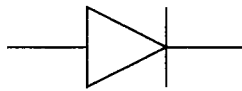
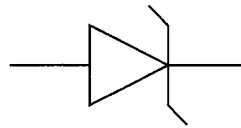
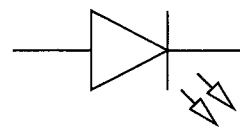
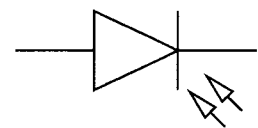
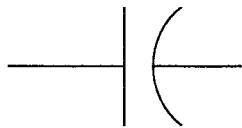
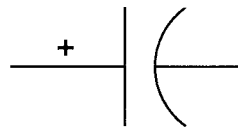
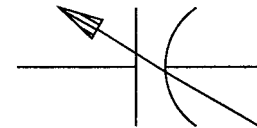
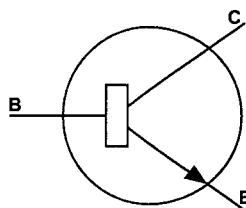
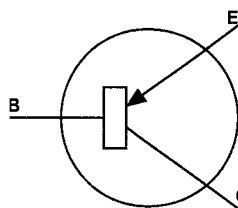
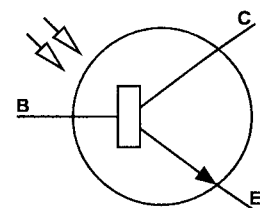
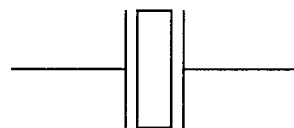
Multiple Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

Schematic Symbols

**Battery****+V****Power****Ground****Connected Wires****Unconnected Wires****Fuse****Circuit Breaker****Bulb****Meter****Pushbutton Switches****NC Switch****NO Switch****On/Off Switches****NC Switch****NO Switch****Transformer (Coil)****Relay**

Schematic Symbols (continued)

**Fixed Resistor****Variable Resistor****Potentiometer****Diode****Zener Diode****LED****Photodiode****Fixed Capacitor****Fixed Capacitor (Polarized)****Variable Capacitor****NPN Transistor****PNP Transistor****Phototransistor****Crystal**

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition system.

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Continued...

Glossary of Electrical Terms (cont)

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific direction, or the LED won’t light.

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm’s Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). $\text{Ohms} \times \text{Amps} = \text{Volts}$; $\text{Volts} \div \text{Ohms} = \text{Amps}$; $\text{Volts} \div \text{Amps} = \text{Ohms}$.

Open Circuit — An incomplete electrical path that won’t provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won’t operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component’s operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won’t prevent the other legs from operating.

Continued...

Glossary of Electrical Terms (cont)

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the voltage signal, based on its position along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device controlling the circuit.

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely be dealing with open and close to control hydraulic flow, to allow the transmission to shift gears, control lockup, and control line pressure.

Thermistor — A semiconductor that varies resistance based on temperature. There are two types of thermistor: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). The NTC thermistor is more common — as the temperature goes up, its resistance goes down.

Continued...

Glossary of Electrical Terms (cont)

Transistor — A semiconductor that operates as an electronic “relay.” Transistors allow a low current circuit to control power or ground to a high current circuit.

Variable Resistor — A one- or two-wire sensor that modifies a voltage signal based on stress or temperature. Thermistors are the most common type of variable resistor in today’s cars and trucks.

Voltage — The pressure in an electrical system, that pushes current through the circuit. One volt of pressure is necessary to push one amp of current through one ohm of resistance. Sometimes called the circuit’s potential.

Voltmeter — Electrical test device that measures the voltage potential in a circuit. Displays its reading in volts.

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kV	Kilovolt
AC	Alternating current	kW	Kilowatt
B, b	Base electrode, units with single base	kWH	Kilowatt hour
°C	Degrees Celsius or centigrade	lb	Pound
C	Capacitance, capacitor	M	Mega; x1,000,000
C, c	Collector electrode	m	Milli; one-one thousandth; 1/1000; 0.001
cm	Centimeter	mf, mfd	Microfarad
cu	Cubic	MHz	Megahertz
db	Decibels	mm	Millimeter
DC	Direct current	NC	Normally closed
dm	Decimeter	Nm	Newton-meter
DPDT	Double-pole, double-throw switch	NO	Normally open
DPST	Double-pole, single-throw switch	R	Resistance; resistor
E, e	Emitter electrode	SPDT	Single-pole, double-throw switch
E, e	Voltage	SPST	Single-pole, single-throw switch
mf	Microfarad	t	Time
°F	Degrees Fahrenheit	T	Temperature
F, f	Frequency	V, v	Volt; voltmeter
flu	Fluid	V _{BB}	Base supply voltage (DC)
FM	Frequency modulation	V _{BC}	Base-to-collector voltage (DC)
g	Gram	V _{BE}	Base-to-emitter voltage (DC)
gnd, grd	Ground	V _{CB}	Collector-to-base voltage (DC)
Hg	Mercury	V _{CC}	Collector supply voltage (DC)
Hz	Hertz	V _{CE}	Collector-to-emitter voltage (DC)
I	Current	V _{EB}	Emitter-to-base voltage (DC)
I _B	Base current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _C	Collector current (DC)	V _{cc}	Emitter supply voltage (DC)
I _E	Emitter current (DC)	V _F	Forward voltage (DC)
k	x1000	W	Watt; work
kg	Kilograms	w	Watt
kHz	Kilohertz	wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	1/128	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	15/128	2.9769		
0.0156	1/16	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	1/8	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	17/128	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	3/128	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	9/64	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	3/16-24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	1/32	0.7925			0.1484	19/128	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	5/32	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	3/16-32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	5/128	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	21/128	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	3/64	1.1913	3/64"	0-80 NF	0.1719	11/64	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	7/128	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	23/128	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1653		4.2000		5.5mm - 0.80
0.0625	1/16	1.5875			0.1820		4.6228	14	12-28 NF
0.0635		1.6129	52		0.1850		4.6990	13	12-32 NEF
0.0670		1.7018	51		0.1875	3/16	4.7625		
0.0700	9/128	1.7780	50	2-56 NC 2-64 NF	0.1890		4.8006	12	
					0.1910		4.8514	11	
0.0730		1.8542	49		0.1935		4.9149	10	14-20 NS
0.0760		1.9304	48		0.1953	25/128	4.9606		
0.0781	5/64	1.9837			0.1960		4.9784	9	
0.0785		1.9939	47	3-48 NC	0.1990		5.0546	8	
0.0810		2.0574	46		0.2010		5.1054	7	1/4-20 NC 14-24 NS
0.0820		2.0828	45	3-56 NF					
0.0860	11/128	2.1844	44	4-36 NS	0.2031	13/64	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	3/32	2.3825		1/8-32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	1/4-24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	27/128	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	1/4-28 NF
0.1015		2.5781	38	1/8-40NF 5-40NC	0.2188	7/32	5.5575		1/4-32 NEF
					0.2210		5.6134	2	
0.1016	13/128	2.5806			0.2266	29/128	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	1/4-40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	7/64	2.7788			0.2344	15/64	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	²⁹ / ₆₄	11.5087		¹ / ₂ -20 NF
0.2422	³¹ / ₁₂₈	6.1519							¹ / ₂ -24 NS
0.2460		6.2484	D		0.4609	⁵⁹ / ₁₂₈	11.7069		
0.2500	¹ / ₄	6.3500	E		0.4688	¹⁵ / ₃₂	11.9075		
0.2570		6.5278	F	⁵ / ₁₆ -18 NC	0.4766	⁶¹ / ₁₂₈	12.1056		
0.2578	³³ / ₁₂₈	6.5481			0.4800		12.1920		14mm - 2.00
0.2610		6.6294	G		0.4844	³¹ / ₆₄	12.3038		⁹ / ₁₆ -12 NC
0.2656	¹⁷ / ₆₄	6.7462			0.4922	⁶³ / ₁₂₈	12.5019		
0.2660		6.7564	H		0.5000	¹ / ₂	12.7000		14mm - 1.50
0.2720		6.9088	I	8mm - 1.25	0.5039		12.8000		14mm - 1.25
				⁵ / ₁₆ -24 NF	0.5156	³³ / ₆₄	13.0962		⁹ / ₁₆ -18 NF
0.2734	³⁵ / ₁₂₈	6.9444			0.5312	¹⁷ / ₃₂	13.0962		⁵ / ₈ -11 NC
0.2770		7.0358	J		0.5469	³⁵ / ₆₄	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	⁹ / ₁₆	14.2875		
0.2813	⁹ / ₃₂	7.1450		⁵ / ₁₆ -32 NEF	0.5781	³⁷ / ₆₄	14.6837		⁵ / ₈ -18NF
0.2891	³⁷ / ₁₂₈	7.3431							³ / ₈ -18NPT
0.2900		7.3660	L		0.5787		14.7000		16mm - 1.50
0.2950		7.4930	M		0.5938	¹⁹ / ₃₂	15.0825		¹¹ / ₁₆ -11 NS
0.2969	¹⁹ / ₆₄	7.5413			0.6094	³⁹ / ₆₄	15.4788		
0.3020		7.6708	N		0.6220		15.8000		18mm - 2.50
0.3047	³⁹ / ₁₂₈	7.7394			0.6250	⁵ / ₈	15.8750		¹¹ / ₁₆ -16 NS
0.3110		7.8994		9mm - 1.25	0.6406	⁴¹ / ₆₄	16.2712		
0.3125	⁵ / ₁₆	7.9375		³ / ₈ -16 NC	0.6562	²¹ / ₃₂	16.6675		³ / ₄ -10 NC
0.3160		8.0264	O		0.6614		16.8000		18mm - 1.50
0.3190		8.1026		9mm - 1.00	0.6719	⁴³ / ₆₄	17.0663		
0.3203	⁴¹ / ₁₂₈	8.1356			0.6875	¹¹ / ₁₆	17.4625		³ / ₄ -16NF
0.3230		8.2042	P		0.7008		17.8000		20mm - 2.50
0.3270		8.3058		9mm - 0.75	0.7031	⁴⁵ / ₆₄			¹ / ₂ -14 NPT
0.3281	²¹ / ₆₄	8.3337			0.7187	²³ / ₃₂			
0.3320		8.4328	Q	³ / ₈ -24 NF	0.7344	⁴⁷ / ₆₄			
0.3359	⁴³ / ₁₂₈	8.5319			0.7500	³ / ₄			
0.3390		8.6106	R	¹ / ₈ -27 NPT	0.7656	⁴⁹ / ₆₄			⁷ / ₈ -9 NC
0.3430		8.7122		10mm - 1.50	0.7812	²⁵ / ₃₂			
0.3438	¹¹ / ₃₂	8.7325			0.7969	⁵¹ / ₆₄			
0.3480		8.8392	S		0.8125	¹³ / ₁₆			⁷ / ₈ -14 NF
0.3500		8.8900		10mm - 1.25	0.8228		20.9000		22mm - 1.50
0.3516	⁴⁵ / ₁₂₈	8.9306			0.8281	⁵³ / ₆₄			⁷ / ₈ -18 NS
0.3580		9.0932	T	10mm - 1.0	0.8425		21.4000		24mm - 3.00
0.3594	²³ / ₆₄	9.1288			0.8437	²⁷ / ₃₂			
0.3672	⁴⁷ / ₁₂₈	9.3269			0.8594	⁵⁵ / ₆₄			
0.3680		9.3472	U	⁷ / ₁₆ -14 NC	0.8750	⁷ / ₈			1-8 NC
0.3750	³ / ₈	9.5250			0.8779		22.3000		24mm - 2.00
0.3770		9.5758	V		0.8906	⁵⁷ / ₆₄			
0.3820		9.7028		11mm - 1.50	0.9062	²⁹ / ₃₂			
0.3828	⁴⁹ / ₁₂₈	9.7231			0.9219	⁵⁹ / ₆₄			1-12 NF
0.3860		9.8044	W						³ / ₄ -14 NPT
0.3906	²⁵ / ₆₄	9.9212		⁷ / ₁₆ -20 NF	0.9375	¹⁵ / ₁₆			1-14 NS
0.3970		10.0838	X		0.9531	⁶¹ / ₆₄			
0.3984	⁵¹ / ₁₂₈	10.1194			0.9687	³¹ / ₃₂			
0.4040		10.2616	Y		0.9844	⁶³ / ₆₄			
0.4063	¹³ / ₃₂	10.3200			1.0000	1			
0.4130		10.4902	Z	12mm - 1.75					
0.4141	⁵³ / ₁₂₈	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	²⁷ / ₆₄	10.7163		¹ / ₂ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	⁵⁵ / ₁₂₈	10.9144							
0.4375	⁷ / ₁₆	11.1125		¹ / ₄ -18NPT					
0.4453	⁵⁷ / ₁₂₈	11.3106							

TECHNICAL SEMINAR



ISSUE 10

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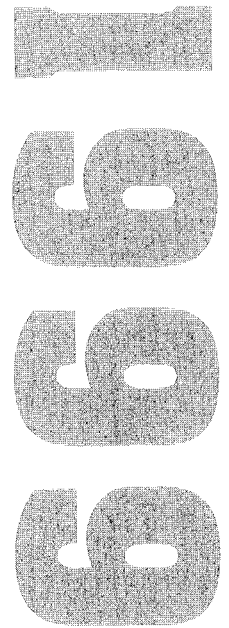
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TECHNICAL SEMINAR



ISSUE 10

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Scan Tools

Introduction

When it comes to diagnosing on-board computer systems, few tools provide more information faster than a scan tool. Just plug into the vehicle's diagnostic link connector, use the keypad to enter a few simple selections, and in seconds you have diagnostic trouble codes, sensor feedback and solenoid commands right at your fingertips.

And, by comparing sensor data to computer commands, you can evaluate the cause and effect of systems operation; a "closed loop" for each system under computer control.

If that wasn't enough, many vehicles also offer system actuation testing through a scan tool: Just enter the proper commands, and the scan tool orders the computer to energize individual circuits. This allows you to verify whether the circuit or system is capable of operating, to help you identify system failures quickly.

Many early vehicles provided only minimal scan tool support; some, notably the European imports, provided none at all. But with the introduction of OBD-II standards, every vehicle must now provide a minimal level of scan tool diagnostics and support, through any OBD-II compliant scan tool.

Scan Tool Limits

Every tool has its limits; scan tools are no exception. To begin with, computer communication through a scan tool can be exceedingly slow. Depending on how many parameters you're examining at the same time, it may take as much as several seconds between updates. A lot can happen in those seconds between updates — much of which you could easily miss, due to the delay.

What's more, you may have heard that OBD-II means all scan tools are equal. Terms like *common* and *universal* keep cropping up when people talk about OBD-II. But it doesn't take long to recognize that some scan tools are more common and universal than others.

And, while OBD-II standards put certain minimum requirements on the amount of data vehicle manufacturers must provide, OBD-II scan tools don't provide anywhere near the data available through most manufacturers' dedicated scan tools. Quite simply, there's a lot more information to be had, if you have the tools to retrieve it.

Scan Tools (continued)

Not the Actual Sensor Readings...

Another limitation is that scan tools don't provide actual sensor readings. Instead, they provide the on-board computer's *interpretation* of the readings it receives. This may sound like we're splitting hairs, but it can make a drastic difference in the actual cause of a problem.

For example, suppose you're checking a car with a performance problem, such as late shifts. There's a code in memory: *P0122 — Throttle Position Sensor Low Input*. Okay, you check the TPS voltage signal with your scan tool, and sure enough, TPS voltage remains at zero. So, is the sensor bad?

Maybe... or maybe there's a bad connection at the sensor or the computer. Or maybe there's a break in the power feed to the sensor. Or maybe there's a break in the signal wire from the sensor. Or maybe the computer itself is damaged. Or...

Get the idea? So what good is the scan tool data if you can't trust it for diagnosis?

Don't get the wrong idea; you *can* trust the scan tool... for what it was designed to do. The scan tool is telling you that the computer isn't seeing a TPS signal. That information is right on the money. And thanks to the scan tool, you know exactly what input is preventing the vehicle from operating properly.

From there, you have to continue your diagnosis, using a digital volt-ohmmeter or oscilloscope, to pinpoint the precise cause of the problem. The scan tool isn't the *end* of the diagnosis: it's often just the beginning. In this case, the scan tool simply points you in the right direction. From there, diagnosis is still up to you.

What Sets the Code?

Not all codes are as straightforward as P0122 (Throttle Position Sensor Low Input). With that one, you know to look at the throttle position sensor circuit. Simple.

But what about a vehicle with this code: P0741 — Torque Converter Clutch System Performance or Stuck Off. Okay, you check the converter clutch solenoid, and it's working fine. So you pull the trans, pop in a new converter, and within a few miles the system sets code P0741 — Torque Converter Clutch System Performance or Stuck Off. Now what?

The problem is, you're assuming that just because the code indicates a problem with the torque converter clutch, that there's a problem with the torque converter clutch.

Surprise! What it's *really* telling you is that, with the converter clutch engaged, there's too much of a difference between the engine RPM and the input shaft RPM; or on some vehicles the difference could be between the engine RPM and a calculated reading from the output RPM. The *actual* problem could be a slipping clutch in the trans, or a ratio error caused by using the wrong geartrain components.

The point to remember is that, to diagnose any diagnostic trouble code, you must first understand how the computer checks for a problem, and what levels it uses for a cutoff point for setting the code.

Once you understand that, you'll have a much better idea of what to look for when a code shows up in memory.

Scan Tools (continued)

OBD-I vs OBD-II

OBD stands for *On-Board Diagnostics*. In basic terms, OBD is a process the computer system uses to identify problems, and indicate them to the driver or technician.

If you ever worked on a GM gasoline-powered vehicle built since 1981, you're probably familiar with OBD-I. OBD-I included a means of monitoring certain computer systems and circuits; setting trouble codes to indicate problems; and lighting a "Check Engine" light to indicate a problem to the driver.

There were several problems with OBD-I:

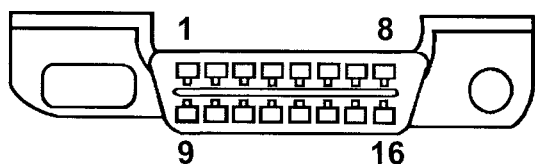
1. It was limited: It could identify shorted or open circuits, but in many cases couldn't determine when a sensor had shifted slightly out of range.
2. No consistency: Code numbers and terms could vary from manufacturer to manufacturer, and even from vehicle to vehicle within the same carline.
3. No verification: The computer would monitor whether a solenoid turned on, but in many cases it never checked whether the system was actually operating.

Enter OBD-II: Its initial goal was to reduce emissions, by monitoring system operation more efficiently. Now, in addition to checking the EGR valve to make sure it opened, the computer also monitors the EGR flow, to make sure the system is working to reduce vehicle emissions.

And in addition to recognizing opens and shorts, the enhanced sensor monitors compare sensor output signals to other sensor readings, to determine whether the system is working within normal ranges. This mostly affects emissions systems; it has very little effect on transmission-specific functions.

Along with these system enhancements, OBD-II promised consistency — in code formats and definitions, scan data, component terms, and even some component locations.

For example, if you've ever used a scan tool in the past, you've probably had the opportunity to play "find the connector." And it's downright amazing where some manufacturers try to hide those things. Then, once you found it, you had to find the adapter to fit it.



OBD-II standards define the shape and type of diagnostic connector, along with some of the terminals.

OBD-II Diagnostic Connector Link			
1	Reserved for OEM	9	Reserved for OEM
2	Communication Bus Pos. (+)	10	Communication Bus Neg. (-)
3	Reserved for OEM	11	Reserved for OEM
4	Chassis Ground (-)	12	Reserved for OEM
5	Signal Ground	13	Reserved for OEM
6	Reserved for OEM	14	Reserved for OEM
7	"K" Line ISO	15	"L" Line ISO
8	Reserved for OEM	16	Unswitched Battery Pos. (+)

But with OBD-II, all that's changed. Because the SAE J1962 requirements for OBD-II include standards for the connector's shape, electrical configuration, and location. So now the OBD-II connector should always be between the center of the dash and the steering column, in plain view from the driver's seat... at least in theory.

If implemented properly, OBD-II promises to make your job easier, and help you do your job better.

Scan Tools (continued)

Connecting Your Scan Tool

Before you begin any scan tool diagnosis, there are a few basic steps you must perform.

1. Does your scan tool require a special cartridge, insert, or a key in the connector? If so, make sure you have the right ones installed for the vehicle you're working on.
2. Locate the diagnostic link connector. If you're working on an OBD-II vehicle, it should be from the left side of the instrument panel to 300mm (11.8 inches) to the right of the vehicle's centerline, accessible from the driver's seat. Make sure you find the connector before going on.
3. Make sure you have the right adapter for the vehicle's diagnostic link connector (DLC). If you're working on an OBD-II vehicle, it should use a standard connector. But earlier vehicles each had their own specific connectors; you'll need the right adapter for the vehicle you're working on.
4. Make sure you have the vehicle ID number (VIN) available. You'll need that information to collect the vehicle model year and system information for the scan tool. Never try to take the year from the build date or registration card; very often, they're not as accurate as the VIN.

Now you're ready to connect the scan tool to the vehicle: Make sure the key is off, and plug the scan tool into the diagnostic connector link. If you're working on an OBD-II vehicle, the scan tool will receive power and ground from the connector; if you're working on an older vehicle, you may have to plug the scan tool into the cigarette lighter or connect it to the battery to provide it with power. Some scan tools have their own battery supply.

Turn the key on, engine off. The scan tool should come on. If not, check for a blown fuse in the vehicle or scan tool. Make sure you have power and ground reaching the scan tool: Some OBD-II connectors have shown up without a ground terminal.

Once the scan tool comes on, enter the vehicle information. It will probably request the vehicle year and one or more of the digits from the VIN number. The scan tool will use that information to determine the vehicle configuration.

NOTICE

Some scan tools are designed to accept the vehicle information before you plug the interface cable into the diagnostic connector.

After it receives the vehicle information, it's ready to provide you with the data you're looking for.

Scan Tools (continued)

No Communication/Scan Tool Errors

Sometimes your first hurdle when checking a computer system is where the scan tool indicates this:

NO DATA

What the scan tool is telling you is that it isn't receiving any information from the computer to display.

There are a few steps you should perform when you receive a No Data/No Communication error from your scan tool:

1. Check your scan tool setup. This includes the connector adapter, interface cards or modules, personality cards, and the software installed in the scan tool. Make sure you're using the right setup before going on.
2. Check your vehicle data. Make sure you've entered the right year and configuration data for the vehicle you're working on. If the vehicle information appears different from the actual vehicle configuration, try entering the data based on your observations; for example: If the VIN indicates the vehicle uses multiport injection, but the vehicle appears to have throttle body injection, try entering the data for throttle body injection. Remember, something could have been changed since the factory installation.
3. Does the scan tool work? Scan tools are mechanical devices, and they can break, too. Try connecting your scan tool to another vehicle, and see if it displays data. If not, suspect a problem with your scan tool.
4. Is there a glitch in the software? Some scan tools have been known to ignore certain years or configurations, due to a bug in the software. Try entering a different model year, and see if that enables the scan tool to begin displaying data. Or choose another vehicle with the same configuration. For example, if you can't get information from a Mazda 626, try entering Ford Probe instead.
5. Check for power and ground to the scan tool. In some cases the scan tool takes its power and ground from the diagnostic connector. Make sure it's getting the power and ground it needs to operate.
6. Check for power and ground to the on-board computer. If the computer isn't powered up, it won't be able to provide the scan tool with the data it needs. Use a schematic to determine where the computer receives power and ground, and make sure they're working properly. If necessary, check the actual voltage drop on these circuits: You shouldn't lose more than 0.01 – 0.02 volts between the battery and the computer on any of these circuits.

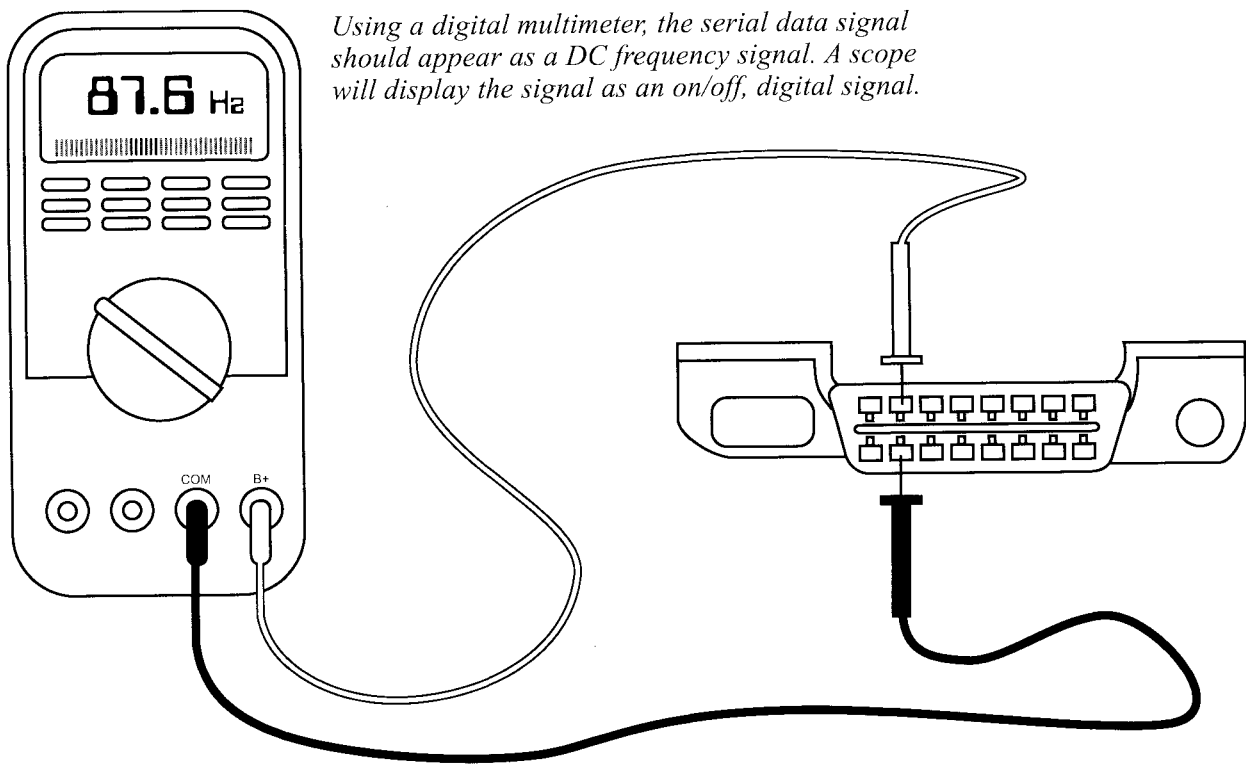
Continued...

Scan Tools (continued)

No Communication/Scan Tool Errors (cont)

7. Check for serial data from the vehicle computer. The on-board computer provides information to the scan tool in the form of a digital signal, called *serial data*. This is an on/off signal, that varies between zero and 5 volts.

With the scan tool connected, and the key on, engine off, connect your digital voltmeter or oscilloscope to the communication terminals — on OBD-II connectors in vehicles built for use in North America, these terminals are 2(+) and 10(–). On some vehicles, you'll need to have your scan tool connected to the diagnostic link connector before the computer will begin pulsing.



Using a digital multimeter, the serial data signal should appear as a DC frequency signal. A scope will display the signal as an on/off, digital signal.

CAUTION

Never allow your test leads to touch each other while connected to the diagnostic connector.

If you're using a scope, you should see the voltage signal switching on and off, between zero and 5 volts. If you're using a digital multimeter, set it to read a DC frequency. It should begin to display a varying frequency signal.

If you don't see a voltage signal or a frequency, the computer isn't providing the scan tool with serial data. If you see the signal, the scan tool isn't reading the data properly.

Scan Tools (continued)

Partial Communications

You may run into some vehicles that seem to provide far less data than other similar vehicles. In some cases that may be normal; some vehicles provide less data than others.

But if you're unsure that you're getting everything you should for the vehicle you're working on, there are a few things you can try:

1. Check your scan tool settings. Make sure you've entered the correct information into the scan tool. A wrong year or improper digit in the configuration setup can prevent the scan tool from providing all the data it should.
2. Make sure you have the proper insert or key installed. These items provide the scan tool with the ability to access far more data from the vehicle's on-board computer. If you leave them out, or install the wrong insert or key, you'll get only a small fraction of the data you should receive.
3. Check your software. Most scan tool manufacturers provide software updates. Those updates enable the scan tool to retrieve and interpret more information than the earlier versions. If you aren't using the most up-to-date software for your scan tool, update it.

Finally, if everything else looks okay, try reinitializing your scan tool. Shut the ignition off, disconnect the scan tool, and start over. Sometimes a little electrical glitch can confuse the system, and prevent it from operating properly. Starting over can help smooth out the lines of communication, and improve the data you're receiving. Remember, each scan tool has its own procedure for entering vehicle information; make sure you're familiar with the procedures for the one you're using.

Failsafe with No Codes

Not every condition that affects transmission operation will set a code. If you're using the generic OBD-II settings, try the enhanced settings, to see if you get any further information. No codes may be due to the scan tool's software: Try a different scan tool or different software. In some cases you may need to use the factory scan tool to retrieve codes.

On EEC-IV Fords, no codes may be a normal condition, if the problem wasn't set in Continuous Memory. Make sure you check the On-Demand codes, both key on, engine off, and engine running. Finally, no codes in memory could indicate a software problem, either in the vehicle's computer or your scan tool.

If you run into a unit with no codes in memory, but the transmission is in failsafe, make sure the transmission solenoids are receiving power. Check a schematic to see where the power comes from; very often you'll find a blown fuse or bad relay.

If you suspect the computer has a problem where it won't set codes, try to force a code. Disconnect a sensor, such as a TR sensor or TPS, and drive the vehicle. Or disconnect the transmission solenoids. The computer should set a code within a short time.

DIAGNOSTIC TIP OBD-II systems won't set many codes until the computer sees a failure during two consecutive "trips." This means that, for a code to set, the engine has to go through warmup, cool back down, and warm up again.

Scan Tools (continued)

Reading the Diagnostic Trouble Codes

For years, many techs relied on counting a flashing light on the dash to read trouble codes. A scan tool makes checking those codes much easier.

Most vehicles will provide up to 10 codes in memory. The question is, are they *hard* codes (codes indicating a problem that's taking place right now), or *soft* codes (codes that indicate a problem that took place once before, but isn't there right now).

The easiest way to tell what type of codes you're looking at is to clear the codes, and then drive the vehicle. If the code reappears, it's a hard code. If the code doesn't come back, it's probably due to an intermittent problem — one that isn't there right now.

DIAGNOSTIC TIP OBD-II systems won't set many codes until the computer sees a failure during two consecutive "trips." This means that, for some codes to set, the engine has to go through warmup, cool back down, and warm up again.

CAUTION Never attempt repairs based strictly on a diagnostic trouble code. Always confirm the specific problem using standard diagnostic methods. A diagnostic trouble code is just an indicator, designed to help focus your diagnosis.

Scan Tools (continued)

Clearing the Codes

Once you've read and recorded any codes in memory, your next step is to clear the codes. Whenever possible, you should use the "clear codes" function on your scan tool to perform this task.

Avoid disconnecting the battery to clear codes. There are a few reasons this isn't a good procedure:

1. On many of today's cars, disconnecting the battery won't clear the codes. These computers have non-volatile memory, so the computer will maintain its memory, even if the computer loses power.
2. Disconnecting the battery will clear more than the codes in the computer system's memory. It also clears radio presets, seat memories, clock settings and so on. Then you have a choice of resetting everything in the vehicle, or dealing with an unhappy customer.
3. Many radios today include a theft deterrent device, designed to disable the radio if it loses power. Enabling the radio requires a code (which the customer is sure to have lost long ago). And that's if you're lucky: On some vehicles — Europeans in particular — the only way to re-enable the radio is to remove it from the vehicle, and send it back to the manufacturer to be reset.

So your best bet is to use the scan tool to clear codes whenever possible. If that isn't one of the choices, check your manual: There may be a fuse you can disconnect to clear the codes without affecting the rest of the vehicle. If all else fails, try disconnecting the computer itself — that should be just as good as disconnecting the battery, without affecting the other systems' memories.

Many vehicles won't allow you to clear codes from memory until you've read them. This is the system's way of telling you it's smarter than you are. Your best bet, after gesturing wildly and cursing the system, is to read the codes again. Then the system will allow you to clear the codes.

Ford P1000 Code — After disconnecting the computer or the vehicle battery on late-model Fords, you'll probably find a new code in memory: P1000. This code simply indicates that the computer lost power, and the vehicle hasn't been driven through a complete OBD-II Drive Cycle yet. Ford claims this code will require up to three consecutive Drive Cycles to clear this code.

Scan Tools (continued)

Trips and Drive Cycles

With the introduction of OBD-II, we've begun to introduce the concepts of *trips* and *drive cycles*. These are OBD-II terms that have specific meanings regarding vehicle operation and diagnosis.

An OBD-II trip is a series of driving conditions, during which the vehicle's diagnostic monitors meet their "enabling criteria." That is, each monitor meets the conditions necessary to perform its system checks. These include sensor monitors, heated oxygen sensor monitors, EGR monitors, evaporative monitors and so on.

It would be wonderful to be able to tell you the exact driving conditions that comprise a trip; unfortunately, they're different for each manufacturer (yes, we know it's OBD-II — we didn't make this stuff up!)

What *is* common from manufacturer to manufacturer is that the vehicle must start cold, and must go from cold to warm — about a 40° – 60° F increase. It must drive under different conditions, such as medium and hard accelerations, decelerations, and low and high speed cruise.

An OBD-II *drive cycle* is the same thing as a trip, with one additional condition: a long (90 seconds to 2 minutes) high speed cruise condition, after the system is fully warmed up. This provides the system with the time and conditions necessary to perform a catalytic converter monitor.

The system will only perform this monitor if the oxygen sensors pass their monitor; if not, the system will never go through a complete drive cycle. Here's an example of a typical OBD-II trip and drive cycle; the specific conditions will vary from manufacturer to manufacturer.

Example OBD-II Trip and Drive Cycle								
Driving Conditions	Start cold; warm engine to about 180° F (82° C)	Idle	Accelerate to 40 MPH at ¼ throttle	Steady throttle 30 – 40 MPH	Normal driving, 20 – 40 MPH (no WOT)	Decelerate and Idle	Accelerate to 55 MPH at ½ throttle	Steady throttle 40 – 60 MPH
Time	At least 4 minutes	45 seconds	About 10 seconds	60 seconds	4 minutes	10 seconds	10 seconds	60 seconds
	Misfire and Adaptive Fuel Monitors							Catalyst Efficiency Monitor
	Heated Oxygen Sensor Monitors							
	Comprehensive Component and EGR Monitor							
	OBD-II Trip							
OBD-II Drive Cycle								

While SAE standards do define the monitors that must take place, each manufacturer designs what constitutes its own "Trip" and "Drive Cycle." The only real difference is that a Drive Cycle includes the catalyst monitor; a Trip doesn't.

Scan Tools (continued)

Cause and Effect

Scan tools are a great way to read and clear codes. But let's face it: We were doing that with a jumper wire and a light on the dash for years. Reading the codes doesn't even begin to take full advantage of the scan tool's functions.

The real advantage of a scan tool is its ability to provide you with a comparison of cause and effect. Here's what that means:

You're looking for a pressure control system problem. You check these five data parameters:

1. Throttle Position Sensor signal
2. MAP sensor signal
3. Pressure control signal (in percent)
4. Pressure control desired
5. Pressure control circuit (amperage)

Both the TPS and MAP signals seem to be indicating load changes properly. The duty cycle of the pressure control solenoid corresponds to the pressure control desired signal. But the pressure control circuit remains at zero amps. What's wrong?

Well, the computer sees the load changes (cause), and it seems to be reacting properly to them (effect). But shouldn't we see a changing amperage signal at the pressure control solenoid?

Chances are there's an open in the pressure control circuit: either a broken wire, loose connection or an electrically-open solenoid. Any of these conditions will keep current from flowing through the pressure control solenoid circuit. And once again, we never left the driver's seat.

By examining the cause and effect for each action in the system, you can learn more from your scan tool, so you'll spend less time on diagnosis, and more time on fixing the problem.

Scan Tools (continued)

Record Functions

The toughest types of problems to diagnose are the ones that only show up occasionally... problems that don't occur in the shop, under controlled conditions. You know the ones: Everything seems fine during normal driving conditions. Until you're at $\frac{3}{4}$ throttle, and the unit shifts 2-3... and then goes right into failsafe.

This is another type of problem that a scan tool can help you find, because scan tools offer two types of record functions: freeze frame and snapshot (movie) modes.

Freeze Frame

Freeze frame is an automatic function required as part of OBD-II standards. Very simply, freeze frame grabs the readings taking place while the computer sets an emission-related code.

For example, suppose the EGR flow sensor indicates no EGR flow when the EGR is supposed to be open. The computer will set a code P0401 to indicate a problem with the EGR system. At the same time, freeze frame captures several key engine readings. In most cases, the system will capture these readings:

- Diagnostic Trouble Code (the one that set this freeze frame data)
- Engine RPM
- Barometer (estimated)
- Coolant Temperature
- Air Flow Rate
- Engine Load
- Short Term Fuel Trim
- Long Term Fuel Trim
- Injector Pulse Width
- Learn Factor
- Manifold Absolute Pressure (MAP)
- Loop Status
- Vehicle Speed

Some vehicles will provide more or less information, depending on the vehicle's configuration.

One limit of freeze frame data is that the system can only store data from one code at a time. If the system stores another code it may overwrite the data already stored in memory. Whether it will or not depends on the priority of the failure. A failure that will cause an emission level increase of about $1\frac{1}{2}$ times the federal test procedure limits has a priority level 3. A misfire will be a priority level 4.

A priority level 4 failure will overwrite anything previously in freeze frame memory. A priority level 3 failure will overwrite another priority level 3, but not a priority level 4.

But freeze frame data will only store for an emission related failure. To capture data on any other type of failure, you'll need to enable the snapshot function.

Scan Tools (continued)

Snapshot Function

Snapshot is a very versatile record function that allows you to capture a range of sensor data, based on a specific moment that you select.

Sometimes called “movie” or “flight record,” snapshot can be configured to begin recording when you want it to, and what parameters to record. On some scan tools, you can select a point, based on a range that lasts up to about a minute long. Then, when you activate the snapshot function, it records the range before and after that moment, based on your selection.

Lets use our previous example: You’re driving at $\frac{3}{4}$ throttle, the transmission shifts 2–3, and goes into failsafe. You trigger snapshot, and the unit captures up to a minute’s worth of data. That can be a minute before the moment you selected, a minute after, or anything in between.

On some scan tools, you can choose the trigger point. For example, you can set the trigger point midway in the range. Then, when you trigger snapshot, the computer stores 30 seconds before the trigger point, and continues to grab the next 30 seconds of data. And you can trigger snapshot manually, or set it to trigger when a diagnostic trouble code sets. Of course, this function isn’t available through all scan tools.

Then, once you get back to the shop, you can replay that data on the scan tool. The next few pages provide examples of snapshot data, from Chrysler, Ford and GM vehicles.

If you have a program that allows you to download the data to your computer, you can display the data in a
Continued...

SCAN TOOL DIAGNOSIS

Scan Tools (continued)

Snapshot Function (continued)

Example Snapshot Data; Chrysler

4th&LOCK UP, SEBRING

1997 CCD SYS ALL MODULE: TRANSAXLE

Frame:	-1	+0	+1	+2	+3	+4	+5
ENGINE RPM	1979	2044	2023	1822	1937	2020	2056
GEAR	4TH	4TH	4TH	4TH	4TH	4TH	4TH
TURBINE RPM	1985	2051	2023	1922	1940	2021	2066
PRNODL	O-D	O-D	O-D	O-D	O-D	O-D	O-D
OUTPUT RPM	2881	2978	2930	2786	2829	2936	2983
TPS (V)	1.17	1.11	0.84	1.00	1.29	1.25	0.86
TCC LOCKED	FULL	FULL	NO	NO	FULL	FULL	NO
TPS ANGLE(deg)	10	6	0	6	12	11	1
LIMP-IN	NO	NO	NO	NO	NO	NO	NO
OD PRESS SW	CLSD	CLSD	CLSD	CLSD	CLSD	CLSD	CLSD
C3 (V)	12.0	12.0	12.0	12.0	12.0	12.0	12.0
2-4 PRESS SW	CLSD	CLSD	CLSD	CLSD	CLSD	CLSD	CLSD
C4 (V)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L-R PRESS SW	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
TRANS TEMP(degC)	98	98	98	98	98	98	98
TRANS STATE	HOT	HOT	HOT	HOT	HOT	HOT	HOT
SWITCH BATT(V)	14.0	14.0	14.1	14.0	14.0	14.0	14.1
IGN CYCLES	9	9	9	9	9	9	9
J2 CIRCUIT(V)	12.0	12.0	12.0	12.0	12.0	12.0	12.0
PRNODL	O-D	O-D	O-D	O-D	O-D	O-D	O-D
VERSION NO.	16	16	16	16	16	16	16
C1 SWITCH	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
C2 SWITCH	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
C3 SWITCH	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
C4 SWITCH	CLSD	CLSD	CLSD	CLSD	CLSD	CLSD	CLSD

Continued...

Scan Tools (continued)

Snapshot Function (continued)

Example Snapshot Data; Ford

4th&lockup,w/slow epc communicato 1997 FORD CA 3.0L V6 - EECV SEFI

Frame:	-3	-2	-1	+0	+1	+2	+3
RPM	2365	2282	2257	2261	2280	2291	2305
TP (V)	1.44	1.40	1.58	1.56	1.50	1.42	1.46
DTC CouNT	1	1	1	1	1	1	1
TCC (%)	39.5	48.7	56.5	97.9	102.4	102.4	102.4
ElecPrsCtrl (PSI)	36	36	37	37	38	38	38
EPC (V)	8.99	8.78	8.97	9.03	8.85	8.96	8.91
TCCA (V)	0.38	0.20	0.42	0.44	0.19	0.35	0.35
TCCMACT (RPM)	124	69	2	2	2	1	2
TrnFluidTmp (V)	0.91	0.91	0.90	0.90	0.90	0.90	0.90
ThrPosMODE	P/T	P/T	P/T	P/T	P/T	P/T	P/T
GEAR	DRIVE4	DRIVE4	DRIVE4	DRIVE4	DRIVE4	DRIVE4	DRIVE4
TrnRange	O/D	O/D	O/D	O/D	O/D	O/D	O/D
TrnRange (V)	1.67	1.67	1.67	1.67	1.67	1.67	1.67
TRIP CouNT	0	0	0	0	0	0	0
TurbSpdS (RPM)	2057	2066	2082	2094	2110	2121	2138
VehSpdSnsr (MPH)	57	58	58	58	59	59	60
CASeGND (V)	-0.145	-0.145	-0.154	-0.154	-0.154	-0.164	-0.154
BrakeOnOff	OFF	OFF	OFF	OFF	OFF	OFF	OFF
CoastClSol	OFF	OFF	OFF	OFF	OFF	OFF	OFF
CCSFault	NO	NO	NO	NO	NO	NO	NO
ParkNeuPos	GEAR	GEAR	GEAR	GEAR	GEAR	GEAR	GEAR
ShiftSol1	ON	ON	ON	ON	ON	ON	ON
ShiftSol2	ON	ON	ON	ON	ON	ON	ON
ShiftSol3	ON	ON	ON	ON	ON	ON	ON
TrnAxleLRN	ON	ON	ON	ON	ON	ON	ON
TrnCtrlIndLamp	OFF	OFF	OFF	OFF	OFF	OFF	OFF
TCILFault	YES	YES	YES	YES	YES	YES	YES
TrnCtrlSw	ON	ON	ON	ON	ON	ON	ON
TCCFault	NO	NO	NO	NO	NO	NO	NO
TRACtionassist	OFF	OFF	OFF	OFF	OFF	OFF	OFF
TRIP	NO	NO	NO	NO	NO	NO	NO

Continued...

Scan Tools (continued) **Snapshot Function (continued)**

Example Snapshot Data; General Motors

3rd & lockup

1997 CHEVROL 4.3L V6 CHEVY CSFI

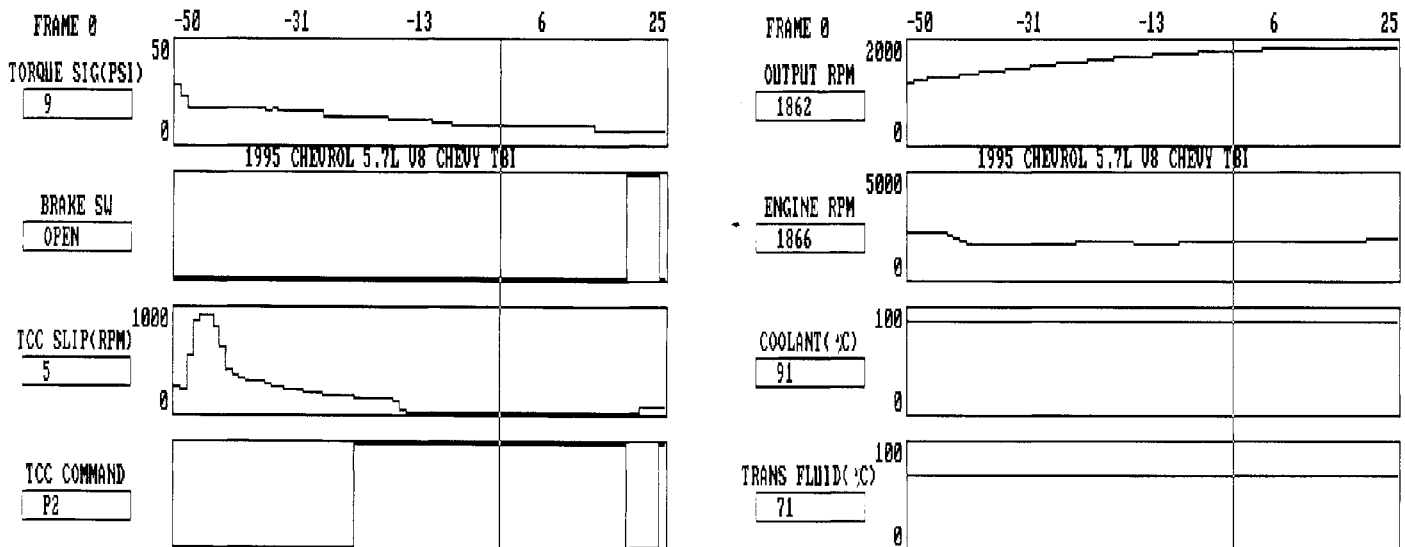
Frame:	-3	-2	-1	+0	+1	+2	+3
RPM	1867	1880	1894	1916	1936	1942	1968
TPS (V)	1.58	1.58	1.58	1.58	1.58	1.58	1.58
TPS (%)	29	29	29	29	29	29	29
TRANS FLUID(degC)	83	83	83	83	83	82	82
TRANS FLUID(V)	2.29	2.29	2.29	2.29	2.29	2.30	2.30
MAP ("Hg)	23.2	23.2	23.1	23.1	23.0	22.8	22.7
MAP (V)	3.59	3.59	3.57	3.57	3.55	3.54	3.52
4WD ACTIVE	NO	NO	NO	NO	NO	NO	NO
4WD LOW SW	OFF	OFF	OFF	OFF	OFF	OFF	OFF
BRAKE SW	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
HOT MODE	NO	NO	NO	NO	NO	NO	NO
TCC DUTY CYCLE	90	90	90	90	90	90	90
TCC SLIP (RPM)	2	1	-1	4	-7	-3	-3
TCC ENABLED	YES	YES	YES	YES	YES	YES	YES
PWR TAKE OFF SW	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1-2 SHIFT (SEC)	0	0	0	0	0	0	0
1-2 ERROR (SEC)	0	0	0	0	0	0	0
2-3 SHIFT (SEC)	0	0	0	0	0	0	0
2-3 ERROR (SEC)	6	6	6	6	6	6	6
3-4 SHIFT (SEC)	0	0	0	0	0	0	0
3-4 ERROR (SEC)	6	6	6	6	6	6	6
1-2 SOL OPEN	NO	NO	NO	NO	NO	NO	NO
1-2 SOL SHRT	NO	NO	NO	NO	NO	NO	NO
2-3 SOL OPEN	NO	NO	NO	NO	NO	NO	NO
2-3 SOL SHRT	NO	NO	NO	NO	NO	NO	NO
3-2 SOL OPEN	NO	NO	NO	NO	NO	NO	NO
3-2 SOL SHRT	NO	NO	NO	NO	NO	NO	NO
TCC ENABLE OPEN	NO	NO	NO	NO	NO	NO	NO
TCC ENABLE SHRT	NO	NO	NO	NO	NO	NO	NO
TCC OPEN CKT	NO	NO	NO	NO	NO	NO	NO
TCC SHRT CKT	NO	NO	NO	NO	NO	NO	NO

Continued...

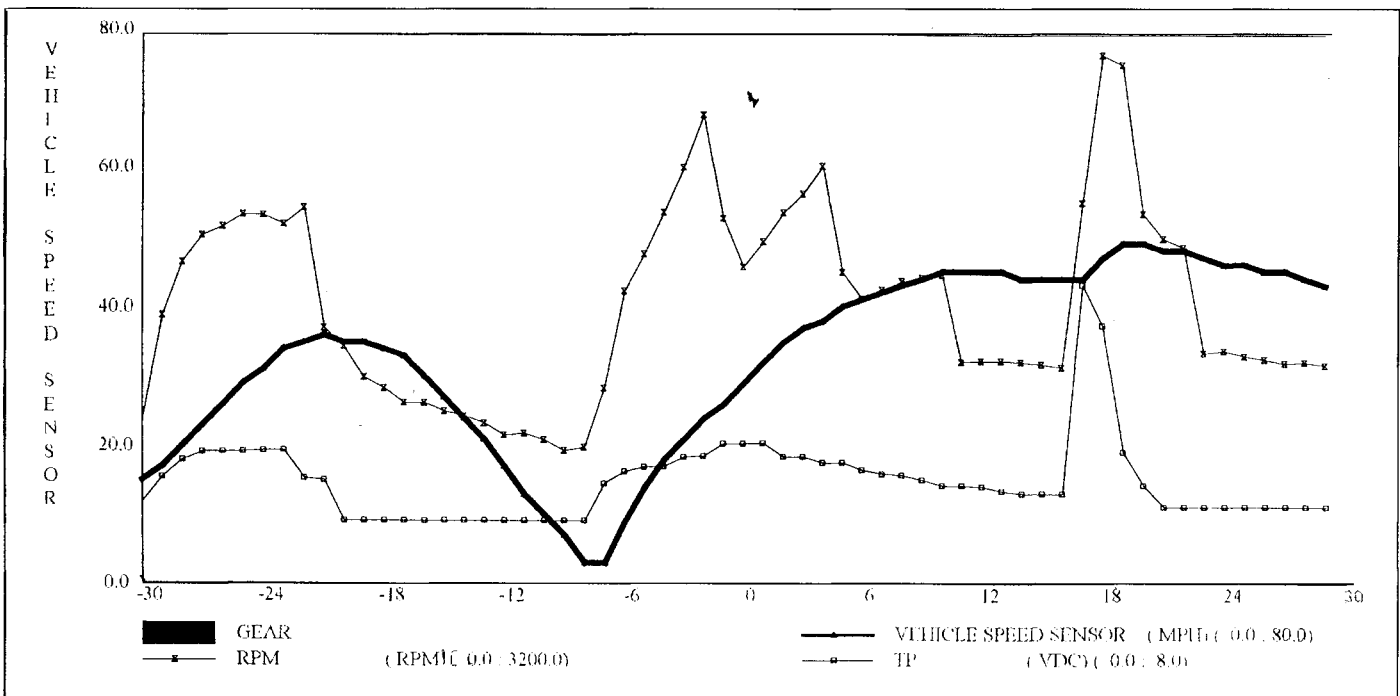
Scan Tools (continued)

Snapshot Function (continued)

If you have a program that allows you to download the data to your computer, you can display the data in a graphic format.



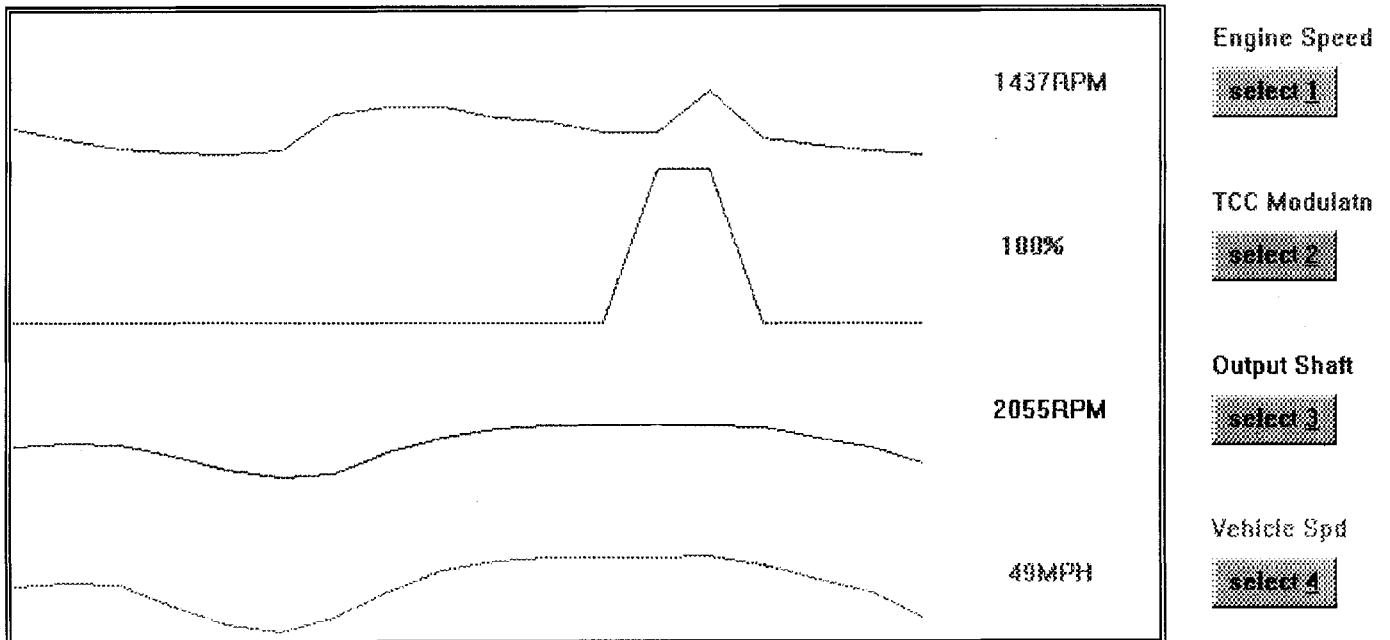
Using an appropriate computer program, you can download scan tool information to a basic PC, and compare a wide range of parameters in a graphic format. This can make finding some problems much easier than simply examining individual readings on the scan tool's display.



Continued...

Scan Tools (continued)

Snapshot Function (continued)



Each scan tool manufacturer offers its own brand of graphical conversion software, to enable you to download the scan tool data, and display it on a common PC.

Using snapshot, you can examine the sensor inputs and computer commands you choose, as the system approached the moment it went into failsafe. This enables you to determine the precise moment and conditions for entering failsafe, so you can diagnose the problem more easily.

Scan Tools (continued)

System Actuator Tests

Another test procedure that scan tools allow you to perform is to actuate certain computer output devices, such as solenoids and relays. From that you can determine if the problem is in the computer, the output circuit, or the inputs the computer receives to control the system operation.

For example, suppose the converter clutch isn't operating. The problem could be the converter clutch solenoid, the computer itself, or the inputs the computer uses to determine when to apply the converter clutch.

The scan tool can help you isolate the problem through its actuator tests. Just choose the TCC solenoid actuator test. If the computer and TCC circuit are okay, you should hear the TCC solenoid click. While the circuit is active, you can use your scope or digital voltmeter to check the circuit operation.

If the circuit operates properly with the scan tool, you know the computer's capable of operating the TCC solenoid. The problem can still be in the mechanical part of the solenoid, the hydraulic lockup system in the transmission, or external, computer-related sensors. But the actuator tests allow you to eliminate the computer driver, the solenoid coil and the wiring between them, right off the bat.

If the solenoid circuit won't operate from the scan tool, you're looking at a problem with the solenoid, its circuit, or the computer itself. You can troubleshoot and isolate the problem while the scan tool keeps the circuit active.

Some scan tools can activate nearly every computer output, from cooling fans to transmission solenoids. Just select the appropriate solenoid, activate it, and check its operation.

Manufacturer Specific Scan Testing

While many scan tool features — such as code retrieval and computer system data — are relatively universal, there are some functions that are specific to individual manufacturers.

In some cases, that's because the manufacturer determined a necessity for that information or feature, and included it in the computer system. In other cases, such as Chrysler's Clutch Volume Index, it's simply a matter of the difference in how the manufacturer's system operates.

In still other cases, it has to do with the individual scan tool, and how much information the vehicle manufacturer provided to the scan tool manufacturer.

We're going to look at some of the more common and more useful test procedures provided for each of the domestic manufacturers, and see how that information can be useful for diagnosing transmission operation.

Chrysler Specific Scan Tool Tests

Chrysler RPM Display

To determine transmission efficiency, the computer compares three different RPM readings: engine, turbine shaft and output shaft. By comparing these readings, the computer can identify gear ratio, measure shift time, and recognize a slip in one of the clutches.

For example, by comparing the turbine shaft speed to the output shaft, the computer can calculate the gear ratio (except for the ratio of the transfer gears and final drive). Or by comparing the engine RPM to the turbine shaft, the computer can measure converter slip.

Some scan tools allow you to read these RPM levels together, so you can compare them the same way the computer does. Called RPM Display, this test can be useful for identifying problems that set a “clutch slipping” code.

Chrysler Quick Learn

To provide the best performance for the driver, Chrysler’s computer system is designed to compensate for variations in the clutch apply time. This compensation shows up as the Clutch Volume Index, or CVI.

But if you clear the system memories, or the system loses power, the clutch volume levels are cleared as well. In that case, the computer reverts to a series of base readings:

- Low/Reverse Clutch — 64
- 2–4 Clutch — 48
- Overdrive Clutch — 89
- Underdrive Clutch — 45

NOTICE 1995-and-later vehicles, or vehicles with a 1995-or-later updated controller, have nonvolatile memory. They won’t reset the CVI readings if the computer loses battery power.

How can you “retrain” the computer? One way is to drive the vehicle through a specific series of conditions. After a while, the system will retrain itself. But that make take some time, and the shift quality will be noticeably poor, for a while.

On 1993-and-later vehicles, you can select Quick Learn through your scan tool. Quick Learn forces the system to make some coarse adjustments very quickly, by following a drive cycle laid out in the computer.

Just select Quick Learn, and follow the prompts on the display. The vehicle’s computer system will relearn the Clutch Volume Index quickly, and shift quality will return nearly to normal.

Of course, Quick Learn only provides a coarse adjustment; over time the system will continue to fine-tune its adjustments, to provide optimal shift quality. This will be based not only on the clutch wear, but also on such factors as the solenoid operation and even the owner’s driving habits.

Chrysler Specific Scan Tool Tests (continued)

Chrysler Clutch Volume Index (CVI)

The Clutch Volume Index is basically a measurement of how long it takes the system to fill each individual clutch pack in the 41TE transaxle and others in its family.

As you know, this transaxle is a bit different from most others in that the solenoids actually provide the fluid directly to each clutch, instead of simply moving a valve.

By comparing the moment it begins feeding apply pressure to the clutches, to the RPM signals from the turbine and output shafts, the computer can determine exactly how long the shift takes, from beginning to end. From this, the computer can determine a clutch fill time for each clutch pack. But remember, this is just a measurement of time, not actual wear. The apply time can be influenced by much more than clutch wear: system pressure, fluid viscosity and leaks in the system can all affect the clutch apply time, too. Each measurement is based on a computer stepper scale of 256 steps.

Based on the clutch fill time information, the transmission computer can now adjust the apply pressures to each clutch pack, to assure a smooth, clean shift for each gear range.

When the transaxle is in good working order, the Clutch Volume Index should fall within these ranges:

Fill Volume			
L/R	Low 0 – 34	Normal 35 – 83	High 84 – 255
2/4	Low 0 – 19	Normal 20 – 77	High 78 – 255
OD	Low 0 – 74	Normal 75 – 150	High 151 – 255
UD	Low 0 – 23	Normal 24 – 70	High 71 – 255

Chrysler Specific Scan Tool Tests (continued)

Chrysler Clutch Volume Index (continued)

If the Clutch Volume Index falls within normal levels, the clutches are applying at the proper rate, so the computer assumes they're in good shape. If the CVI is longer than these readings, suspect worn clutches or excessive clutch clearance.

If the Clutch Volume Index is shorter than those listed, suspect the clutch clearance as being too tight. This is more common immediately after a rebuild, but can indicate a warped or damaged clutch plate.

But don't forget, Clutch Volume Index is based on apply time: Anything that could affect that apply time can also cause the Clutch Volume Index to vary, including leaks in the apply circuit, a solenoid problem or a fluid restriction, to name just a few.

Setting the Clutch Volume Index

Here's when the computer tests the clutch volume index for each clutch circuit:

- Low/reverse — during a forced 2–1 or 3–1 downshift, with the transmission fluid between 70° – 100° F.
- 2/4 — during a 1–2 shift, and the transmission fluid is above 80° F.
- OD — during a 2–3 shift, and the transmission fluid is above 80° F.
- UD — during a forced 4–3 or 4–2 downshift, with the transmission fluid above 80° F, or during initial drive engagement (1995-and-later only).

Chrysler Specific Scan Tool Tests (continued)

Chrysler Battery Disconnect

Battery replacement used to be a simple task. But today, thanks to the different memories and learning factors in the vehicle's computer systems, disconnecting the battery can cause any number of problems.

That's why some scan tools offer a Battery Disconnect function as part of their diagnostic capabilities. This function effectively disconnects battery power from the transmission computer, allowing all memories and learn factors to clear. But at the same time, it leaves power to all of the other computers and systems on the vehicle, so you won't lose the seat memories, digital clock, radio presets, etc.

Just select Battery Disconnect: The scan tool disconnects all power from the transmission computer, for just enough time to clear the memories. Then it reinitializes the computer, so you can perform the necessary Quick Learn functions.

Remember, disconnecting the battery won't clear the memories or CVI on 1995-and-later computers.

Chrysler EMCC Reset

Some Chryslers built in 1992, and all subsequent models, have an Electronically Modulated Converter Clutch (EMCC) to control the operation and feel of the converter clutch. Between 1992 and 1995, the EMCC controlled the converter clutch slip rate. Since then, the system has taken more of a back seat, taking effect only if the system indicates an overheating problem.

To operate properly, the EMCC must go through a 1500-mile break-in cycle after major system repairs or a new computer installed. Choose "EMCC Reset" to reset the cycle to zero.

During the first 500 miles of the break-in cycle, the converter clutch won't operate at all. Over the next 1000 miles, the computer will begin pulsing the converter clutch circuit, to bring the slip from 200 RPM down to about 50 RPM. After the 1500-mile break-in, the EMCC will operate normally.

Your scan tool will indicate the status of the break-in cycle: It will either be *In Progress*, meaning the 1500-mile breaking cycle is still being performed, or *Complete*.

Chrysler Pinion Factor

Like most manufacturers, early Chryslers use a vehicle speed sensor to measure vehicle speed; beginning in 1993, vehicles interpret this reading from the output sensor signal.

The 1993-and-later systems work great for determining vehicle speed, provided the computer is aware of the proper transfer shaft ratio, differential gear ratio, and tire size. Called the Pinion Factor, this is the divisor the computer uses to convert the output sensor signal pulses into miles.

The pinion factor is programmed into the transmission computer when the vehicle is built. But if the transmission computer is replaced, you must have the Pinion Factor recoded with a scan tool. Otherwise the transmission computer won't know how to convert the pulse signal from the output speed sensor into an actual vehicle speed; the speedometer won't work, and the transmission won't shift.

Until late 1998, Pinion Factor was only available through factory scan tools. This feature is now available through some aftermarket scan tools.

GM Specific Scan Tool Tests

GM Reset Adapts

GM transmissions with electronic pressure control learn to adapt to wear in the transmission, and the driving characteristics of the driver. These memories have to be cleared after any major repair to the transmission, to enable the system to relearn for the new conditions.

These systems store three different adaptations in memory:

Upshift Adapt — Controls line pressure during the shifts, to control the time for the shift to take place, which determines shift feel.

Steady State Adapt — Controls line pressure to prevent a slip while in gear, with the throttle held at a steady level.

Garage Shift Adapt — Controls line pressure during initial engagement to provide a smooth apply.

Most scan tools allow you to clear these memories easily. Simply select the adapt you want to erase and clear it through the keypad.

GM Transmission Learn TAPS (Transmission Adaptive Pressure)

Like most other electronically controlled transmissions, GM transmissions with electronic pressure control will learn to adapt for wear in the unit or driver's characteristics. After any major repair, these adapts should be cleared and reset.

Once you've cleared the transmission adapts, you have a choice: You can use the Learn TAPS (Transmission Adapts) function, or you can simply drive the vehicle, and allow it to adapt on its own. Adapting normally can take several hours of driving, during which the trans may experience harsh or sloppy engagements and shifts.

But your scan tool offers a Learn TAPS function, that will reduce the learning time dramatically. Just follow the prompts on the display to work through the procedure. This will enable the computer to develop a rough set of adapt parameters, so the transmission will work fairly well. From there, the system will continue to adapt to the individual driver and the vehicle itself through normal operation.

GM Specific Scan Tool Tests (continued)

GM Transmission Shift and Pressure Tests

Some scan tools will actually allow you to override the transmission computer, and signal the transmission to shift from one gear to the next.

This is very much like some of the transmission testers on the market, with one notable difference: The transmission testers bypass the computer, and signal the transmission to shift directly. A scan tool tells the computer to shift the transmission; the computer actually provides the signals to shift the trans.

This is an important difference, because if the transmission shifts from a transmission tester, it could still have a problem in the computer or the wiring to the transmission. But if the unit shifts from a scan tool, it tells you the computer is capable of developing the signals to shift the transmission. More than likely the computer isn't getting the signals it needs to determine when to shift the transmission.

In addition, some scan tools provide control of the force motor or pressure control solenoid (PCS). By changing the settings, you can compare the signal you're sending to the actual pressure in the transmission. From this you can help isolate pump problems or circuit leaks.

GM RPM Control

Sometimes it's necessary to hold the engine RPM at a steady speed. A common reason is for checking transmission pressures; the specifications usually depend on a specific engine RPM.

More often than not, techs end up trying to hold the throttle steady, while watching a tachometer and a pressure gauge at the same time. And the odds of them holding the throttle accurately are slim... at best.

Your scan tool provides an RPM control function that enables you to set engine RPM precisely, so that you can perform these tests accurately. In this setting, a simple press of the up or down keys allows you to raise or lower the RPM. And at the same time, the scan tool shows you the RPM it's trying to maintain, so you can use this feature to identify idle control problems, too.

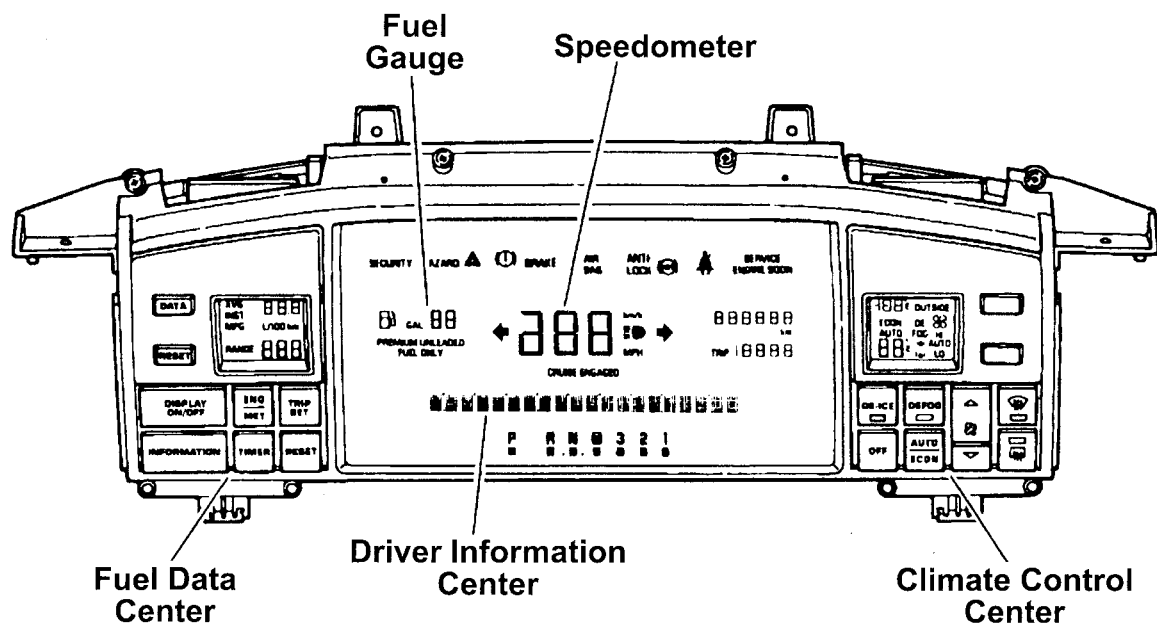
But some scan tools will only hold the RPM for a limited time (5 seconds or so), and only while the vehicle is stopped.

GM Specific Scan Tool Tests (continued)

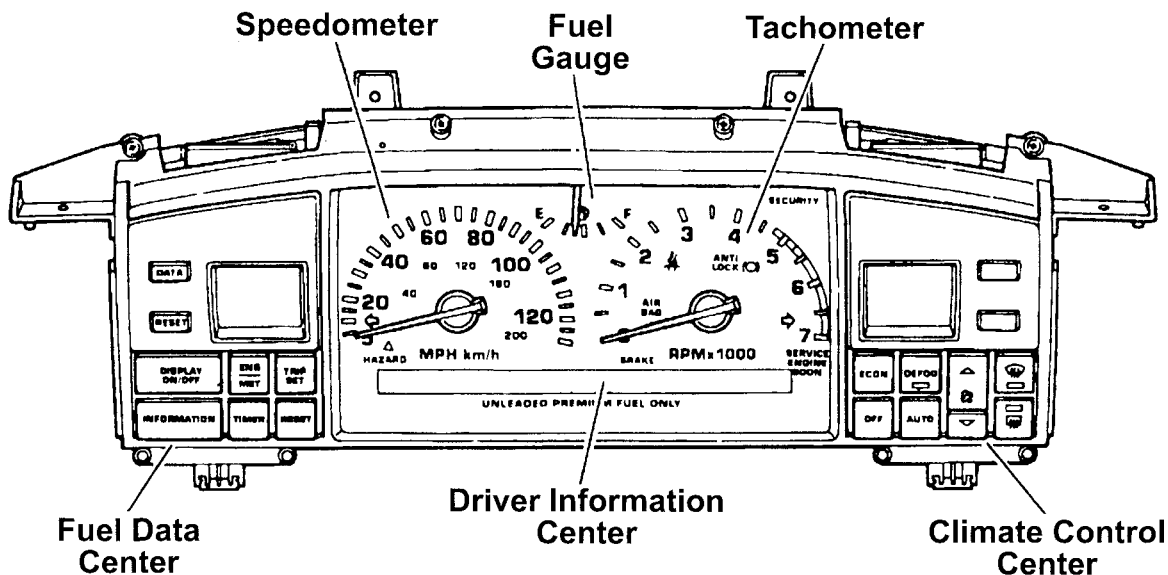
Northstar 4.6L Diagnostic Procedures

These systems are divided into two groups: 1993 through 1995, and 1996 through '98. The first group has more complete self-diagnosis capability. Unfortunately, General Motors has restricted the level of diagnostics on the 1996 through 1998 models; you must obtain most of the data with a scan tool on these models.

There are two important points you should understand about these systems. First, there are two types of gauges and control panels used: analog and digital. Some of the diagnostic routines will vary slightly, depending on what type you're working on. Second, the number and type of computer modules differ from year to year — mostly between the two groups.



Northstar-equipped vehicles come with two styles of instrument panel: digital and analog.



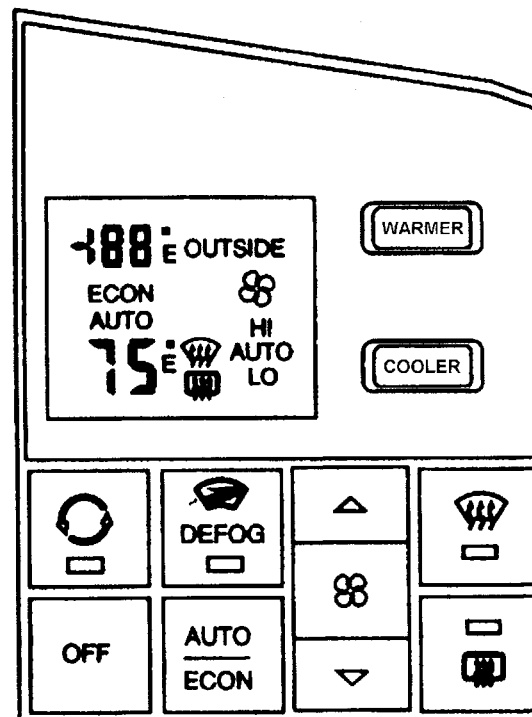
GM Specific Scan Tool Tests (continued)

Northstar 4.6L Diagnostic Procedures (cont)

1993 Through 1995 Models

To enter the diagnostic routine, press the *OFF* and *WARMER* buttons at the same time (this is the same method for entering *all* previous systems). *All* of the LEDs in the Instrument Panel Cluster (IPC) and Climate Control Center (CCC) will light. This confirms that all of the LED segments are working. It will also go through a list of the modules, and display any stored diagnostic trouble codes (DTCs) through the Driver Information Center (DIC). At this point there are several hundred different things you can check.

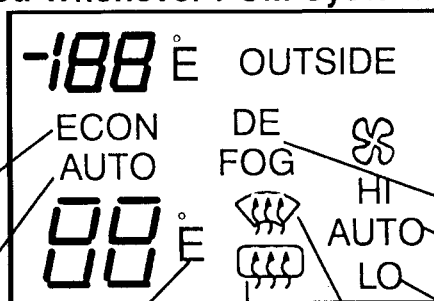
The driver information center will now display "PCM?". This is your cue to enter PCM diagnostics: To do so, simply press the *HI* fan button on the Climate Control Center. If you want to go to a different module, press the *LO* fan button; then a cue for another module will appear, such as "IPC?". Once you select a module, you can scroll through the selections by pressing the *LO* fan button.



You can enter the diagnostic mode by pressing the OFF and WARMER buttons at the same time. The system will display its diagnostic information through the climate control display.

PCM STATUS LIGHTS

Displayed Whenever PCM System Is Selected.



INDICATOR	ECON	AUTO	°E	REAR DEF. 	FRONT DEF.	LO	AUTO	DEFOG
LIGHT ON	ENERGIZED	CLOSED LOOP	DISABLED	ENABLED	ENERGIZED	CLOSED	P/N	ENERGIZED
LIGHT OFF	DE-ENERGIZED	OPEN LOOP	ENABLED	DISABLED	DE-ENERGIZED	OPEN	NOT P/N	DE-ENERGIZED
FUNCTION	TRANSAXLE SHIFT 'B' SOLENOID	PCM OPERATING MODE (LOOP)	TRANSAXLE SHIFT ADAPT STATUS	TCC OUTPUT	A/C CLUTCH COMMAND	THROTTLE POSITION SWITCH	TRANSAXLE RANGE SWITCH	TRANSAXLE SHIFT 'A' SOLENOID

GM Specific Scan Tool Tests (continued)

Northstar 4.6L Diagnostic Procedures (cont)

1993 Through 1995 Models (continued)

There are six selections to choose from:

- DATA
- INPUTS
- OUTPUTS
- OVERRIDE
- CLEAR CODES
- SNAPSHOTS

Here's a brief overview of these features.

DATA — Offers live information on selected sensor inputs and module outputs. Use the *HI* and *LO* fan buttons to scroll through the options.

INPUTS — This mode requires a response. The system will respond to your input by displaying either “HI” or “LO.” It will also display a “0” until you begin the test; then it will display the test results. For example, “P170” is the cruise control brake switch test. The system displays a “HI” with the pedal up, and “LO” when you press the pedal. Then the display will show “P171,” which is your cue to test the TCC brake switch. Keep in mind, some tests will begin with “LO” and then switch to “HI” as you perform the test.

OUTPUTS — This test is done with the key on, engine off. Use the *HI* and *LO* fan buttons to scroll to the desired test. The module will then cycle that component on and off. It will report the status by displaying “HI” (on) or “LO” (off).

OVERRIDE — This selection allows you to operate certain devices manually, while the vehicle is operating. For example, if you want to shift the transaxle manually, you would scroll to “PS11” (by pressing the *HI* and *LO* buttons). Then press the “cooler” button for upshifts and the “warmer” button for downshifts. You can also control the converter clutch and pressure control solenoids.

CLEAR CODES — You can clear diagnostic trouble codes simply by pressing the *HI* fan button.

SNAPSHOT — This mode will capture a series of frames of information based on certain criteria. There are three types of snapshots available: Code Set, On-Board Diagnostics, and Customer.

- *Code Set* occurs when a diagnostic trouble code is stored in memory. This stores the output from any sensors pertinent to that code.
- *On-Board Diagnostics* snapshots are stored in diagnostic mode. When the snapshot feature is armed, simply press the *HI* fan button, and the system will record all current sensor activity. This is great for isolating intermittent problems.
- *Customer* snapshots are very helpful when the problem is so intermittent that only the customer experiences it once in awhile. This mode is put into action by having the customer press the *OFF* and *FRONT DEFROST* buttons simultaneously. The “Service Engine Soon” light will come on for two seconds, confirming the snapshot was taken. Now you can view the sensor activity surrounding the fault the next time the customer comes into your shop.

GM Specific Scan Tool Tests (continued)

Northstar 4.6L Diagnostic Procedures (cont)

1993 Through 1995 Models (continued)

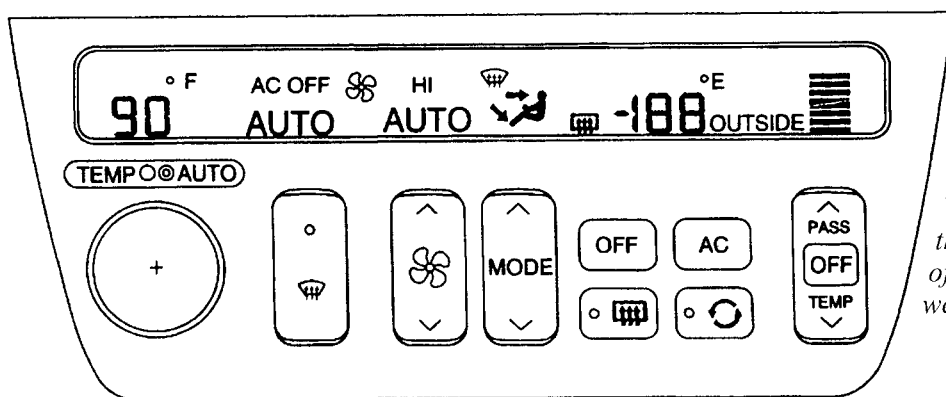
View the snapshot by pressing the *HI* and *LO* fan buttons until you reach "PCM SNAP DATA." Pressing the *HI* fan button puts you into what looks like the PCM data mode. Use it as you would the PCM data mode, scrolling through the parameters until you find the one you want.

CAUTION Never initiate the on-board snapshot function once the customer has recorded a snapshot: This will erase the customer snapshot. This feature can seem a little confusing at first.

There is one more important feature to the self-diagnostic tests available: the PCM status lights. The PCM status lights display anytime you select *PCM* in the self-diagnostic mode. The lights on the climate control center will cycle as the computer activates certain devices. This is particularly useful for transmission technicians. With this feature you can monitor eight devices, including shift solenoid status and TCC output.

1996 Through 1998 Models

Most of the on-car tests have been eliminated; you must use a scan tool for them. You can still go into the diagnostic mode by pressing the *OFF* and *WARMER* buttons (digital dash), or *OFF* and *PASSENGER TEMP* (analog dash). It will now deliver any stored diagnostic trouble codes.



You can still retrieve codes on these vehicles until 1998, but all of the other diagnostic functions were eliminated in 1996.

But 1996-and-later vehicles use OBD-II diagnostic trouble codes. There are more modules on these vehicles, but all of the tests for the PCM have been eliminated.

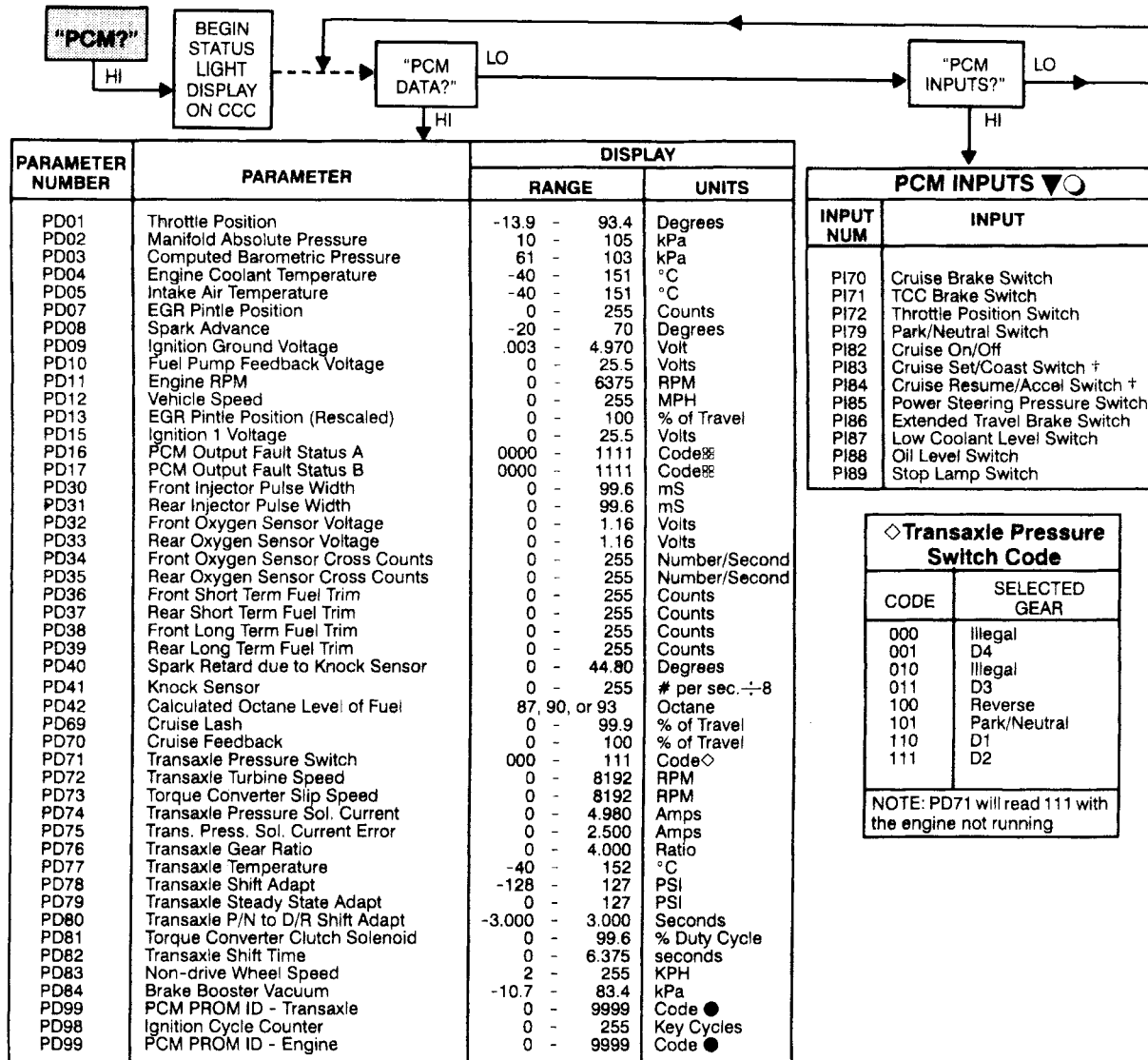
One nice feature: Customer snapshots are still available by pressing the *OFF* and *FRONT DEFROST* buttons simultaneously. But you still have to use a scan tool to retrieve them.

In 1998, all on-board features have been eliminated, except the customer snapshot.

GM Specific Scan Tool Tests (continued)

Northstar 4.6L Diagnostic Procedures (cont)

1993 Through 1995 Models (continued)



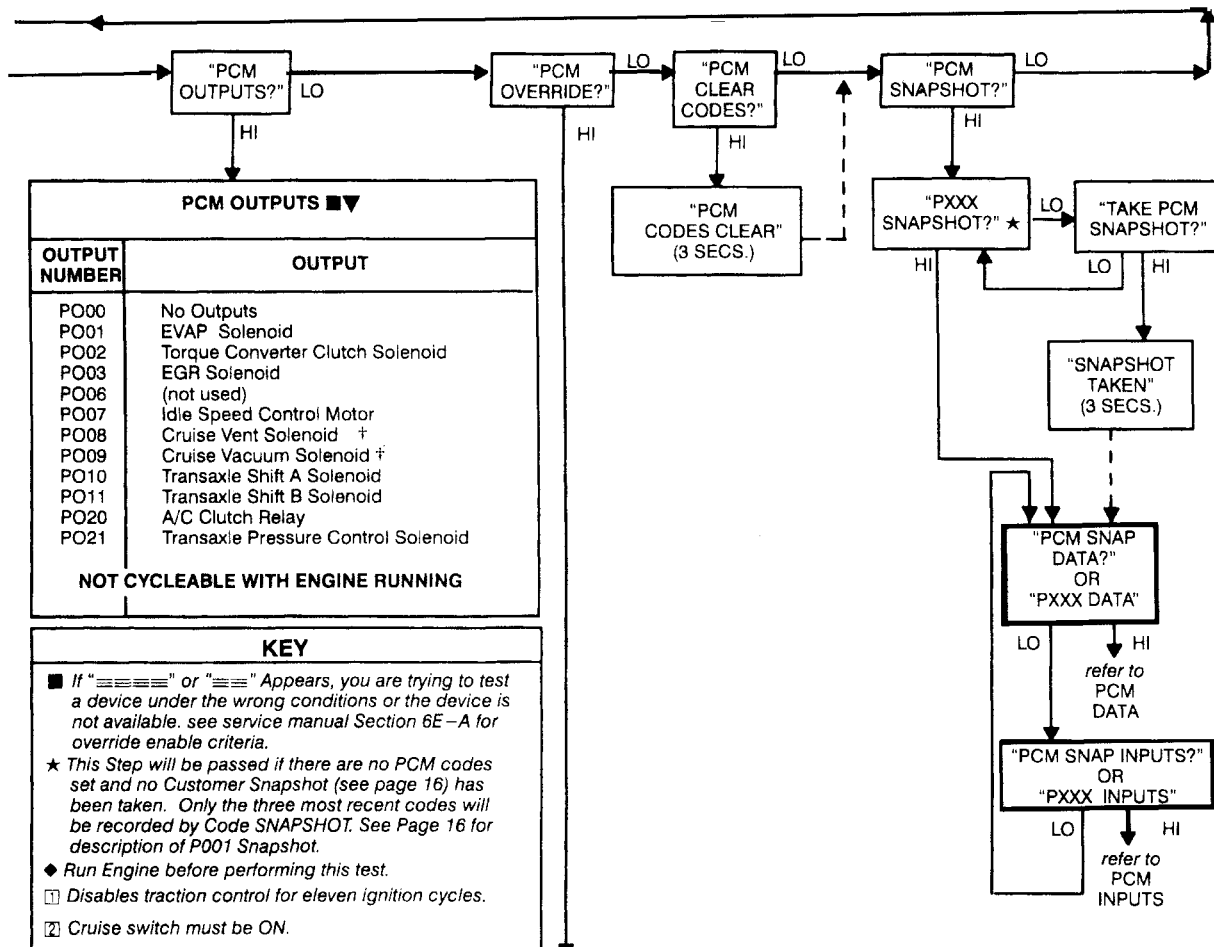
PCM Output Fault Status		
PARAM.	STATUS A	STATUS B
1st Digit	TCC Sol/Engine Temp Lite	Shift 'A'/Shift 'B'
2nd Digit	EGR/EVAP/Starter Inhibit	Injectors
3rd Digit	Cooling Fans/Service Engine Soon MIL	Generator
4th Digit	A/C Clutch/Delivered Torque/RSS Lift/Drive	Not Used

KEY	
To Select Another Test Within A Particular Test Type Press:	
Hi - To Increment	
Lo - To Decrement	
▼ "HI"	= High Signal Voltage
"LO"	= Low Signal Voltage
○ "O"	= Input Same Since Displayed
"X"	= Input Changed Since Displayed
● PROM ID Code Number Identifies An Individual Calibration And Is Periodically Updated; Refer To Latest Service Publication For Correct ID Number.	
† Switch Cruise ON Before Testing	

GM Specific Scan Tool Tests (continued)

Northstar 4.6L Diagnostic Procedures (cont)

1993 Through 1995 Models (continued)



PCM OVERRIDE ■		
OUTPUT OVERRIDE NUMBER	OUTPUT OVERRIDE	OVERRIDE ACTION COOLER WARMER
PS00	No Override	Off On
PS01	Torque Converter Clutch Solenoid	Decrease Increase
PS02	EGR Solenoid	Retract Extend
PS03	ISC Motor	Disable Select
PS04	Injector Disable (1 thru 8)	Off On
PS05	Fuel Pump Relay	Release Pull In
PS06	AIR Pump (not used)	Low Speed High Speed
PS07	Cruise Control Servo◆ ②	Fan Relay Fan Relay
PS08	Cooling Fan Relay	Retard Advance
PS09	Temporary Spark Advance	Select Test
PS10	Injector Flow	Upshift Downshift
PS11	Transaxle Override	Reset No Action
PS12	Long Term Fuel Trim Reset	Reset Learn Reset Adapt
PS13	TP Sensor & Idle Learn/Garage Shift Adapt Reset	Reset Shift Reset Steady
PS14	Transaxle Shift/Steady State Adapt Reset	Decrease Increase
PS15	Transaxle Oil Life	Decrease Increase
PS20	Transaxle Pressure Control	Advance No Action
PS21	Knock Sensor Test	Retard Advance
PS22	Permanent Spark Retard	Off On
PS23	Generator	Enable Disable
PS24	Traction Control Disable ①	

GM Specific Scan Tool Tests (continued)

Northstar 4.6L Diagnostic Procedures (cont)

1996 Through 1998 Models (continued)

Computers, Controllers, Modules	Vehicle Years					
	1993	1994	1995	1996	1997	1998
Air Conditioning Programmer (ACP)						
Air Control Module (ACM)						
Body Control Module (PZM)						
Cellular Telephone (PHN)						
Climate Control Panel (CCP)						
Instrument Panel Cluster (IPC)						
Integrated Radio Control Module (IRC)						
Powertrain Control Module (PCM)						
Real Time Dampening (RTD)						
Remote Function Actuator (RFA)						
Road Sensing Suspension (RSS)						
Sensing and Diagnostic Module (SDM)						
Supplemental Inflatable Restraints (SIR)						
Traction Control System (TCS)						



The computer listed appears in this year vehicle.

Here's a list of some of the different computers, controllers and modules that can appear during a computer system diagnosis. Some can affect transmission operation; others will have no effect whatsoever.

Ford Specific Computer System Tests

Understanding Ford Codes

With most manufacturers, a diagnostic trouble code is either there or it's not. To determine whether a code indicates a problem that's there now or is just a shadow from memory, you clear the codes and see if any return.

It should come as no surprise that Ford's a little different. But this time, that's a good thing, because Ford provides a lot of information through its codes. Depending on where the code appears, you can determine whether the problem is stored in memory or taking place right now. You can even tell if it only occurs with the engine running, or caused by a loose connection, just by using the Ford procedures.

Of course, these codes and procedures just apply to EEC-IV systems: EEC-V is OBD-II, and so it conforms to the OBD-II diagnostic procedures and standards — at least as much as any other manufacturer.

On-Demand vs Continuous Memory

To begin with, Ford offers two different types of codes: On-Demand and Continuous Memory.

On-Demand codes indicate a problem that's taking place right now. They don't store in memory; shutting the key off erases all On-Demand codes. So if you see an On-Demand code, you know there's a problem going on now. These are the first codes you should look into when working on a Ford diagnosis.

Continuous Memory codes are stored in memory. They could indicate a condition that's taking place now, but it's just as likely that they indicate something that took place two weeks ago, and hasn't occurred since.

So how can you tell whether a problem is there now? Easy: In most cases, problem that's taking place right now will appear in the On-Demand codes. If the problem only shows up in the Continuous Memory codes, there's an even chance you're looking at an intermittent problem, so it may not show up during normal diagnostic procedures. But that's okay: Ford also offers a couple of other test procedures, to help you find those intermittent problems.

Separator Codes and Pass 11 (or 111) Codes

Not all codes indicate a problem: Some just tell you where you are in the diagnostic procedure; others indicate there's no problem showing up in the system.

A separator code is a code that indicates that one part of the diagnostic procedure is finished, and you're ready to move on to the next part. In some cases, it's an indicator for you to perform a certain procedure; in others, it's just there to tell you when one test is over.

Ford's separator code is 10. After displaying any On-Demand codes, the system displays code 10 to indicate the On-Demand codes are finished, and the system is preparing to display the Continuous Memory codes.

Pass 11 (or Pass 111) codes indicate there are no codes to be displayed for a particular test. This lets you know the system is working properly: A lack of any code, including a pass code, indicates the system isn't able to display codes. By adding a "pass" code, Ford is telling you the test was completed, and there are no codes for the procedure.

Ford Specific Computer System Tests (cont)

KOEO vs KOER

If supplying two different types of code wasn't enough, Ford also offers two different ways of retrieving the codes: Key On, Engine Off (KOEO); and Key On, Engine Running (KOER).

Key On, Engine Off (KOEO) is just what its name implies: You turn the ignition key to the "on" position, without starting the engine. Your first code retrieval process will be KOEO. While this shouldn't make much difference to the Continuous Memory codes, any On-Demand codes that show up during this procedure indicate real, live problems. Like a dead short or a broken wire... that sort of thing. These should be the easiest problems to identify.

Key On, Engine Running (KOER) is the next diagnostic procedure for retrieving codes. The name is a bit redundant (Is it possible to have a Key Off, Engine Running?), but the test itself is quite useful for identifying the On-Demand codes.

There are several parts to the KOER test beside retrieving codes. It also includes the switch test, the cylinder ID test and the dynamic response test. We'll be covering these test procedures separately.

For example, say you're working on a vehicle with late shifts. When you check for KOEO On-Demand codes, nothing shows up. But with the engine running, you see a code for a MAP sensor problem. There's a good chance you're looking at a vacuum problem; the sensor itself is probably okay.

Code Retrieval

Ford's EEC-IV system provides several ways to retrieve codes, from using an analog voltmeter to a test light or beeper; on later vehicles it would even flash the "Check Engine" light. Then, by following a fairly involved set of procedures, you can force the system to flash out the various codes.

But a much easier way to retrieve codes and diagnostic information is through a scan tool. Most early vehicles won't allow you to examine the sensor readings directly, the way you can with GMs. But a scan tool will provide a much simpler way to display On-Demand and Continuous Memory codes.

Simply connect your scan tool, enter the appropriate vehicle information, and then follow the prompts on the scan tool display. The scan tool will deliver the codes in an easy-to-read format. And it will let you know when you have to interact, such as snapping the throttle or working the switches.

And some scan tools also provide an audible prompt for the wiggle test: When the system sees a problem, the scan tool beeps to let you know it identified a problem, and set a code in Continuous Memory.

Ford Specific Computer System Tests (cont)

Test Sequence

When testing a Ford EEC-IV system, there's a specific test sequence you're expected to follow. Your scan tool will help you through this sequence, by starting you at the proper point, and providing the appropriate prompts to walk you through the procedure.

Here's the order for the Ford test procedure:

1. Key On, Engine Off (KOEO)
 - A. On-Demand Codes
 - B. Separator Code (10)
 - C. Continuous Memory Codes
 - D. Output State Test — Your scan tool may not prompt you for this test; you have to know how and when to enter it.
2. Key On, Engine Running (KOER)
 - A. Engine ID Code — The system will pulse once for every two cylinders in the engine; diesels will pulse 5 times.
 - B. Switch Test — The system will prompt you to operate the different switches, and it checks their operation.
 - C. Dynamic Response Test — Also called the "Goose" test; you goose the throttle so the computer can check the system response to a quick throttle opening and closing.
 - D. On-Demand Codes KOER — Compare these codes to the earlier check to identify problems directly related to the engine performance.
 - E. Computed Timing Test — The computer holds the timing at about 20° before the base timing, so you can check the computer's ability to control ignition timing.
 - F. Cylinder Balance Test — Your scan tool may not prompt you for this test; you have to know how and when to enter it.

Output State Test

After displaying the diagnostic codes, the final step of the KOEO test is the output state test. This procedure allows you to signal the computer to energize or de-energize the different solenoid and relays that the computer controls.

Each time you press and release the throttle, the computer cycles the outputs, turning them on or off. Now you can use a digital multimeter to determine whether the computer is supplying the proper signal, and whether the output is operating properly.

This test is similar to the actuator test procedures that most scan tools provide, except that the Ford computer energizes and de-energizes all of the outputs at the same time, instead of a selected one.

Ford Specific Computer System Tests (cont)

Engine ID Code

The engine ID code is the first part of the KOER test. This single code indicates the number of cylinders in the engine. The computer will pulse once for every two cylinders, so the computer will pulse 3 times for a 6-cylinder engine, and 4 times for an 8-cylinder engine. Diesels will pulse 5 times.

Compare the engine ID code to the actual number of cylinders in the engine. An error here may indicate the wrong computer in the vehicle.

During the engine ID code, the computer also monitors the engine operation at idle. Once it's completed the "engine at idle" checks, the computer signals it's ready to move on to the next step in the test procedure.

Ford Switch Test

After the engine ID, the system goes into the switch test. The concept is simple: You operate the switches, and the computer watches them to make sure they're working properly.

For example, the computer will tell you to apply the brake pedal, and then to release it. During this part of the test, the computer watches the brake switch signal, to see that it opens and closes on command. If not, the computer identifies a problem in the brake switch.

The switch test is easy to perform: Just enter the KOER test, and follow the directions on the scan tool display. After the engine ID, the scan tool will tell you when to press the brake, when to release it, turn the steering wheel, etc.

Here's the procedure for the switch test:

- Apply and release the brake pedal.
- Turn the steering wheel at least a half turn.
- Cycle the TCS, if equipped.
- Cycle the 4WD-Low switch, if equipped.

IMPORTANT Not all scan tools will prompt you to cycle the TCS or 4WD-Low switches. Always cycle these switches during the switch test, regardless of whether the scan tool prompts you for it.

There are three important things to remember about this test:

1. Always follow the directions on your scan tool display exactly.
2. Never press the gas or brake (or operate anything else) unless you're told to.
3. Just because the scan tool indicates a problem doesn't mean the switch is bad. You could still have a problem in the circuit that's preventing the computer from seeing the switch open and close. Always check the circuit completely if the scan tool indicates a switch problem.

Ford Specific Computer System Tests (cont)

Dynamic Response Test

The next step in the KOER test is the dynamic response test. This test allows the computer to check the system's response to a rapid change in throttle position.

Your scan tool will prompt you to goose the throttle. During this momentary throttle opening and closing, the computer monitors the inputs' response to the changes in vacuum, RPM, throttle position, etc. This test enables the computer to check the MAP, MAF, TPS, and Knock sensors.

After the dynamic response test, the computer will display any On-Demand codes it has set during the KOER test.

Computed Timing Test

After the dynamic response test, the system allows you to enter the computed timing test as the next part of the KOER test. This allows you to check the system's ability to control ignition timing.

The computer holds the timing at 20° BTDC for two minutes. During this time, you can check the ignition timing, using a timing light or magnetic probe. This allows you to verify that the computer is able to advance timing properly.

Ford Specific Computer System Tests (cont)

Ford Cylinder Balance Test

Another procedure Ford builds into certain vehicles is a cylinder balance test. This test is only available on vehicles with sequential fuel injection (SEFI). These are the systems where each cylinder has its own injector, and each injector fires separately, based on engine timing.

This can be a useful test, because all too often customers mistake engine problems for transmission problems. This is a useful way of identifying engine problems quickly.

To initiate the cylinder balance test:

- Perform a self test with the engine running (KOER)
- Wait 10 seconds after the system finishes displaying the on-demand codes
- Hold the engine steady at about 1600 RPM for a few seconds

NOTICE

Some scanners will allow you to enter the Cylinder Balance Test directly, without going through these steps.

The system will take control of the throttle, and begin the cylinder balance test. Stay off of the throttle during the test.

During this test, the computer disables the injectors, one at a time, and measures the RPM drop. Then it displays a code to indicate any problems it found:

Code	Cylinder
90	Pass
10	1
20	2
30	3
40	4
50	5
60	6
70	7
80	8
77	Retest

If the vehicle passes the test the first time out, the engine is firing evenly; there's no need to go further.

But if the system indicates a problem, you should retest it. On 1987-and-later vehicles, you can retest it up to three times: Each retest adjusts the measurement, to give you a more accurate indication of the engine's condition. To retest the engine, goose the throttle anytime within 2 minutes of the end of the test.

If the vehicle fails the first test, but passes the next two, there's a slight drop between cylinders. This could indicate a slightly clogged injector, a vacuum leak, or worn ignition components.

If the vehicle fails the first two tests, but passes the third, look for a more severe problem. It could still indicate a clogged injector, a vacuum leak or an ignition problem, or it could even have weak compression. This time the cylinder is much weaker, and is barely firing.

If the vehicle fails all three tests, the cylinder's completely dead. Look for a bad injector, shorted or open ignition or an internal engine problem, such as a burnt valve or broken rocker.

Ford Specific Computer System Tests (cont)

Ford Wiggle Test

Connection problems are more common on Ford vehicles than on most other manufacturers. That's because, unlike other manufacturers, Ford uses universal harnesses that plug into one another. It's very common to see a single Ford circuit with as many as three or four connectors between the computer and the component. And that means three or four additional locations for a potential connection problem.

Most other manufacturers have avoided this situation by developing custom harnesses for each vehicle and configuration. The harness has only two connections: One at the computer, and the other at the component.

To help you find connection problems easily, Ford provides something called a Wiggle test. The concept is simple: Set the computer to a more sensitive level, and wait for a dropout in the circuits. Then it's up to you to make the circuit lose connection.

The way to do that is to wiggle the harness. Grab onto different areas of the harness, and give them a good shake. Tap on connectors. Give them a gentle tug. Bounce the car up and down. Anything to simulate the movement that takes place during normal driving conditions. In addition, you can even drive the vehicle during this test, to provide a more accurate simulation of vehicle operation.

There are two different wiggle tests available: Key on, engine off (KOEO), or engine running (KOER). The one you choose may depend on the condition you're looking for. For example, if you're looking for a dropout on the PIP (Profile Ignition Pickup) or SPOUT (Spark Output) signals, you'd need the engine running, since neither signal will be there with the engine off.

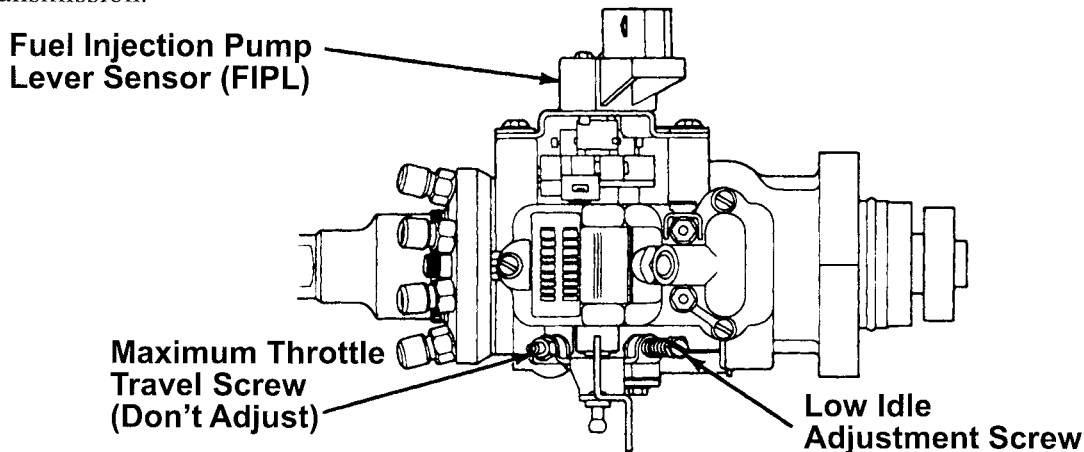
When you disturb the bad connection, the computer sets a code in continuous memory, and your scan tool will indicate it, either by beeping or flashing a light; and all of them will flash the MIL or Check Engine light. Then you have to go back to the KOEO test and extract the continuous memory codes; this tells you exactly where to look for the connection problem. From there, the repair is a simple matter of cleaning, tightening or replacing the offending connection.

Of course, don't forget to recheck the circuit, once you've made your repairs. Perform the wiggle test again, this time directing your attention right on the repair. If your repairs are successful, the computer will never record a break in the connection.

Ford Specific Computer System Tests (cont)

Fuel Injection Pump Lever (FIPL) Adjustment

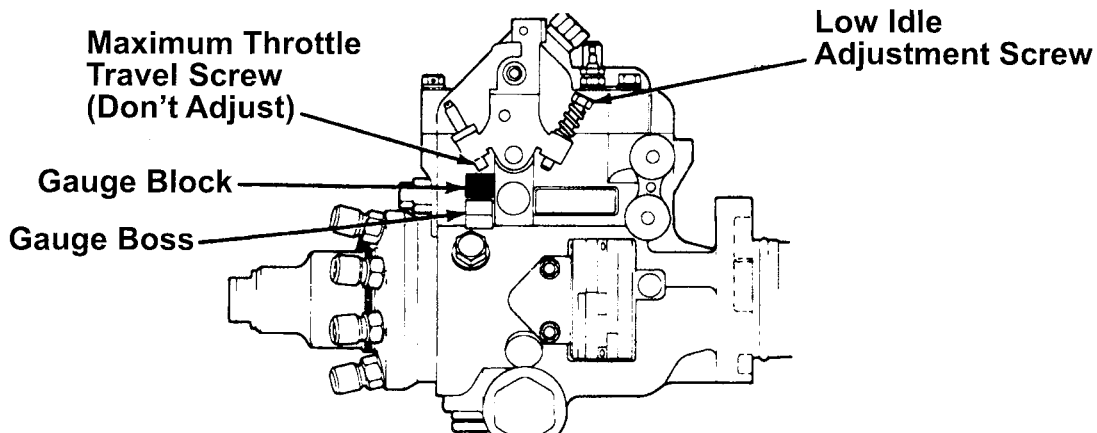
Gasoline engines use a throttle position sensor (TPS) or manifold absolute pressure (MAP) to indicate engine load. Diesel engines use a fuel injection pump lever sensor (FIPL) for the same purpose. In each case, the computer uses this signal to determine engine load. From this, the computer can develop a load signal for the transmission.



A damaged or misadjusted FIPL can cause high line pressure and harsh shifts. So it's important to make sure the FIPL is adjusted correctly, whenever you're working on the transmission in a Ford diesel.

The adjustment procedure is fairly easy, and requires a 0.515" gauge. Here's how to adjust the FIPL:

1. Select FIPL ADJUST from the scan tool, and follow the directions on the display. They'll tell you to insert the adjustment gauge between the FIPL travel screw and gauge boss.
2. To hold the throttle against the gauge, disconnect the throttle cable, and switch the return spring so it holds the throttle open. Then slide the gauge into place.



3. Press "Y" on your scan tool, and turn the key on, engine off. Don't touch the throttle again during this test. The system will go through a self test procedure.

Ford Specific Computer System Tests (cont)

FIPL Adjustment (continued)

4. The scan tool will display this message:

Engine off test complete. Ready for FIPL adjustment.
Without releasing the throttle, press the overdrive cancel
switch once to start FIPL adjustment.

5. Press the overdrive cancel switch once, and your scan tool will display this message:

If necessary, loosen FIPL sensor screws and
rotate sensor to correct setting.

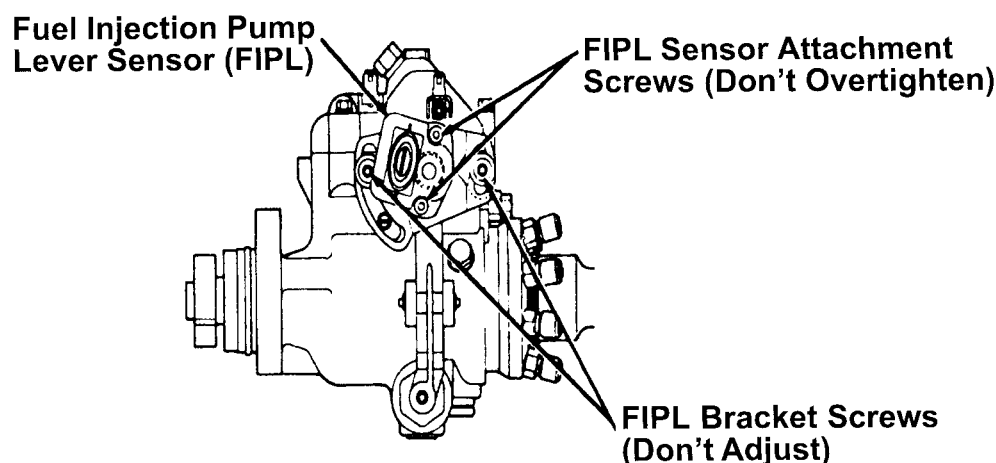
Current condition is:

**** FIPL Setting Is _____ ****

At this point, there will be three possibilities: Either the FIPL will be Too High, Too Low or Correct.

If the FIPL setting is correct, don't touch it; just remove the gauge and reconnect the throttle cable and return spring.

If the FIPL setting is too high or too low, you can adjust it. Loosen the two FIPL sensor mounting screws (not the lever bracket screws) and adjust the sensor until the scan tool display changes to Correct.



Then snug the screws, work the throttle a few times, and recheck the adjustment. If the scan tool still displays the setting is Correct, torque the mounting screws to 75 – 90 inch-lbs. Remove the adjustment gauge and reconnect the throttle cable and return spring; the adjustment is complete.

But if your scan tool reads Too High or Too Low after you work the throttle, readjust the sensor until it reads Correct again. Keep repeating the procedure until the FIPL setting is correct after you work the throttle.

DIAGNOSTIC TIP If you can't bring the FIPL into adjustment for any reason, replace the sensor and try adjusting it again.

DIAGNOSTIC TIP If you can't bring the sensor into adjustment with the mounting screws, break the epoxy away from the bracket screws and adjust it there.

Code Troubleshooting

Fixing computer-related problems is usually pretty straightforward. But sometimes the meaning of the code runs deeper than the code definition.

Some codes are much more common than others. In this section we'll cover codes that require a little more involved diagnostic process to pinpoint and repair the source of the problem. We'll also cover some simple tests and tips that will either fix the problem right away, or at least rule out a lot of possibilities.

As transmission technicians, the common codes we see are those related to shifter position, solenoid electrical failures, and ratio errors, such as a slip or a shift that's out of sequence. We'll look at each of these problems separately, for both GM and Ford transmissions. For Chrysler, we'll delve a little deeper, into some other areas of transmission operation.

Chrysler Code Troubleshooting

Pressure Switch Circuits

OBD-I Codes

- 21 — OD Pressure Switch Circuit Problem
- 22 — 2/4 Pressure Switch Circuit Problem
- 23 — 2/4 and OD Pressure Switch Circuits have a Problem
- 24 — LR Pressure Switch Circuit Problem
- 25 — LR and OD Pressure Switch Circuit Problem
- 26 — LR and 2/4 Pressure Switch Circuit Problem
- 27 — All Pressure Switch Circuits have a Problem
- 31 — OD Pressure Switch Circuit Problem
- 32 — 2/4 Pressure Switch Circuit Problem
- 33 — 2/4 and OD Pressure Switch Circuits have a Problem

OBD-II Codes

- P1780 — OD Pressure Switch Circuit Problem
- P1781 — 2/4 Pressure Switch Circuit Problem
- P1782 — 2/4 and OD Pressure Switch Circuits have a Problem
- P1783 — LR Pressure Switch Circuit Problem
- P1784 — LR and OD Pressure Switch Circuit Problem
- P1785 — LR and 2/4 Pressure Switch Circuit Problem
- P1786 — All Pressure Switch Circuits have a Problem
- P1787 — OD Pressure Switch Circuit Problem
- P1788 — 2/4 Pressure Switch Circuit Problem
- P1789 — 2/4 and OD Pressure Switch Circuits have a Problem

About the Components

The 41TE transaxle uses a series of three pressure switches, designed to confirm solenoid operation. When the computer energizes or de-energizes a solenoid, it looks for the appropriate pressure switch to open or close, to determine whether the fluid pressure is applying the right clutch pack.

These are on-off switches: The switch closes when the pressure in the circuit reaches 23 PSI, and opens when the pressure drops back below 11 PSI. The computer can't determine actual circuit pressure from these switches; it can only determine whether the pressure reached the circuit.

Continued...

Chrysler Code Troubleshooting (continued)

Pressure Switch Circuits (continued)

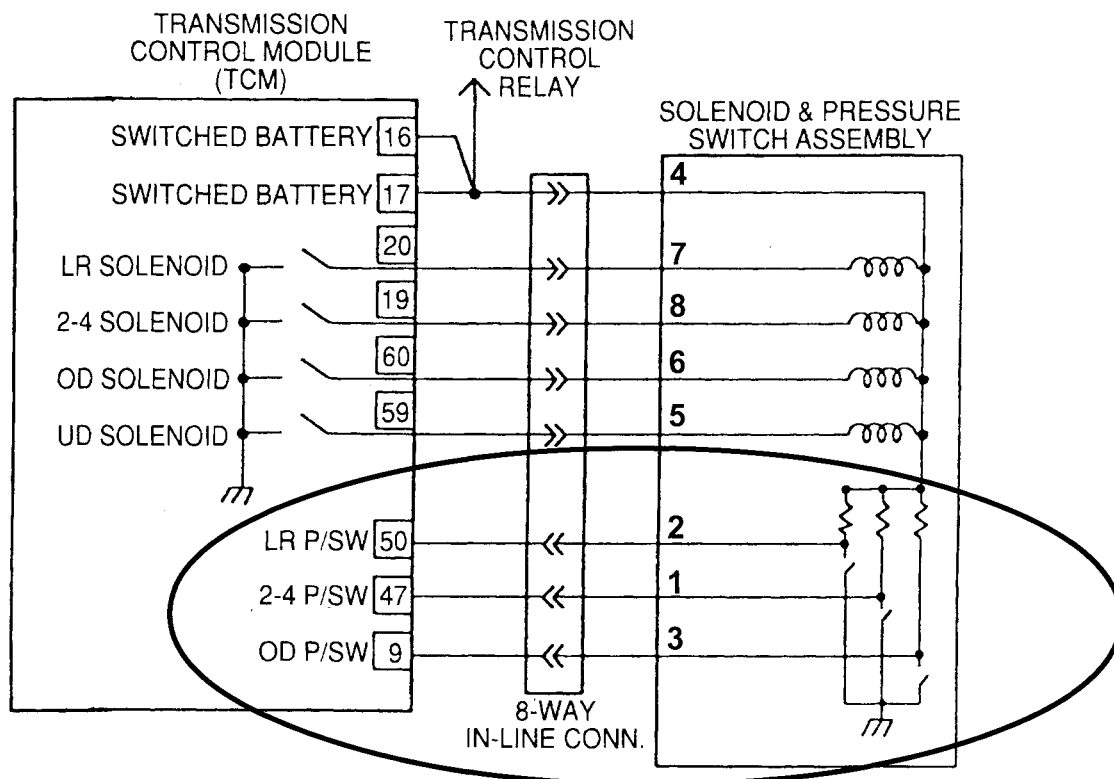
Setting the Code

For any of these codes to set:

- the vehicle must have been running for at least 2 seconds
- the engine must reach at least 500 RPM
- the transmission hasn't lost its prime
- the unit can't be shifting
- the switch condition must differ from the signal operating the solenoids.

These codes will set within 1 – 3 seconds of the failure occurring, depending on the transmission operating temperature.

The computer compares the switch condition to the solenoid signals about every 7 milliseconds, or about 143 times every second. If the switch condition doesn't match the solenoid command, the computer tests the solenoid circuit for continuity. If the solenoids check out okay, the computer assumes a switch problem, and sets one of these switch codes.



The computer uses the solenoid switches to monitor pressure in each clutch circuit, and compares that pressure to the solenoid commands. If the switch position doesn't match the solenoid command, the computer checks for a solenoid problem; if it doesn't detect a problem, the computer sets a switch code.

Continued...

Chrysler Code Troubleshooting (continued)

Pressure Switch Circuits (continued)

Setting the Code (continued)

These codes don't necessarily indicate a bad switch; they simply indicate there's no pressure to the clutch circuit when it's supposed to be there, or there's pressure at the switch when there shouldn't be.

Code 27 is a good example of a code that probably doesn't indicate a bad switch. What are the odds of all of the switches being faulty? Not very likely. More likely, there's a problem in the circuit feeding the switches, or in the computer sensing circuit itself.

Using a Scan Tool

Set your scan tool to display the condition of the switch in question. Then watch the switch readout as you operate the transmission. The switches should close when the clutch is applied, and open as the clutch releases. So the 2/4 switch should be closed in 2nd and 4th gears.

If the problem is intermittent, you may have a broken wire or bad connection. Put the unit into a gear that closes the switch that set the code, and try wiggling the harness from the transmission case. Watch the scan tool display as you wiggle the wires: If you see the switch open, look for a break in the wires or a connection problem.

DIAGNOSTIC TIP If a switch never closes, you may have a computer problem: Try shorting the switch wire to ground, and see if the scan tool indicates the switch is closed. If not, there may be an open in the wire to the computer, or the computer is faulty.

DIAGNOSTIC TIP Some replacement switch seals are thicker than the originals; this can hold the switch closed, and prevent it from opening when the clutch releases. If the transmission was just rebuilt, or you're using a reconditioned solenoid pack, check for oversized seals.

Chrysler Code Troubleshooting (continued)

PRNODL and Neutral Start Switches (continued)

About the Components (continued)

The computer uses the switch pattern to determine the shift lever position. A switch or circuit failure will set a code almost instantly, and the computer monitors these circuits constantly. If you see a code 28 on one of these systems, check the switch signals with your scan tool.

Here's a chart of the scan tool displays you can expect, based on the switch patterns:

Switches	Switch Position							
NS1								
RL1								
NS2								
RL2								
Scan Tool Display	P	R	N	OD	D	L	T1	T2

 Switch Closed

T1 and T2 are transition conditions; they occur while the shifter is in between ranges.

And here's how those patterns indicate the shift lever position:

Switches	Shift Lever Position													
	P	Transition P – R			R	Trans R–N	N	Transition N–OD		OD	Trans OD–D	D	Trans D– L	L
NS1														
RL1														
NS2														
RL2														
Scan Tool Display	P	T1	T2	D	R	D	N	T1	T2	OD	T2	D	T2	L

If the unit you're checking doesn't match this switch pattern, use the schematic to check for individual switch operation. These switch signals depend on more than just the actual switch operation: Loose connections, bad grounds or broken wires can all affect the signals making their way back to the computer.

If the voltage and ground circuits to the PRNODL and neutral start switches are all okay, any discrepancy in the switch signals are probably due to a switch failure or a problem with the manual lever rooster comb.

Continued...

Chrysler Code Troubleshooting (continued)

PRNODL and Neutral Start Switches (continued)

Setting the Code

The computer will set a code for the PRNODL or neutral start switch if it receives an invalid switch pattern for a few seconds.

Using a Scan Tool

Your scan tool provides open and closed indications for all four switches (RL1, RL2, NS1 and NS2). Finding the switch problem is a simple matter of watching the display as you work the manual lever through the gears. Compare your results to the charts: If any of the switches don't conform to the chart, replace the switch.

DIAGNOSTIC TIP One of the best ways to prevent a diagnostic problem after a rebuild is to replace both switches during every rebuild. They're very inexpensive, and will cost far less than any diagnostic procedure you would have to perform to find a bad one.

DIAGNOSTIC TIP If you still have a switch code after replacing both switches, try grounding the NS1 and NS2 switches, and see if your scan tool indicates they're closing. If not, look for an open circuit to the computer, or a bad computer. You can also try jumping the two wires for the RL1 switch together, and then jump the wires for the RL2 switch. Both switches should show up as being closed on your scan tool when the wires are jumped together.

Chrysler Code Troubleshooting (continued)

Transmission Range Sensor; 1996 – on

OBD-I Codes

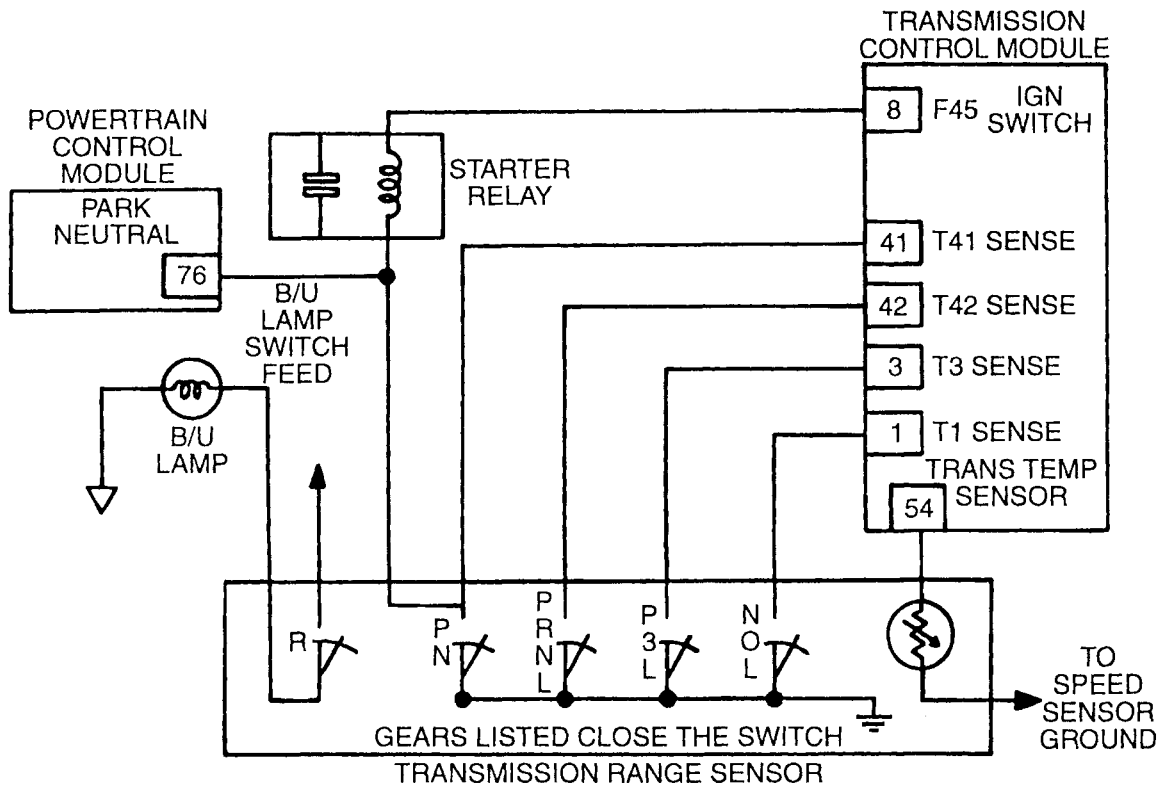
- 28 — Transmission Range Sensor Signal has a Problem
- 72 — Thermistor Input Circuit Open or Shorted
- 74 — Calculated Oil Temperature in Use (Thermistor Voltage is Out of Range)

OBD-II Codes

- P0705 — Transmission Range Sensor Signal has a Problem
- P0710 — Thermistor Input Circuit Open or Shorted
- P1799 — Calculated Oil Temperature in Use (Thermistor Voltage is Out of Range)

About the Components

In 1996, Chrysler eliminated the PRNODL and neutral start switches, replacing them with a single transmission range sensor mounted inside the transmission, on the valve body. This sensor provides all of the functions of the earlier switches, plus adds a thermistor, to monitor transmission oil temperature.

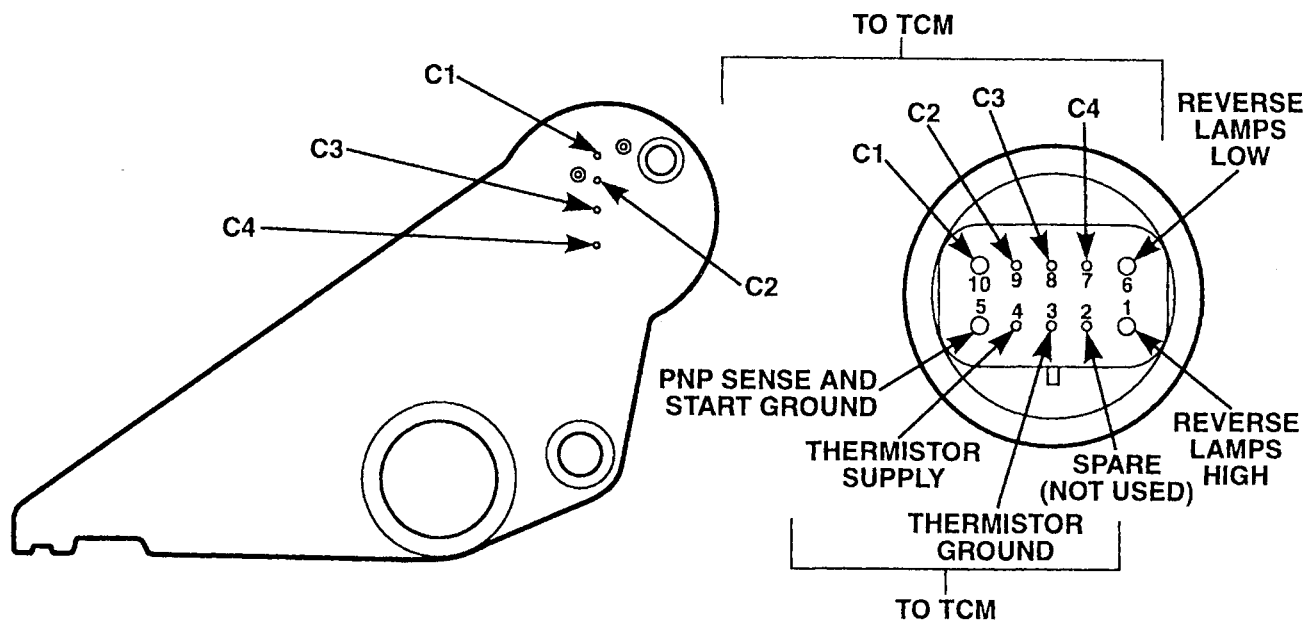


Continued...

Chrysler Code Troubleshooting (continued)

Transmission Range Sensor (continued)

About the Components (continued)



Here's a list of the transmission range sensor terminals, and the signals you can expect from them:

Terminal Function

- 1 F20 — Fused power input to power the backup lights
- 2 Not used
- 3 T13 — Thermistor ground
- 4 T54 — Thermistor sensor signal
- 5 T41 — Park/neutral ground for the starter solenoid
- 6 L1 — Power signal to operate the backup lights
- 7 T1 (C4 switch) — Range sensor position switch, grounded in neutral, overdrive and low
- 8 T3 (C3 switch) — Range sensor position switch, grounded in park, manual 3 and low
- 9 T42 (C2 switch) — Range sensor position switch, grounded in park, reverse, neutral and low
- 10 T41 (C1 switch) — Range sensor position switch, grounded in park and neutral

Here's a chart that indicates the switch status in each gear range:

Selector Position		T41 (C1)	T42 (C2)	T3 (C3)	T1 (C4)
P	P				
R	R				
N	N				
OD	D				
3	2				
L	1				

 Switch Closed

Continued...

Chrysler Code Troubleshooting (continued)

Transmission Range Sensor (continued)

Setting the Code

The computer will set a code for the transmission range sensor if it receives an invalid switch pattern for a few seconds.

Using a Scan Tool

Your scan tool provides open and closed indications for all four switches (C1 through C4). Finding the switch problem is a simple matter of watching the display as you work the manual lever through the gears. Compare your results to the charts: If any of the switches don't conform to the chart, replace the range sensor.

DIAGNOSTIC TIP

If you still have a bad switch code after replacing the transmission range sensor, try grounding the individual switch circuit wires, one at a time, and see if your scan tool indicates they're closing. If not, look for an open circuit to the computer, or a bad computer.

Chrysler Code Troubleshooting (continued)

Shift Solenoids

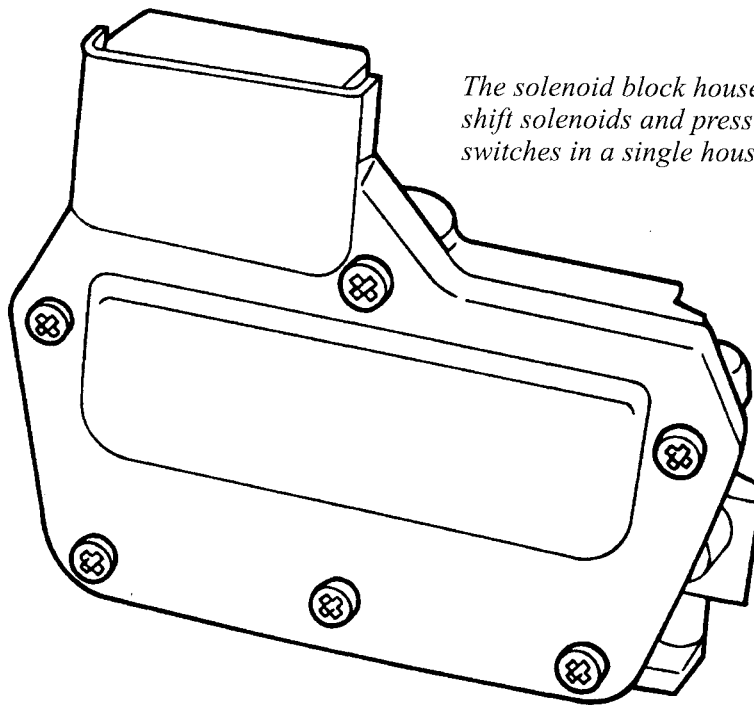
OBD-I Codes

- 41 — LR Solenoid Circuit is Either Open or Shorted
- 42 — 2/4 Solenoid Circuit is Either Open or Shorted
- 43 — O/D Solenoid Circuit is Either Open or Shorted
- 44 — U/D Solenoid Circuit is Either Open or Shorted

OBD-II Codes

- P0750 — LR Solenoid Circuit is Either Open or Shorted
- P0755 — 2/4 Solenoid Circuit is Either Open or Shorted
- P0760 — O/D Solenoid Circuit is Either Open or Shorted
- P0765 — U/D Solenoid Circuit is Either Open or Shorted

Setting the Code



The solenoid block houses the shift solenoids and pressure switches in a single housing.

The 41TE uses four solenoids to control transaxle operation. The computer tests these solenoid circuits roughly every ten seconds, and immediately after a gear ratio error or pressure switch error sets a code. This test enables the computer to determine whether there's a problem in any of the solenoid circuits. Here's how the computer tests these circuits:

Continued...

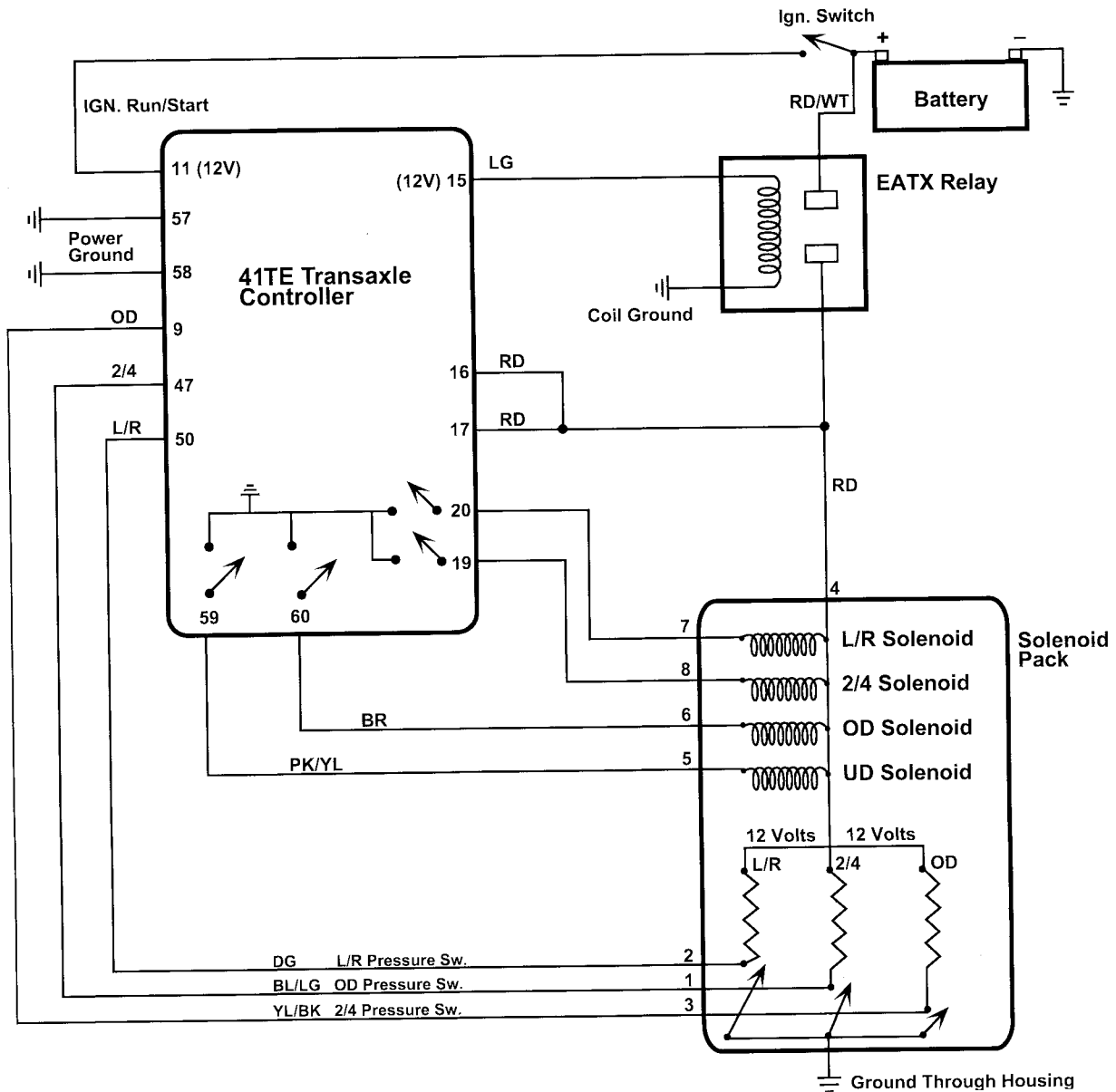
Chrysler Code Troubleshooting (continued)

Shift Solenoids (continued)

Setting the Code (continued)

Whenever an electrical solenoid turns off, it develops a voltage spike as the magnetic field breaks down. This process is similar to the way the ignition coil develops a spark to run the engine.

The voltage of the spike is based directly on the condition of the circuit. If the solenoid windings are shorted, or there's a loose ground in the circuit, the spike will be lower.



Continued...

Chrysler Code Troubleshooting (continued)

Shift Solenoids (continued)

Setting the Code (continued)

To test the solenoid circuits, the computer turns the solenoids off, and measures the voltage spike. If the spike doesn't reach a predetermined voltage level, the computer determines there's a problem in the circuit, and sets a diagnostic trouble code for that circuit.

The computer will set a code after three failed continuity tests, or after one failed test that occurs immediately after a pressure switch or gear ratio problem.

DIAGNOSTIC TIP Loose connections are a common source of solenoid codes. Use a #43 drill bit to check and size the female electrical terminals at the solenoid pack harness, and a #57 drill bit for the transmission computer harness.

DIAGNOSTIC TIP The problem that sets one of these codes isn't necessarily due to a damaged or worn out solenoid. Remember, these are electrical circuits: Problems anywhere in the circuit will affect the voltage spike, and cause a code to set. Electrical circuit problems that will set a solenoid code include:

- Low battery voltage
- Loose electrical connections
- Bad computer ground
- Faulty or damaged EATX relay

Chrysler Code Troubleshooting (continued)

Gear Ratio Errors

OBD-I Codes

- 39 — Gear Ratio Error (Pre-1991 Only)
- 50 — Gear Ratio Error in Reverse
- 51 — Gear Ratio Error in 1st Gear
- 52 — Gear Ratio Error in 2nd Gear
- 53 — Gear Ratio Error in 3rd Gear
- 54 — Gear Ratio Error in 4th Gear
- 56 — Turbine Shaft Sensor Error
- 57 — Output Shaft Sensor Error
- 58 — Sensor Ground is Loose or Damaged

OBD-II Codes

- P0730 — Gear Ratio Error in Reverse
- P0731 — Gear Ratio Error in 1st Gear
- P0732 — Gear Ratio Error in 2nd Gear
- P0733 — Gear Ratio Error in 3rd Gear
- P0734 — Gear Ratio Error in 4th Gear
- P0715 — Turbine Shaft Sensor Error
- P0720 — Output Shaft Sensor Error
- P1794 — Sensor Ground is Loose or Damaged

About the Components

Whenever a 41TE is on the road, it's constantly comparing the signals from the two speed sensors, to monitor gear ratios.

These are permanent magnet speed sensors: They should have between 300 and 1200 ohms resistance, and should develop a magnetic field around the sensor all the time.

Setting the Code

If at any time during normal operation, the ratio the computer calculates doesn't match the gear ratio for the gear the computer is signaling, the computer sets a gear ratio error code.

If the computer notices a major RPM change in the signal from one of the sensors while it's operating, it sets a code for that individual sensor. However, the computer never sets a ratio error while a shift is taking place.

Before 1991, there was only one code available to indicate a problem in these sensors: code 39. If you experience a code 39, it's important to find out as much as possible about the transaxle's operating conditions that occurred right before the unit went into limp-in mode. Those conditions are the only clues you have to identify the specific cause of the failure, and the source of the code.

Continued...

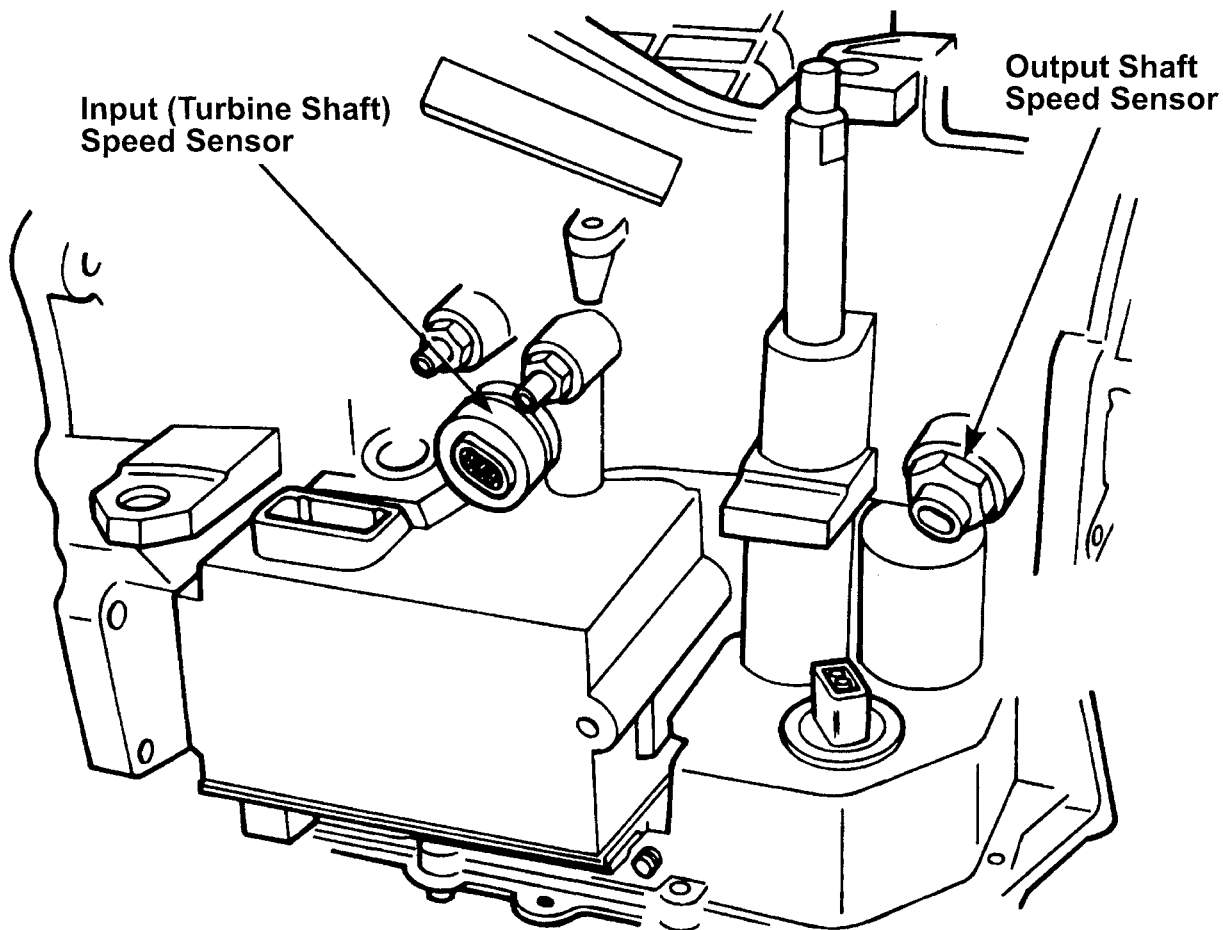
Chrysler Code Troubleshooting (continued)

Gear Ratio Errors (continued)

Setting the Code (continued)

But on 1991-and-later models, the computer sets a specific code for the gear range or sensor involved. This makes isolating and identifying the problem much easier.

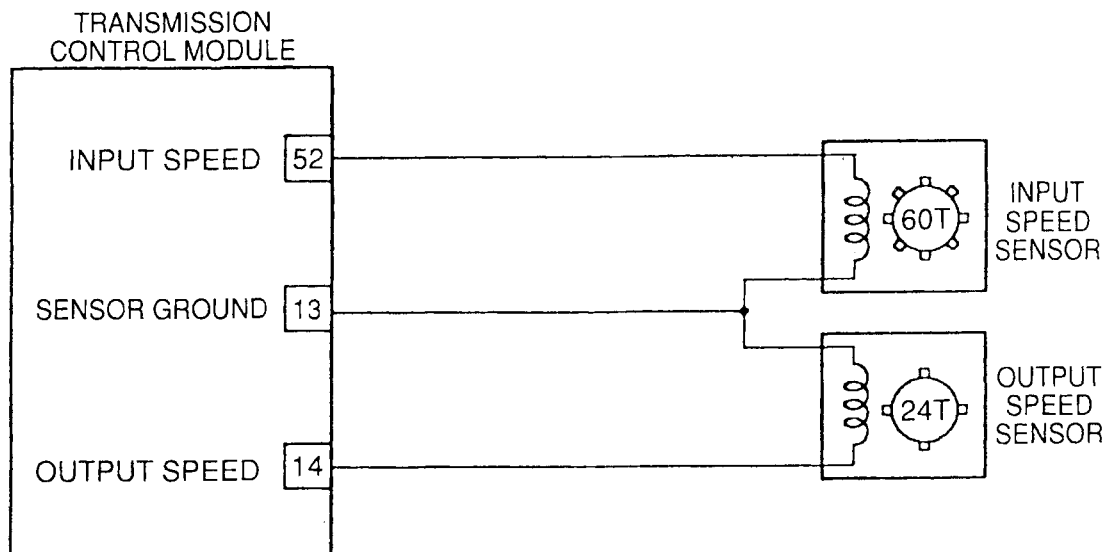
One common cause for gear ratio codes is electrical interference in the sensor circuits. Electromagnetic interference (EMI) often bleeds over from the ignition system, or through a motor circuit.



Continued...

Chrysler Code Troubleshooting (continued)

Gear Ratio Errors (continued)



Using a Scan Tool

One easy way to identify this type of electrical “bleed-over” is to check the speed sensor signals with your scan tool, while the vehicle is in gear, and fully stopped. If you see any signal other than zero at either sensor, suspect electrical interference.

Very often, correcting electrical interference is simply a matter of rerouting the wires away from the source of the interference. Another way to reduce this interference is to twist the insulated part of the wires together.

DIAGNOSTIC TIP If the interference seems to relate to an electric motor, make sure the motor ground is good, and check the motor itself; a bad motor can send electrical interference through the entire electrical system. If possible, try disconnecting the motor and see if the problem goes away. If the motor and grounds are okay, you may have to look into adding a capacitor to the circuit, to reduce the interference.

DIAGNOSTIC TIP Additional sources of gear ratio errors can be caused by a damaged sensor ring, reducing the number of pulses the sensor can develop, or a bad sensor itself.

GM Code Troubleshooting

Shifter Position

OBD-I Codes

28 — Transmission Range Sensor (4T60E)

28 — Pressure Switch Manifold (PSM) or Pressure Switch Assembly (PSA) (4L60E and 4L80E)

OBD-II Codes

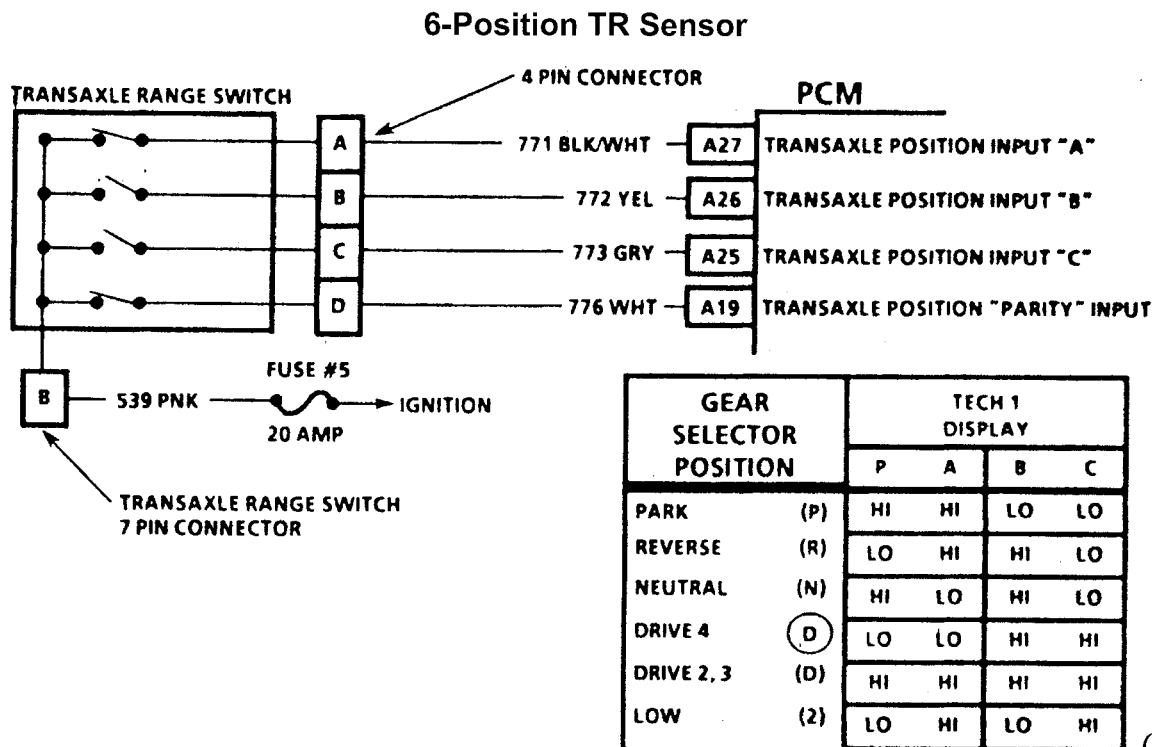
P0705 — 4T60E Transmission Range Sensor

P1810 — 4L60E and 4L80E Pressure Switch Manifold (PSM) or Pressure Switch Assembly (PSA)

About the Components

The 4T60E uses a Transmission Range (TR) switch located on the transmission manual shaft. It contains four on/off switches that provide a digital signal to the computer. Because it has four switches, it can provide a total of 16 possible on/off combinations, but depending on the model, *only six or seven are legal combinations*. Regardless of the vehicle year and model, the four switches are labeled A, B, C, and P; P is often labeled "parity input." The computer provides 12 volts to the switches, and the switches will either pull down to ground or remain open.

The 4L60E and 4L80E use five pressure switches mounted to the valve body. These five switches work in series and parallel circuits which lead to three wires labeled A, B and C. The Pressure Switch Manifold has a total of eight possible on/off combinations, *but only six are legal combinations*. The computer provides 12 volts to the switches, and the switches will either pull down to ground or remain open.



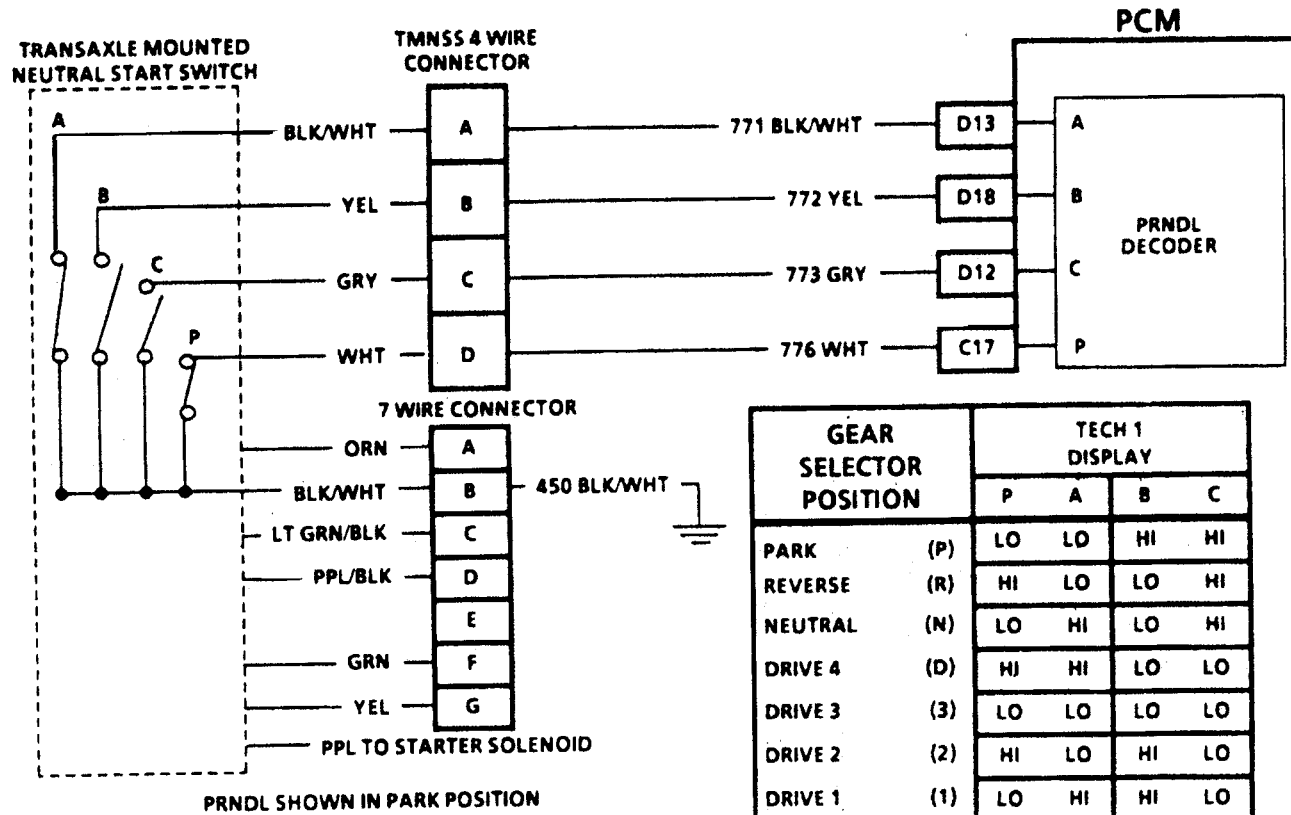
Continued...

GM Code Troubleshooting (continued)

Shifter Position (continued)

About the Components (continued)

7-Position TR Sensor



Continued...

GM Code Troubleshooting (continued)

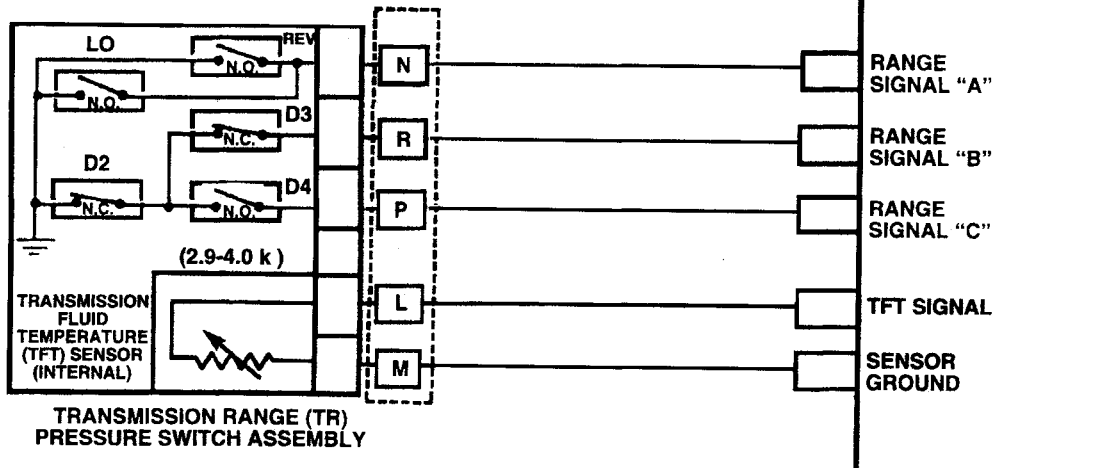
Shifter Position (continued)

About the Components (continued)

Pressure Switch Assembly

VALID COMBINATION CHART
GND = 0 VOLTS OPEN = B+

RANGE SIGNAL	A	B	C
PARK	OPEN	GND	OPEN
REV	GND	GND	OPEN
NEUTRAL	OPEN	GND	OPEN
D4	OPEN	GND	GND
D3	OPEN	OPEN	GND
D2	OPEN	OPEN	OPEN
D1	GND	OPEN	OPEN
ILLEGAL	GND	OPEN	GND
ILLEGAL	GND	GND	GND



Continued...

GM Code Troubleshooting (continued)

Shifter Position (continued)

Setting the Code

Transmission Range sensor codes will set for a number of reasons, based on the year and model. One thing that will trigger the code on all models is an illegal switch combination. Sometimes you'll get a code if the computer sees the engine start while the TR sensor shows a range other than Park or Neutral. You may also get this code if the computer sees the car accelerating or the cruise control is engaged while the TR sensor is reporting Park or Neutral.

Using a Scan Tool

First check to make sure the shifter range changes on the scan tool as you move the shifter. Since the computer sets the code, a problem should show up on your scan tool as limited activity or the wrong range. If it looks okay, try moving the TR or PSM harness connector and harness, make sure the engine will only start when the selector's in Park or Neutral.

In most cases you'll find that the TR or PSM is reporting an incorrect range. To identify the specific source of the problem, set your scan tool to display the individual readings from each of the switches. As you move the shifter, notice which switch (or switches) doesn't change state.

If all of the switches are open (12 V), suspect a broken ground wire to the switch, or a problem with the switch itself. But if only one switch isn't working (changing states), look for a short or an open in one of the wires.

Disconnect the TR harness: Your scan tool should now indicate all of the switches are open (12V). If one of the switch wires remains closed (0 V), either the wire is shorted to ground or the computer is bad; you may need to cut the wire near the computer and check it again (remember to leave room to repair the wire afterward).

If one of the switches always appears open, try shorting it to ground; your scan tool should now report it as closed. If the "switch" doesn't close when you short it to ground, look for a broken wire to the computer, or a bad computer.

DIAGNOSTIC TIP Don't bother checking the Pressure Switch Manifold for continuity to ground while moving the shifter. The reason? When you disconnect the transmission harness you also disconnect the force motor, which increases line pressure. The excess pressure may overcome the problem switch, indicating a false pass for the switch.

GM Code Troubleshooting (continued)

Quad Driver and Solenoids

OBD-I Codes

- 26 — Quad Driver Module (4T60E)
- 27 — Quad Driver Module A (4T60E)
- 29 — Quad Driver Module B (4T60E)
- 56 — Quad Driver Module (4T60E)
- 66 — 3-2 Solenoid (4L60E)
- 67 — TCC Solenoid (4L60E)
- 73 — Force Motor (4L60E, 4L80E)
- 81 — 2-3 (B) Solenoid (4L60E, 4L80E)
- 82 — 1-2 (A) Solenoid (4L60E, 4L80E)
- 83 — TCC PWM Solenoid (4L60E, 4L80E)
- 84 — 3-2 Solenoid (4L60E)
- 90 — TCC Solenoid (4L60E)
- 93 — Force Motor (4L60E)

OBD-II Codes

- P0748 — Force Motor (4L60E, 4L80E)
- P0753 — 1-2 (A) Solenoid (4L60E, 4L80E)
- P0756 — 2-3 (B) Solenoid (4L60E, 4L80E)
- P1640 — Quad Driver Module (4T60E)
- P1650 — Quad Driver Module (4T60E)
- P1860 — TCC PWM Solenoid (4L60E, 4L80E)
- P1864 — TCC Solenoid (4L60E)
- P1886 — 3-2 Solenoid (4L60E)

About the Components

Quad Driver Module (QDM) and solenoid codes are some of the most common — and sometimes most challenging — codes you'll come across. The reason these codes are so difficult to repair is because replacing the solenoid usually doesn't fix the problem.

The computer uses two methods for verifying the integrity of solenoid circuitry. First, it can measure the circuit amperage and compare it to the amperage the processor commands. This method is used with force motors. With other solenoids, the computer uses a feedback, or *sense* lead (built into the computer), that monitors the ground wire of the driver.

When the driver energizes the solenoid, the sense lead voltage drops (for on/off solenoids it will go to zero; for PWM solenoids it will vary based on the command of the computer). When the driver turns the solenoid off, voltage on the sense lead will return to battery voltage.

GM Code Troubleshooting (continued)

Quad Driver and Solenoids (continued)

Setting the Code

The computer will operate the force motor from between 0.1 and 1.1 Amps. Force motor codes will set if the actual amperage is 0.16 Amps above or below the desired amperage. QDM and solenoid codes will set if the voltage on the sense lead is high when the processor commands the solenoid on, or if it's low when the processor commands the solenoid off. The only difference between QDM codes and other on/off solenoid codes is that each QDM operates four devices; a code will set if *any* of the four items fail. In some cases, you'll get a code if any item from *two* QDMs fails, which means you may have eight items to check.

For example, the QDM codes for the 4T60E can set if you sit in Park or Neutral with your foot on the brake for more than 30 seconds. This is because the brake switch supplies voltage to the TCC solenoid. While your foot's on the brake, the TCC sense lead drops to zero volts, so the computer *thinks* the QDM is commanding it on.

Using a Scan Tool

Force Motor Codes: First verify that the desired amperage is within 0.16 amps of the actual amperage. If it is, the code is probably intermittent. In this case, set your scan tool to record a snapshot (sometimes called a movie) and drive the vehicle. When the code sets, record the snapshot. When you review the snapshot, confirm that the amperage difference exceeded 0.16 (as described above). If it didn't, you probably have a computer problem, which may be caused by poor power or ground to the computer.

For other solenoid codes, simply confirm solenoid operation. In most cases you'll find the solenoid is commanded *on* when it should be off. For example, the TCC solenoid turns on while you're sitting still. For other solenoid codes, you'll want to be familiar with the on/off patterns of the trans you're working on.

If you can duplicate the problem on the lift, check the ground lead for the solenoid in question *while the problem is happening*. If you have battery voltage on the ground lead when the solenoid is supposed to be energized, the problem is either resistance in the wire (between where you're checking it and the computer) or a bad computer. Again, poor battery voltage or ground to the computer can be responsible for this. If voltage is low (or zero), you probably have a bad solenoid or low battery voltage to the solenoid.

DIAGNOSTIC TIP Never rely on the computer to prompt you for having a low battery. For the computer to set a low-battery code, some systems will have to drop below 9 volts — far too low for proper computer operation. As with all electrical problems, begin your test at the battery. Get into the habit of accepting nothing less than 12.45 volts at the battery posts (with the engine off). Also, check your chassis ground for voltage; it should never exceed 0.1 volts while the engine is running and accessories are on (turn as many on as you can for this test).

DIAGNOSTIC TIP If you're getting these codes, try bypassing the ignition circuits at the transmission. In other words, connect a jumper lead directly from the battery to the solenoid feed on the trans. Now see if the code sets. In many cases you won't get the code any more. This is very common on trucks, and is often caused by the ignition switch, or loose connections at the fuse box.

GM Code Troubleshooting (continued)

Ratio Errors

OBD-I Codes

- 36 — Shift Problem—4T60E
- 39 — TCC Slipping or Off (4T60E, 4L60E, and 4L80E)
- 68 — Overdrive Ratio Error (4L80E)
- 85 — Undefined Ratio (4L80E)
- 86 — Solenoid B Stuck Closed (4L80E)
- 87 — Solenoid B Stuck Open (4L80E)

OBD-II Codes

- P0740 — TCC Slipping or Stuck Off (4T60E)
- P0741 — TCC Slipping or Stuck Off (4L80E)
- P0751 — Solenoid A Stuck Off (4L40E, 4L80E)
- P0755 — Solenoid B On/Off Error (4T60E)
- P0756 — Solenoid A Stuck On (4L40E, 4L80E)
- P1870 — TCC Slipping or Stuck Off (4L40E, 4L80E)
- P1871 — Undefined Ratio Error (4L80E)

About the Components

Transmission ratios are a feedback feature the computer uses to determine whether the transmission is shifting into the proper gear range. To calculate this ratio, the computer compares an input sensor speed to an output sensor speed. The degree of sensitivity and accuracy is based on the number of sensors it uses.

For example, the 4L60E and 4T60E use only engine RPM as the input and the vehicle speed sensor as the output. Because of this, the computer can't discern between a TCC slip or a slip in the transmission itself.

On the other hand, the 4L80E uses engine RPM and the Transmission Input Sensor Speed (TISS) for monitoring TCC and overdrive slip, and the Transmission Input Sensor Speed (TISS) vs Transmission Output Sensor Speed (TOSS) for ratio errors in first, second and third gears. Recognizing *how* each unit monitors the various ratios will help you pinpoint the cause of the code, and ultimately allow you to fix the problem.

Setting the Code

The 4L60E and 4T60E compare engine RPM to output shaft RPM while in third and fourth gear; some models will include second gear. When engine RPM exceeds 65% of the output shaft speed, multiplied by the transmission ratio, the computer will set a code for TCC slip. The 4T60E also has a limited sense of solenoid function. For example, both solenoid A and B are off in third gear. If the computer senses the RPM difference is *higher* than a torque converter clutch failure would cause, it assumes the solenoids aren't working properly (stuck closed).

GM Code Troubleshooting (continued)

Ratio Errors (continued)

Setting the Code (continued)

The 4L80E computer compares the Transmission Input Sensor Speed and Transmission Output Sensor Speed to measure slip in first, second, third and reverse. A code 85 or P1871 will set if one of these gears shows a ratio outside of these ranges:

1st — 2.38:1 – 2.63:1

2nd — 1.43:1 – 1.58:1

3rd — 0.95:1 – 1.05:1

Rev — 1.97:1 – 2.17:1

The computer will also compare engine RPM to the Transmission Input Shaft Speed to monitor fourth gear and TCC slip. If there's more than a 65 RPM difference between engine RPM and the input shaft RPM in 2nd or 3rd gears, while the computer is commanding the TCC on, you'll get a code 39 or P1870. But if the computer *doesn't* sense a TCC slip in 2nd or 3rd, and the difference between engine RPM and the input shaft speed *does* exceed 200 in fourth gear, the computer will set a code 68.

If the computer sees ratios calculated from the Transmission Input Sensor Speed and the Transmission Output Sensor Speed for a gear other than the one commanded, it will set a code indicating one of the solenoids is stuck open or closed.

Using a Scan Tool

If you're working on a TCC slip problem, set your scan tool to monitor engine RPM, output shaft RPM, TCC slip, and TCC duty cycle. On a 4L80E, include the input shaft RPM. Compare your scan tool's engine RPM reading to the actual engine RPM, and make sure the output shaft (or VSS) speed is zero when the vehicle is stopped. If any of these readings is incorrect, you may be facing a problem caused by electrical interference; the best way to isolate this type of interference is with an oscilloscope.

If the initial readings look okay, drive the vehicle at light throttle while monitoring TCC slip and TCC duty cycle. Normally TCC slip will fall between zero and six RPM. If it looks okay, begin increasing the throttle. If TCC slip begins to increase — as well as TCC duty cycle — you have a legitimate TCC slip.

IMPORTANT This is a tricky test. If you want to get good at this you *must* use your scan tool on vehicles that are running properly, to be able to recognize how the system should be working.

Ratio errors on the 4L80E are somewhat trickier. If the code is for a ratio error or solenoid sticking, simply monitor the gear ratio on your scan tool and see if it's correct. Also, just like the TCC slip problem, make sure engine RPM is correct and both the input and output shaft RPM read zero, while the unit is in gear and vehicle is stationary.

And just like a TCC slip problem, you'll want to add torque to the trans while monitoring the slip, to see if it increases. Again, checking vehicles that are working right *before* you come across a problem vehicle will help you interpret the test results.

GM Code Troubleshooting (continued)

Ratio Errors (continued)

Using a Scan Tool (continued)

If you're dealing with a ratio problem in fourth gear on a 4L80E, keep in mind that the computer has no way of knowing the difference between TCC slip and a fourth-gear slip. This is because both the torque converter *and* the overdrive clutch are between the engine and the input shaft. So, if the computer sees higher than normal engine RPM in fourth, it *assumes* the problem is with the overdrive clutch.

For this test, set your scan tool to display TCC slip and gear ratio. Now test the TCC as mentioned earlier. While you're driving in third gear, add enough torque to the trans to really work the converter clutch, but not enough to force the converter clutch to release or for the transmission to downshift to 2nd. If TCC slip remains low (under 10 RPM) you probably have a genuine fourth gear slip. If TCC slip is between 10 and 65 RPM, the converter clutch may be part of the problem. Naturally, you'll want to let the trans shift into fourth gear and verify there actually is a ratio problem.

DIAGNOSTIC TIP A transmission may have ratio errors and TCC slip problems because of a bad alternator, which is sending an AC signal through the vehicle wiring. To test for this, disconnect the alternator and see if the codes go away.

DIAGNOSTIC TIP Solenoid codes can set if solenoid feed is insufficient. This is often caused by a poor grade of ATF or leaks in the solenoid feed circuit. Enlarging the solenoid feed holes will often fix these problems.

DIAGNOSTIC TIP 4T60E: Attach a vacuum pump to the modulator. While monitoring TCC slip, reduce the vacuum and see if the slip decreases. If it doesn't you may have a built-in ratio problem. That is, the trans may have the wrong final drive or chain sprockets for the application. You can also use the vacuum pump to test for shifting-out-of-sequence codes (solenoid codes). If the unit is skipping a gear or shifting out of sequence, drive the vehicle with low (or no) vacuum. If the problem is caused by low solenoid feed or a leaking solenoid, the problem will usually go away.

DIAGNOSTIC TIP 4L80E: If you have a fourth gear ratio problem you can separate the overdrive clutch from the TCC by removing the #10 checkball. If the code goes away, you definitely have an overdrive clutch problem.

Ford Code Troubleshooting

Shifter Position

OBD-I Codes

- 522 — Transmission Range Sensor Open Circuit (AODE/4R70W, AX4N, AX4S, CD4E)
- 634 — Manual Lever Position Sensor Out of Range (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- 632 — Transmission Control Switch Failure (AOD, CD4E, E4OD)
- 654 — Manual Lever Position Sensor has No Park Indication (AODE/4R70W, AX4N, AX4S, E4OD)
- 659 — Manual Lever Position Sensor Park Indication (AODE/4R70W, AX4N, AX4S, E4OD)
- 667 — Manual Lever Position Sensor Low Voltage (AODE/4R70W, CD4E, E4OD)
- 668 — Manual Lever Position Sensor High Voltage (AODE/4R70W, CD4E, E4OD)
- 675 — Manual Lever Position Sensor Out of Range (AODE/4R70W)

OBD-II Codes

- P0705 — Transmission Range Sensor Out of Range (AODE/4R70W, E4OD)
- P0707 — Transmission Range Sensor Low Voltage (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- P0708 — Transmission Range Sensor High Voltage (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- P1705 — Transmission Range Sensor Never Indicates Park (AX4N, AX4S, CD4E, E4OD)
- P1709 — Transmission Range Sensor Never Indicates Park (AODE/4R70W)
- P1780 — TCS Malfunction (AODE/4R70W, CD4E, E4OD)

About the Components

Until 1997, all Ford computer-controlled transmissions used a transmission range (TR) sensor, located on the manual shaft of the transmission. Ford's pre-1997 TR sensor consists of several open/closed switches for functions such as Park/Neutral start, backup lights, etc. The computer-related feature, however, is a series of ganged resistors on a common lead for the ground wire, and a sweeper arm that moves from one contact point to another. As the sweeper arm moves, it adds more of the ganged resistors to the circuit, which changes in the overall resistance. The result is a change in voltage signal to the computer.

Some vehicles also incorporate a Transmission Control Switch (TCS), usually mounted on the shifter. The TCS is simply an overdrive cancel switch. It's a momentary switch that will enable or disable overdrive each time you press it. Starting in 1997, many units came with a *digital* TR sensor. The digital sensor is simply a group of open/closed switches. The combination of open and closed switches provides the computer with the shifter position.

Ford Code Troubleshooting (continued)

Shifter Position (continued)

About the Components (continued)

Most shifter position problems you'll see are with the earlier, ganged-resistor style TR sensor. This TR sensor has a stepped resistance value, and provides the computer with a stepped voltage signal. All Ford TR sensors of this type used these voltage specifications:

w/TCS Switch		w/o TCS Switch	
Gear	Voltage	Gear	Voltage
P	4.4	P	4.4
R	3.5	R	3.5
N	2.8	N	2.8
D	2.1	OD	2.1
2	1.4	D	1.4
1	0.7	L	0.7

All voltage values are $\pm 10\%$

Setting the Code

Although there are many codes related to the TR sensor, you practically have to disconnect or short it to set a code. But a common way of setting one of these codes is if you retrieve codes while the shifter is in any range other than park. If you get a TR sensor code, make sure the connector is tight and the shifter is in park.

TCS codes are very common, and in most cases you'll get them during the key on, engine running test. That's because, during this part of the test, your scan tool will prompt you to press and release the brake, and then turn the steering wheel. But many scan tools *won't* prompt you to cycle the TCS. The problem is the computer has cycling the TCS as part of its script, and it looks for the switch to cycle during the switch test. So when you don't cycle it, it sets a code. Just make sure you cycle the switch after cycling the brake switch and turning the steering wheel.

Using a Scan Tool

First make sure the shifter range changes as you move the shifter. Since the computer set the code, you should notice limited activity or the wrong range. If it looks okay, try moving the TR harness connector and harness. Also make sure the engine won't start in any range other than park or neutral.

In most cases you'll find the TR isn't reporting the correct range. In many cases, it's reporting a range closer to park; this is often caused by a poor ground inside the TR sensor.

DIAGNOSTIC TIP

If your scan tool reports everything is okay, invoke the Wiggle Test, then move the TR wire harness, or, if need be, drive the vehicle. Keep in mind, many TR-related problems *won't* set a code. These include falling out of gear or harsh shifts (maximum line pressure). If you have these complaints but no codes, use a DVOM at the TR wire and make sure the voltage is correct for each shifter position. You may also want to drive the vehicle while measuring the voltage.

Ford Code Troubleshooting (continued)

Solenoids

OBD-I Codes

- 621 — SS1 Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- 622 — SS2 Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- 624 — EPC Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- 626 — Coast Clutch Solenoid Circuit Failure (E4OD)
- 627 — TCC Solenoid Circuit Failure (E4OD)
- 641 — SS3 Circuit Failure (AX4N, AX4S)
- 652 — TCC Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E)

OBD-II Codes

- P0743 — TCC Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- P0750 — SS1 Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- P0755 — SS2 Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- P0760 — SS3 Circuit Failure (AX4N, AX4S)
- P1743 — TCC Circuit Failure (AX4N, AX4S)
- P1744 — TCC Engagement Error (AODE/4R70W, AX4N, AX4S, E4OD)
- P1746 — Open PCM Driver for EPC Solenoid (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- P1747 — EPC Circuit Failure (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- P1754 — Coast Clutch Solenoid Circuit Failure (E4OD)
- P1788 — 3-2/CCS Solenoid Circuit Failure (CD4E)
- P1789 — 3-2/CCS Solenoid Circuit Failure (CD4E)

About the Components

Solenoid codes are some of the most common — and the most challenging — codes you'll come across. The reason is that in most cases, the problem isn't with the solenoid, it's with the rest of the circuit, or sometimes factors outside the circuit. That's why replacing the solenoid usually doesn't fix the complaint.

Setting the Code

Unfortunately, Ford isn't in the habit of revealing the computer strategy used for setting most of its codes. Instead, they provide tests intended to eliminate everything in the circuit of the suspect part; through the process of elimination, you're expected to find the faulty component.

Ford Code Troubleshooting (continued)

Solenoids (continued)

Using a Scan Tool

Here's a case where serial data from the scan tool doesn't have much value. But you can use your scan tool to invoke the Wiggle Test, which is an excellent test for checking intermittent opens and loose connections in the circuit. The scan tool can also command the computer to energize and de-energize the solenoids it controls. This is called a System Actuator Test. You can find complete information on the system actuator test in the "Scan Tools" section of this manual.

DIAGNOSTIC TIP Never rely on the computer to prompt you for having a low battery. For the computer to set a low-battery code, some systems will have to drop below 9 volts — far too low for proper computer operation. As with all electrical problems, begin your test at the battery. Get into the habit of accepting nothing less than 12.45 volts at the battery posts. Also, check your chassis ground for voltage; it should never exceed 0.1 volts while the engine is running and accessories are on (turn as many on as you can for this test).

DIAGNOSTIC TIP If you're getting these codes, try bypassing the ignition circuits at the transmission. In other words, connect a jumper lead directly from the battery to the solenoid feed on the trans. Now see if the code sets. In many cases you won't get the code any more. This is often caused by loose connections in the different harness connectors.

Ford Code Troubleshooting (continued)

Ratio Errors

OBD-I Codes

- 617 — 1-2 Shift Error (AODE/4R70W, E4OD)
- 618 — 2-3 Shift Error (AODE/4R70W, E4OD)
- 619 — 3-4 Shift Error (AODE/4R70W, E4OD)
- 628 — TCC Engagement Error (AODE/4R70W, AX4N, AX4S, CD4E, E4OD)
- 645 — No 1st Gear (AX4N, AX4S, CD4E)
- 646 — No 2nd Gear (AX4N, AX4S, CD4E)
- 647 — No 3rd Gear (AX4N, AX4S, CD4E)
- 648 — No 4th Gear (AX4N, AX4S, CD4E)
- 656 — TCC Continuous Slip (AODE/4R70W, AX4N, AX4S)

OBD-II Codes

- P0731 — No 1st Gear (AX4N, AX4S, CD4E)
- P0732 — No 2nd Gear (AX4N, AX4S, CD4E)
- P0733 — No 3rd Gear (AX4N, AX4S, CD4E)
- P0734 — No 4th Gear (AX4N, AX4S, CD4E)
- P0741 — TCC Engagement Error (AX4N, AX4S, CD4E)
- P0751 — SS1 Mechanical Failure (AODE/4R70W, AX4N, AX4S, E4OD)
- P0756 — SS2 Mechanical Failure (AODE/4R70W, AX4N, AX4S, E4OD)
- P0761 — SS3 Mechanical Failure (AX4N, AX4S)
- P0781 — 1-2 Shift Error (E4OD)
- P0782 — 2-3 Shift Error (E4OD)
- P0783 — 3-4 Shift Error (E4OD)
- P1728 — Transmission Slipping (E4OD)
- P1731 — 1-2 Shift Error (AODE/4R70W)
- P1732 — 2-3 Shift Error (AODE/4R70W)
- P1733 — 3-4 Shift Error (AODE/4R70W)
- P1741 — TCC Engagement Error (AODE/4R70W, AX4N, AX4S)
- P1751 — SS1 Mechanical Failure (AX4N, AX4S)
- P1756 — SS2 Mechanical Failure (AX4N, AX4S)
- P1761 — SS3 Mechanical Failure (AX4N, AX4S)
- P1784 — Mechanical Failure; 1st/Rev (AX4N, AX4S)
- P1785 — Mechanical Failure; 1st/2nd (AX4N, AX4S)

About the Components

Transmission ratio is a feedback feature the computer uses to determine whether the transmission is following its commands. In *all* cases, the computer will compare some type of input sensor speed to an output sensor speed. The degree of sensitivity and accuracy the computer has is based on the number of sensors it uses.

Ford Code Troubleshooting (continued)

Ratio Errors (continued)

About the Components (continued)

For example, the E4OD uses only engine RPM as the input and the vehicle speed sensor as the output. The AODE/4R70W isn't much better; it uses only engine RPM as the input and the output sensor as the output. Because of this, the computer can't discern between a TCC slip or a slip in the transmission itself.

On the other hand, the AX4N, AX4S, and CD4E compare engine RPM to the turbine shaft RPM for monitoring TCC slip, and turbine shaft RPM to output RPM for ratio errors in first, second, third and fourth gears. Recognizing *how* each unit monitors the various ratios will help you pinpoint the cause of the code, and ultimately allow you to fix the problem.

Setting the Code

The E4OD and AODE/4R70W compare engine RPM to output shaft RPM. Because of this, the computer really has no idea whether a slip is in the converter or the transmission itself.

On the other hand, the AX4N, AX4S, and CD4E have a turbine shaft sensor, so their systems *can* see the difference between a TCC slip and a slip in the trans. For checking internal slips, the computer simply compares turbine RPM with output RPM and references the ratio with the ratio in its programming for that gear.

Unfortunately, Ford doesn't include the RPM thresholds for setting any ratio error codes. Instead, they use a transmission tester, along with some electric tests, which are intended to *rule out* everything but the TCC or internal component.

Using a Scan Tool

If you're working on a TCC slip, set your scan tool to monitor engine RPM, turbine shaft RPM, TCC slip, and TCC duty cycle. Compare your scan tool's engine RPM reading to the actual engine RPM, and make sure the turbine shaft speed and output speed are zero when the vehicle is stopped and in gear. If any of these readings is incorrect, you may be facing a problem caused by electrical interference. The best way to isolate this type of interference is with an oscilloscope.

If the initial readings look okay, drive the vehicle at light throttle while monitoring TCC slip and TCC duty cycle. Normally TCC slip will fall between zero and 10 RPM. On models with a modulated converter clutch, the computer typically commands 102% duty cycle. If it looks okay, begin increasing the throttle. If TCC slip begins to increase — as well as TCC duty cycle — you have a legitimate TCC slip.

IMPORTANT This is a tricky test. If you want to get good at this you *must* use your scan tool on vehicles that are running properly, to be able to recognize how the system should be working. Also, just like the TCC slip problem, make sure engine RPM is correct and both the input and output shaft RPM read zero, while the unit is in gear and vehicle is stationary.

And just like a TCC slip problem, you'll want to add torque to the trans while monitoring the slip, to see if it increases. Again, checking vehicles that are working right *before* you come across a problem vehicle will help you interpret the test results.

Ford Code Troubleshooting (continued)

Ratio Errors (continued)

Using a Scan Tool (continued)

DIAGNOSTIC TIP A transmission may have ratio errors and TCC slip problems because of a bad alternator, which is sending an AC signal through the vehicle wiring. To test for this, disconnect the alternator and see if the codes go away.

E4OD and AODE/4R70W TCC slip codes:

Because these units don't have a turbine shaft sensor, their computers can't differentiate between a TCC slip and internal transmission slip. You may see a code for a TCC slip when there's really nothing wrong with the unit — particularly if you've just replaced the computer.

The fix? Change your driving habits. That is, when you go for your test drive, *don't let the trans shift to overdrive; only let it shift into third gear*. This way, the computer will *learn* what a 1:1 ratio looks like. After 10 or 15 minutes of driving in third gear (take it on the freeway), you can enable overdrive. Now the computer will use what it knows about the 1:1 ratio it just learned, *and* the OD ratio it already knows, and have a better chance of recognizing a *true* TCC slip.

AODE/4R70W transmission slip codes:

The AODE/4R70W transmissions are almost identical. But one of the most important differences is they have different gear ratios. Because of this, you can get a ratio error code by using the planetary set for one unit in the other transmission. If you're getting codes that involve a slip of any kind, find out first whether someone used the wrong planet.

Ford Code Troubleshooting (continued)

Ratio Errors (continued)

Using a Scan Tool (continued)

AX4S TCC slip codes:

The AX4S comes with different sprocket ratios, based on the model and engine size. Using the wrong sprockets will affect the ratio between the driven sprocket (where the turbine sensor monitors) and the input shaft. The computer uses the sprocket ratio in its calculations for TCC slip, so the wrong sprockets will affect its calculations. The following chart shows what sprockets go with each model.

AX4S Transaxle Sprocket and Chain Application				
Application	Drive Sprocket	Driven Sprocket	Chain	Ratio
91–95 3.0L Taurus/Sable 91–95 3.8L Police Units 91–94 3.8L Continental 95 3.8L Windstar	37 Teeth E6DZ-7G129A	36 Teeth F1DZ-7G132A	1 ID Link E6DZ-7G249A	3.37:1
91–95 3.8L Taurus/Sable	38 Teeth E9DZ-7G129A	35 Teeth F1DZ-7G132C	1 ID Link E6DZ-7G249A	3.19:1
93–95 3.2L Taurus SHO	35 Teeth F3DZ-7G129A	38 Teeth F3DZ-7G132B	3 ID Links F3DZ-7G249A	3.77:1
95–96 3.0L Windstar	34 Teeth F1DZ-7G129A	39 Teeth F1DZ-7G132B	1 ID Link E6DZ-7G249A	3.98:1
96 3.8L Windstar	38 Teeth E9DZ-7G129A	39 Teeth F1DZ-7G132B	2 ID Links F68Z-7G249A	3.56:1
96 3.0–3.2L Taurus/Sable	35 Teeth F6DZ-7G129A	38 Teeth F6DZ-7G132A	1 ID Link E6DZ-7G249A	3.77:1

DIAGNOSTIC TIP

If you want to be creative, you can take engine RPM and turbine shaft sensor RPM and calculate their ratio. Then compare it with the ratio in the chart. You may find an exact match — perhaps the *wrong* exact match, but at least it'll send you in the right direction.

Diagnostic Trouble Codes

Reading the Codes

One type of standardization introduced with OBD-II was the J-1930 standard for diagnostic trouble codes (DTC). These codes must now follow a standard for format and definition from manufacturer to manufacturer.

Here's how to read and interpret these codes:

Example Code: P1709

Code Type: _____

P = Powertrain
C = Chassis
B = Body

Assigned By: _____

0 = SAE
1 = Vehicle Manufacturer

System: _____

0 = Total System
1 = Air/Fuel Control
2 = Air/Fuel Control
3 = Ignition System or Misfire
4 = Auxiliary Emission Controls
5 = Idle or Speed Controls
6 = Computer System (PCM or I/O)
7 = Transmission
8 = Non-Computer Controlled Powertrain

Specific Problem: _____

So code P1709 indicates:

P = Powertrain Code
1 = Defined by the vehicle manufacturer
7 = Transmission
09 = Kickdown servo switch is shorted or open

Diagnostic Trouble Codes (continued)

SAE Defined Codes

P01XX Fuel and Air Metering

P0100	Mass or Volume Airflow Circuit Problem
P0101	Mass or Volume Airflow Circuit Range or Performance Problem
P0102	Mass or Volume Airflow Circuit Low Input
P0103	Mass or Volume Airflow Circuit High Input
P0105	MAP or BARO Circuit Problem
P0106	MAP or BARO Circuit Range or Performance Problem
P0107	MAP or BARO Circuit Low Input
P0108	MAP or BARO Circuit High Input
P0110	Intake Air Temperature Circuit Problem
P0111	Intake Air Temperature Circuit Range or Performance Problem
P0112	Intake Air Temperature Circuit Low Input
P0113	Intake Air Temperature Circuit High Input
P0115	Engine Coolant Temperature Circuit Problem
P0116	Engine Coolant Temperature Circuit Range or Performance Problem
P0117	Engine Coolant Temperature Circuit Low Input
P0118	Engine Coolant Temperature Circuit High Input
P0120	Throttle Position Circuit Problem
P0121	Throttle Position Circuit Range or Performance Problem
P0122	Throttle Position Circuit Low Input
P0123	Throttle Position Circuit High Input
P0125	Excessive Time to Enter Closed Loop Fuel Control
P0130	O ₂ Sensor Circuit Problem (Bank 1 Sensor 1)
P0131	O ₂ Sensor Circuit Low Voltage (Bank 1 Sensor 1)
P0132	O ₂ Sensor Circuit High Voltage (Bank 1 Sensor 1)
P0133	O ₂ Sensor Circuit Slow Response (Bank 1 Sensor 1)
P0134	O ₂ Sensor Circuit No Activity Detected (Bank 1 Sensor 1)
P0135	O ₂ Sensor Heater Circuit Problem (Bank 1 Sensor 1)
P0136	O ₂ Sensor Circuit Problem (Bank 1 Sensor 2)
P0137	O ₂ Sensor Circuit Low Voltage (Bank 1 Sensor 2)
P0138	O ₂ Sensor Circuit High Voltage (Bank 1 Sensor 2)
P0139	O ₂ Sensor Circuit Slow Response (Bank 1 Sensor 2)
P0140	O ₂ Sensor Circuit No Activity Detected (Bank 1 Sensor 2)
P0141	O ₂ Sensor Heater Circuit Problem (Bank 1 Sensor 2)
P0142	O ₂ Sensor Circuit Problem (Bank 1 Sensor 3)

Diagnostic Trouble Codes (continued)

SAE Defined Codes (continued)

P01XX Fuel and Air Metering (continued)

P0143	O ₂ Sensor Circuit Low Voltage (Bank 1 Sensor 3)
P0144	O ₂ Sensor Circuit High Voltage (Bank 1 Sensor 3)
P0145	O ₂ Sensor Circuit Slow Response (Bank 1 Sensor 3)
P0146	O ₂ Sensor Circuit No Activity Detected (Bank 1 Sensor 3)
P0147	O ₂ Sensor Heater Circuit Problem (Bank 1 Sensor 3)
P0150	O ₂ Sensor Circuit Problem (Bank 2 Sensor 1)
P0151	O ₂ Sensor Circuit Low Voltage (Bank 2 Sensor 1)
P0152	O ₂ Sensor Circuit High Voltage (Bank 2 Sensor 1)
P0153	O ₂ Sensor Circuit Slow Response (Bank 2 Sensor 1)
P0154	O ₂ Sensor Circuit No Activity Detected (Bank 2 Sensor 1)
P0155	O ₂ Sensor Heater Circuit Problem (Bank 2 Sensor 1)
P0156	O ₂ Sensor Circuit Problem (Bank 2 Sensor 2)
P0157	O ₂ Sensor Circuit Low Voltage (Bank 2 Sensor 2)
P0158	O ₂ Sensor Circuit High Voltage (Bank 2 Sensor 2)
P0159	O ₂ Sensor Circuit Slow Response (Bank 2 Sensor 2)
P0160	O ₂ Sensor Circuit No Activity Detected (Bank 2 Sensor 2)
P0161	O ₂ Sensor Heater Circuit Problem (Bank 2 Sensor 2)
P0162	O ₂ Sensor Circuit Problem (Bank 2 Sensor 3)
P0163	O ₂ Sensor Circuit Low Voltage (Bank 2 Sensor 3)
P0164	O ₂ Sensor Circuit High Voltage (Bank 2 Sensor 3)
P0165	O ₂ Sensor Circuit Slow Response (Bank 2 Sensor 3)
P0166	O ₂ Sensor Circuit No Activity Detected (Bank 2 Sensor 3)
P0167	O ₂ Sensor Heater Circuit Problem (Bank 2 Sensor 3)
P0170	Fuel Trim Problem (Bank 1)
P0171	System Too Lean (Bank 1)
P0172	System Too Rich (Bank 1)
P0173	Fuel Trim Problem (Bank 2)
P0174	System Too Lean (Bank 2)
P0175	System Too Rich (Bank 2)
P0176	Fuel Composition Sensor Circuit Problem
P0177	Fuel Composition Sensor Circuit Range or Performance
P0178	Fuel Composition Sensor Circuit Low Input
P0179	Fuel Composition Sensor Circuit High Input
P0180	Fuel Temperature Sensor Circuit Problem

Diagnostic Trouble Codes (continued)

SAE Defined Codes (continued)

P01XX Fuel and Air Metering (continued)

- P0181 Fuel Temperature Sensor Circuit Range or Performance
- P0182 Fuel Temperature Sensor Circuit Low Input
- P0183 Fuel Temperature Sensor Circuit High Input

P02XX Fuel and Air Metering

- P0201 Injector Circuit Problem — Cylinder 1
- P0202 Injector Circuit Problem — Cylinder 2
- P0203 Injector Circuit Problem — Cylinder 3
- P0204 Injector Circuit Problem — Cylinder 4
- P0205 Injector Circuit Problem — Cylinder 5
- P0206 Injector Circuit Problem — Cylinder 6
- P0207 Injector Circuit Problem — Cylinder 7
- P0208 Injector Circuit Problem — Cylinder 8
- P0209 Injector Circuit Problem — Cylinder 9
- P0210 Injector Circuit Problem — Cylinder 10
- P0211 Injector Circuit Problem — Cylinder 11
- P0212 Injector Circuit Problem — Cylinder 12
- P0213 Cold Start Injector 1 Problem
- P0214 Cold Start Injector 2 Problem

P03XX Ignition System or Misfire

- P0300 Random Misfire Detected
- P0301 Cylinder 1 Misfire Detected
- P0302 Cylinder 2 Misfire Detected
- P0303 Cylinder 3 Misfire Detected
- P0304 Cylinder 4 Misfire Detected
- P0305 Cylinder 5 Misfire Detected
- P0306 Cylinder 6 Misfire Detected
- P0307 Cylinder 7 Misfire Detected
- P0308 Cylinder 8 Misfire Detected
- P0309 Cylinder 9 Misfire Detected
- P0310 Cylinder 10 Misfire Detected
- P0311 Cylinder 11 Misfire Detected
- P0312 Cylinder 12 Misfire Detected

Diagnostic Trouble Codes (continued)

SAE Defined Codes (continued)

P03XX Ignition System or Misfire (continued)

- P0320 Ignition or Distributor Engine Speed Input Circuit Problem
- P0321 Ignition or Distributor Engine Speed Input Circuit Range or Performance
- P0322 Ignition or Distributor Engine Speed Input Circuit No Signal
- P0325 Knock Sensor 1 Circuit Problem
- P0326 Knock Sensor 1 Circuit Range or Performance
- P0327 Knock Sensor 1 Circuit Low Input
- P0328 Knock Sensor 1 Circuit High Input
- P0330 Knock Sensor 2 Circuit Problem
- P0331 Knock Sensor 2 Circuit Range or Performance
- P0332 Knock Sensor 2 Circuit Low Input
- P0333 Knock Sensor 2 Circuit High Input
- P0335 Crankshaft Position Sensor Circuit Problem
- P0336 Crankshaft Position Sensor Circuit Range or Performance
- P0337 Crankshaft Position Sensor Circuit Low Input
- P0338 Crankshaft Position Sensor Circuit High Input

P04XX Auxiliary Emission Controls

- P0400 Exhaust Gas Recirculation Flow Problem
- P0401 Exhaust Gas Recirculation Flow Insufficient Detected
- P0402 Exhaust Gas Recirculation Flow Excessive Detected
- P0405 Air Conditioner Refrigerant Charge Loss
- P0410 Secondary Air Injection System Problem
- P0411 Secondary Air Injection System Insufficient Flow Detected
- P0412 Secondary Air Injection System Switching Valve or Circuit Problem
- P0413 Secondary Air Injection System Switching Valve or Circuit Open
- P0414 Secondary Air Injection System Switching Valve or Circuit Shorted
- P0420 Catalyst System Efficiency Below Threshold (Bank 1)
- P0421 Warm Up Catalyst Efficiency Below Threshold (Bank 1)
- P0422 Main Catalyst Efficiency Below Threshold (Bank 1)
- P0423 Heated Catalyst Efficiency Below Threshold (Bank 1)
- P0424 Heated Catalyst Temperature Below Threshold (Bank 1)
- P0430 Catalyst System Efficiency Below Threshold (Bank 2)
- P0431 Warm Up Catalyst Efficiency Below Threshold (Bank 2)
- P0432 Main Catalyst Efficiency Below Threshold (Bank 2)

Diagnostic Trouble Codes (continued)

SAE Defined Codes (continued)

P04XX Auxiliary Emission Controls (continued)

- P0433 Heated Catalyst Efficiency Below Threshold (Bank 2)
- P0434 Heated Catalyst Temperature Below Threshold (Bank 2)
- P0440 Evaporative Emission Control System Problem
- P0441 Evaporative Emission Control System Insufficient Purge Flow
- P0442 Evaporative Emission Control System Leak Detected
- P0443 Evaporative Emission Control System Purge Control Valve Circuit Problem
- P0444 Evaporative Emission Control System Purge Control Valve Circuit Open
- P0445 Evaporative Emission Control System Purge Control Valve Circuit Shorted
- P0446 Evaporative Emission Control System Vent Control Problem
- P0447 Evaporative Emission Control System Vent Control Open
- P0448 Evaporative Emission Control System Vent Control Shorted
- P0450 Evaporative Emission Control System Pressure Sensor Problem
- P0451 Evaporative Emission Control System Pressure Sensor Range or Performance
- P0452 Evaporative Emission Control System Pressure Sensor Low Input
- P0453 Evaporative Emission Control System Pressure Sensor High Input

P05XX Vehicle Speed Control and Idle Control System

- P0500 Vehicle Speed Sensor Problem
- P0501 Vehicle Speed Sensor Range or Performance
- P0502 Vehicle Speed Sensor Low Input
- P0505 Idle Control System Problem
- P0506 Idle Control System RPM Lower Than Expected
- P0507 Idle Control System RPM Higher Than Expected
- P0510 Closed Throttle Position Switch Problem

P06XX Computer and Output Circuits

- P0600 Serial Communication Link Problem
- P0605 Internal Control Module (Module Identification Defined by J1979)

Diagnostic Trouble Codes (continued)

SAE Defined Codes (continued)

P07XX Transmission

P0703	Brake Switch Input Problem
P0705	Transmission Range Sensor Circuit Problem (PRNDL Input)
P0706	Transmission Range Sensor Circuit Range or Performance
P0707	Transmission Range Sensor Circuit Low Input
P0708	Transmission Range Sensor Circuit High Input
P0710	Transmission Fluid Temperature Sensor Circuit Problem
P0711	Transmission Fluid Temperature Sensor Circuit Range or Performance
P0712	Transmission Fluid Temperature Sensor Circuit Low Input
P0713	Transmission Fluid Temperature Sensor Circuit High Input
P0715	Input or Turbine Speed Sensor Circuit Problem
P0716	Input or Turbine Speed Sensor Circuit Range or Performance
P0717	Input or Turbine Speed Sensor Circuit No Signal
P0720	Output Speed Sensor Circuit Problem
P0721	Output Speed Sensor Circuit Range or Performance
P0722	Output Speed Sensor Circuit No Signal
P0725	Engine Speed Input Circuit Problem
P0726	Engine Speed Input Circuit Range or Performance
P0727	Engine Speed Input Circuit No Signal
P0730	Incorrect Gear Ratio
P0731	Gear 1 Incorrect Ratio
P0732	Gear 2 Incorrect Ratio
P0733	Gear 3 Incorrect Ratio
P0734	Gear 4 Incorrect Ratio
P0735	Gear 5 Incorrect Ratio
P0736	Reverse Incorrect Ratio
P0740	Torque Converter Clutch System Problem
P0741	Torque Converter Clutch System Performance or Stuck Off
P0742	Torque Converter Clutch System Stuck On
P0743	Torque Converter Clutch System Electrical
P0745	Pressure Control Solenoid Problem
P0746	Pressure Control Solenoid Performance or Stuck Off
P0747	Pressure Control Solenoid Stuck On
P0748	Pressure Control Solenoid Electrical
P0750	Shift Solenoid A Problem

Diagnostic Trouble Codes (continued)

SAE Defined Codes (continued)

P07XX Transmission (continued)

P0751	Shift Solenoid A Performance or Stuck Off
P0752	Shift Solenoid A Stuck On
P0753	Shift Solenoid A Electrical
P0755	Shift Solenoid B Problem
P0756	Shift Solenoid B Performance or Stuck Off
P0757	Shift Solenoid B Stuck On
P0758	Shift Solenoid B Electrical
P0760	Shift Solenoid C Problem
P0761	Shift Solenoid C Performance or Stuck Off
P0762	Shift Solenoid C Stuck On
P0763	Shift Solenoid C Electrical
P0765	Shift Solenoid D Problem
P0766	Shift Solenoid D Performance or Stuck Off
P0767	Shift Solenoid D Stuck On
P0768	Shift Solenoid D Electrical
P0770	Shift Solenoid E Problem
P0771	Shift Solenoid E Performance or Stuck Off
P0772	Shift Solenoid E Stuck On
P0773	Shift Solenoid E Electrical

Diagnostic Trouble Codes (continued)

GM Specific Codes

P11XX Fuel and Air Metering

- P1106 MAP Sensor Circuit Intermittent High Voltage
- P1107 MAP Sensor Circuit Intermittent Low Voltage
- P1108 BARO to MAP Signal Comparison Too High
- P1111 IAT Sensor Circuit Intermittent High Voltage (Low Temperature)
- P1112 IAT Sensor Circuit Intermittent Low Voltage (High Temperature)
- P1114 ECT Sensor Circuit Intermittent Low Voltage (High Temperature)
- P1115 ECT Sensor Circuit Intermittent High Voltage (Low Temperature)
- P1121 TP Sensor Circuit Intermittent High Voltage
- P1122 TP Sensor Circuit Intermittent Low Voltage
- P1125 Accelerator Pedal Position Sensor System Fault
- P1133 HO₂S1 Insufficient Switches (Bank 1 Sensor 1)
- P1134 HO₂S1 Transition Time Ratio (Bank 1 Sensor 1)
- P1139 HO₂S2 Insufficient Switching (Bank 1 Sensor 2)
- P1140 HO₂S2 Transmission Time Ratio (Bank 1 Sensor 2)
- P1153 HO₂S1 Insufficient Switches (Bank 2 Sensor 1)
- P1154 HO₂S1 Transition Time Ratio (Bank 2 Sensor 1)
- P1158 HO₂S2 Shifted Rich (Bank 2 Sensor 2)
- P1171 Fuel System Lean During Acceleration
- P1187 Engine Oil Temperature Sensor Low Voltage
- P1188 Engine Oil Temperature Sensor High Voltage

P12XX Fuel and Air Metering

- P1200 Fuel Injector Circuit Fault
- P1214 Fuel Injector Pump Timing Offset
- P1215 Generator GFD Fault
- P1216 Fuel Solenoid Response Time Too Short
- P1217 Fuel Solenoid Response Time Too Long
- P1218 Injection Pump Calibration Circuit Fault
- P1221 Fuel Injector Secondary System Circuit Low Input
- P1222 Fuel Injector Control Circuit Intermittent
- P1250 Early Fuel Evaporation (EFE) Heater Circuit Fault
- P1257 Boost Control Circuit Fault
- P1257 Supercharger System Overboost Fault
- P1258 Engine Metal Over-Temperature Protection

Diagnostic Trouble Codes (continued)

GM Specific Codes (continued)

P13XX Ignition System or Misfire

- P1300 Ignition Control Module (Igniter) Circuit
- P1320 ICM 4x Reference Circuit Intermittent, No Pulses
- P1323 ICM 24x Reference Circuit Low Frequency
- P1335 Crankshaft Position Sensor Circuit
- P1345 Camshaft to Crankshaft Position Correlation Fault
- P1350 IC System, Bypass Line Monitor Fault
- P1351 Ignition Control Module Circuit High Voltage
- P1351 Ignition Control Circuit 1 & 4, Short-to-Voltage
- P1352 Ignition Control Circuit 2 & 3, Short-to-Voltage
- P1361 Ignition Control Not Toggling After Enable (Low Voltage)
- P1370 IC Module 4x Reference Circuit Too Many Pulses
- P1371 IC Module 4x Reference Circuit Too Few Pulses
- P1374 IC Module 3x Reference Circuit Fault
- P1375 IC Module 24x Reference Circuit High Voltage
- P1376 IC Module Ignition Ground Circuit Fault
- P1377 ICM CMP Pulse to 4x Reference Pulse Comparison
- P1380 EBTCM DTC Detected, Rough Road Data Unusable
- P1381 Engine Misfire Detected, No EBTCM/PCM Serial Data

P14XX Auxiliary Emission Controls

- P1401 Exhaust Gas Recirculation Flow Test Fault
- P1403 Exhaust Gas Recirculation Error (EGR No. 1)
- P1404 Exhaust Gas Recirculation Error (EGR No. 2)
- P1405 Exhaust Gas Recirculation Error (EGR No. 3)
- P1406 EGR Valve Pintle Position Circuit Fault
- P1410 Fuel Tank Pressure System Fault
- P1415 Secondary Air Injection System (Bank 1)
- P1416 Secondary Air Injection System (Bank 2)
- P1441 EVAP Control System Flow During Non-Purge
- P1442 EVAP Vacuum Switch High Voltage at Ignition On
- P1450 Barometric Pressure Sensor Circuit Fault
- P1451 Barometric Pressure Sensor Performance
- P1460 Cooling Fan Control System Fault

Diagnostic Trouble Codes (continued)

GM Specific Codes (continued)

P15XX Vehicle Speed Control and Idle Control System

- P1500 Starter Signal Circuit Fault
- P1508 Idle Air Control System Low RPM; Valve Stuck Closed
- P1509 Idle Air Control System High RPM; Valve Stuck Open
- P1510 Backup Power Supply Fault
- P1520 Park Neutral Position Switch Circuit Fault
- P1524 TP Learned Closed Throttle Degrees Out-of-Range
- P1526 TP Sensor Learn Not Completed
- P1530 Ignition Timing Adjustment Switch Circuit
- P1530 Air Conditioning Refrigerant Pressure Sensor Error
- P1531 Low Air Conditioning Refrigerant Charge
- P1532 A/C Evaporative Temperature Sensor Circuit Low Voltage
- P1533 A/C Evaporative Temperature Sensor Circuit High Voltage
- P1535 A/C High Side Temperature Sensor Circuit Fault
- P1536 A/C System, ECT Sensor Over-Temperature
- P1537 A/C Request Circuit Voltage Low
- P1538 A/C Request Circuit Voltage High
- P1539 A/C High Pressure Switch High Voltage
- P1540 A/C System High Pressure
- P1542 A/C System, High Pressure/High Temperature
- P1543 A/C System Performance
- P1545 A/C Clutch Relay Control Circuit
- P1546 A/C Clutch Status Circuit Low Voltage
- P1550 Stepper Motor Cruise Control Fault
- P1554 Cruise Engaged Circuit High Voltage
- P1555 Electronic Variable Orifice Fault
- P1558 Cruise Control System, SPS Circuit Indicated Low
- P1560 Cruise Control System, Transaxle Not in Drive
- P1561 Cruise Vent Solenoid Circuit Fault
- P1562 Cruise Vacuum Solenoid Circuit Fault
- P1564 Cruise Control, Vehicle Acceleration Too High
- P1565 Cruise Servo Position Sensor Fault
- P1566 Cruise Control System, Engine RPM Too High
- P1567 Cruise Switches Circuit Fault

Diagnostic Trouble Codes (continued)

GM Specific Codes (continued)

P15XX Vehicle Speed Control and Idle Control System (continued)

- P1568 Cruise Control System, SPS Circuit Indicated High
- P1570 Cruise Control System, Traction Control Active
- P1571 Traction Control System, PWM Circuit No Frequency; Desired Torque Out-of-Range
- P1572 Traction Control System, Circuit Low Too Long
- P1573 TCS, Loss of ABS/TCS Serial Data
- P1754 EBTCS Stop Lamp Switch Circuit High Voltage
- P1575 Extended Travel Brake Switch, Circuit High Voltage
- P1576 Brake Booster Vacuum Sensor Circuit High Voltage
- P1577 Brake Booster Vacuum Sensor Circuit Low Voltage

P15XX Vehicle Speed Control and Idle Control System (continued)

- P1578 Brake Booster Vacuum Sensor Circuit Low Vacuum
- P1579 P/N to Drive or Reverse at High Throttle Angle
- P1580 Cruise Control Module Move Circuit, Low Voltage
- P1581 Cruise Control Module Move Circuit, High Voltage
- P1582 Cruise Control Module Direction Low Voltage
- P1583 Cruise Control Direction Circuit High Voltage
- P1584 Cruise Control Disabled
- P1599 Cruise Power Management Mode Enabled
- P1599 Engine Stall Or Near Stall Detected

Diagnostic Trouble Codes (continued)

GM Specific Codes (continued)

P16XX Computer and Output Circuits

P1600	PCM (ECM) Battery Circuit Fault
P1601	PCM Serial Communications Fault
P1602	Loss of EBTSM Serial Data; ABS Message Fault
P1603	Loss of Sensing Diagnostic Mode Data
P1604	Loss of IPC Serial Data
P1605	Loss of HVAC Serial Data
P1610	Loss of Platform Zone Module (PZM) Serial Data
P1611	Loss of CVRTD Serial Data
P1619	Engine Oil Reset Monitor Circuit Fault
P1620	Engine Coolant, Low Coolant Lever
P1621	PCM Memory Performance Error
P1623	PCM PROM Error
P1623	Transaxle Temperature Pullup Resistor Fault
P1624	Customer Snapshot Data Available
P1625	TCM Flash Checksum Fault
P1626	Theft Deterrent Signal Not Present, Engine Running
P1627	ECM/PCM Analog-to-Digital (A/D) Converter Fault
P1628	PCM Engine Control Temp Pullup Resistor Fault
P1629	Theft Deterrent Signal Not Present, Engine Cranking
P1630	Theft Deterrent System, PCM in Learn Mode
P1631	Theft Deterrent System, Password Incorrect
P1632	Theft Deterrent System, Fuel Disabled
P1633	Ignition Supplement Power Circuit Low Voltage
P1634	Ignition 1 Power Circuit Low Voltage
P1635	PCM 5-Volt Reference Circuit Error
P1637	Generator L Terminal Circuit Fault
P1638	Generator F Terminal Circuit Fault
P1639	5-Volt Reference B Circuit Fault
P1639	TCM Analog-to-Digital (A/D) Converter Fault
P1640	Output Driver Module A Circuit Fault
P1641	Fan Control Relay 1 Control Unit
P1641	Quad Driver Module A Quickset Fault Detected
P1642	Fan Control Relay 2 and 3 Control Circuit
P1642	Vehicle Speed Output Circuit Fault

Diagnostic Trouble Codes (continued)

GM Specific Codes (continued)

P16XX Computer and Output Circuits (continued)

P1642	Secondary AIR System Control Circuit Fault
P1643	Engine Speed (RPM) Output Circuit
P1643	Fuel Pump PWM Control Circuit
P1644	Delivered Torque Output Circuit Fault
P1645	EVAP Solenoid Output Circuit Fault
P1645	Boost Control Solenoid Circuit Fault
P1650	Output Driver Module B Circuit Fault
P1651	Fan 1 Control Relay Circuit Fault
P1651	Quad Driver Module B Quickset Fault Detected
P1652	Vehicle Speed Sensor Output Circuit Fault
P1652	Fan 2 Relay Control Circuit Fault
P1652	Lift/Drive Output Circuit Fault
P1653	Oil Level Lamp Control Circuit Fault
P1653	ETCS Torque Control Circuit Fault
P1653	EGR Vent Solenoid Control Circuit Fault
P1654	A/C Relay Control Circuit Fault
P1654	Service Throttle Soon Control Circuit Fault
P1654	Cruise Disable Output Circuit Fault
P1655	EVAP Purge Solenoid Control Circuit Fault
P1655	EGR Solenoid Control Circuit Fault
P1656	Wastegate Solenoid Control Circuit Fault
P1657	Skip Shift 1 to 4 Upshift System Control Circuit
P1660	Cooling Fan Control Circuit Fault
P1660	TCM Generator Field Driven (GFD) Device Fault
P1661	MIL Control Circuit Fault
P1662	Cruise Control Inhibit Control Circuit Fault
P1663	Change Oil Lamp Control Circuit
P1664	Skip Shift 1-4 Upshift Lamp Control Circuit
P1667	Reverse Inhibit Solenoid Control Circuit
P1670	Output Driver Module 4 Circuit Fault
P1672	Low Engine Oil Level Lamp Control Circuit
P1673	Engine Hot Lamp Control Circuit
P1675	EVAP Vent Solenoid Control Circuit
P1691	Coolant Gauge Circuit Fault

Diagnostic Trouble Codes (continued)

GM Specific Codes (continued)

P16XX Computer and Output Circuits (continued)

- P1693 Tachometer Circuit Fault
- P1695 Remote Keyless Entry Circuit Low
- P1697 Remote Keyless Entry Circuit High

P17XX Transmission

- P1780 Park/Neutral Position (PNP) Switch Fault

P18XX Non-Computer Controlled Powertrain

- P1810 Transmission Pressure Switch Assembly Fault
- P1811 Long Shift and Maximum Adaptive
- P1812 Transmission Fluid Over Temperature
- P1814 Torque Converter Overstress
- P1860 TCC PWM Solenoid Electrical Fault
- P1864 TCC Enable Solenoid Electrical Fault
- P1870 Transmission Component Slipping
- P1871 Undefined Gear Ratio
- P1875 Transmission 4WD Low Switch (Mechanical Shift)
- P1875 Transmission 4WD Low Switch (Electrical Shift)
- P1886 3-2 Timing Solenoid Performance

Diagnostic Trouble Codes (continued)

Ford Specific Codes

P11XX Fuel and Air Metering

- P1000 OBD-II Monitor Drive Cycle Not Completed
- P1001 KOER Self-Test Not Completed, Test Aborted
- P1100 Mass Airflow MAF Sensor Intermittent
- P1101 Mass Airflow MAF Sensor Out of Self-Test Range
- P1112 IAT Sensor Intermittent
- P1116 ECT Sensor Out of Self-Test Range
- P1117 ECT Sensor Intermittent
- P1120 TP Sensor Out of Range Low
- P1121 TP Sensor Not Consistent with MAF Sensor
- P1124 TP Sensor Out of Self-Test Range
- P1125 TP Sensor Circuit Intermittent
- P1127 Exhaust Not Warm Enough, HO₂S₂ Not Tested
- P1128 HO₂S₁ Wiring Crossed from Bank to Bank
- P1129 HO₂S₂ Wiring Crossed from Bank to Bank
- P1130 Fuel System Not Switching (Bank 1 Sensor 1)
- P1131 Lack of HO₂S₁ Switches, Lean (Bank 1, Sensor 1)
- P1132 Lack of HO₂S₁ Switches, Rich (Bank 1, Sensor 1)
- P1137 Lack of HO₂S₂ Switches, Lean (Bank 1, Sensor 2)
- P1138 Lack of HO₂S₂ Switches, Rich (Bank 1, Sensor 2)
- P1150 Lack of HO₂S₁ Switches (Bank 2, Sensor 1)
- P1151 Lack of HO₂S₁ Switches, Lean (Bank 2, Sensor 1)
- P1152 Lack of HO₂S₁ Switches, Rich (Bank 2, Sensor 1)
- P1157 Lack of HO₂S₂ Switches, Lean (Bank 2, Sensor 2)
- P1158 Lack of HO₂S₂ Switches, Rich (Bank 2, Sensor 2)

P12XX Fuel and Air Metering

- P1220 Series Throttle Control Fault
- P1224 TP Sensor B Out of Self-Test Range
- P1230 Fuel Pump Low Speed Fault
- P1231 Fuel Pump Secondary Circuit Low with Pump On
- P1232 Fuel Pump Low Speed Primary Circuit Fault
- P1233 Fuel Pump Driver Module Disabled
- P1234 Fuel Pump Driver Module Disabled
- P1235 Fuel Pump Control Out of Self-Test Range

Diagnostic Trouble Codes (continued)

Ford Specific Codes (continued)

P12XX Fuel and Air Metering (continued)

- P1236 Fuel Pump Control Out of Self-Test Range
- P1237 Fuel Pump Secondary Circuit Fault
- P1238 Fuel Pump Secondary Circuit Fault
- P1260 Theft Detected, Engine Disabled
- P1270 Engine RPM or Vehicle Speed Limiter Reached
- P1288 Engine Cylinder Head Temp Sensor Out-of-Range
- P1289 Engine Cylinder Head Temp Sensor Low Input
- P1290 Engine Cylinder Head Temp Sensor High Input
- P1299 Engine Over-Temperature Condition

P13XX Ignition System or Misfire

- P1351 Distributor IDM Circuit Input Fault
- P1352 Ignition Coil 1, 2, 3 or 4 Primary Circuit Fault
- P1356 PIP Signal Present with Engine Off
- P1358 IDM Out of Self-Test Range
- P1359 Spark Output SPOUT Circuit Fault
- P1364 Ignition Coil Primary Circuit Fault
- P1390 Octane Adjust Out of Self-Test Range

P14XX Auxiliary Emission Controls

- P1400 EGR EVP or DPFE Sensor Circuit Low Voltage Detected
- P1401 EGR EVP or DPFE Sensor Circuit High Voltage Detected
- P1403 DPFE Pressure Sensor Hoses Reversed
- P1405 DPFE Sensor Upstream Hose Off or Plugged
- P1406 DPFE Sensor Downstream Hose Off or Plugged
- P1407 No EGR Flow — Valve Stuck Closed or Faulty
- P1408 EGR Flow Out of Self-Test Range
- P1409 EGR EVR Control Circuit Fault
- P1411 Secondary AIR System Incorrect Downstream Flow
- P1413 Secondary Air System Monitor Circuit Low Voltage
- P1414 Secondary AIR System Monitor Circuit High Voltage
- P1442 Evaporative System Small Leak Detected
- P1443 EVAP Vacuum System, Purge or VMVV Fault
- P1444 Purge Flow Sensor Circuit Low Input

Diagnostic Trouble Codes (continued)

Ford Specific Codes (continued)

P14XX Auxiliary Emission Controls (continued)

- P1445 Purge Flow Sensor Circuit High Input
- P1450 Unable to Bleed Up Fuel Tank Vacuum
- P1452 Unable to Bleed Up Fuel Tank Vacuum
- P1455 Evaporative System Large Leak Detected
- P1460 WOT Air Conditioning Cutout Circuit Fault
- P1461 A/C Pressure Sensor Circuit High Input
- P1462 A/C Pressure Sensor Circuit Low Input
- P1463 A/C Pressure Sensor Insufficient Change
- P1464 A/C Demand Switch Out of Self-Test Range
- P1469 A/C Low Cycling Period
- P1473 Fan Secondary High with Fan(s) Off
- P1474 Low Fan Control Primary Circuit Fault
- P1479 High Fan Control Primary Circuit Fault
- P1480 Fan Secondary Low with Low Fan On
- P1481 Fan Secondary Low with High Fan On
- P1483 Power to Fan Circuit Over Current
- P1484 Open Main Ground Circuit to VLC Module

P15XX Vehicle Speed Control and Idle Control System

- P1500 Vehicle Speed Sensor Circuit Intermittent
- P1501 VSS Circuit Out of Self-Test Range
- P1504 Idle Air Control Circuit Fault
- P1505 Idle Air Control System at Adaptive Clip
- P1506 Idle Air Control Overspeed Error
- P1507 Idle Air Control Underspeed Error
- P1512 Intake Manifold Runner Control Closed (Bank 1)
- P1513 Intake Manifold Runner Control Closed (Bank 2)
- P1516 Intake Manifold Runner Control Error (Bank 1)
- P1517 Intake Manifold Runner Control Error (Bank 2)
- P1518 Intake Manifold Runner Control Error
- P1519 Intake Manifold Runner Control Error
- P1520 Intake Manifold Runner Control Circuit Fault
- P1530 Air Conditioning Clutch Circuit Fault

Diagnostic Trouble Codes (continued)

Ford Specific Codes (continued)

P15XX Vehicle Speed Control and Idle Control System (continued)

- P1537 Intake Manifold Runner Control Open (Bank 1)
- P1538 Intake Manifold Runner Control Open (Bank 2)
- P1539 Power to A/C Clutch Circuit Over Current
- P1550 PSP Sensor Out of Self-Test Range

P16XX Computer and Output Circuits

- P1605 PCM Keep Alive Memory (KAM) Test Error
- P1625 Battery Supply to VLC Module Fan Circuit
- P1626 Battery Supply to VLC Module A\C Circuit
- P1650 PSP Switch Out of Self-Test Range
- P1651 Power Steering Pressure Switch Input Fault

P17XX Transmission

- P1701 Reverse Engagement Error
- P1703 Brake On/Off Switch Out of Self-Test Range
- P1705 Transmission Range Sensor Out of Self-Test Range
- P1709 P/N Switch Not Indicating Neutral in KOEO Test
- P1711 TFT Sensor Out of Self-Test Range
- P1727 Transmission Coast Clutch Solenoid Fault
- P1728 Transmission Slip Fault
- P1729 Transmission 4x4 Low Switch Error
- P1741 Torque Converter Clutch Control Error
- P1742 TCC Solenoid Failed On, MIL Lamp On
- P1743 TCC Solenoid Failed On, TCIL Lamp On
- P1744 TCC Mechanical Noise or Stuck in Off Position
- P1746 Electronic Press Control Solenoid Open Circuit
- P1747 Electronic Press Control Solenoid Short Circuit
- P1749 Electronic Press Control Solenoid Failed Low
- P1751 Transmission Shift Solenoid SS1 Performance
- P1754 Coast Clutch Solenoid Circuit Fault
- P1756 Transmission Shift Solenoid SS2 Performance
- P1761 Transmission Shift Solenoid SS3 Performance
- P1780 Transmission Control Switch Out of Self-Test Range
- P1781 4x4 Low Switch Out of Self-Test Range

Diagnostic Trouble Codes (continued)

Ford Specific Codes (continued)

P17XX Transmission (continued)

- P1783 Transmission Over Temperature Condition
- P1784 Transmission First or Reverse Gear Electrical Fault
- P1785 Transmission First or Second Gear Electrical Fault
- P1786 Transmission Second or Third Gear Electrical Fault
- P1787 Transmission Third or Fourth Gear Electrical Fault
- P1788 Transmission 2-3 Timing or CCS Circuit Open
- P1789 Transmission 2-3 Timing or CCS Circuit Shorted

Diagnostic Trouble Codes (continued)

Chrysler Specific Codes

P12XX Fuel and Air Metering

- P1289 Manifold Tune Valve Solenoid Circuit Fault
- P1291 No Temperature Rise Seen From Intake Heaters
- P1292 CNG Pressure Sensor Voltage Too High
- P1293 CNG Pressure Sensor Voltage Too Low
- P1294 Engine Target Idle Speed Not Reached
- P1296 5-Volt Reference to MAP Sensor Missing
- P1297 No Change in MAP Signal from Start to Run
- P1299 Vacuum Leak Found with IAC Fully Seated

P13XX Ignition System or Misfire

- P1300 Ignition Timing Adjustment Circuit Fault
- P1390 Engine Timing Belt Skipped One or More Teeth
- P1391 Camshaft or Crankshaft Sensor Signal Intermittent
- P1398 Engine Misfire Adaptive Numerator At Limit

P14XX Auxiliary Emission Controls

- P1400 Manifold Differential Pressure Sensor Fault
- P1486 Evaporative System Hose Pinched
- P1487 High Speed Radiator Fan Control Relay Circuit Fault
- P1489 High Speed Fan Control Relay Circuit Fault
- P1490 Low Speed Fan Relay Circuit Fault
- P1491 Radiator Fan Relay Circuit Fault
- P1492 Battery Temp Sensor Voltage Too High
- P1493 Battery Temp Sensor Voltage Too Low
- P1494 EVAP Leak Detection Pump Pressure Switch
- P1495 EVAP Leak Detection Pump Solenoid Circuit
- P1496 5-Volt Supply Output Low
- P1498 Auxiliary 5-Volt Supply Output Low
- P1498 High Speed Radiator Fan Ground Control Relay Fault

P15XX Vehicle Speed Control and Idle Control System

- P1500 General Alternator FR Terminal Circuit Fault

Diagnostic Trouble Codes (continued)

Chrysler Specific Codes (continued)

P16XX Computer and Output Circuits

- P1696 PCM EEPROM Fault Write Denied
- P1697 PCM Fault, SRI Mileage Not Stored
- P1698 PCM Fault, No CCD Messages from TCM
- P1698 PCM Fault, EEPROM Write Denied

P17XX Transmission

- P1705 Transmission Range Sensor Never Indicates Park
- P1709 Transmission Range Sensor Never Indicates Park
- P1728 Transmission Slipping
- P1731 1–2 Shift Error
- P1732 2–3 Shift Error
- P1733 3–4 Shift Error
- P1738 Transaxle Overheat
- P1739 Powerup at Speed
- P1741 TCC Engagement Error
- P1743 TCC Circuit Failure
- P1744 TCC Engagement Error
- P1746 Open PCM Driver for EPC Solenoid
- P1747 EPC Circuit Failure
- P1751 SS1 Mechanical Failure
- P1754 Coast Clutch Solenoid Circuit Failure
- P1756 SS2 Mechanical Failure
- P1756 Governor Pressure Above 3 PSI in Gear at 0 MPH
- P1757 Governor Pressure Not Equal to Target at 15–20 PSI
- P1761 SS3 Mechanical Failure
- P1763 Governor Pressure Sensor Voltage Too High
- P1764 Governor Pressure Sensor Voltage Too Low
- P1765 Transmission 12V Supply Relay Control Circuit Fault
- P1767 EATX (Main Power) Relay is Always On
- P1768 EATX (Main Power) Relay is Always Off
- P1770 LR Clutch Volume Too Low
- P1771 2/4 Clutch Volume Too Low
- P1772 OD Clutch Volume Too Low

Diagnostic Trouble Codes (continued)

Chrysler Specific Codes (continued)

P17XX Transmission (continued)

- P1775 Solenoid Switch Valve Stuck in Lockup Position
- P1776 Solenoid Switch Valve Stuck in LR Position
- P1780 TCS Failure
- P1780 OD Pressure Switch Circuit Problem
- P1781 2/4 Pressure Switch Circuit Problem
- P1782 2/4 and OD Pressure Switch Circuits have a Problem
- P1783 LR Pressure Switch Circuit Problem
- P1784 LR and OD Pressure Switch Circuits have a Problem
- P1784 Mechanical Failure; 1st/Rev
- P1785 LR and 2/4 Pressure Switch Circuits have a Problem
- P1785 Mechanical Failure; 1st/2nd
- P1786 All Pressure Switch Circuits have a Problem
- P1787 OD Hydraulic Pressure Switch Circuit Problem
- P1788 2/4 Hydraulic Pressure Switch Circuit Problem
- P1788 3-2/CCS Solenoid Circuit Failure
- P1789 OD and 2/4 Hydraulic Pressure Switch Circuits have a Problem
- P1789 3-2/CCS Solenoid Circuit Failure
- P1790 Fault Immediately After a Shift (Slipping Clutch, Gear Ratio Error, etc.)
- P1791 Loss of Hydraulic Prime (Pump Drawing Air into the System)
- P1792 Battery was Disconnected
- P1793 Torque Reduction Data (TRD) Link Communication Error
- P1794 Sensor Ground is Loose or Damaged
- P1795 Internal 41TE Controller Error (E2 Memory Failure)
- P1796 Autostick Input Circuit Failure
- P1797 Manual Shift Overheat
- P1798 Worn Out or Burnt Transaxle Fluid
- P1799 Calculated Oil Temperature in Use (Thermistor Voltage is Out of Range)

P18XX Transmission

- P1862 Governor Pressure Sensor Voltage Too Low or High
- P1899 Park/Neutral Switch Circuit Fault

SCAN TOOL DIAGNOSIS

GM Contents

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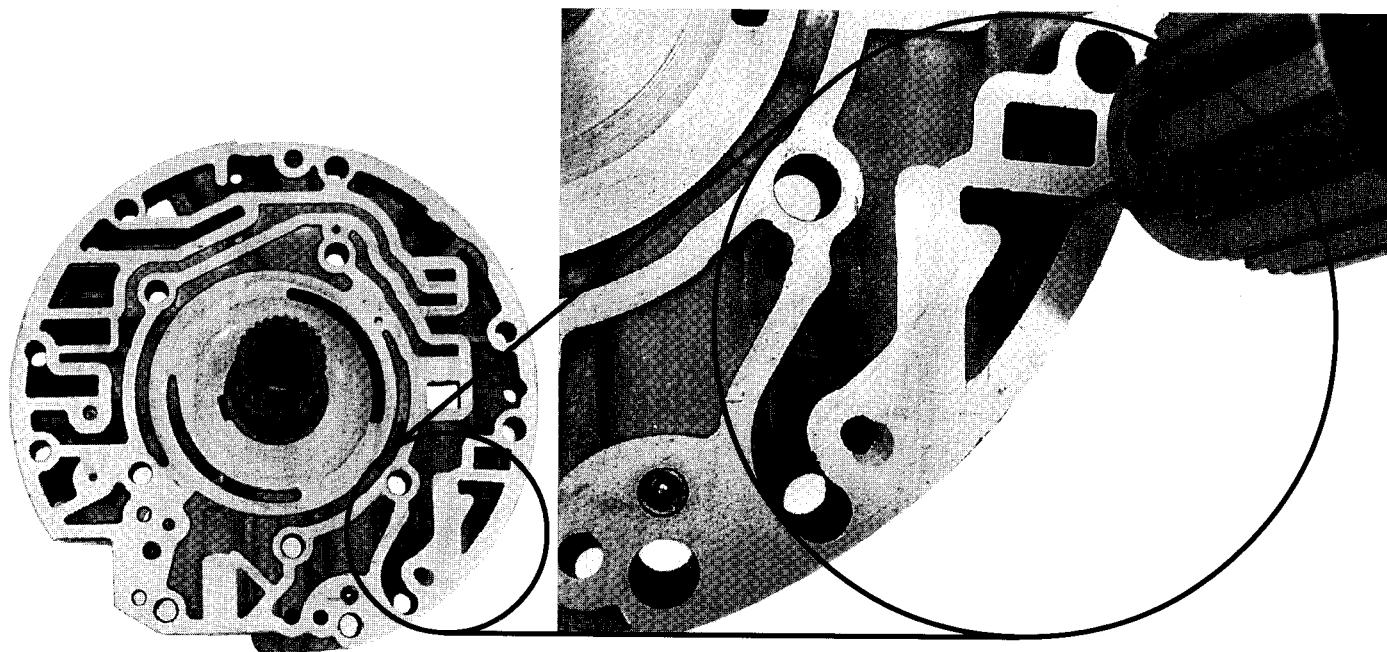
4L60/4L60E

Pump Interchange

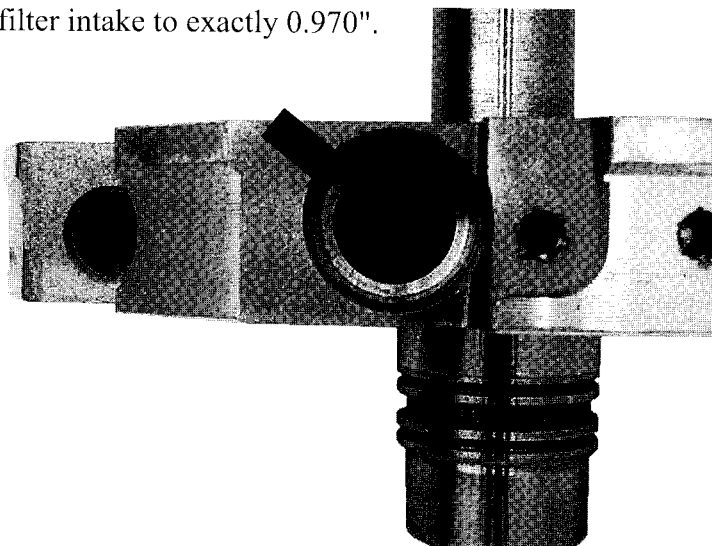
If you need a pump for a 1993 – 94 4L60E, you may use one from an 1985 – 93 4L60. The pump body on these units will interchange without modification.

You can also use the pump stator support, but for that you will have to make a few modifications that will require machine shop capabilities.

Modification 1: Drill a $\frac{1}{8}$ " exhaust hole as shown.



Modification 2: Enlarge the filter intake to exactly 0.970".

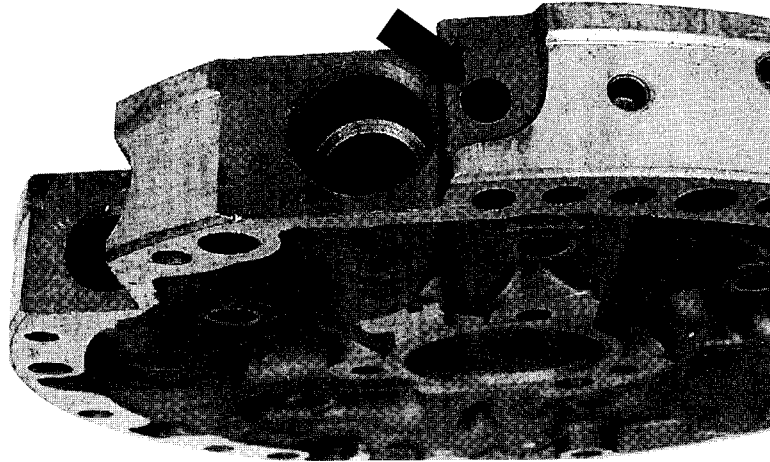


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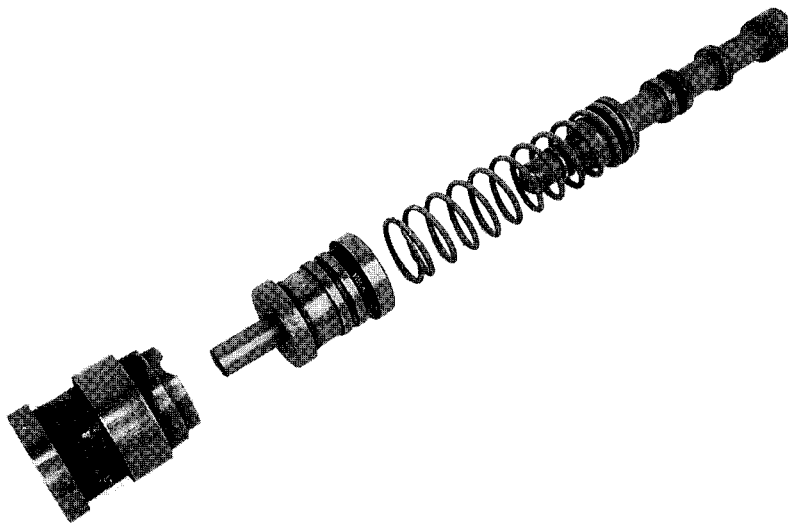
4L60/4L60E

Pump Interchange (continued)

Modification 3: If the pump is from a 1987 – 93 unit, you'll have to block the passage in the stator support for the forward clutch tube.



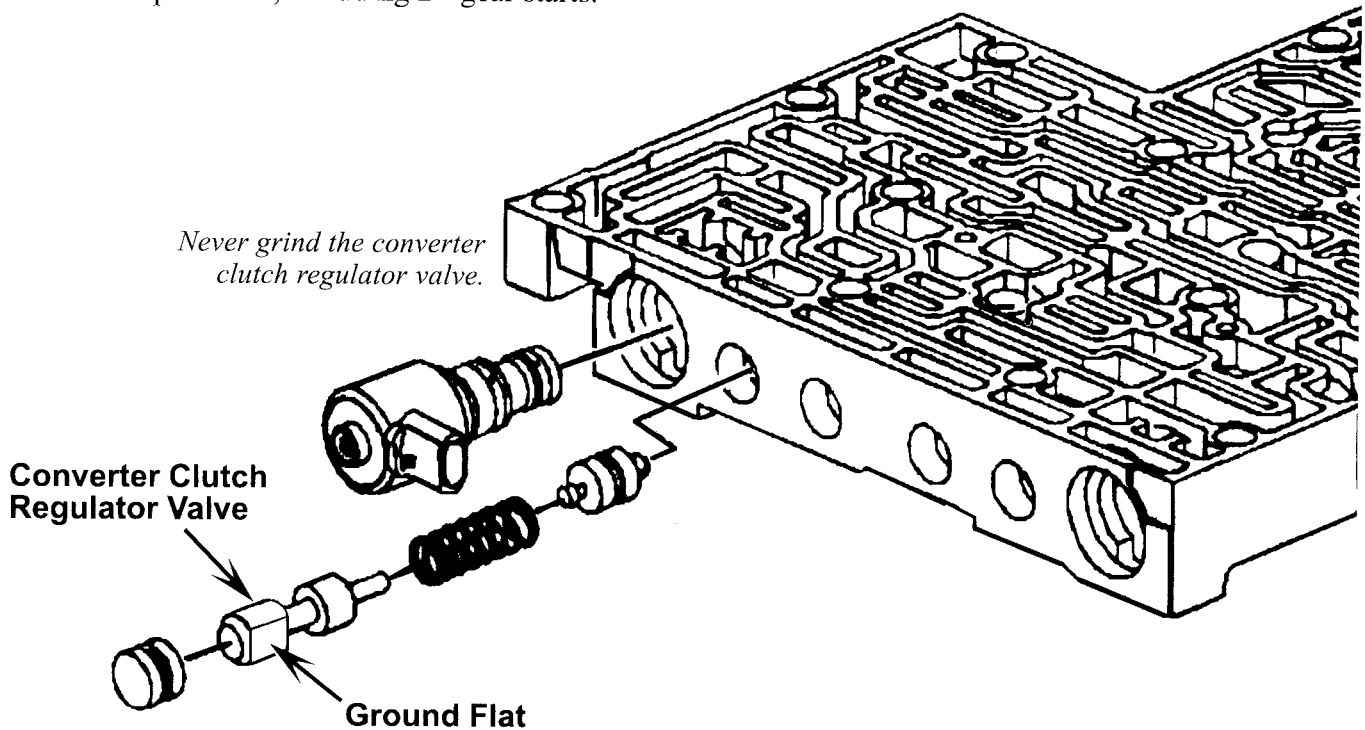
You'll also have to use the 4L60 (nonelectronic) pressure regulator valve assembly; the electronic style valve won't fit the pump.



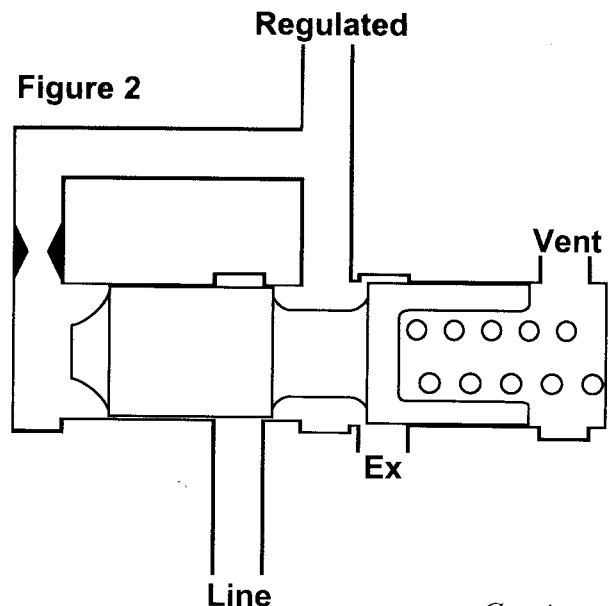
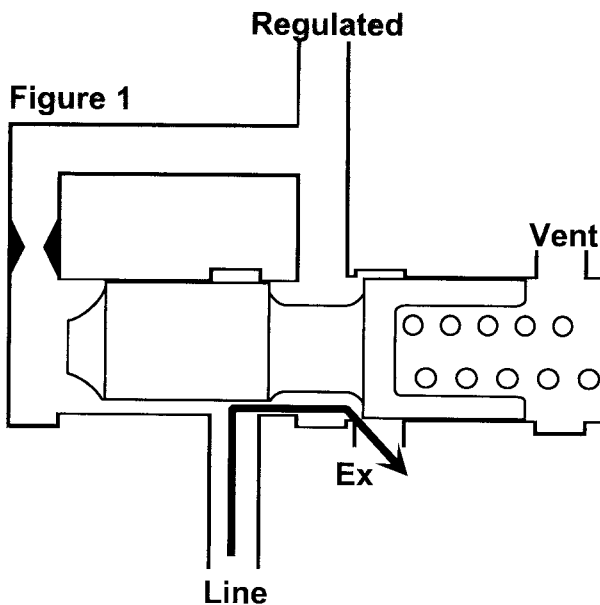
4L60E

Low Line Pressure; 2nd Gear Starts

A number of technicians have been attempting to improve converter clutch apply on a 4L60E by grinding the converter clutch regulator valve. While this may seem to improve converter clutch apply, it's more likely to cause other problems, including 2nd gear starts.



This doesn't just apply to the converter clutch regulator; it's also true for other regulators. Here's why: During normal operation, the regulator shuttles back and forth, alternately opening the line pressure port (figure 1) and dumping to exhaust (figure 2). The result is to maintain a fairly consistent pressure.

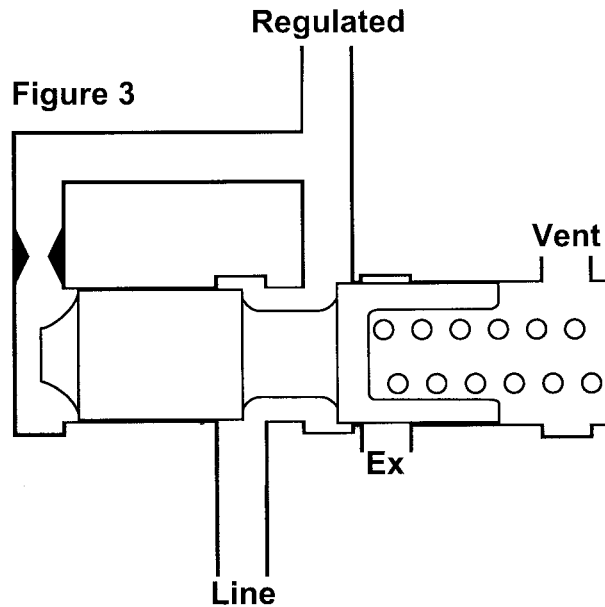


Continued...

4L60E

Low Line Pressure; 2nd Gear Starts (continued)

But if you grind the land (figure 3), line pressure bypasses the land, and leaks directly out the exhaust. The result is regulator pressure is slightly higher, so the system seems to work better. But line pressure suffers, causing any number of problems. On 4L60Es, the most common problem caused by grinding the converter clutch regulator is 2nd gear starts.



4L80E Pump Updates

The pump for the 4L80E was changed in 1997 as part of a lube modification. In addition, GM came out with a new pump assembly to replace the early (1991 – 96) pump assembly. This replacement uses the same stator support castings as the late stator support, so never use the casting numbers to identify which stator support you're using.

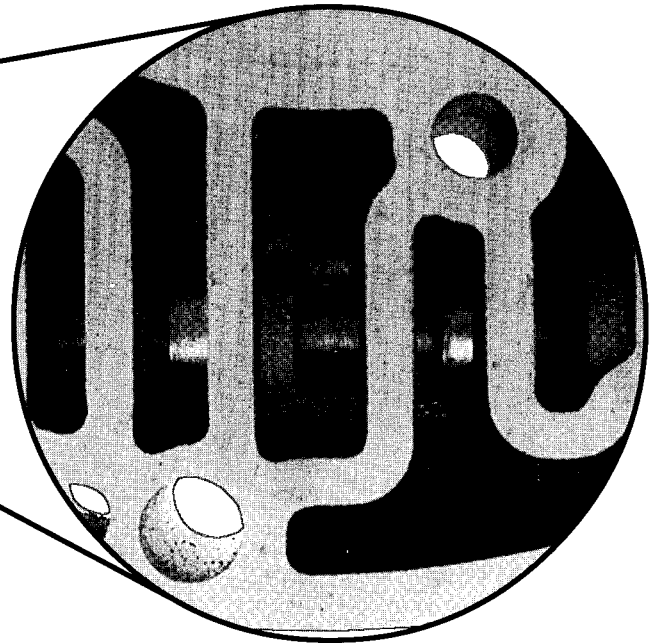
The difference is in the bathtub: The late stator support is drilled; the early replacement isn't.

Any pump body will work in an early transmission, but it must be bolted to the early-design stator support. Never swap the stator supports between early and late transmissions. Never use an early pump body or stator support in a late transmission.

1991 – 96 (Early) Stator Support



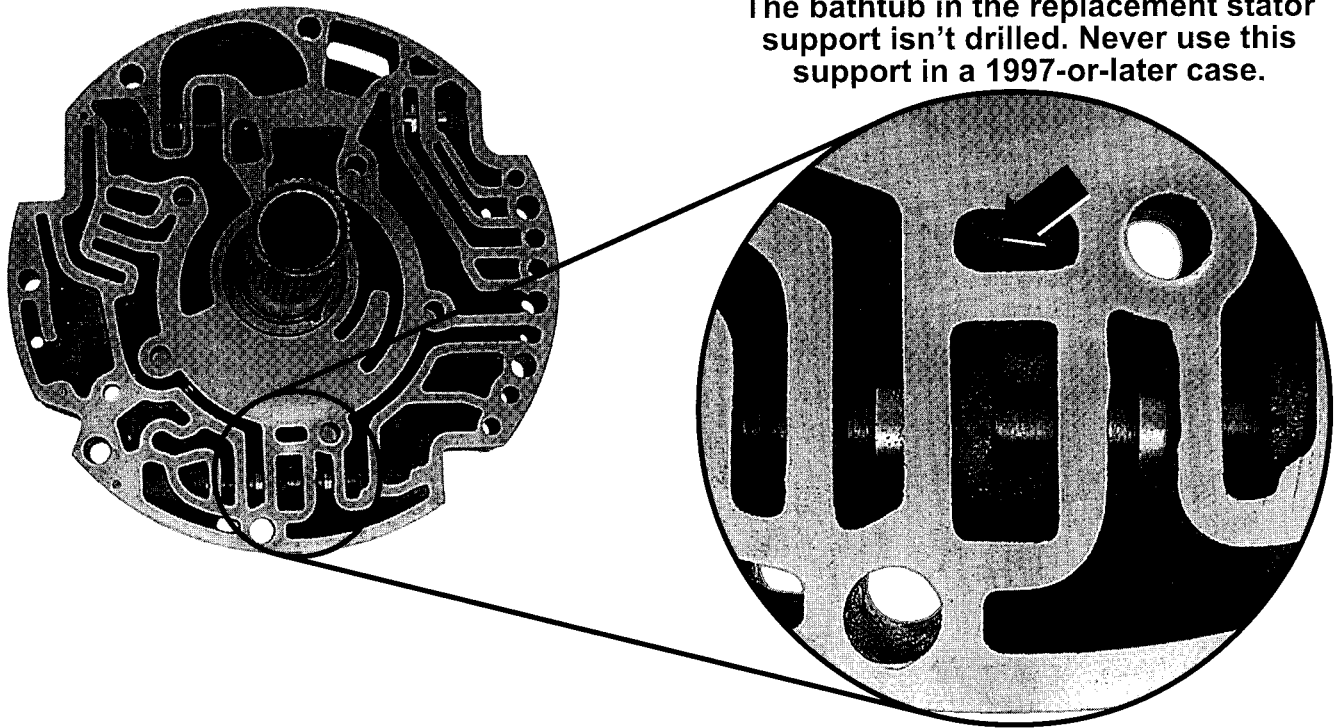
The large single channel indicates this is an early-design stator support.



4L80E Pump Updates (continued)

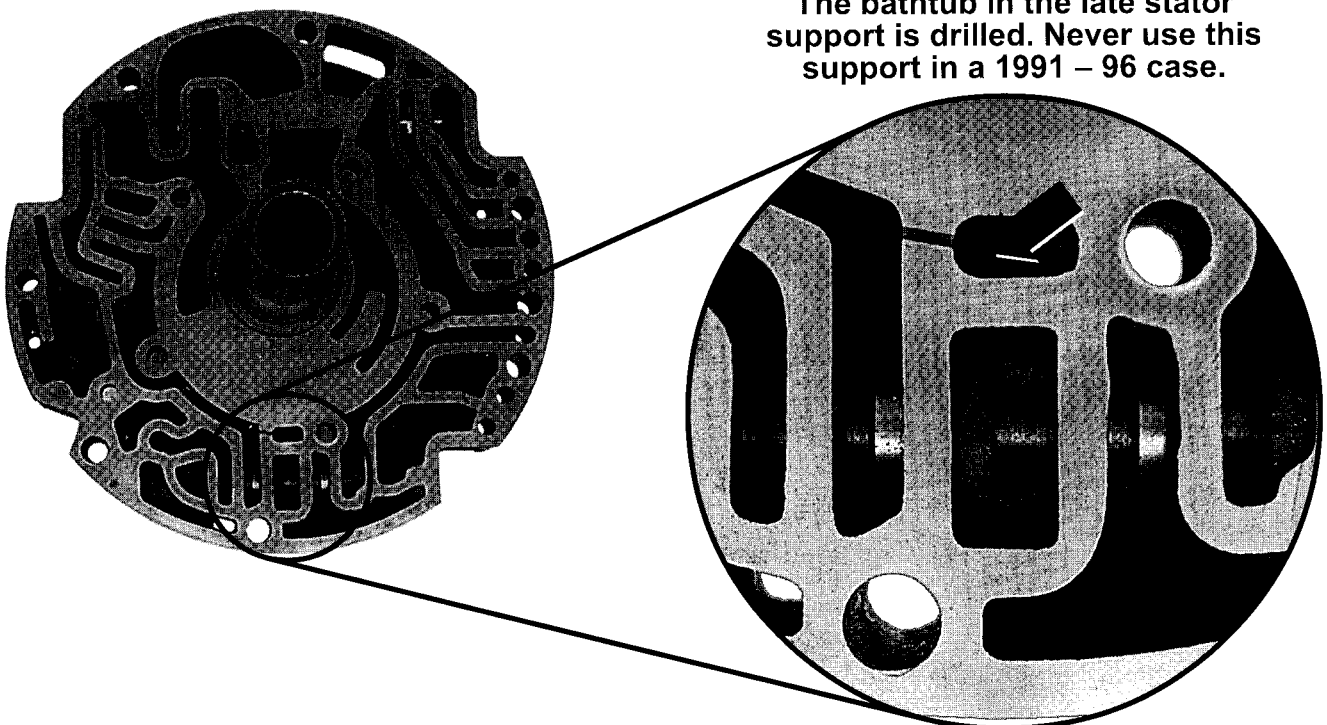
1991 – 96 Replacement Stator Support

The bathtub in the replacement stator support isn't drilled. Never use this support in a 1997-or-later case.



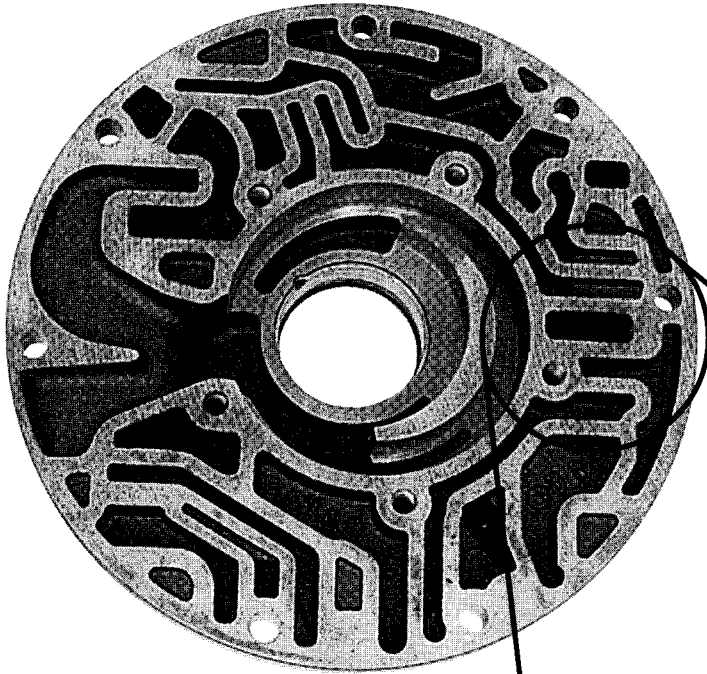
1997 – on (Late) Stator Support

The bathtub in the late stator support is drilled. Never use this support in a 1991 – 96 case.



4L80E Pump Updates (continued)

1991 – 96 Pump Body



Never use this pump body
with the late stator support
and transmission case.



4L80E Pump Updates (continued)

1991 – 96 Replacement and 1997 – on Pump Body



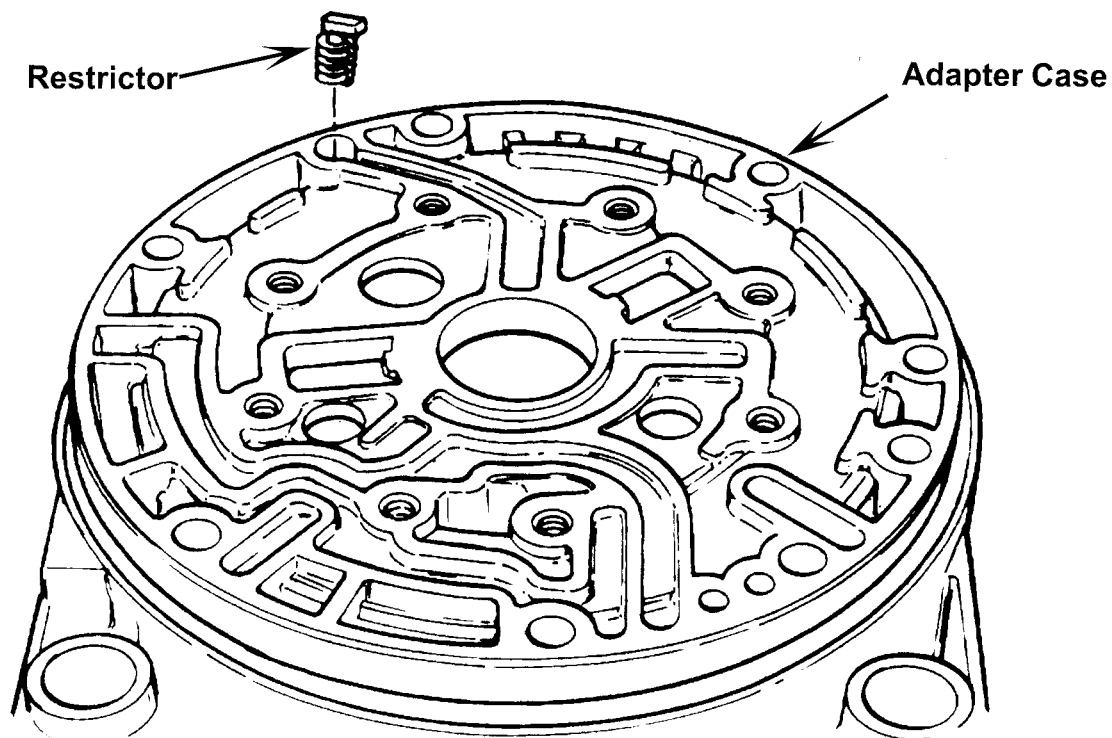
This pump body will
work with both early and
late stator supports.



4L30E Lube Restrictor

The 4L30E has a lube restrictor that fits into the overdrive housing. This restrictor helps distribute lube oil equally throughout the transmission. Without it, some parts of the unit would starve for lube.

It's easy to lose track of where this restrictor belongs. The picture shows the proper location for the lube restrictor.



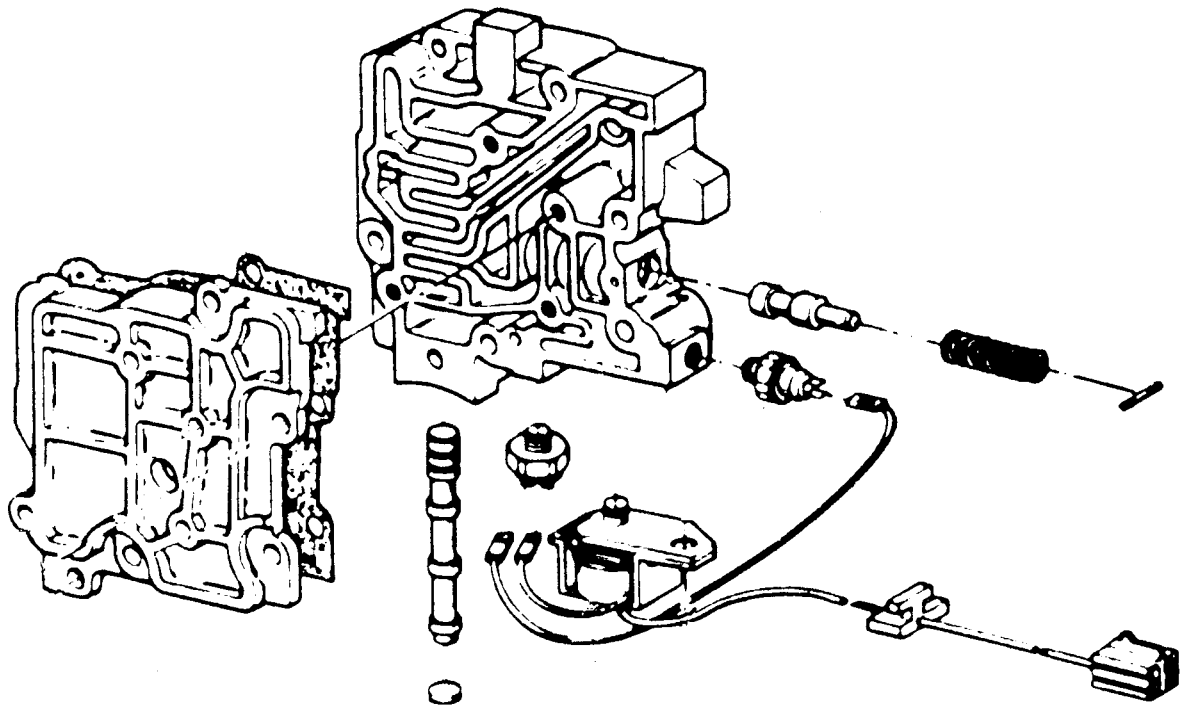
3T40

Valve Body/Auxiliary Valve Body Identification and Interchange

Introduced in 1980, the 125 transaxle has been a mainstay of the transmission industry for over 18 years. Now identified as the 3T40, it's still a common fixture in transmission repair shops all across the country.

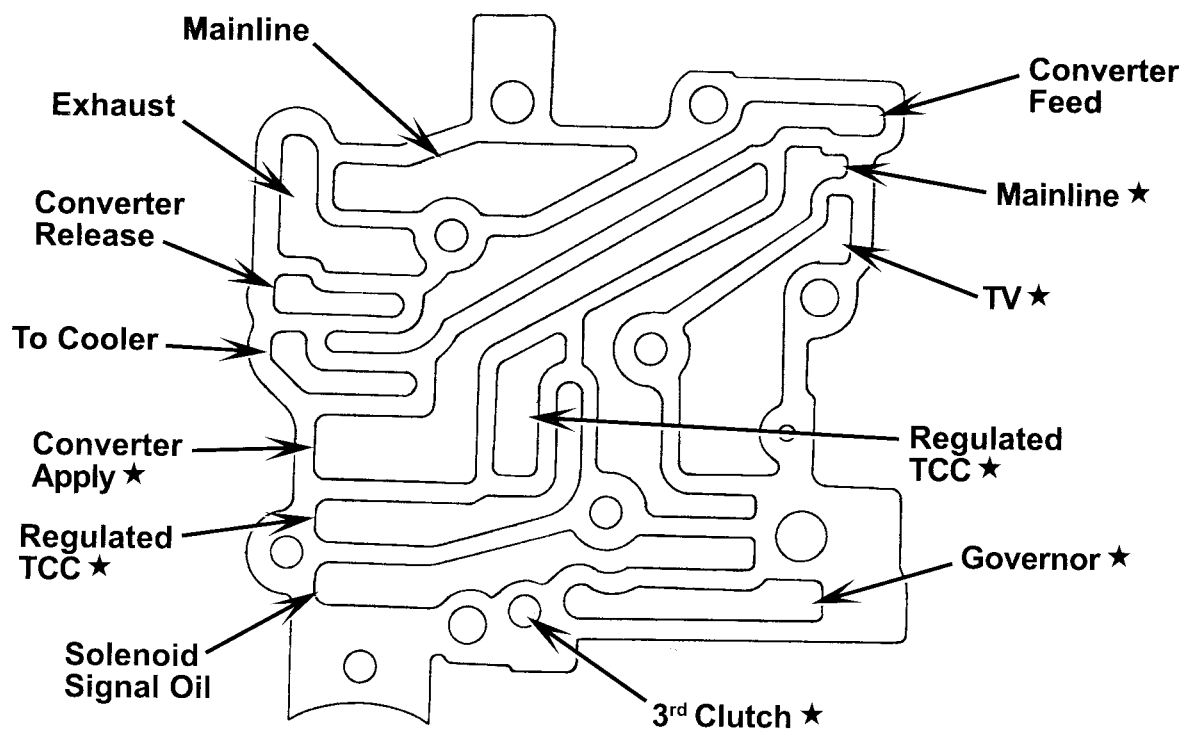
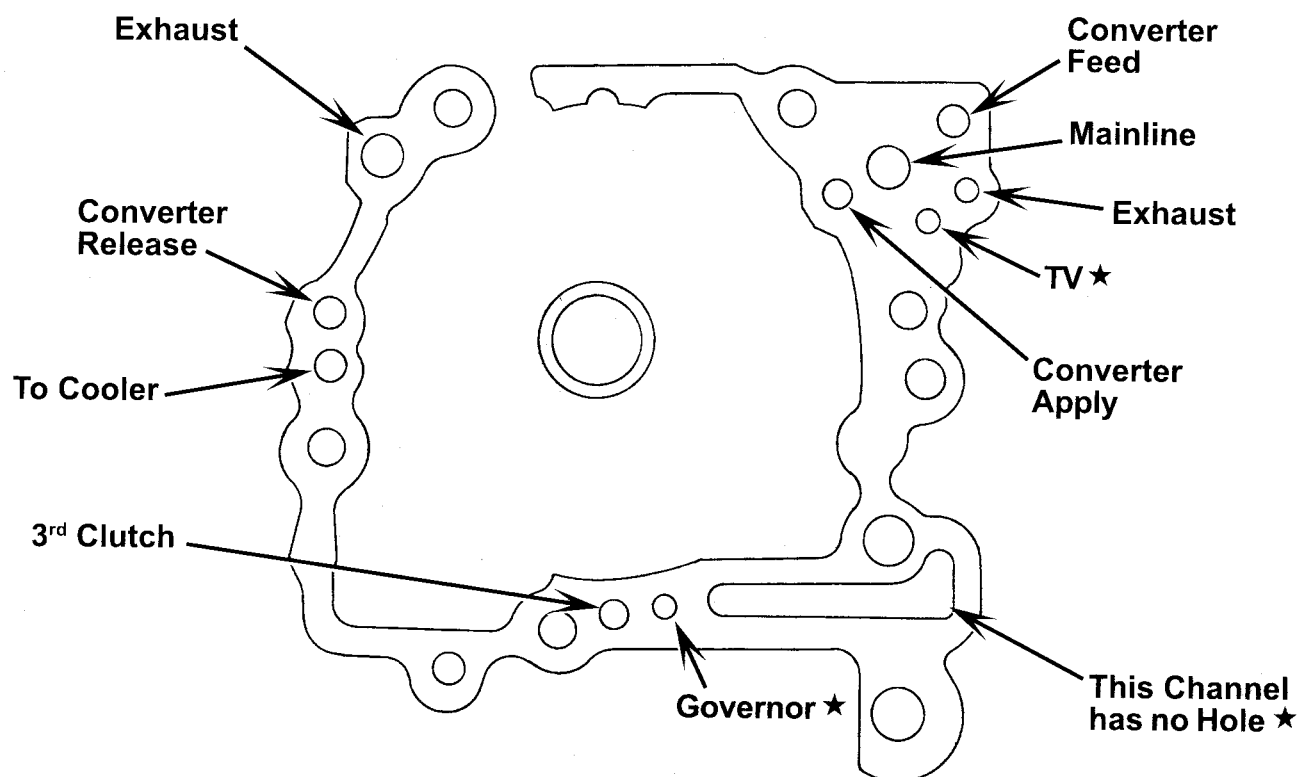
Over the years there have been three major changes to the valve body assembly, including the valve body, auxiliary valve body, gaskets and cover. A mistake during interchange of these components can cause any number of driveability problems, including wrong gear starts and 1-3 upshifts.

In this section you'll learn how to identify the differences between these valve body components. And you'll learn how to modify the different components to allow them to interchange, from one type to the next. When interchanged properly, all 3T40 valve body assemblies will work with any other 3T40 transaxle.



3T40 Valve Body ID (continued)

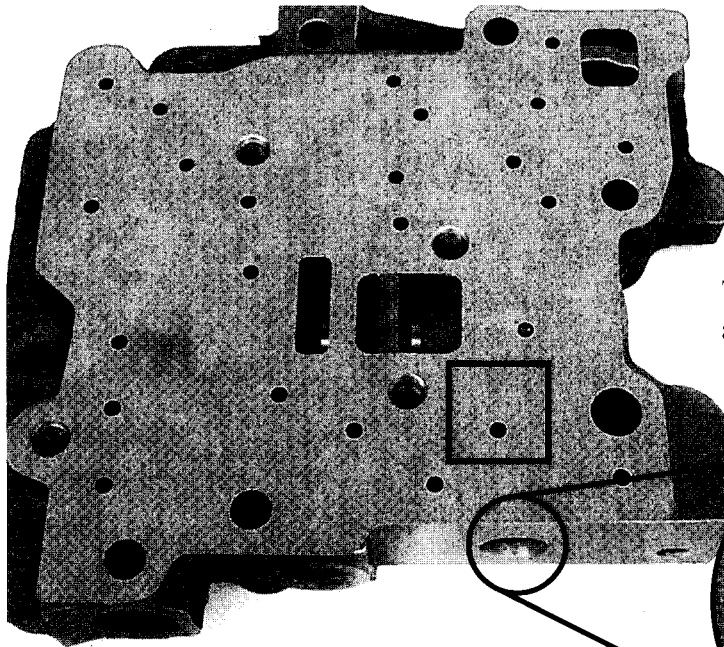
Type 1A and 1B



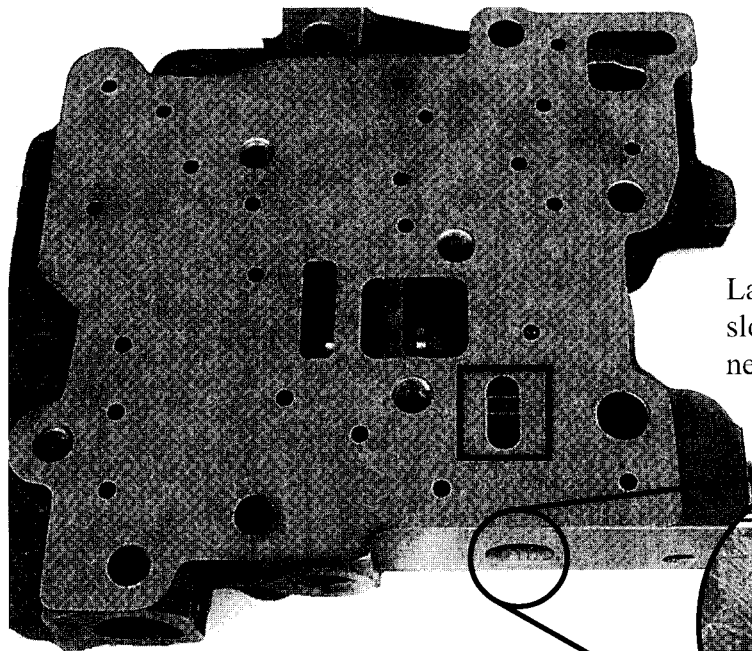
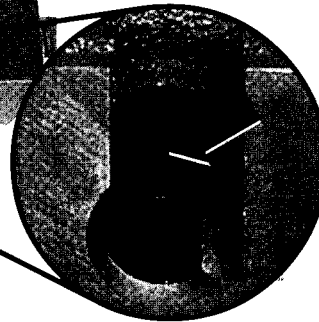
★ These channels change shape or function on other types of valve body components.

3T40 Valve Body ID (continued)

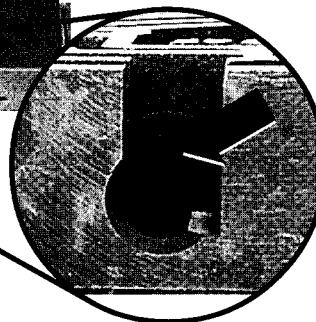
Type 1A and 1B (continued)



The original 3T40 uses an orificed apply plug to feed the lockup solenoid.

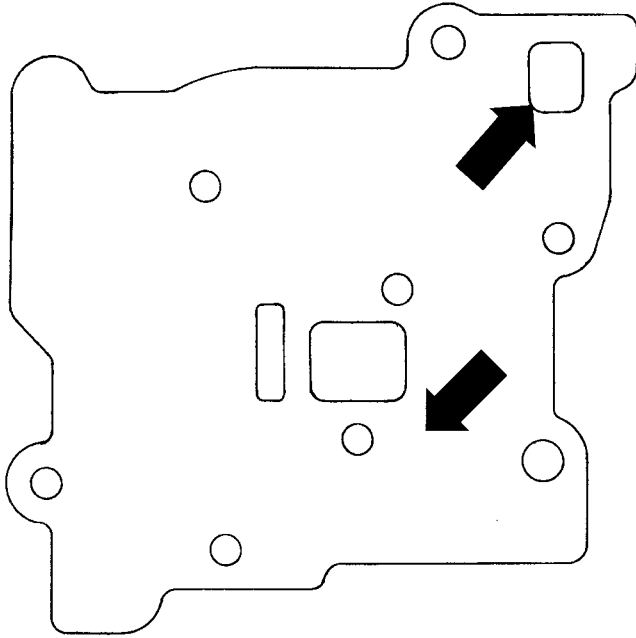


Later units omitted the orifice, and added a slot to the gasket, which provided the flow necessary for the lockup solenoid.

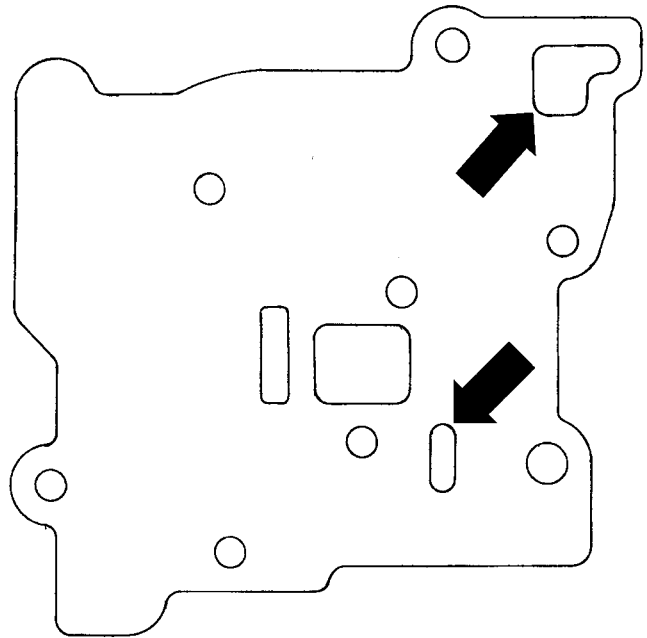


3T40 Valve Body ID (continued)

Type 1A and 1B (continued)



Type 1A Auxiliary Valve Body Gasket

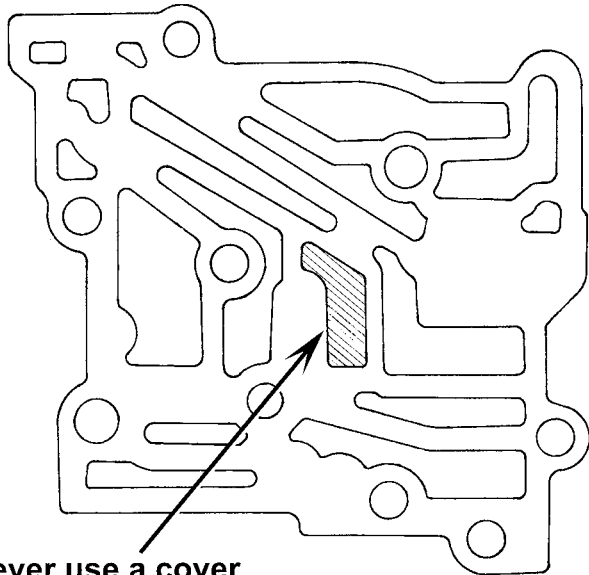


Type 1B Auxiliary Valve Body Gasket

3T40 Valve Body ID (continued)

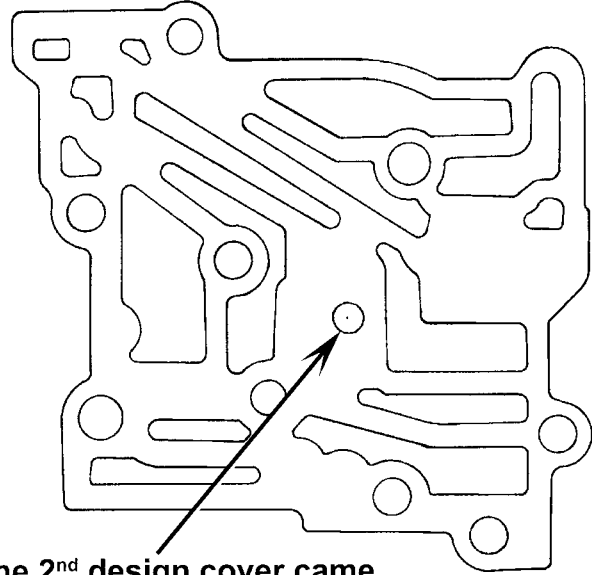
Valve Body Covers

Type 1A and 1B; 1st Design



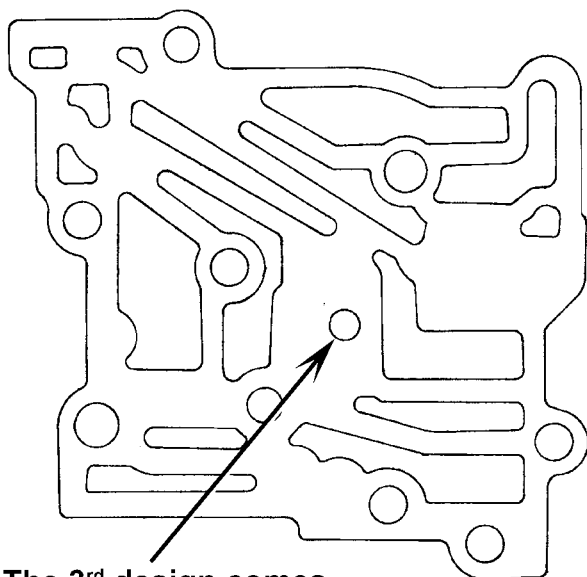
Never use a cover that has this slot.

Type 1A and 1B; 2nd Design



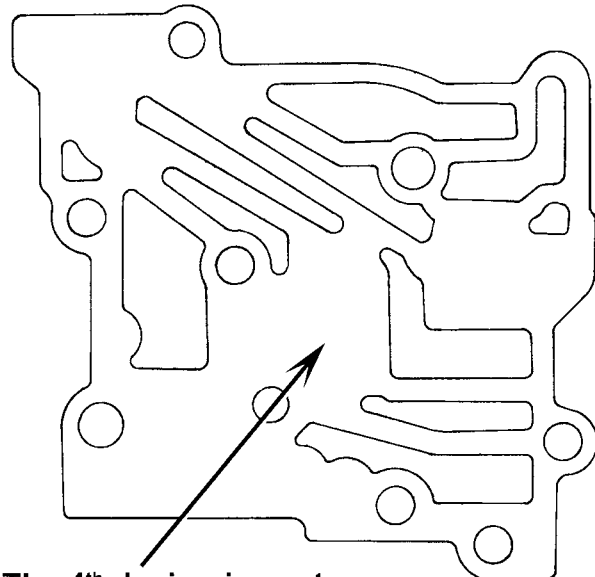
The 2nd design cover came with an orificed cup plug. Always replace it with a solid one.

Type 1A and 1B; 3rd Design



The 3rd design comes with a solid cup plug.

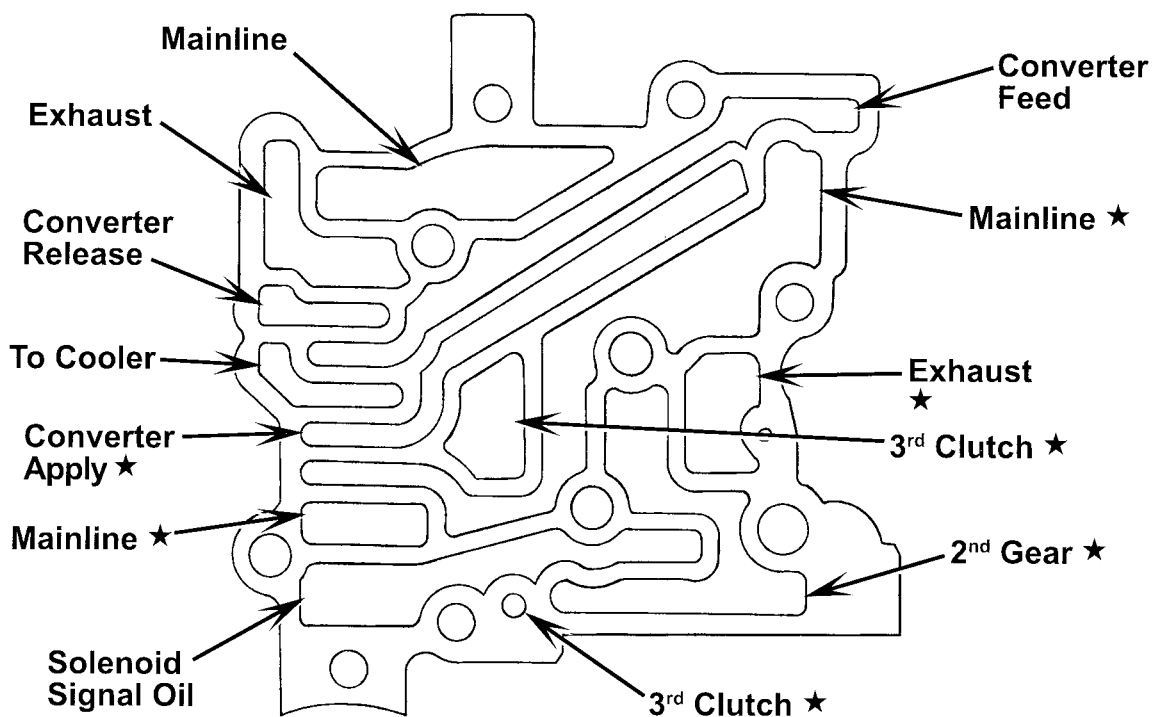
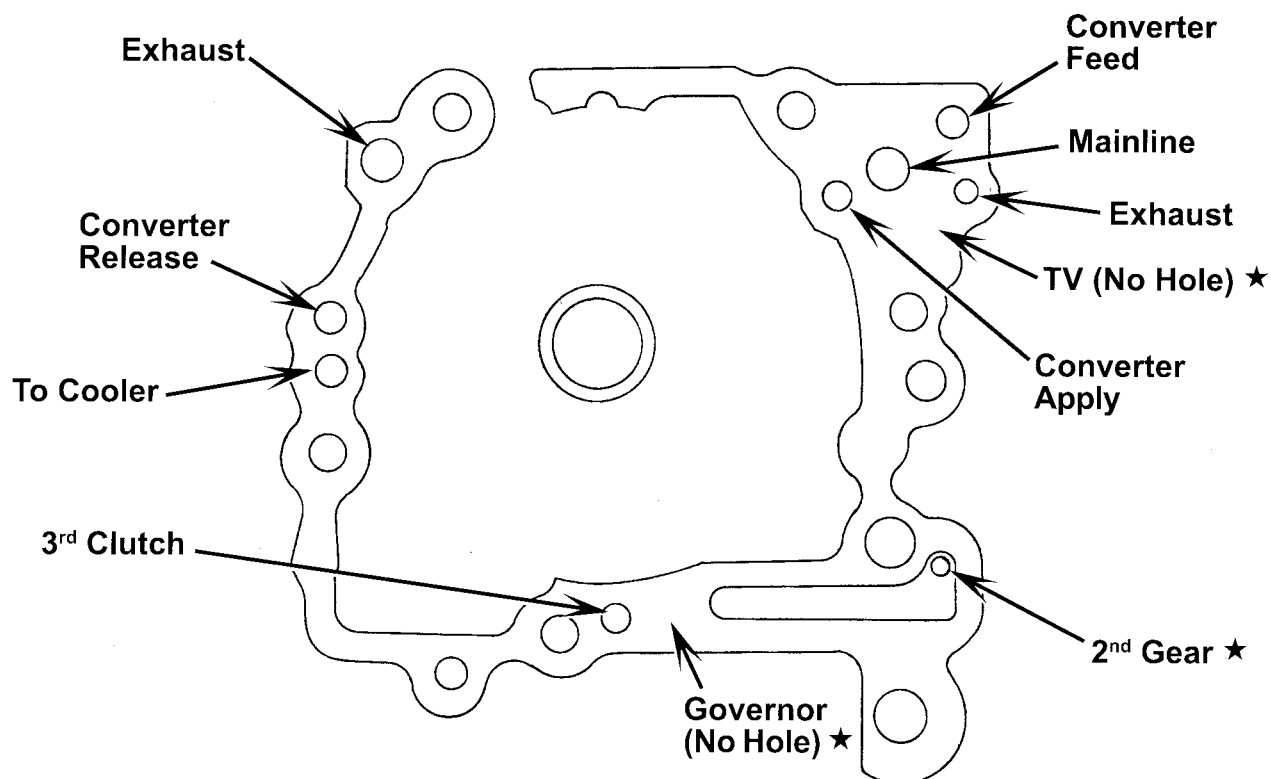
Type 1A and 1B; 4th Design



The 4th design is cast over in this area.

3T40 Valve Body ID (continued)

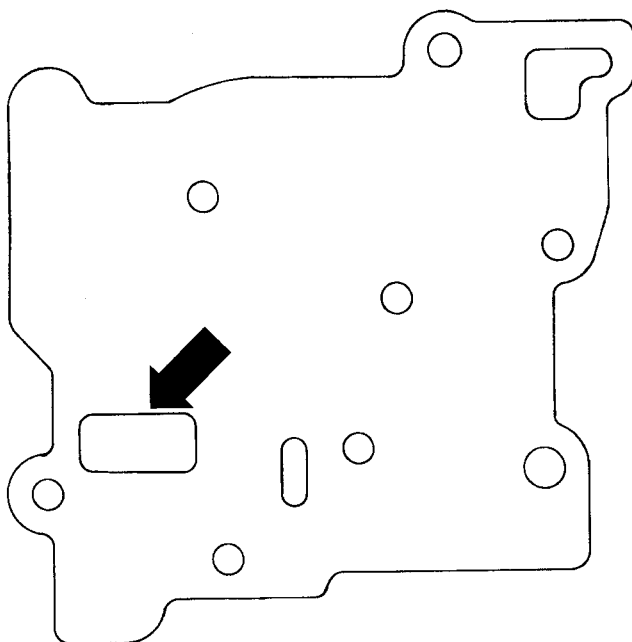
Type 2



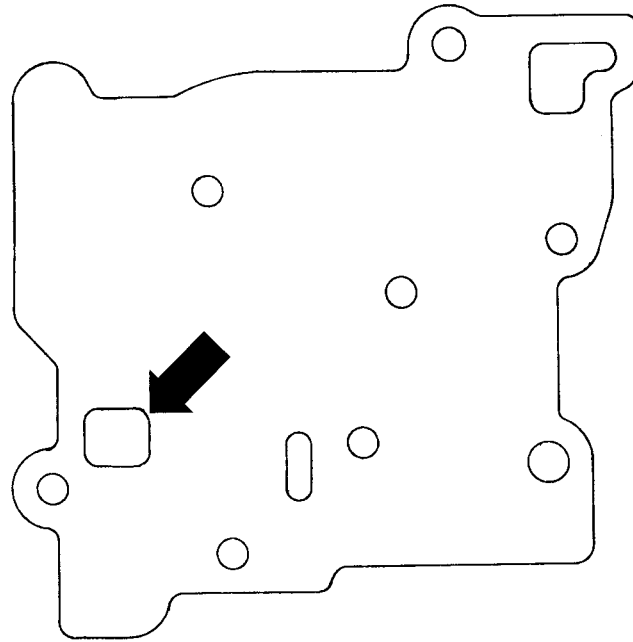
★ These channels change shape or function on other types of valve body components.

3T40 Valve Body ID (continued)

Type 2 (continued)



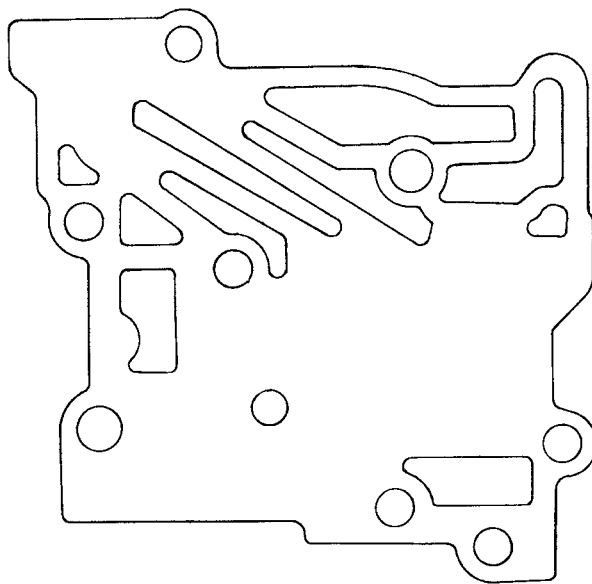
Preferred Type 2 Gasket



Alternate Type 2 Gasket

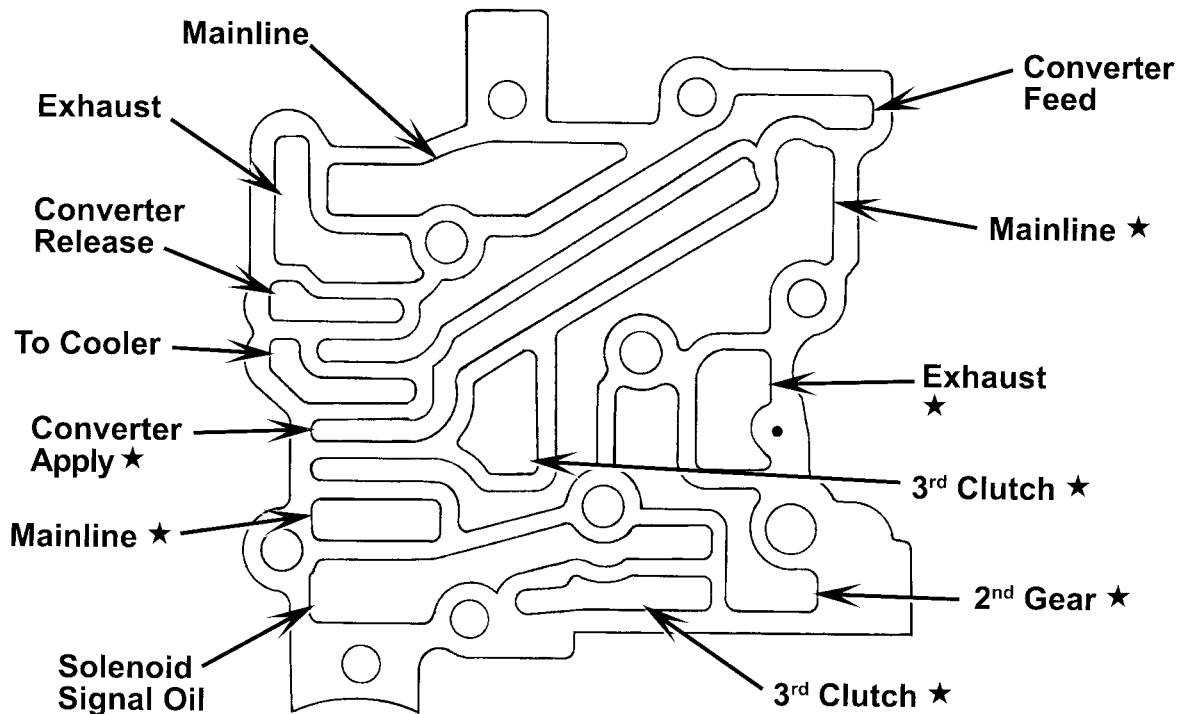
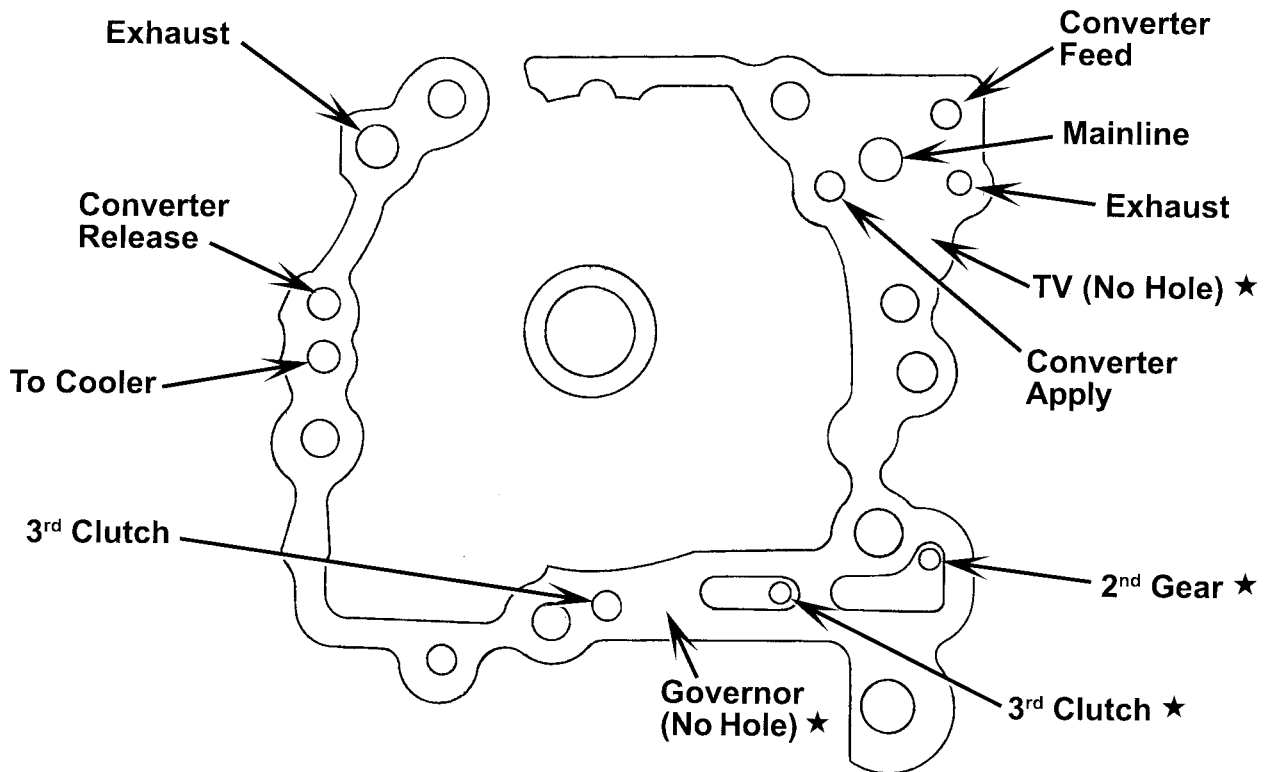
Types 2 and 3 Valve Body Cover

The cover designed for Types 2 and 3 will work on all models, without modification.



3T40 Valve Body ID (continued)

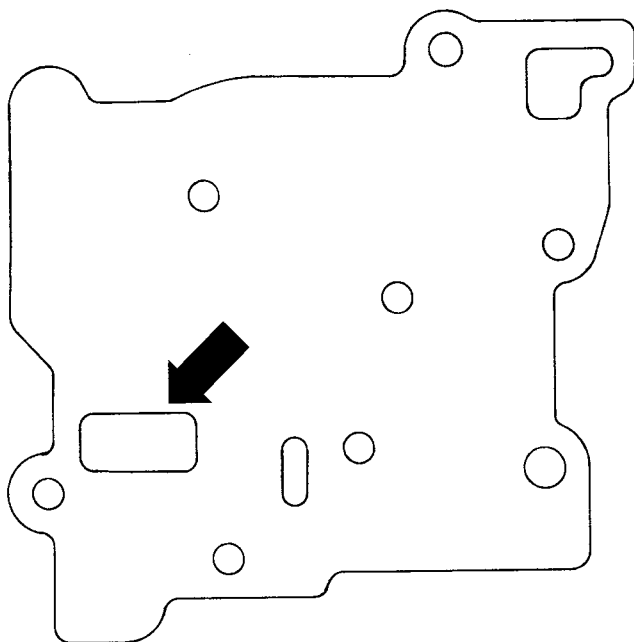
Type 3



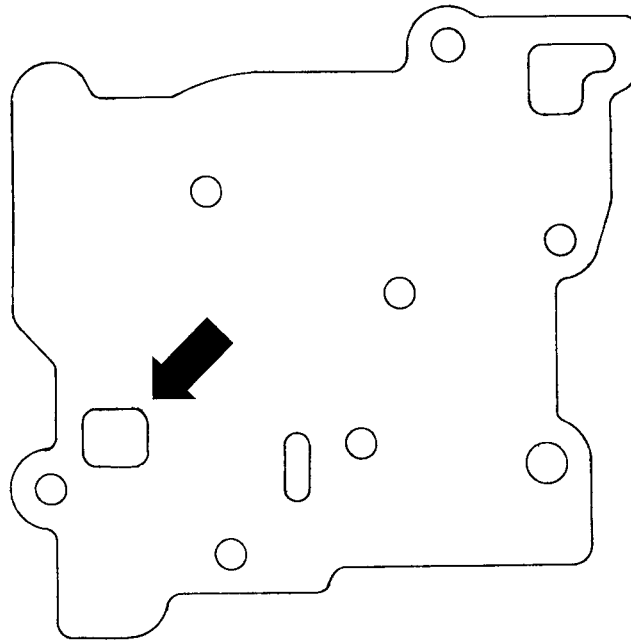
★ These channels change shape or function on other types of valve body components.

3T40 Valve Body ID (continued)

Type 3 (continued)



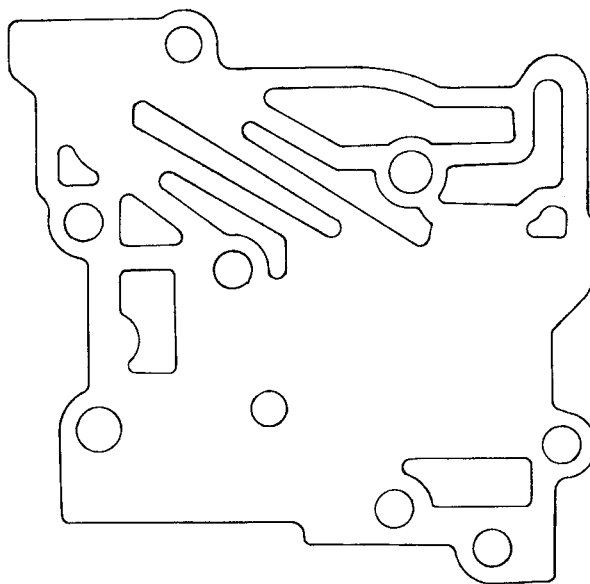
Preferred Type 3 Gasket



Alternate Type 3 Gasket

Types 2 and 3 Valve Body Cover

The cover designed for Types 2 and 3 will work on all models, without modification.



3T40 Valve Body ID (continued)

Component Interchange

As replacement parts become more difficult to obtain, you may find yourself in the situation of having only mismatched valve body parts available. Fortunately, there are ways of modifying these components to allow them to work with any other combination of valve body parts.

In addition to the three different types of valve body component, there is one other variation: Some valve bodies have a governor pressure switch threaded into the lower right side of the auxiliary valve body. Others have a 2nd gear pressure switch.

Here's how to use this interchange chart:

1. Identify the combination of components you have, using the identification pictures on the previous pages.
2. Identify whether the vehicle uses a governor switch or a 2nd gear switch.
3. Use the chart to find the specific modifications necessary to make that specific combination of components work.

The next page provides graphics showing where to look for the modification holes referenced in the chart.

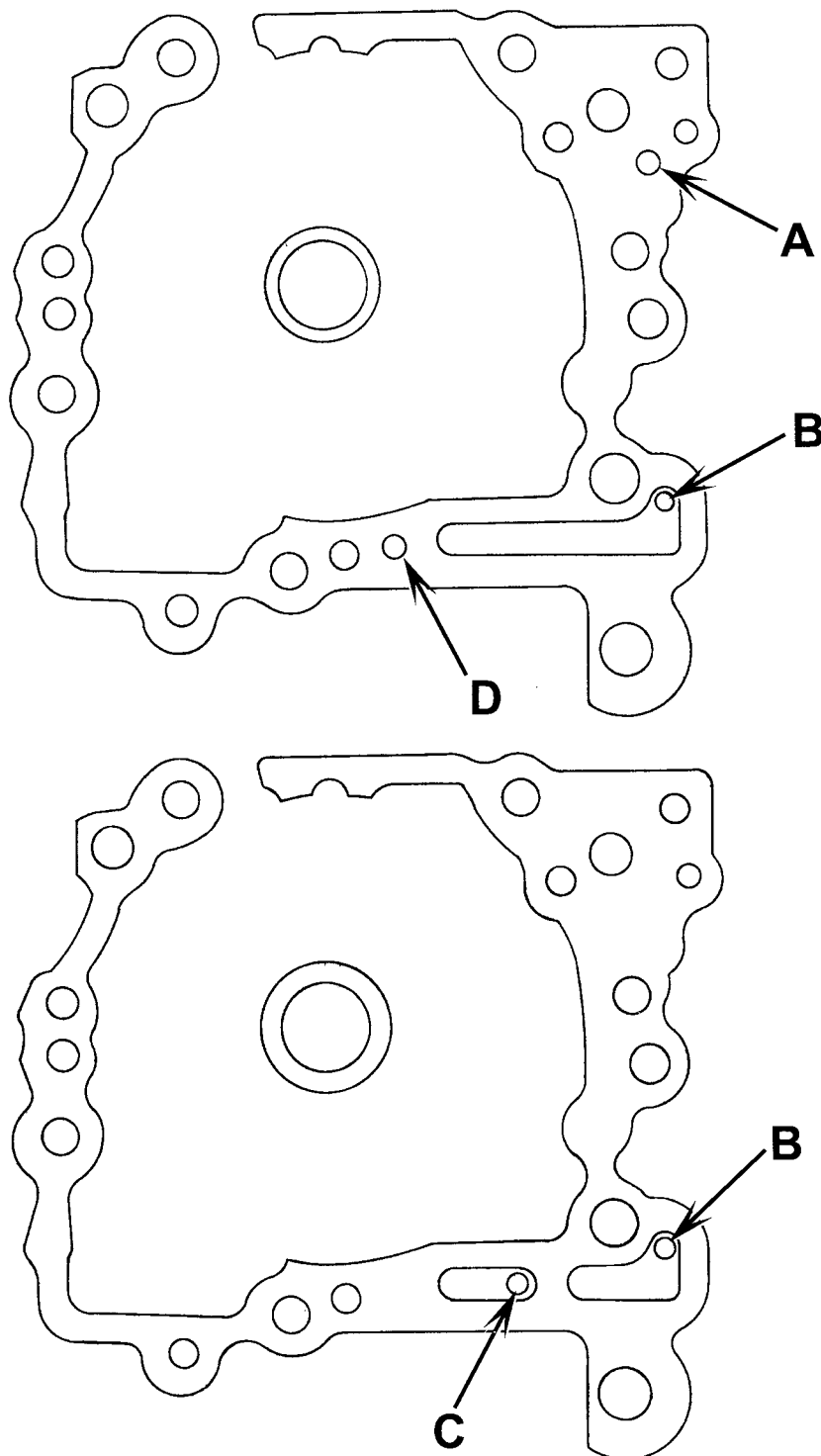
Main Valve Body	Auxiliary Valve Body		
	Type 1	Type 2	Type 3
Type 1 With Governor Switches	No changes necessary	Block orifice control valve	Block orifice control valve
All Others	1. Plug hole D 2. Drill hole B	1. Plug hole D 2. Drill hole B	1. Plug hole D 2. Drill hole B
Type 2 With Governor Switches	1. Drill hole A 2. Drill hole D 3. Plug hole B	1. Drill hole D 2. Plug hole B 3. Block orifice control valve	1. Drill hole D 2. Plug hole B 3. Block orifice control valve
All Others	Drill hole A	No changes necessary	No changes necessary
Type 3 With Governor Switches	1. Drill hole A 2. Drill hole D 3. Plug hole B 4. Plug hole C	1. Drill hole D 2. Plug hole B 3. Plug hole C 4. Block orifice control valve	Governor pressure isn't available on Type 3 assemblies.
All Others	1. Drill hole A 2. Plug hole C	Plug hole C	No changes necessary

3T40 Valve Body ID (continued)

Component Interchange (continued)

Modification Hole Identification

When drilling through the valve body, hole position is critical. Always use a very small, very sharp drill to start the hole, then enlarge it afterward. A final size of about $\frac{1}{8}$ " should work great.



Continued...

3T40 Valve Body ID (continued)

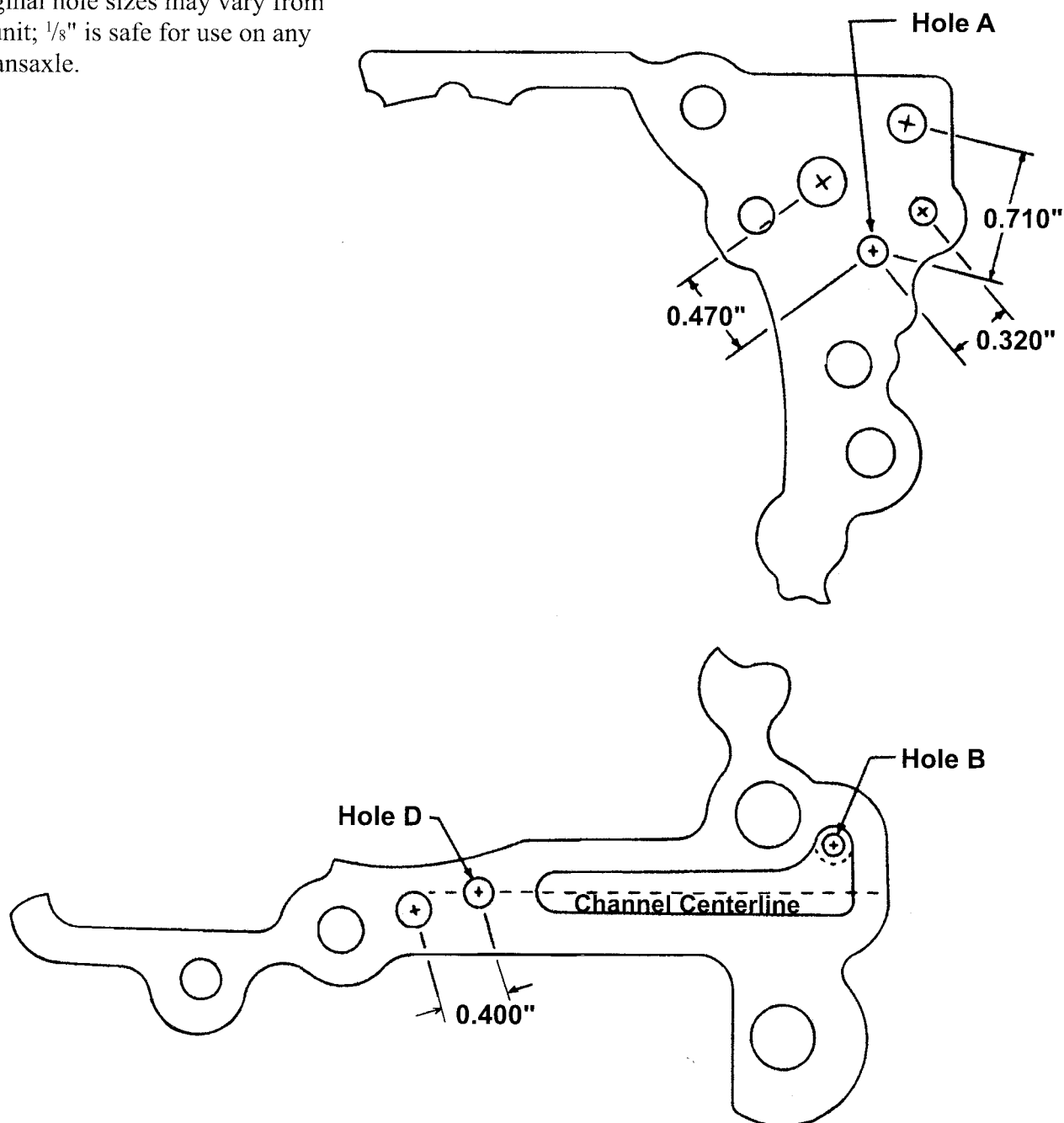
Component Interchange (continued)

Modification Hole Identification (continued)

Accurate hole placement is critical when modifying one of these units. Use these graphics as a guide, and measure the position for these openings carefully.

CAUTION Always remove the 2-3 shift valve before attempting to drill hole D.

The original hole sizes may vary from unit to unit; $\frac{1}{8}$ " is safe for use on any 3T40 transaxle.

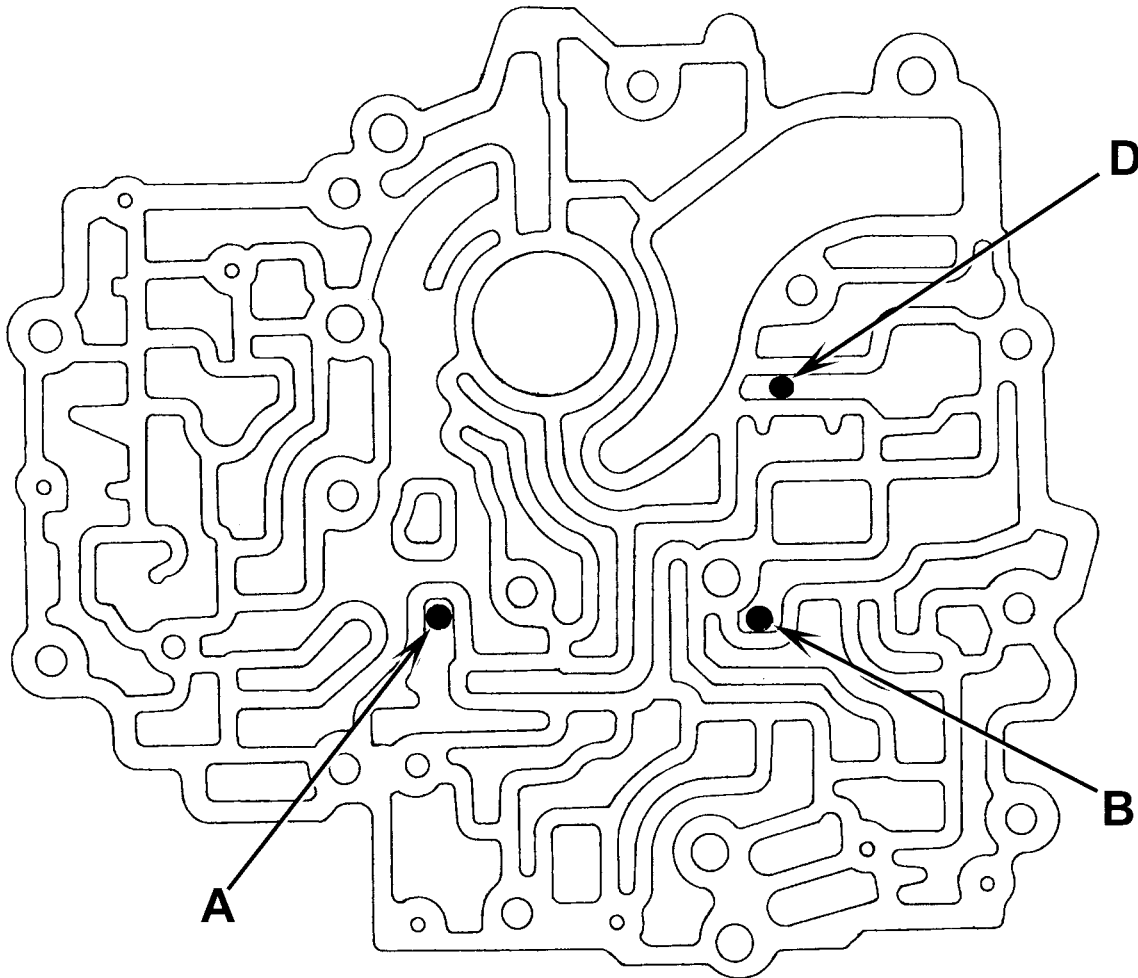


3T40 Valve Body ID (continued)

Component Interchange (continued)

Modification Hole Identification (continued)

Here's where these holes should come through the valve body. Remember, be very careful when drilling the valve body; the hole placement is critical.



3T40 Valve Body ID (continued)

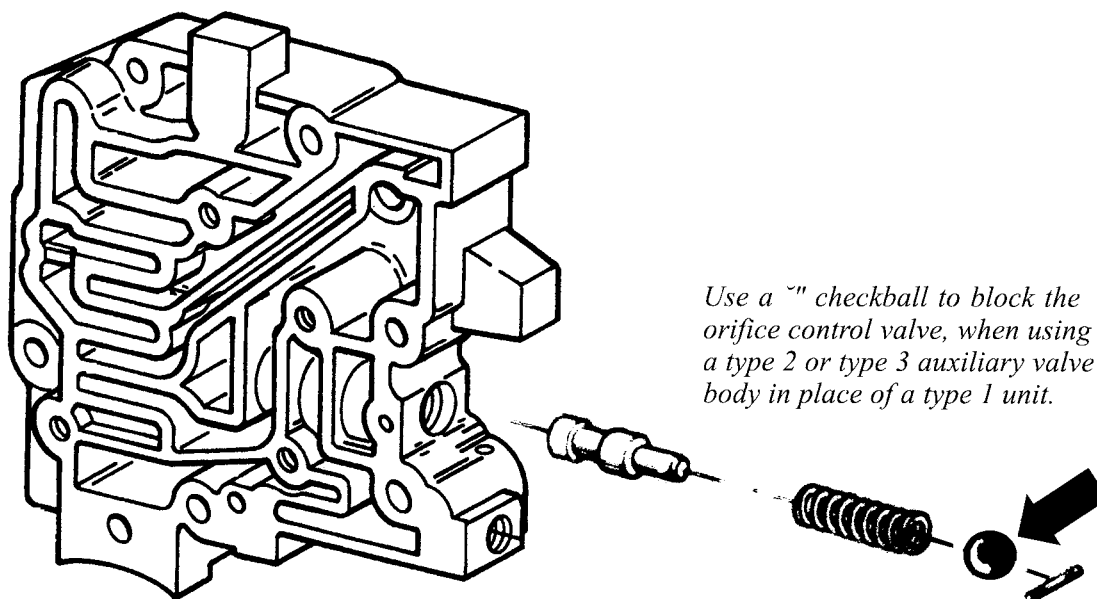
Component Interchange (continued)

Blocking the Orifice Control Valve

If the interchange instructions require blocking the orifice control valve, install a 0.250" checkball between the valve and the retaining pin. That will block the valve from operating.

NOTICE

The only time you will need to block this valve is when modifying a type 2 or type 3 auxiliary valve body to work in place of a type 1 unit. This modification supplies governor pressure to what was the 2nd gear port.

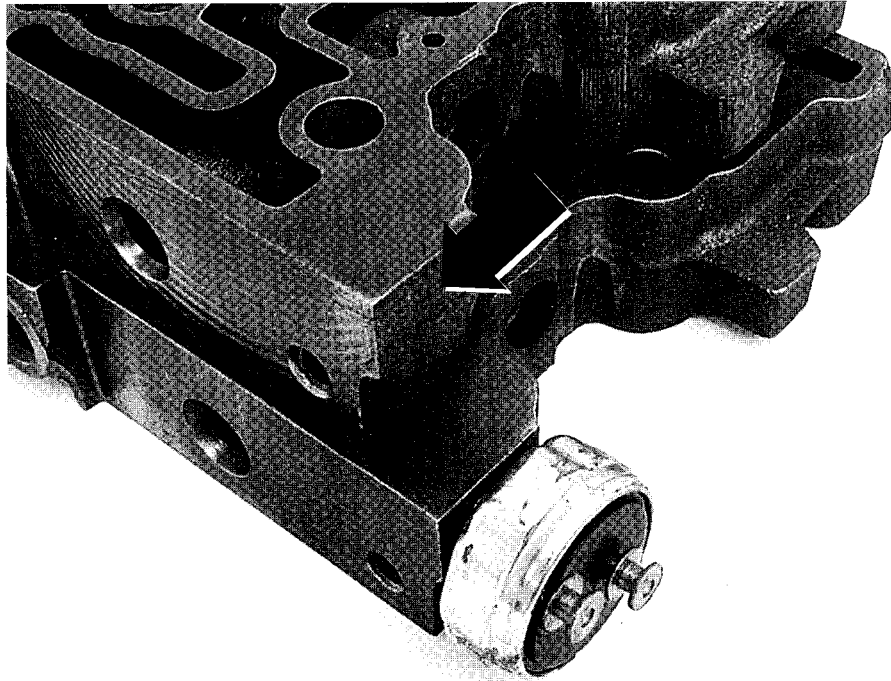


3T40 Valve Body ID (continued)

Component Interchange (continued)

Drilling the Governor/2nd Gear Switch Port

Some auxiliary valve bodies came without a port for a governor switch or a 2nd gear switch. If the vehicle requires a switch in this location, but the auxiliary valve body doesn't have a port for it, you can drill and tap a hole in this location. Both switches require a 1/8" pipe thread port.



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CD4E

Clutch and Band Application

The apply components of the CD4E transaxle work together to provide a flow of power, as the chart below shows.

- In *reverse* and *4th gear*, engine braking occurs regardless of coast clutch operation. Under these conditions, one-way clutches aren't in the torque path.
- In *1st gear*, *2nd gear* and *3rd gear*, no engine braking occurs because the coast clutch is released.
- In *manual 1st gear*, *manual 2nd gear* and *3rd gear with the TCS on (overdrive disabled)*, coast braking occurs because the coast clutch is applied.

CD4E with Transmission Control Switch

Gear		Forward Clutch	Coast Clutch	2/4 Band	Direct Clutch	Reverse Clutch	Low/Reverse Clutch	Forward Sprag	Low One-Way Clutch
Park									
Reverse									
Neutral									
Drive w/TCS Off	1 st								
	2 nd								OR
	3 rd								OR
	4 th							OR	OR
Drive w/TCS On	1 st								
	2 nd								OR
	3 rd								OR
Manual 2 nd									OR
Manual 1 st									



= Applied

OR = Overrunning

Continued...

FORD UPDATES AND CHANGES

CD4E (continued)

Clutch and Band Application (continued)

CD4E with Manual Hold Switch Off

Gear		Forward Clutch	Coast Clutch	2/4 Band	Direct Clutch	Reverse Clutch	Low/Reverse Clutch	Forward Sprag	Low One-Way Clutch
Park									
Reverse									
Neutral									
D	1 st								
	2 nd								OR
	3 rd								OR
	4 th							OR	OR
S	1 st								
	2 nd								OR
	3 rd								OR
L	1 st								
	2 nd								OR

CD4E with Manual Hold Switch On

Gear		Forward Clutch	Coast Clutch	2/4 Band	Direct Clutch	Reverse Clutch	Low/Reverse Clutch	Forward Sprag	Low One-Way Clutch
Park									
Reverse									
Neutral									
D	2 nd								OR
	3 rd								OR
S	2 nd								OR
L	1 st								



= Applied

OR = Overrunning

CD4E Shift Patterns

VEHICLE WITH TRANSMISSION CONTROL SWITCH (TCS) – O/D Button

Manual Lever Position	Mode Select Capabilities		
	Auto Operation	TCS	Comment
	1↔2↔3↔4	OFF	Four gears operation.
D	1↔2↔3←4	ON	Three gears operation, 4th gear is inhibited.
2	1→2←3←4	OFF or ON	2nd gear hold. Transaxle will shift to 2nd gear automatically.
1	1←2←3←4	OFF or ON	1st gear hold. Transaxle will shift to 1st gear automatically.

→ Upshifting

← Downshifting

□ Desired steady-state gear

VEHICLE WITH MANUAL HOLD SWITCH (MHS) – HOLD Button

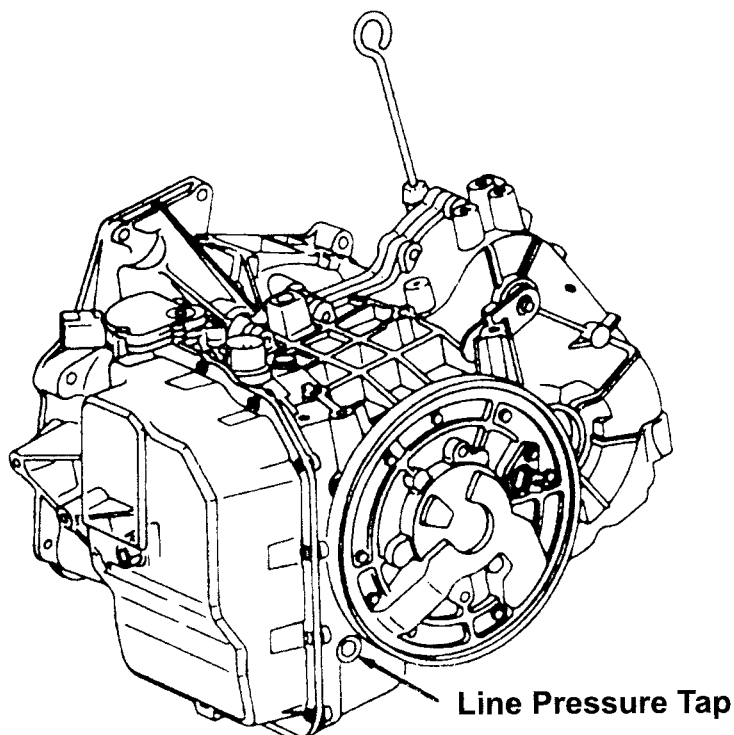
Manual Lever Position	Mode Select Capabilities		
	Auto Operation	MHS	Comment
D	1↔2↔3↔4	OFF	Four gears operation.
	1→2↔3←4	ON	Two gears operation (2nd and 3rd).
S	1↔2↔3←4	OFF	Three gears operation, 4th is inhibited.
	1→2←3←4	ON	2nd gear hold. Transaxle will shift to 2nd gear automatically.
L	1↔2←3←4	OFF	Two gears operation, 4th and 3rd gears are inhibited.
	1←2←3←4	ON	1st gear hold. Transaxle will shift to 1st gear automatically.

→ Upshifting

← Downshifting

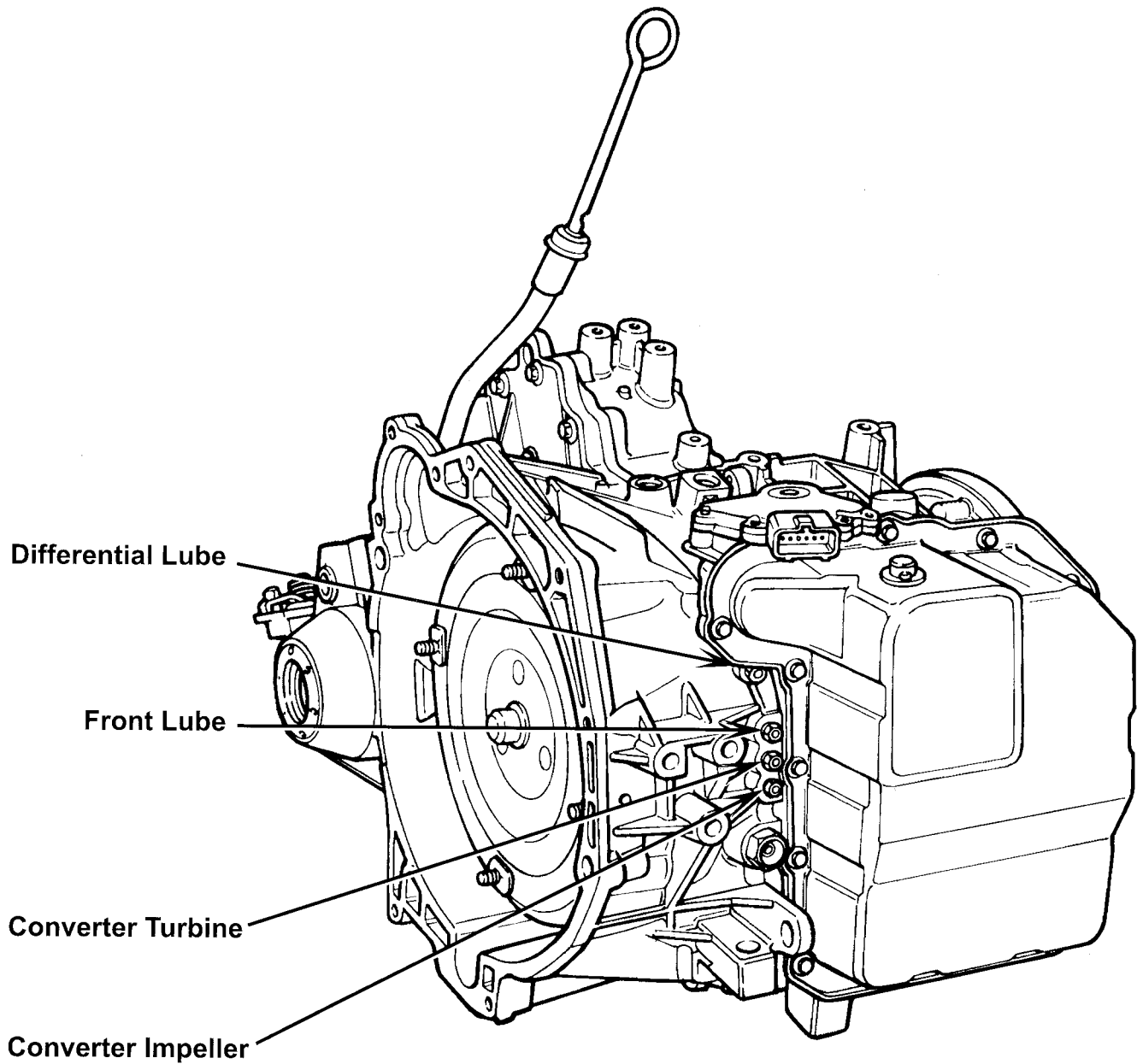
□ Desired steady-state gear

CD4E Pressure Specifications



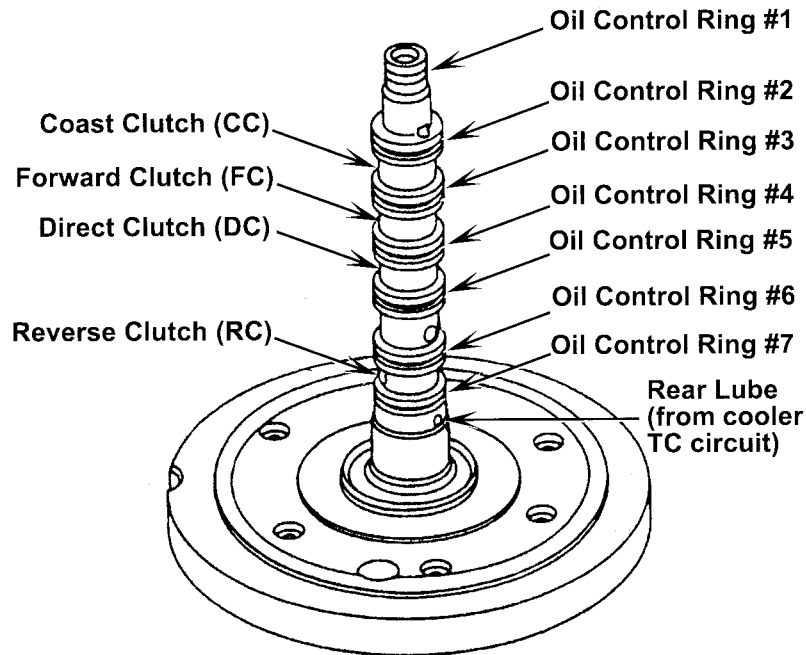
Gear Range	Line Pressure (PSI)	
	Idle	Stall
Park, Neutral	64 – 76	—
Reverse	64 – 76	259 – 294
Drive	45 – 63	168 – 184
2 nd	45 – 63	168 – 184
1 st	45 – 63	168 – 184

CD4E Auxiliary Pressure Taps

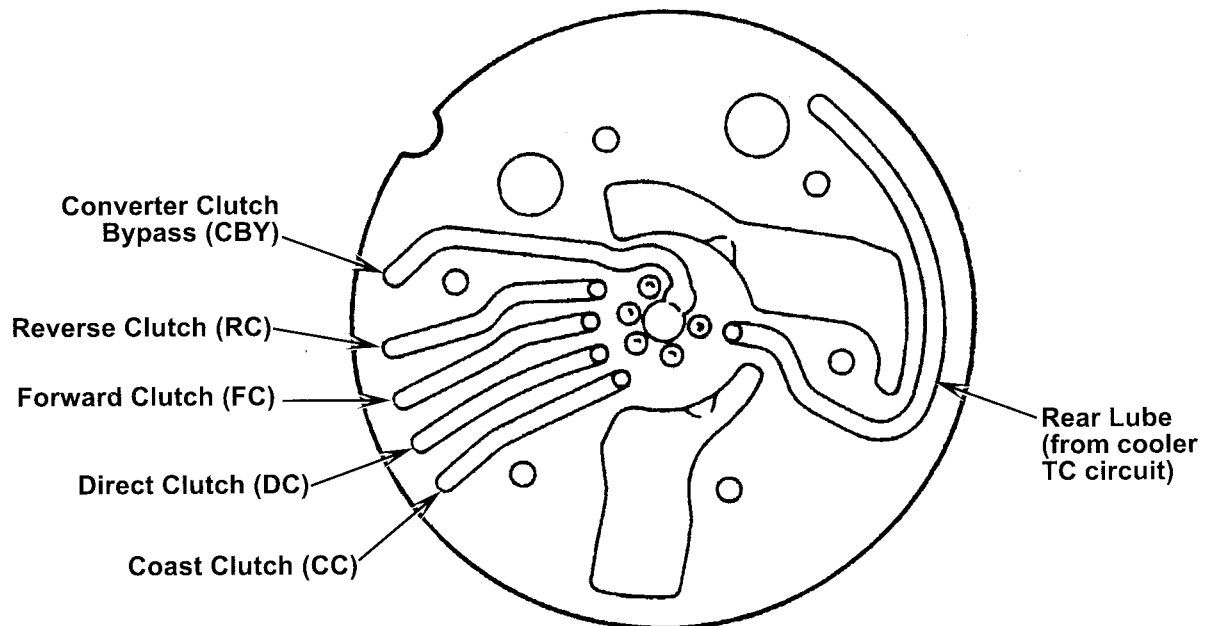


CD4E Pump Hydraulic Passages

Side View

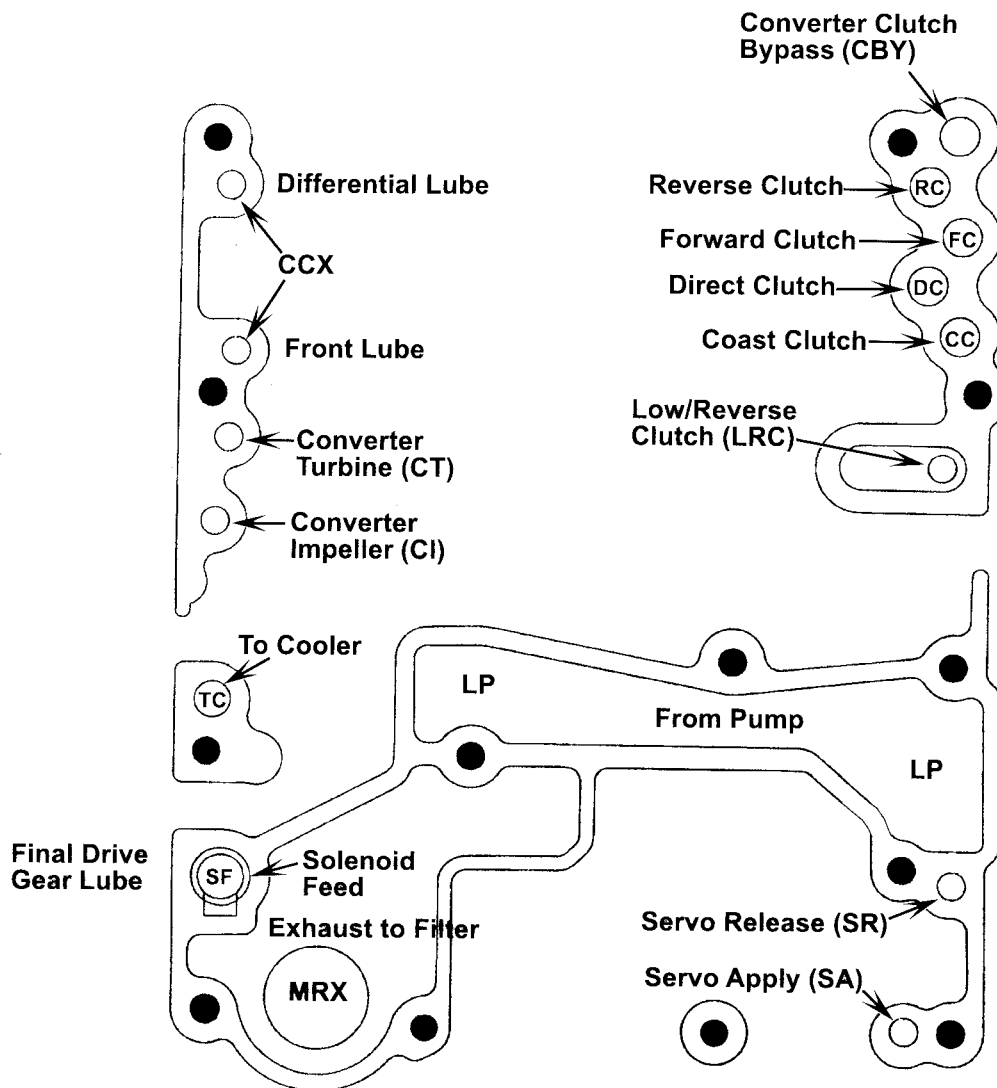


Bottom View



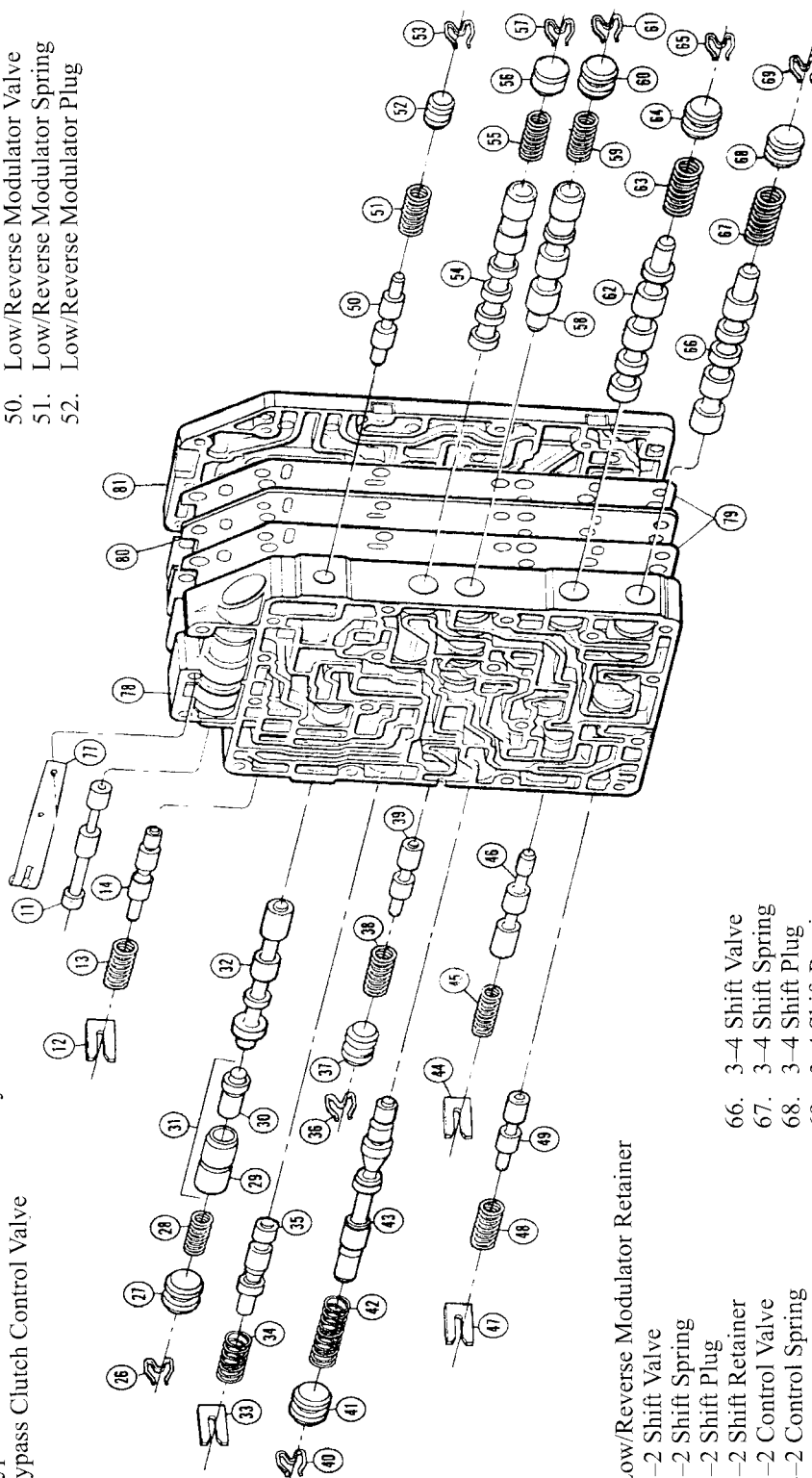
CD4E Hydraulic Passages (continued)

Transaxle Case



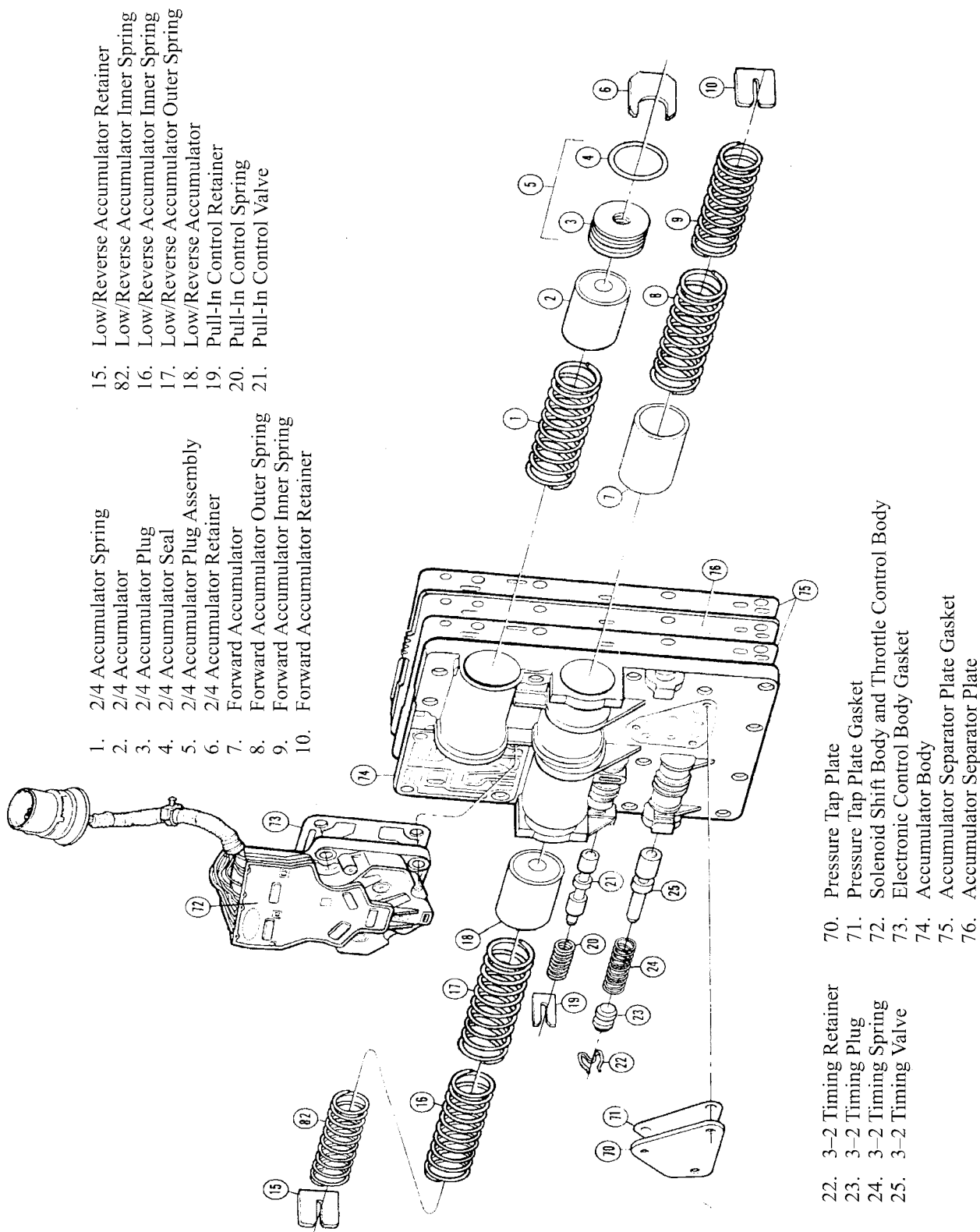
CD4E Valve Body

- | | | |
|--|----------------------------------|------------------------------------|
| 11. Manual Control Valve | 33. Converter Regulator Retainer | 40. Main Regulator Plug Retainer |
| 12. Solenoid Regulator Retainer | 34. Converter Regulator Spring | 41. Main Regulator Plug |
| 13. Solenoid Regulator Spring | 35. Converter Regulator Valve | 42. Main Regulator Spring |
| 14. Solenoid Regulator Valve | 36. Line Modulator Plug Retainer | 43. Main Regulator Valve |
| 26. Bypass Clutch Control Retainer | 37. Line Modulator Plug | 44. Servo Release Shuttle Retainer |
| 27. Bypass Clutch Control Spring | 38. Line Modulator Spring | 45. Servo Release Shuttle Spring |
| 28. Bypass Clutch Control Valve Sleeve | 39. Line Modulator Valve | 46. Servo Release Shuttle Valve |
| 29. Bypass Clutch Control Valve Plunger | | 47. Coast Clutch Shift Retainer |
| 30. Bypass Clutch Control Valve Assembly | | 48. Coast Clutch Shift Spring |
| 31. Bypass Clutch Control Valve | | 49. Coast Clutch Shift Valve |
| 32. Bypass Clutch Control Valve | | 50. Low/Reverse Modulator Valve |
| | | 51. Low/Reverse Modulator Spring |
| | | 52. Low/Reverse Modulator Plug |



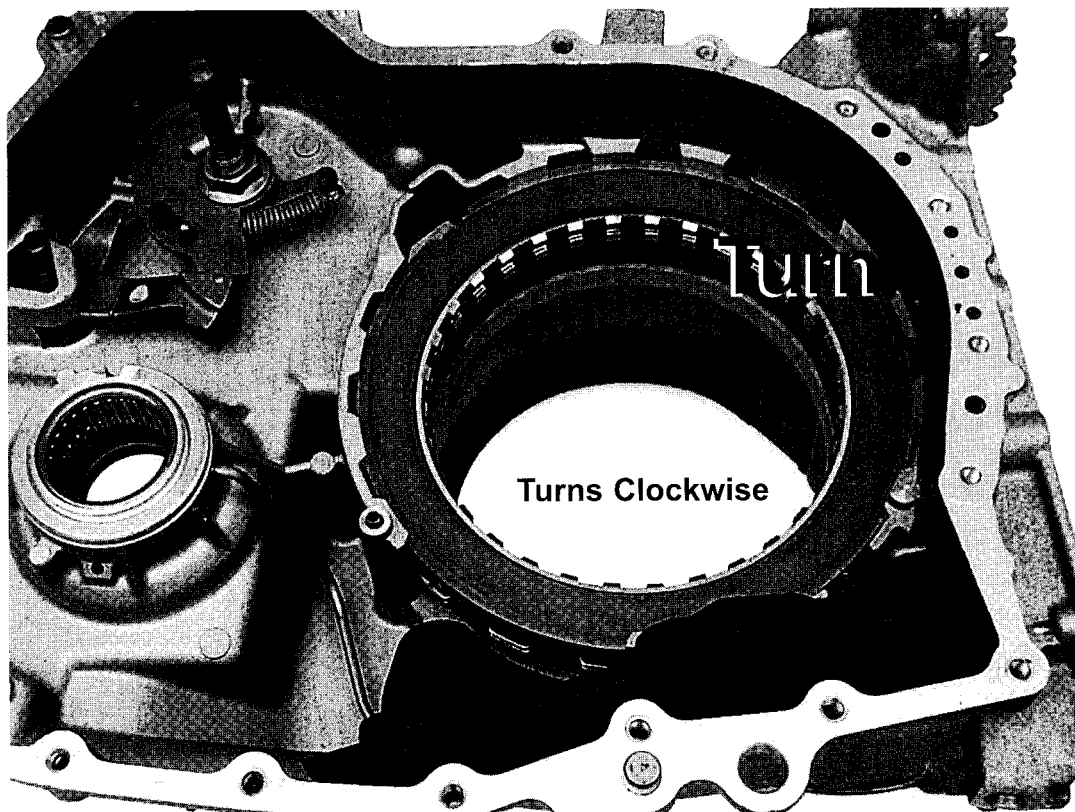
- | | | |
|------------------------------------|------------------------|--------------------------------|
| 53. Low/Reverse Modulator Retainer | 66. 3-4 Shift Valve | 77. Manual Valve Detent Spring |
| 54. 1-2 Shift Valve | 67. 3-4 Shift Spring | 78. Main Valve Body |
| 55. 1-2 Shift Spring | 68. 3-4 Shift Plug | 79. Separator Plate Gasket |
| 56. 1-2 Shift Plug | 69. 3-4 Shift Retainer | 80. Separator Plate |
| 57. 1-2 Shift Retainer | | 81. Transfer Plate |
| 58. 3-2 Control Valve | | |
| 59. 3-2 Control Spring | | |
| 60. 3-2 Control Plug | | |
| 61. 3-2 Control Retainer | | |
| 62. 2-3 Shift Valve | | |
| 63. 2-3 Shift Spring | | |
| 64. 2-3 Shift Plug | | |
| 65. 2-3 Shift Retainer | | |

CD4E Valve Body (continued)

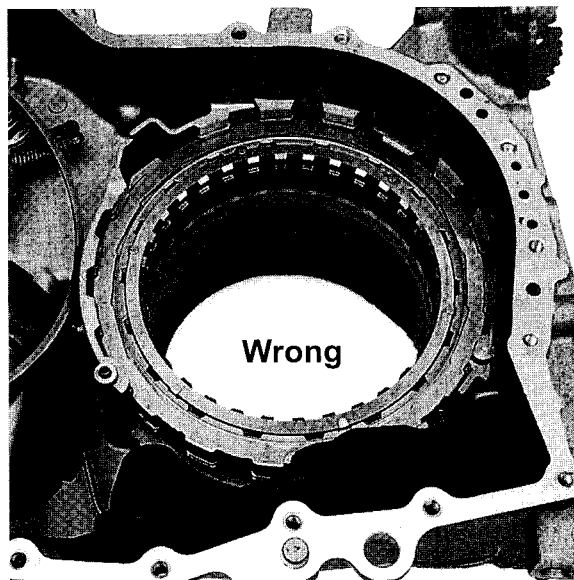
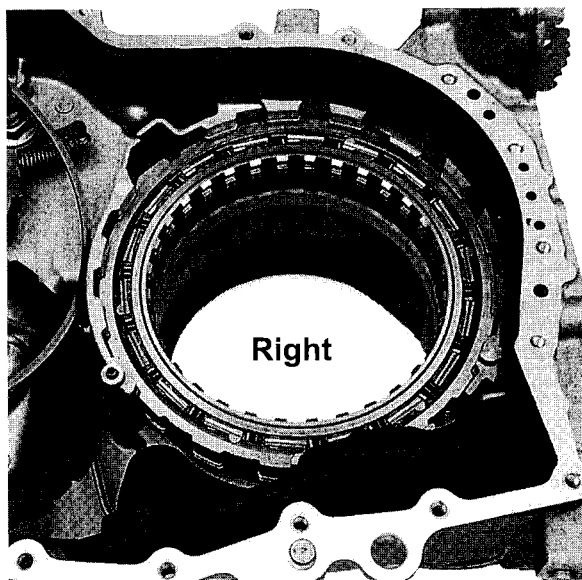


CD4E One Way-Clutch Assemblies

Low One-Way Clutch

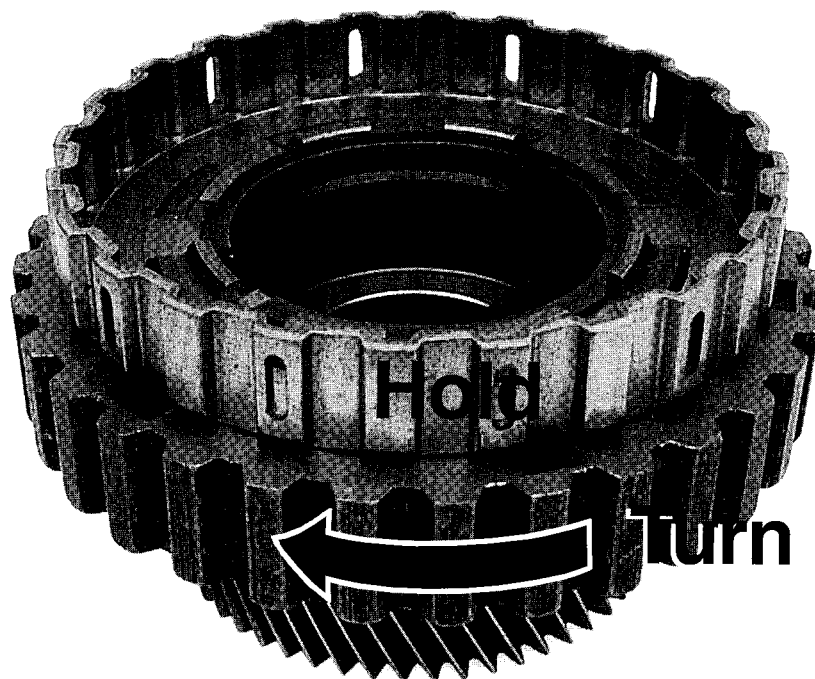


The inner race should turn clockwise, and lock counterclockwise (above). When installed properly, you should be able to see the rollers until you install the retainer (below left). If you can't see the rollers with the retainer out, you have the low one-way clutch installed backward (below right).



CD4E One Way-Clutch Assemblies (cont)

Forward One-Way Clutch

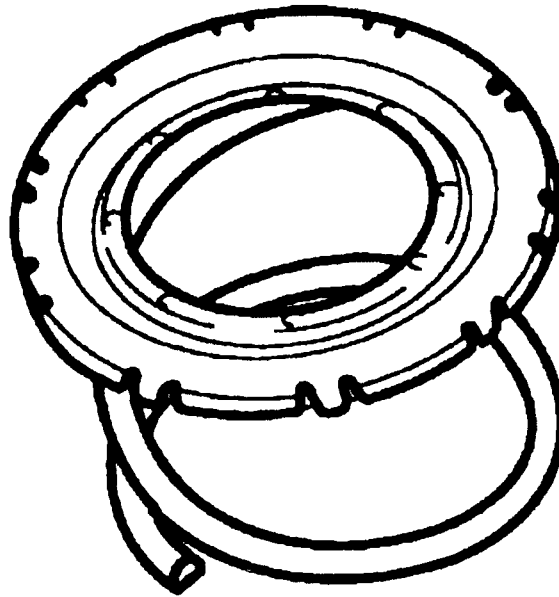


CD4E Updates

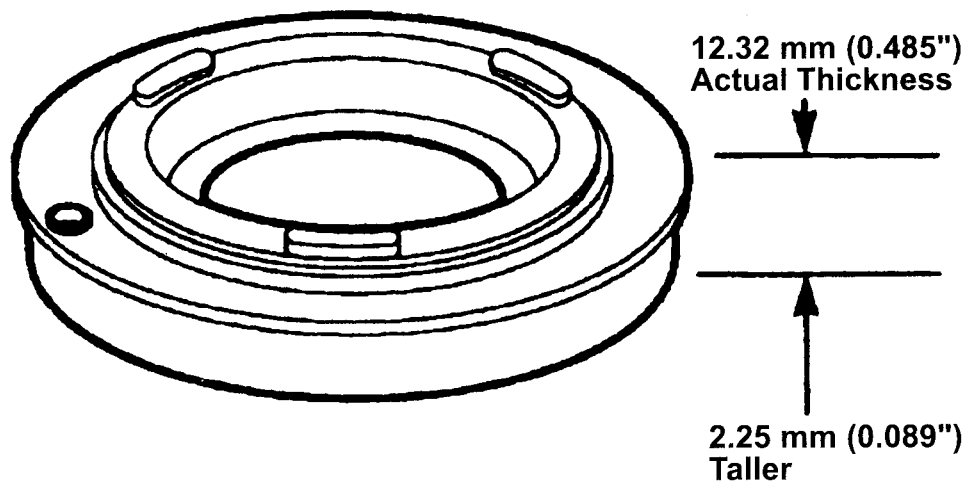
Mid-1998 Changes

Beginning with build date 1/5/1998, Ford made several modifications to the CD4E forward/coast/direct clutch drum. These new parts aren't interchangeable with the earlier parts.

1. The forward clutch return spring is now an open coil design with a retainer — F8RZ-7G299-AA



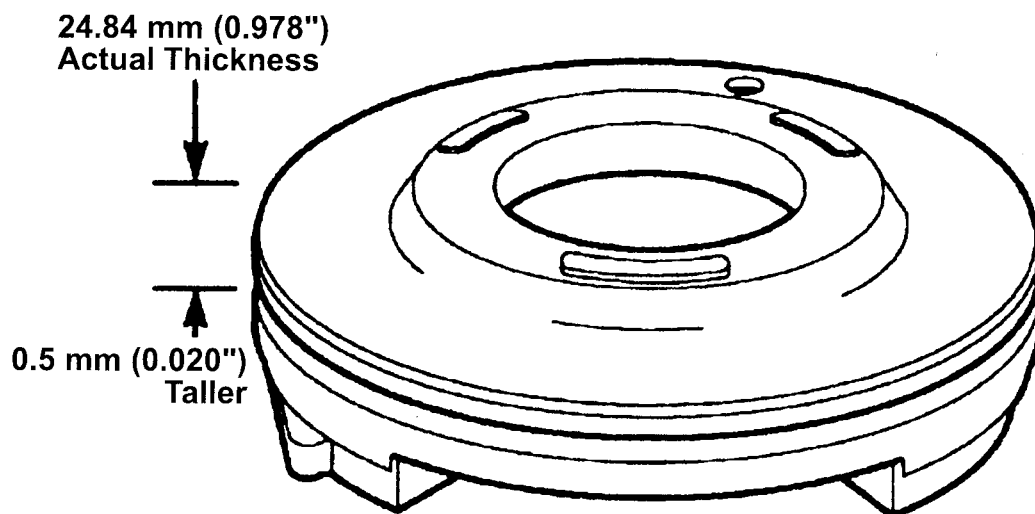
2. The coast clutch piston and seal assembly is now 2.25 mm taller than the earlier assembly — F8RZ-7A262BA



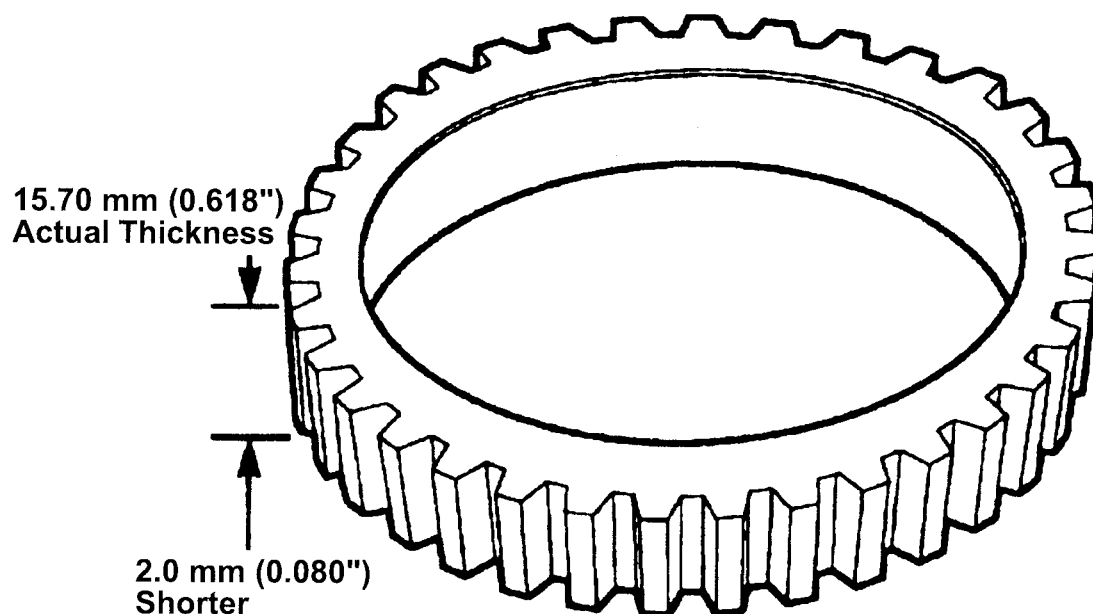
CD4E Updates (continued)

Mid-1998 Changes (continued)

3. The forward clutch piston assembly is now 0.5 mm taller than the earlier design, and has a new casting prefix (RFF8RP) — F8RZ-7A262-AB



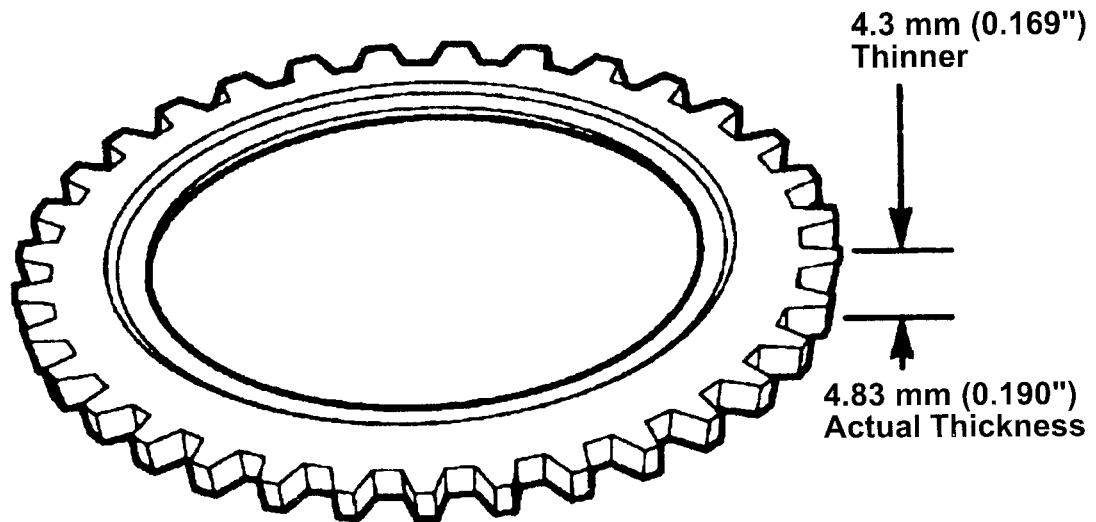
4. The forward outer one-way clutch race is now 2.0 mm shorter than the earlier design. It's part of the one-way clutch assembly — F8RZ-7A069-AA



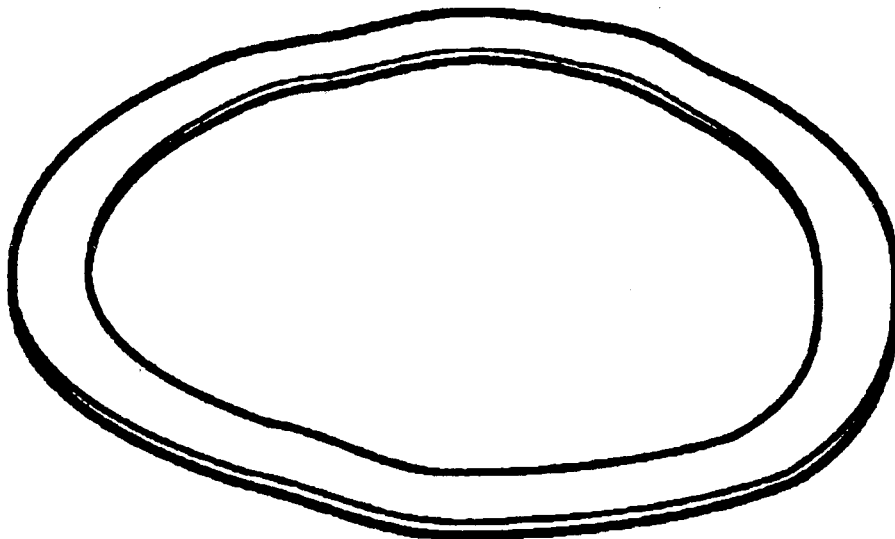
CD4E Updates (continued)

Mid-1998 Changes (continued)

5. The forward clutch pressure plate is now 4.3 mm thinner than the earlier part — F8RZ-7B066-AA



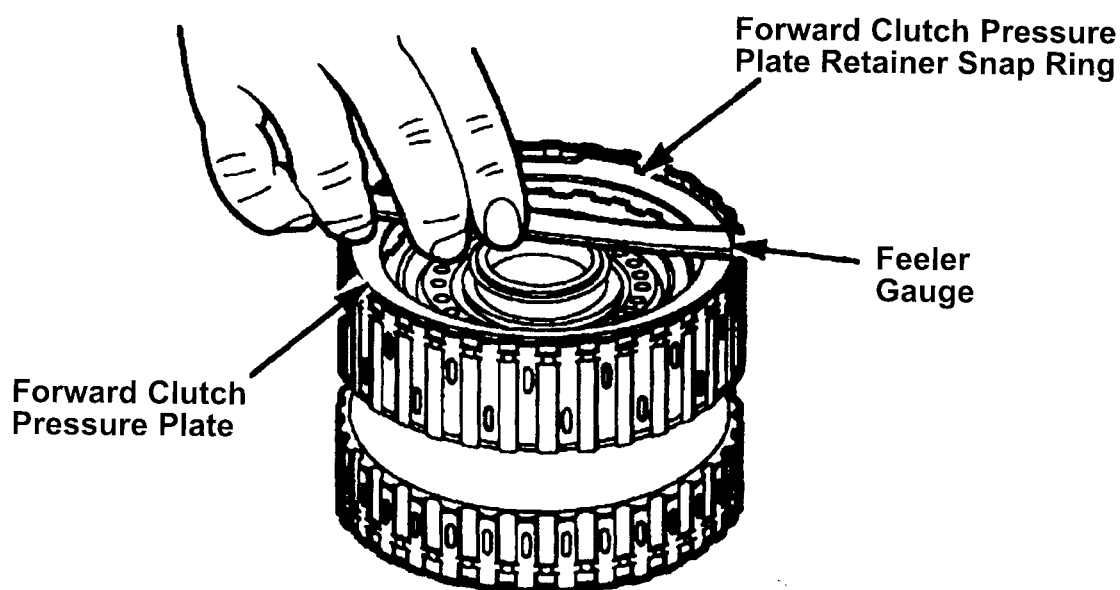
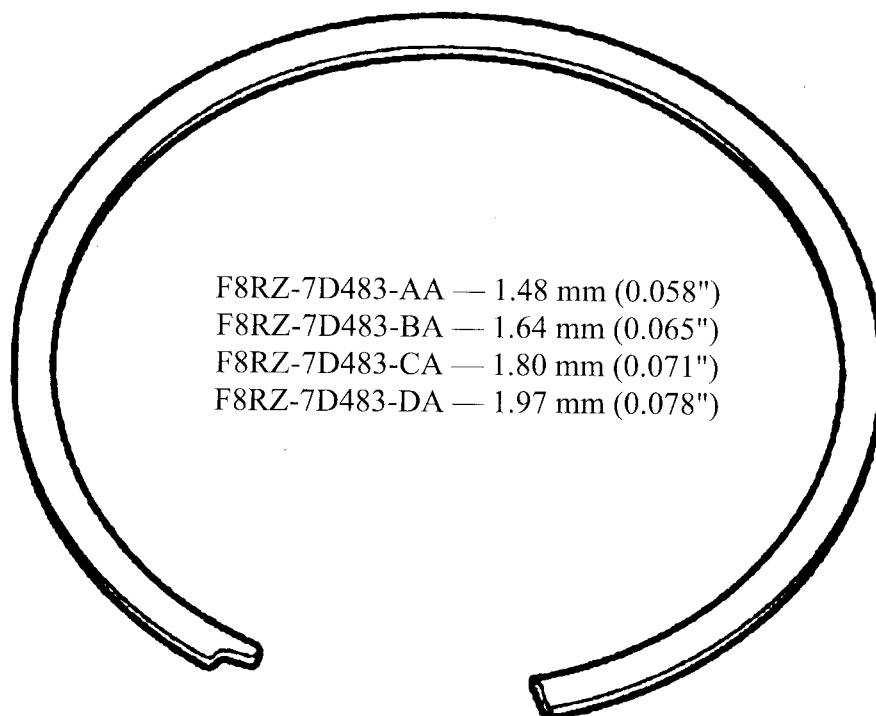
6. The forward clutch includes a new wave spring — F8RZ-7E085-AA



CD4E Updates (continued)

Mid-1998 Changes (continued)

7. There are four new selective snap rings available:

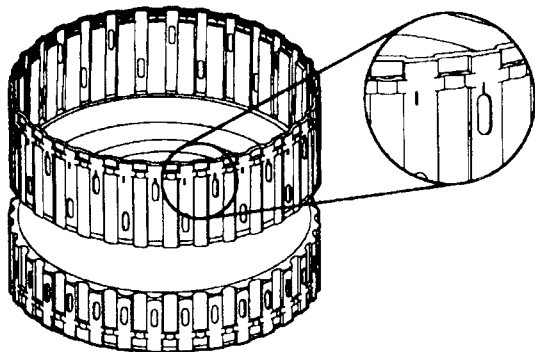


Set clearance to 0.32 – 0.98 mm (0.012" – 0.038")

CD4E Updates (continued)

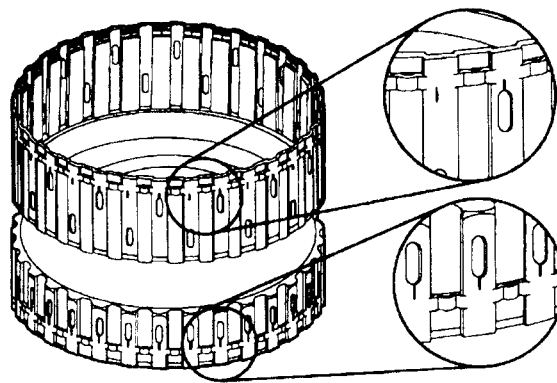
Mid-1998 Changes (continued)

8. There are now five different forward/coast/direct drums available. You can identify which drum you have by the small lines scribed into the spline areas.



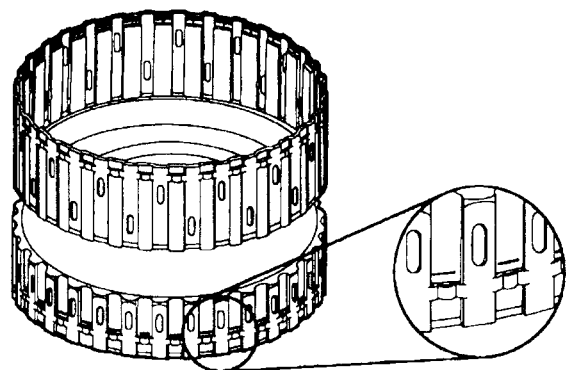
**Vertical Mark on the Forward Spline
No Mark on the Direct Spline
4-cyl 1998^{1/2} – on
F8RZ-7G120-AA**

Requires 3 mm (0.118") Steel Direct Plates



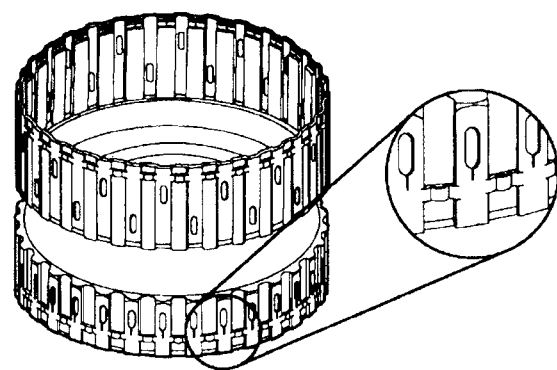
**Vertical Mark on the Forward Spline
Vertical Mark on the Direct Spline
V6 1998^{1/2} – on
F8RZ-7G120-BA**

Requires 2 mm (0.079") Steel Direct Plates



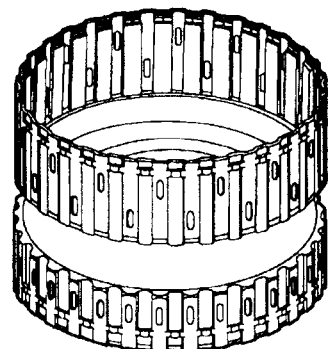
**Yellow Paint on the Forward Spline Minor
Horizontal Mark on the Direct Spline
4-cyl up to 1998^{1/2}
F5RZ-7G120-A**

Requires 3 mm (0.118") Steel Direct Plates



**No Mark on the Forward Spline
Vertical Mark on the Direct Spline
V6 up to 1998^{1/2}
F4RZ-7G120-A**

Requires 2 mm (0.079") Steel Direct Plates



**No Mark on the Forward Spline
No Mark on the Direct Spline
4-cyl up to 1998^{1/2}
F7RZ-7G120-AA**

Requires 2 mm (0.079") Steel Direct Plates

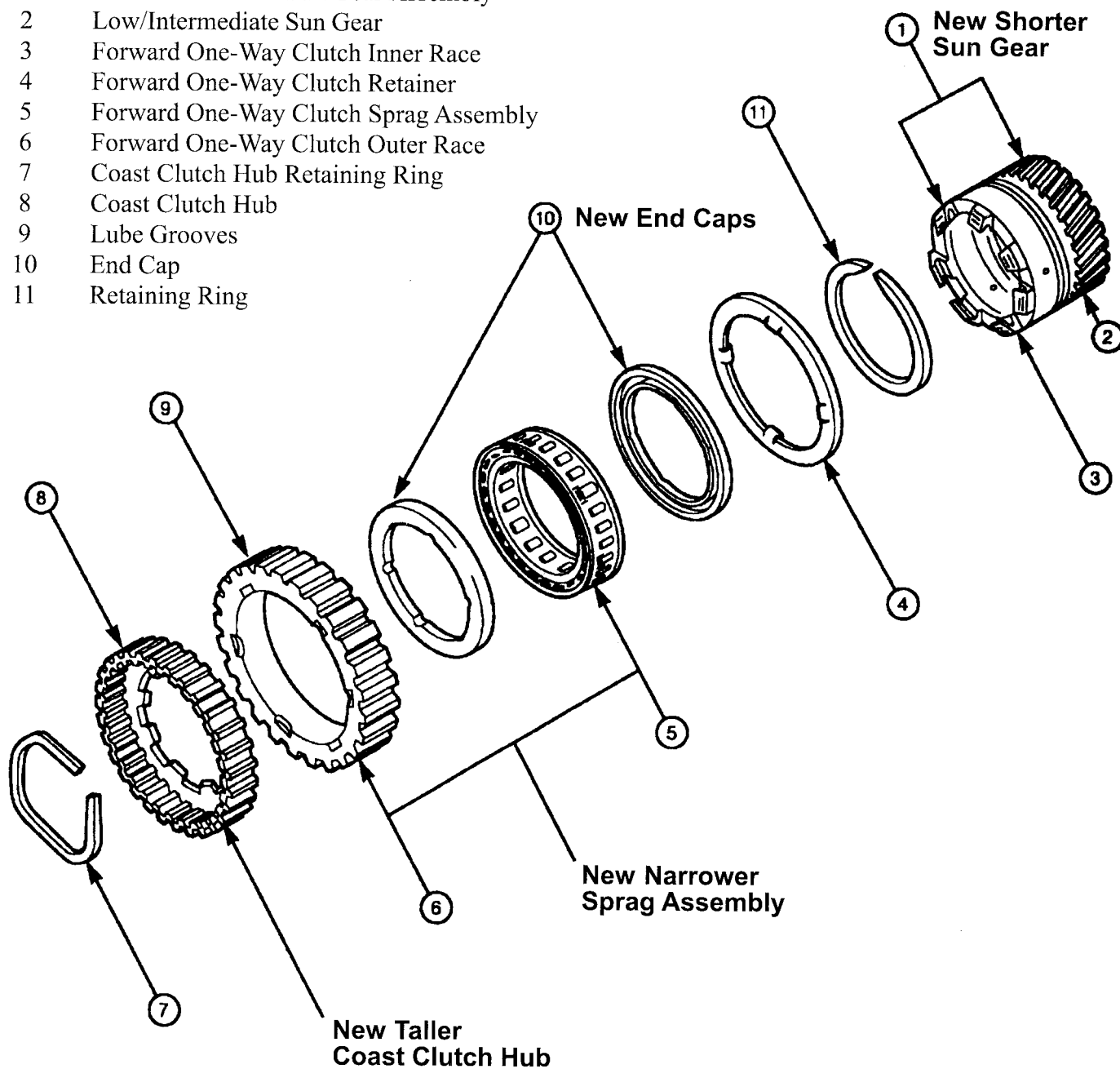
CD4E Updates (continued)

Mid-1998 Changes (continued)

Forward One-Way Clutch and Low/Intermediate Sun Gear Assembly; Exploded View

Item	Description
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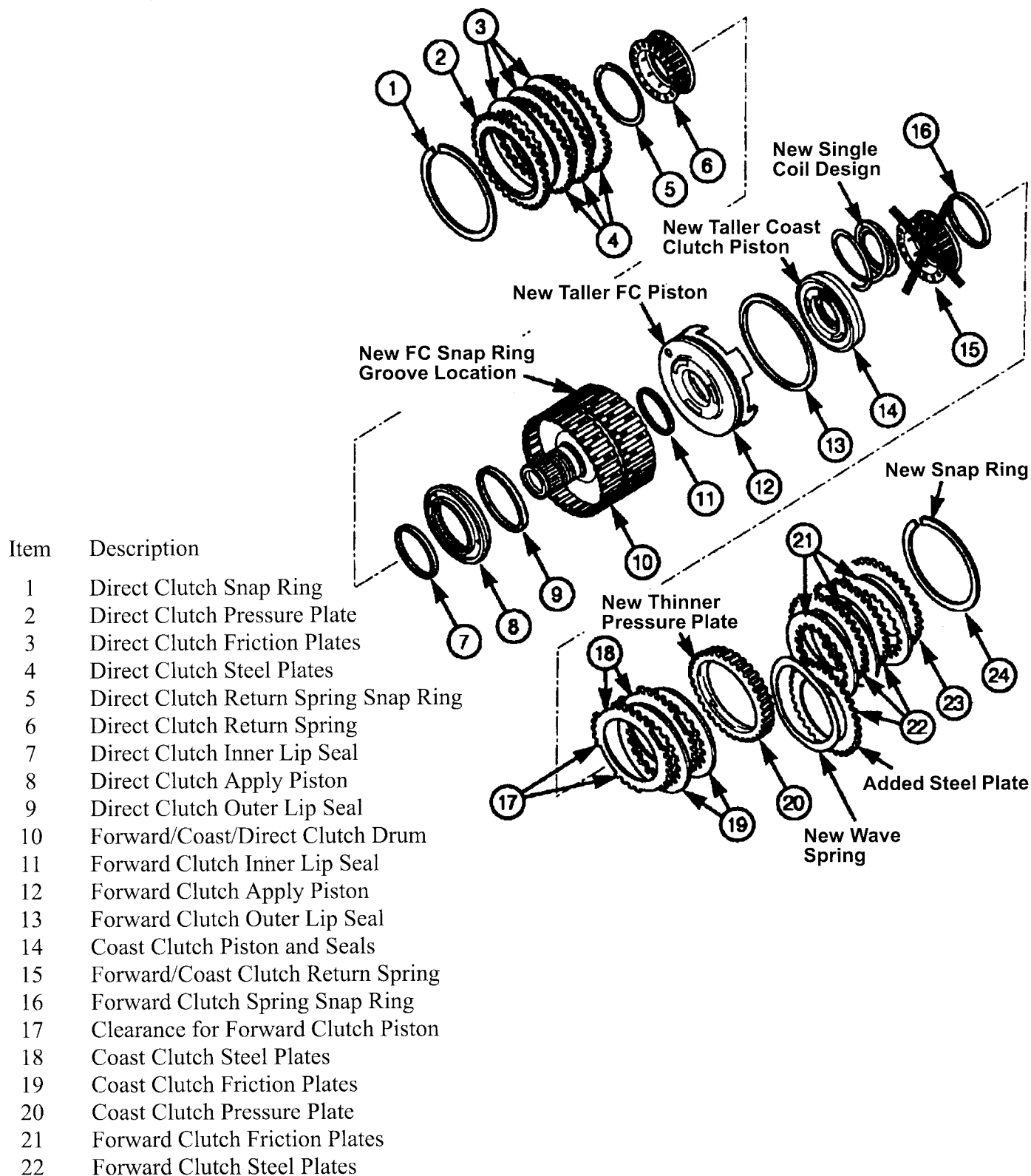
- | | |
|----|---------------------------------------|
| 1 | Low/Intermediate Sun Gear Assembly |
| 2 | Low/Intermediate Sun Gear |
| 3 | Forward One-Way Clutch Inner Race |
| 4 | Forward One-Way Clutch Retainer |
| 5 | Forward One-Way Clutch Sprag Assembly |
| 6 | Forward One-Way Clutch Outer Race |
| 7 | Coast Clutch Hub Retaining Ring |
| 8 | Coast Clutch Hub |
| 9 | Lube Grooves |
| 10 | End Cap |
| 11 | Retaining Ring |



CD4E Updates (continued)

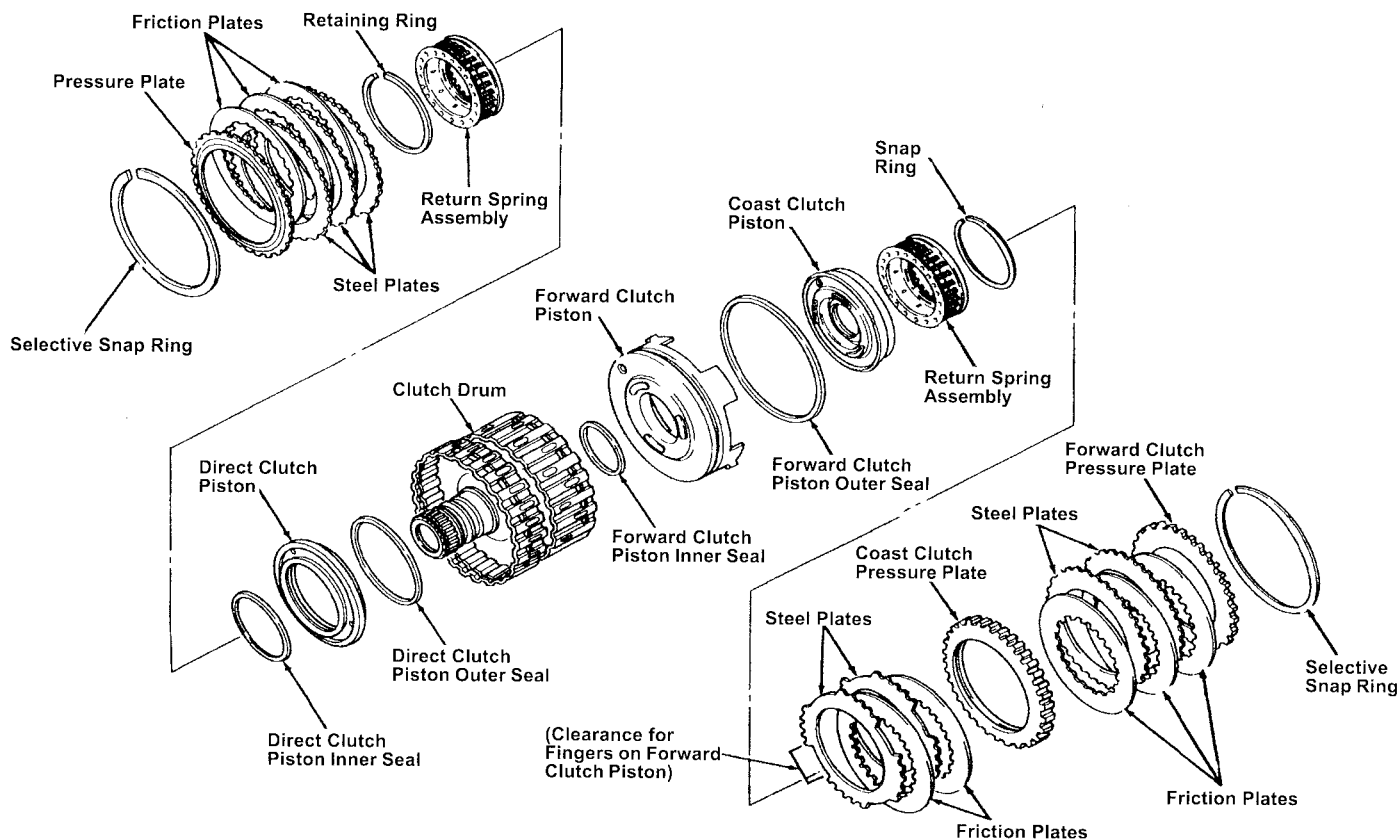
Mid-1998 Changes (continued)

Forward/Coast/Direct Clutch Assembly; Exploded View



CD4E Coast Clutch Assemblies

There are two clutch drums available for the CD4E: One for four cylinder engines and one for six cylinder engines. The difference is in the number of direct clutch friction plates that are used: The four cylinder drum uses three clutches; the six cylinder uses four clutches.



The clutch clearance for the forward and the three-friction direct clutch is 0.51 – 1.02 mm (0.020" – 0.040"). The clearance for the four-friction direct clutch is 0.76 – 1.52 mm (0.030" – 0.060").

You can alter the clutch clearance by changing the selective snap ring. Here are the snap rings available:

- 1.27 – 1.37 mm (0.050" – 0.054")
- 1.40 – 1.50 mm (0.055" – 0.059")
- 1.52 – 1.63 mm (0.060" – 0.064")
- 1.65 – 1.75 mm (0.065" – 0.069")

IMPORTANT

Some clutch drums were manufactured with a defective weld that would cause the forward and direct clutch to leak. The defective cylinders were used on transaxles with serial numbers 4271-0000 through 4303-9999. Here are the replacement clutch drums for those units:

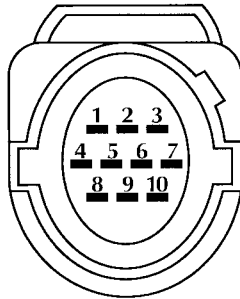
- 4-Cylinder Clutch Drum – F5RZ-7G120-A
- 6-Cylinder Clutch Drum – F4RZ-7G120-A

Testing the CD4E Shifts

Terminal Identification

Here's a breakdown of the individual connector terminals:

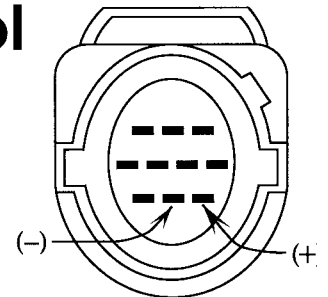
Shown from the terminal side of the transmission connector.



Transmission Connector Identification			
ID	Function	ID	Function
1	TFT (+)	6	Shift Solenoid (B+)
2	TFT (-)	7	Shift Solenoid 1
3	TCC (B+)	8	3-2T/CCS Solenoid
4	TCC Apply (-)	9	EPC (B+)
5	Shift Solenoid 2	10	EPC (-)

Electronic Pressure Control

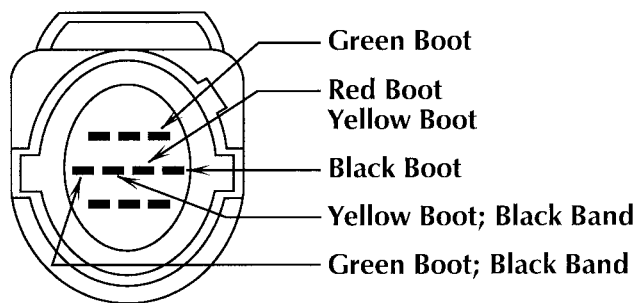
To check the electronic pressure control signal, connect your high-impedance voltmeter or signal monitor to the terminals shown.



Checking the Shift Pattern

Here's how to connect your signal monitor to check the transmission shift signals:

Backprobe the terminals with the harness connector still connected to the transmission



And here's the signal pattern you should see:

Transmission Shift Pattern			
First Gear			
Second Gear			
Third Gear			
Fourth Gear w/Lockup			

The far right LED indicates the signal to the converter clutch (TCC) solenoid.

continued...

Testing the CD4E Shifts (continued)

Forcing the Shift

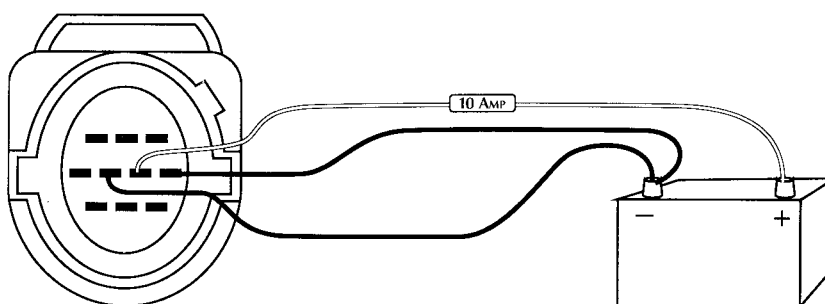
Here's the manual shift pattern you can expect with the transmission in failsafe:

Manual Gear Ranges in Failsafe						
Selector Position	Park	Reverse	Neutral	D or 3	S or 2	L or 1
Gear Range	Park	Reverse	Neutral	3 rd	3 rd	1 st

And here's how to force the CD4E to shift electrically:

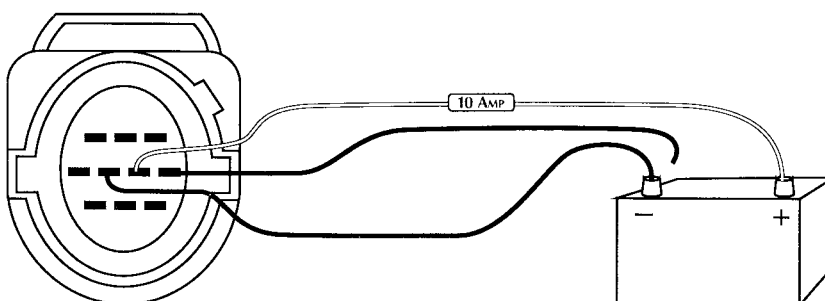
First Gear

In first gear, shift solenoids 1 and 2 both receive ground.



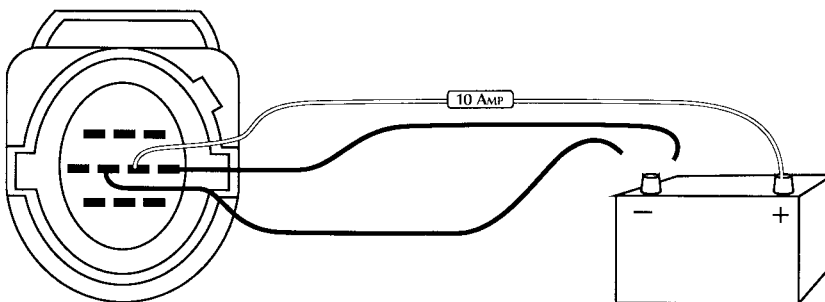
Second Gear

To shift into second gear, the computer releases ground from solenoid 1; only solenoid 2 remains grounded.



Third Gear

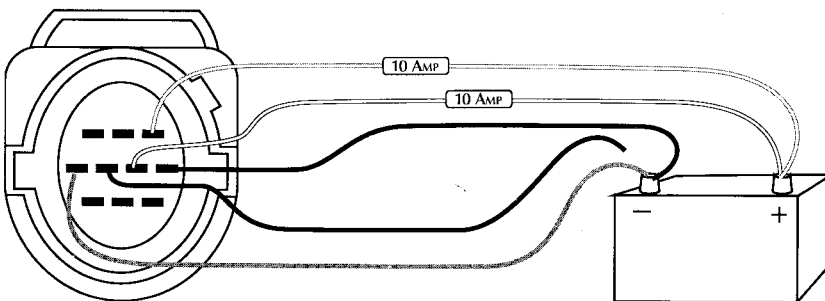
To shift into third gear, the computer releases solenoid 2; neither shift solenoid is grounded.



Fourth Gear

To shift into fourth gear, the computer grounds solenoid 1; solenoid 2 remains open.

The gray lines are the connections necessary to apply the converter clutch.



CD4E (continued)

Code 628, P0741, P1741; New Pump

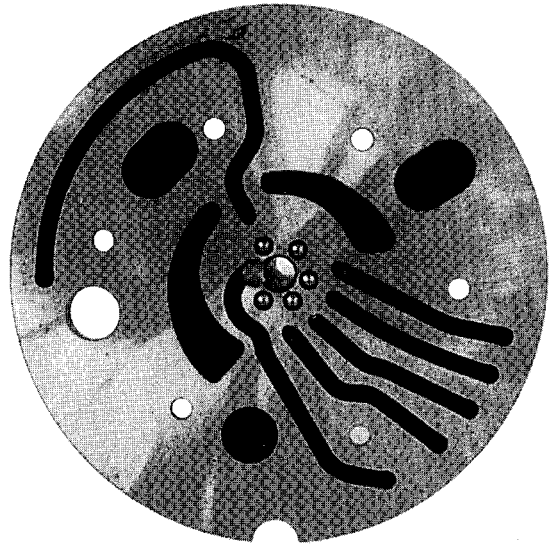
Diagnostic trouble codes 628, P0741 and P1741 all indicate the same problem: converter clutch slip. What happens is the pump gasket blows out, which allows line pressure to drop and lets the converter clutch slip. To correct this problem, Ford has released a new pump, designed to improve the clamping force between the pump plate and the drum support.

CD4E Replacement Pump — F7RZ-7A103-AA

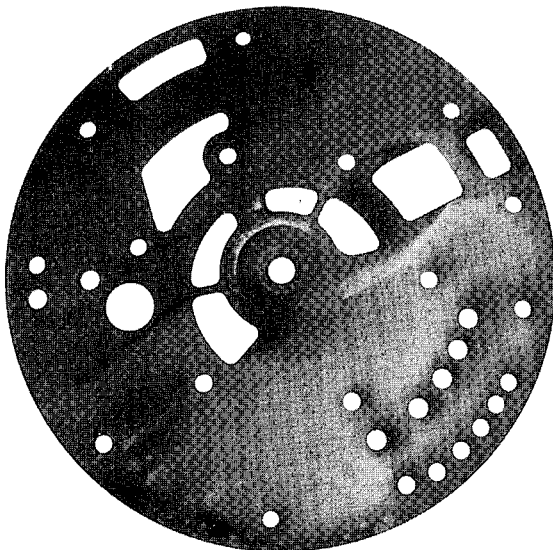
The pump body in the new pump is identical to the original pump; but the support and plate aren't available separately, so you'll have to purchase the complete pump assembly.



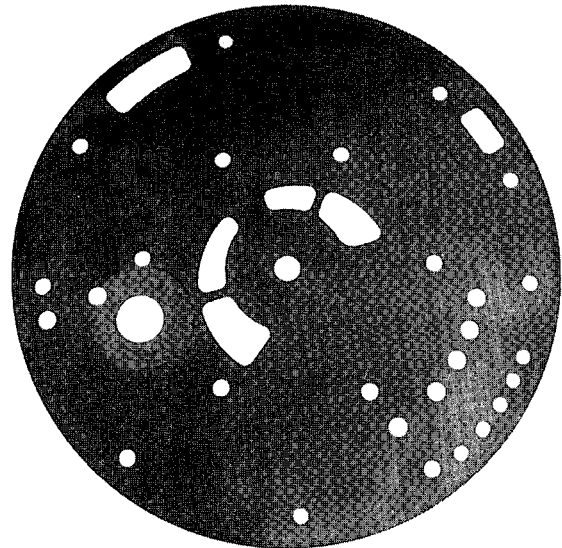
Early Support



Late Support



Early Plate

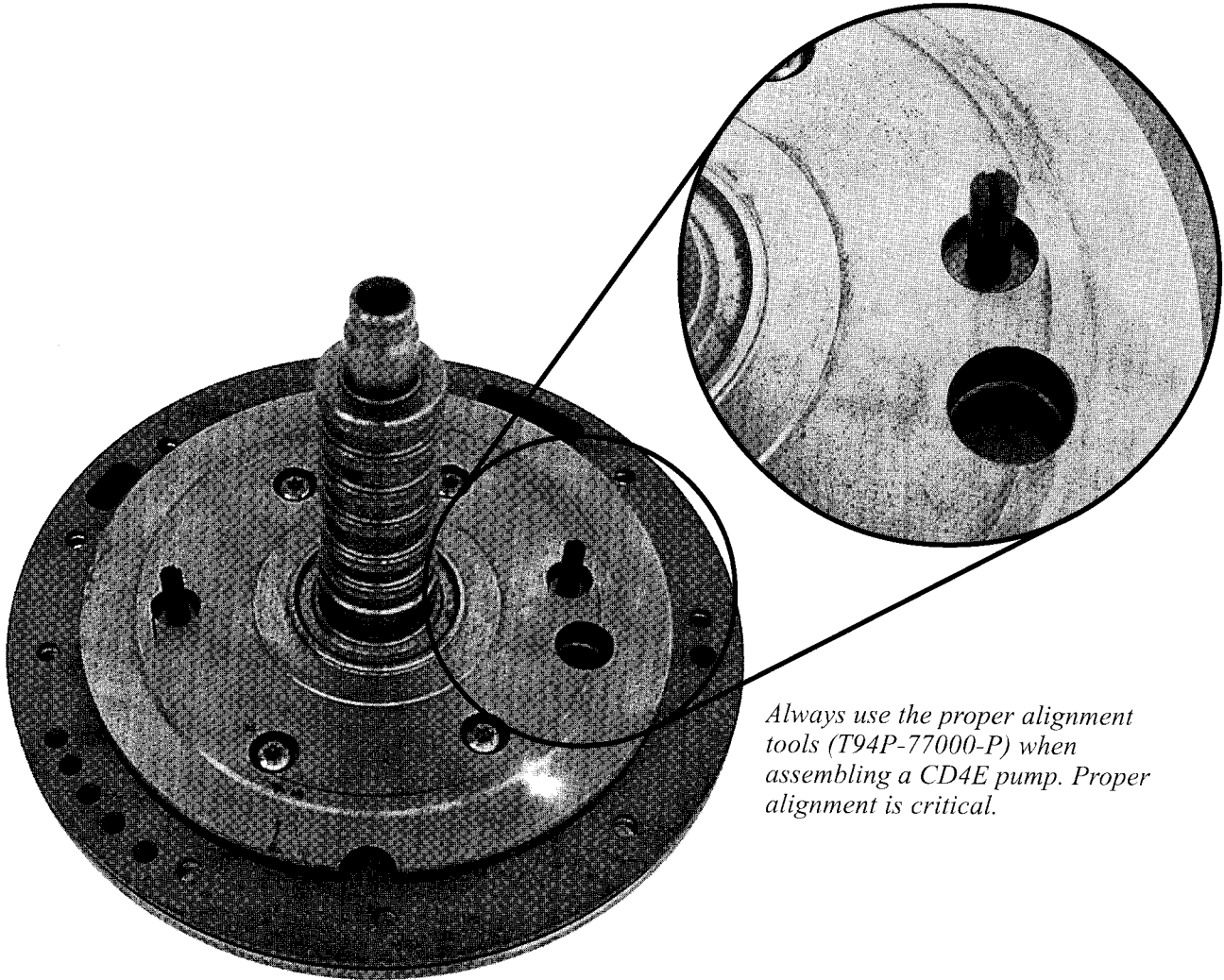


Late Plate

Continued...

CD4E (continued)**Code 628, P0741, P1741; New Pump (continued)**

IMPORTANT When assembling the CD4E pump, proper alignment is critical; always use the proper alignment tools before bolting the support to the pump.



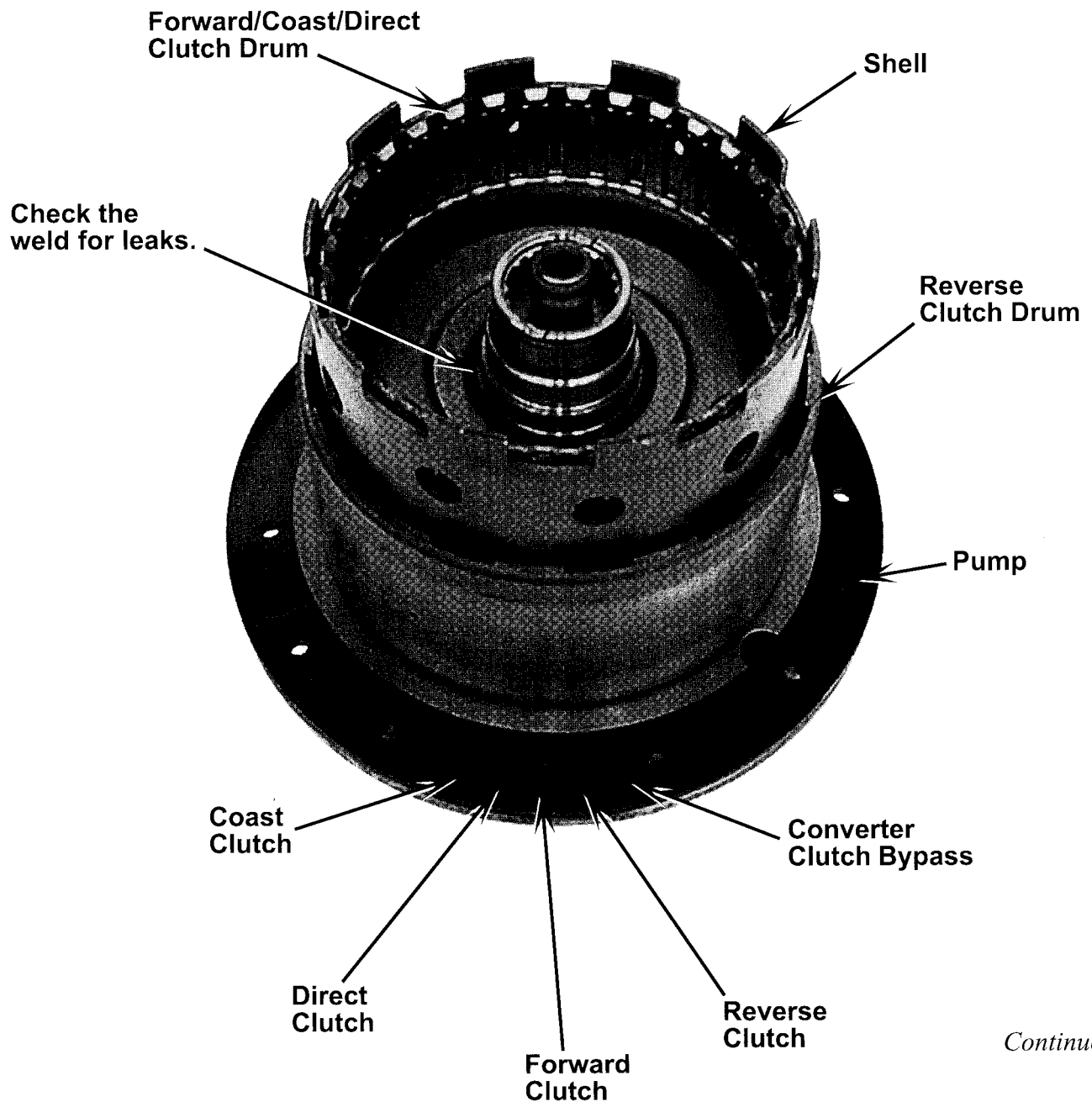
Always use the proper alignment tools (T94P-77000-P) when assembling a CD4E pump. Proper alignment is critical.

CD4E (continued)

3rd Gear Starts; 1–2 Bindup

Either 3rd gear starts or a bindup on the 1–2 shift can be symptoms of a cracked weld in the forward/coast/direct drum.

To pinpoint the problem, remove the forward and coast clutches and pistons from the drum. Leave the direct clutches and piston in the drum. Then air check the direct drum. If the weld is cracked, you should see air leaks in the area indicated.



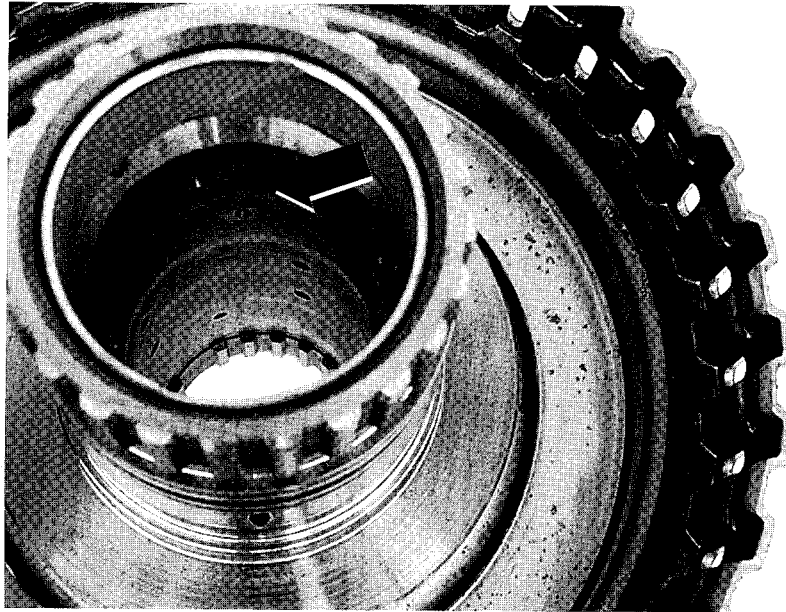
Continued...

CD4E (continued)

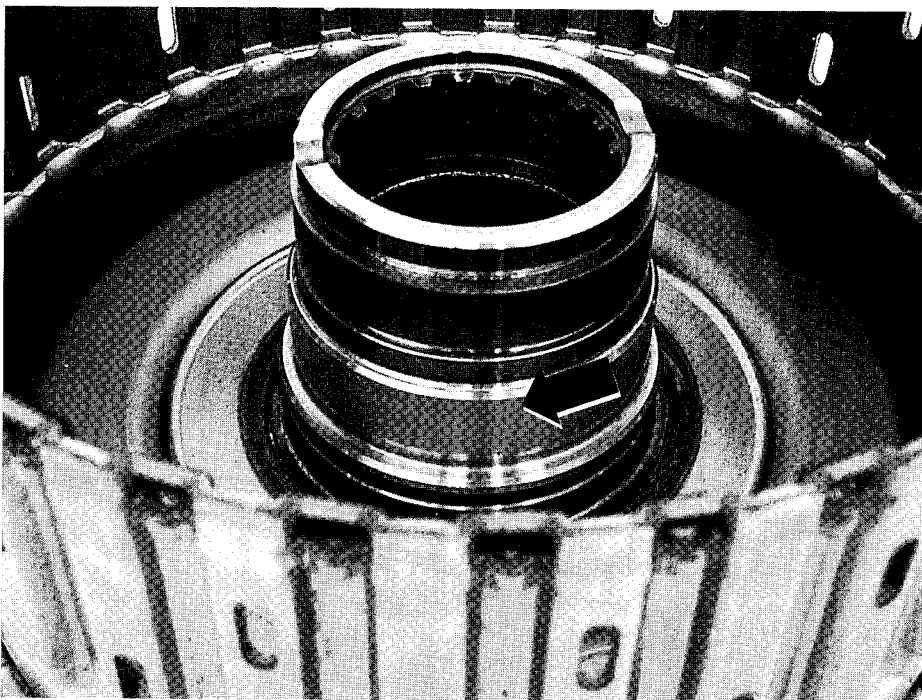
3rd Gear Starts; 1–2 Bindup (continued)

When replacing the drum, always check the ring bore on the new drum; some have shown up brand new with damage where the rings ride.

If the new drum has damage to the ring bore, don't use it; replace the drum.



In addition, check the apply holes against the original drum; some drums have shown up from the factory with one or more of the holes left out. If you get a drum with damage in the ring bore or apply holes missing, return it to the dealer, and get another drum.



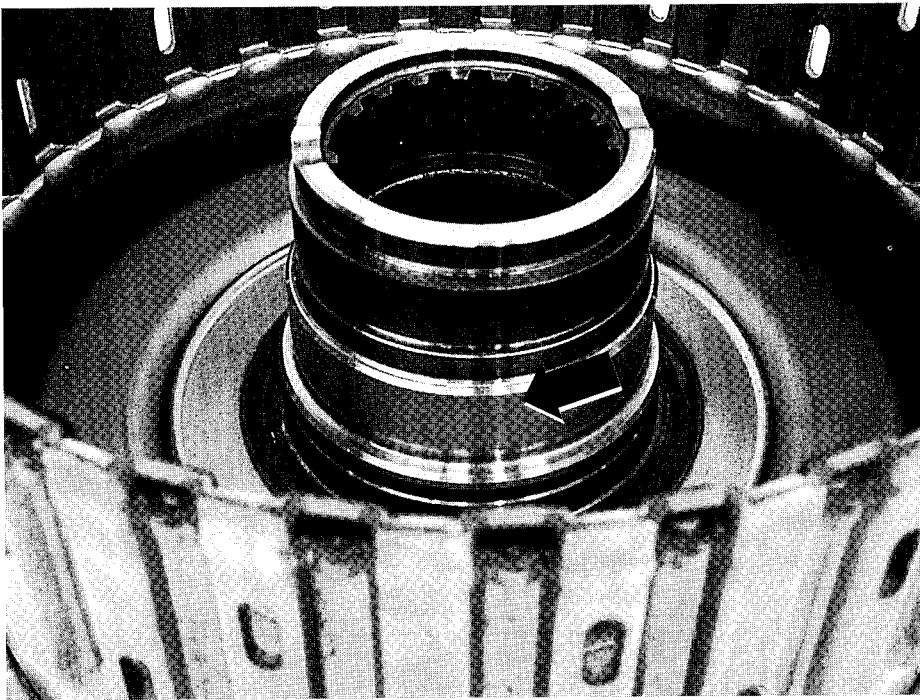
And always check for missing apply holes; some of these drums have been coming from the factory with apply holes missing. If the drum you get is missing a hole, return it and get another drum.

CD4E (continued)

No Engine Braking; Binds in 4th Gear

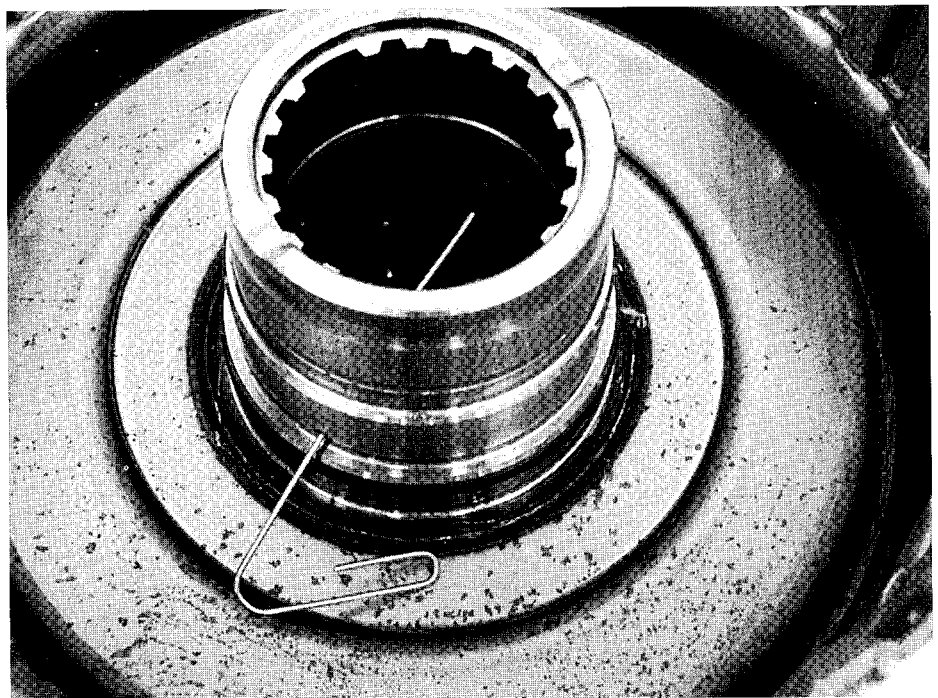
Some forward/coast/direct drums were manufactured without the coast clutch feed holes drilled. Since the coast clutch can't apply, the unit will never develop engine braking.

To prevent this problem, always check the forward/coast/direct clutch drum for all feed holes — especially if you're replacing the drum. If any of the feed holes are missing, replace the drum.



If the factory forgot to drill the coast clutch feed holes, you won't have any engine braking.

The fix for this is simple: Replace the drum. And always make sure all of the feed holes are drilled through on any drum you replace.



CD4E (continued)

Vent Leaks

Many 1994 – 97 CD4Es have experienced ATF leaking from the vent during normal operation. This leak is caused by the pressure control solenoid, which sprays ATF right at the vent during normal operation.

In January, 1997, Ford began using a new side pan, with a redesigned vent and tube assembly. If you need to replace the side pan on an earlier model unit, upgrade to the new design pan, P/N F7RZ-7G004-AA

And if you're installing a new pan, or need to replace the vent tube on a unit that already has a new pan, you'll also need the redesigned vent kit:

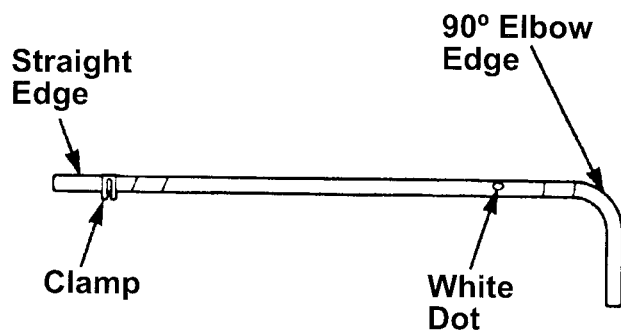
Contour/Mystique: F6RZ-7034-BA

Probe: F6RZ-7034-CA

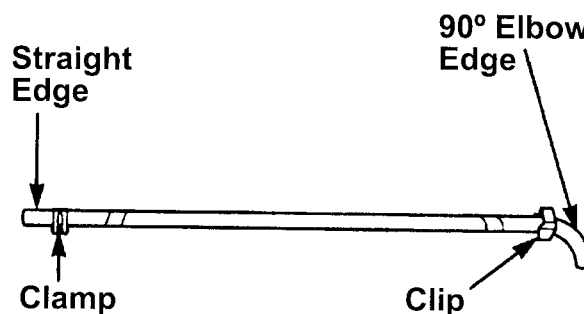
Ford also offers a vent kit for 1994 – 96 models with the original pan. To modify one of these units, order the appropriate vent kit:

Contour/Mystique: F6RZ-7034-AA

Probe: F6RZ-7034-AB



Probe Vent Assembly



Contour/Mystique Vent Assembly

4R44E, 4R55E and 5R55E

Clutch and Band Application

4R44E and 4R55E

Gear	Forward Clutch	Direct Clutch	Coast Clutch	Low/Reverse Band	Intermediate Band	Overdrive Band	OD One-Way Clutch	Low One-Way Clutch	Gear Ratios
Park									
Neutral									
OD Overdrive Active	Rev								2.10:1
	1 st								2.47:1
	2 nd							OR	1.47:1
	3 rd							OR	1.00:1
	4 th						OR	OR	0.75:1
OD Overdrive Cancelled	Rev								2.10:1
	1 st								2.47:1
	2 nd							OR	1.47:1
	3 rd							OR	1.00:1
	4 th	Cancelled							
Manual 2								OR	1.47:1
Manual 1									2.47:1

5R55E

Gear	Forward Clutch	Direct Clutch	Coast Clutch	Low/Reverse Band	Intermediate Band	Front Band	Front One-Way Clutch	Rear One-Way Clutch	Gear Ratios
Park									
Reverse									2.10:1
Neutral									
OD TCIL Off	1 st								2.47:1
	2 nd						OR		1.86:1
	3 rd							OR	1.47:1
	4 th							OR	1.00:1
	5 th						OR	OR	0.75:1
OD TCIL On	1 st								2.47:1
	2 nd						OR		1.86:1
	3 rd							OR	1.47:1
	4 th							OR	1.00:1
	5 th	Cancelled							
2 (Manual 3)								OR	1.47:1
1 (Manual 1)									2.47:1

 = Applied TCIL = Transmission Control Indicator Light

4R44E, 4R55E and 5R55E (continued)

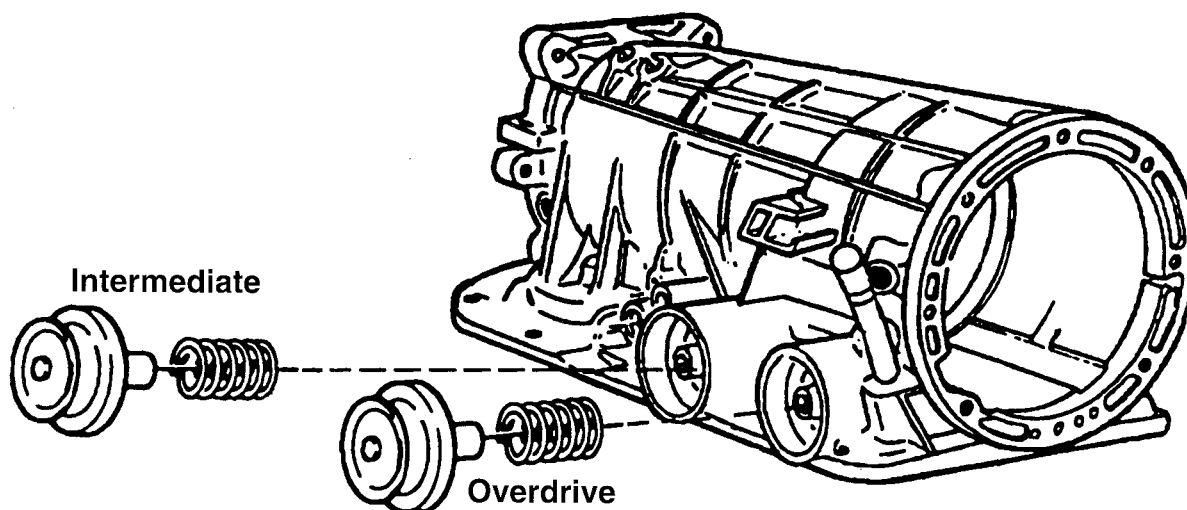
Slips in 2nd or 4th (4-Speed)

Slips in 2nd, 3rd or 5th (5-Speed)

Slipping complaints in one of these ranges usually indicate the servo seals are hard, so they won't seal properly in the bore.

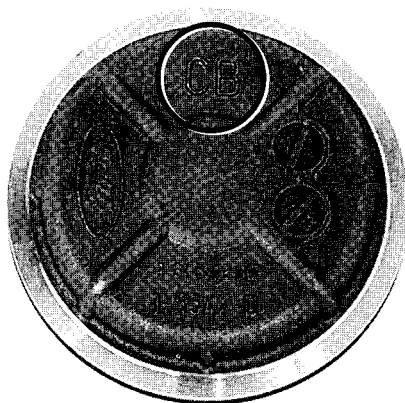
On a 4-speed unit, a slip in 2nd gear indicates a hard intermediate servo seal; a slip in 4th gear indicates an overdrive servo seal problem.

On a 5-speed unit, a slip in 2nd or 5th indicates a hard overdrive servo seal; a slip in 3rd indicates a problem with the intermediate servo. In some cases, a hard intermediate servo seal can cause a bindup in 3rd gear.



The replacement servos have a vulcanized rubber compound seal that resists heat damage, so they're more likely to remain pliable. Use the ID letters on the servo cover to make sure you order the right servo piston. Changing any of these components will affect shift feel.

You can identify the servo by the ID letters, cast into the outside of the cover. If you're replacing the servo with a different one, always replace the servo and cover as a set.



Servo Cover		Servo	
ID	Part Number	Diameter	Part Number
ZC	F77Z-7D027-ZC	2.314"	F77Z-7D021-ZA
AB	E6TZ-7D027-B	2.077"	F77Z-7D021-A2A
BB	E6TZ-7D027-C	1.917"	F77Z-7D021-BA
CB	E6TZ-7D027-D	1.812"	F77Z-7D021-CA
DB	E6TZ-7D027-A	1.751"	F77Z-7D021-DA

4R44E, 4R55E and 5R55E (continued)

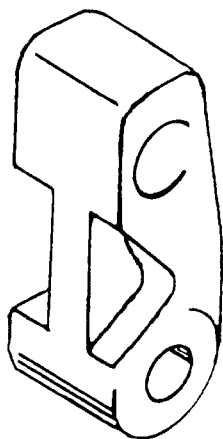
Slips in 2nd or 4th (4-Speed)

Slips in 2nd 3rd or 5th (5-Speed)

There are four different servo springs available. This chart lists those springs, in order, from lightest to heaviest.

Color	Wire Thickness	Free Height	Part Number
Green	0.079"	1.492"	E3TZ-7D028-A
Blue	0.089"	1.810"	E0BZ-7D028-A
Yellow	0.098"	1.898"	F0TZ-7D028-A
Orange	0.110"	1.870"	D4ZZ-7D028-A

In addition, there are five servo levers available, each with its own ratio. You can identify the lever and its ratio from the letter stamped into it.



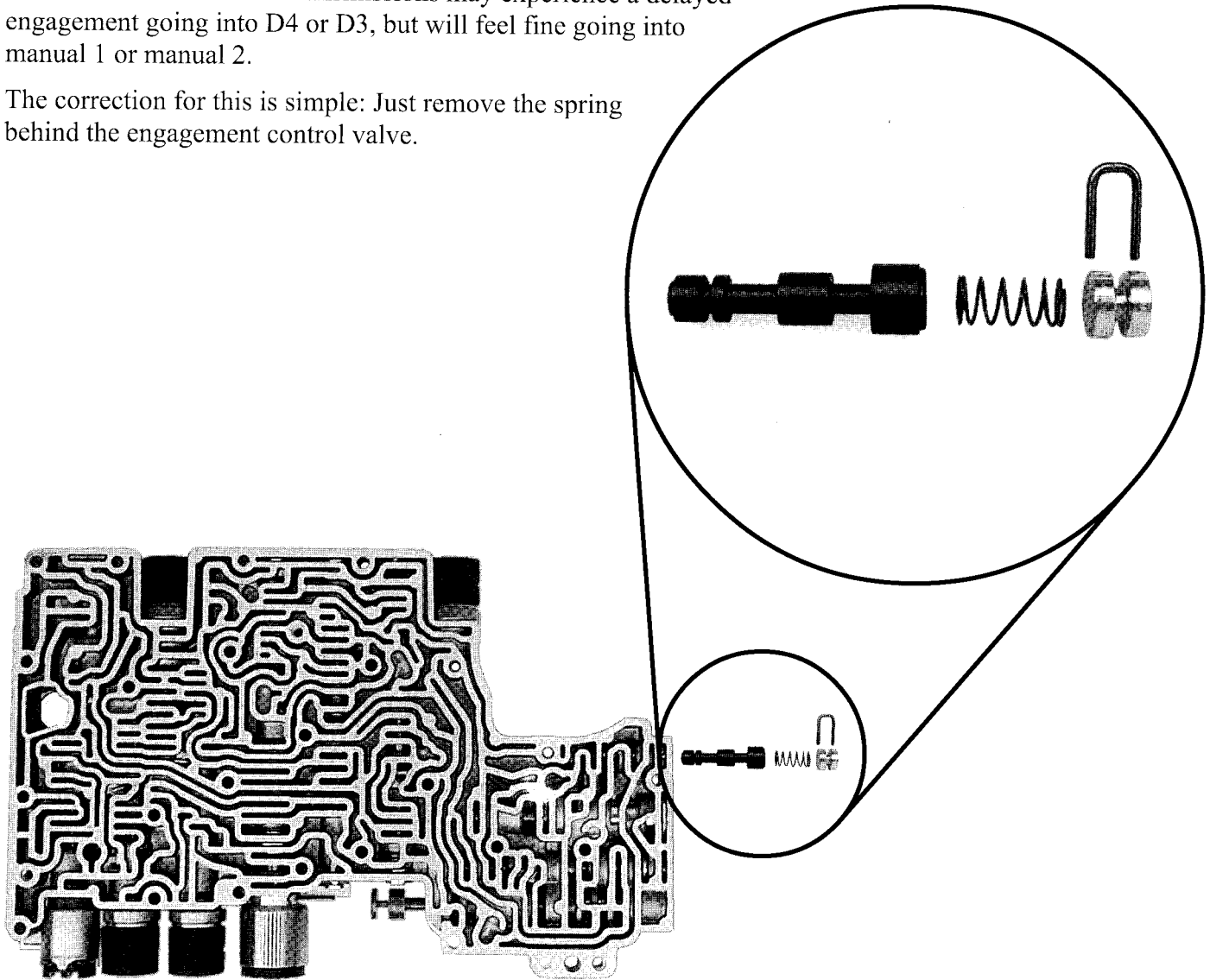
ID	Ratio	Part Number
A	2.058:1	E7RY-7330-A
C	1.773:1	E8TZ-7330-A
D	1.525:1	F0TZ-7330-A
E	1.448:1	E5TZ-7330-B
G	1.271:1	E5TZ-7330-A

4R44E, 4R55E and 5R55E (continued)

Delayed Engagement in Drive

Some 4R55E and 5R55E transmissions may experience a delayed engagement going into D4 or D3, but will feel fine going into manual 1 or manual 2.

The correction for this is simple: Just remove the spring behind the engagement control valve.

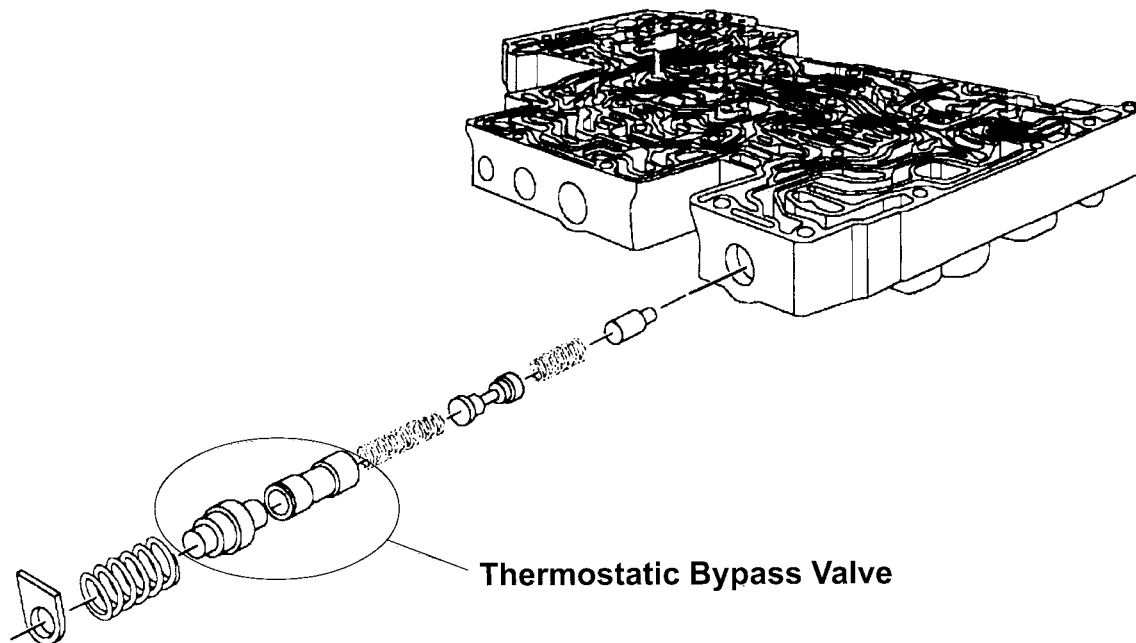


4R44E, 4R55E and 5R55E (continued)

No Cooler Flow Cold

No cooler flow when cold is a normal condition on these units. These transmissions have a thermostatic bypass valve in the valve body, designed to bypass cooler flow until the transmission warms up. This enables the transmission to reach normal operating temperature more quickly.

Until the unit warms up, converter charge oil bypasses the cooler, and goes right to the lube circuit.



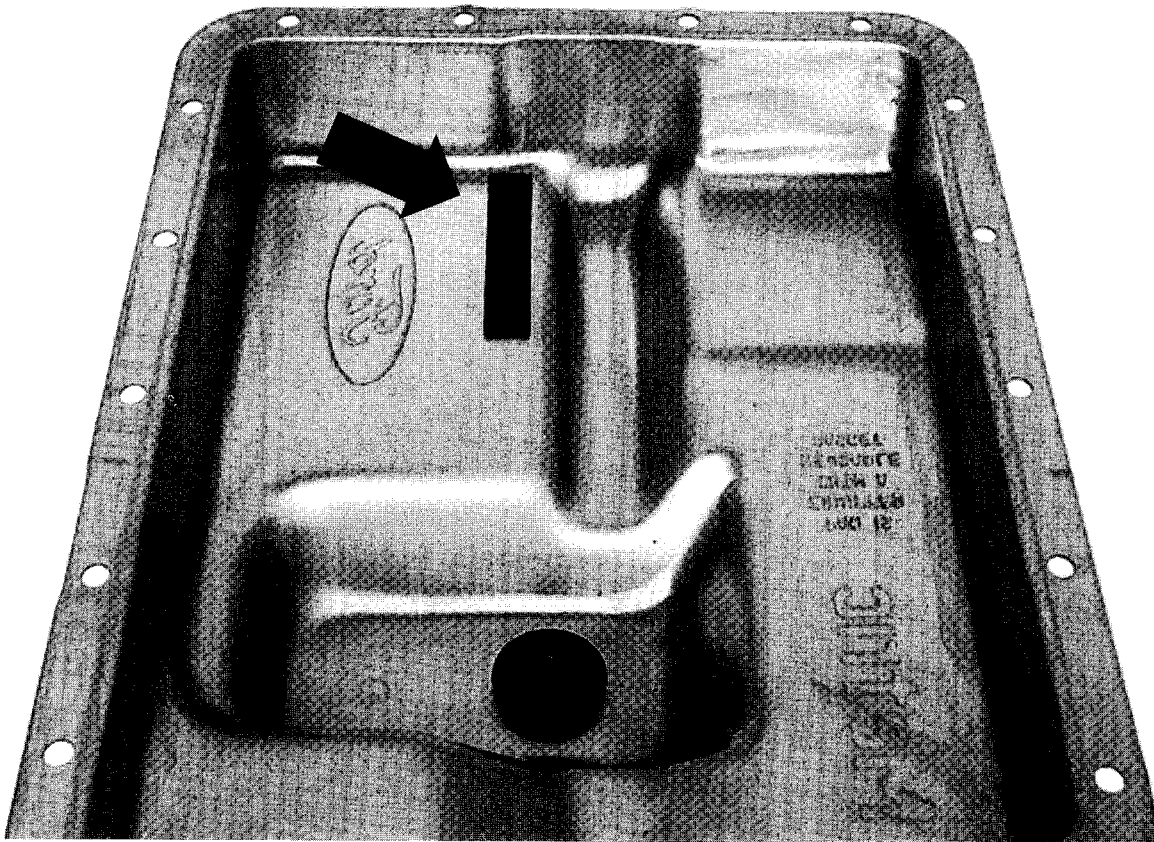
4R100/E4OD

Kills the Engine Going into Gear

Some E4ODs will stall or shut the engine off as you put them in gear, or shortly after going into gear. It doesn't matter whether you're putting it into drive or reverse.

This may be due to something as simple as a loose filter. To prevent this from occurring, Ford now offers a magnet for the bottom of the pan. This magnet doubles as a filter retainer, holding the filter tightly into the pump.

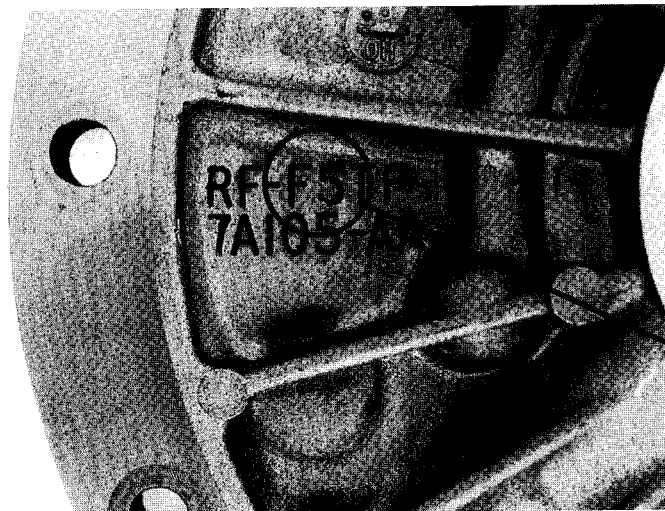
Sump Magnet — F3RZ-7E290-AC



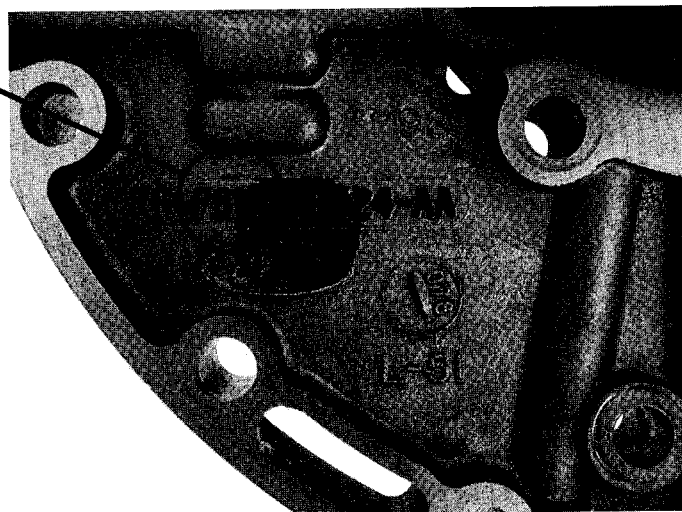
4R100/E4OD (continued)

Pump and Coast Clutch Variations

In 1998, Ford introduced the 4R100, a unit that was very similar to the E4OD. In fact, one of the 4R100 pump assemblies is the replacement for all E4OD pumps. To determine whether the pump you have is pre-1998, check the rough forge codes. F8 indicates 1998. Any other codes will work interchangeably on any E4OD.



All E4OD pumps were completely interchangeable. In 1998, Ford introduced the 4R100; one of the pumps made for this unit is interchangeable with the E4OD pump. To see if you have this pump, check the rough forge codes: In this case, the pump is from 1995, while the stator is from 1998, so the two don't match. In 1998, Ford added several pump assemblies, so the rough forge number was no longer the key to interchanging pump components.



In 1998, Ford came out with four new pump assemblies. One of them (type 1), used with the 5.4L and 6.8L gas engines, without a PTO, can be used interchangeably in all E4ODs, as a complete assembly.

You can identify the differences in these pumps by looking at three different areas:

- The bushing placement in the coast clutch drum.
- Whether the TCC valve is designed for standard application or pulse-width modulated operation (the PWM setup is used with diesel engine's only for 1998; in 1999, some gas engines will also use PWM TCC systems).
- Whether the stator support uses a bushing or a bearing to support the input shaft, which was only used in 1998; we'll cover this later.

IMPORTANT In 1998, all of the pump assemblies used the same pump body, so all of the rough forge numbers are the same (F8, indicating 1998). So in 1998, you can't use the rough forge numbers to indicate which pump assembly goes with which transmission; instead, you must use the specific differences of the stator support for identification.

4R100/E4OD (continued)

Pump and Coast Clutch Variations (continued)

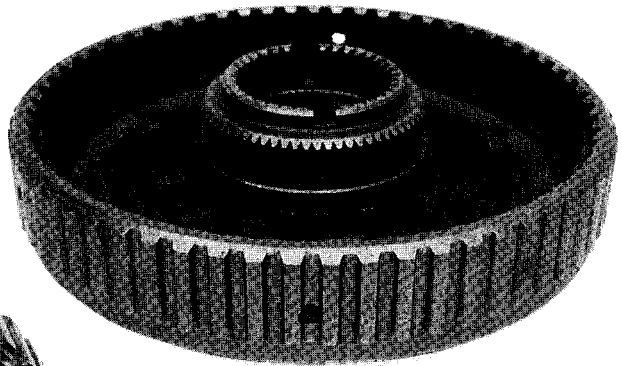
Here's how to identify the 1998 pump and coast clutch drum you have, and which vehicles they were designed to work with:

1998 Type 1: 5.4L and 6.8L gas without PTO — These units use a carry-over cast-iron design drum. The coast clutch has a high bushing, so the pump oil control rings sit close to the stator support.

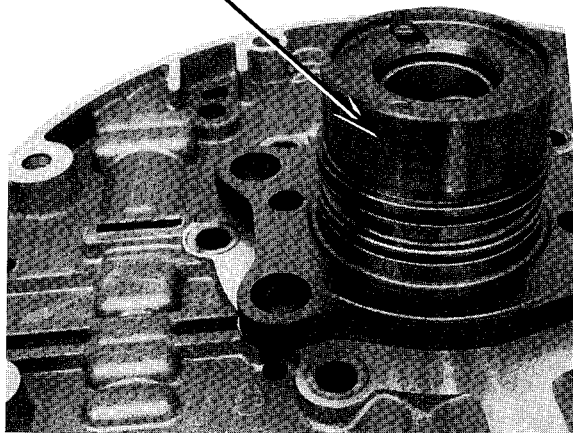
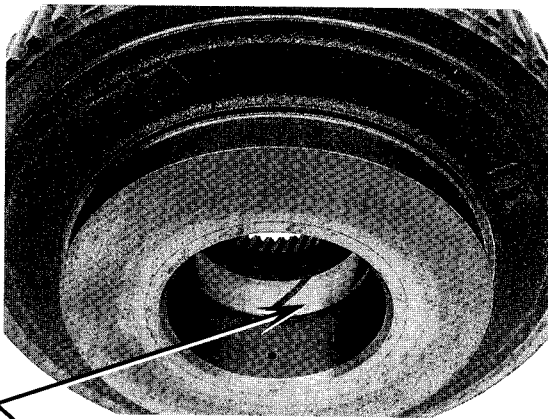
Because the transmission works with a gas engine, the lockup valve is designed for standard, on/off operation. You can identify this by checking the lockup valve; it uses a flat plug on the end of the valve train. This pump assembly is also the replacement for all E4ODs.

Pump Assembly P/N: F81Z-7A103-BA

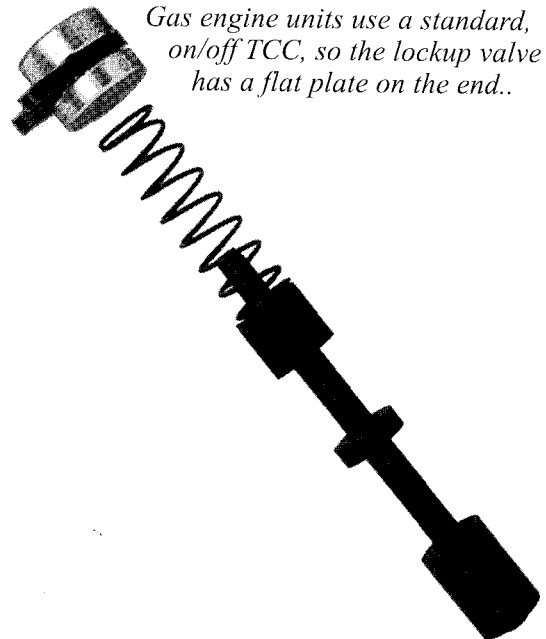
5.4L and 6.8L gas units use a carry-over cast iron drum.



The bushing sits high in the drum, so the oil control rings sit close to the support.



Gas engine units use a standard, on/off TCC, so the lockup valve has a flat plate on the end..



4R100/E4OD (continued)

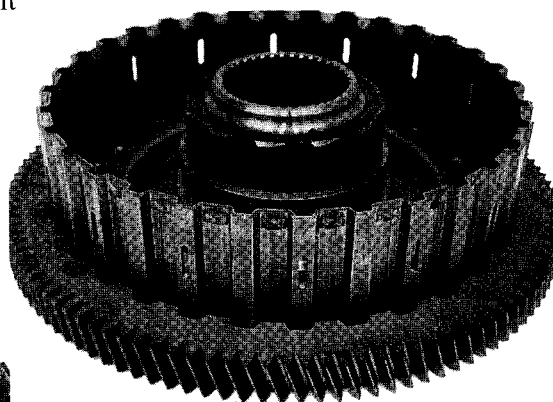
Pump and Coast Clutch Variations (continued)

1998 Type 2: 6.8L gas with PTO — These units use a new design, stamped steel drum, with a pressed-on PTO ring gear. The coast clutch has a low bearing (instead of a bushing), so the pump oil control rings sit high, away from the support. And, like the other gas units, the lockup valve is designed for standard, on/off operation.

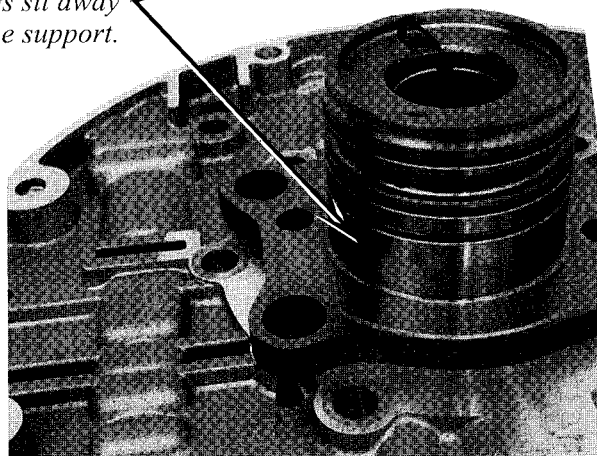
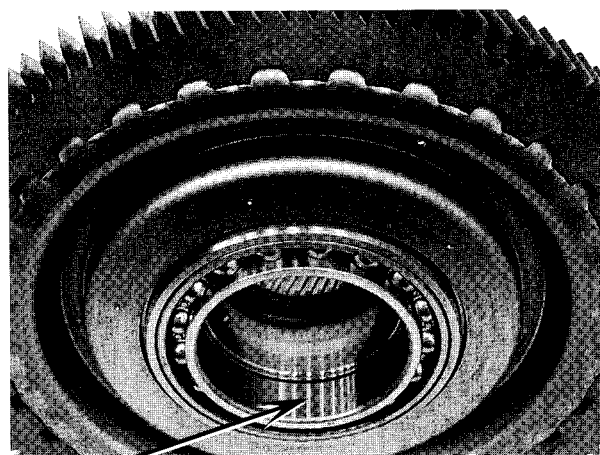
Another difference on these units is the rear input shaft bushing has been replaced with a needle roller bearing. But this was only for 1998; in 1999 Ford discontinued the use of this bearing, and went back to a bushing on replacement stator supports.

Pump Assembly P/N: XC3Z-7A103-DA

Units with a PTO use a stamped steel drum with a pressed-on PTO ring gear.

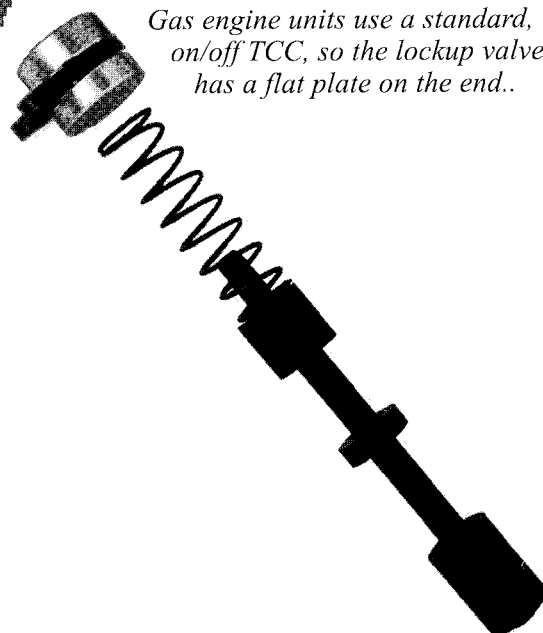


Instead of a bushing, these units use a bearing in the drum. The bearing sits low in the drum, so the oil control rings sit away from the support.



The original stator support had a bearing inside to support the input shaft. Replacements used a bushing.

Gas engine units use a standard, on/off TCC, so the lockup valve has a flat plate on the end..



4R100/E4OD (continued)

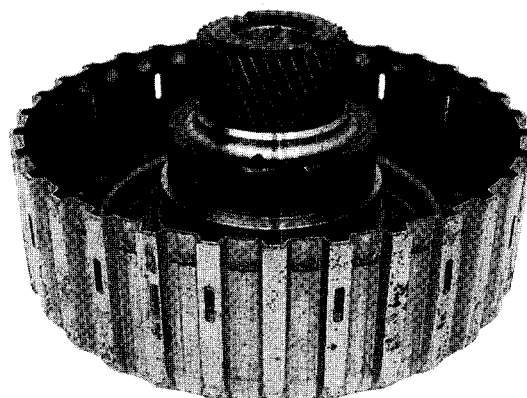
Pump and Coast Clutch Variations (continued)

1998 Type 3: 7.3L Diesel *without* PTO — These units use a new design stamped steel drum, without a pressed-on PTO ring gear. The coast clutch has a low bushing, so the pump oil control rings sit high, away from the support. These units came with a rear input shaft *bushing* instead of a needle roller bearing.

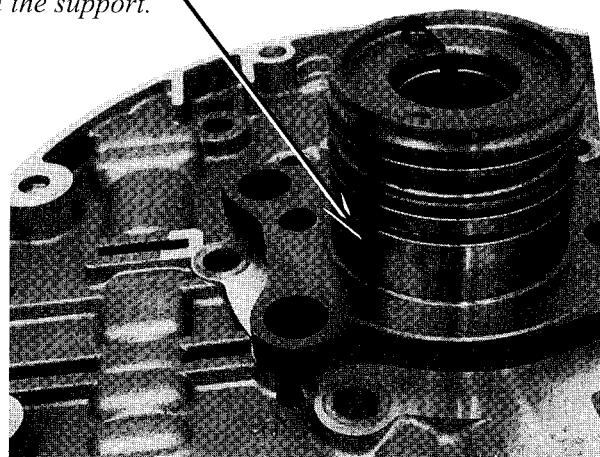
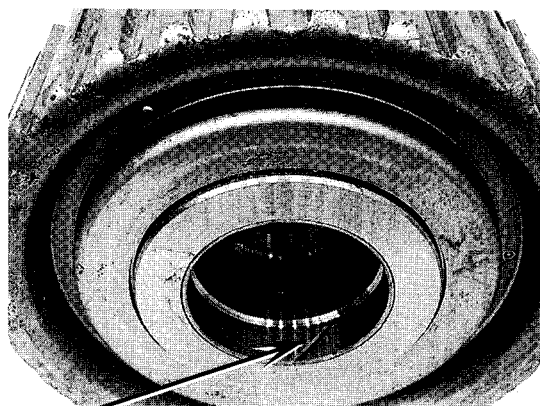
The lockup valve in these pumps is designed for pulse width modulation (PWM) operation. You can identify this easily: Instead of a flat plug on the end of the lockup valve train, these units have a bushing with a valve inside.

Pump Assembly P/N: F81Z-7A103-CA

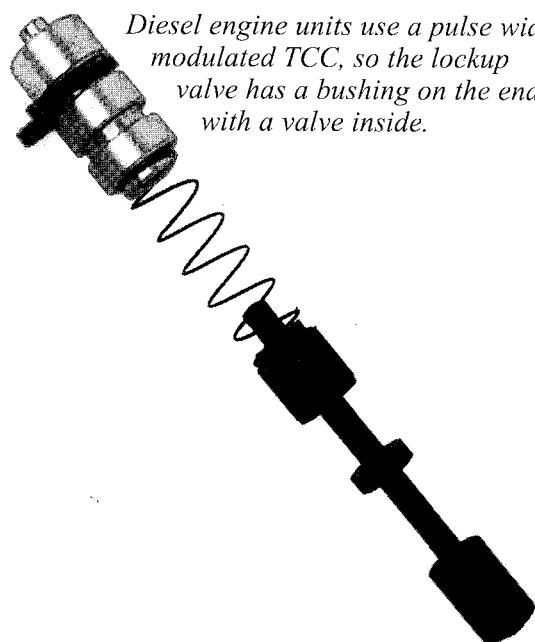
Units with a PTO use a stamped steel drum without a pressed-on PTO ring gear.



The bushing sits low in the drum, so the oil control rings sit away from the support.



Diesel engine units use a pulse width modulated TCC, so the lockup valve has a bushing on the end, with a valve inside.



4R100/E4OD (continued)

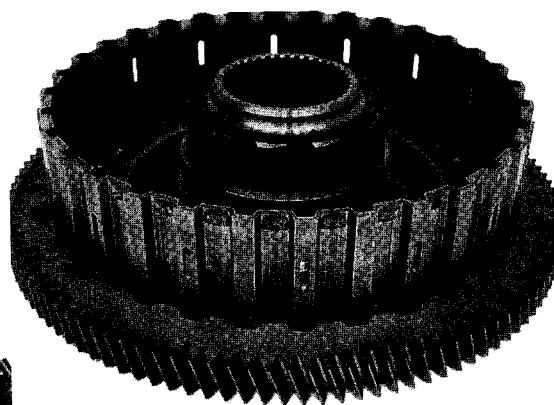
Pump and Coast Clutch Variations (continued)

1998 Type 4: 7.3L Diesel *with* PTO — These units use the same drum as the 6.8L gas with PTO; stamped steel drum with a pressed-on PTO ring gear. The coast clutch has a low bearing (instead of a bushing), so the pump oil control rings sit high, away from the support.

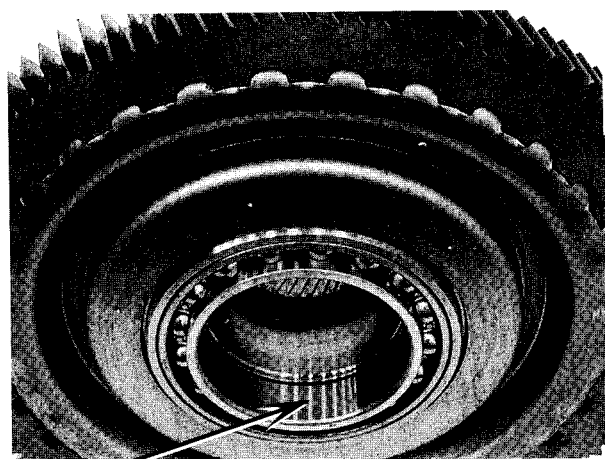
These units also used a needle roller bearing in the stator support for 1998, instead of a bushing. And once again, Ford discontinued the use of this bearing, and went back to a bushing on replacement stator supports. These replacement stator supports are identical to the ones designed for the 7.3L diesel engine without a PTO, and are interchangeable with them.

And, because it's a diesel engine, the lockup valve in these pumps is designed for pulse width modulation (PWM) operation. Instead of a flat plug on the end of the lockup valve train, these units have a bushing with a valve inside.

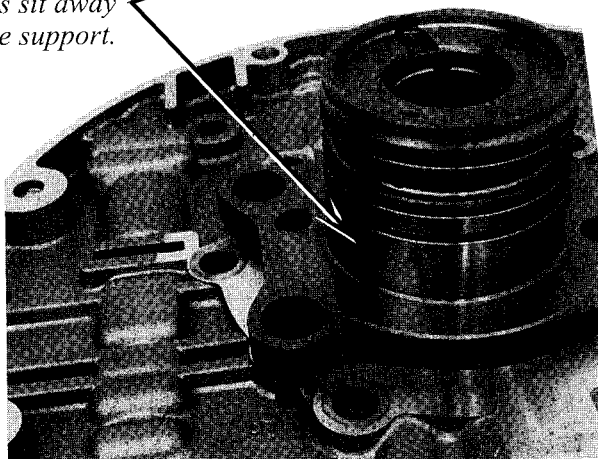
Pump Assembly P/N: F81Z-7A103-CA



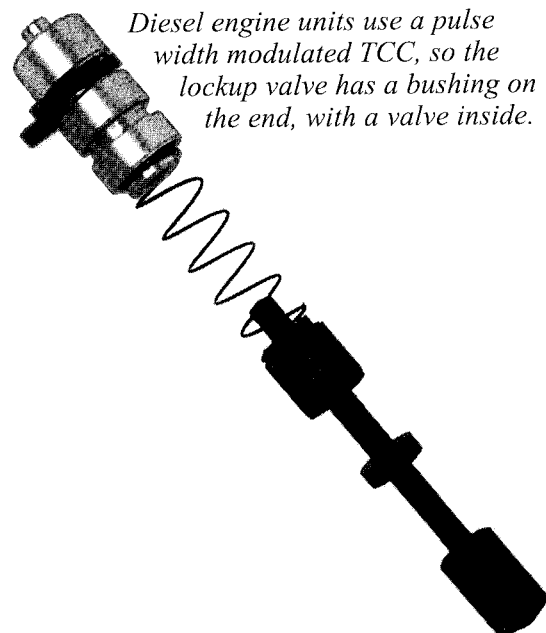
Units with a PTO use a stamped steel drum with a pressed-on PTO ring gear.



Instead of a bushing, these units use a bearing in the drum. The bearing sits low in the drum, so the oil control rings sit away from the support.



The original stator support had a bearing inside to support the input shaft. Replacements used a bushing, and are identical to units without a PTO.



Diesel engine units use a pulse width modulated TCC, so the lockup valve has a bushing on the end, with a valve inside.

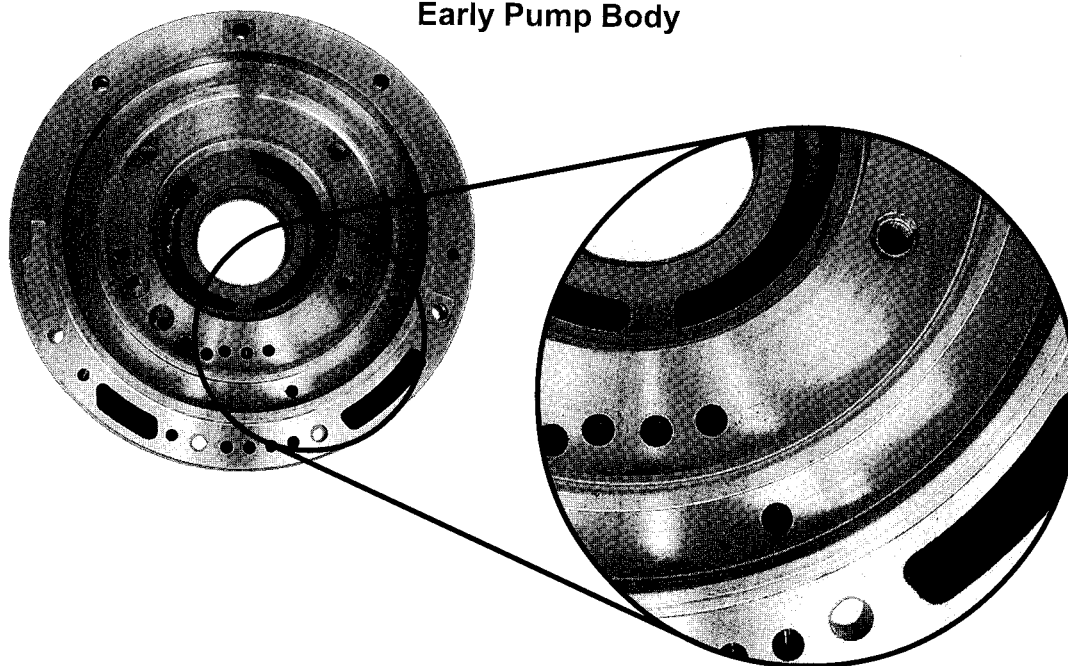
AODE/4R70W

Pump Interchange

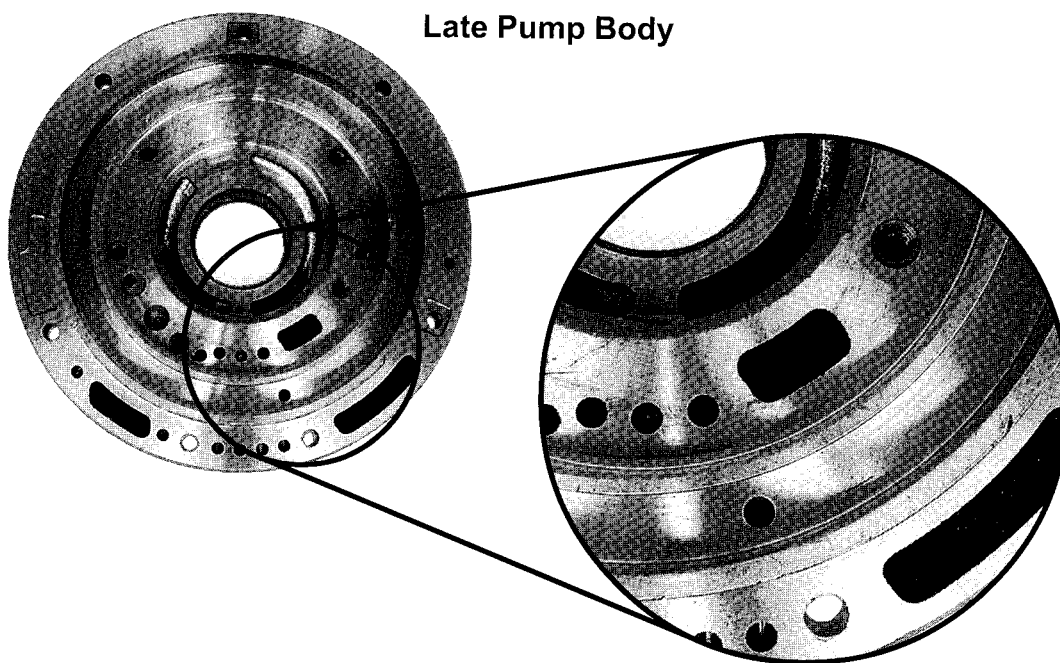
There are two different pumps for these transmissions: The change took place in 1994. And as you can see, they look very different when compared side by side.

But appearances can be deceiving: These pumps are completely interchangeable, either as a complete assembly, or the pump body and stator support individually.

Early Pump Body



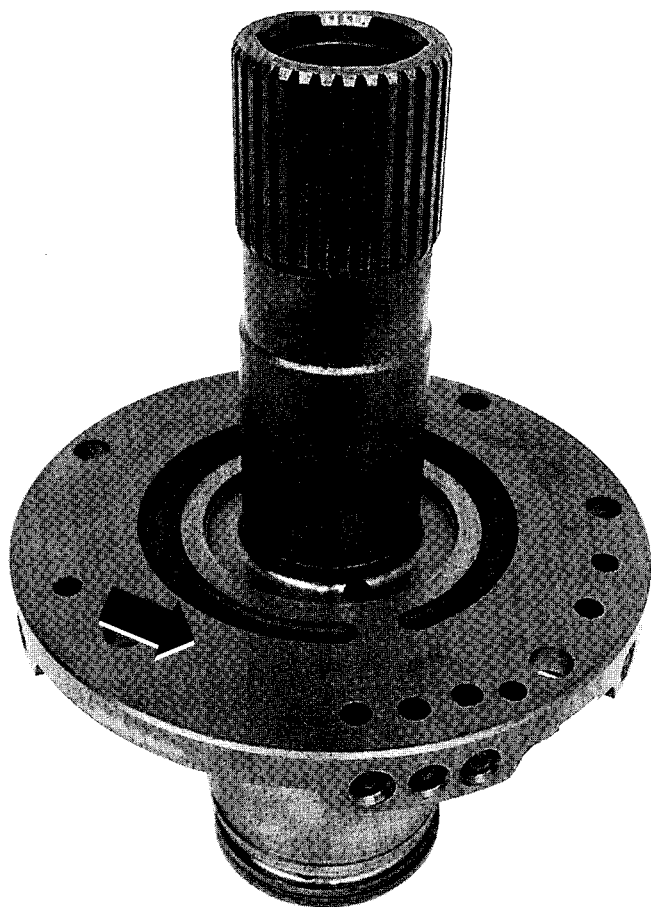
Late Pump Body



AODE/4R70W (continued)

Pump Interchange (continued)

Early Stator Support



Late Stator Support

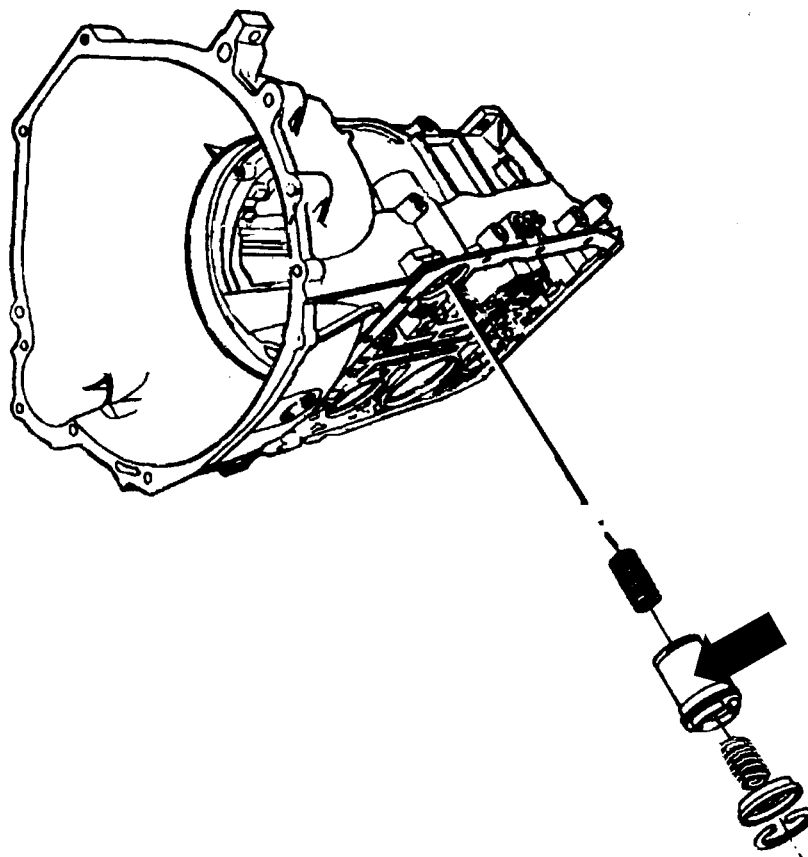


AODE/4R70W (continued)

2nd Gear Starts; Binds in Manual Low

Either of these two problems can be caused by a leaking 1-2 accumulator. The best way to avoid this problem is to install the one-piece accumulator piston, with the vulcanized seal during every rebuild.

One-Piece Vulcanized 1-2 Accumulator P/N: F7AZ-7F251-AA

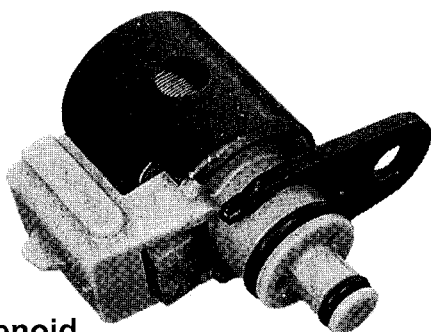


AODE/4R70W (continued)

Sets Code P0743

1995-and-later AODEs may set diagnostic trouble code P0743, indicating an electrical problem in the lockup solenoid circuit. This can be caused if someone replaced the lockup solenoid with one for an earlier transmission. The early solenoids had only 1 – 3 ohms resistance; the later solenoid has 10 – 16 ohms.

You can identify the later solenoid by its white electrical connector; the earlier solenoid has a beige or natural-color connector.



Early Solenoid
Beige Connector
1 – 3 Ohms Resistance



Late Solenoid
White Connector
10 – 16 Ohms Resistance

AX4N

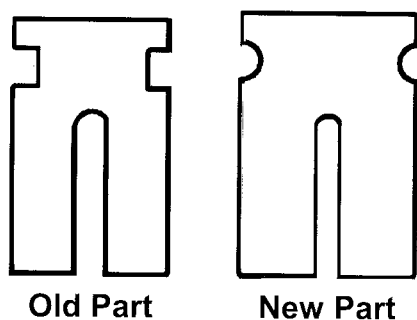
No Forward Ranges

If you're working on an AX4N that exhibits any of these conditions:

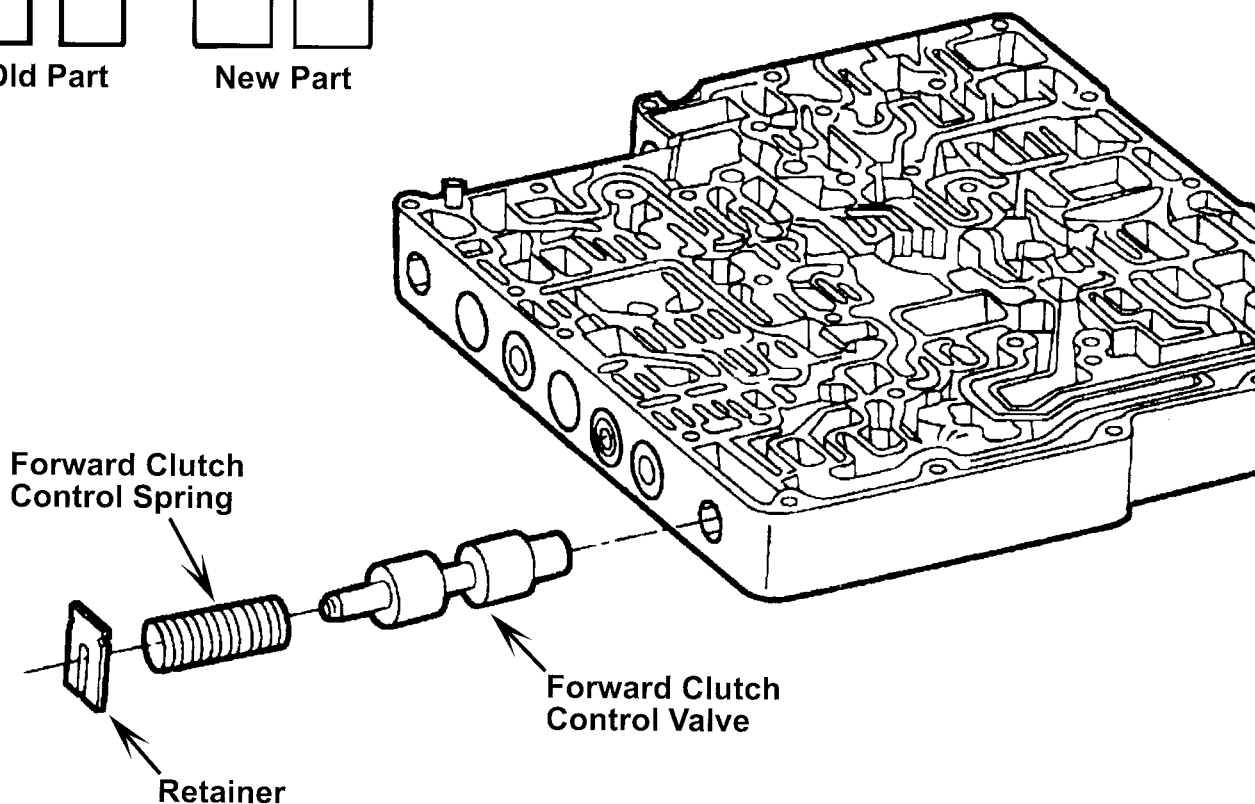
- Falls out of gear at a stop intermittently
- Won't upshift from 3rd to 4th gear
- Sets one or more of these trouble codes: P0734, P0761, P0648

Look for a broken retaining clip in the forward clutch control valve train. The revised clip is stronger, and less likely to break.

Forward Clutch Control Valve Retainer — F8DZ-7F194-AA



The new retainer is easy to recognize by the rounded cutouts on either side. Always replace the early retainer with the updated one during a rebuild.



AX4N (continued)

Separator Plates

There are several AX4N separator plates available; each with slight differences in the size of the apply holes. But only a few of those hole sizes are critical. To be sure you always have the separator plate you need in stock, order plate ID 15. Then use the chart to determine which holes need to be changed, and which can be used as is.

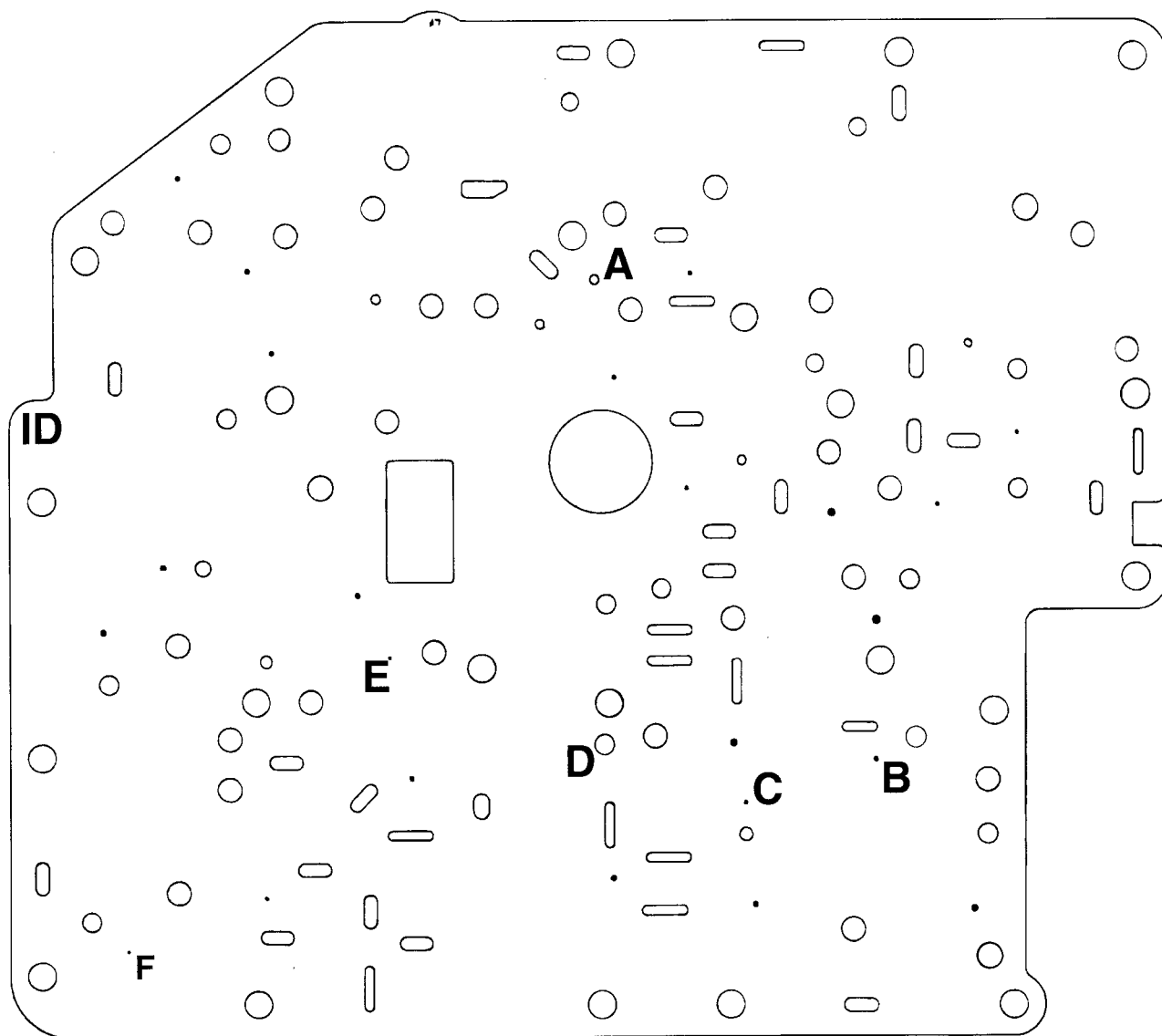


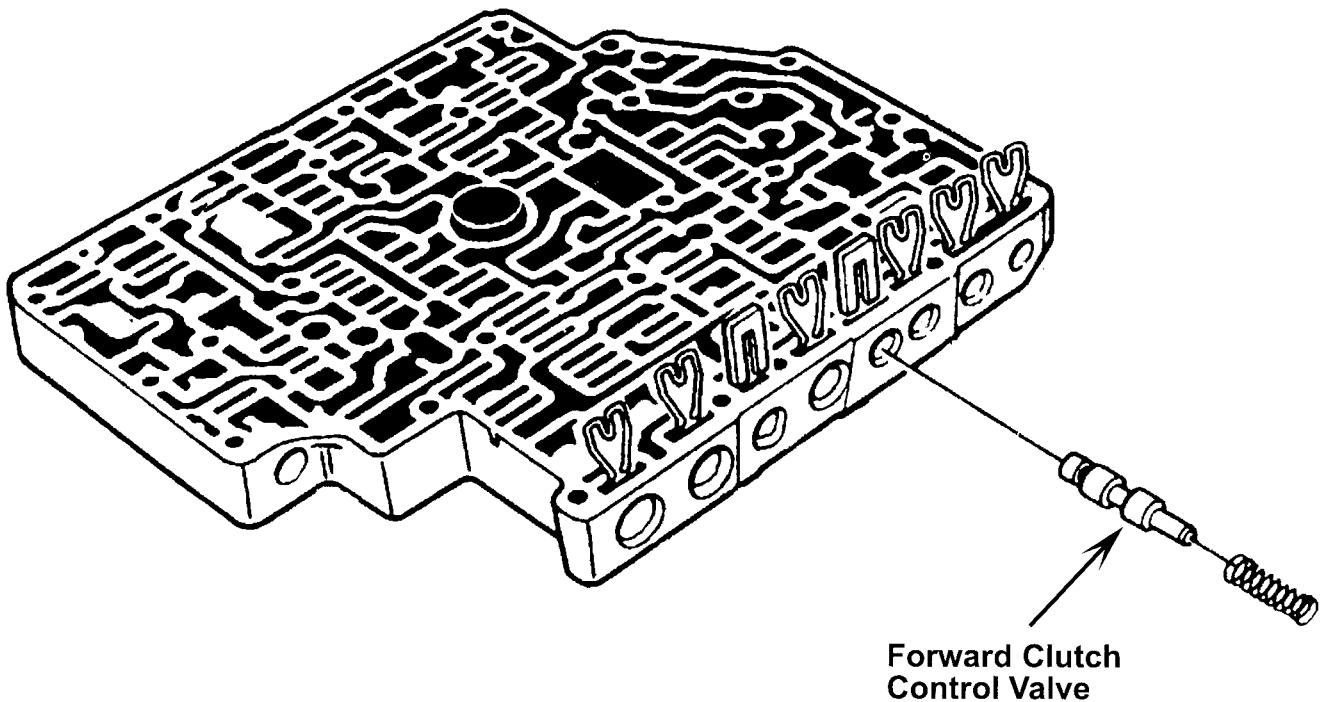
Plate ID	Hole					
	A	B	C	D	E	F
No Mark	0.116"	0.052"	0.031"	0.220"	0.055"	0.070"
11	0.116"	0.059"	0.033"	0.099"	0.046"	0.070"
13	0.116"	0.059"	0.033"	0.220"	0.046"	0.067"
14	0.116"	0.059"	0.041"	0.220"	0.046"	0.046"
15	0.120"	0.059"	0.033"	0.099"	0.046"	0.046"

AX4S

Shifts 1 – 2 – 3 – 2

If the unit shifts into second during a command for 4th gear, look for a problem in the forward clutch control valve. The valve may be sticking in its bore, or the return spring may be broken.

If the spring is broken, you can replace it with any spring that's similar in size and tension; it's just a return spring, so precise tension isn't important.



FORD UPDATES AND CHANGES

AX4S (continued)

No Lockup

Some 1996 – 97 Taurus/Sables with 3.0L engines and AX4S may not have lockup. If you run into one of these vehicles, first look for this modification sticker, right near the emissions label.

	AUTHORIZED MODIFICATIONS
THE FOLLOWING MODIFICATIONS HAVE BEEN MADE:	
<i>Reprogrammed Powertrain Control Module</i>	
<i>(PCM) per TSB 98-13-7</i>	
THESE MODIFICATIONS HAVE BEEN APPROVED, AS APPROPRIATE, BY EPA AND CARB.	
DEALER NUMBER:	DATE:
CHANGE AUTHORITY:	
FPS 8262 9/78	FORD MOTOR COMPANY
PRINTED IN U.S.A.	

If you find this label, don't bother looking further: This modification to the computer disables lockup, due to a number of problems they were having with this unit.

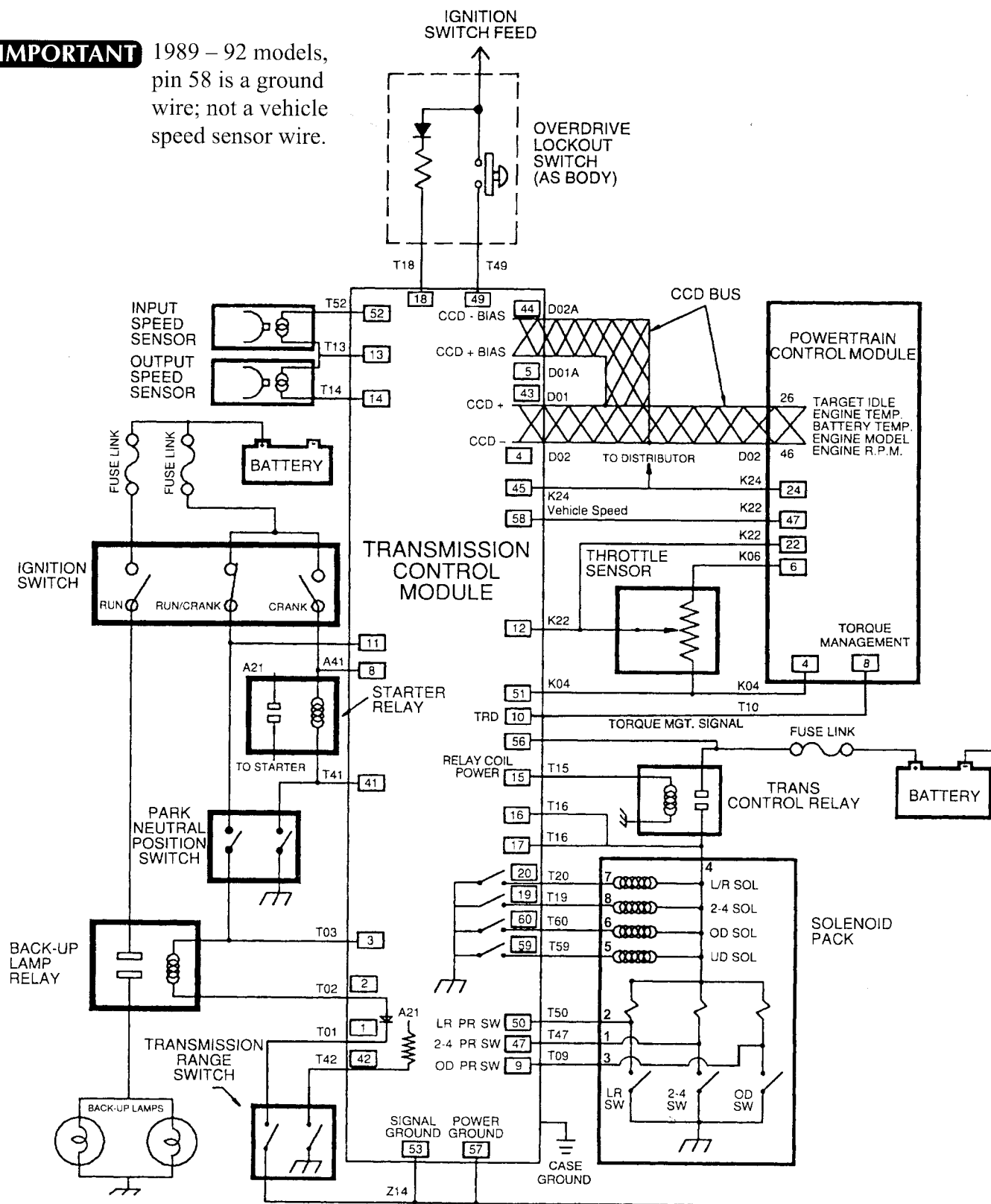
Chrysler Contents

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41TE Electrical Schematics

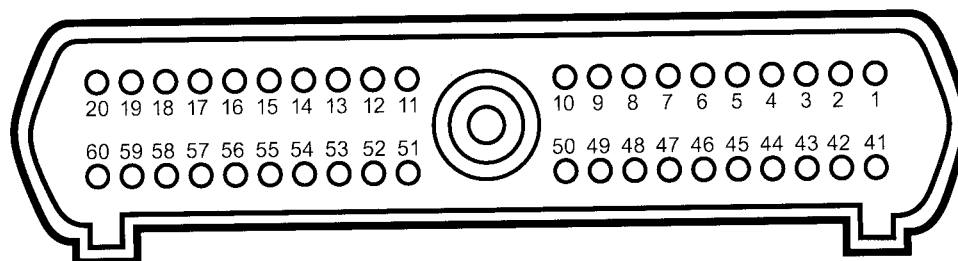
Main Schematic, 1989 – 95

IMPORTANT 1989 – 92 models,
pin 58 is a ground
wire; not a vehicle
speed sensor wire.



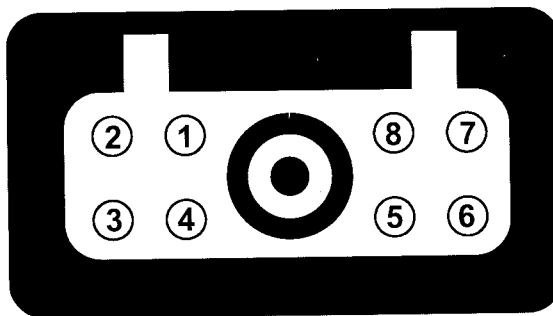
41TE Electrical Schematics (continued)

Terminal Identification, 1989 – 95



1	Transmission Range; B+	41	Park/Neutral Position Sense
2	Transmission Range; B+	42	Reverse Position Sense
3	Transmission Gear Range Sense	43	CCD +
4	CCD –	44	CCD – Bias
5	CCD + Bias	45	Engine RPM Signal
6	Not Used	46	Not Used
7	Not Used	47	2/4 Pressure Switch Signal
8	Ignition Switch; Start	48	Not Used
9	OD Pressure Switch Signal	49	OD Off Switch Signal
10	Torque Management Request (TRD) Link	50	Low/Reverse Pressure Switch Signal
11	Ignition Switch (B+)	51	Sensor Ground
12	Throttle Position Sensor Signal	52	Input Shaft Speed Sensor Signal
13	Sensor Ground	53	Signal Ground
14	Output Shaft Speed Sensor Signal	54	Not Used
15	Transmission Control Relay Power	55	Not Used
16	Switched Battery Power (B+)	56	Fused Battery (B+)
17	Switched Battery Power (B+)	57	Ground
18	Ignition Feed; Overdrive Lockout	58	Vehicle Speed Signal to the PCM
19	2/4 Solenoid Control	59	UD Solenoid Control
20	Low/Reverse Solenoid Control	60	OD Solenoid Control

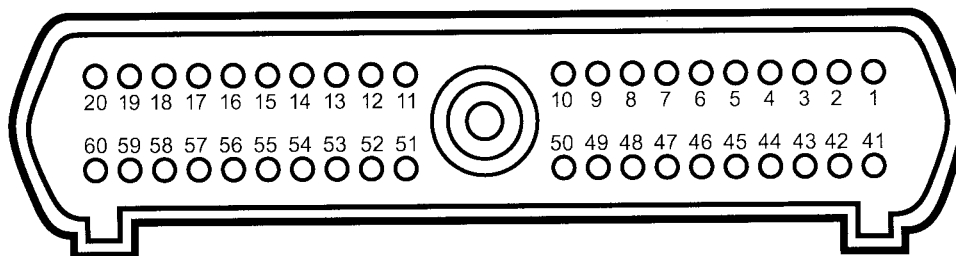
Solenoid Pack Connector Terminal Identification



1	2/4 Pressure Switch Signal	5	UD Solenoid Ground
2	Low/Reverse Pressure Switch Signal	6	OD Solenoid Ground
3	OD Pressure Switch Signal	7	Low/Reverse Solenoid Ground
4	12 Volt Power Supply from EATX Relay	8	2/4 Solenoid Ground

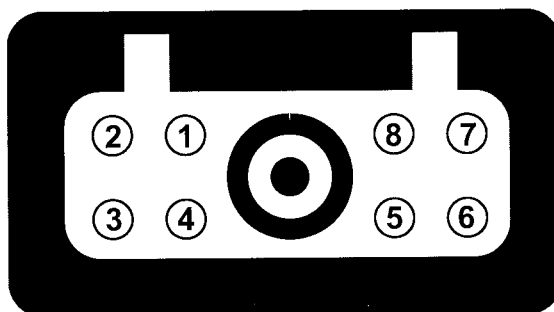
41TE Electrical Schematics (continued)

Terminal Identification, 1996 – on



1	Transmission Gear Range Sensor T1 Sense	41	Transmission Gear Range Sensor T41 Sense
2	Not Used	42	Transmission Gear Range Sensor T42 Sense
3	Transmission Gear Range Sensor T3 Sense	43	CCD –
4	CCD +	44	Autostick Down
5	Autostick Up	45	Not Used
6	Engine RPM Signal	46	SCI Receive
7	SCI Transmit	47	2/4 Pressure Switch Signal
8	Ignition Switch (B+)	48	Test Terminal
9	OD Pressure Switch Signal	49	OD Off Switch Signal
10	Torque Management Request (TRD) Link	50	Low/Reverse Pressure Switch Signal
11	Ignition Switch (B+)	51	Sensor Ground
12	Throttle Position Sensor Signal	52	Input Shaft Speed Sensor Signal
13	Sensor Ground	53	Ground
14	Output Shaft Speed Sensor Signal	54	Transmission Temperature Sensor
15	Transmission Control Relay Power	55	Not Used
16	Switched Battery Power (B+)	56	Fused Battery (B+)
17	Switched Battery Power (B+)	57	Ground
18	Not Used	58	Vehicle Speed Signal to the PCM
19	2/4 Solenoid Control	59	UD Solenoid Control
20	Low/Reverse Solenoid Control	60	OD Solenoid Control

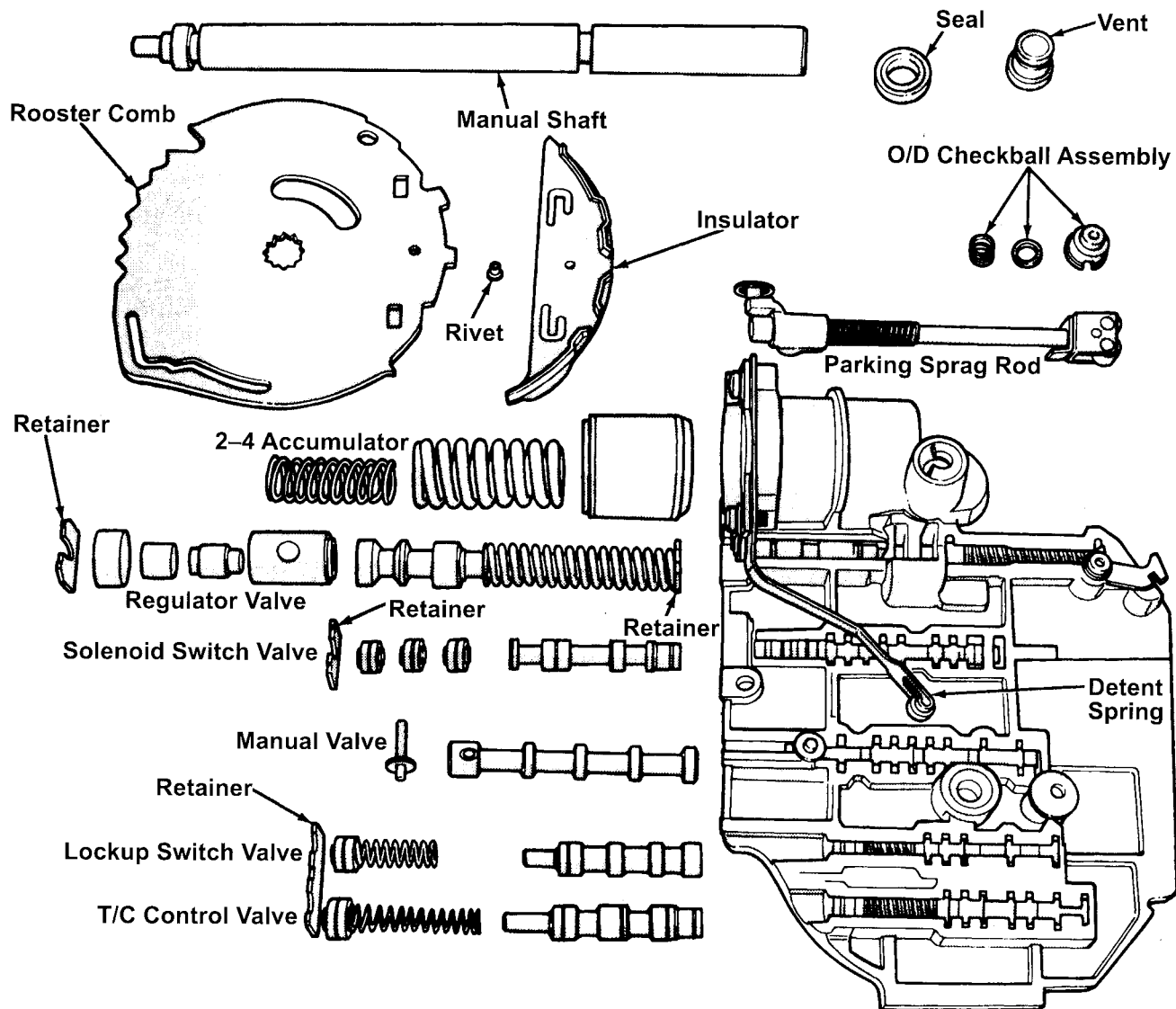
Solenoid Pack Connector Terminal Identification



1	2/4 Pressure Switch Signal	5	UD Solenoid Ground
2	Low/Reverse Pressure Switch Signal	6	OD Solenoid Ground
3	OD Pressure Switch Signal	7	Low/Reverse Solenoid Ground
4	12 Volt Power Supply from EATX Relay	8	2/4 Solenoid Ground

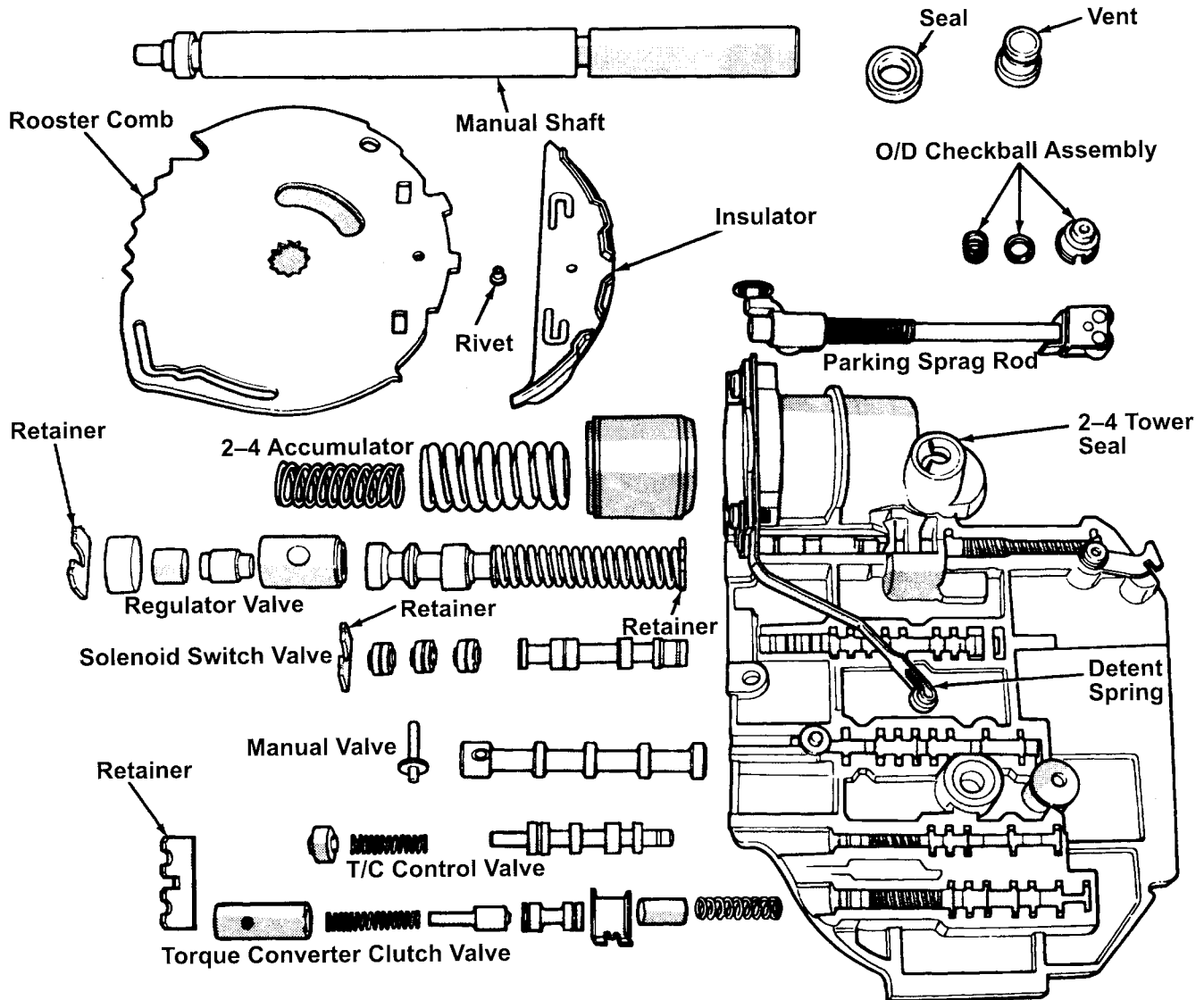
41TE Valve Body

1989 – 91 Valve Body Exploded View



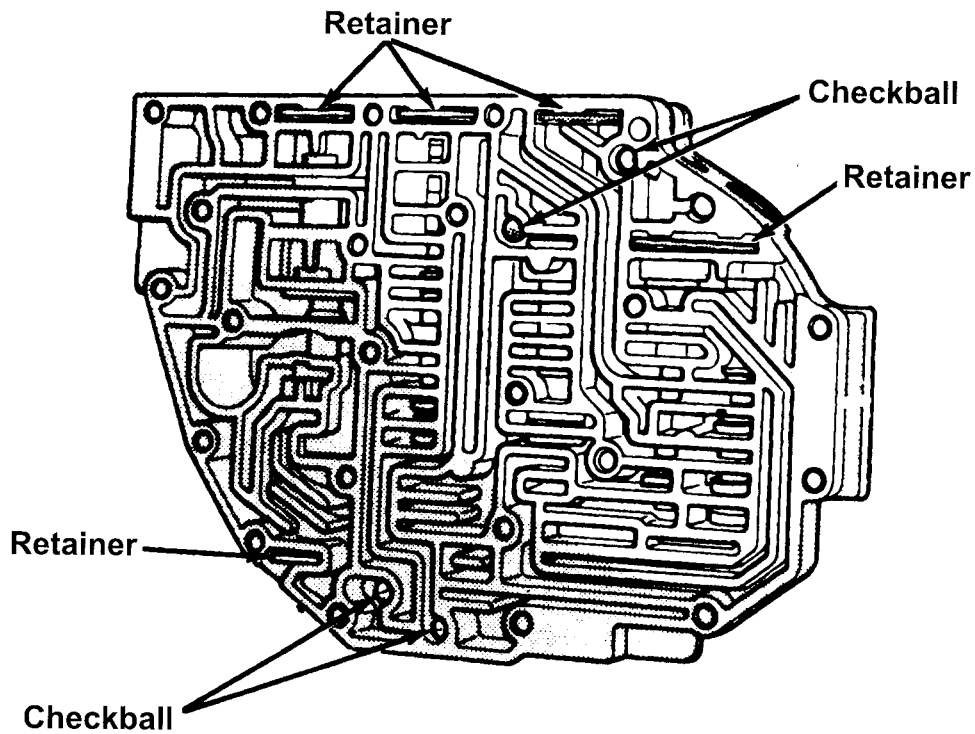
41TE Valve Body (continued)

1992 – 96 Valve Body Exploded View



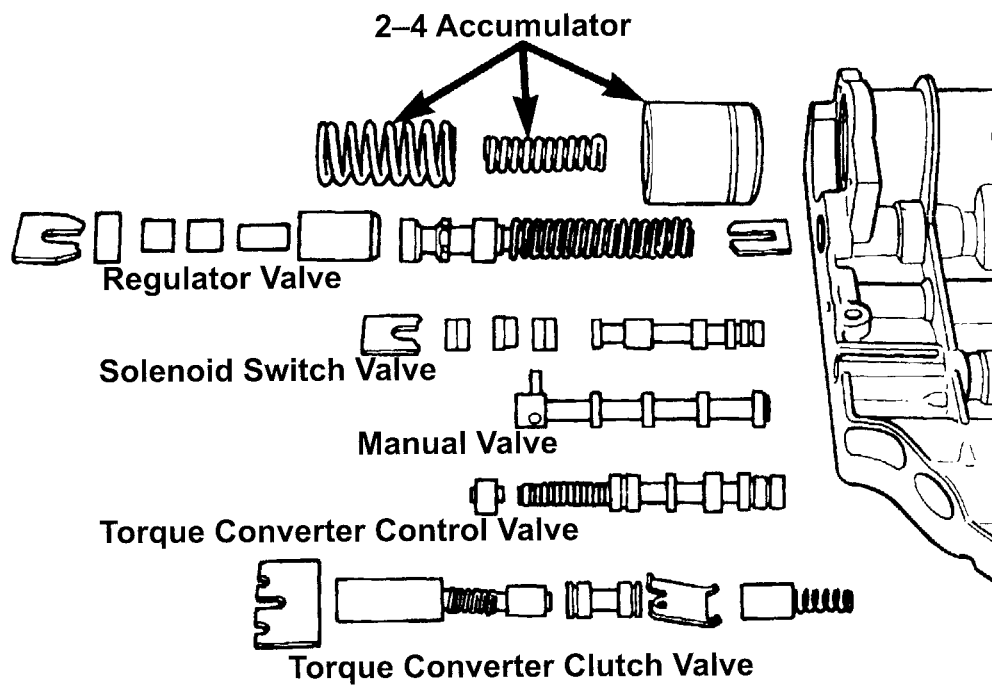
41TE Valve Body (continued)

1989 – 96 Checkball Locations



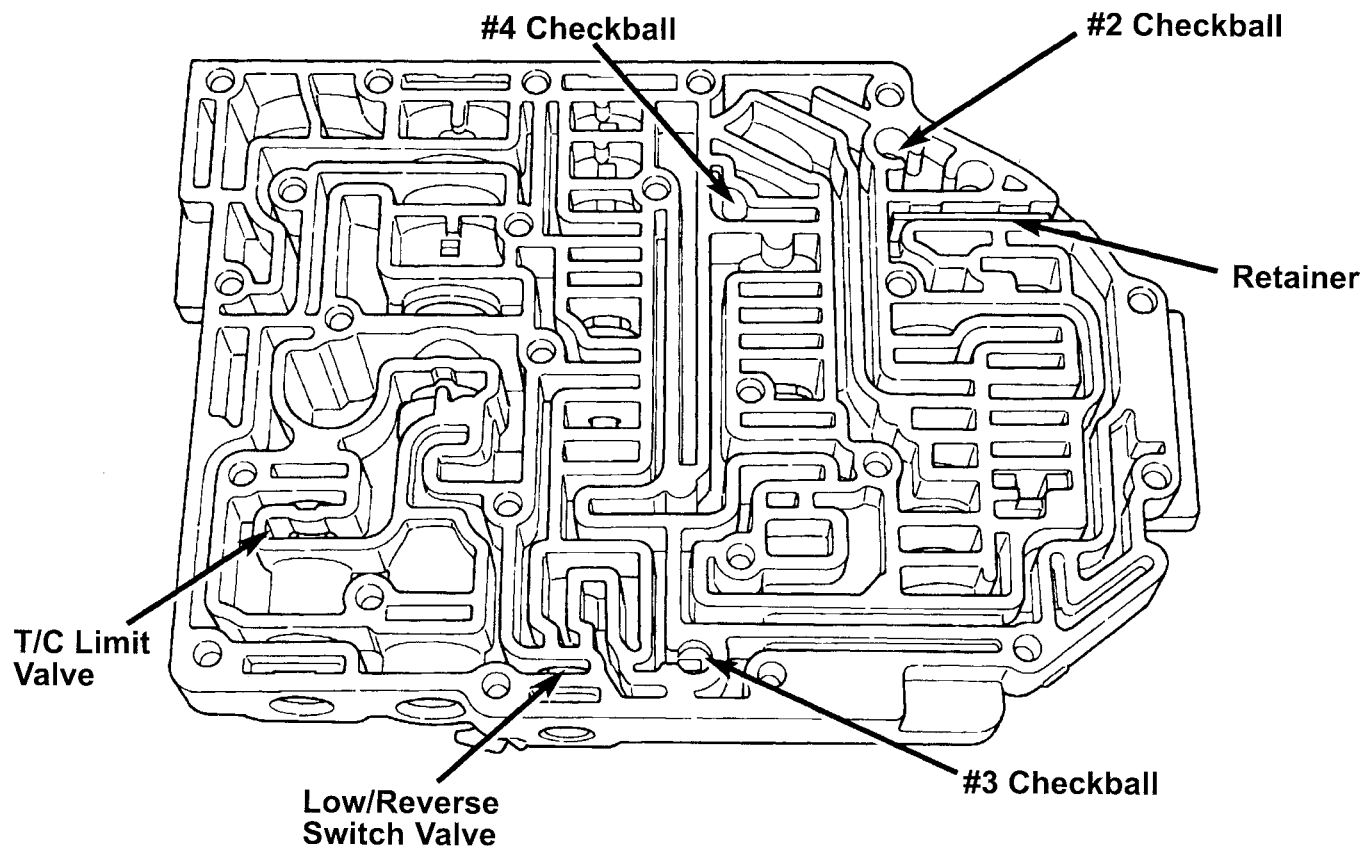
41TE Valve Body (continued)

1997 – 98 Valve Body Exploded View

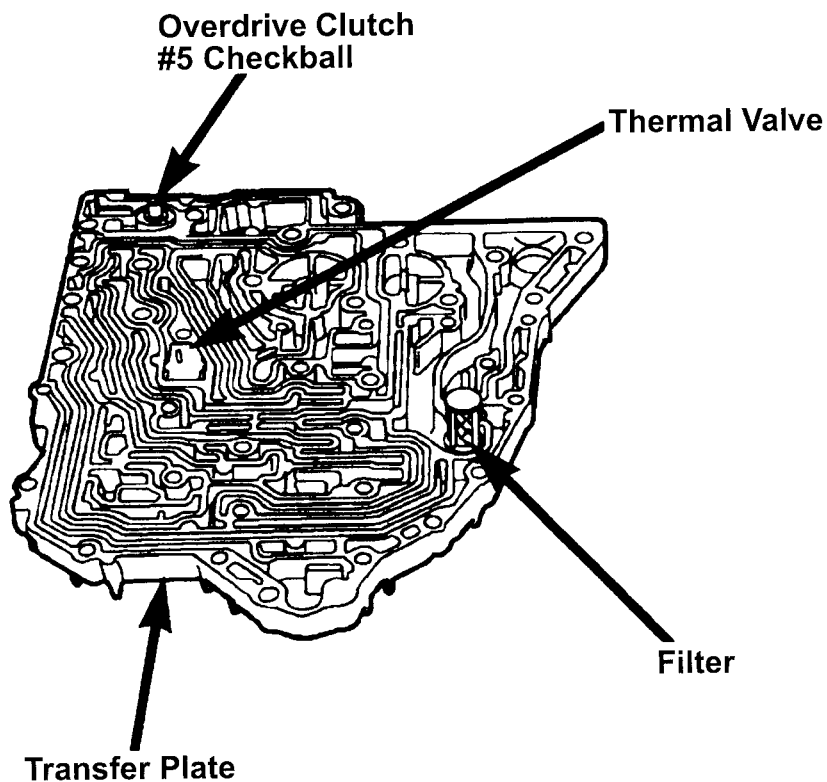


41TE Valve Body (continued)

1997 – 98 Checkball Locations



41TE Valve Body (continued) 1989 – 98 Channel Casting



42RE, 46RE, 47RE

Transmission Testing

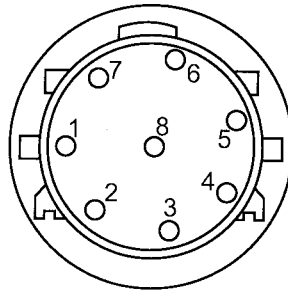
Transmission Overview

Chrysler's 42RE, 46RE and 47RE are similar to the 42RH and 46RH units, which were electronically-controlled versions of the A500 and the A518. Just like the earlier units, these transmissions still control first, second and third gears hydraulically; only overdrive and the converter clutch are computer controlled. What's different is that, instead of a governor, these units develop a calculated governor pressure signal, through the governor pressure solenoid, based on vehicle speed.

Terminal Identification

Here's a breakdown of the individual connector terminals on the unit that controls fourth gear electrically:

Shown from the terminal side of the transmission connector.



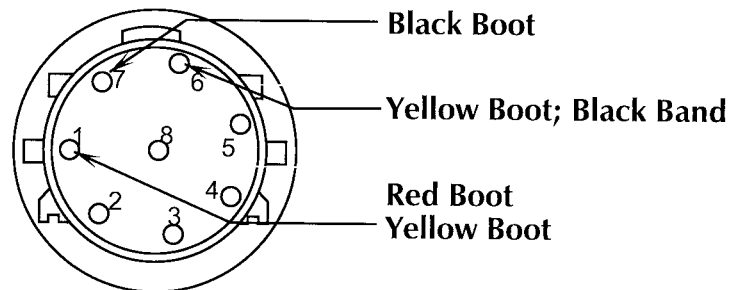
Transmission Connector Identification

ID	Function	ID	Function
1	Power (B +)	5	Gov. Press. Solenoid
2	5-Volt Supply (+)	6	3-4 Shift Solenoid
3	Sensor Ground	7	TCC Solenoid
4	Gov. Press. Sensor	8	TFT Sensor

Checking the Shift Pattern

Here's how to connect your signal monitor to check the signals for 4th gear and lockup:

Backprobe the terminals with the harness connector still connected to the transmission



And here's what your signal monitor should indicate:

Transmission Shift Pattern

	LED 1	LED 2	LED 3
First Gear			
Second Gear			
Third Gear			
Fourth Gear w/Lockup			

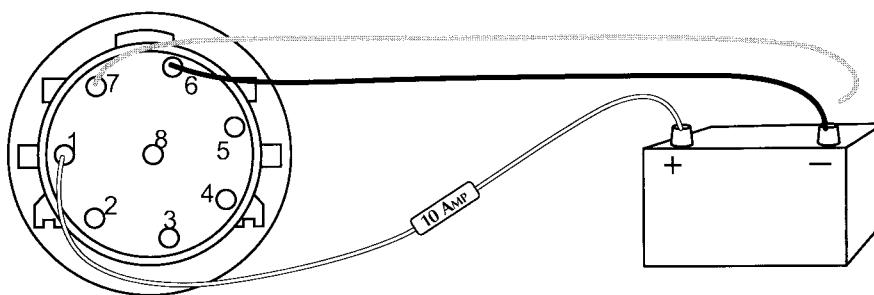
The middle LED indicates the signal to the converter clutch (TCC) solenoid.

42RE, 46RE, 47RE (continued) Transmission Testing (continued)

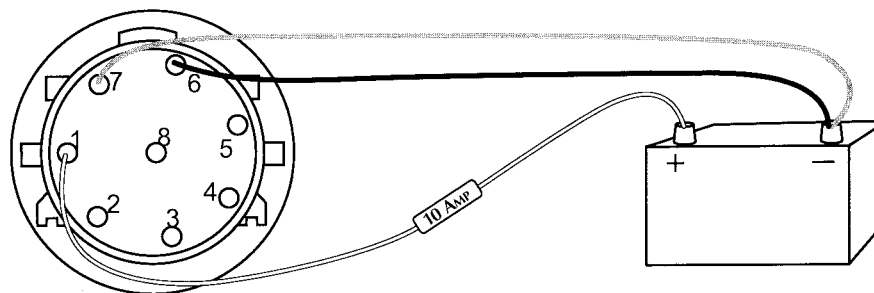
Forcing 3 – 4 and Lockup Electrically

While gears 1 through 3 operate hydraulically, you can energize overdrive and the TCC solenoid. Start the engine, and put the unit in gear. Give it gas until the transmission shifts into 3rd gear. Then complete the circuits as shown to shift the unit into 4th gear and to energize the TCC.

4th Gear



Lockup



Solenoid Resistance Checks

One of the most common diagnostic checks on an electrical solenoid is electrical resistance. When checking resistance, remember that resistance increases as temperature goes up.

3-4 Solenoid: 31 – 34 Ohms

Lockup Solenoid: 31 – 34 Ohms

Governor Pressure Solenoid: 3.8 – 4.0 Ohms

42RE, 46RE, 47RE (continued)

Transmission Testing (continued)

Governor Pressure Testing

Unlike any other electronically-controlled units in production, these transmissions still operate on governor pressure to shift from 1st to 3rd gear. Governor pressure is created by a pulse width modulated solenoid, based on vehicle speed.

The computer monitors governor pressure using a pressure transducer, which varies resistance based on pressure. To check the transducer, backprobe terminal 4, and compare the voltage and governor pressure to the readings listed here. This chart shows how the transducer voltages changes with governor pressure.

Pressure (PSI)	Voltage
5	0.81
10	1.00
15	1.20
20	1.40
25	1.60
30	1.80
35	2.00
40	2.20
45	2.40
50	2.60
55	2.80
60	3.00

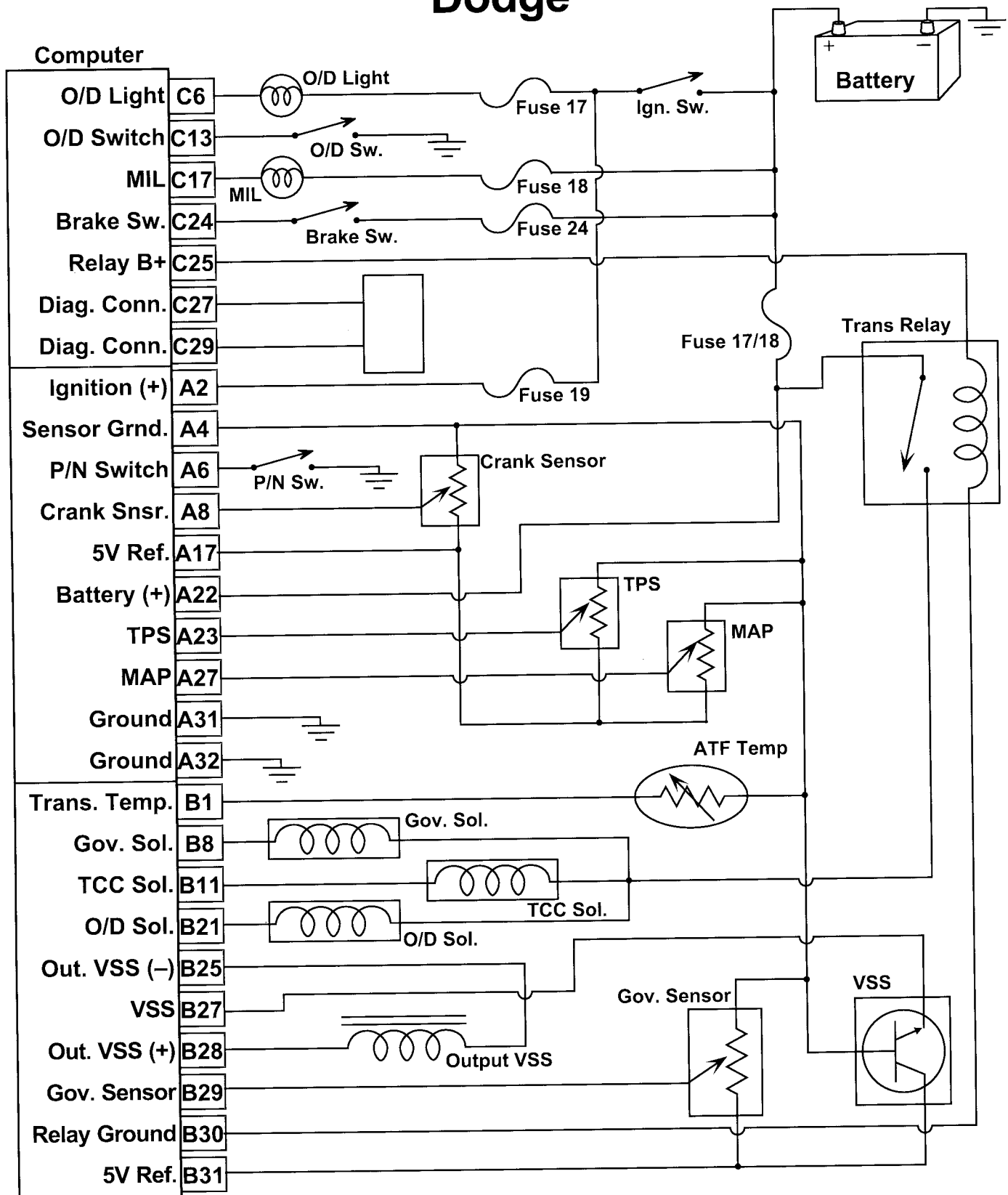
Transmission Fluid Temperature Sensor

Fluid temperature can have an effect on both lockup and overdrive. And the only way the computer can determine transmission fluid temperature is from the transmission fluid temperature signal. To check the TFT sensor, compare its resistance to the readings on the chart.

Temperature		Resistance (Ohms)	
°C	°F	Minimum	Maximum
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	81,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9120	10,880
30	86	7370	8750
40	104	4900	5750
50	122	3330	3880
60	140	2310	2670
70	158	1630	1870
80	176	1170	1340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

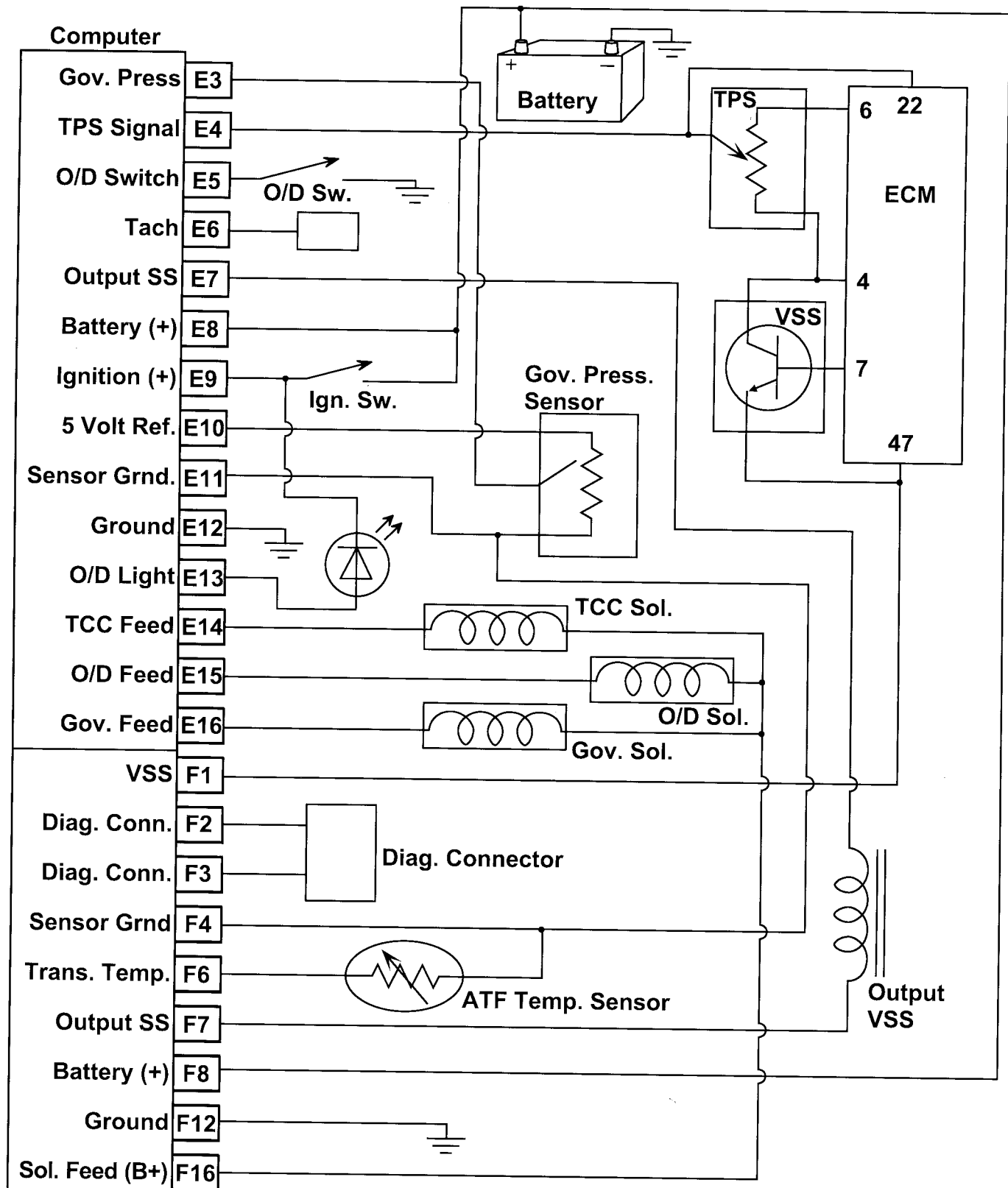
42RE Electrical Schematics

Dodge



42RE Electrical Schematics (continued)

Jeep



Import Contents

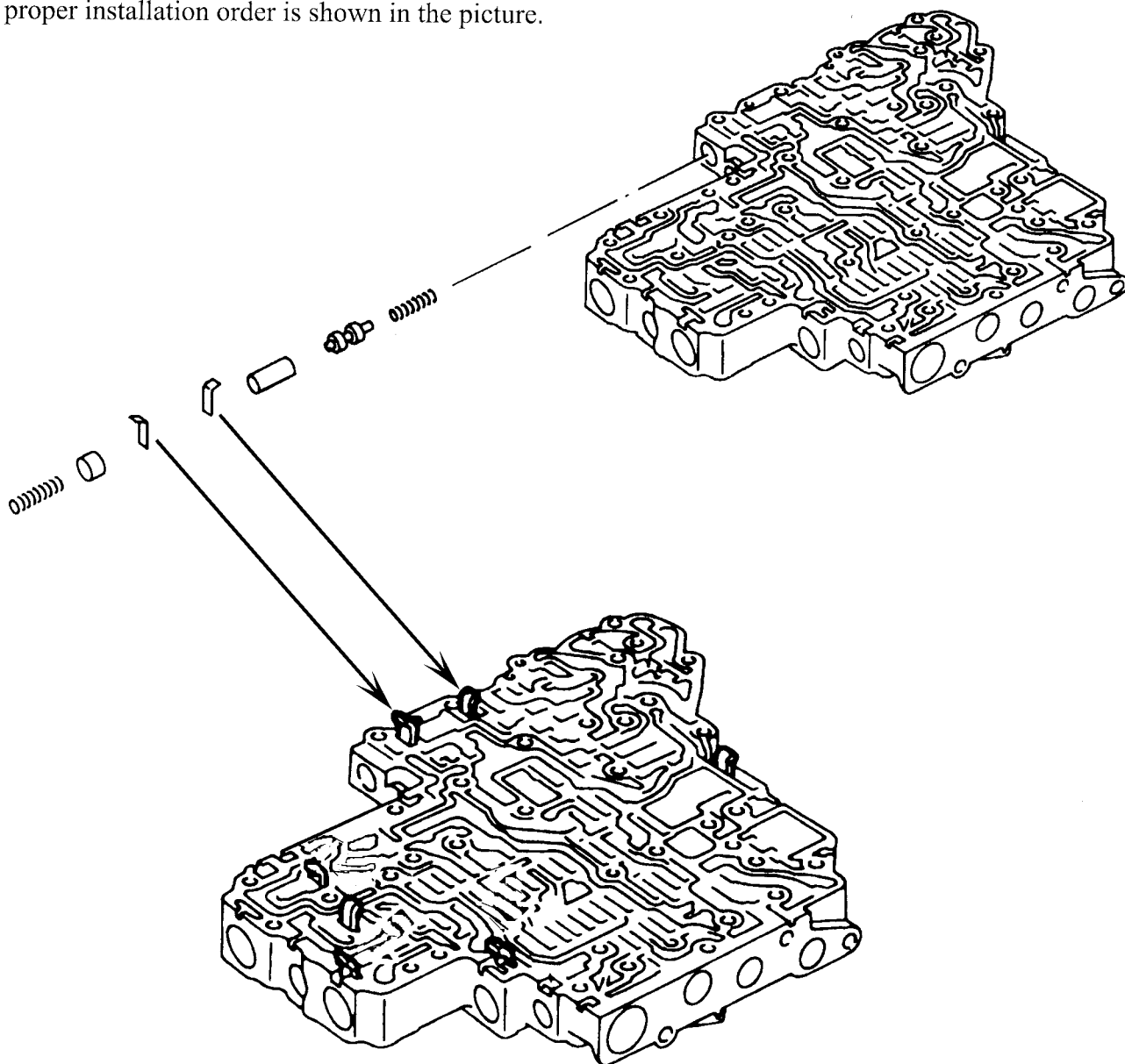
Nissan 4F20E, RE4F04A/V; No Line Rise	192
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Nissan 4F20E, RE4F04A/V

No Line Rise

No line rise after a rebuild on one of these units could be due to having installed the pressure control solenoid plug retainer incorrectly. The retainer is supposed to act as a stop, to prevent the plug from moving too far from the line pressure solenoid.

The proper installation order is shown in the picture.

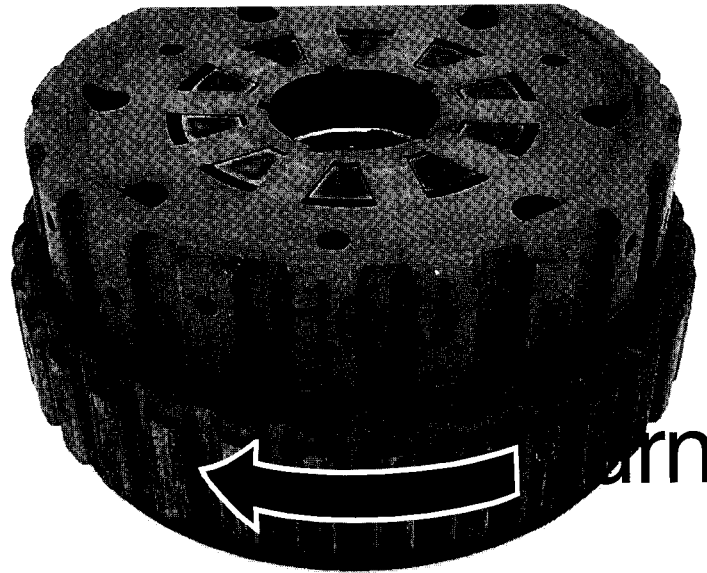


Nissan RL4F03A/V, RE4F03A/V, RE4F04A/V, 4F20E

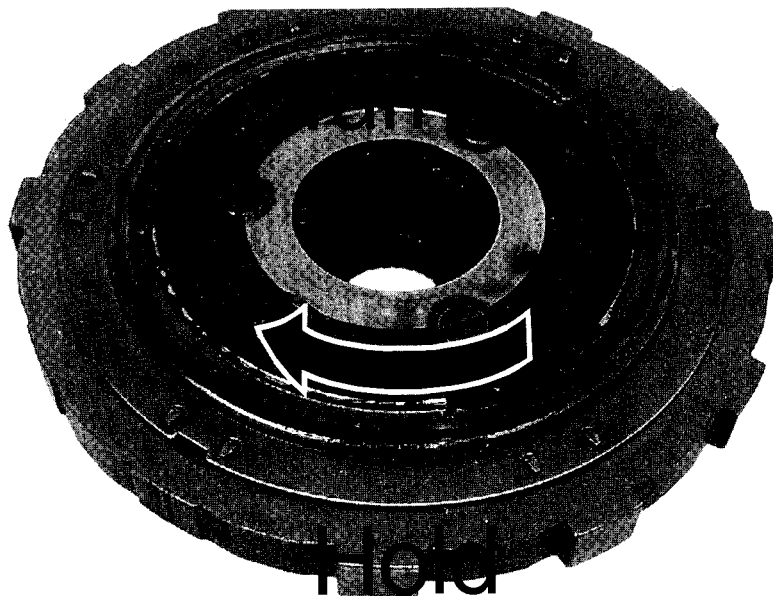
Forward Sprag Rotation

Some manuals may be misleading when describing the forward sprag rotation.

The forward clutch hub should turn clockwise, but should lock counterclockwise.



Low/Reverse Sprag Rotation

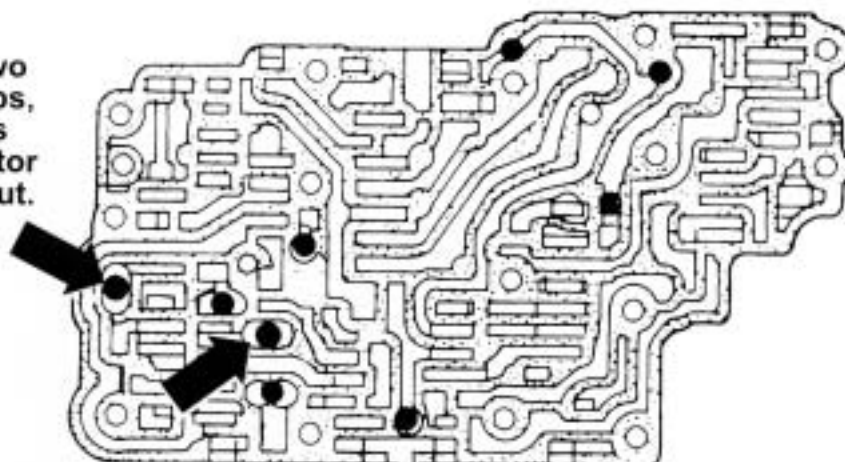


Nissan RL4F03A

Checkball Locations

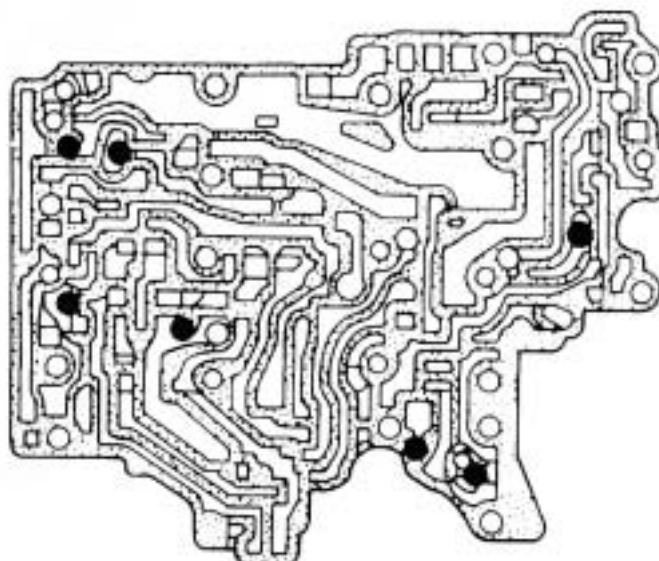
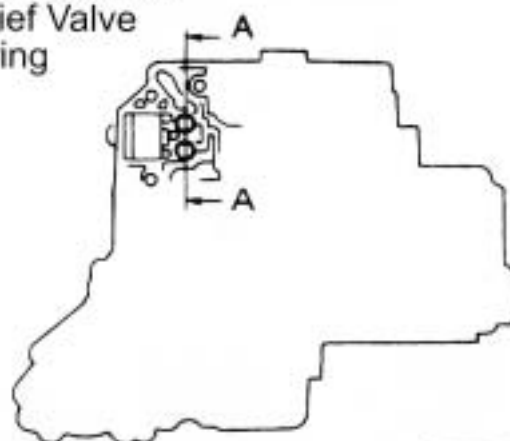
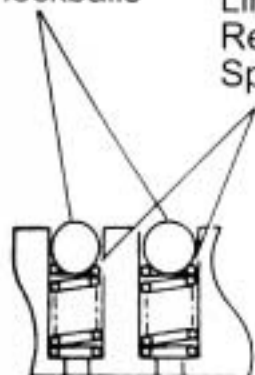
There have been a few changes in the checkball locations over the years. The best way to make sure which checkballs to install and which ones to leave out is to check the separator plate.

If the separator plate has two holes feeding these bathtubs, install a checkball. If there's only one hole in the separator plate, leave the checkball out.



Checkballs

Line Pressure
Relief Valve
Spring



Mazda F4AEL

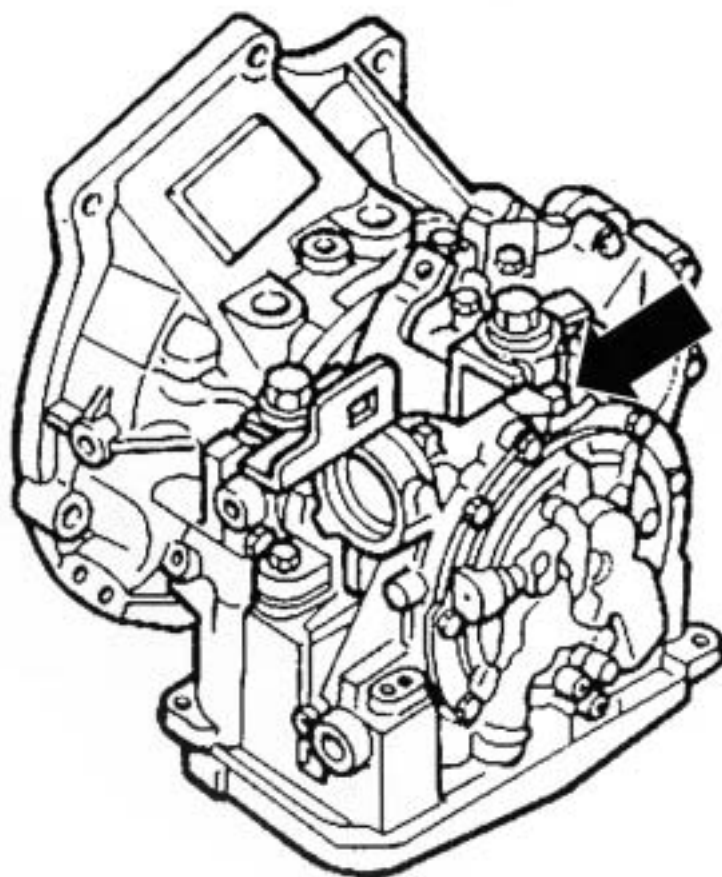
Neutral-Drive Hunt

Some F4AEL units can seem to hunt between drive and neutral when you put them in gear. This can be caused by a forward clutch or forward sprag failure; or, after a rebuild, it could indicate the sprag is in backward. That's because the computer calculates vehicle speed from the input shaft speed sensor instead of the output shaft speed sensor. Here's what happens:

When you put the shifter in drive, the computer commands first gear. But if the forward clutch or sprag aren't holding properly, the input shaft begins to turn. The vehicle isn't moving, but the computer *thinks* it is, so it begins to upshift the transmission.

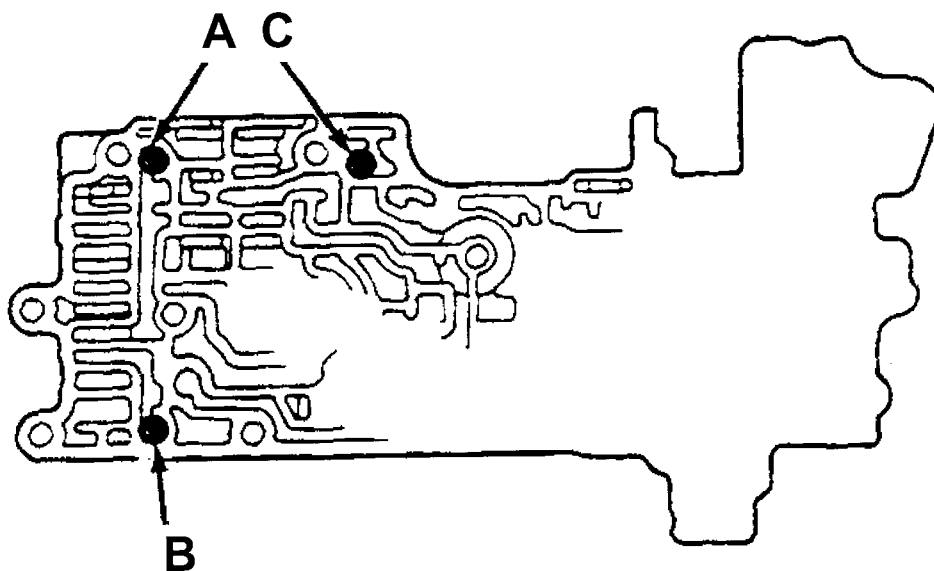
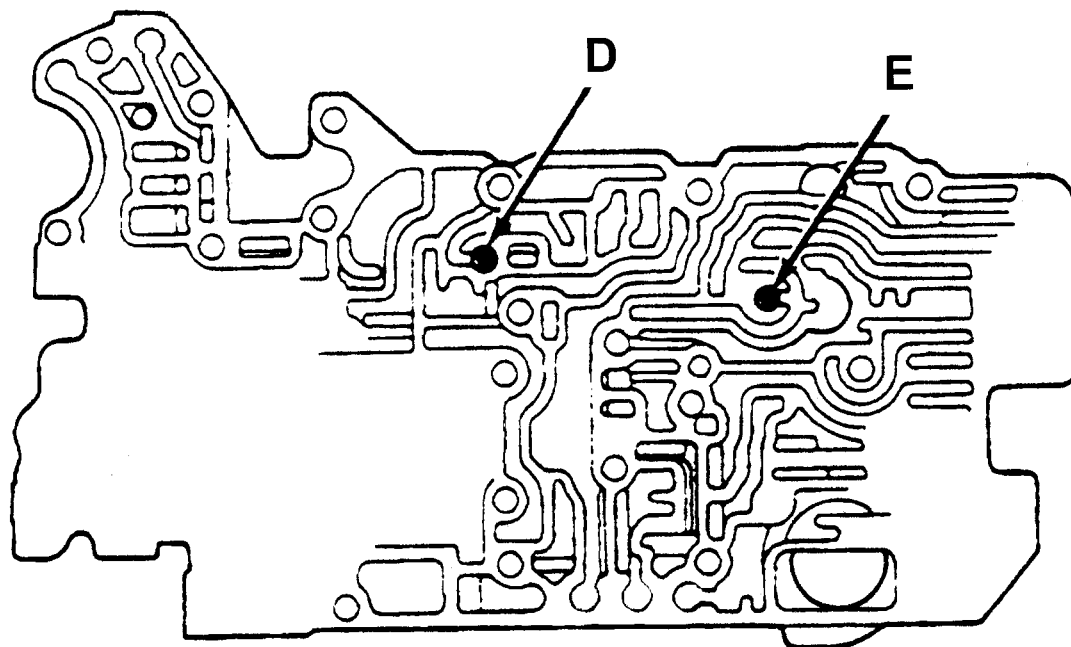
When the transmission shifts to 3rd gear, the coast clutch applies. The coast clutch overrides the forward clutch and sprag, which stops the input shaft. Now the computer sees the input shaft is stopped, so it assumes the vehicle is stopped, and downshifts it into 1st gear. And then the cycle repeats itself.

There's a simple test to see if that's the problem you're facing: Unbolt the input speed sensor, and remove it from the transmission. Leave the wires connected to the sensor. Then start the engine, and put the transmission in gear. If the unit stops hunting for drive, look for a problem in the forward clutch or forward sprag. If you've just rebuilt the unit, make sure the forward sprag isn't backward.



If the transmission stops hunting for drive after you remove the input speed sensor from the case, look for a problem in the forward clutch or forward sprag.

Mazda F4AEL (continued) Checkball Locations



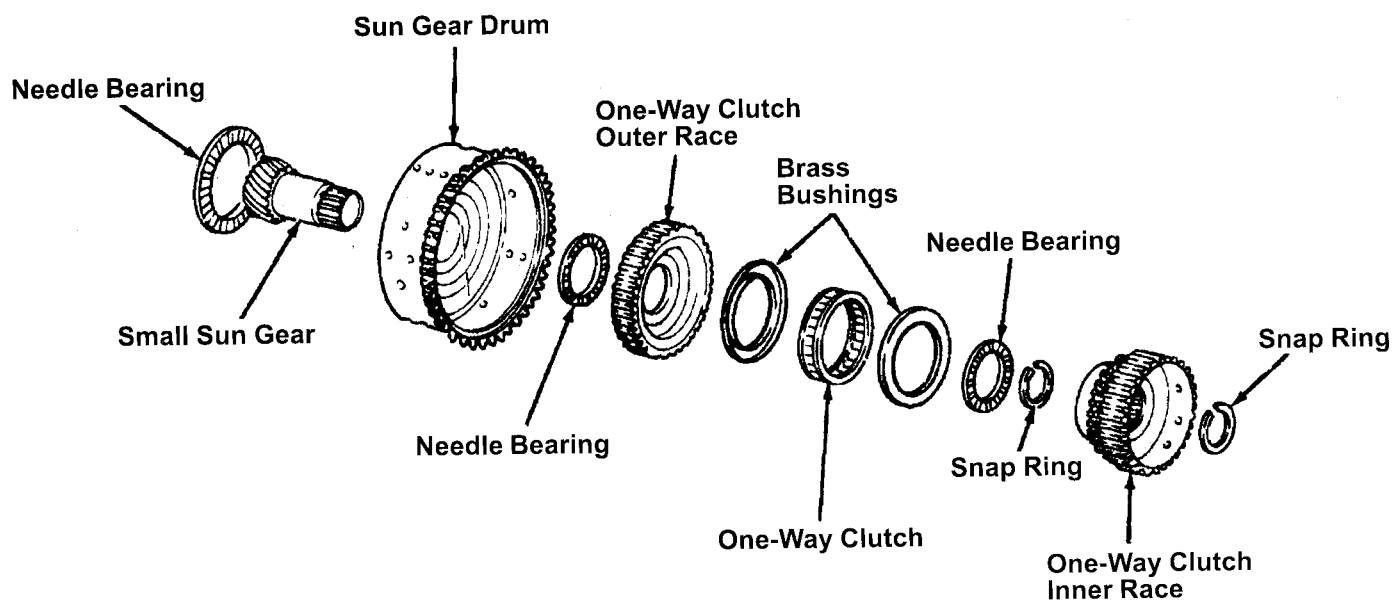
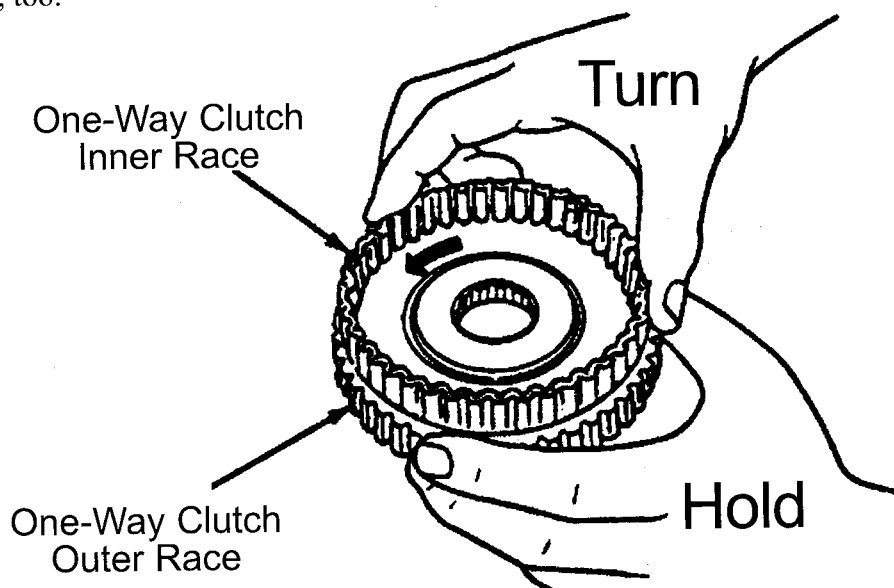
- A — Forward Clutch Feed
- B — Coast Clutch Feed
- C — Low/Reverse Shuttle
- D — Reverse Clutch Feed
- E — 3rd Clutch Feed

Mazda G4AEL, GF4AEL, F4AEL

4 – 2 and 3 – 2 Flairs

A flair shift on 4 – 2 and 3 – 2 downshifts can be due to a bad forward sprag. In 3rd gear, the coast clutch is on, which helps support the forward sprag. But when the unit downshifts into 2nd, the coast clutch comes off, and the forward sprag is all that's keeping the unit in gear.

To verify whether you're looking at a sprag problem or not, try disconnecting the 3 – 4 shift solenoid. This keeps the coast clutch on in all gear ranges. You won't be able to shift into 4th gear, but if the 3 – 2 flair goes away or improves, you know you're looking at a bad forward sprag. During the repair, don't forget to check the forward clutch, too.



Mazda GF4AEL

Hard Shifts Caused by High Line Pressure

One of the more common complaints on the GF4AEL is harsh shifts, caused by high line pressure. Normal pressure on these units should be:

Idle in Drive — 60 – 75 PSI
 Stall in Drive — 160 – 170 PSI

While usually due to a problem with the valve body, your first step for diagnosing high line pressure is to eliminate the computer system as a source of the problem.

Leave the case connector plugged in, and backprobe terminal G on the connector; that's the feed to the pressure control solenoid. Then start the engine, put the transmission in drive, and check the voltage signal to the solenoid.

At idle, the solenoid should receive about 8 volts; at wide-open throttle, the signal should drop to about 1.6 volts. If the voltage is out of range, check for a problem with the TPS signal, or a transmission fluid temperature signal problem.



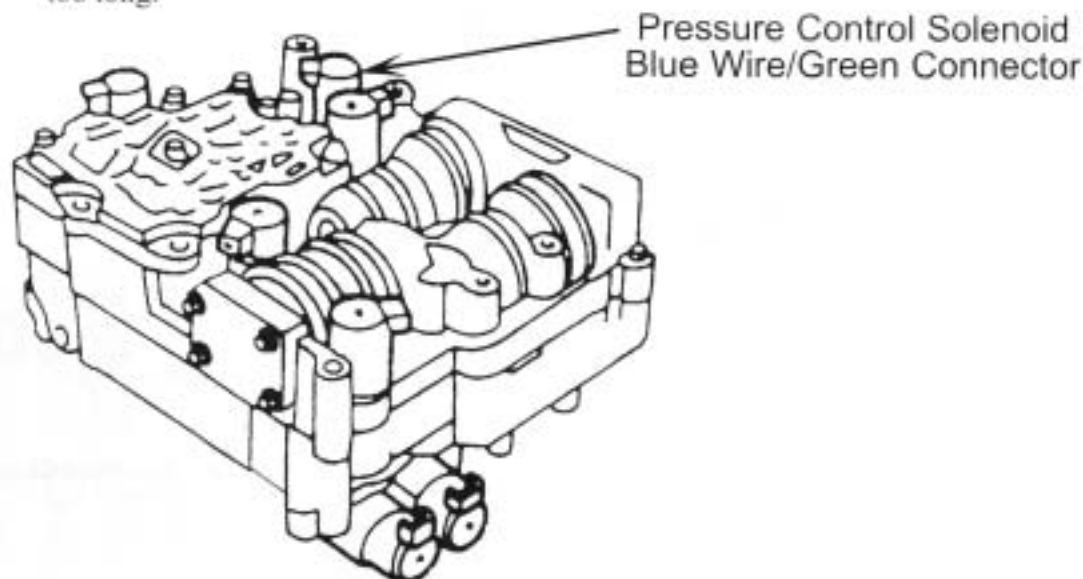
To examine the line pressure signal, connect your voltmeter to terminal G on the case connector.

But in most cases, you'll find the voltage is well within specs. Then it's time to look for a problem in the valve body. Possible problem areas include the pressure control solenoid, the pressure regulator, or the valve body itself.

Solenoid problems aren't very common, but they do occur. Start by checking the solenoid for proper resistance, and make sure it opens properly when you apply current.

CAUTION

Never keep voltage applied to the pressure control solenoid for more than a few seconds. These solenoids have very low resistance, so they can burn out if you keep current applied too long.



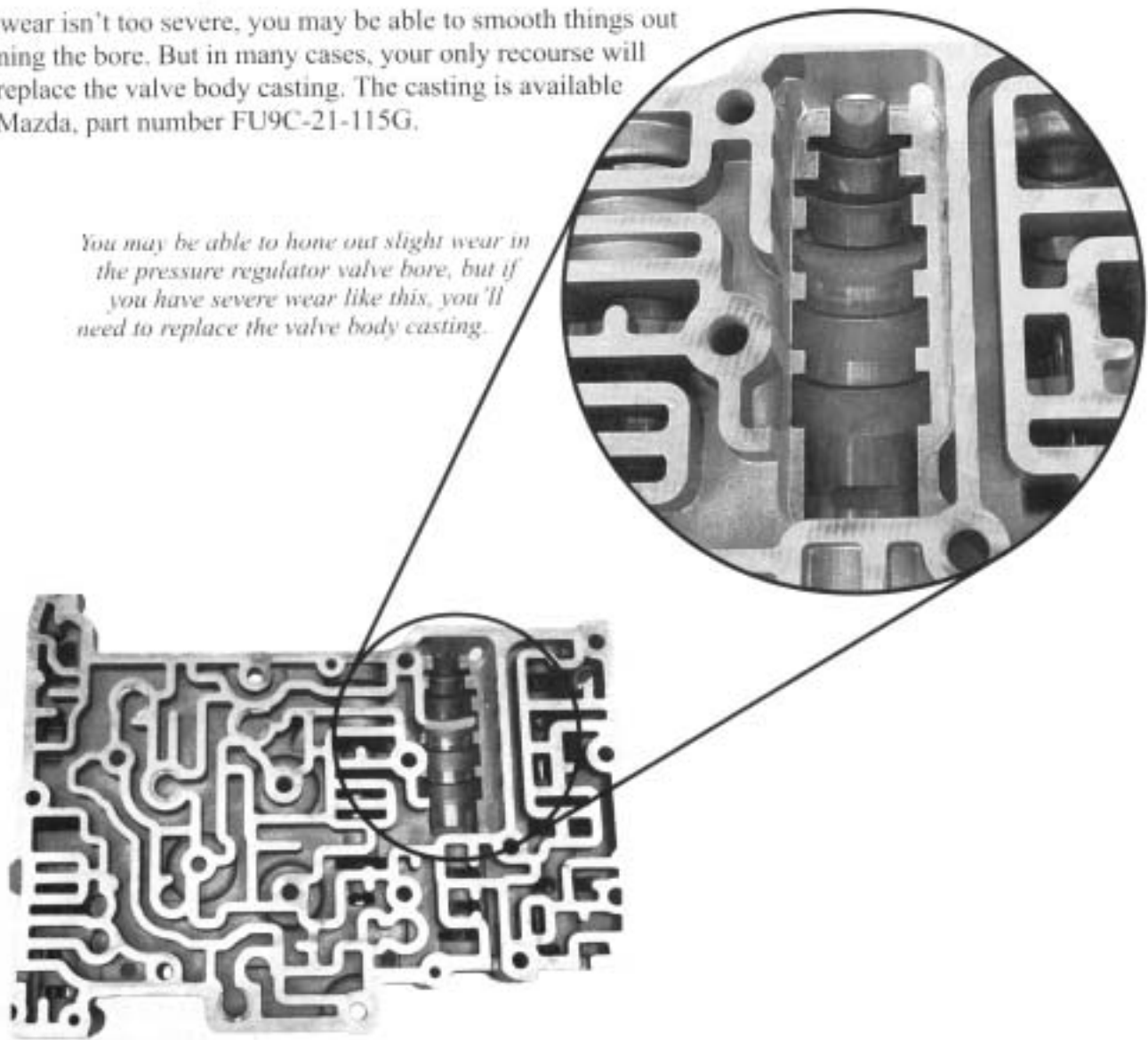
Mazda GF4AEL (continued)

High Line Pressure (continued)

Next, check the pressure regulator valve and spring for wear or damage. If the valve's sticking in its bore, pressure will vary, depending on where the valve sticks. If the valve itself looks okay, check the bore for wear. This is a common place for wear, and is one of the most likely causes for high line pressure.

If the wear isn't too severe, you may be able to smooth things out by honing the bore. But in many cases, your only recourse will be to replace the valve body casting. The casting is available from Mazda, part number FU9C-21-115G.

You may be able to hone out slight wear in the pressure regulator valve bore, but if you have severe wear like this, you'll need to replace the valve body casting.



Bore wear can cause a couple of different problems. One obvious problem is if the wear causes the pressure regulator valve to stick. But a less obvious problem is where the valve becomes loose in the bore, allowing balance pressure to leak past the valve lands, to the spring side of the valve. If the balance pressure leaks past the valve, the valve won't regulate line pressure.

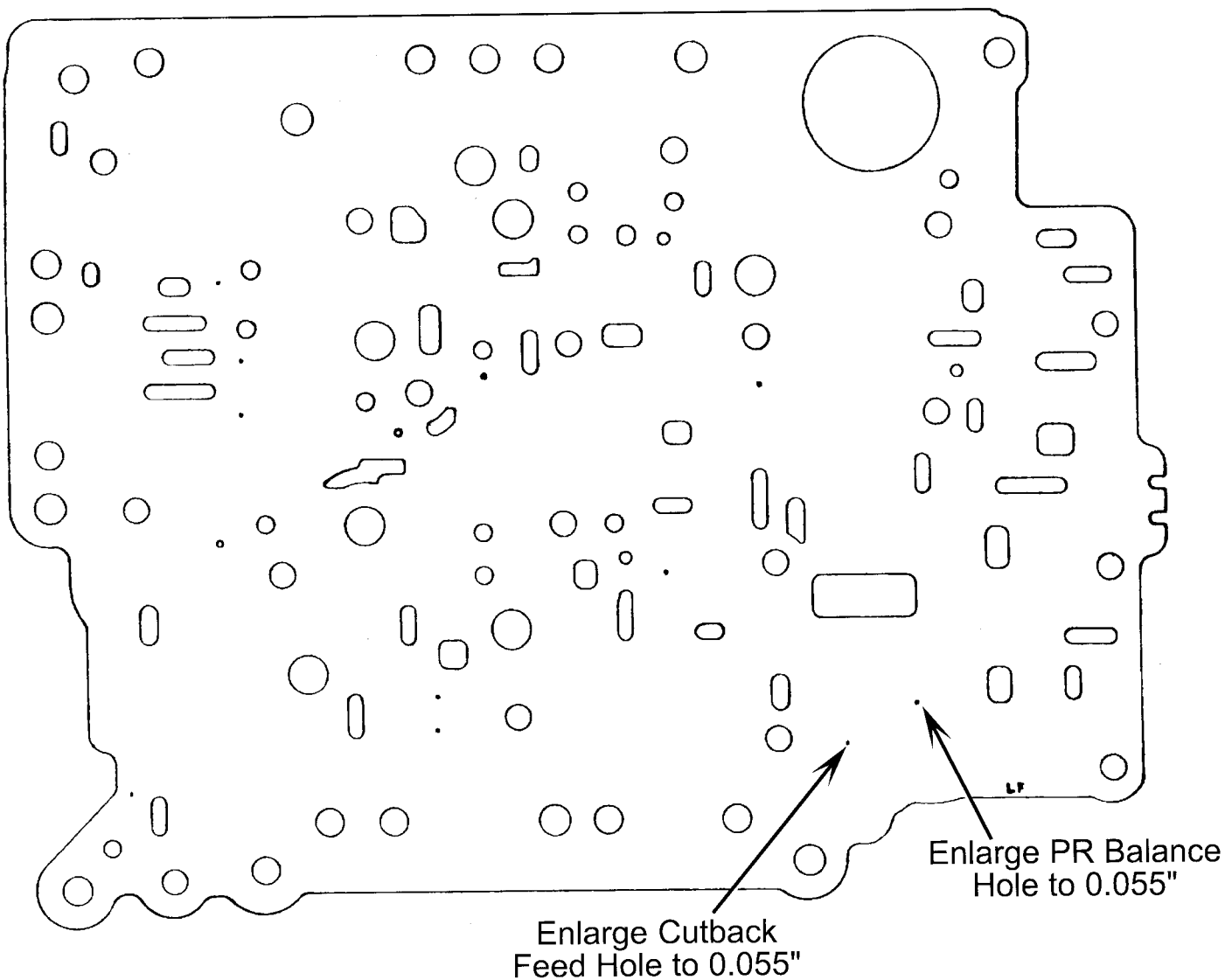
And not just line pressure: cutback pressure can leak, too. This prevents the regulator valve from lowering the pressure in the higher gears. And since the line pressure remains high, the shifts tend to be harsh.

Mazda GF4AEL (continued)

High Line Pressure (continued)

One thing you can do to overcome this problem (assuming the transmission is still in good shape), and to prevent it from occurring on other units you rebuild, is to enlarge the feed holes to the balance and cutback pressure circuits to 0.055". This will flood the balance and cutback circuits with enough fluid to overcome a small leak in the pressure regulator valve. This is a good practice to follow on every GF4AEL you rebuild.

Keep in mind that while this modification may overcome a slight wear in the pressure regulator circuit, it may not be enough if bore wear is excessive. For those units, you'll have to replace the valve body casting.

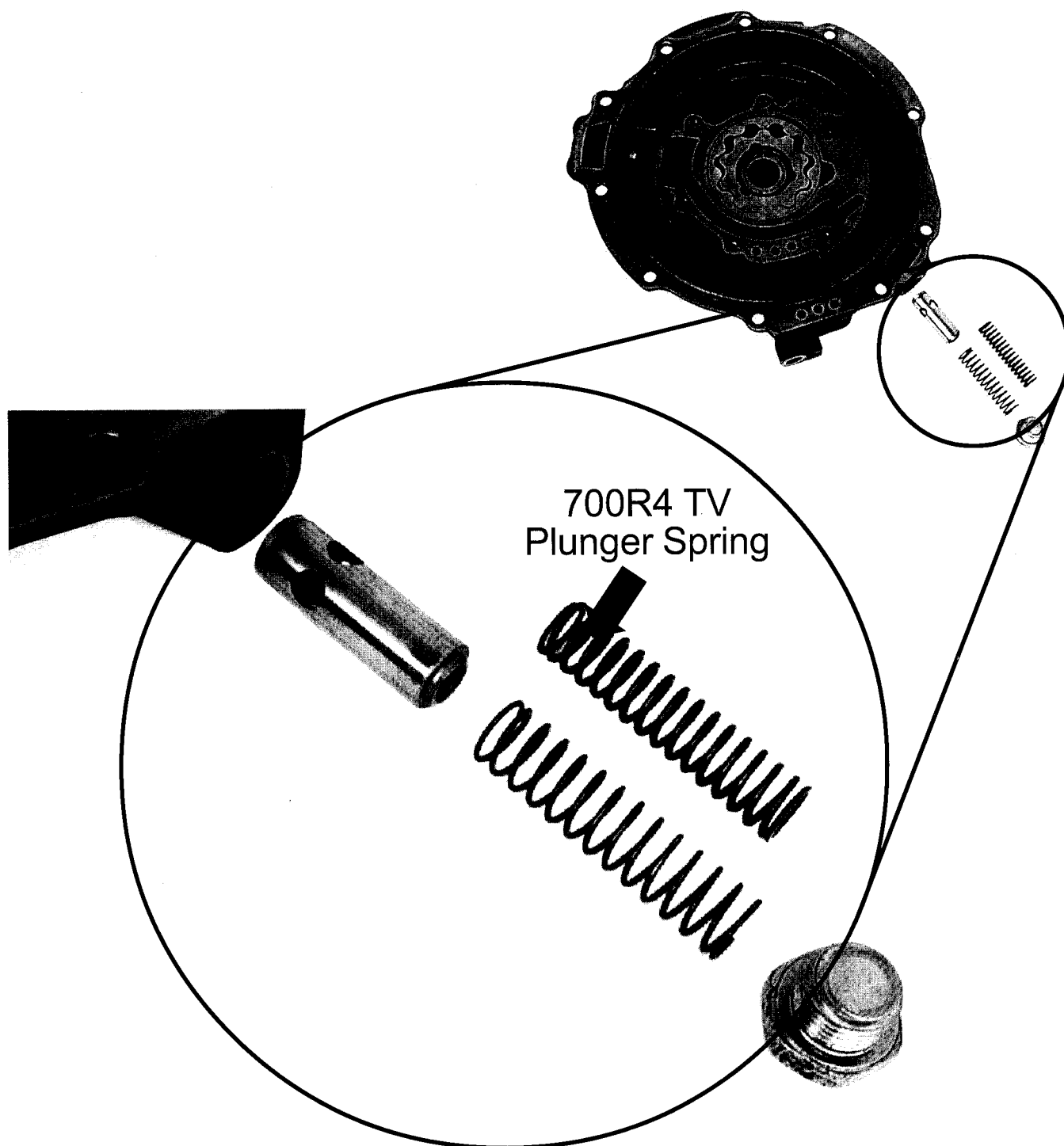


Mazda GF4AEL (continued)

Low Line Pressure at Idle

A common after-rebuild problem on these units is low line pressure, due to a sticking spool valve in the pump. This can be caused by dirt, rag lint, dust or other contaminants. When the valve sticks in the low volume (spring compressed) position, it routes pump output volume back into the pump intake.

The best fix is to polish the valve and install a heavier spring: The TV plunger spring from a 700R4 seems to work well.



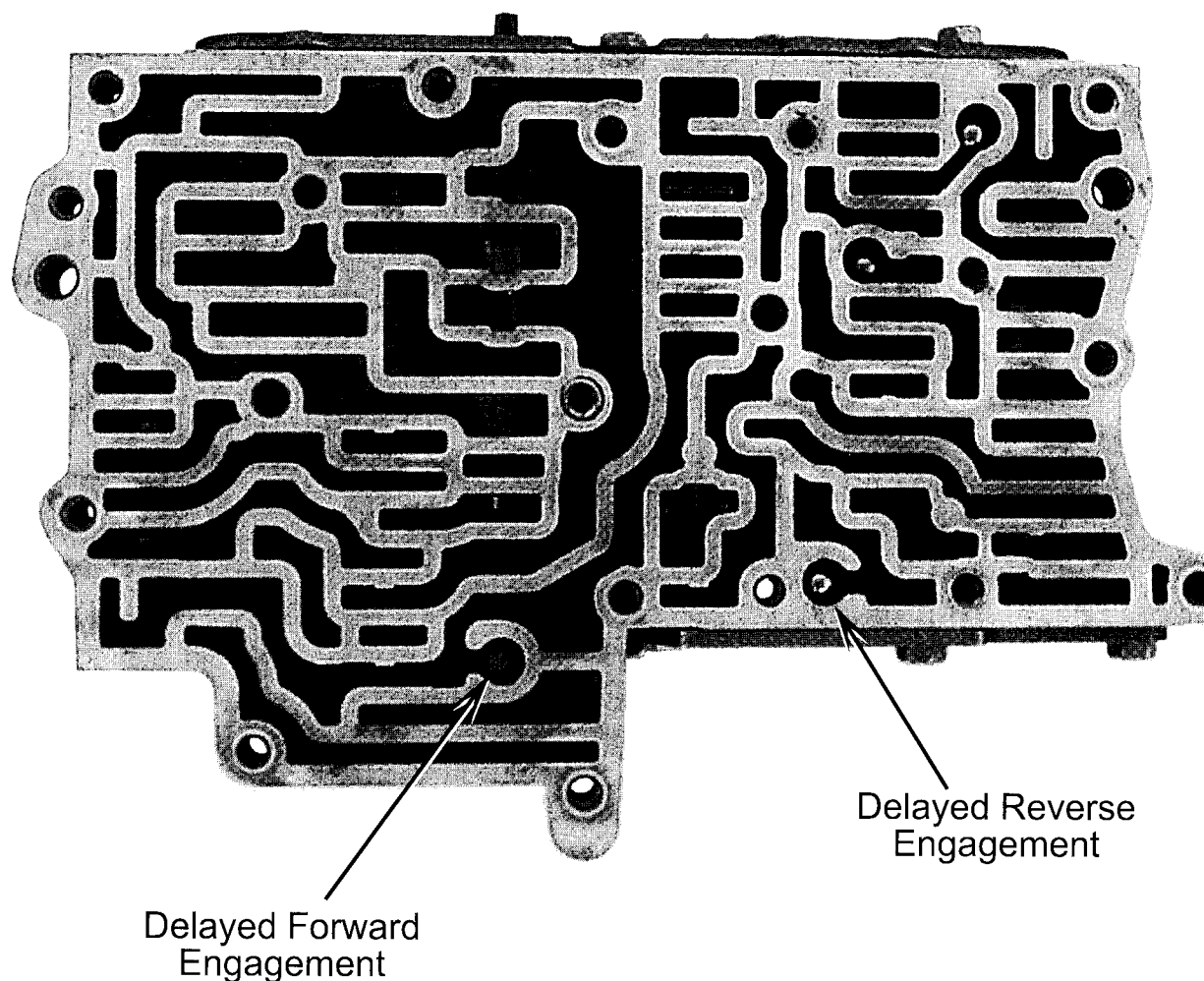
Mitsubishi; Hyundai

Delayed Engagement, Forward or Reverse

A delayed engagement in either forward or reverse can be caused by a computer problem.

As long as there are no other complaints with the unit, you can overcome this problem by removing one of the checkballs from the valve body. There's one checkball for forward, and a different one for reverse.

Don't remove these checkballs during a normal rebuild: Only use this procedure to correct a specific problem or complaint.



Mitsubishi; Hyundai (continued)

Coastdown Clunk

A misadjusted or broken accelerator switch is a common cause for a coastdown clunk on Mitsubishi and Hyundai transaxles.

In 1991 Mitsubishi incorporated the accelerator switch in the throttle position sensor on some models, and began referring to it as a closed throttle switch. Hyundai began using a separate switch, called an idle switch, in 1994. If these switches are working properly, you should have 15 – 20 PSI servo pressure, with the unit in drive, the vehicle stationary, and your foot off the gas. If pressure is higher, the problem is probably in the valve body; if pressure is zero, look for a problem with one of these switches.

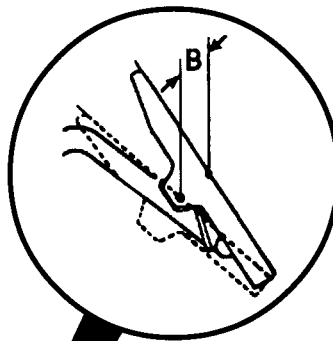
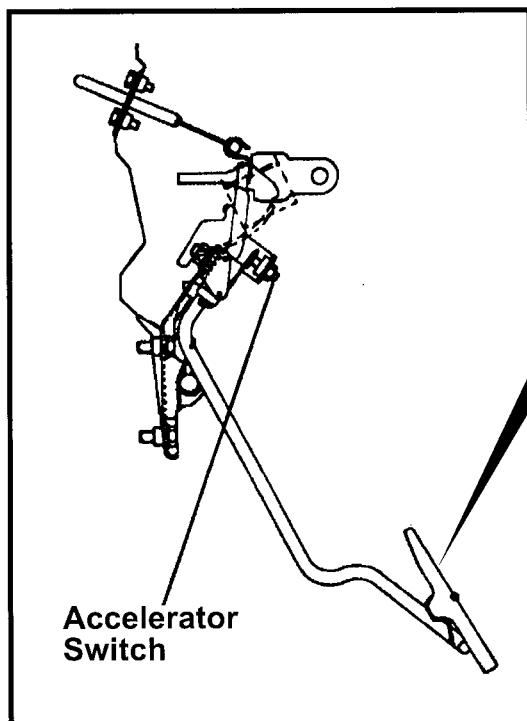
Refer to these illustrations for the different closed throttle switch connectors in use, and the procedures for testing them.

DIAGNOSTIC TIP

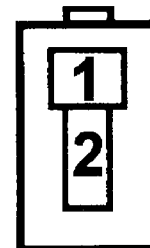
The actual breakpoints where these vehicles went from one switch to the next is just a bit confusing. But there's an easy way to find the switch for the vehicle you're working on:

- Start by looking for an accelerator switch right above the gas pedal. If you find the switch, check it using the procedures outlined on this page.
- If you don't see the accelerator switch, check throttle position sensor. If it has four wires, the idle switch is in the TPS. If it has three wires, look for the separate one-wire idle switch.

Accelerator Switch



"B" is between
0.016" and 0.030"



Terminal 1: (-)

Terminal 2: (+)

To check the accelerator switch operation and adjustment:

1. Backprobe connector terminal 2 with your voltmeter positive lead.
2. Connect your voltmeter negative lead to a good ground.
3. Turn the key on, engine off.

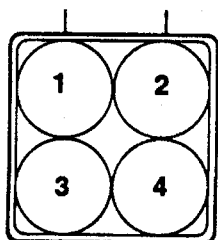
With the throttle fully closed, you should have zero volts.

With the throttle cracked open (about 0.030"), the voltage should rise to either 5 or 12 volts, depending on the system.

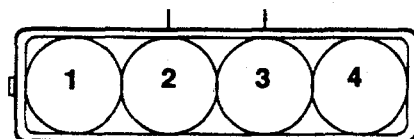
Mitsubishi; Hyundai (continued)

Coastdown Clunk (continued)

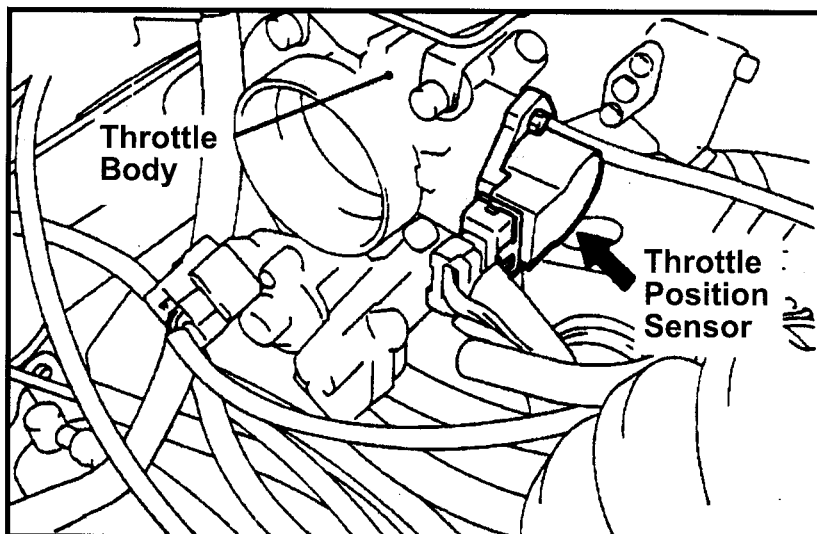
Throttle Position Sensor



- 1 – Closed Throttle Switch
- 2 – Ground
- 3 – Power
- 4 – Output



- 1 – Power
- 2 – Output
- 3 – Closed Throttle Switch
- 4 – Ground



To check the throttle position sensor closed throttle switch operation and adjustment:

1. Backprobe the closed throttle switch terminal with your voltmeter positive lead.
2. Connect your voltmeter negative lead to a good ground.
3. Turn the key on, engine off.

With the throttle fully closed, you should have zero volts.

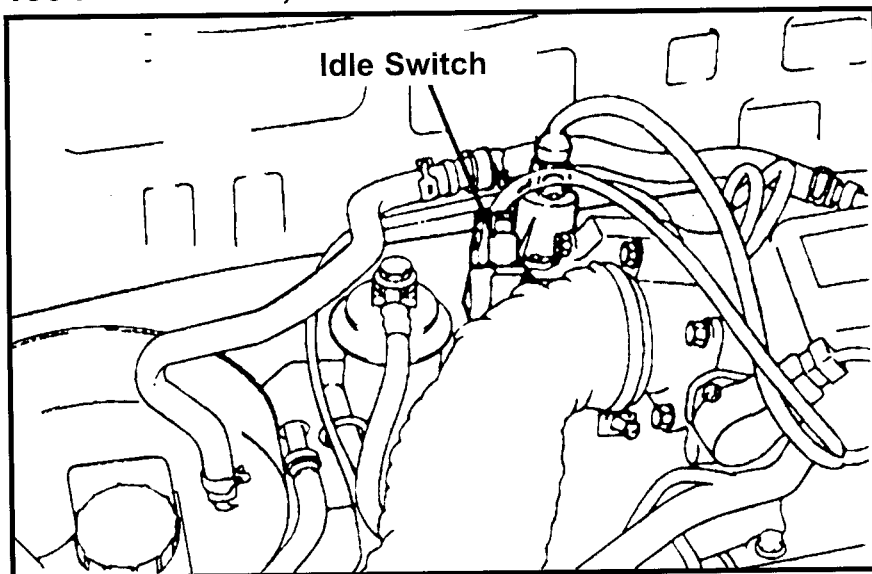
With the throttle cracked open (about 0.030"), the voltage should rise to either 5 or 12 volts, depending on the system.

Mitsubishi; Hyundai (continued)

Coastdown Clunk (continued)

Idle Switch; Hyundai Only

1994 – on Excel, Elantra



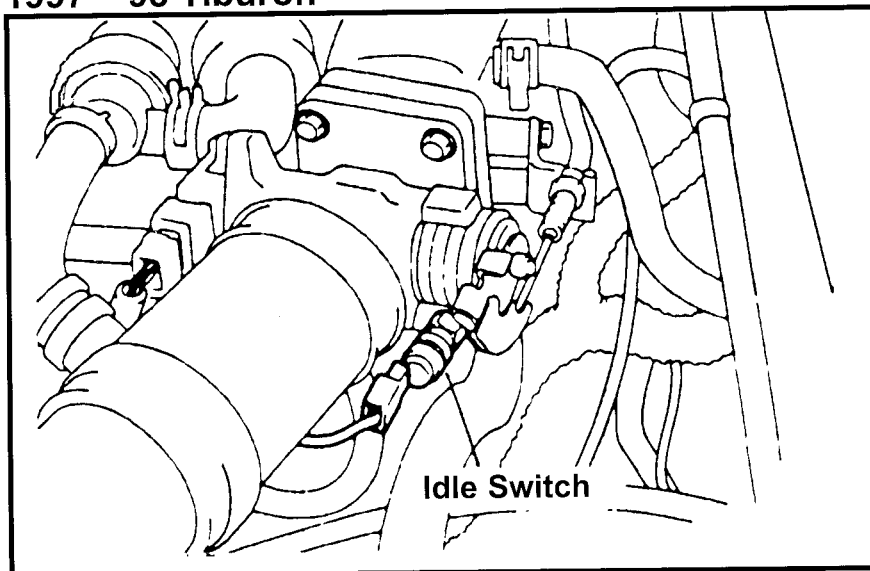
To check the idle switch operation and adjustment:

1. Backprobe the closed throttle switch terminal with your voltmeter positive lead.
2. Connect your voltmeter negative lead to a good ground.
3. Turn the key on, engine off.

With the throttle fully closed, you should have zero volts.

With the throttle cracked open (about 0.030"), the voltage should rise to 5 volts.

1995 – 98 Accent
1997 – 98 Tiburon



Mitsubishi; Hyundai (continued)

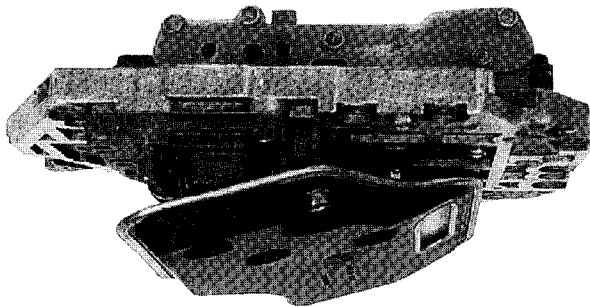
Falls Out of Gear; Slips

A Mitsubishi or Hyundai transaxle that falls out of gear or slips could have the wrong filter in it.

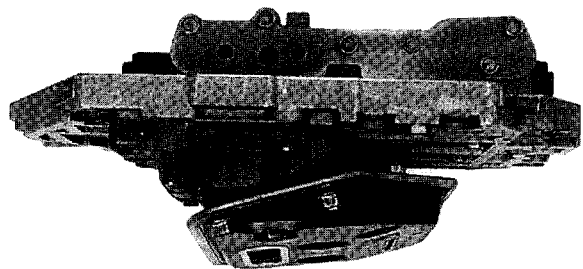
Both manufacturers build vehicles with engine and transaxle assemblies that sit vertically and on a slant. Each requires a different filter, designed to keep the pickup opening covered with fluid. Using a filter for a slanted powertrain in a vehicle with a vertical one (or the other way around) can allow the transmission to pull air into the pump.

The key is to make sure you're using the right filter for the vehicle you're working on.

Vertical Engine and Trans

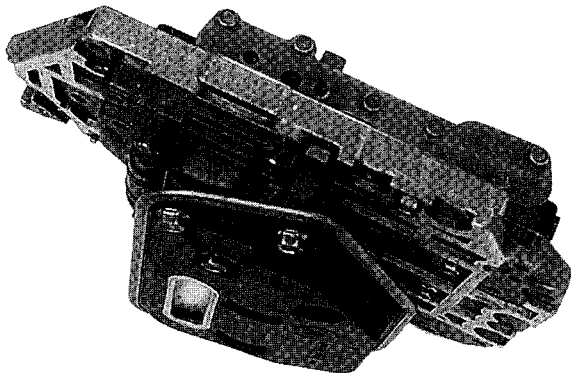


Wrong Filter

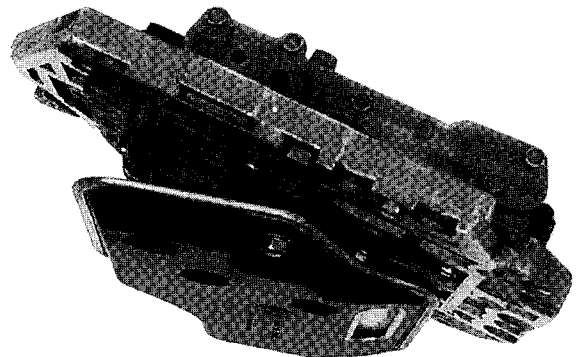


Right Filter

Slanted Engine and Trans



Wrong Filter



Right Filter

Mitsubishi; Hyundai (continued)

No Fourth Gear

If the unit won't shift into overdrive, but shift timing and lockup apply are correct, check the OD cancel circuit. First make sure the OD cancel light turns on and off when you operate the switch. If not, check the switch. As long as the light turns on and off when you operate the switch, the problem is more than likely caused by the cruise control computer.

The cruise control computer receives the OD enable signal from the OD cancel button. The cruise control computer then tells the transmission computer that it's okay to shift to OD. If the cruise control computer fails or is missing, the trans won't shift into overdrive.

To test for this problem

Step 1: Monitor the OD signal wire at the cruise control computer. This is the wire that leads to the TCU. It should have battery voltage, which is the enabled mode. On some vehicles it may be easier to check this right at the computer connector.

☐ Battery voltage present — The cruise control computer is working properly; look for a broken wire to the transmission computer, a transmission computer or system problem, or an internal transmission problem.

☐ No voltage present — Try cycling the OD cancel button. If it still won't work:

Step 2: Monitor the OD wire at the cruise control computer; this is the wire from the OD cancel button. It should switch from battery voltage, to zero volts as you cycle the button.

☐ No voltage present — Look for a problem with the switch or the wire.

☐ Voltage cycles normally as you operate the switch — The problem is in the cruise control computer.

If the switch works properly, but the cruise control computer doesn't, you can bypass the cruise control computer. Simply unplug the harness and jump the two leads shown in the illustrations. Overdrive should work, and the OD cancel button should function normally.

Continued...

Mitsubishi; Hyundai (continued)

No Fourth Gear (continued)

There are three cruise control computer designs from 1987 – 1998. We've included illustrations of the harness connector which will make it easier to identify.

87–90 Mitsubishi, 89–94 Hyundai, exc. 94 Elantra

1	2	3	4			5	6	7	8	9
10	11	12	13			16	17	18	19	20

The overdrive cancel switch feeds terminal 17; terminal 16 is the overdrive cancel signal to the transmission computer.

95–98 Hyundai and 94 Elantra

1	2	3	4			5	6	7	8
9	10	11	12			15	16	17	18

The overdrive cancel switch feeds terminal 8; terminal 17 is the overdrive cancel signal to the transmission computer.

91–98 Mitsubishi

1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	26

The overdrive cancel switch feeds terminal 11; terminal 10 is the overdrive cancel signal to the transmission computer.

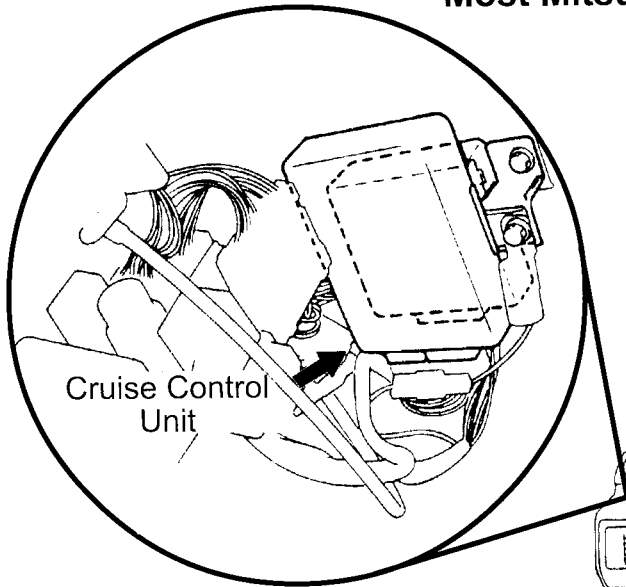
Continued...

Mitsubishi; Hyundai (continued)

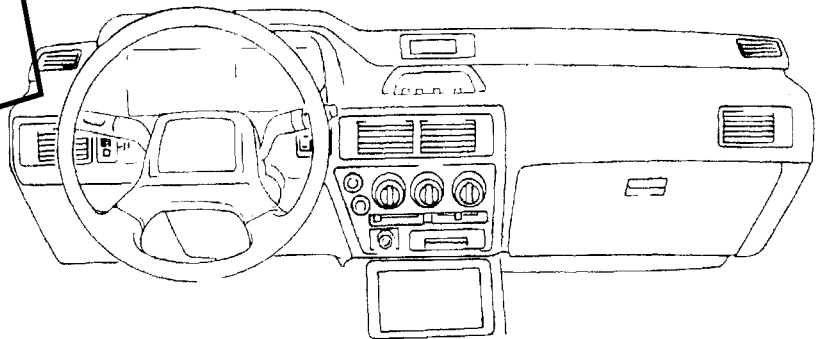
No Fourth Gear (continued)

Here are illustrations to help you find the cruise control computer.

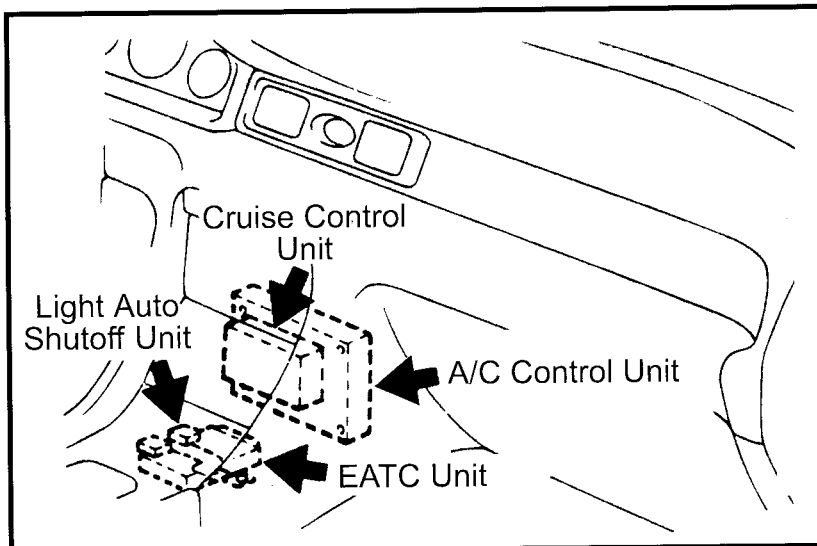
Most Mitsubishi and Hyundai



Look for the cruise control computer at the far left (driver's) side.



Diamonte

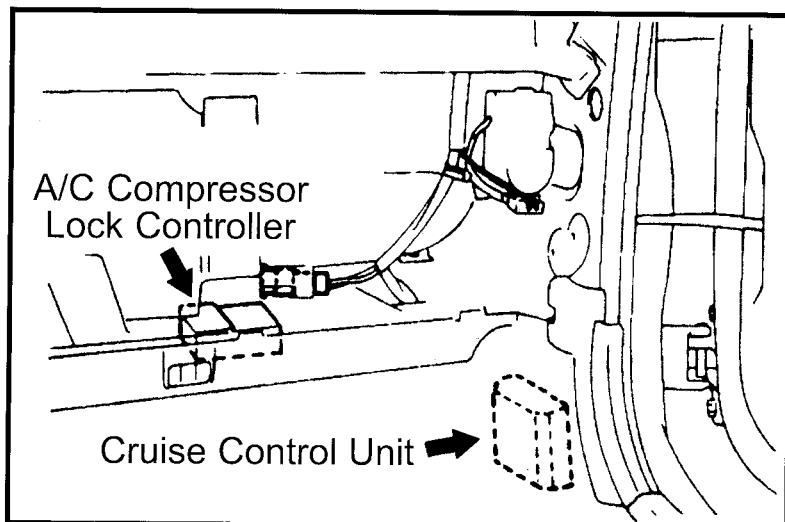


Look for the cruise control computer behind the center console by the transaxle computer.

Continued...

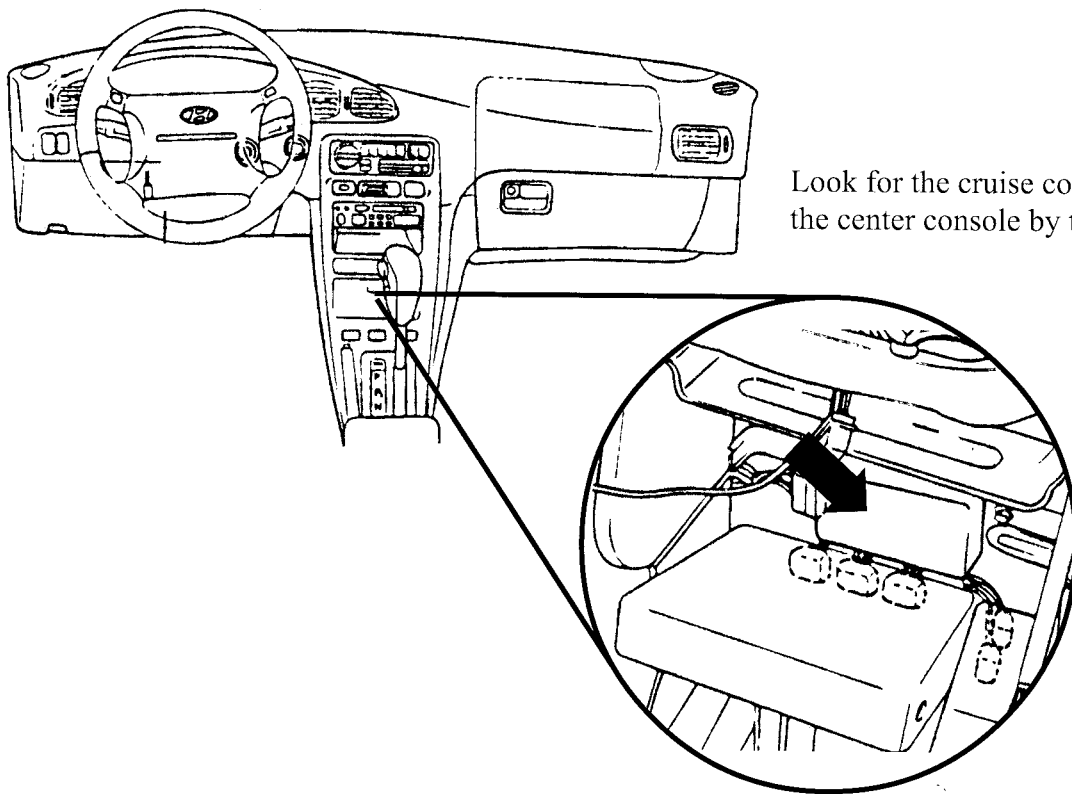
Mitsubishi; Hyundai (continued) No Fourth Gear (continued)

3000GT and Stealth



Look for the cruise control computer behind the right (passenger's) side kickpanel.

Tiburon, 1995-98 Sonata

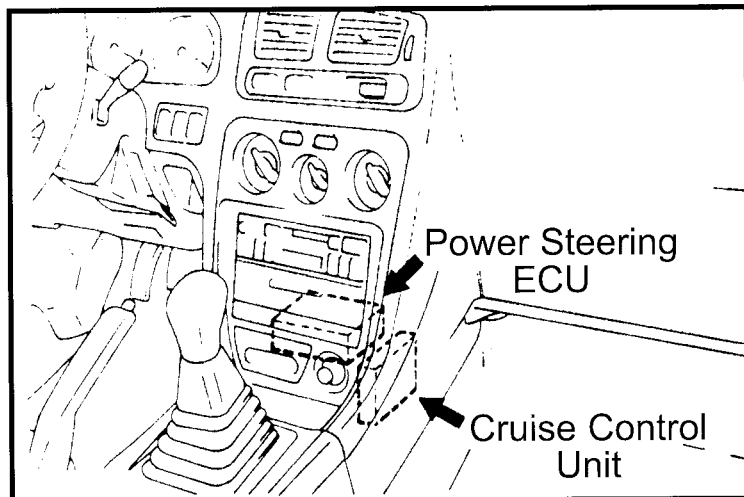


Look for the cruise control computer behind the center console by the transaxle computer.

Continued...

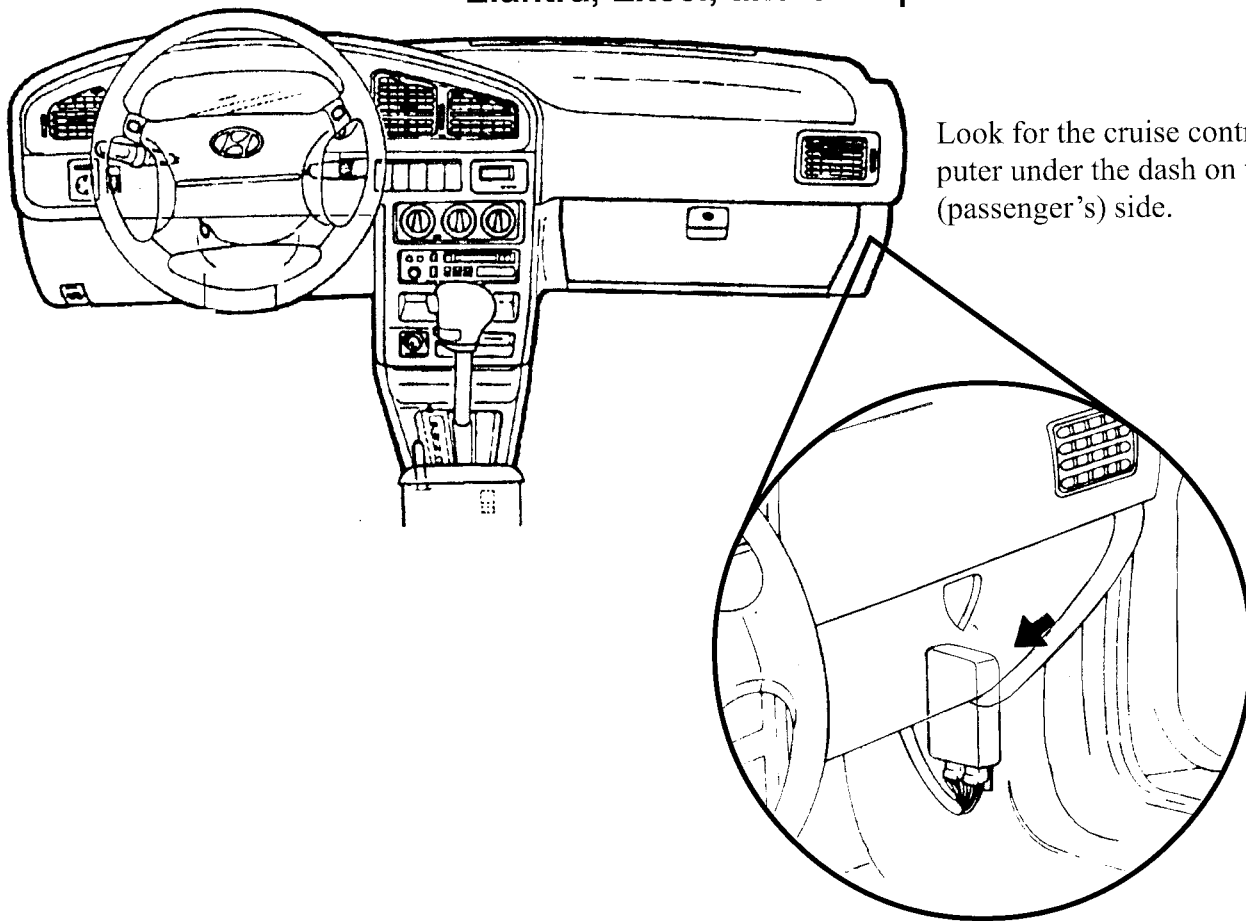
Mitsubishi; Hyundai (continued) No Fourth Gear (continued)

1994-and-later Galant



Look for the cruise control computer behind the center console by the transaxle computer.

Elantra, Excel, and Scoupe



Look for the cruise control computer under the dash on the right (passenger's) side.

Reference Contents

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Conversion Tables

Area		
Multiply	By	To Obtain
in ²	645.2	mm ²
in ²	6.452	cm ²
in ²	0.0069	ft ²
ft ²	0.0929	m ²
ft ²	144.0	in ²
m ²	10.764	ft ²
cm ²	0.155	in ²
mm ²	0.00155	in ²
area of a circle = πr^2 area of a cylinder = $\pi r^2 h$		
$\pi = 3.14$ r = Radius h = Height		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
miles	5280.0	ft
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Continued...

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

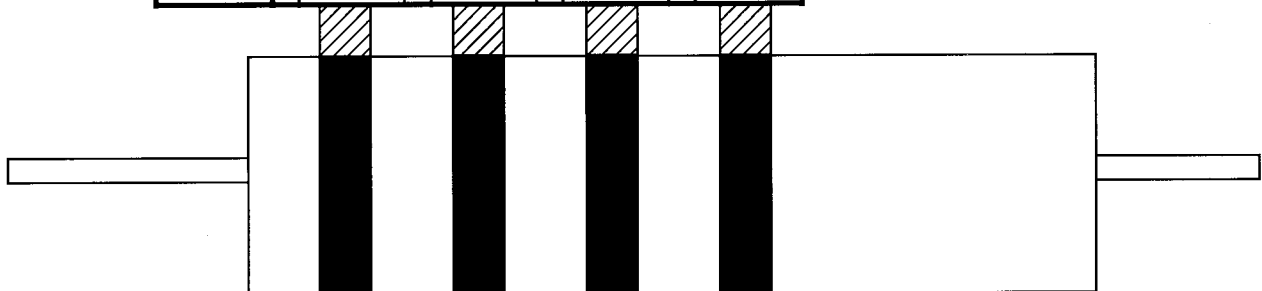
*The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	0	—
Brown	1	1	1	1%
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%



So if the bands are:

Blue Green Yellow Silver

6 5 0,000 ±10% = 650 kΩ, ±10%

Red Violet Brown Gold

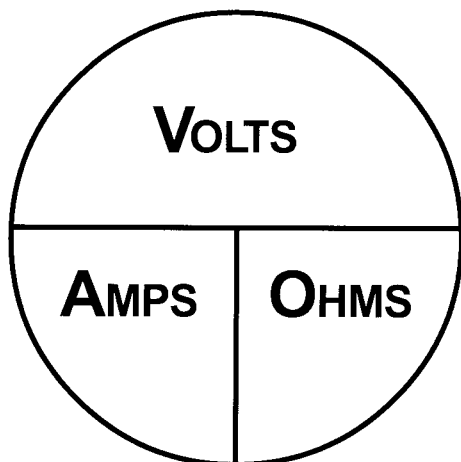
2 7 0 ±5% = 270 Ω, ±5%

White Orange Violet Plain

9 3 0,000,000 ±20% = 930 MΩ, ±20%

The resistor value is:

Ohm's Law



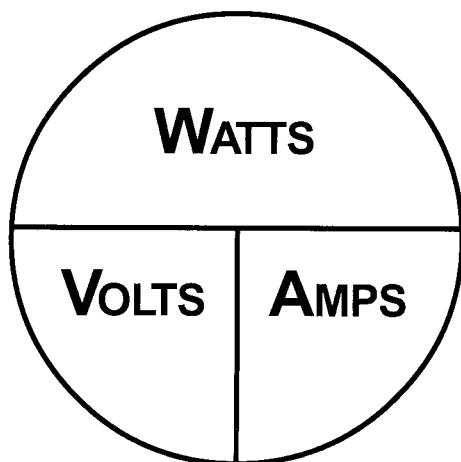
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

Multiple Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

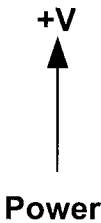
Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

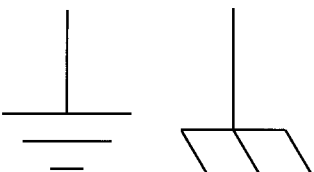
Schematic Symbols



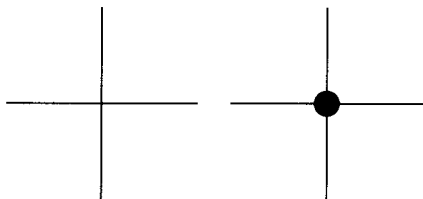
Battery



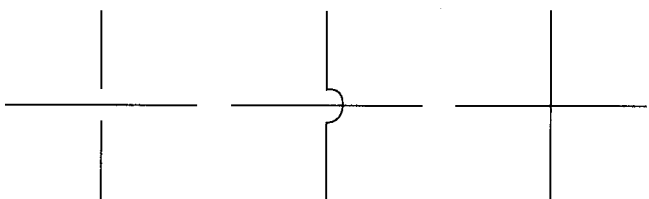
Power



Ground



Connected Wires



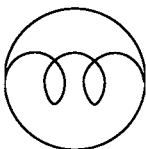
Unconnected Wires



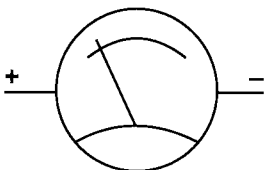
Fuse



Circuit Breaker



Bulb

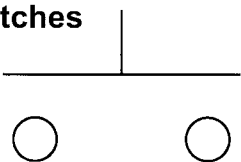


Meter

Pushbutton Switches

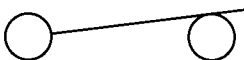


NC Switch

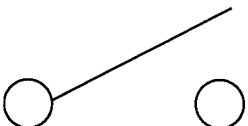


NO Switch

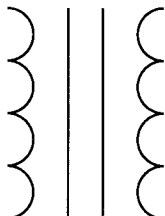
On/Off Switches



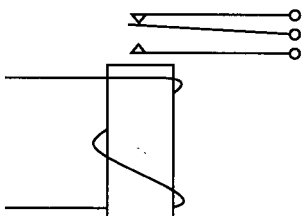
NC Switch



NO Switch

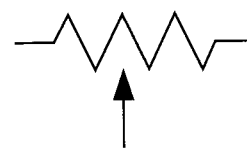
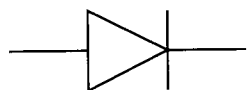
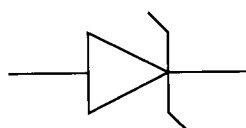
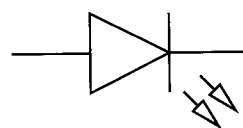
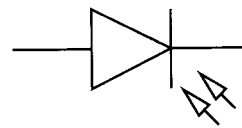
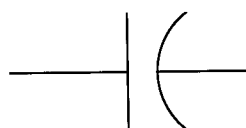
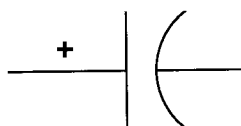
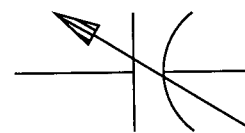
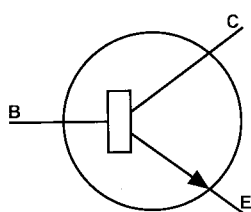
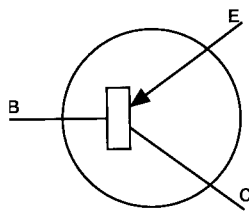
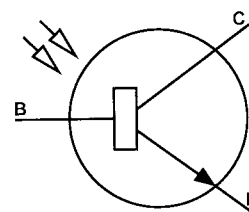
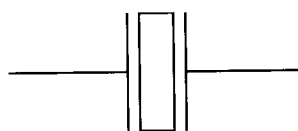


Transformer (Coil)



Relay

Schematic Symbols (continued)

**Fixed Resistor****Variable Resistor****Potentiometer****Diode****Zener Diode****LED****Photodiode****Fixed Capacitor****Fixed Capacitor (Polarized)****Variable Capacitor****NPN Transistor****PNP Transistor****Phototransistor****Crystal**

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition system.

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Continued...

Glossary of Electrical Terms (cont)

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less

effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific direction, or the LED won’t light.

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm’s Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). $\text{Ohms} \times \text{Amps} = \text{Volts}$; $\text{Volts} \div \text{Ohms} = \text{Amps}$; $\text{Volts} \div \text{Amps} = \text{Ohms}$.

Open Circuit — An incomplete electrical path that won’t provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won’t operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component’s operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a

Continued...

Glossary of Electrical Terms (cont)

parallel circuit opens, it won't prevent the other legs from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the voltage signal, based on its position along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device controlling the circuit.

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely be dealing with open and close to control hydraulic flow, to allow the transmission to shift gears, control lockup, and control line pressure.

Continued...

Glossary of Electrical Terms (cont)

Thermistor — A semiconductor that varies resistance based on temperature. There are two types of thermistor: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). The NTC thermistor is more common — as the temperature goes up, its resistance goes down.

Transistor — A semiconductor that operates as an electronic “relay.” Transistors allow a low current circuit to control power or ground to a high current circuit.

Variable Resistor — A one- or two-wire sensor that modifies a voltage signal based on stress or temperature. Thermistors are the most common type of variable resistor in today’s cars and trucks.

Voltage — The pressure in an electrical system, that pushes current through the circuit. One volt of pressure is necessary to push one amp of current through one ohm of resistance. Sometimes called the circuit’s potential.

Voltmeter — Electrical test device that measures the voltage potential in a circuit. Displays its reading in volts.

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kV	Kilovolt
AC	Alternating current	kW	Kilowatt
B, b	Base electrode, units with single base	kWH	Kilowatt hour
°C	Degrees Celsius or centigrade	lb	Pound
C	Capacitance, capacitor	M	Mega; x1,000,000
C, c	Collector electrode	m	Milli; one-one thousandth; 1/1000; 0.001
cm	Centimeter	mf, mfd	Microfarad
cu	Cubic	MHz	Megahertz
db	Decibels	mm	Millimeter
DC	Direct current	NC	Normally closed
dm	Decimeter	Nm	Newton-meter
DPDT	Double-pole, double-throw switch	NO	Normally open
DPST	Double-pole, single-throw switch	R	Resistance; resistor
E, e	Emitter electrode	SPDT	Single-pole, double-throw switch
E, e	Voltage	SPST	Single-pole, single-throw switch
mf	Microfarad	t	Time
°F	Degrees Fahrenheit	T	Temperature
F, f	Frequency	V, v	Volt; voltmeter
flu	Fluid	V _{BB}	Base supply voltage (DC)
FM	Frequency modulation	V _{BC}	Base-to-collector voltage (DC)
g	Gram	V _{BE}	Base-to-emitter voltage (DC)
gnd, grd	Ground	V _{CB}	Collector-to-base voltage (DC)
Hg	Mercury	V _{CC}	Collector supply voltage (DC)
Hz	Hertz	V _{CE}	Collector-to-emitter voltage (DC)
I	Current	V _{EB}	Emitter-to-base voltage (DC)
I _B	Base current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _C	Collector current (DC)	v _{ec}	Emitter supply voltage (DC)
I _E	Emitter current (DC)	V _F	Forward voltage (DC)
k	x1000	W	Watt; work
kg	Kilograms	w	Watt
kHz	Kilohertz	wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	$\frac{1}{128}$	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	$\frac{15}{128}$	2.9769		
0.0156	$\frac{1}{16}$	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	$\frac{1}{8}$	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	$\frac{17}{128}$	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	$\frac{3}{128}$	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	$\frac{9}{64}$	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	$\frac{3}{16}$ -24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	$\frac{1}{32}$	0.7925			0.1484	$\frac{19}{128}$	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	$\frac{5}{32}$	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	$\frac{3}{16}$ -32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	$\frac{5}{128}$	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	$\frac{21}{128}$	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	$\frac{3}{64}$	1.1913		0-80 NF	0.1719	$\frac{11}{64}$	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	$\frac{7}{128}$	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	$\frac{23}{128}$	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1820		4.6228	14	5.5mm - 0.80
0.0625	$\frac{1}{16}$	1.5875			0.1850		4.6990	13	12-28 NF
0.0635		1.6129	52		0.1875	$\frac{3}{16}$	4.7625		12-32 NEF
0.0670		1.7018	51		0.1890		4.8006	12	
0.0700	$\frac{9}{128}$	1.7780	50	2-56 NC 2-64 NF	0.1910		4.8514	11	
					0.1935		4.9149	10	14-20 NS
0.0730		1.8542	49		0.1953	$\frac{25}{128}$	4.9606		
0.0760		1.9304	48		0.1960		4.9784	9	
0.0781	$\frac{5}{64}$	1.9837			0.1990		5.0546	8	
0.0785		1.9939	47	3-48 NC	0.2010		5.1054	7	$\frac{1}{4}$ -20 NC
0.0810		2.0574	46						14-24 NS
0.0820		2.0828	45	3-56 NF					
0.0860	$\frac{11}{128}$	2.1844	44	4-36 NS	0.2031	$\frac{13}{64}$	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	$\frac{3}{32}$	2.3825		$\frac{1}{8}$ -32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	$\frac{1}{4}$ -24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	$\frac{27}{128}$	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	$\frac{1}{4}$ -28 NF
0.1015		2.5781	38	$\frac{1}{8}$ -40NF 5-40NC	0.2188	$\frac{7}{32}$	5.5575		$\frac{1}{4}$ -32 NEF
					0.2210		5.6134	2	
0.1016	$\frac{13}{128}$	2.5806			0.2266	$\frac{29}{128}$	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	$\frac{1}{4}$ -40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	$\frac{7}{64}$	2.7788			0.2344	$\frac{15}{64}$	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	²⁹ / ₆₄	11.5087		¹ / ₂ -20 NF
0.2422	³¹ / ₁₂₈	6.1519							¹ / ₂ -24 NS
0.2460		6.2484	D		0.4609	⁵⁹ / ₁₂₈	11.7069		
0.2500	¹ / ₄	6.3500	E		0.4688	¹⁵ / ₃₂	11.9075		
0.2570		6.5278	F	⁵ / ₁₆ -18 NC	0.4766	⁶¹ / ₁₂₈	12.1056		
0.2578	³³ / ₁₂₈	6.5481			0.4800		12.1920		14mm - 2.00
0.2610		6.6294	G		0.4844	³¹ / ₆₄	12.3038		⁹ / ₁₆ -12 NC
0.2656	¹⁷ / ₆₄	6.7462			0.4922	⁶³ / ₁₂₈	12.5019		
0.2660		6.7564	H		0.5000	¹ / ₂	12.7000		14mm - 1.50
0.2720		6.9088	I	8mm - 1.25	0.5039		12.8000		14mm - 1.25
				⁵ / ₁₆ -24 NF	0.5156	³³ / ₆₄	13.0962		⁹ / ₁₆ -18 NF
0.2734	³⁵ / ₁₂₈	6.9444			0.5312	¹⁷ / ₃₂	13.0962		⁵ / ₈ -11 NC
0.2770		7.0358	J		0.5469	³⁵ / ₆₄	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	⁹ / ₁₆	14.2875		
0.2813	⁹ / ₃₂	7.1450		⁵ / ₁₆ -32 NEF	0.5781	³⁷ / ₆₄	14.6837		⁵ / ₈ -18NF
0.2891	³⁷ / ₁₂₈	7.3431							³ / ₈ -18NPT
0.2900		7.3660	L		0.5787		14.7000		16mm - 1.50
0.2950		7.4930	M		0.5938	¹⁹ / ₃₂	15.0825		¹¹ / ₁₆ -11 NS
0.2969	¹⁹ / ₆₄	7.5413			0.6094	³⁹ / ₆₄	15.4788		
0.3020		7.6708	N		0.6220		15.8000		18mm - 2.50
0.3047	³⁹ / ₁₂₈	7.7394			0.6250	⁵ / ₈	15.8750		¹¹ / ₁₆ -16 NS
0.3110		7.8994		9mm - 1.25	0.6406	⁴¹ / ₆₄	16.2712		
0.3125	⁵ / ₁₆	7.9375		³ / ₈ -16 NC	0.6562	²¹ / ₃₂	16.6675		³ / ₄ -10 NC
0.3160		8.0264	O		0.6614		16.8000		18mm - 1.50
0.3190		8.1026		9mm - 1.00	0.6719	⁴³ / ₆₄	17.0663		
0.3203	⁴¹ / ₁₂₈	8.1356			0.6875	¹¹ / ₁₆	17.4625		³ / ₄ -16NF
0.3230		8.2042	P		0.7008		17.8000		20mm - 2.50
0.3270		8.3058		9mm - 0.75	0.7031	⁴⁵ / ₆₄			¹ / ₂ -14 NPT
0.3281	²¹ / ₆₄	8.3337			0.7187	²³ / ₃₂			
0.3320		8.4328	Q	³ / ₈ -24 NF	0.7344	⁴⁷ / ₆₄			
0.3359	⁴³ / ₁₂₈	8.5319			0.7500	³ / ₄			
0.3390		8.6106	R	¹ / ₈ -27 NPT	0.7656	⁴⁹ / ₆₄			⁷ / ₈ -9 NC
0.3430		8.7122		10mm - 1.50	0.7812	²⁵ / ₃₂			
0.3438	¹¹ / ₃₂	8.7325			0.7969	⁵¹ / ₆₄			
0.3480		8.8392	S		0.8125	¹³ / ₁₆			⁷ / ₈ -14 NF
0.3500		8.8900		10mm - 1.25	0.8228		20.9000		22mm - 1.50
0.3516	⁴⁵ / ₁₂₈	8.9306			0.8281	⁵³ / ₆₄			⁷ / ₈ -18 NS
0.3580		9.0932	T	10mm - 1.0	0.8425		21.4000		24mm - 3.00
0.3594	²³ / ₆₄	9.1288			0.8437	²⁷ / ₃₂			
0.3672	⁴⁷ / ₁₂₈	9.3269			0.8594	⁵⁵ / ₆₄			
0.3680		9.3472	U	⁷ / ₁₆ -14 NC	0.8750	⁷ / ₈			1-8 NC
0.3750	³ / ₈	9.5250			0.8779		22.3000		24mm - 2.00
0.3770		9.5758	V		0.8906	⁵⁷ / ₆₄			
0.3820		9.7028		11mm - 1.50	0.9062	²⁹ / ₃₂			
0.3828	⁴⁹ / ₁₂₈	9.7231			0.9219	⁵⁹ / ₆₄			1-12 NF
0.3860		9.8044	W						³ / ₄ -14 NPT
0.3906	²⁵ / ₆₄	9.9212		⁷ / ₁₆ -20 NF	0.9375	¹⁵ / ₁₆			1-14 NS
0.3970		10.0838	X		0.9531	⁶¹ / ₆₄			
0.3984	⁵¹ / ₁₂₈	10.1194			0.9687	³¹ / ₃₂			
0.4040		10.2616	Y		0.9844	⁶³ / ₆₄			
0.4063	¹³ / ₃₂	10.3200			1.0000	1			
0.4130		10.4902	Z	12mm - 1.75					
0.4141	⁵³ / ₁₂₈	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	²⁷ / ₆₄	10.7163		¹ / ₂ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	⁵⁵ / ₁₂₈	10.9144							
0.4375	⁷ / ₁₆	11.1125		¹ / ₄ -18NPT					
0.4453	⁵⁷ / ₁₂₈	11.3106							

A large, faint, light gray graphic of a crowd of people, composed of many small, stylized human figures, is positioned on the left side of the page, extending from the top left towards the bottom right.

2000

TECHNICAL SEMINAR

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Dennis Madden
Technical Director

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4L60E

Neutral Safety Switch Replacement

Very often, the harnesses for the neutral safety switch are melted to the point that you can't remove them without damaging the harness, switch, or both. The switch, and both harness connectors are available separately.

Pay attention to the color and position of the existing wires *before* cutting them; the replacement harness connectors aren't color-coded.

The GM part numbers are:

12450016.....	Neutral Safety Switch
15305887.....	Large Connector
15305925.....	Small Connector

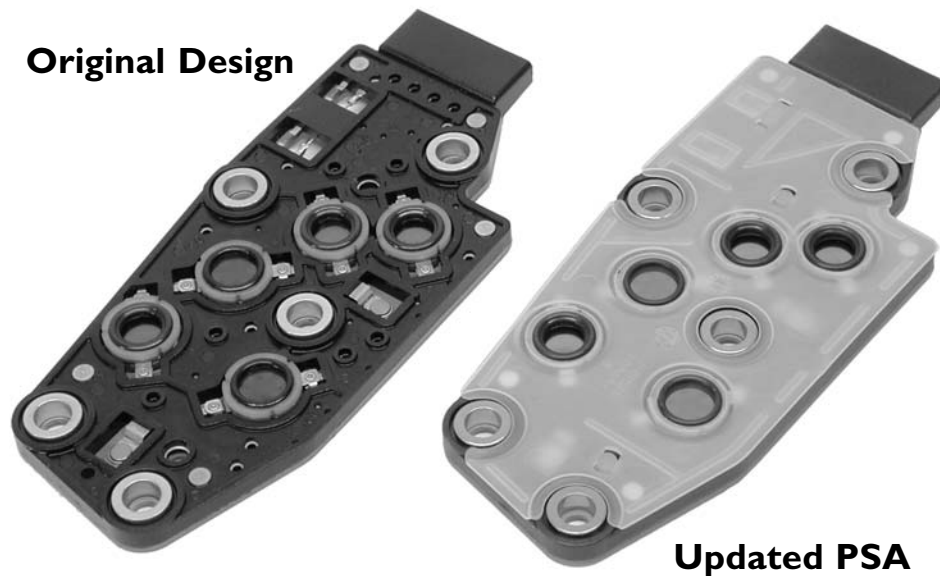


4L60E

New-Design Pressure Switch Assembly; Code P1810

A diagnostic trouble code P1810 refers to a problem with the pressure switch assembly. This can be caused by debris shorting out the switch contacts. GM has introduced a new-design switch assembly that has a plastic shield, to protect the switch contacts from exposure to debris.

The GM part number for the new switch assembly is 24215111.



4L60E

P1870 Sets Regularly or Intermittently

Diagnostic trouble code P1870 (Transmission Component Slipping) is a very common problem on the 4L60E. It sets on all vehicles, and can be difficult to diagnose as it's often intermittent. P1870 will set if:

- TCC is commanded on
- TCC duty cycle is at maximum
- TCC slip RPM is greater than 130 for longer than 7 seconds
- DTCs P0122, P0123, P0502, P0503, P0711, P0712, P0713, P0740, P0753, P0758, P1810, P1860 aren't set.
- VSS is between 30 and 70 MPH (48–112 KPH)
- Speed ratio (engine speed divided by output speed, also known as N/V ratio on some scan tools) is between 0.69 and 0.88
- D4 range is selected
- TP is between 9% and 35%
- TFT is between 68° F and 266° F (20° – 130° C)

The computer reacts to code P1870 by:

- Raising line pressure to maximum
- Freezing shift adapts
- Inhibiting TCC

Any type of slip in 4th gear may lead to code P1870. This means a problem with the 3–4 clutch, 2–4 band or the forward clutch could cause this code. So P1870 isn't just related to the TCC or TCC operation. Other causes for code P1870 include:

- Clutch or servo sealing problems (seals, bushings, shafts, pistons)
- Friction material damage or improper stacking
- TCC or its feed circuit is leaking
- Solenoid problems (hydraulic leakage and low current flow)
- TCC pressure regulator valve side-loading in the bore, causing it to stick intermittently. This results in low TCC apply pressure.

4L60E

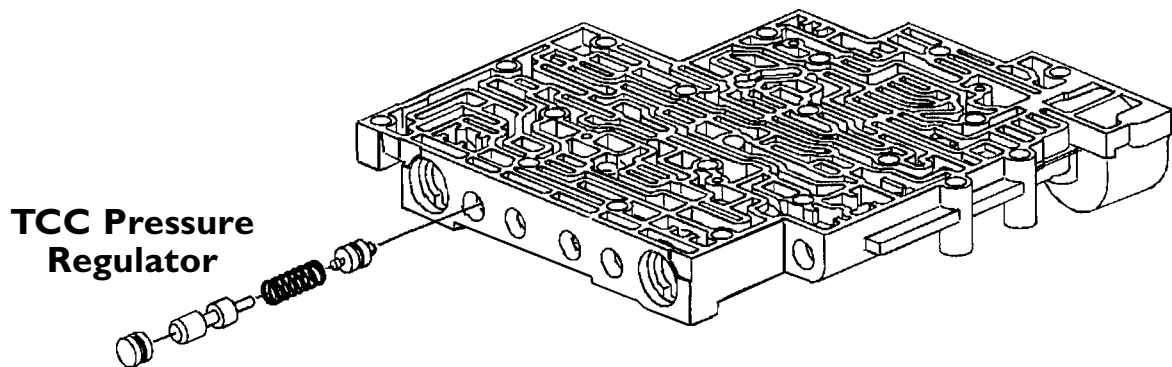
P1870 Sets Regularly or Intermittently (cont)

To isolate the cause of the P1870 DTC:

Use a scan tool to check whether the TCC slip values are consistent while driving at a steady throttle with the TCC applied. Apply and release the converter several times and check the slip RPM. Slip RPM at steady throttle should range between -10 to +30 for non-Electronically Controlled Capacity Clutch (EC³) torque converter applications and -10 to +60 on EC³ applications.

Watch the slip RPM each time the TCC applies. After the first time the TCC slips too much, pay attention to how often it occurs on each subsequent apply. If there's too much slip on every apply, inspect the TCC hydraulic system for leaks (all TCC seal rings, gaskets, bushings, solenoids, converter. Replace the damaged or faulty components).

If the slip isn't consistent with every TCC apply, check the TCC pressure regulator valve in the valve body for side-loading.



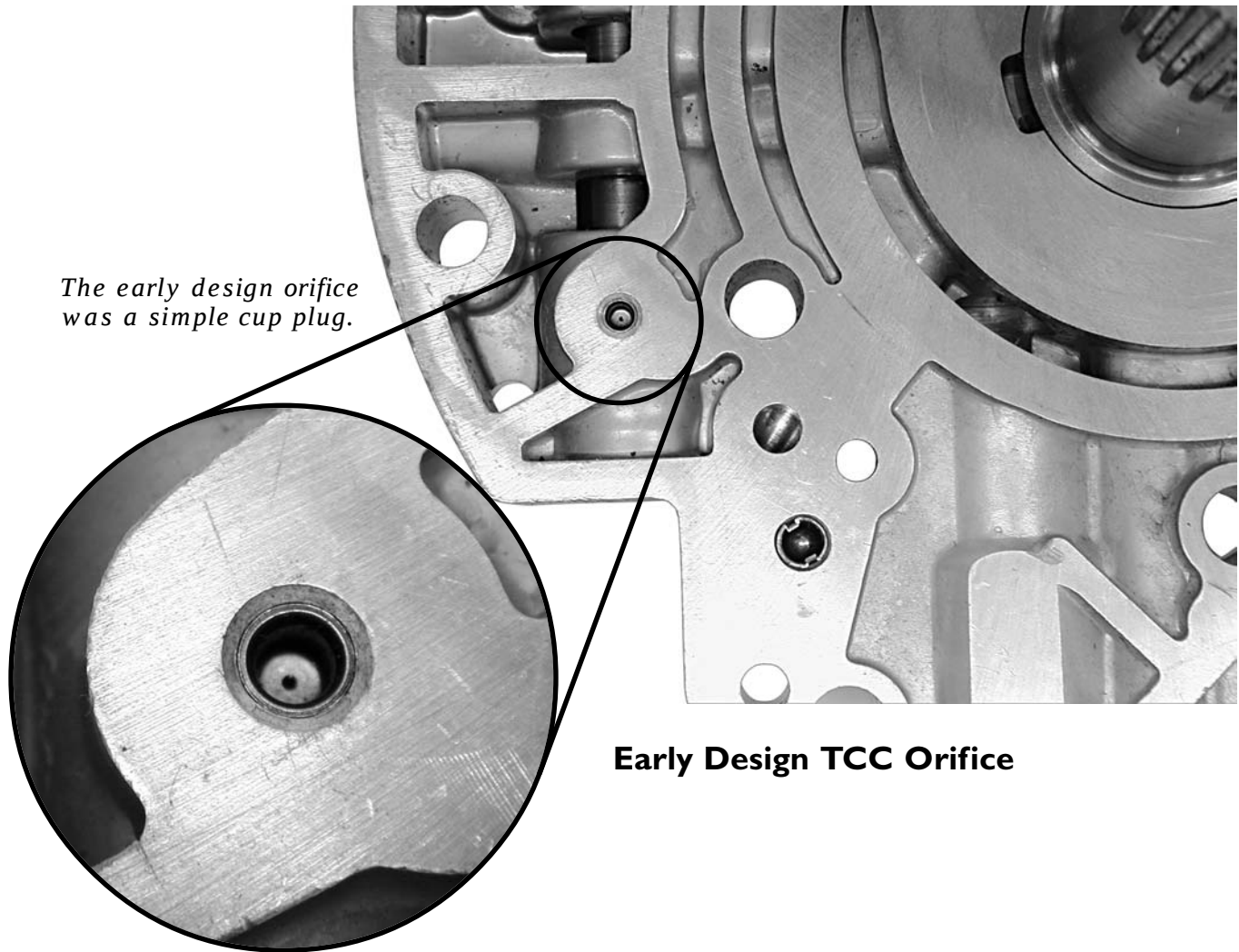
This is a very common problem and very often the valve body bore is worn, allowing the valve to cock in the bore. This reduces the amount of TCC apply pressure, resulting in excessive TCC slip. If a possible side loading occurs, replace the valve body or install a TCC pressure regulator valve kit readily available from many aftermarket companies. GM no longer produces new valve bodies as service parts: All valve bodies are now serviced as remanufactured valve bodies only.

If no damage is present and you are confident a TCC pressure regulator valve side loading isn't present, replace the TCC PWM solenoid.

4L60E; 1997-on

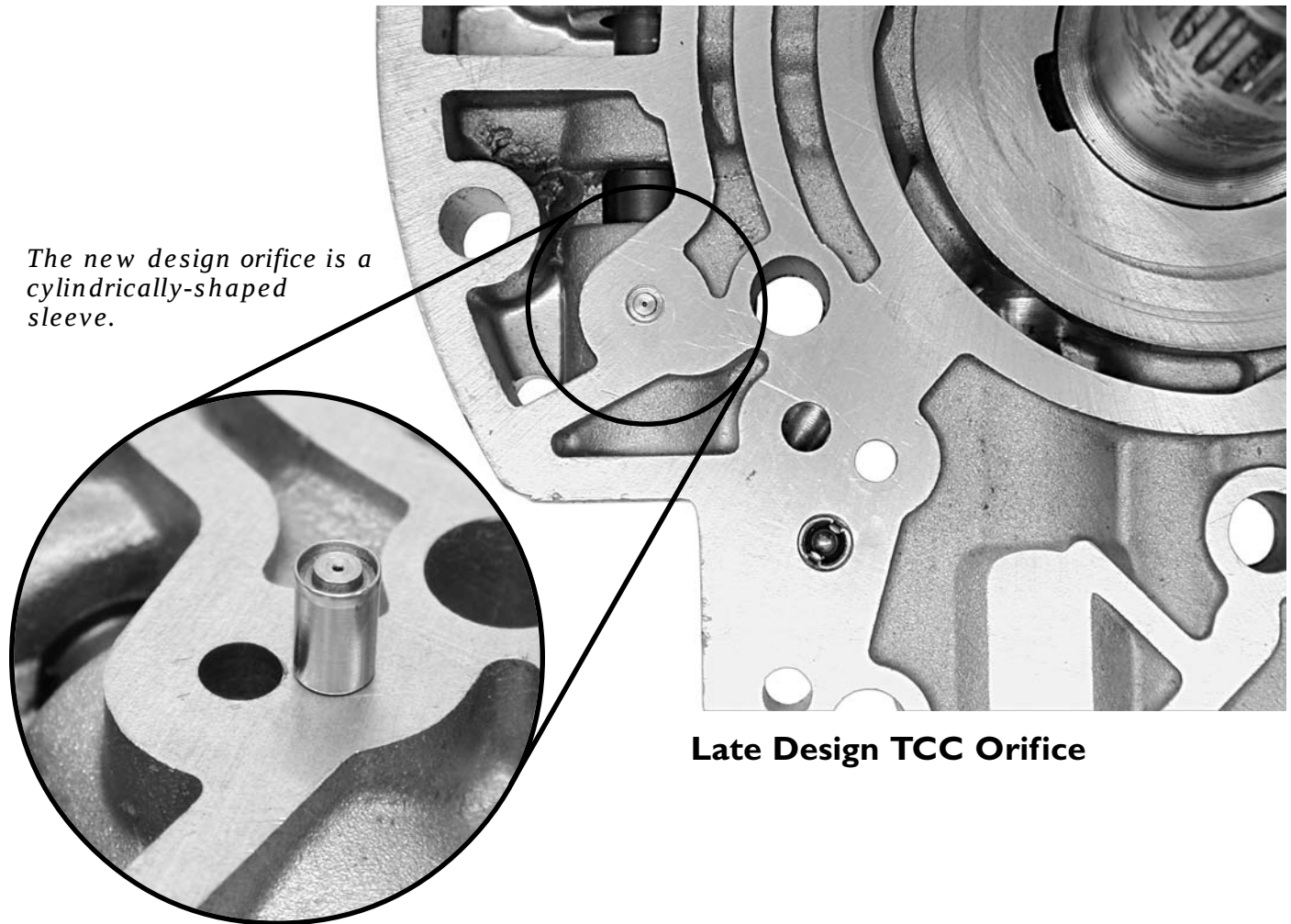
New TCC Orifice

The 1997-and-later stator supports use a new design orifice for TCC solenoid feed. This new orifice consists of a metal housing with a plastic insert.



4L60E; 1997-on

New TCC Orifice (continued)



The new design orifice is a cylindrically-shaped sleeve.

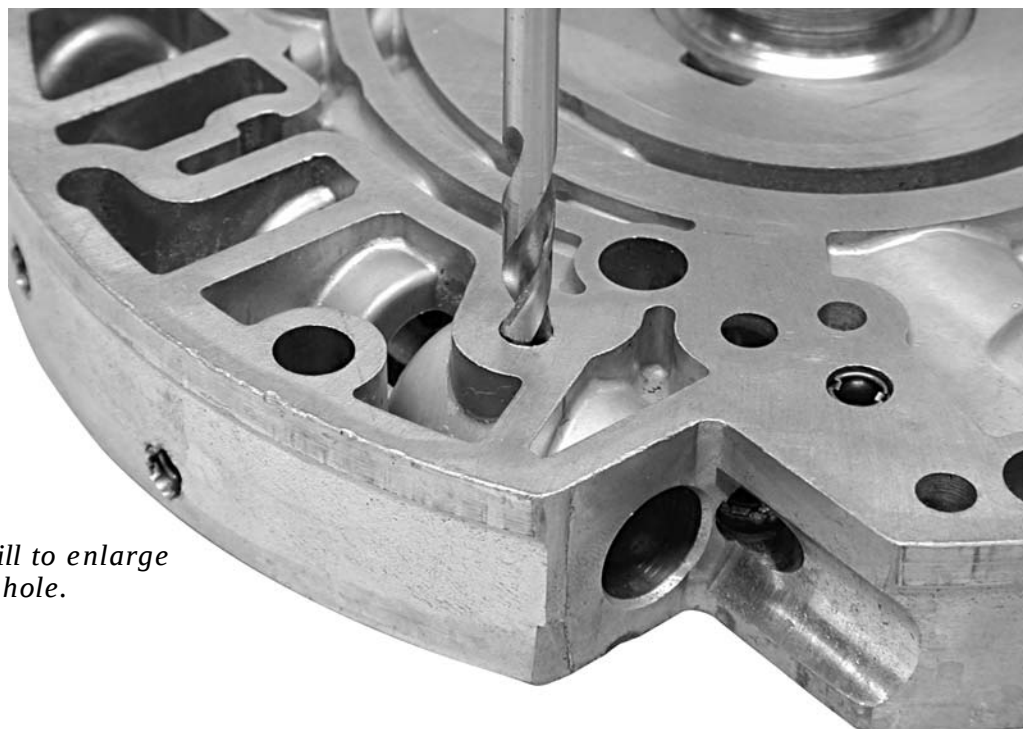
Late Design TCC Orifice

Under severe overheating conditions, the plastic insert can melt, clogging the orifice. Currently, the orifice isn't serviced separately, which gives you two choices:

1. You can replace the stator support with an earlier PWM support.
2. You can replace the orifice with an orificed cup plug. The cup plug used in earlier supports is too small for the bore, but you can use a larger plug. To do this you first need to enlarge the existing hole.

4L60E; 1997-on

New TCC Orifice (continued)



Use a 1/4" drill to enlarge the existing hole.

Use part number 8628864 for the new orifice.



4L60E; 1997-on

New TCC Orifice (continued)



Drive the new orificed plug into the newly drilled hole, just below flush.

IMPORTANT The orifice in the new plug is too small. Always enlarge it to 0.028".

4L60E

No 2nd, 4th and Reverse

Many 1997-99 4L60Es may lose reverse, 2nd and 4th gears. This is caused by a change in the manufacturing process for the sun gear reaction shell. During production, the radius of the area attaching the splines on the shell to the shell housing was reduced. This leads to a fatigue failure of the shell.



Here's how the sun shell should look

This is how the sun shell looks when it strips out



4L60E

No 2nd, 4th and Reverse (continued)

GM increased the radius of this area for added strength. To repair this condition, replace the shell. The part number for the updated shell is the same as the old shell. What's more, GM didn't purge the faulty parts from inventory, so you may not get the updated part when you order it.

The best way to tell if your part is the updated one is by checking the ID stamped inside the shell. The ID consists of a letter and three numbers. If your shell begins with the letters A or B, you have the old-style shell. The updated shells begin with the letter W.

The GM part number for the sun gear shell is 8683439.



4L60E/4L80E

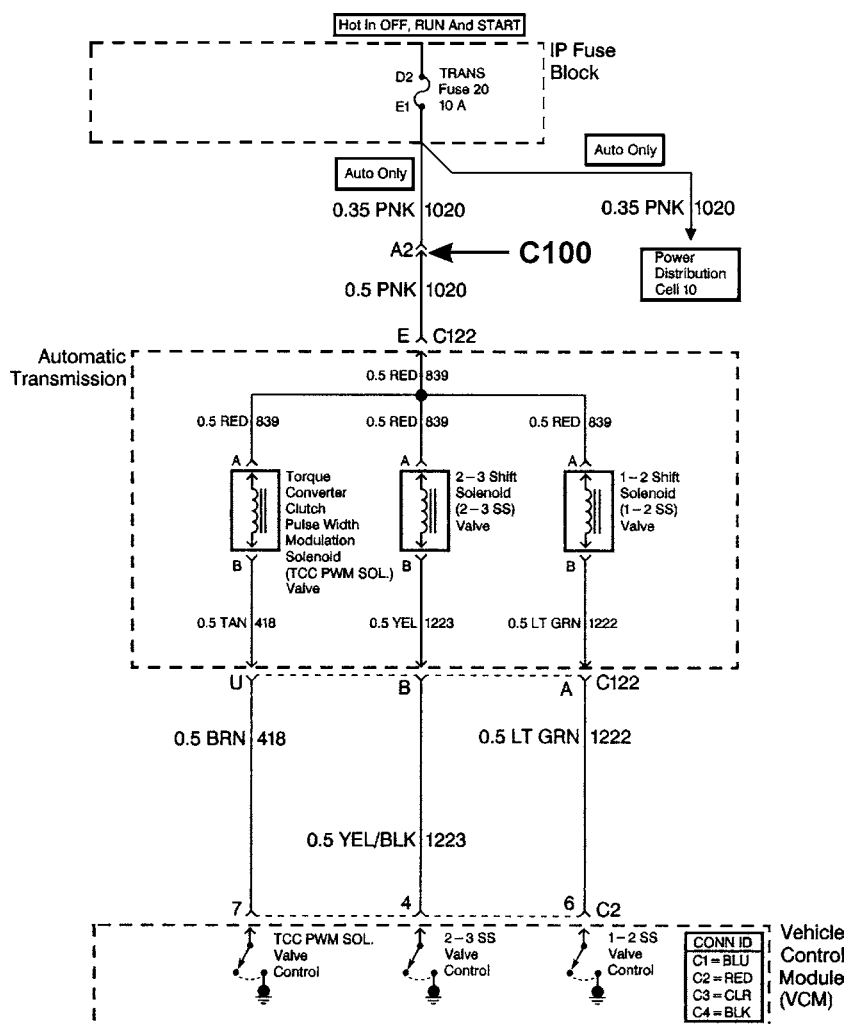
Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860

4L60E/4L80E transmissions may exhibit any or all of these trouble codes and driveability problems:

- P0740 — TCC Solenoid Electrical Fault
- P0753 — 1-2 Solenoid Electrical Fault
- P0758 — 2-3 Solenoid Electrical Fault
- P0785 — 3-2 Solenoid Electrical Fault
- P1860 — TCC PWM Solenoid Electrical Fault

- 4L80E applications fail to shift, or will drop into second gear intermittently. The customer may complain that the “vehicle is going to neutral at higher road speeds.”
- 4L60Es fail to shift and may drop or stay in 3rd gear when the shift lever is in the OD position.
- Any or all of these codes may set: P0758, P0785, P1860, P0753, P0740. If the problem is intermittent, the system may not set a code.

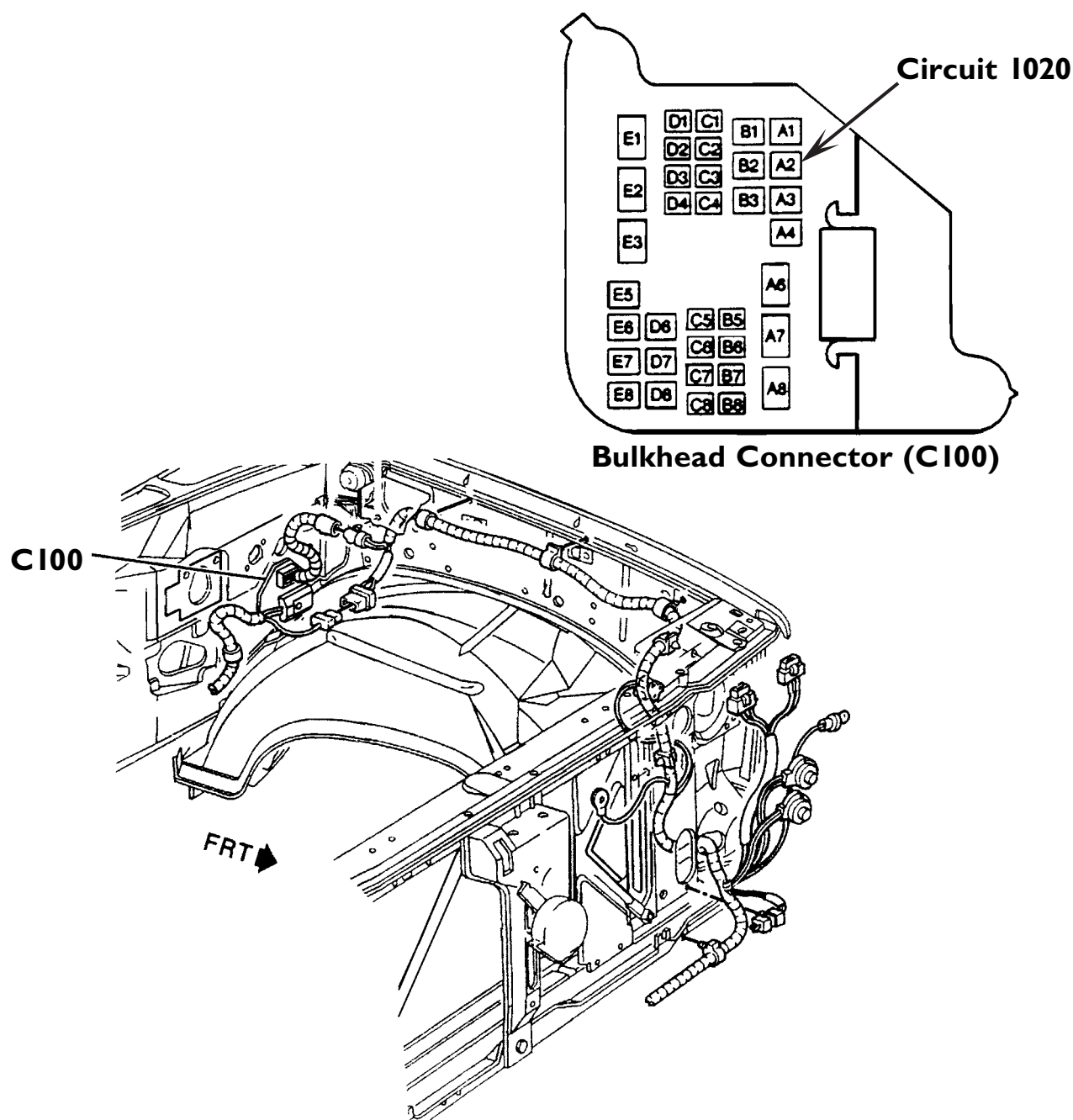
This problem is caused by a poor crimp on one of the terminals for circuit 1020.



4L60E/4L80E

Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)

Generally the crimp concern is cavity A2 at the bulkhead connector or (C100) on later model applications at connector C2, pins F2 or E2 of the UBEC (Underhood Bussed Electrical Center, used on many trucks).



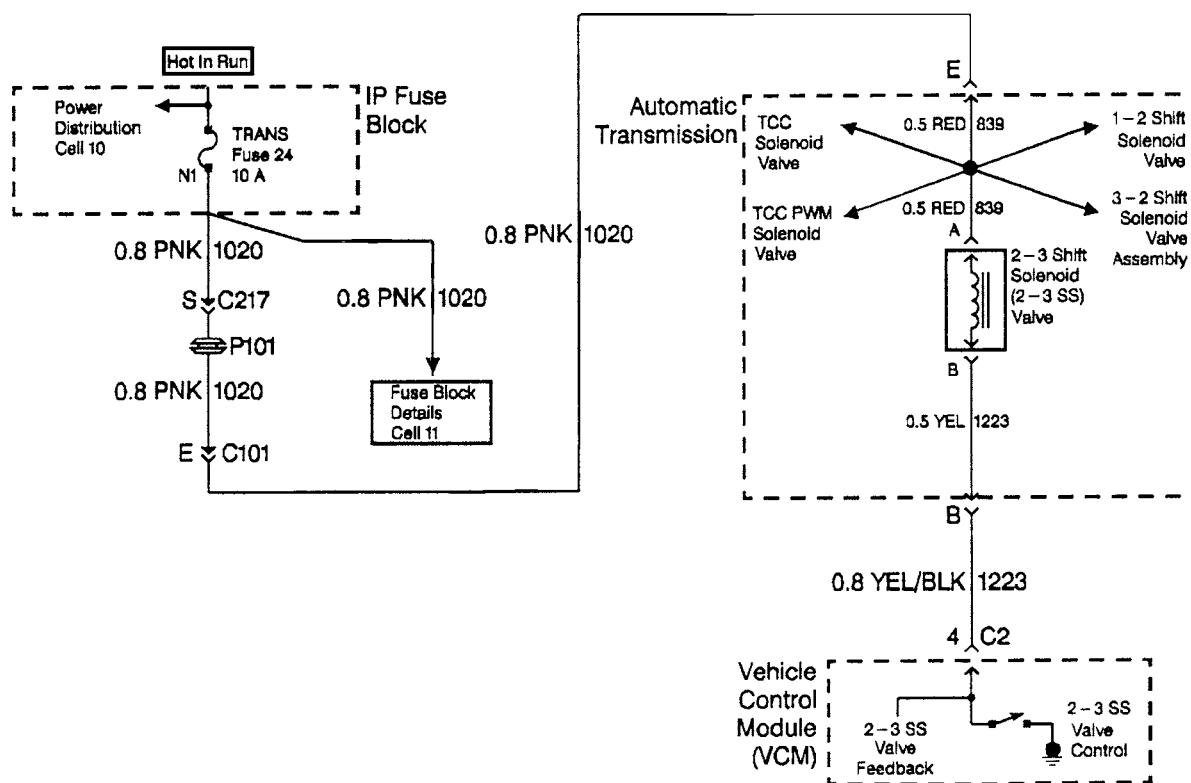
4L60E/4L80E

Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)

On VCM applications, if a code sets for only one or two solenoids or circuits, inspect the weatherpack seal at the VCM. You may find the seal is mispositioned, allowing water into the VCM connector. This may cause severe corrosion, which can degrade solenoid performance and cause codes to set. If corrosion is present, the VCM and the female terminals may require replacement.

The ignition switch is also a common source of any or all of these problems. This holds true for the redesigned, 3-contact ignition switches used on the S-10s.

To isolate this as a possible source of the problem, monitor pin voltage on circuit 1020 when the condition occurs. If the voltage drops below battery voltage, inspect the pins listed or the ignition switch for possible problems. If you find an open in the UBEC, you'll have to replace it, as it can't be disassembled and reassembled effectively.



4L80E

No Reverse / Slips in Reverse

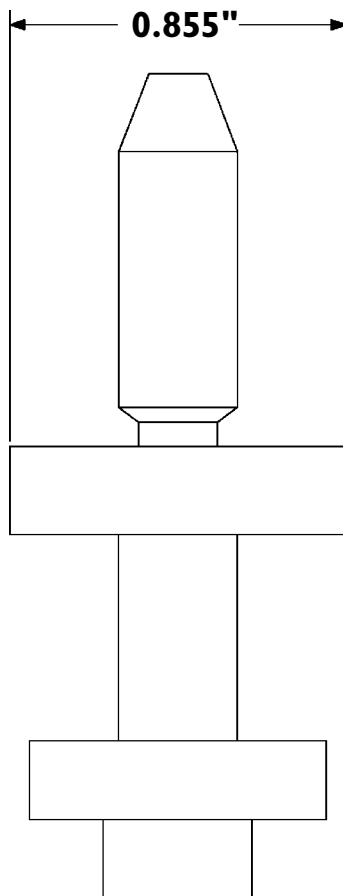
No reverse or a slip in reverse after a rebuild can be caused by installing a replacement boost valve bushing that doesn't match the original valve.

Some late-model pumps use a smaller boost valve than earlier models. Installing a smaller, late-model boost valve in a larger, early replacement bushing creates a large leak in the reverse apply circuit.

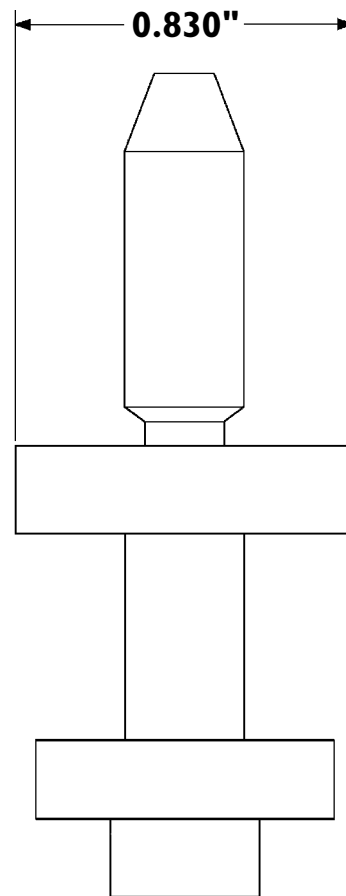
For now, the late-model valves and bushings aren't available separately, so if you have a smaller valve that needs replacement, you'll have to replace the valve-and-bushing assembly with the early set. These early design components are available separately.

Early Valve — 8680549

Early Bushing — 8682856



Early Valve



Late Valve

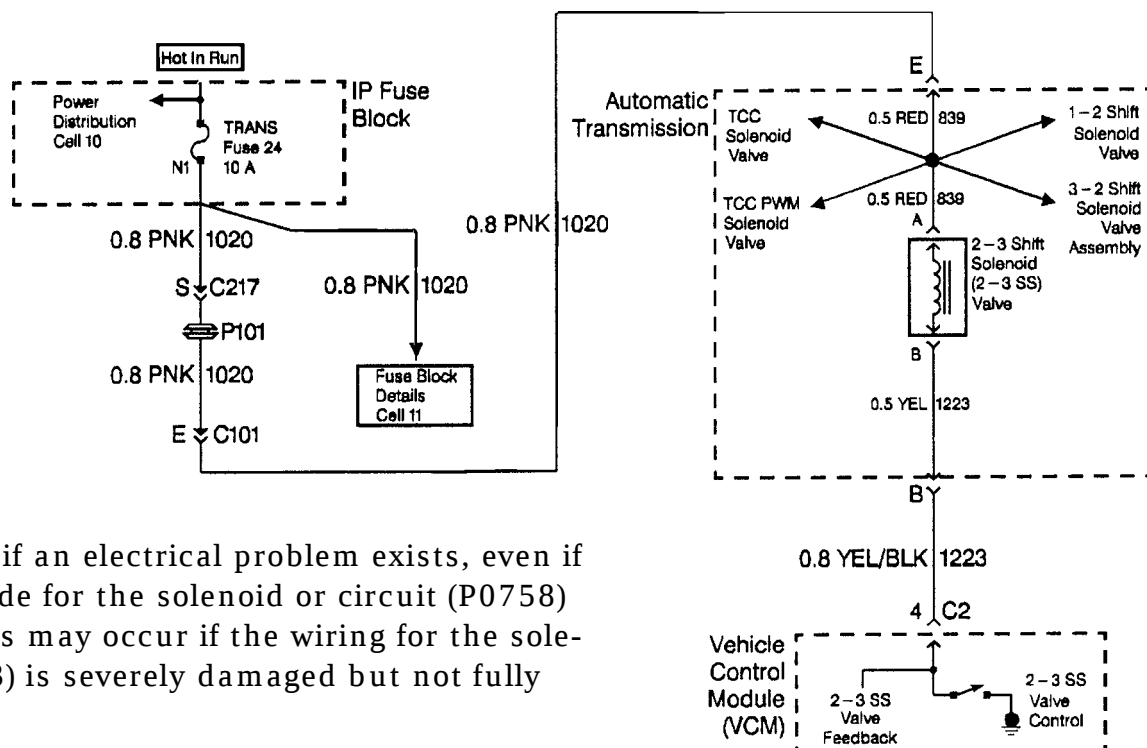
4L80E

Possible P0756, 2-3 Shift Solenoid Performance

Some 4L80E transmissions may intermittently set a P0756 code, which indicates performance problem in the 2-3 shift solenoid.

The parameters for setting a P0756 are:

- No TPS, VSS, TCC, PSM, or shift solenoid codes are set in memory
- VSS greater than 5 MPH
- TPS angle 15–20% and steady
- MAP value is steady between 0–105 kPa
- Calculated engine torque is between 5–450 ft-lbs
- Engine speed is above 450 RPM
- Transmission fluid temperature is between 68°F and 266°F
- The PCM/VCM commands a specific gear and then calculates a range other than the desired ratio has been achieved. The computer monitors N/V ratio (speed ratio; engine speed divided by transmission output speed) and determines the shift didn't occur. If the speed ratio doesn't drop more than 0.3 when the computer commands the shift to 3rd, and the condition exists longer than 1.5 seconds, the computer will set the code.



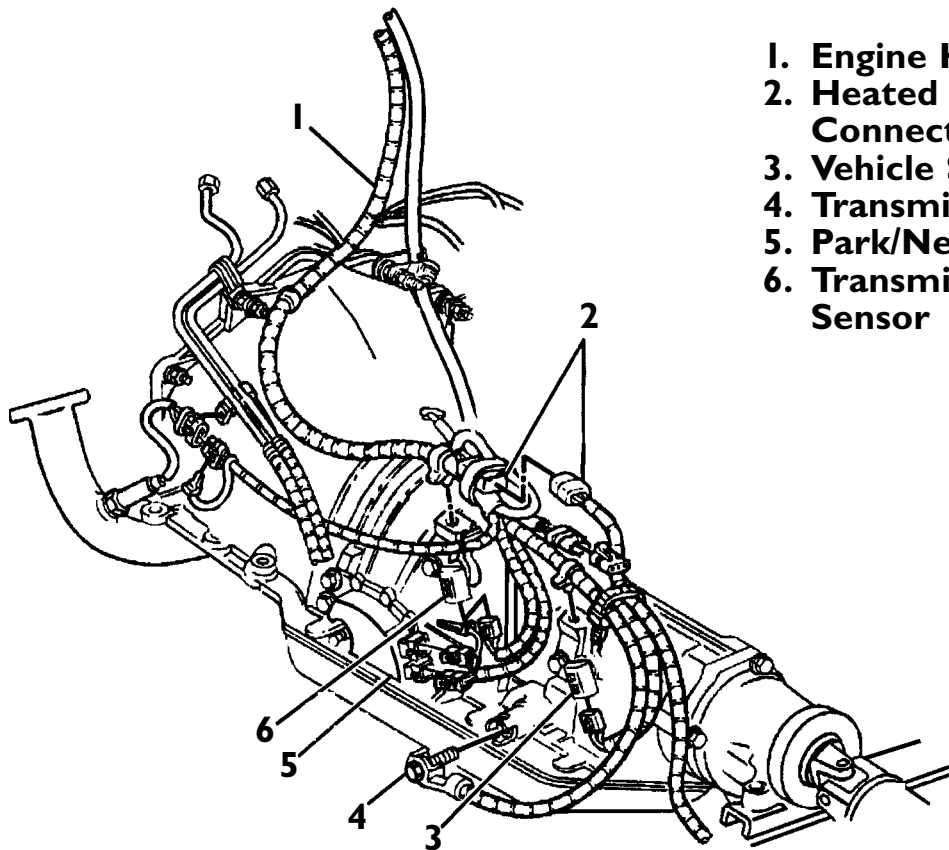
P0756 may set if an electrical problem exists, even if an electrical code for the solenoid or circuit (P0758) doesn't set. This may occur if the wiring for the solenoid (CKT 1223) is severely damaged but not fully severed.

4L80E

Possible P0756, 2-3 Shift Solenoid Perf. (cont)

If there's resistance in the wiring, such as corrosion or a bad connection, current flow through the solenoid will be very low. Low current flow through the solenoid will cause the solenoid to fail hydraulically when the computer energizes it. If the 2-3 solenoid fails to hold pressure, the ratio will be incorrect.

The typical cause for this code is the wiring is incorrectly routed. The harness is designed to be routed over the top of the transmission bell housing. In many cases the harness is incorrectly positioned, allowing it to wedge between the fuel lines and the body. This results in severe damage to the wiring harness, as the pinch weld on the body wears through the conduit and wiring insulation.



1. Engine Harness
2. Heated Oxygen Sensor Connectors
3. Vehicle Speed Sensor
4. Transmission Connector
5. Park/Neutral Position Switch
6. Transmission Input Speed Sensor

If code P0756 is set, inspect the harness, and repair as necessary. If there's no damage to the harness, other possible causes include:

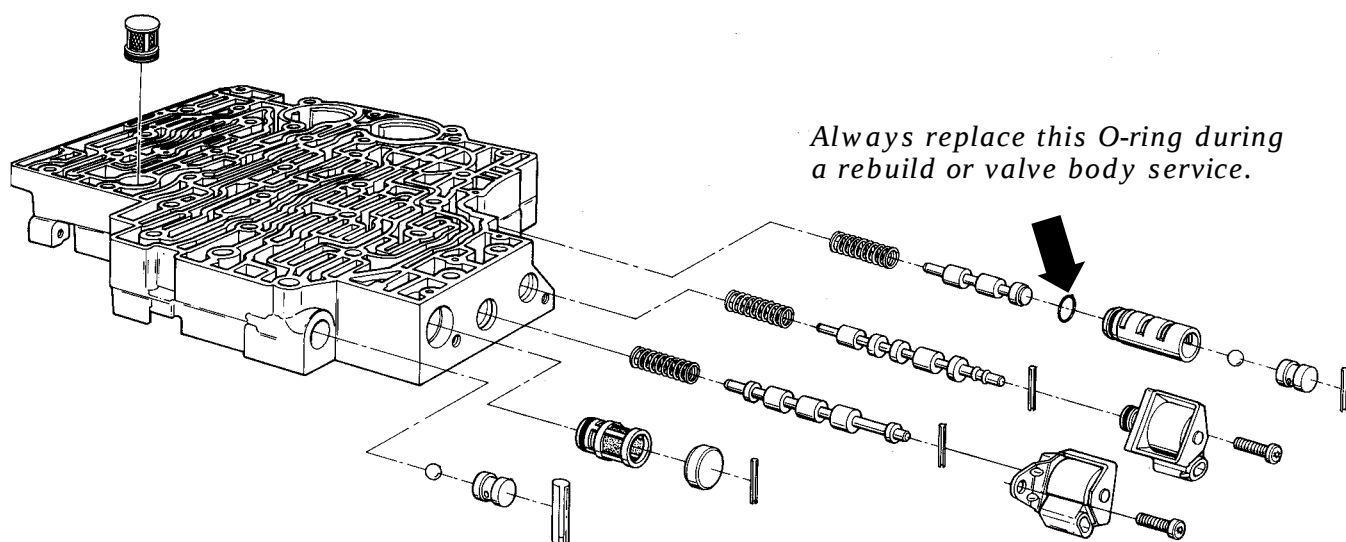
- faulty 2-3 shift solenoid
- sticking 2-3 shift valve
- loss of line pressure feed to the direct clutch
- faulty/damaged direct clutch
- insufficient feed to the solenoid

4L80E

Second Gear Starts

A second gear start complaint (that often goes away when you step on the gas) is often caused by poor shift solenoid A pressure. This can be caused by a leaking shift solenoid or poor feed to the shift solenoid.

One of the often overlooked areas for this leak is the O-ring on the #11 checkball capsule bushing. This bushing is located at the end of the 3-4 shift valve bore, and serves as a seal for solenoid A pressure. Always replace this O-ring during a rebuild or valve body service.



4L80E

Lube Problems; Parts Interchange

In 1997, General Motors altered the lube circuit of the 4L80E. The 1991-through-96 models had two lube circuits, both originating from the return cooler line. The front lube circuit started at the return cooler line, went up to the pump, then flowed toward the rear, providing lubrication for the overdrive section. The rear lube, also originating from the return cooler line, flowed from the output shaft, forward. This circuit lubed everything from the output shaft-to-case bushing to the forward clutch hub.

In 1997, GM broke the lube circuit into three separate sections, each with its own lube source. Front lube now has its own circuit. Rather than using cooler return oil, front lube is provided by a new circuit that uses converter charge oil. Another new circuit is for the rear lube. This new circuit uses oil from the actuator feed limit circuit, and only lubes the case bushing.

Cooler return oil is now solely responsible for lubricating the main gear train; but rather than the oil flowing from the rear all the way to the forward clutch hub, it now flows from the center support, then flows both forward and rearward.

In this section we'll look at all three lube circuits, and compare the earlier components with the revised parts used in the 1997-and-later units. But before we compare these components, you must be aware of the differences in the cases. The later case has a cooler return line that enters the center of the case, rather than at the front. Obviously, the early and late cases are not interchangeable.

Front Lube Circuit

Front lube is provided through a new circuit that comes from converter charge. This is provided by a slot created in the stator support. Both the pump and stator support were changed to provide for this circuit. Early and late pump assemblies aren't interchangeable. However, the late pump *will* work in an early unit. Also, GM has replacement pumps and stator supports that look very similar to the later parts. Make sure you know what you're using before you install the parts.

4L80E

Lube Problems; Parts Interchange (continued)

Front Lube Circuit (continued)

The pump for the 4L80E was changed in 1997 as part of a lube modification. In addition, GM came out with a new pump assembly to replace the early (1991 – 96) pump assembly. This replacement uses the same stator support castings as the late stator support, so never use the casting numbers to identify which stator support you're using.

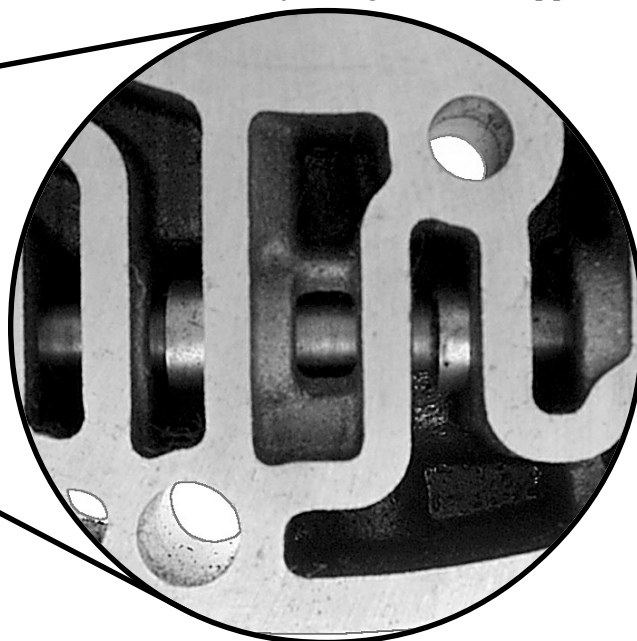
The difference is in the bathtub: The late stator support is drilled; the early replacement isn't.

Any pump body will work in an early transmission, but it must be bolted to the early-design stator support. Never swap the stator supports between early and late transmissions. Never use an early pump body or stator support in a late transmission.

1991 – 96 (Early) Stator Support



The large single channel indicates this is an early-design stator support.



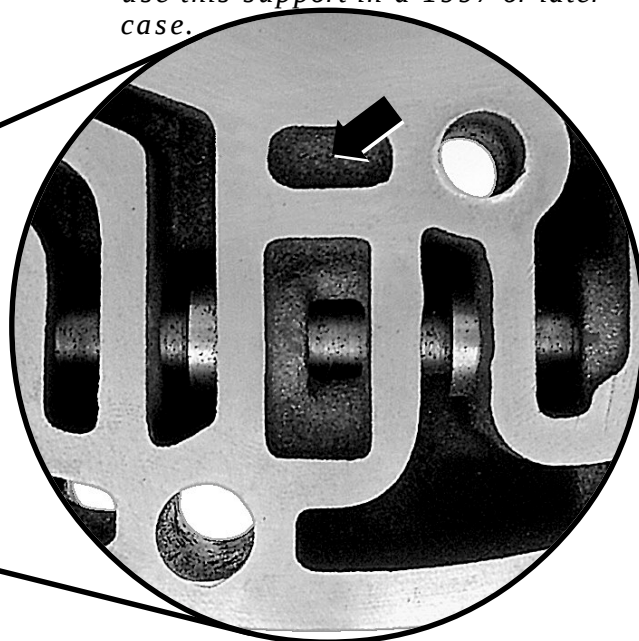
4L80E

Lube Problems; Parts Interchange (continued)

1991 – 96 Replacement Stator Support



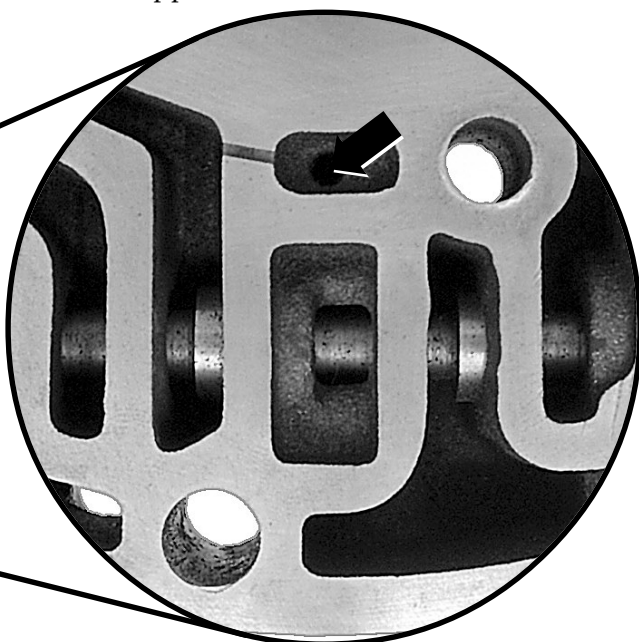
The bathtub in the replacement stator support isn't drilled. Never use this support in a 1997-or-later case.



1997 – on (Late) Stator Support



The bathtub in the late stator support is drilled. Never use this support in a 1991 – 96 case.



4L80E

Lube Problems; Parts Interchange (continued)

1991 – 96 Pump Body



*Never use this pump body
with the late stator support
and transmission case.*



4L80E

Lube Problems; Parts Interchange (continued)

**1991 – 96 Replacement and
1997 – on Pump Body**



*This pump body will work
with both early and late
stator supports.*

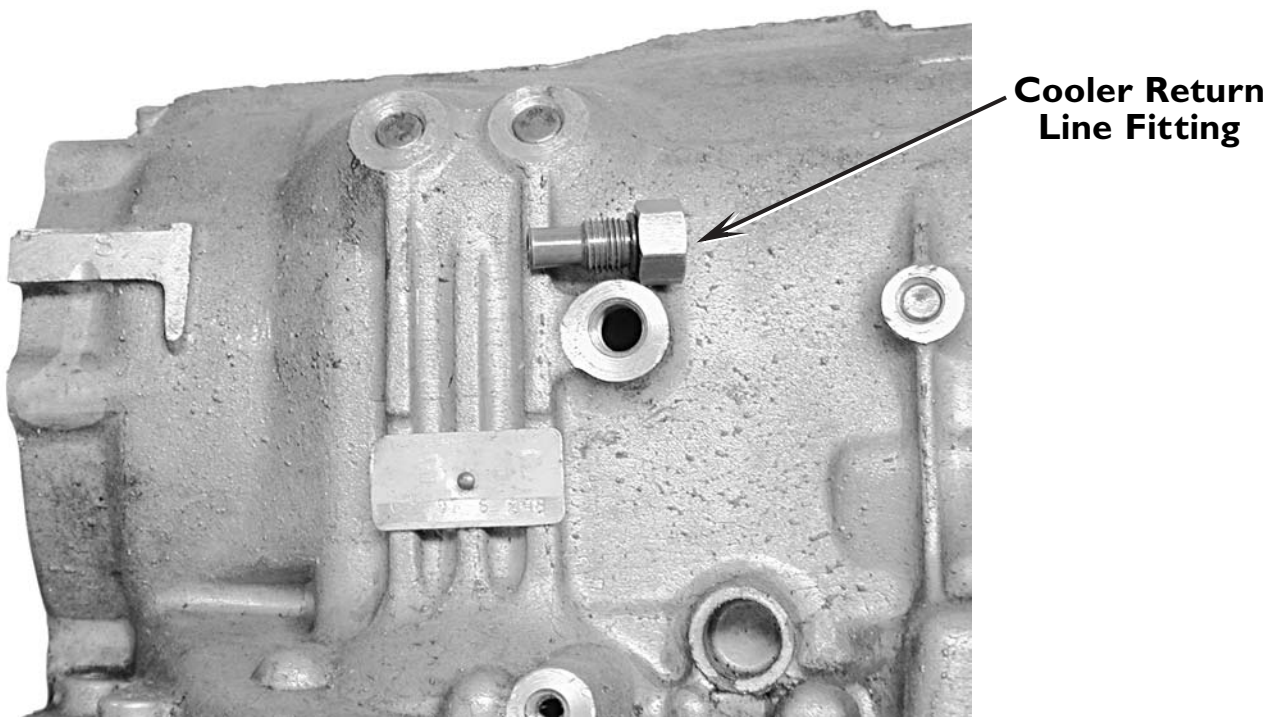


4L80E

Lube Problems; Parts Interchange (continued)

Center Lube Circuit

Center lube comes from the cooler return line. It enters the case, directly to the center support. It flows both forward to the forward clutch hub, and rearward to the front of the output shaft.



Here are the parts that were changed, and how they affect the lube circuit:

4L80E

Lube Problems; Parts Interchange (continued)

Center Support

The center support has a new port that allows oil from the cooler return line to enter the support. Obviously, the early and late supports aren't interchangeable.

1991 – 1996



1997-On



Cooler Return Passage

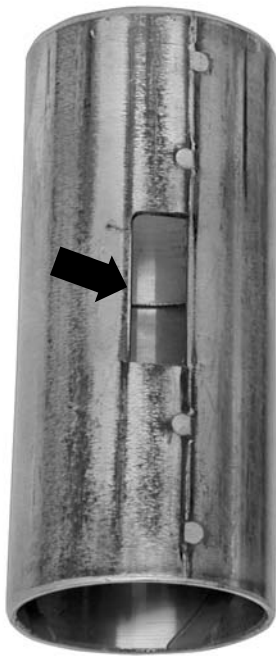
4L80E

Lube Problems; Parts Interchange (continued)

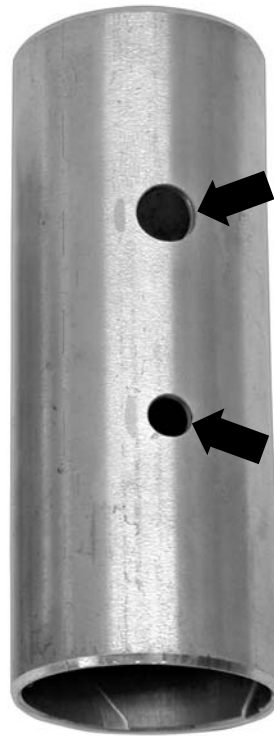
Center Support Bushing

The obvious difference between the early and late bushings is their height. However, interchanging these bushings will reduce — or completely block off — lube flow to all sections on the gear train.

1991 – 1996



1997-On



4L80E

Lube Problems; Parts Interchange (continued)

Sun Gear Tube

The sun gear tube now has a wider groove, which takes oil from the center support and feeds it to the intermediate roller clutch.



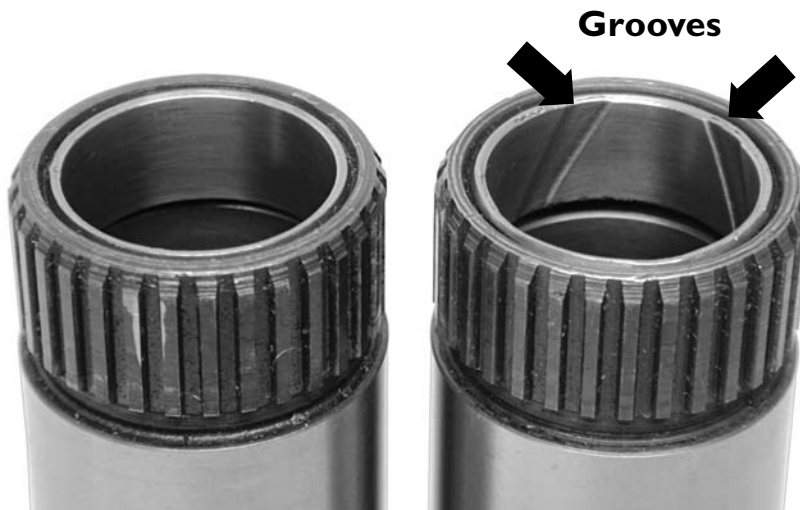
1991 – 1996



1997-On

CAUTION

The early tube uses solid bushings; the late tube uses grooved bushings. Using solid bushings in the late tube will cut off lube oil to the forward clutch hub and the rear ring gear.



1991 – 1996

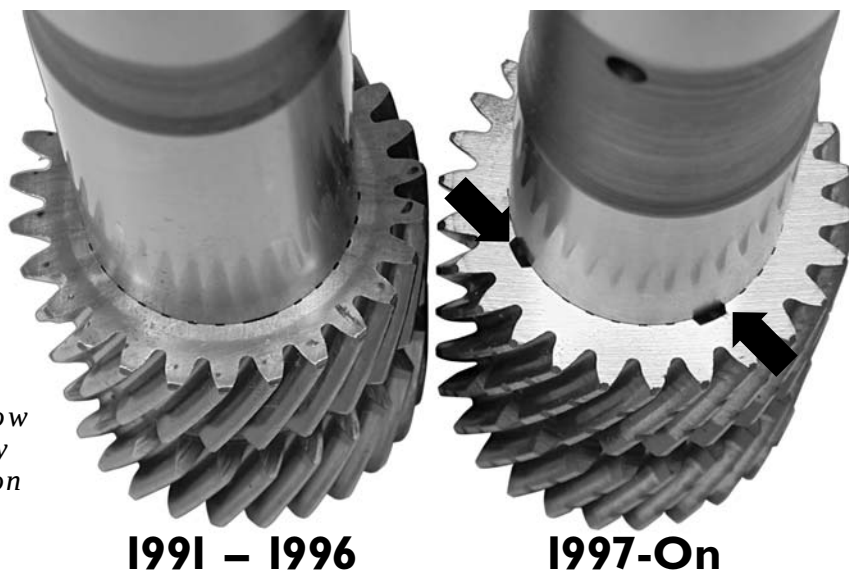
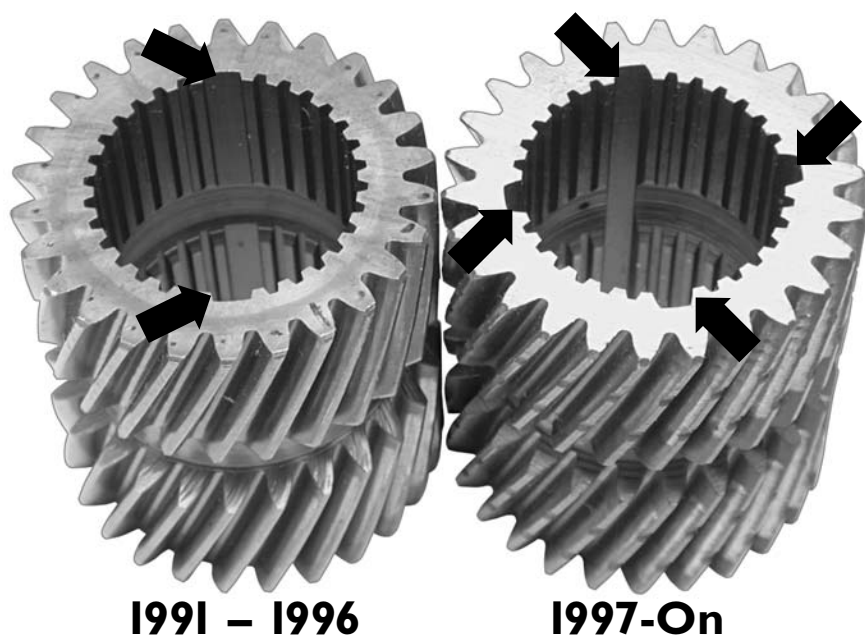
1997-On

4L80E

Lube Problems; Parts Interchange (continued)

Sun Gear

The late-design sun gear has four lube slots, versus the earlier gear, which had two. At first it seems as though this difference is negligible; however, when you compare how the two gears match up with the sun gear tube you can see that the tube completely cuts off oil flow between the tube and gear. These gears are not interchangeable.



Notice the tube cuts off all flow through the slots on the early gear; the slots remain open on the late assembly.

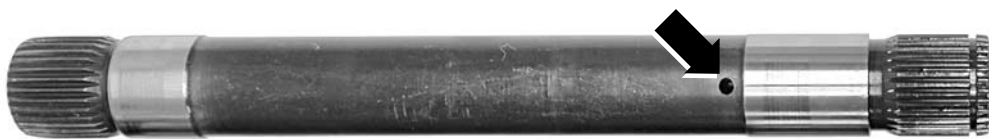
4L80E

Lube Problems; Parts Interchange (continued)

Rear Ring Gear Shaft

The early shaft is hollow. It allows oil to flow from the output shaft to the forward clutch hub. The late shaft is solid. Using the solid shaft in an early unit will starve the forward clutch hub, center support bushing and intermediate roller clutch. Never interchange these shafts.

1991 – 1996



1997-On



Hollow

Solid



1991 – 1996

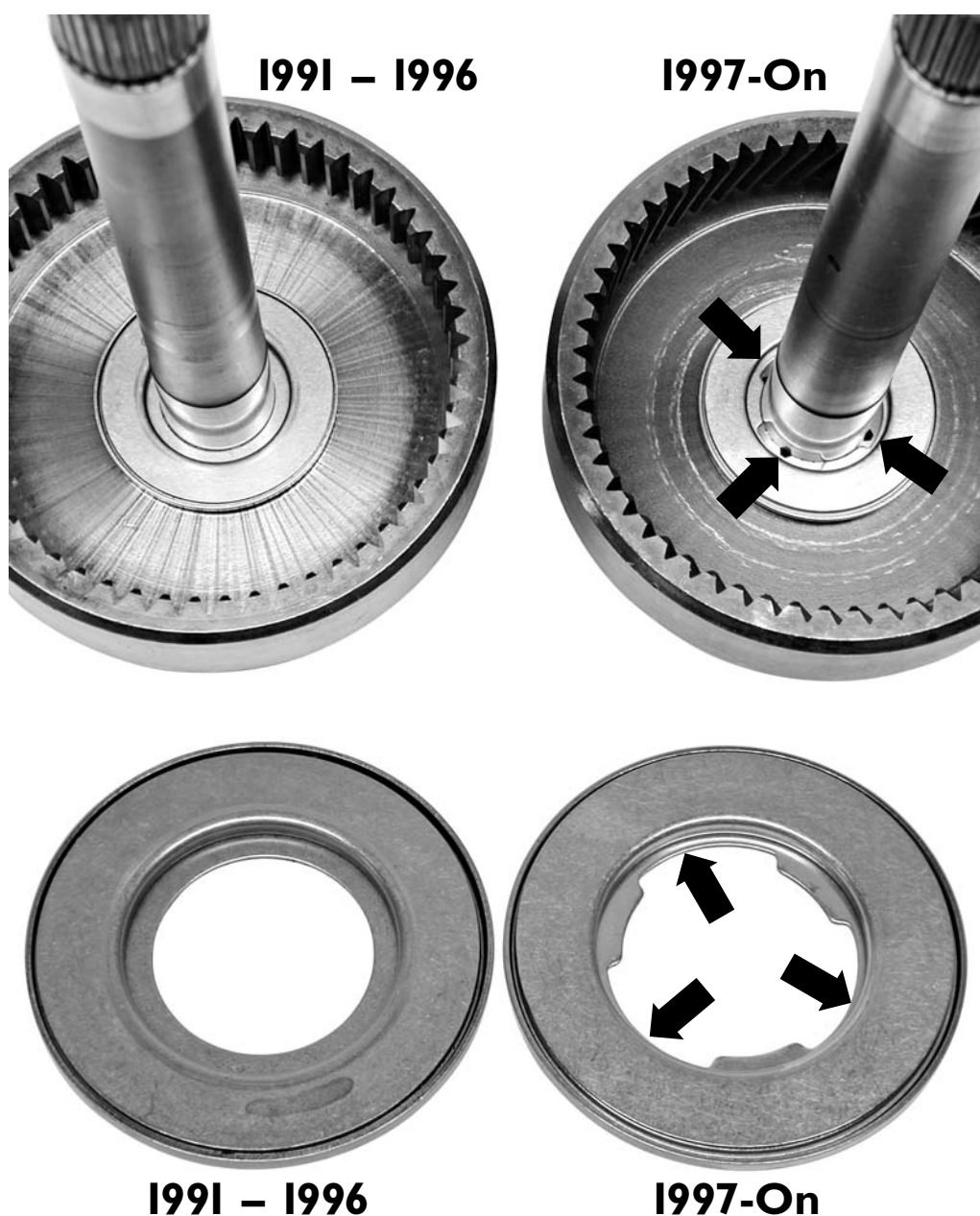
1997-On

4L80E

Lube Problems; Parts Interchange (continued)

Rear Ring Gear

The late rear ring gear has four lube slots that allow oil to flow to the bushing in the output shaft. Using the early gear will starve this bushing. Also, the front bearing for this ring gear has notches in it that allows for oil to flow to the notches in the gear. The late bearing will work on all models. The early bearing will only work on early models.

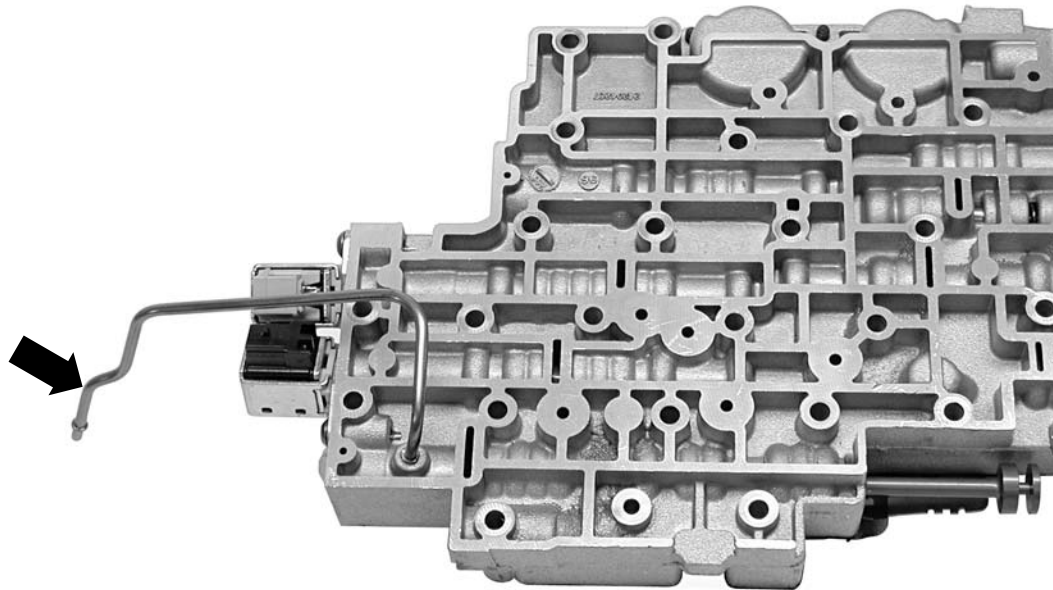


4L80E

Lube Problems; Parts Interchange (continued)

Rear Lube Circuit

Rear lube comes from the actuator feed limit circuit. It flows from the valve body, through a tube, to the case bushing.

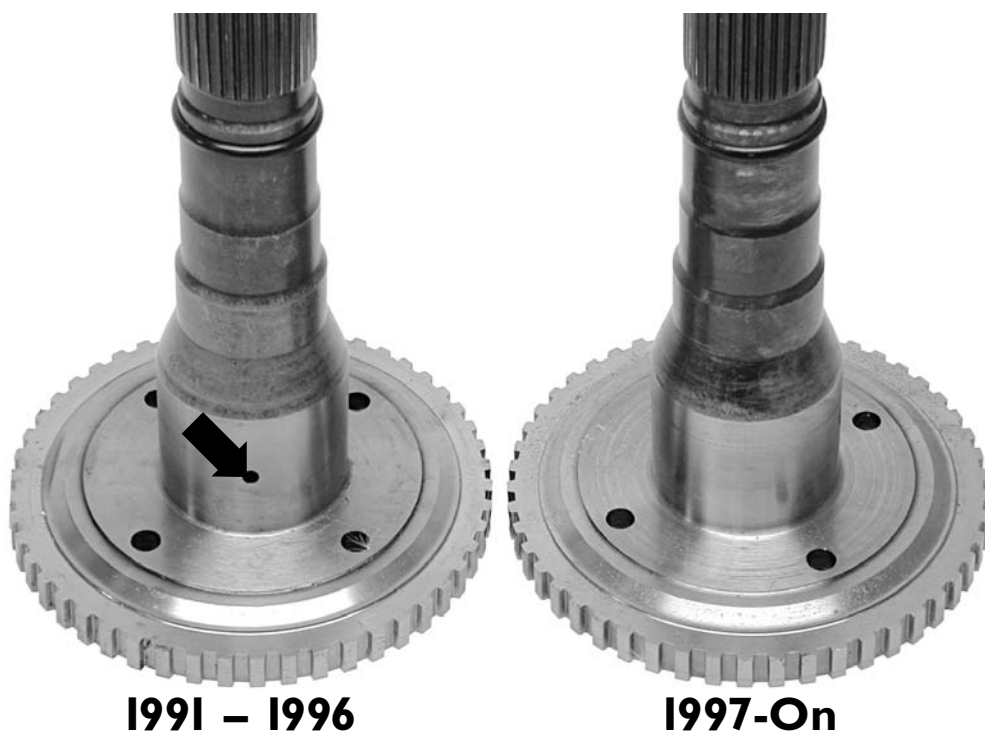


4L80E

Lube Problems; Parts Interchange (continued)

Output Shaft

The output shaft has a feed hole for gear train lube. The late shaft is solid. Using the late shaft on an early unit will starve the entire gear train of oil. Using the early shaft on a late unit will connect the center and rear lube circuits. These shafts aren't interchangeable.



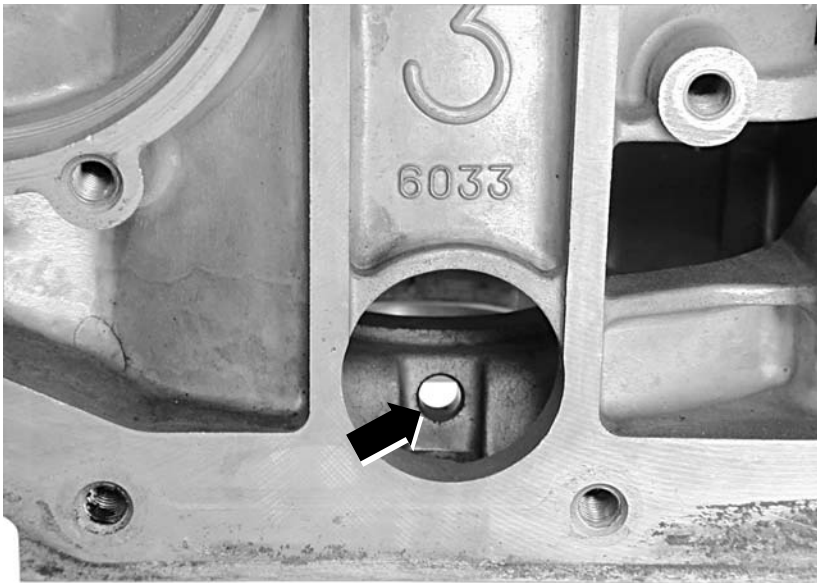
4L80E

Lube Problems; Parts Interchange (continued)

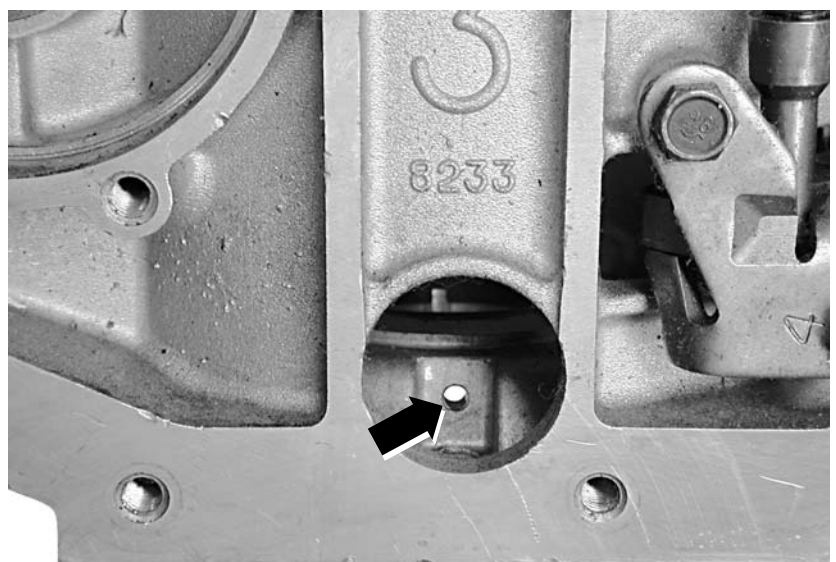
Case, Valve Body and Separator Plates

The case, valve body and separator plate were also changed. The case and valve body changes are obvious; the separator plate change is somewhat subtle.

These plates are not interchangeable. Interchanging these plates will completely starve some gear train components.



Early Case with Large Opening for Lube Tube



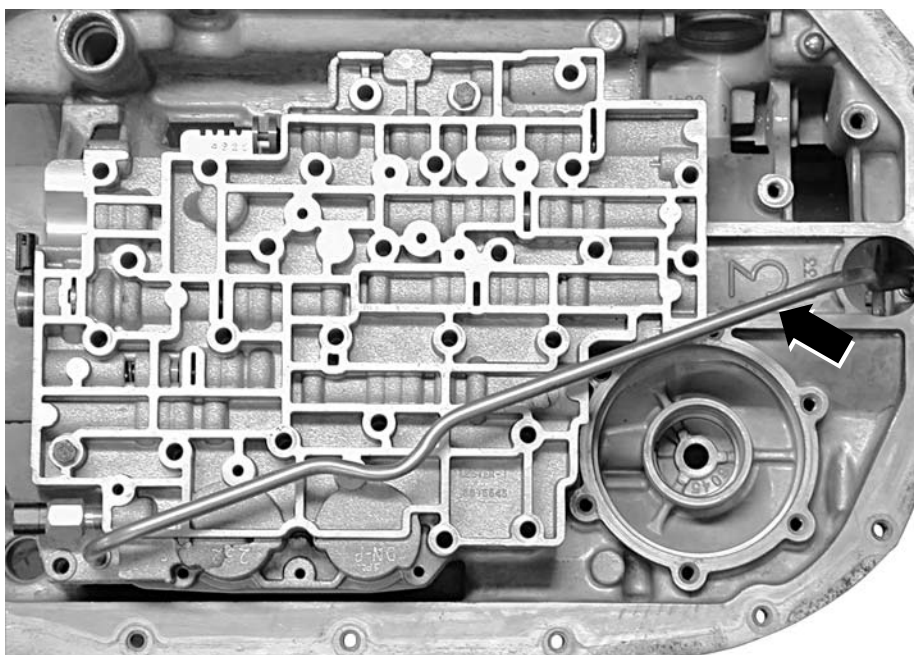
Late Case with Small Opening for Lube Tube

4L80E

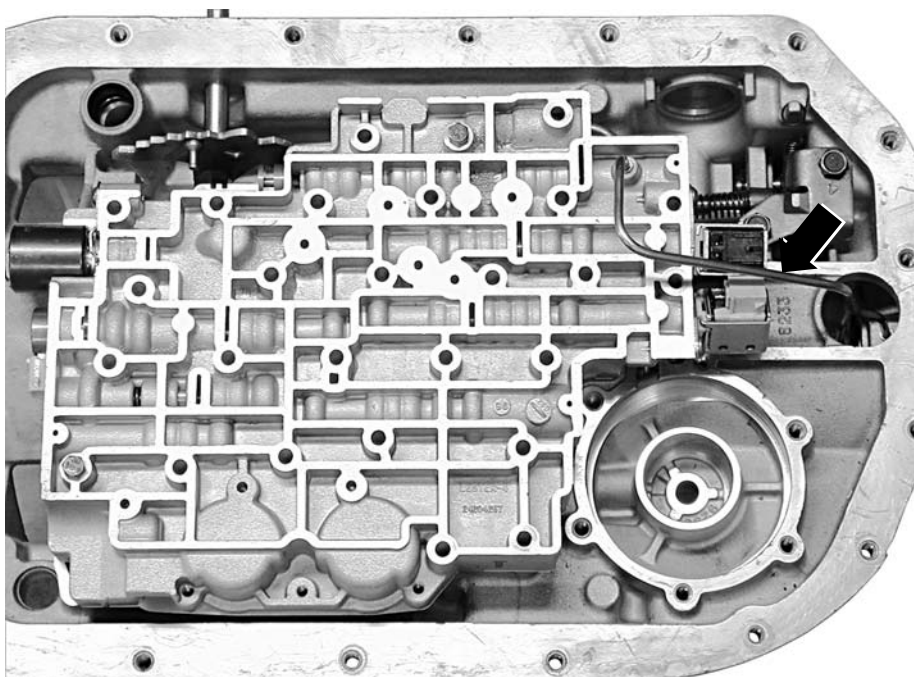
Lube Problems; Parts Interchange (continued)

Case, Valve Body and Separator Plates (continued)

Early Design with the
Large Lube Tube



Late Design with the
Small Lube Tube



4L80E

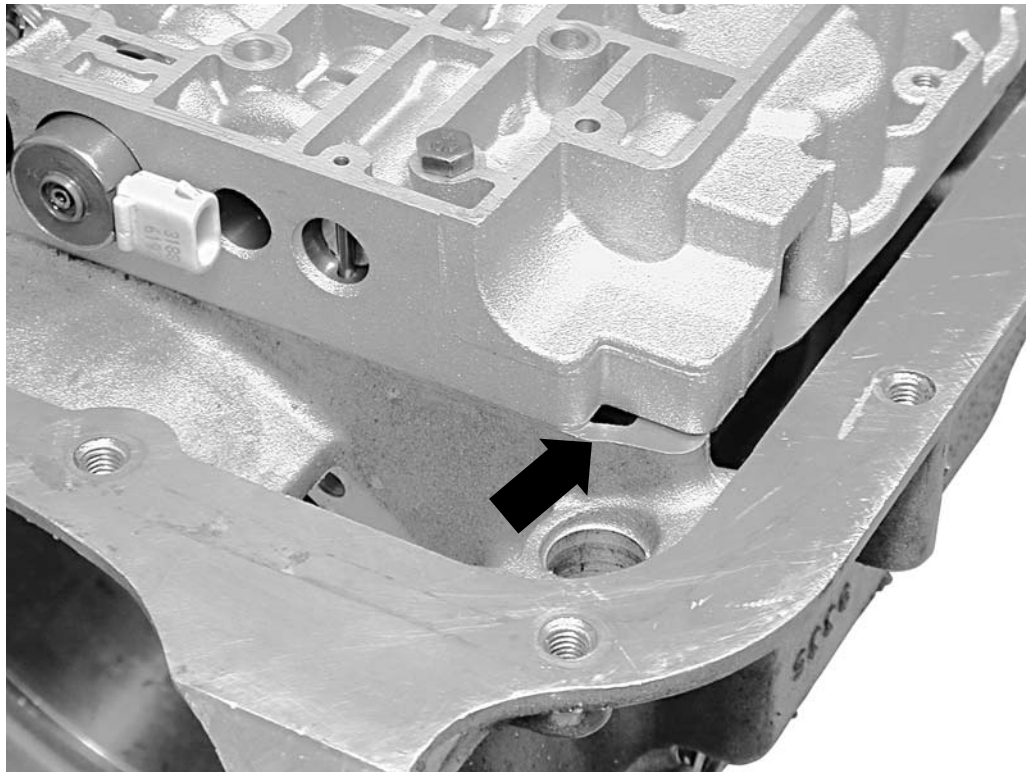
Lube Problems; Parts Interchange (continued)

Case, Valve Body and Separator Plates (continued)

You can create a serious mismatch by using the late separator plate with the early valve body and case.

The late separator plate and valve body are notched in the front, exposing a cavity in the case. On the late case, that cavity is void; it serves no purpose. On the early case, that cavity is cooler return, which provides gear train lube oil.

Using the late separator plate with an early valve body and case will dump lube oil into the sump, and starve the gear train.



4T40E/4T45E

Slips in 4th; No 4th; Slips in 3rd and 4th; No 3rd or 4th; Possible DTC P0730

Some 4T40E/4T45E transaxles may experience one of the following problems:

- Slips in 4th or no 4th
- Slips in 3rd and 4th or no 3rd or 4th
- Possible code P0730 set in memory

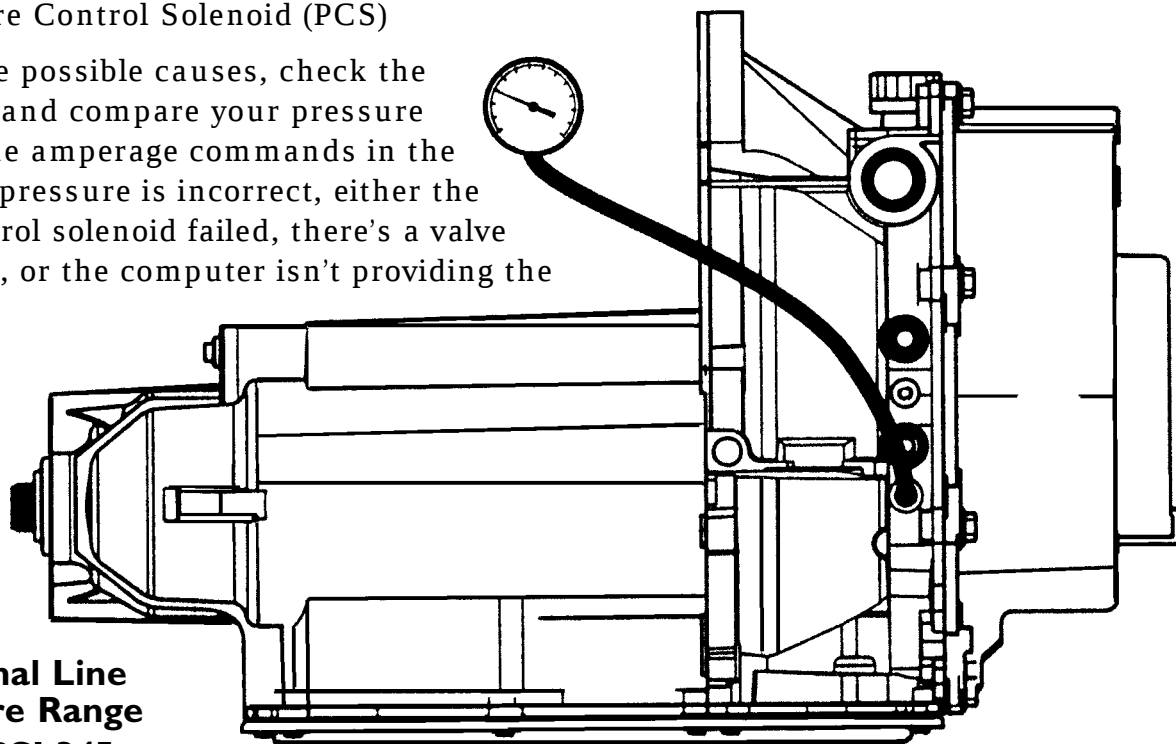
To diagnose this problem, monitor gear ratio on your scan tool. Typically you'll notice an incorrect gear ratio in 4th gear. You should notice this problem in 4th gear before the transaxle develops a ratio error problem in 3rd gear. This is because the torque to the clutches is nearly 100% in 4th but drops to around 60% in 3rd gear.

If the problem has been going on for a while, you'll see incorrect ratios for 3rd and 4th gears. The correct ratio in 3rd gear is between 0.91:1 and 1.07:1, while 4th gear ratio should remain between 0.61:1 and 0.72:1.

The most common causes for this problem are:

- Direct clutch piston seal delamination
- Pressure Control Solenoid (PCS)

To identify the possible causes, check the line pressure and compare your pressure readings to the amperage commands in the tables. If line pressure is incorrect, either the pressure control solenoid failed, there's a valve body problem, or the computer isn't providing the proper signal.



**Nominal Line
Pressure Range**

**50 – 160 PSI 345 –
58 – 186 PSI 400 –**

4T40E/4T45E

***Slips in 4th; No 4th; Slips in 3rd and 4th;
No 3rd or 4th; Possible DTC P0730 (continued)***

Pressure Control Solenoid Current (Amps)	Line Pressure (PSI)
0.00	152 – 160
0.10	149 – 151
0.30	141 – 143
0.50	124 – 127
0.60	111 – 115
0.70	97 – 101
0.80	81 – 84
0.90	64 – 67
0.95	56 – 58
1.00	50 – 51
1.05	50
1.10	50

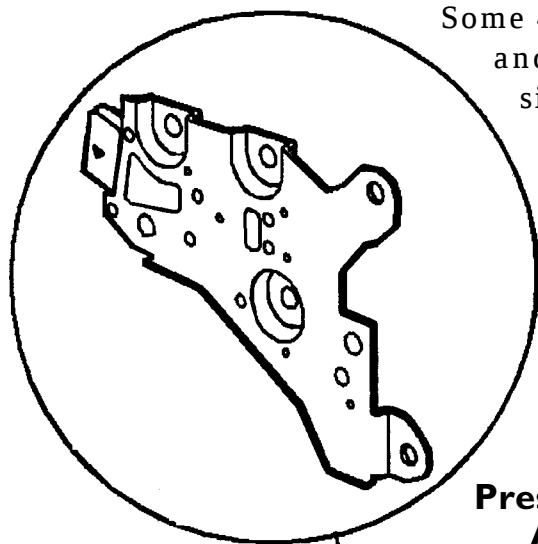
If line pressure readings are within specifications, inspect the direct clutch piston for possible seal delamination. If chunks of the seal are missing or if cracks are developing in the seal rubber, the seal is delaminating. The seal used in the direct clutch is a molded design; that is, the piston and seal are a one-piece assembly.

An upgraded molded piston has been released. You can identify the new piston by the part number molded into the rubber of the seal. Updated pistons have number 24205044 molded into the seal.



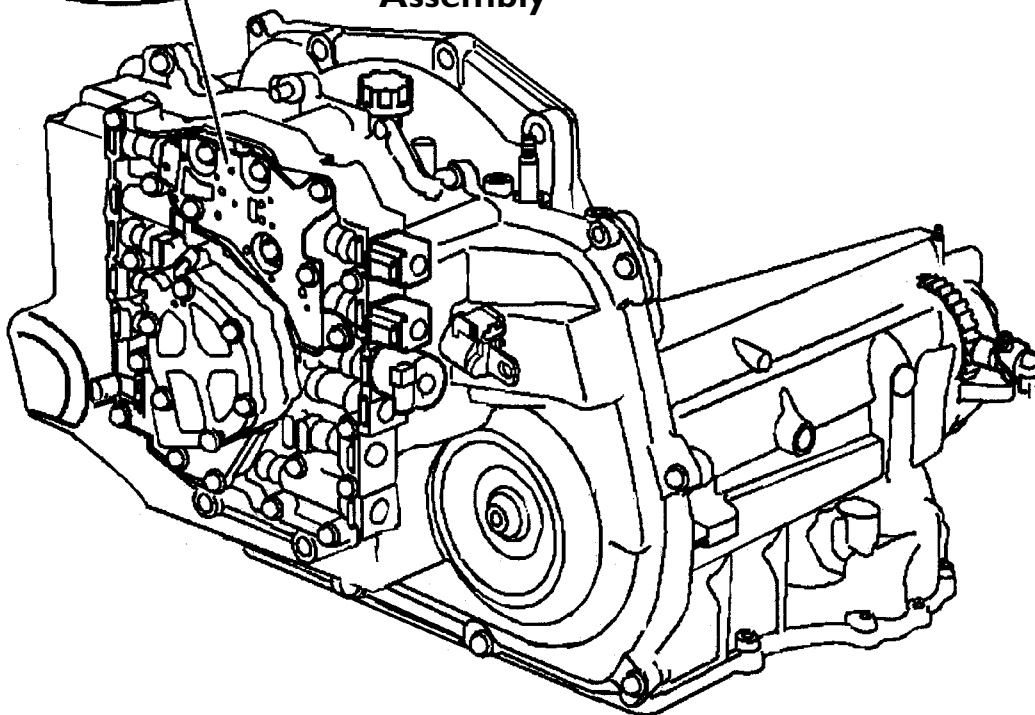
4T40E

Intermittent Loss of TCC



Some 4T40Es may lose TCC until you cycle the ignition off and on. This condition may also set DTC P1887. Diagnosis using the service manual may lead you to replacing the TCC release switch. The TCC release switch has created this problem, especially on early model units. The TCC release switch is part of the Pressure Switch Assembly (PSA) and is serviced by replacing the PSA.

**Pressure Switch
Assembly**



Another possibility is an open or short in the TCC release switch circuit on the PSA. To isolate this problem, use a scan tool and monitor the position of the TCC release switch.

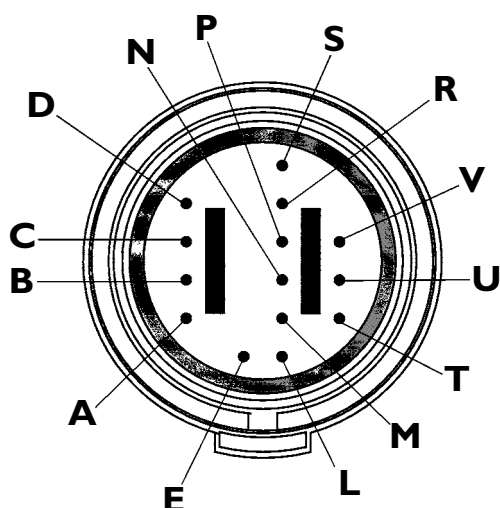
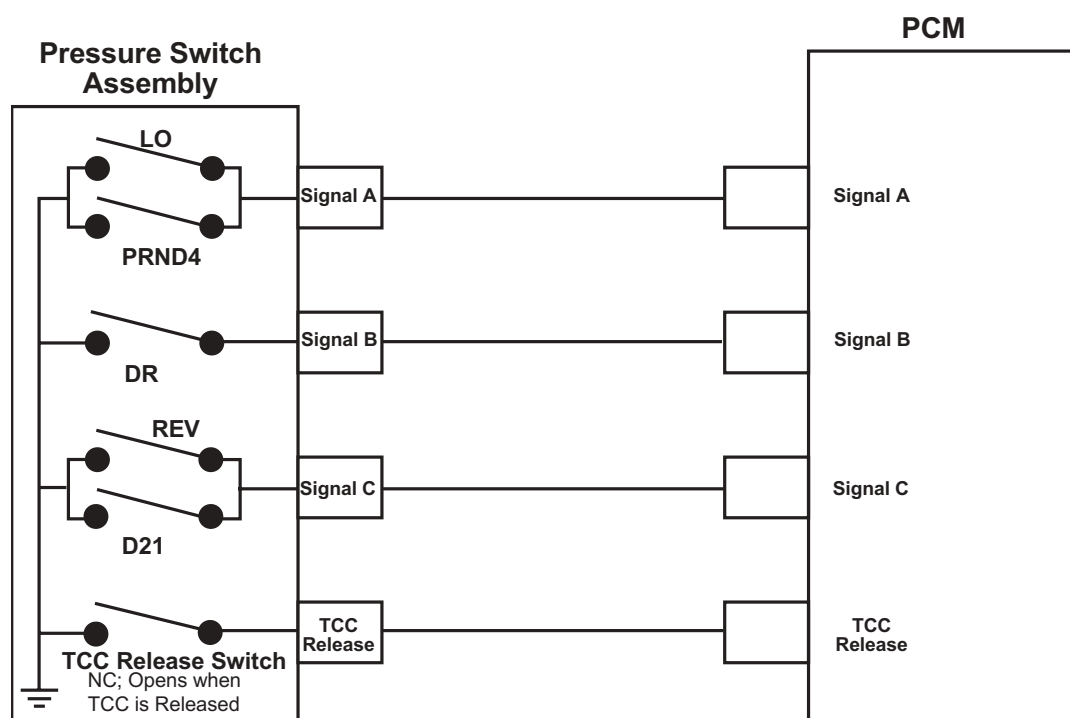
- With the key on, engine off, monitor the TCC release pressure data. TCC release pressure should indicate “NO” when monitoring with key on, engine off. If it indicates “YES,” check the harness for a possible open circuit, wiring damage, or weak terminal pin tension before replacing the switch.

4T40E

Intermittent Loss of TCC (continued)

- Start the engine and monitor the switch status. If the TCC release switch data displays “NO,” check the switch wiring for a short to ground. If the wiring is okay, replace the switch. If the switch has already been replaced for this condition, check for a hydraulic problem (gasket, debris) that could prevent pressure from dropping at the switch when the TCC turns off.

The GM part number for the pressure switch assembly is 24200495.



Pin	Function
A	1-2 Solenoid
B	2-3 Solenoid
C	Pressure Control Solenoid (High)
D	Pressure Control Solenoid (Low)
E	B+ Supply for Shift Solenoids and PWM Solenoid
L	TFT (High)
M	TFT (Low)
N	Pressure Switch Assembly Signal A
P	Pressure Switch Assembly Signal B
R	Pressure Switch Assembly Signal C
S	Input Speed Sensor (High)
T	PWM Solenoid
U	TCC Release Switch
V	Input Speed Sensor (Low)

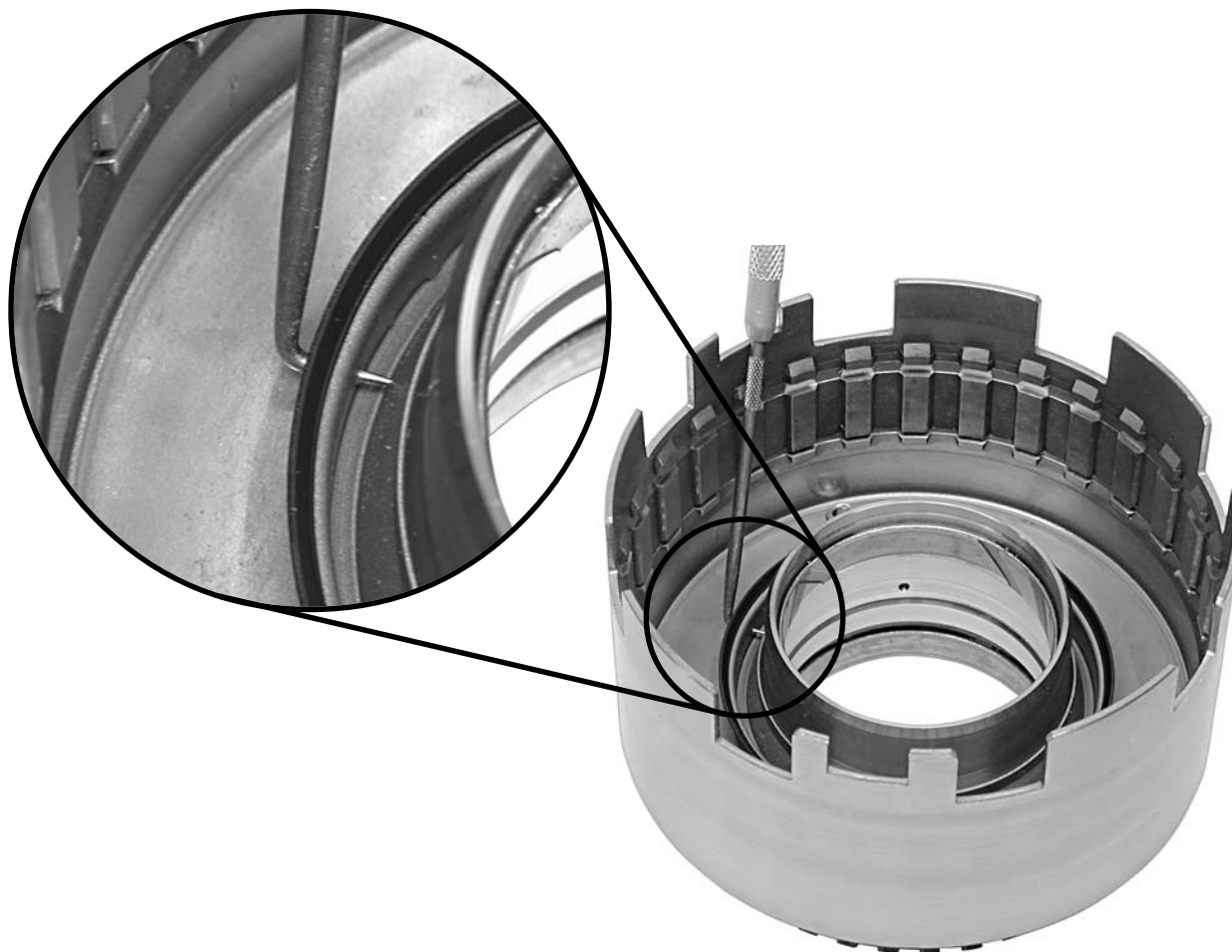
4T40E

Slips in Reverse at Heavy Throttle; Possible Burnt Reverse Clutches

Some 4T40E transaxles may slip in reverse, at mid to high throttle openings. The slip may seem worse when the transaxle is cold. This condition is most common on J-body vehicles (Sunfire, Cavalier), though it does occur in other applications.

Check line pressure and the Pressure Control Solenoid (PCS) commanded status before disassembling the unit. If line pressure the PCS commanded and actual amperage readings are correct, check the orifice in the reverse input clutch center retainer and seal assembly. Make sure it isn't plugged, incorrectly sized, or missing. The orifice should be about 0.055" in diameter.

A problem at this orifice will prevent the reverse clutch from applying all the way, which can lead to slipping and cause the clutches to fail. The slip is caused by a reduced clutch clamping load as the outer diameter of the piston isn't being supplied with enough pressure. The GM part number for the retainer and seal assembly is 24205041.

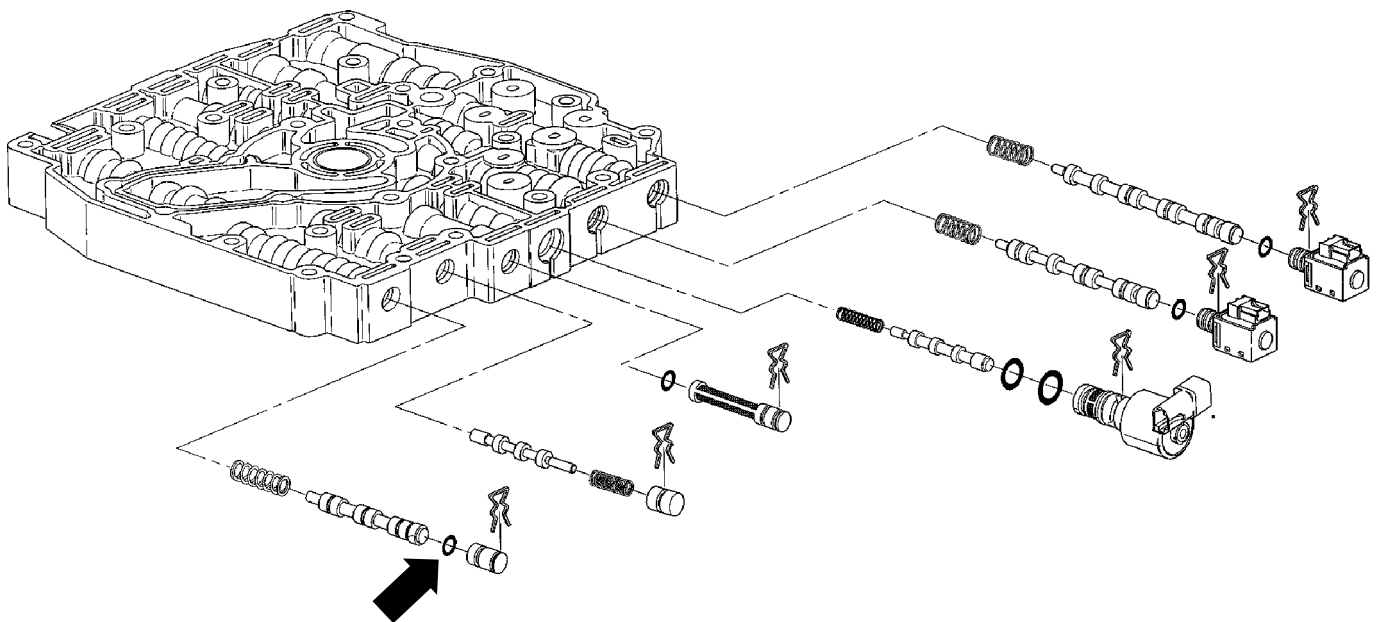


4T40E

Second Gear Starts

A second gear start complaint (that often goes away when you step on the gas) is often caused by poor shift solenoid A pressure. This can be caused by a leaking shift solenoid or poor feed to the shift solenoid.

One of the often overlooked areas for this leak is the O-ring on the 3-4 shift valve plug. Always replace this O-ring during a rebuild or valve body service.

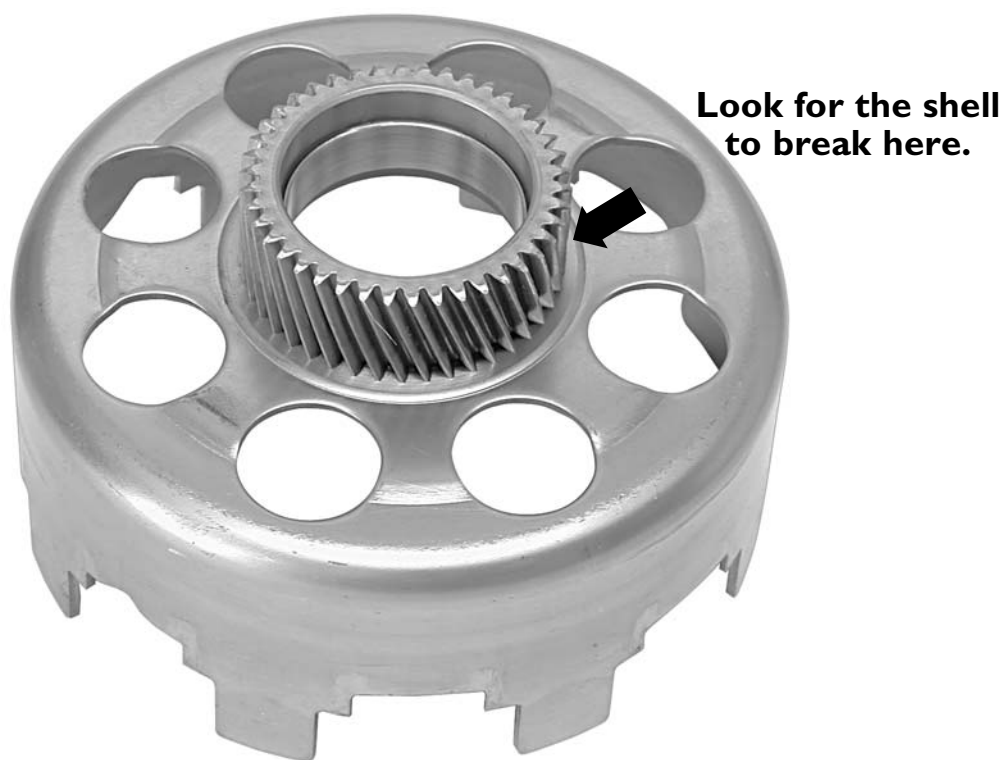


*A leak at this O-ring can
cause 2nd gear starts.*

4T40E/4T45E

1st Gear Only

A common problem on 97-and-later 4T40E/4T45E applications is a lack of 2nd, 3rd, 4th and reverse gears. This is caused by a broken weld on the reaction sun gear and shell assembly. Typically the friction weld attaching the sun gear to the shell breaks, allowing the sun gear to turn free of the shell. To repair, replace the shell with an updated version. The GM part number for the revised shell is 24204471.

**DIAGNOSTIC TIP**

Here's an easy way to confirm whether the shell is broken:

- Remove the pan, and then remove intermediate/4th servo assembly.
- Take the unit out of park.
- Use a long screwdriver or rod to push up on the band, locking the shell in place.

If the shell is broken, you'll be able to turn both drive wheels backward at the same time. If the shell is okay, the drive wheels will lock when you try to turn them both backward at the same time. However, both wheels will turn forward, regardless of the condition of the shell.

4T40E/4T45E

No Movement Forward or Reverse; Possible Noise that Follows RPM

This resembles the problem faced several years ago on the 3T40: Generally the customer comes out one morning, puts the car into gear, and it won't move forward or backward. In many instances, the transaxle may exhibit a grinding/rattling type noise.

This problem is usually caused by a shattered or broken pump rotor, caused by one of these conditions:

- an improper heat-treating process during manufacturing.
- the spacer on the pump drive shaft came apart and got into the pump rotor.

To repair this problem, clean the unit thoroughly and install a new pump assembly. Both of these failures have been addressed in the service pumps available.



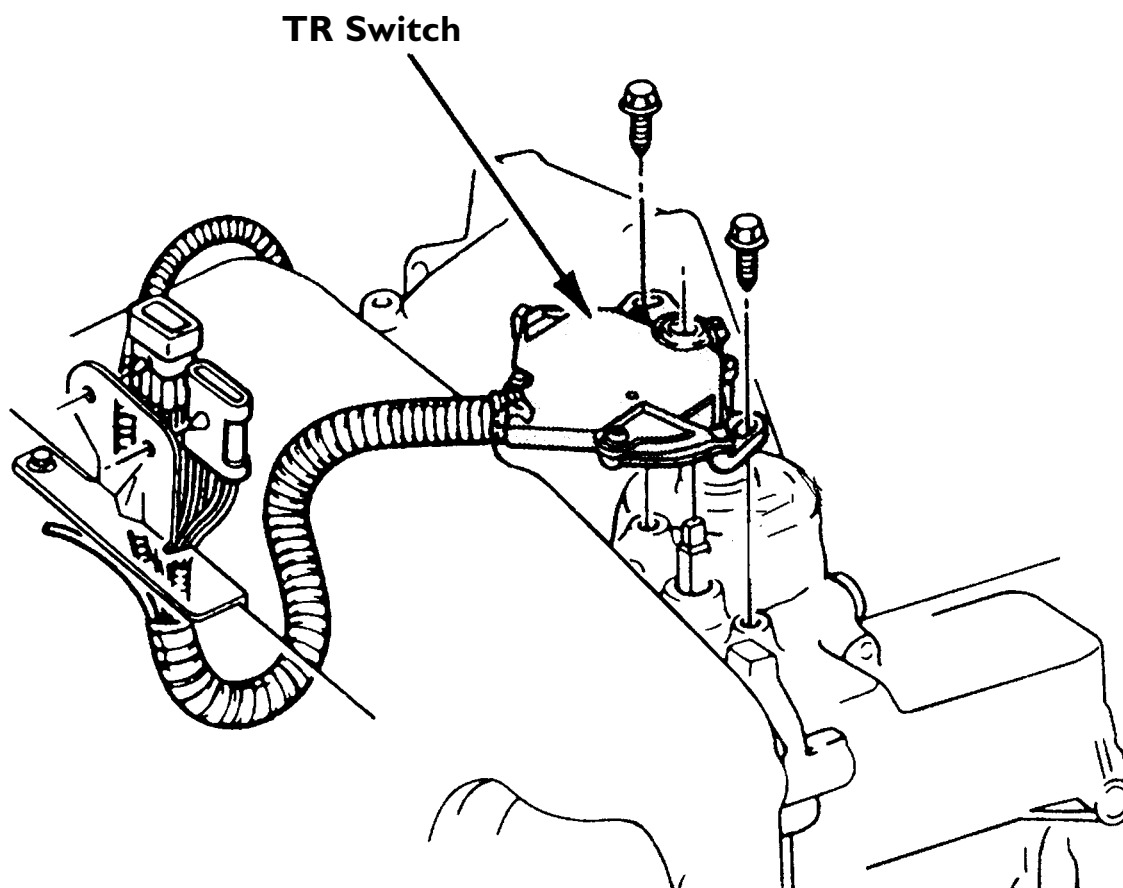
IMPORTANT Another cause for a broken shaft or rotor is high line pressure — always check line pressure before delivering the vehicle.

4T60E

Intermittent No 4th and Possibly No TCC; Possible DTC 31, 91, E91 or P0705

Some applications may experience an intermittent loss of TCC and possibly 4th gear; code 31, 91, E91, P0705 may be stored in memory, depending on the year and model of the vehicle. These codes indicate a misadjusted Transmission Range (TR) switch.

On many applications, no code will set; codes aren't available for TR switch failures on some vehicles. In that case the computer will inhibit 4th gear as long as it believes the shifter is in D range instead of OD. The PCM programming is designed to inhibit TCC when the code sets. Most shops won't be able to duplicate this condition.



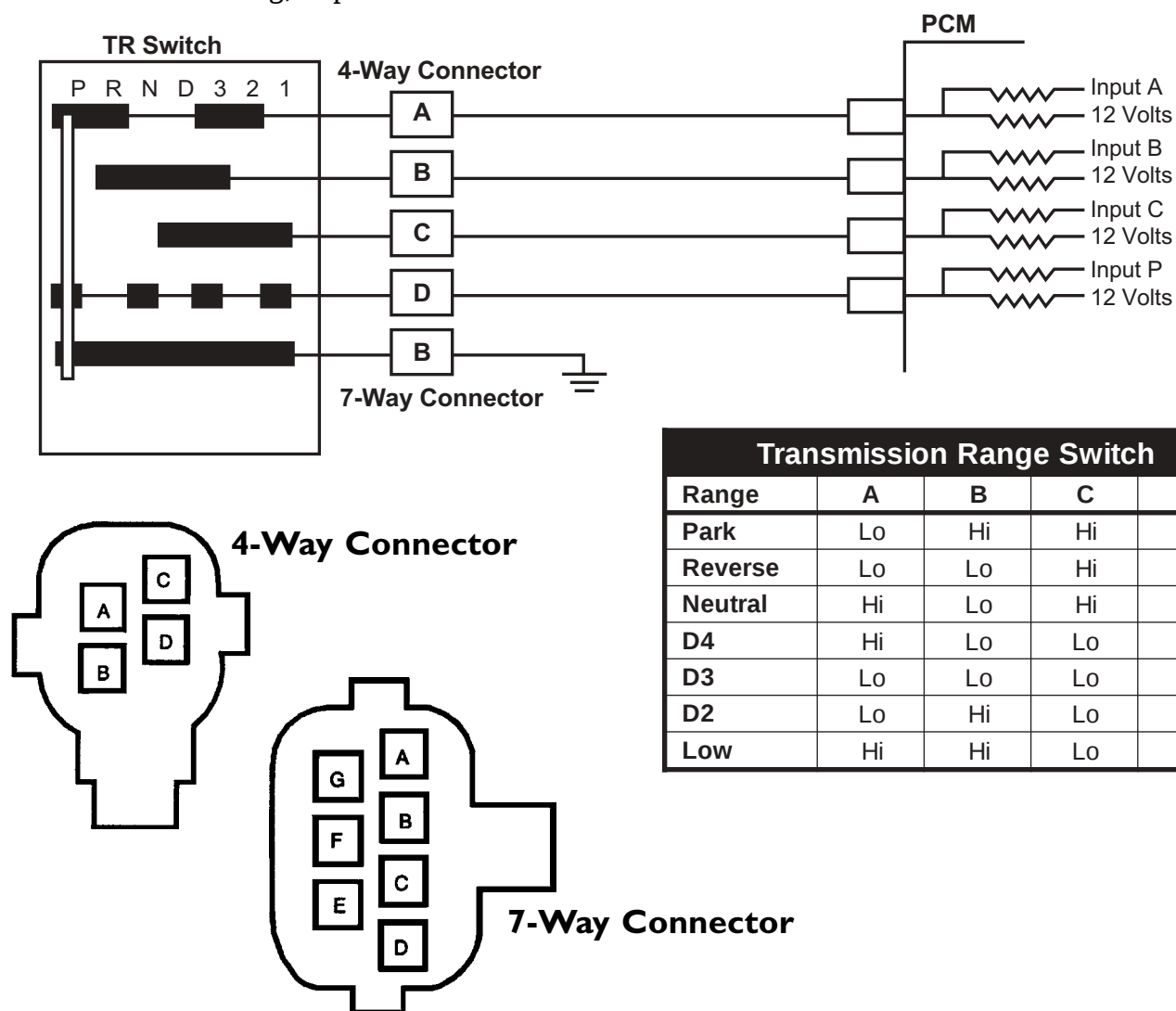
4T60E

Intermittent No 4th and Possibly No TCC; Possible DTC 31, 91, E91 or P0705 (continued)

This intermittent problem can be due to a misadjusted TR switch; but it may occur if the driver rests his hand on the shift lever. To identify the source of the problem, monitor the TR switch scan data while applying slight pressure to the shift lever. The correct scan data display for OD range is: A = HI, B = LO, C = LO, P = HI

On Cadillacs, the values may be listed as binary code values where a HI is represented by 1, and low is 0.

If the scan data indicates LO/LO/LO/LO, adjust the sensor and recheck the scan values. If the scan values remain LO/LO/LO/LO, inspect the wiring. If you don't find any problems in the wiring, replace the TR switch.



4T60, 4T60E

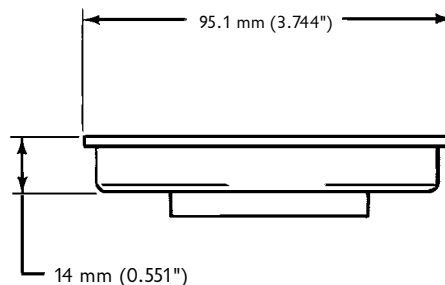
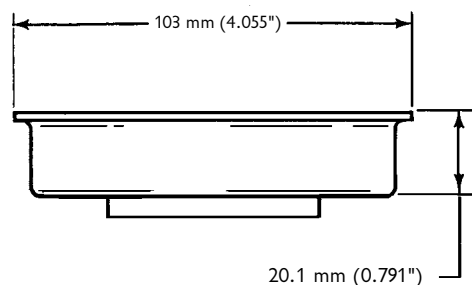
Binds on the 1-2 Shift

A bindup during the 1-2 shift, which then goes away in 3rd and 4th is caused by a 3rd clutch that is applied all the time, or applies anytime the input clutch is applied. This can be caused by cross leaks, such as the input clutch drum sealing rings in the driven sprocket support, or any number of areas in the valve body or channel casting.

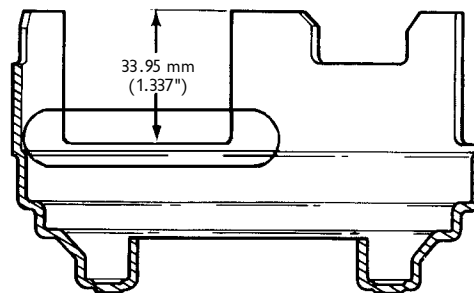
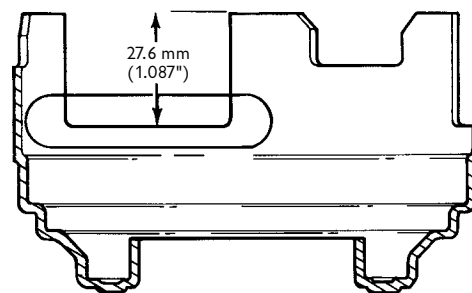
One of the more common causes is a mismatch between the type of input clutch piston and 3rd clutch piston used. If you use 10-plate 3rd clutch components with an input clutch piston designed for 8-clutch 3rd clutch components, the input clutch piston will interfere with the 3rd clutches, causing the 3rd clutch to apply anytime the input clutch is applied.

Use the illustrations below to identify the parts. Always make sure that the 3rd clutch rotates freely when you air check the input clutch.

3rd Clutch Piston



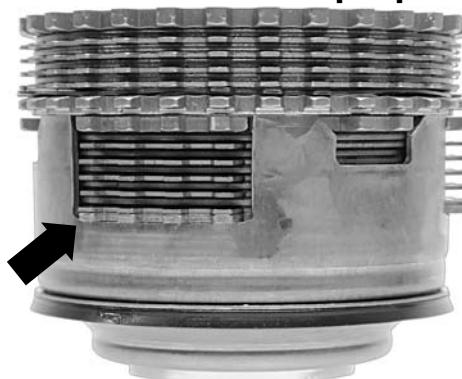
Input Clutch Piston



Clutch Stacked Properly



Clutch Stacked Improperly



4T60E/4T65E

Intermittent Delayed Engagement or Neutral while Driving

Some 4T60Es and 4T65Es may experience a delayed engagement when you first place the shift lever into gear. This complaint is similar to having a rolled input clutch seal (a common cause of delayed engagement on these applications).

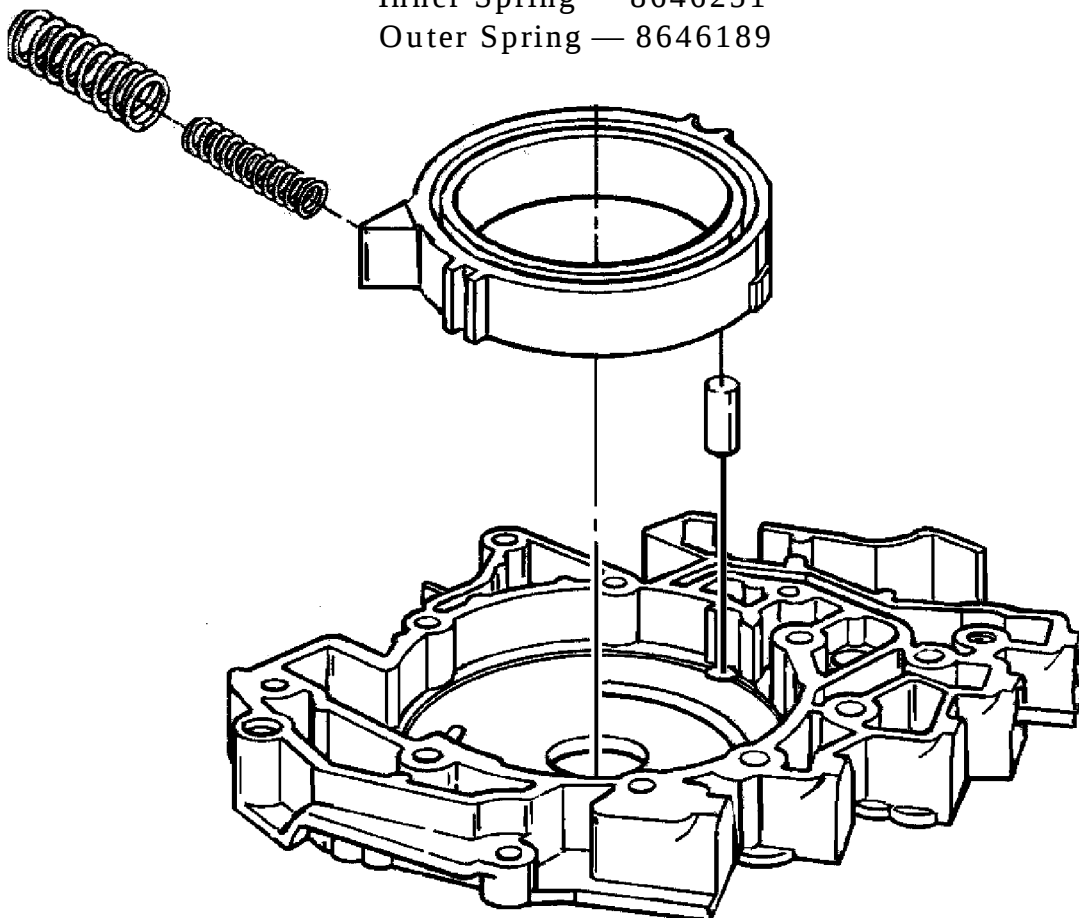
In addition, the transaxle may seem to go into neutral while driving. This problem may be caused by a broken pump priming spring or springs. This allows oil pressure to intermittently drop to minimum pressure, allowing the clutch or band to release.

Testing this problem can be difficult. Before you tear into the trans to check the spring, always check any external components that could be responsible. Make sure the modulator valve moves freely in the bore, and the modulator is in good shape. If you're working on a 4T65E, verify the computer signal for line rise. The easiest way to check it is with a scan tool.

If the primary springs are broken, replace them. The GM part numbers for the springs are:

Inner Spring — 8646251

Outer Spring — 8646189

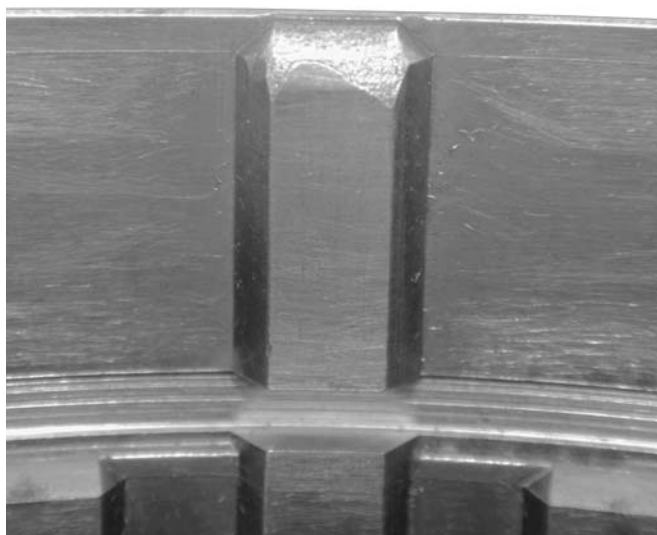
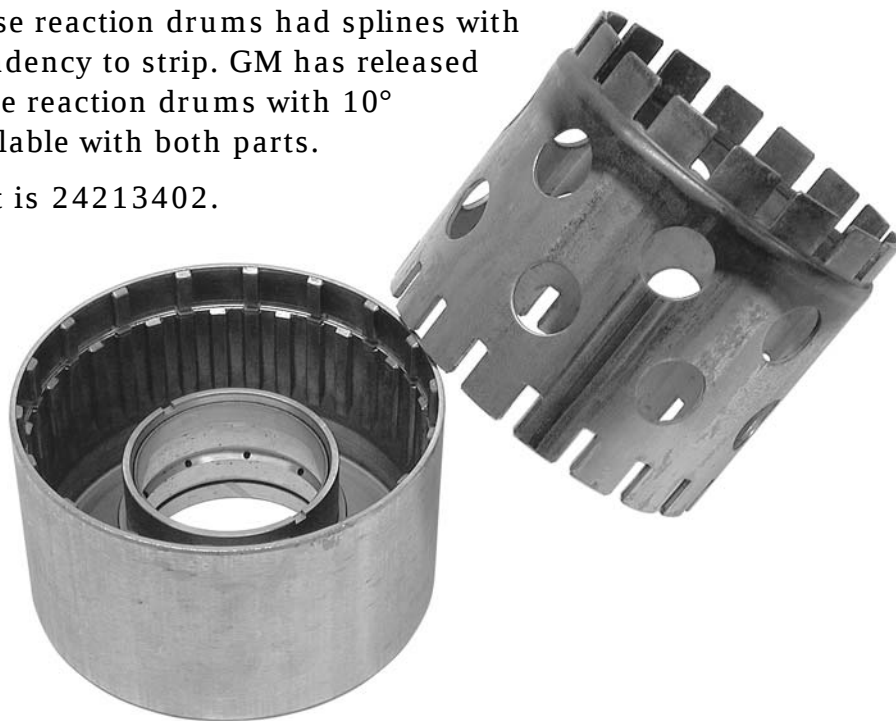


4T65E

Reverse Reaction Drum Breaking

The original 2nd clutch and reverse reaction drums had splines with 25° sides; these drums had a tendency to strip. GM has released new-design 2nd clutch and reverse reaction drums with 10° sides on the splines. A kit is available with both parts.

The GM part number for the kit is 24213402.



Original Drum with 25° Splines



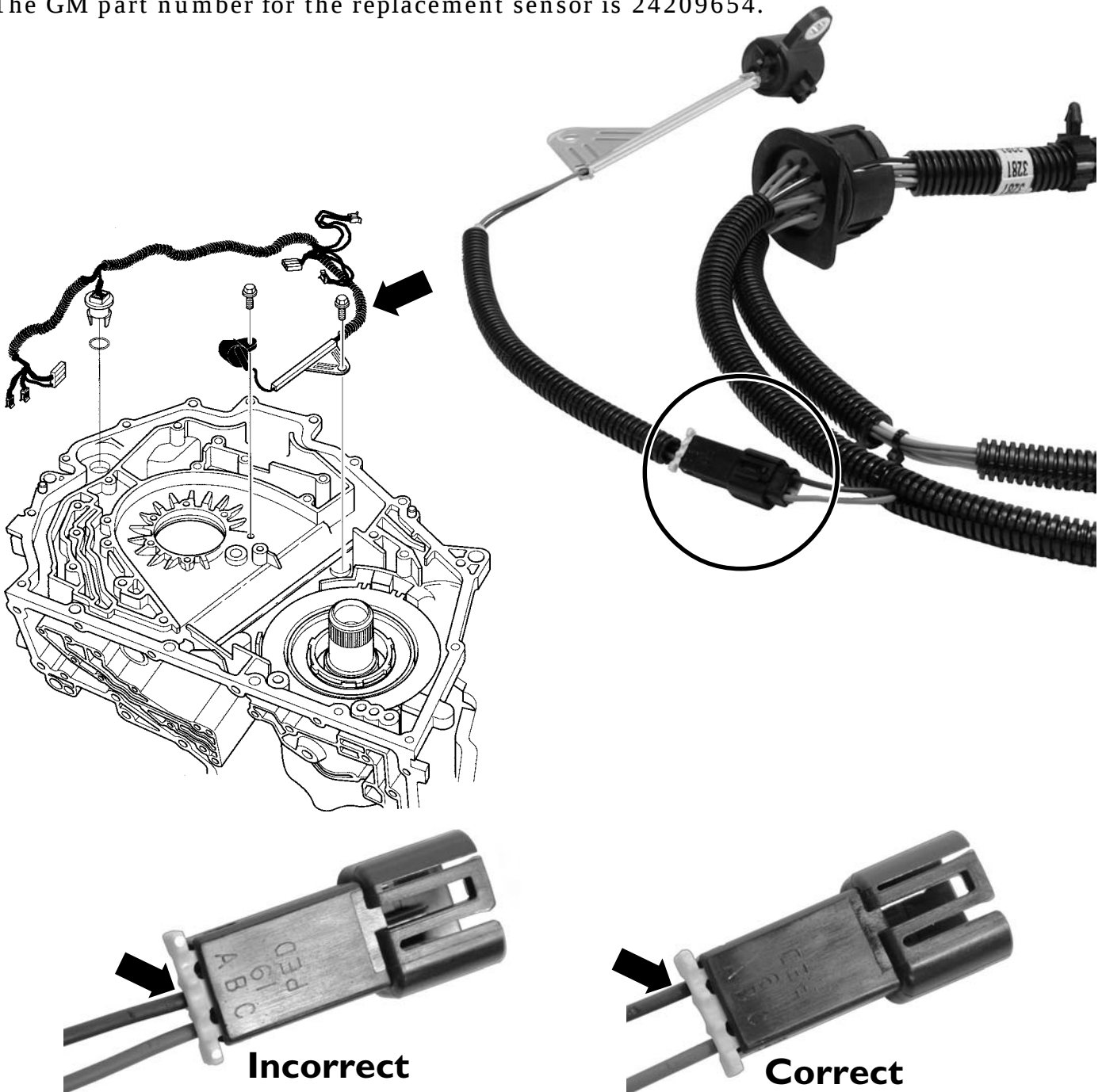
Updated Drum with 10° Splines

4T80E

Turbine Speed Sensor Failure

It's a good idea to replace the turbine speed sensor on every 4T80 rebuild. But don't be surprised to find the wires on the replacement sensor are out of position. Always check to make sure that the sensor wires are indexed into locations A and C.

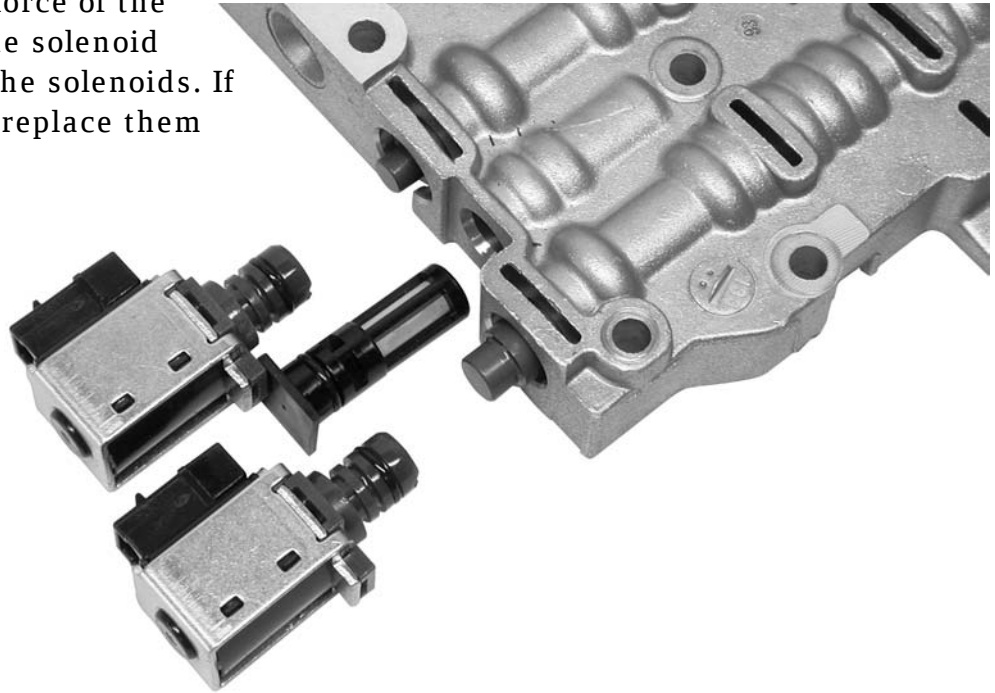
The GM part number for the replacement sensor is 24209654.



4T80E

Second Gear Starts

A second gear start (that usually goes away when you step on the gas) is often caused by poor pressure at shift solenoid A. This can be caused a leaking shift solenoid, or poor feed to the solenoid. Early solenoids were designed to hold the pressure control solenoid feed screen in place. The force of the screen pushing against the solenoid had a tendency to break the solenoids. If you have the early setup, replace them with the upgrade kit.

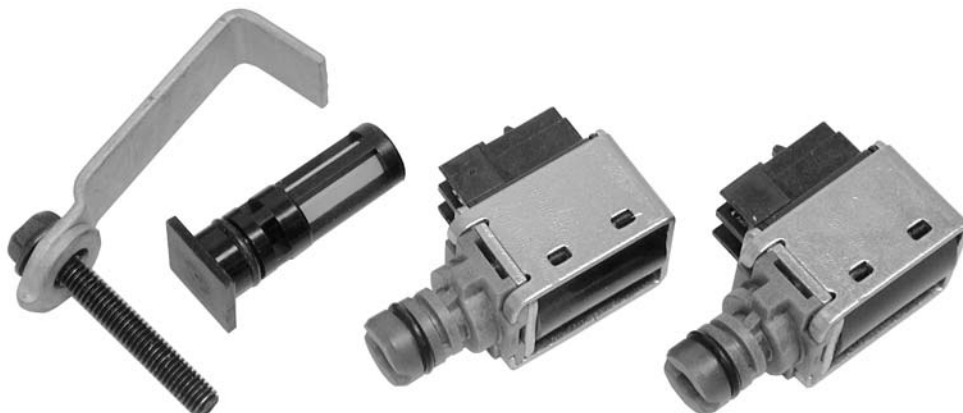


The later solenoid setup used a separate bracket to hold the screen in place.

The GM part number for the solenoid update kit is 24211355.

If you already have the later solenoid setup, the GM part number for the solenoids is 24207662.

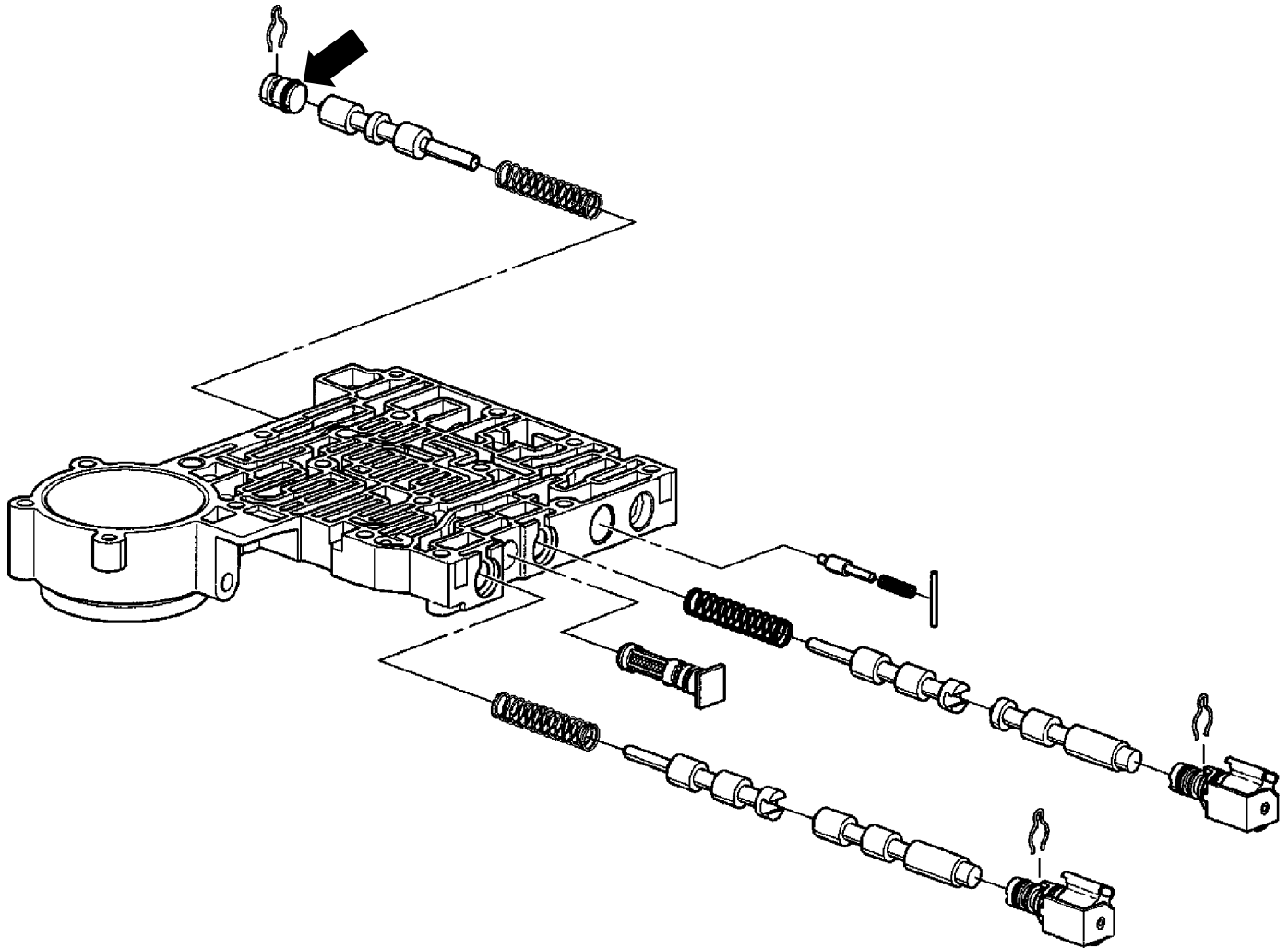
The GM part number for the screen is 8680389.



4T80E

Second Gear Starts (continued)

Another source for solenoid A leaks is the 3-4 shift valve plug. The 3-4 shift valve plug has an O-ring that seals solenoid A pressure. Replace this O-ring on every rebuild.

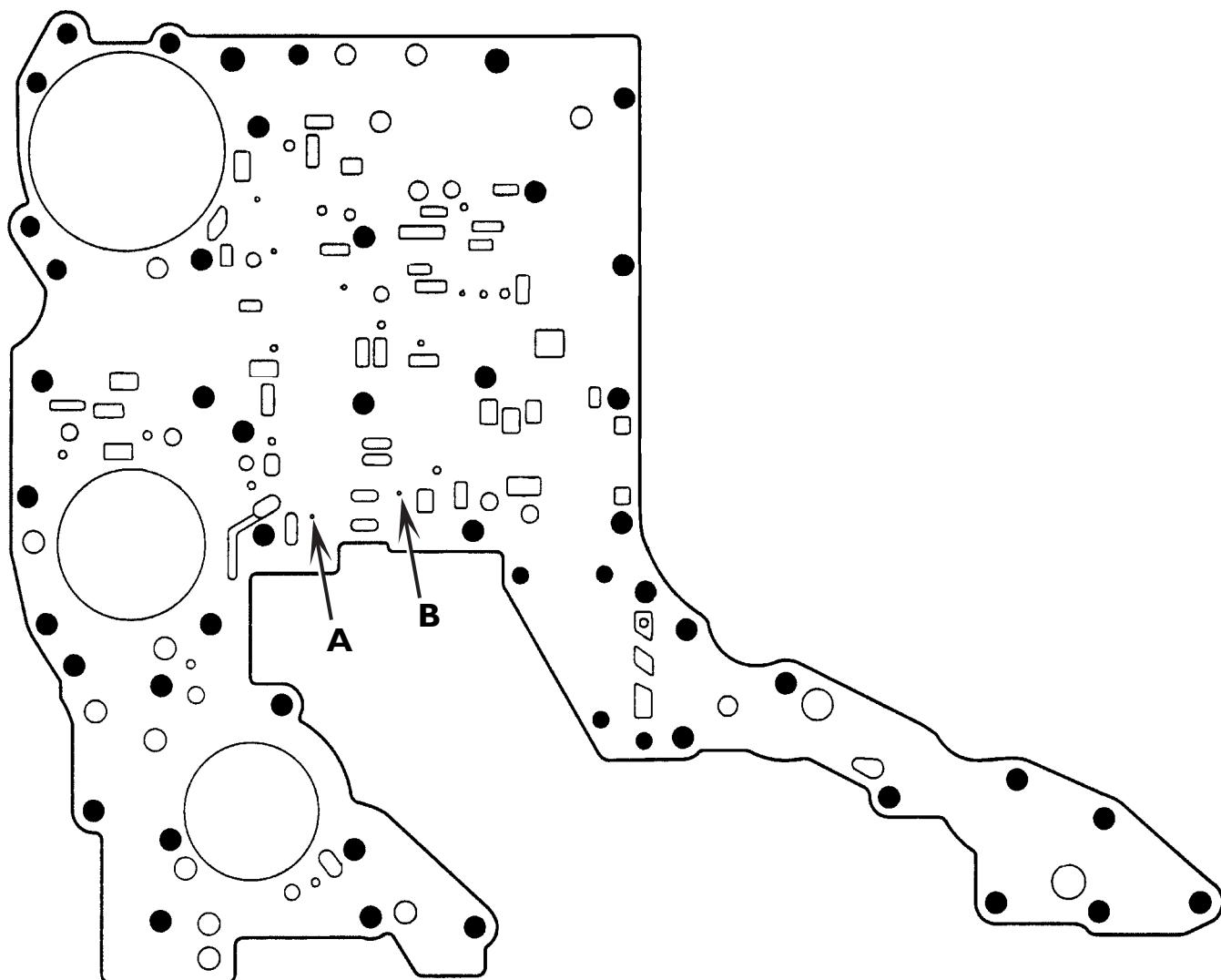


4T80E

Second Gear Starts (continued)

Another measure you can take to correct second gear starts is to enlarge the feed orifice for solenoid A to 0.035".

CAUTION This isn't a rebuild procedure; only modify the plate if the other repairs don't fix the problem.



4T80E

Second Gear Starts (continued)

A simple cause of a second gear start complaint is having the traction control disabled. Cadillac programs a second gear start whenever the traction control is off. Cycle the traction control switch and look for the words “Traction Ready.” If you see this, the traction control system is functioning properly, and isn’t the cause of your second gear starts.



4T80E

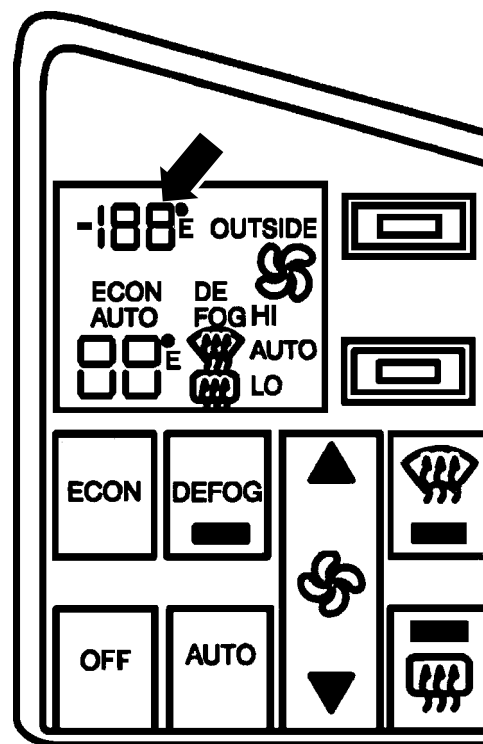
1993–95 Cadillacs ATF Indicator Reset

1993-and-later Cadillacs have an “ATF Life” telltale that shows when the transmission should be serviced. This usually sets at about 100,000 miles. The actual display will vary from model to model; however, the key (and problem) is the display has a message that you seemingly can’t get rid of.

For 1993 through 1995 models you can reset the ATF life through the self-diagnostic functions in the instrument panel. To do so, follow these steps.

1. Key on, engine off.
2. Press the OFF and WARMER buttons simultaneously on the climate control panel. Allow the display to show if there are any codes before continuing.
3. When the display shows “PCM?” press the HIGH fan button. The display will ask which function you want, beginning with PCM DATA. Press the LOW fan button to select different functions. Continue pressing the LOW fan button until you see PCM OVERRIDE on the display.
4. Press the HIGH fan button. You should see PS00 in the display.
5. Use the HIGH fan button again, to scroll through the parameters (e.g. PS01, PS02 etc.) until you get to PS15.
6. Look at the Climate Control Panel’s Temperature display. The number in the display indicates ATF Life.
7. Use the WARMER button to raise ATF life. The display only has two digits. When it reaches 100, it’ll display – –.
8. Turn the ignition off; the ATF Life is reset.

For 1996-and-later vehicles, you’ll need a scan tool to reset the ATF Life indicator.



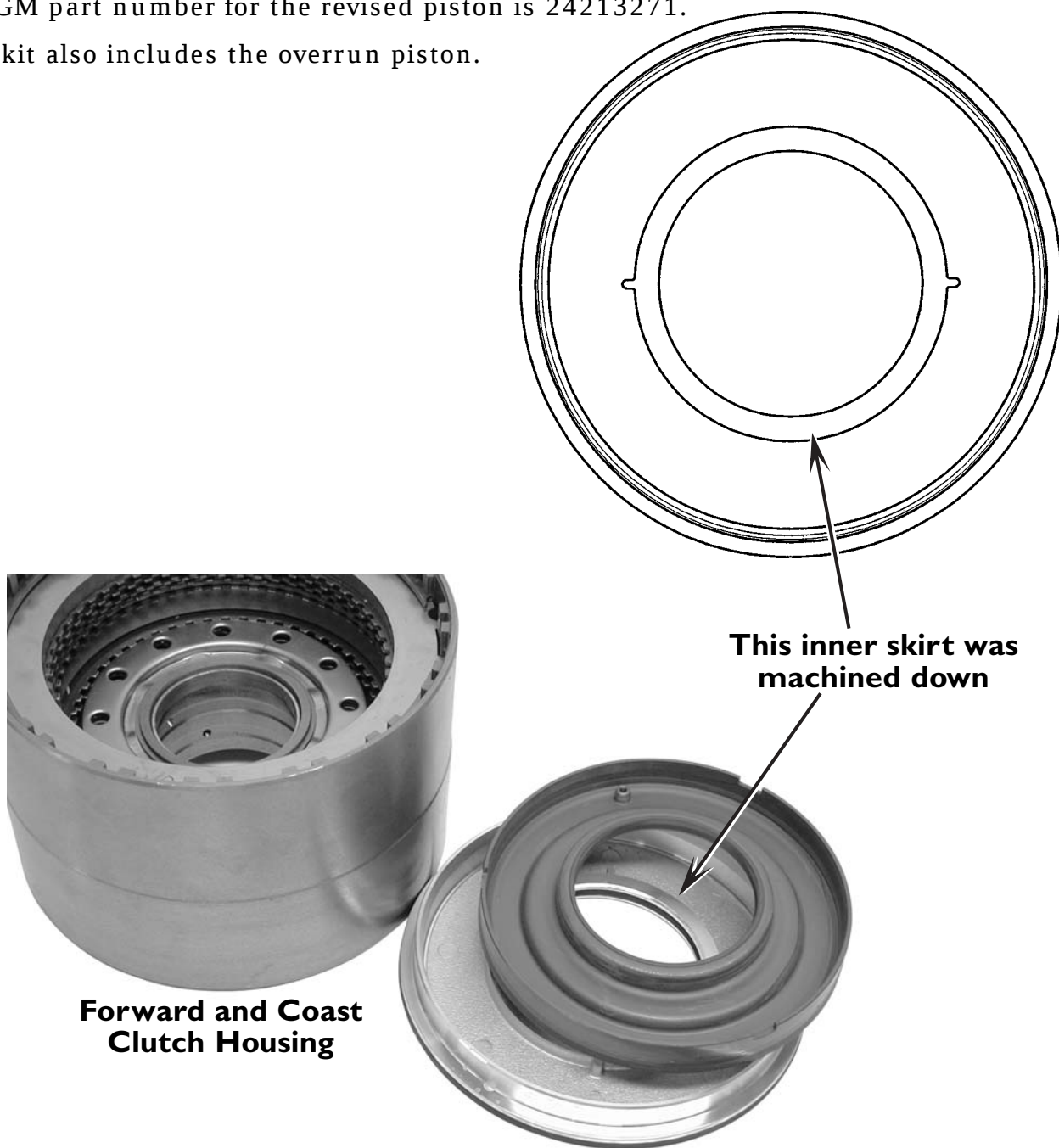
4T80E

Delayed or No Engine Braking In D3, D2, or L

A loss of engine braking can occur if the forward clutch piston inner skirt is too high. These pistons restrict oil flow to the overrun piston, either delaying or preventing engine braking in any forward manual ranges. GM has a revised forward piston that is machined down on the inner skirt to allow for better flow to the overrun piston.

The GM part number for the revised piston is 24213271.

This kit also includes the overrun piston.



GM Front Wheel Drive VSS Harness Repair Kit

The VSS harness connector will often crack or break while disconnecting the harness during transmission removal. Never reuse a broken harness connector; replace it with a new harness connector.

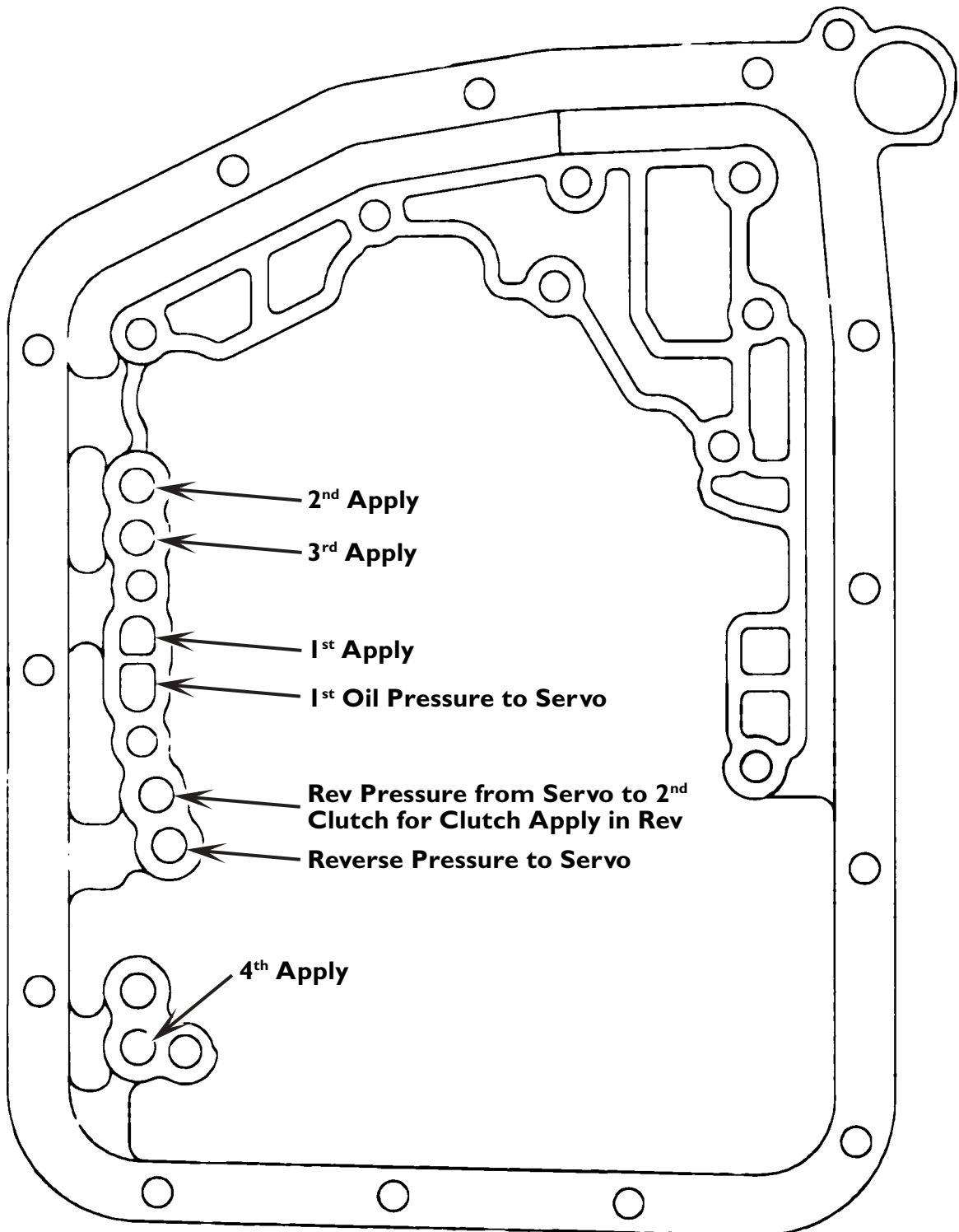
The GM part number for the harness kit is 12101899.

The kit contains the harness (with wires) and two crimp connectors.



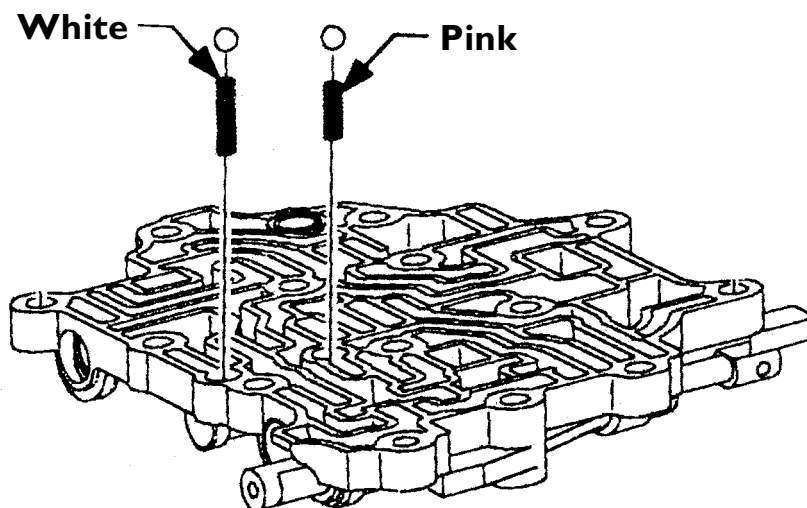
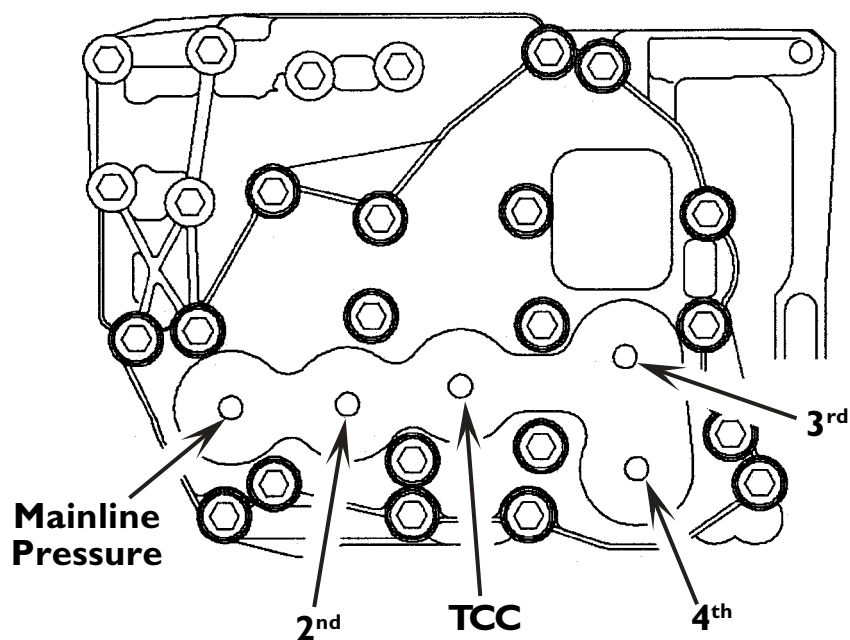
Saturn TAAT

Air Check Locations



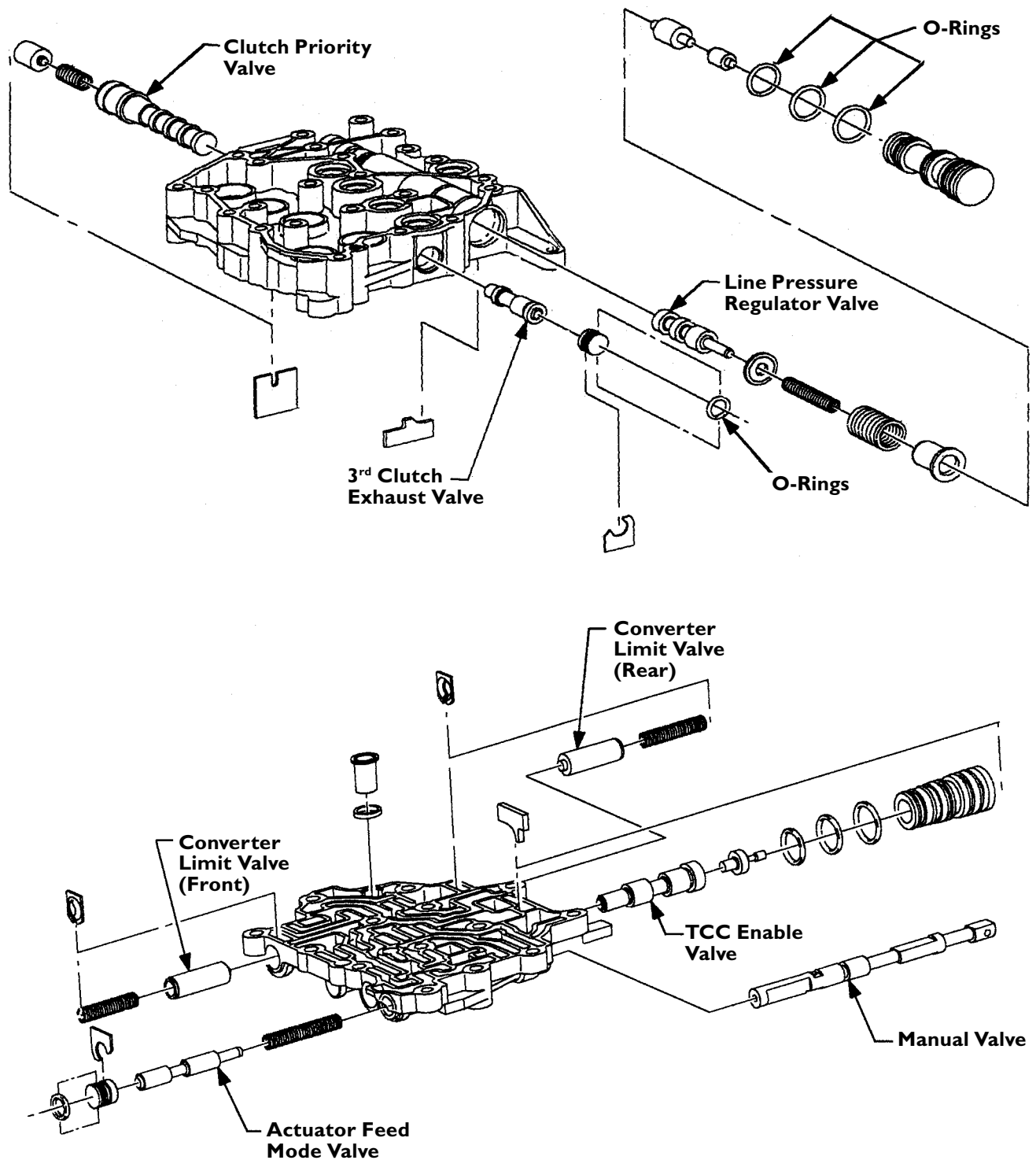
Saturn TAAT

Valve Body



Saturn TAAT

Valve Body (continued)



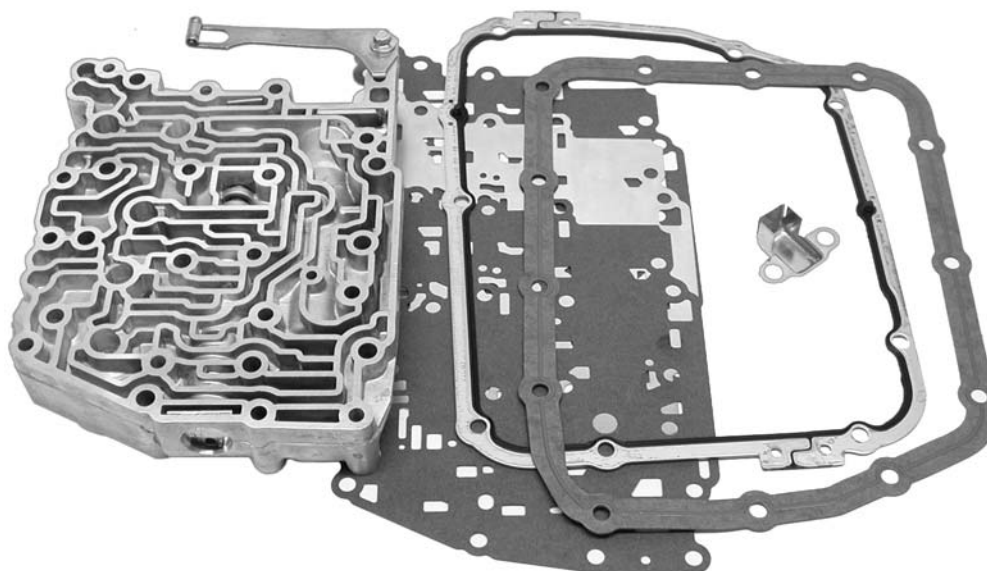
Saturn TAAT

Harsh Reverse

A harsh reverse condition is often caused by a worn out pressure regulator bore. Saturn offers a kit that includes the valve body half (with regulator valve) and gaskets.

The Saturn part number for the kit is 21005813.

When the pressure regulator bore wears out, line pressure will go higher than commanded. To verify line pressure, follow the procedures on page 62.



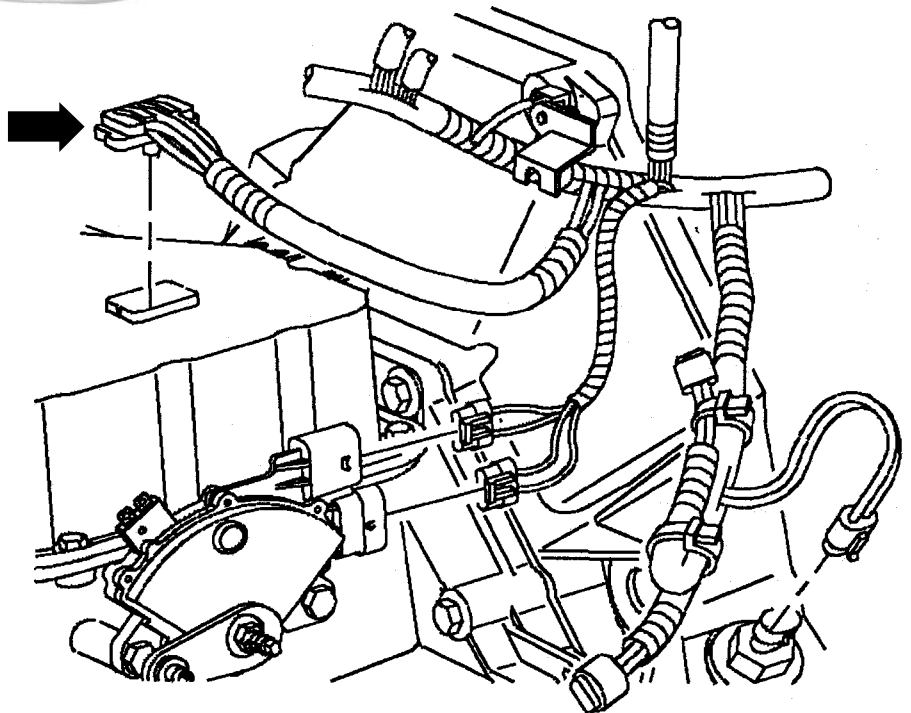
Saturn TAAT

Solenoid Harness Kit

Poor connections at the solenoid harness connector can cause many problems including wrong gear starts and harsh shifts. In some cases no DTCs will set.

Saturn offers a solenoid harness connector repair kit for replacing this connector. The Saturn part number for the kit is 12116563.

Always stagger the splices about $\frac{1}{2}$ " apart, beginning with the first splice, which you should start about 1" from the connector.

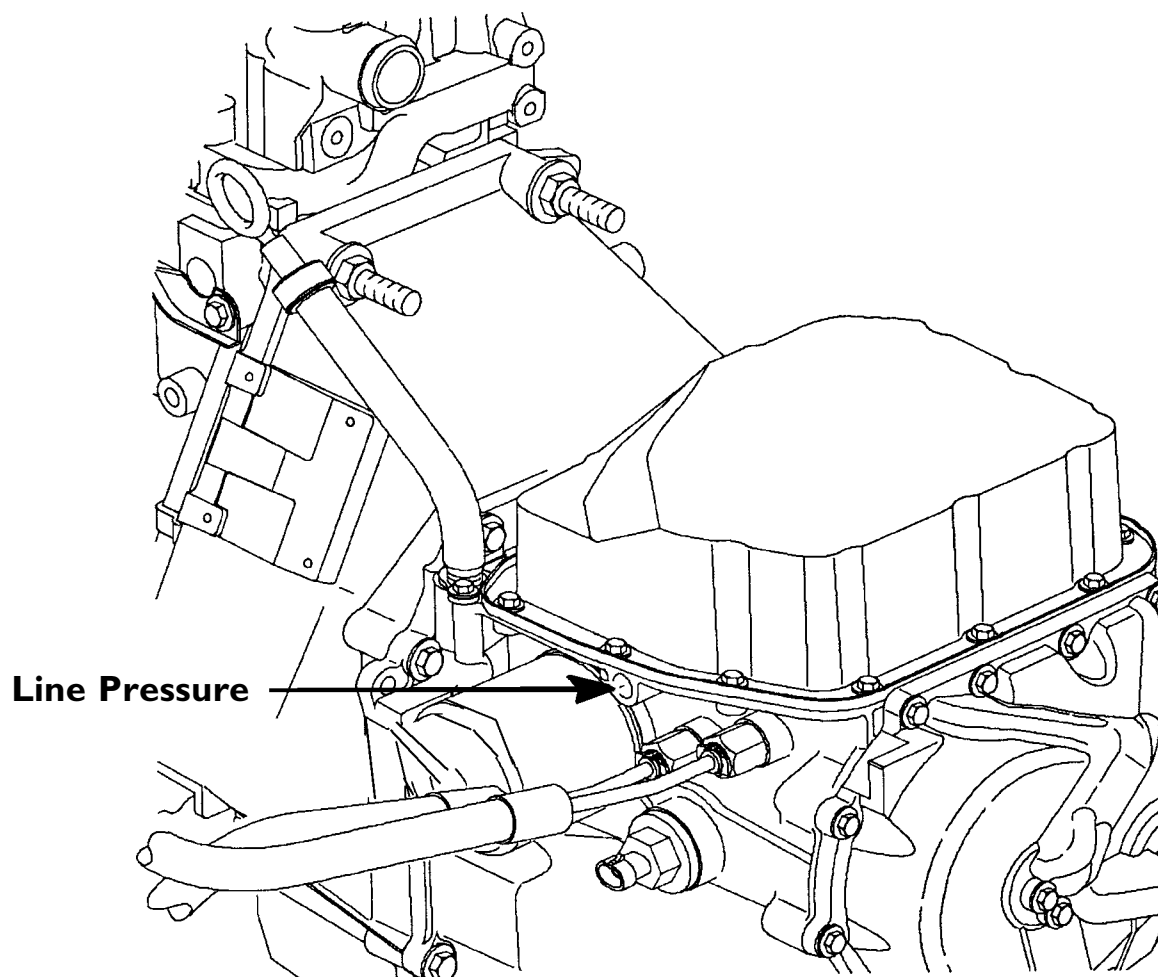


Saturn TAAT

Pressure Testing

Normal line pressure in park ranges from a minimum of 58–72 PSI at an idle to a maximum of 175–245 PSI. There are two methods you can use to check line pressure: The first is the easiest and is for checking minimum and maximum pressures. Here's how:

- Connect a pressure gauge to the line pressure port.

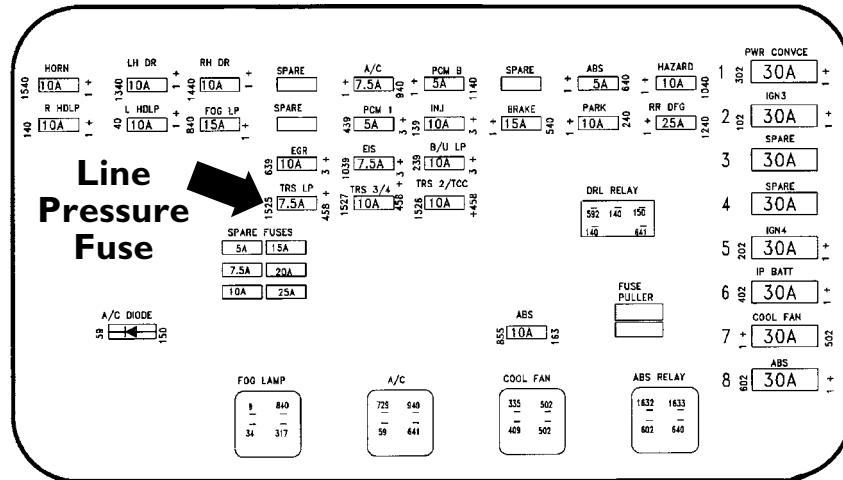


- With the engine idling and the transmission in park you should have between 58 and 72 PSI.

Saturn TAAT

Pressure Testing (continued)

- Remove the line pressure solenoid fuse, located in the fuse block in the engine compartment.



When you remove the fuse, line pressure should rise to between 175 and 245 PSI. You may need to raise engine RPM a bit to achieve maximum pressure.

The second method for checking line pressure is by commanding pressure rise with a scan tool and verifying the results with a pressure gauge. Begin this test by connecting your scan tool to the diagnostic connector. Don't start the engine yet.

- Scroll through the menu until you get to "Special Tests."
- Select "Line Pressure."
- The scan tool will prompt you to start the engine.
- Select "Run."

The test will begin. All functions are automatic. The test will set the engine to 1500 RPM. It will then command line pressure from 396 kPa to 1518 kPa, in 100 kPa increments. As it does, verify that line pressure rises on your pressure gauge. Use the chart to convert kPa to PSI.

Command Line Pressure		Gauge Readings Should Be:	
kPa	PSI	kPa	PSI
396	57	400 – 500	58 – 72
498	72	425 – 550	61 – 80
600	87	500 – 675	72 – 98
702	102	600 – 800	87 – 116
804	117	700 – 925	101 – 134
906	131	800 – 1050	116 – 152
1008	146	900 – 1175	130 – 170
1110	161	1000 – 1300	145 – 188
1212	175	1100 – 1400	159 – 203
1314	191	1200 – 1500	174 – 218
1416	205	1300 – 1650	188 – 240
1518	220	1500 – 1850	218 – 268

Saturn TAAT

Second Design Shift Solenoids

Beginning with 1997 models, Saturn began using a second design solenoid for the 2nd/Reverse, 3rd and 4th clutch. The second design solenoid has a screen on the feed side and is less likely to fail mechanically.

You can use the second design solenoid for all past models, but never use it for the TCC or pressure solenoid locations. For those locations, continue using the first design solenoid.

The Saturn part numbers for these solenoids are:

First Design — 21002509

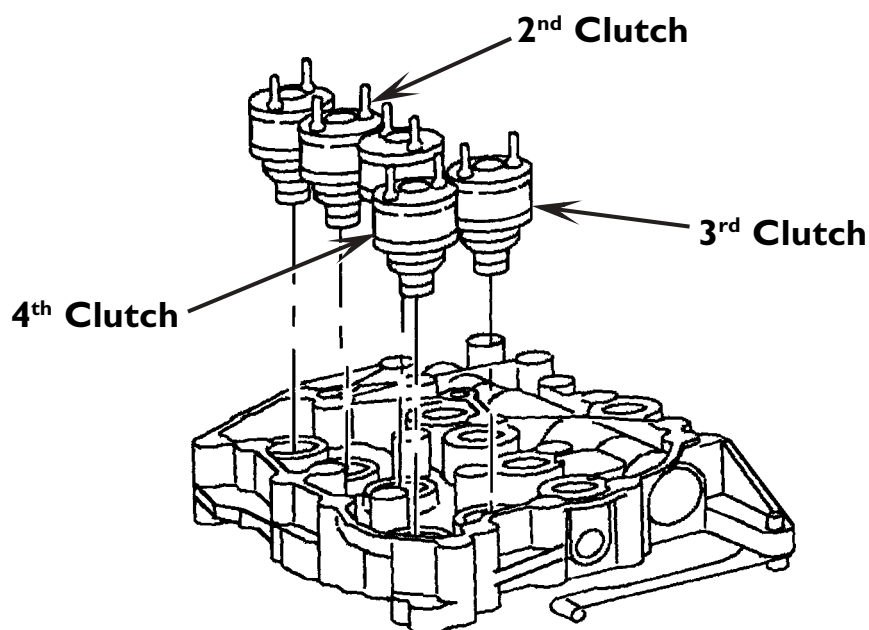
Second Design — 21003289



First Design



Second Design



Ford Contents

4R44E, 4R55E, 5R55E

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4R44E, 4R55E, 5R55E

Application

The 4R44E and the 4R55E are almost identical; the difference between them is in the load capacity: The 4R55E is stronger than the 4R44E.

Even though the 5R55E is a 5-speed automatic, it is mechanically the same as its 4-speed cousins, the 4R44E and the 4R55E. The difference is in the way the computer commands the upshifts. By commanding the overdrive band on while the transmission is in 1st gear, the 5R55E develops a 1.86:1 ratio. This falls between 1st gear (2.47:1) and 2nd gear (1.47:1). Here's how it works:

1st gear is still 1st gear. However, rather than applying the intermediate band for 2nd gear, the OD band applies for 2nd. It's actually an overdriven 1st gear. For 3rd gear the unit releases the OD band and applies the intermediate band. Applying the direct clutch puts the unit into 4th gear. Finally the OD band reapplies to put the transmission into 5th gear.

Confused? That's okay: As long as you remember the extra gear falls between 1st and 2nd gear, the 5R55E will be a lot easier to diagnose.

Because these units look very similar and the computer is what decides whether it's a 4 speed or 5 speed, use the vehicle application chart to verify which unit you're working on.

Transmission Application			
Year and Engine	Ranger	Aerostar	Explorer and Mountaineer
1995			
2.3L, 3.0L	4R44E		
4.0L	4R55E		4R55E
1996			
2.3L, 3.0L	4R44E	4R44E	
4.0L	4R55E	4R55E	4R55E
1997			
2.3L, 3.0L	4R44E	4R44E	
4.0L	5R55E	5R55E	5R55E
1998-on			
2.5L, 3.0L	4R44E		
4.0L	5R55E		5R55E

4R44E, 4R55E, 5R55E

4R44E and 4R55E Clutch and Band Application

Gear	Forward Clutch	Direct Drum	Intermediate Band	Overdrive Band	Coast Clutch	Low/Reverse Band	Overdrive Sprag	Low Sprag	Gear Ratios
Park									
Reverse									2.10:1
Neutral									
Drive; Overdrive Enabled	4 th						F/W	F/W	0.75:1
	3 rd							F/W	1.00:1
	2 nd							F/W	1.47:1
	1 st								2.47:1
Drive; Overdrive Disabled	3 rd							F/W	1.00:1
	2 nd							F/W	1.47:1
	1 st								2.47:1
Manual 2								F/W	1.47:1
Manual 1									2.47:1

 = Applied F/W = Freewheeling

4R44E and 4R55E Solenoid Operation

Solenoid Operation: 4R44E / 4R55E						
Selector Position	Gear Range	Shift Solenoid 1	Shift Solenoid 2	Shift Solenoid 3	Coast Clutch Solenoid	Engine Braking
Park/Neutral	P/N	On	Off	Off	Off	No
Reverse	R	On	Off	Off	Off	Yes
Drive; Overdrive Enabled	4 th	Off	Off	On	Off	Yes
	3 rd	Off	Off	Off	Off	No
	2 nd	On	On	Off	Off	No
	1 st	On	Off	Off	Off	No
Drive; Overdrive Disabled	3 rd	Off	Off	Off	On	Yes
	2 nd	On	On	Off	On	Yes
	1 st	On	Off	Off	On	No
Manual 2	2 nd	On	On	Off	Off	Yes
Low	1 st	On	Off	Off	Off	Yes

4R44E, 4R55E, 5R55E

5R55E Clutch and Band Application

Gear		Forward Clutch	Direct Drum	Intermed Band	Overdrive Band	1997 Coast Cl	1998-on Coast Cl	Low/Rev Band	Overdrive Sprag	Low Sprag	Gear Ratio
Park											
Reverse											2.10:1
Neutral											
Drive; Overdrive Enabled	5 th								F/W	F/W	0.75:1
	4 th									F/W	1.00:1
	3 rd									F/W	1.47:1
	2 nd								F/W	F/W	1.86:1
	1 st										2.47:1
Drive; Overdrive Disabled	4 th									F/W	1.00:1
	3 rd									F/W	1.47:1
	2 nd								F/W	F/W	1.86:1
	1 st										2.47:1
Manual 2									F/W	F/W	1.86:1
Low											2.47:1

 = Applied F/W = Freewheeling

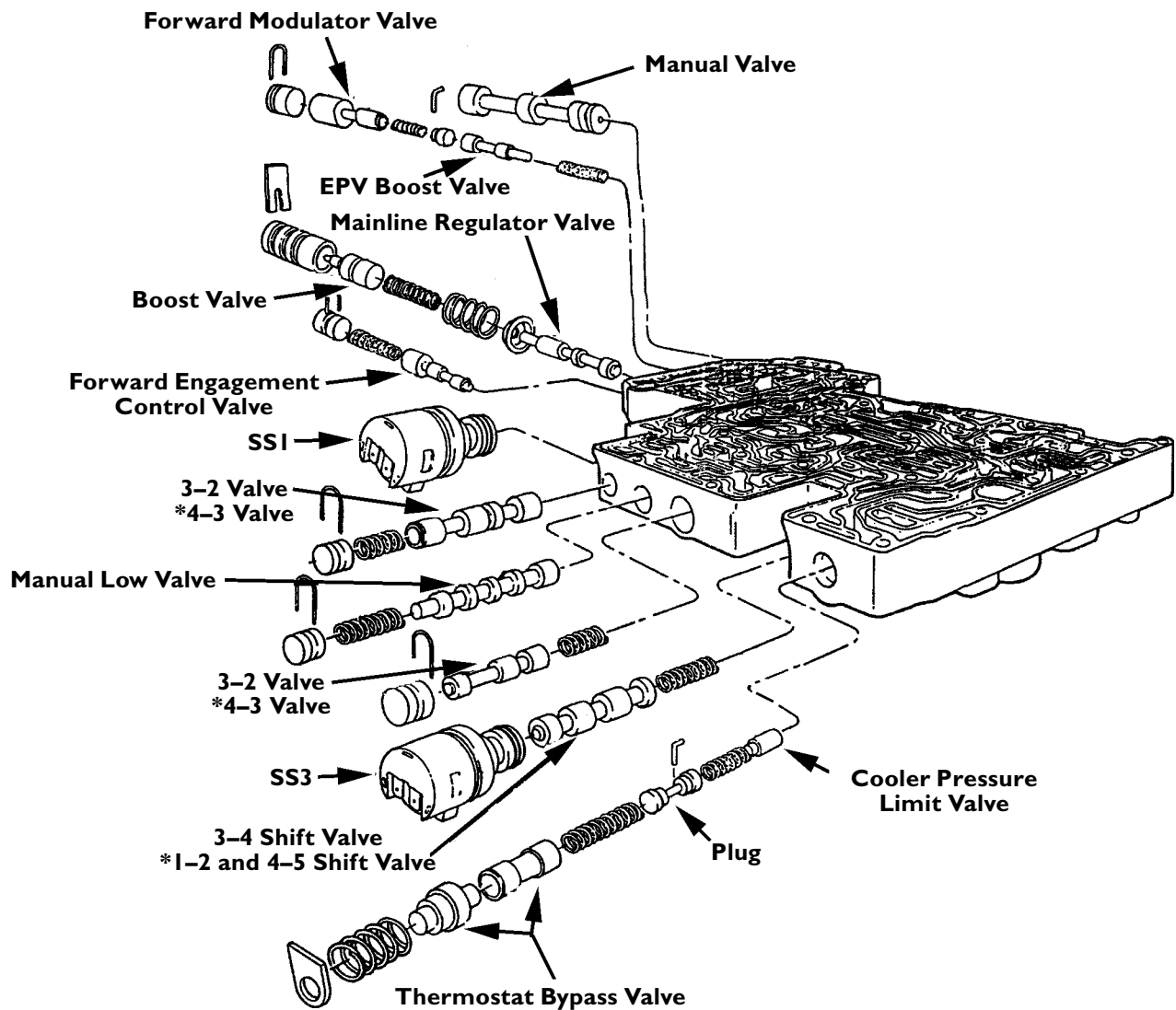
5R55E Solenoid Application

Solenoid Operation: 5R55E								
Selector Position	Gear Range	Shift Solenoid 1	Shift Solenoid 2	Shift Solenoid 3	1997 Only Coast Clutch Solenoid	Engine Braking	1998-On Coast Clutch Solenoid	Engine Braking
Park/Neutral	P/N	On	Off	Off	Off	No	Off	No
Reverse	R	On	Off	Off	On	Yes	On	Yes
Drive; Overdrive Enabled	5 th	Off	Off	On	Off	Yes	Off	Yes
	4 th	Off	Off	Off	Off	No	Off	No
	3 rd	On	On	Off	Off	No	Off	No
	2 nd	On	Off	On	Off	No	Off	No
	1 st	On	Off	Off	Off	No	Off	No
Drive; Overdrive Disabled	4 th	Off	Off	Off	On	Yes	On	Yes
	3 rd	On	On	Off	Off	No	On	Yes
	2 nd	On	Off	On	Off	No	Off	No
	1 st	On	Off	Off	Off	No	Off	No
Manual 2	2 nd	On	Off	Off	On	Yes	On	Yes
Low	1 st	On	Off	Off	On	Yes	On	Yes

Differences between 1997 and later models highlighted by dark band.

4R44E, 4R55E, 5R55E

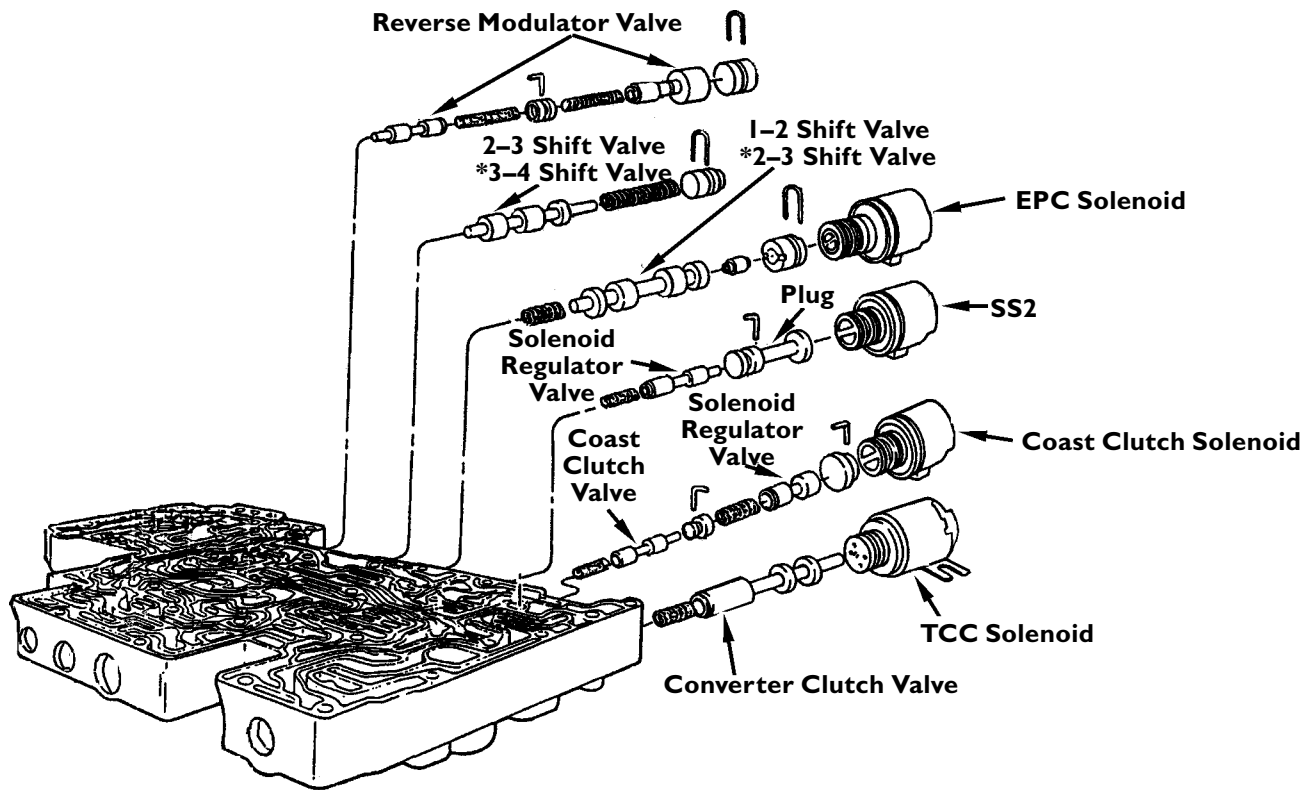
Valve Locations; Right Side



*** 5R55E Only**

4R44E, 4R55E, 5R55E

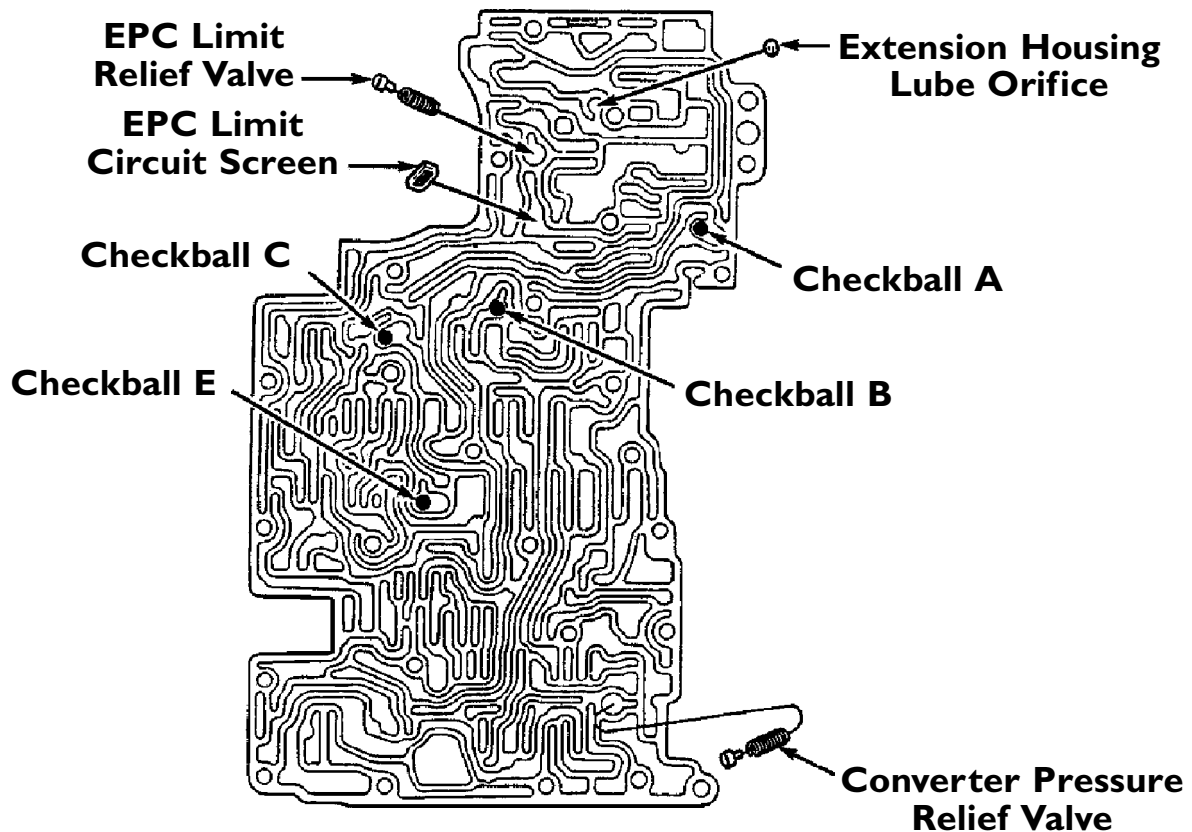
Valve Locations; Left Side



* 5R55E Only

4R44E, 4R55E, 5R55E

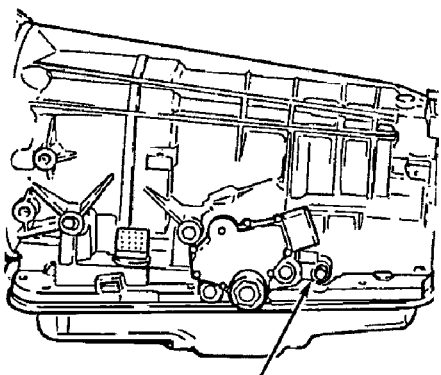
Checkball and Small Part Locations



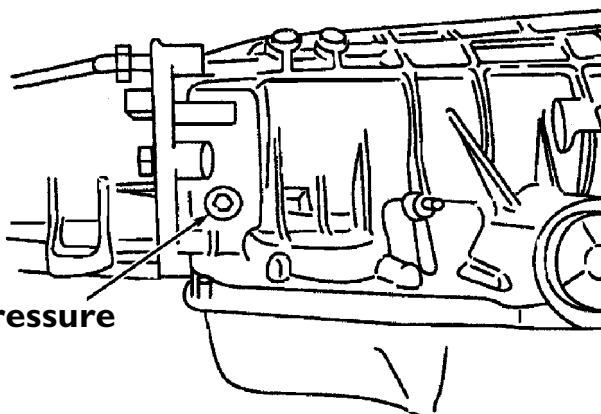
Item	Description	Function
1	Checkball A	Allows checkball C to receive pressure in reverse, manual 2 and manual low
2	Checkball B	Orifices the apply oil to the direct clutch in reverse only
3	Checkball C	Allows the 3-4 shift valve to be controlled by SS1 or Checkball A pressures (reverse, manual 2 or manual low)
4	Checkball E	Low/reverse checkball
5	Converter Relief Valve	Limits the maximum converter charge pressure
6	EPC Relief Valve	Limits the maximum EPC pressure
7	Extension Housing Lube Orifice	Limits the amount of lube oil sent to the rear bushing
8	EPC Screen	Filters EPC oil

4R44E, 4R55E, 5R55E

Mainline and EPC Pressure Testing



Mainline Pressure



EPC Pressure

Transmission	Gear Range	Mainline Pressure (PSI)		EPC Pressure (PSI)	
		Idle	WOT	Idle	WOT
4R44E 2.3L, 2.5L	OD, 2, L	75–100	225–260	20–30	110–135
	Rev	115–145	280–350	35–45	110–135
4R44E 3.0L	OD, 2, L	105–135	225–260	30–40	110–135
	Rev	150–180	280–350	45–55	110–135
4R55E 4.0L	OD, 2, L	85–100	225–260	25–35	110–135
	Rev	95–160	280–350	55–65	110–135
5R55E 4.0L OHV	OD, 2, L	80–115	225–260	25–35	110–135
	Rev	135–165	280–350	55–65	110–135
5R55E 4.0L SOHC	OD, 2, L	95–125	225–260	40–50	110–135
	Rev	100–130	280–350	55–65	110–135

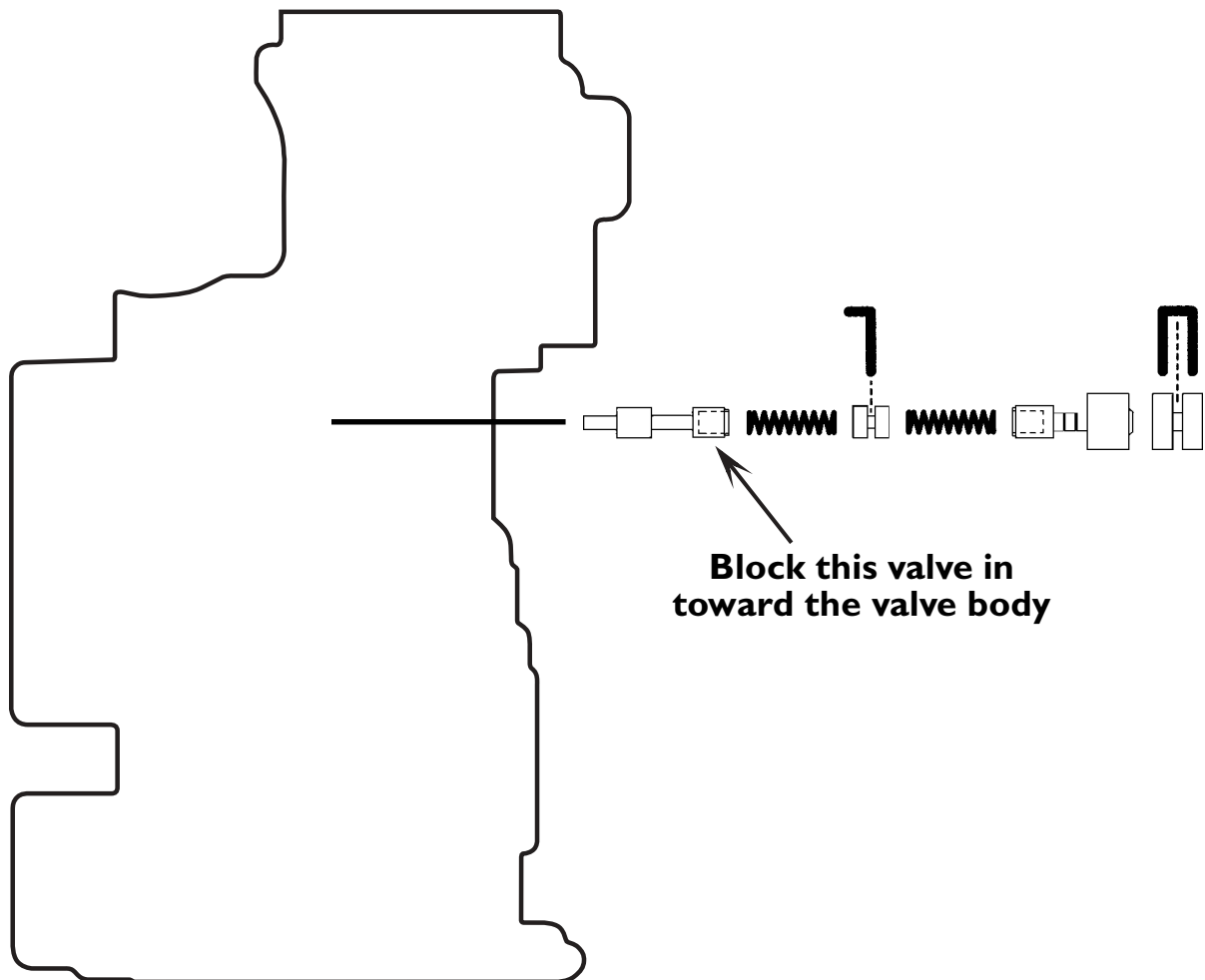
4R44E, 4R55E, 5R55E

Delayed Reverse

Like the A4LD, delayed reverse engagements are common in the 4R44E, 4R55E and 5R55E. And just like the A4LD, there are ways to correct the problem. Here are the most common causes for a delayed reverse:

- 1) Low line pressure.
- 2) Excessive low/reverse band clearance.
- 3) Excessive direct clutch clearance. Direct clutch clearance should be between 0.008" – 0.010" per friction.
- 4) Leaks in the reverse apply circuit, such as direct drum piston seals, direct drum to center support seal rings, intermediate servo, low/reverse servo seals.

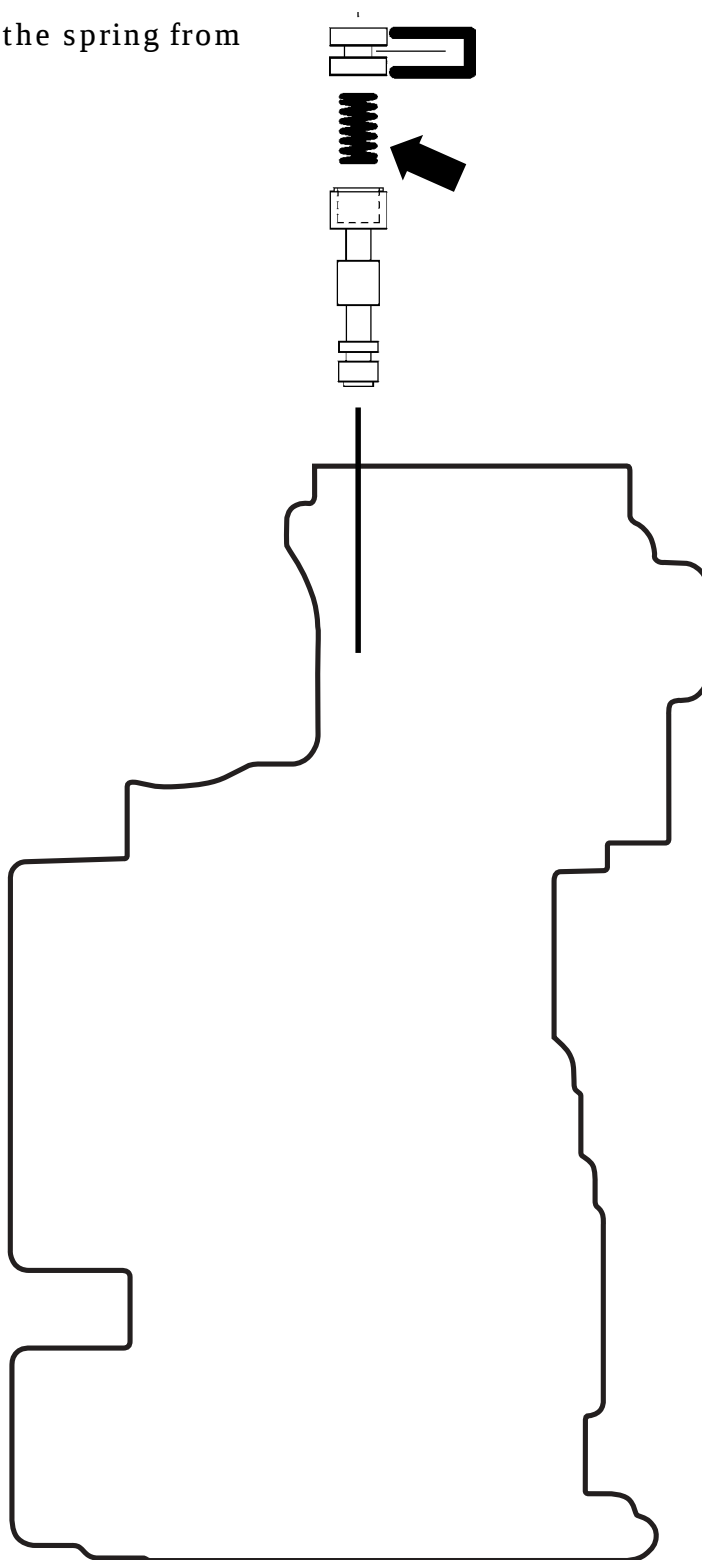
If all of these items are okay and you're still experiencing a delayed reverse engagement, try blocking the reverse modulator valve.



4R44E, 4R55E, 5R55E

Delayed Forward Engagement

To improve forward engagement, remove the spring from the engagement control valve.

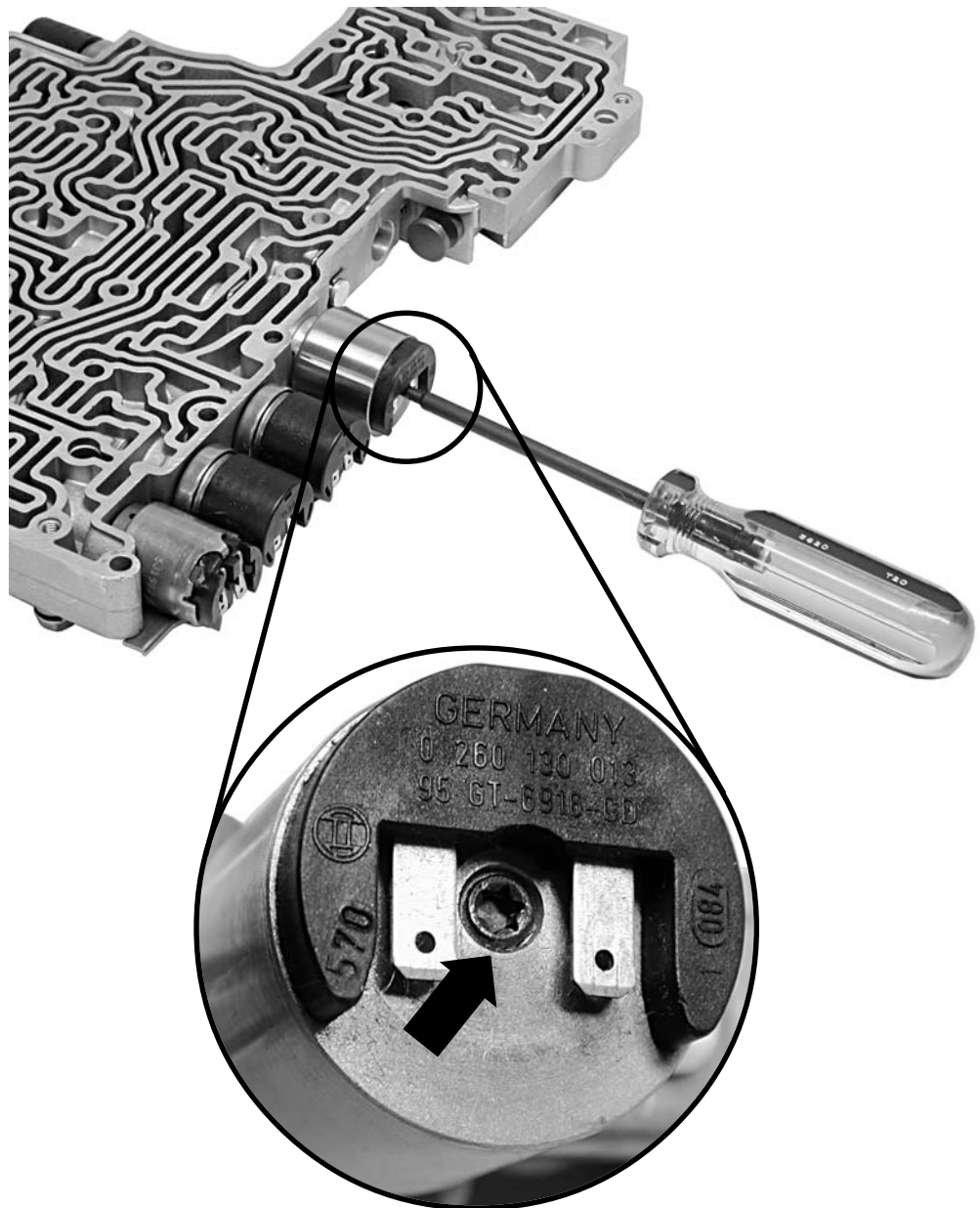


4R44E, 4R55E, 5R55E

2–3 Flare (4R44E, 4R55E); 3–4 Flare (5R55E)

A 2–3 flare on a 4R44E or 4R55E (or a 3–4 flare on the 5R55E) is often caused by low line pressure. The problem isn't that the computer doesn't vary line pressure, or that there's an underlying valve body problem. It's simply the computer doesn't command line pressure high enough to make a proper shift.

If the intermediate servo is in good shape, and you *do* get line pressure variation during throttle changes, try adjusting the pressure control solenoid adjustment screw clockwise, $\frac{3}{4}$ of a turn.

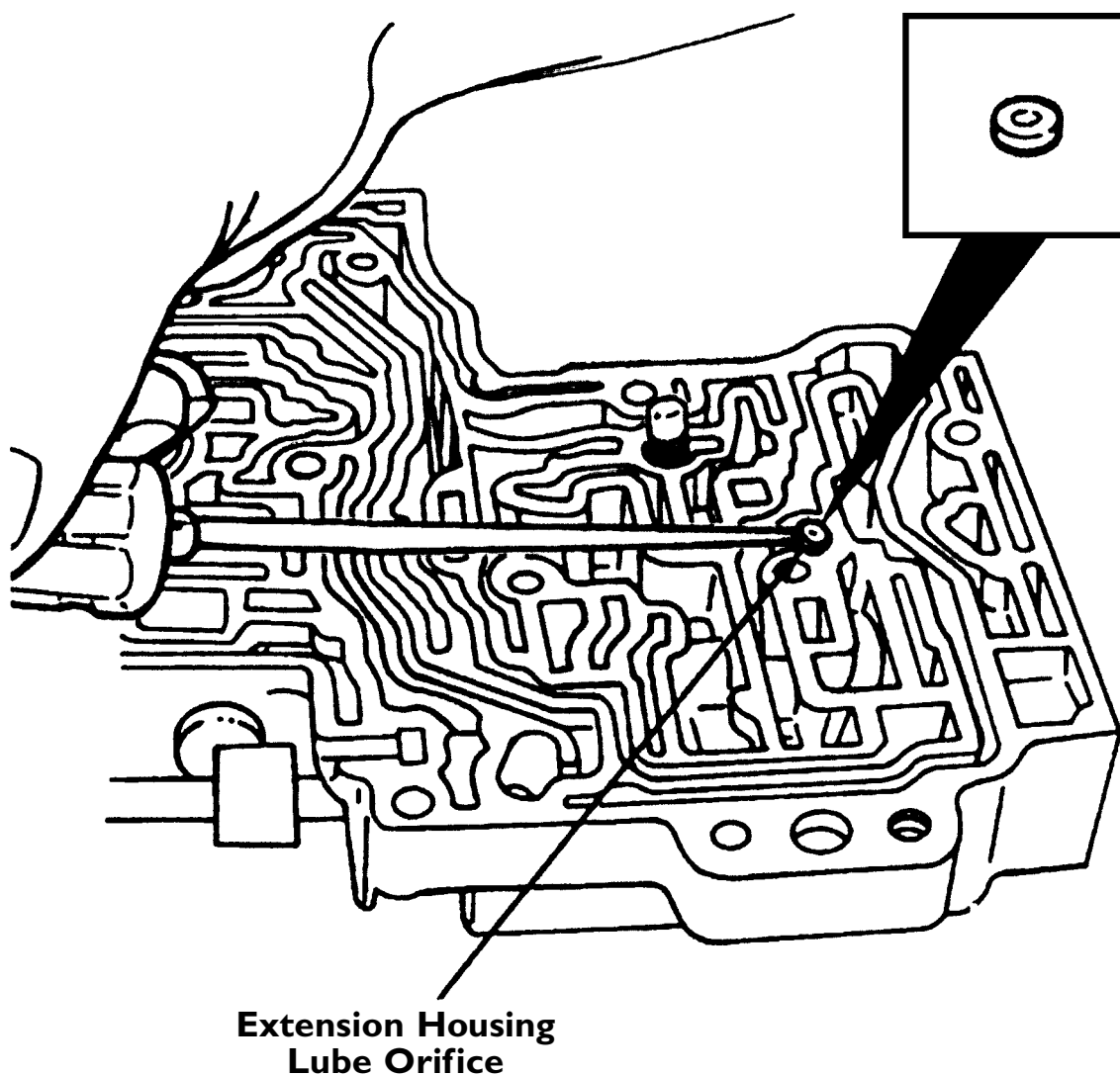


4R44E, 4R55E, 5R55E

Lube Orifice

The removable lube orifice shown here is used to limit the amount of lube oil supplied to the extension housing. Since this circuit receives mainline pressure directly, modifying the orifice or leaving it out will affect line pressure.

Never modify or omit this orifice. If the puck is missing you can use an A4LD valve body puck. Make sure the hole through the center is 0.025".



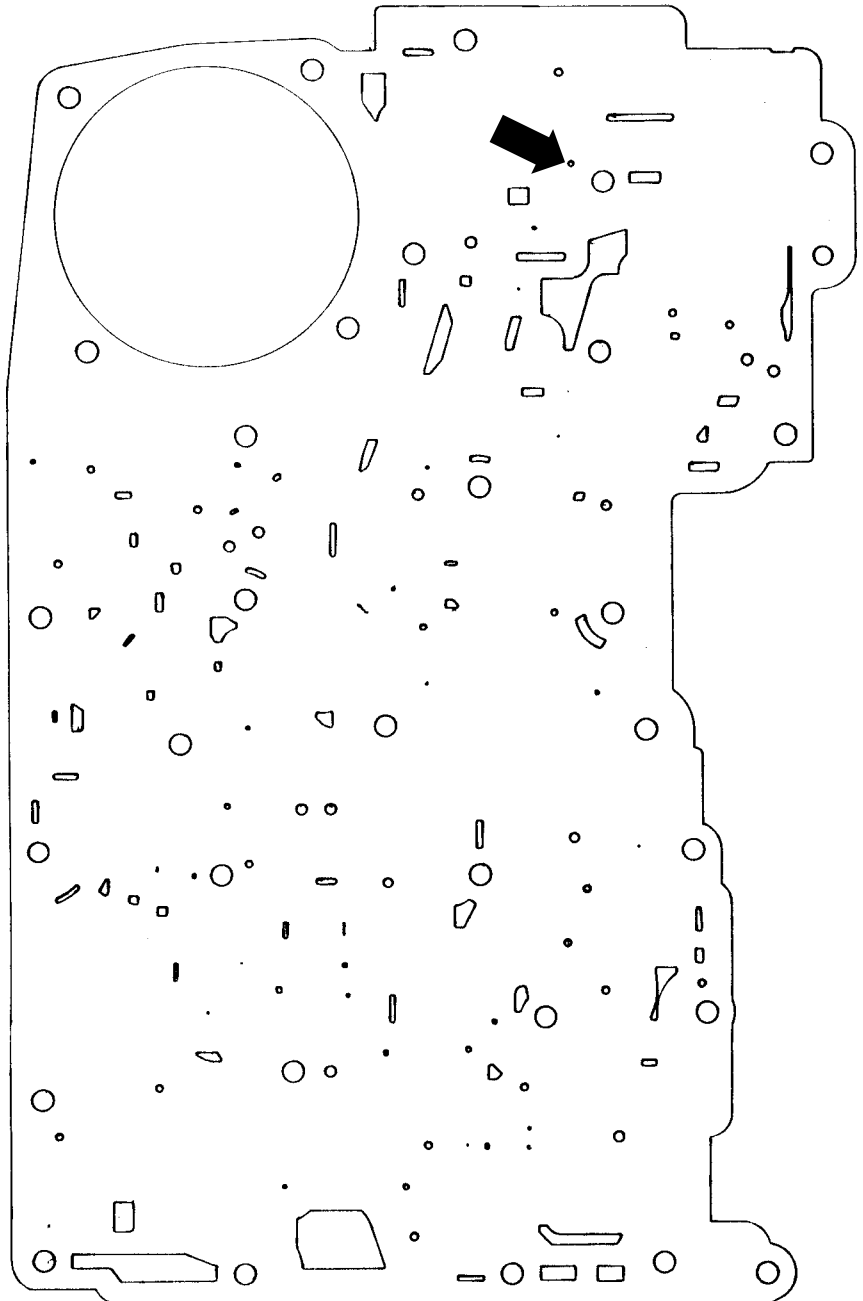
4R44E, 4R55E, 5R55E

Lube Orifice (continued)

Some valve bodies don't have a pocket for a removable orifice. In these valve bodies, the 0.025" orifice is located in the separator plate.

IMPORTANT All valve bodies must have an orifice of one type or the other.

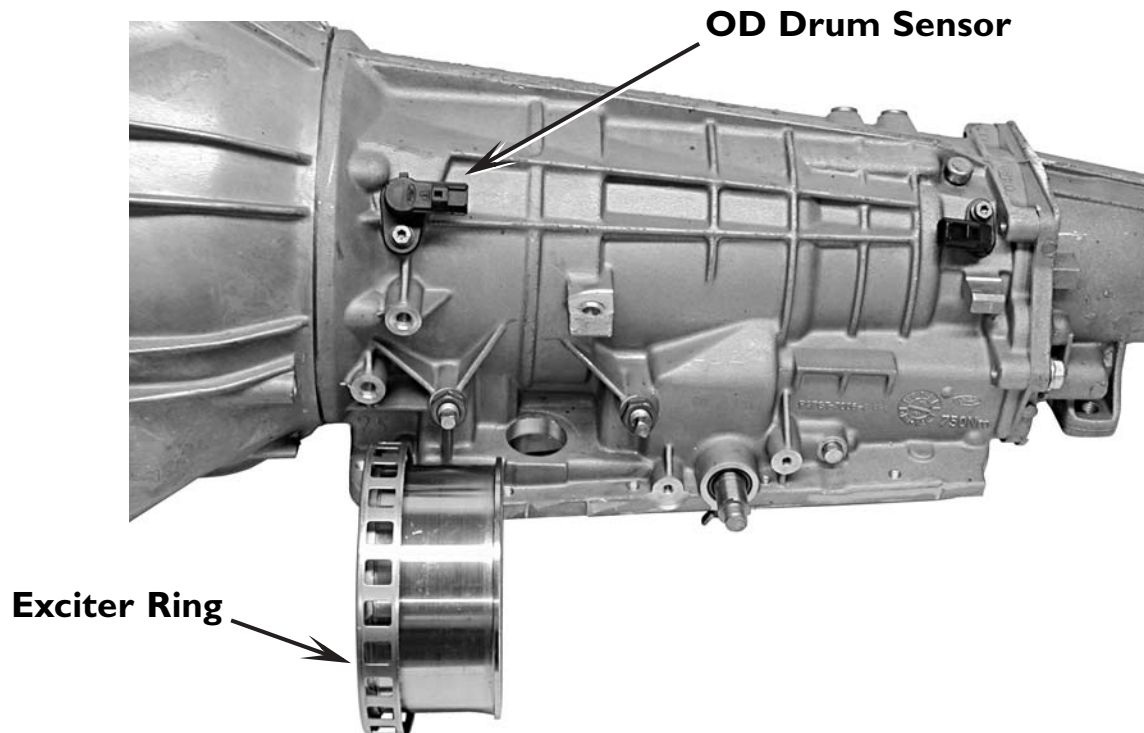
If this orifice is 0.025" in diameter, the lube orifice puck isn't necessary.



4R44E, 4R55E, 5R55E

OD Drum Sensor

Although every 97–98 5R55E was equipped with a fully functional OD drum sensor, Ford not only states that the computer was never programmed to use the signal, but also suggests disabling the sensor.



To disable the OD drum sensor properly, simply splice the two wires together that go to the sensor. This will prevent stray signals from confusing the computer.

4R44E, 4R55E, 5R55E

OD Drum Sensor (continued)

In some cases, the exciter ring can become damaged, causing noises during operation.



The best way to prevent these noises is to remove the exciter ring during every rebuild.



4R44E, 4R55E, 5R55E

Diagnostic Trouble Codes (DTC)

There are many ways to approach trouble codes. Some technicians prefer to diagnose the system completely, while others simply want a list of possibilities to throw parts at the problem. Both of these extremes have their benefits and drawbacks. The true technician knows which approach to choose for a successful diagnosis.

In this section we've tried to offer enough information to aid everyone's approach, including a brief definition of most codes associated with the 4R44E family, common causes, "quick fix" suggestions, and some computer strategies that happen due to certain codes. By strategies, we mean functions that the computer is programmed to change in the event of a trouble code.

Understanding these strategy changes can be useful for diagnosis, or at least offer an explanation when the transmission does something really strange. Very little is published about specific code strategies and even less is given to us by the manufacturer. The code strategies listed in this section are only some we know exist.

Among the first things you should check on a vehicle with electrical codes are the power and grounds supplied to the computer. Poor values in these two circuits can be the root cause of many electrical trouble codes. To keep from repeating this throughout the section, we'll assumed you've already checked these circuits and are known to be good. You must include these in your testing, whether we mention it or not.

4R44E, 4R55E, 5R55E

Solenoid Circuit Failure Codes

P0743, 652:	TCC solenoid open or shorted circuit.
P0750, 621:	SS1 open or shorted circuit.
P0755, 622:	SS2 open or shorted circuit.
P0760, 641:	SS3 open or shorted circuit.
P0765, P1754, 643:	SS4 open or shorted circuit.
P1746, P1747, 624:	EPC solenoid open or shorted circuit.

How the Codes Set:

The computer constantly monitors current flow through each solenoid. If the current goes out of normal range, the computer will set the corresponding code.

Possible Causes:

- 1) Bad wire or poor connections
- 2) Bad solenoid
- 3) Bad computer

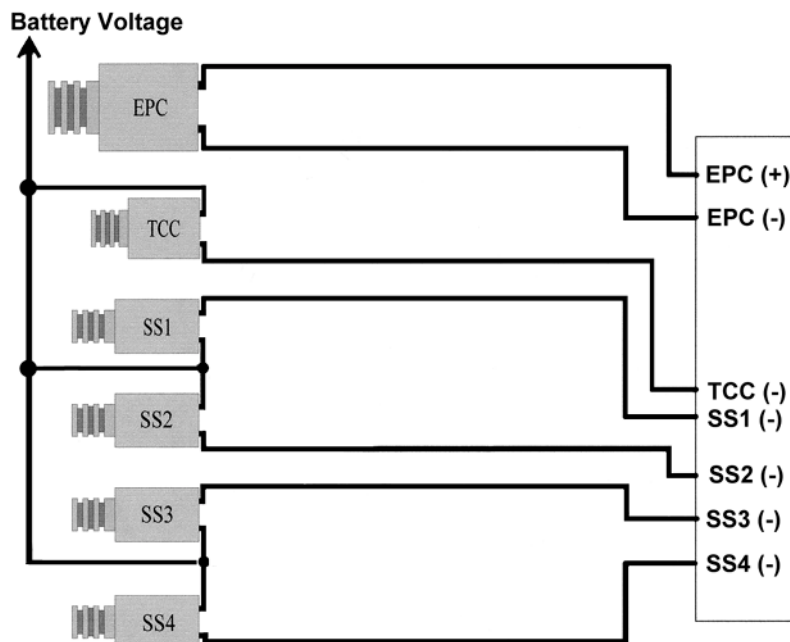
Common Causes:

- 1) Bad connections or wiring
- 2) Bad solenoid

The Quick Fix:

- 1) Clean and tighten related connections.
- 2) Replace the wire that connects the related solenoid to the computer.
- 3) Replace the solenoid.

DIAGNOSTIC TIP Try these suggestions one at a time. The order is simply our suggestion based on simplicity, cost or frequent helpline calls. There is no reason to follow this order.



4R44E, 4R55E, 5R55E

Solenoid Circuit Failure Codes (continued)

Strategies

When the EPC solenoid sets a solenoid circuit code, the computer turns the EPC solenoid off, causing high line pressure and hard shifts.

When the TCC solenoid sets a solenoid circuit code, the computer turns the TCC solenoid off, disabling lockup.

When a shift solenoid circuit code sets, the computer shuts the failed solenoid off. The following charts show the changes in shift patterns due to these strategies.

4R44E / 4R55E Shift Strategies

SS1 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	3 rd	2 nd	*1 st
2 nd	2 nd	2 nd	—
3 rd	3 rd	—	—
4 th	4 th	—	—

* With SS1 always off, the L/R band isn't applied in manual low.

SS3 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	1 st	2 nd	1 st
2 nd	2 nd	2 nd	—
3 rd	3 rd	—	—
4 th	3 rd	—	—

SS2 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	1 st	2 nd	1 st
2 nd	1 st	2 nd	—
3 rd	3 rd	—	—
4 th	4 th	—	—

SS4 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	1 st	2 nd	1 st
2 nd	2 nd	2 nd	—
3 rd	3 rd	—	—
4 th	4 th	—	—

SS4 always off causes no engine braking.

4R44E, 4R55E, 5R55E

Solenoid Circuit Failure Codes (continued)

5R55E Shift Strategies

SS1 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	4 th	3 rd	3 rd
2 nd	5 th	*	—
3 rd	3 rd	—	—
4 th	4 th	—	—
5 th	5 th	—	—

* Overdriven 2nd gear; 1.10:1 ratio.

SS3 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	1 st	3 rd	1 st
2 nd	1 st	3 rd	—
3 rd	3 rd	—	—
4 th	4 th	—	—
5 th	4 th	—	—

SS2 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	1 st	3 rd	1 st
2 nd	2 nd	*	—
3 rd	1 st	—	—
4 th	4 th	—	—
5 th	5 th	—	—

* Overdriven 2nd gear; 1.10:1 ratio.

SS4 Always Off			
Gear Commanded	Actual Gear Range		
	OD	Manual 2	Manual L
1 st	1 st	3 rd	1 st
2 nd	2 nd	*	—
3 rd	3 rd	—	—
4 th	4 th	—	—
5 th	5 th	—	—

* Overdriven 2nd gear; 1.10:1 ratio.

4R44E, 4R55E, 5R55E

Solenoid Circuit Failure Codes (continued)

Diagnostic Suggestions

Here's some useful data you can use to test each solenoid circuit for problems. Perform these tests at the computer connector with the computer disconnected.

- 1) Use the specifications chart for computer pin ID and resistance values. Check resistance between the positive and negative terminals for each solenoid. They should fall between the specs listed.
- 2) Check resistance between the negative terminal and chassis ground. The readings for all solenoids should read infinity (no continuity). This is testing the circuit for shorts to ground.

Solenoid	All Except 95 Explorer	95 Explorer	Resistance (Ohms)
All Solenoids (+)	Pins 71, 97	Pin 37, 57	
EPC (-)	Pin 81	Pin 38	3.1 – 5.7
TCC (-)	Pin 54	Pin 53	8.9 – 16.0
CCS (-)	Pin 28	Pin 28	22.0 – 48.0
SS1 (-)	Pin 27	Pin 51	22.0 – 48.0
SS2 (-)	Pin 1	Pin 52	22.0 – 48.0
SS3 (-)	Pin 53	Pin 55	22.0 – 48.0

CAUTION Always perform these tests with the computer disconnected.

Because the computer monitors the amperage through each of the solenoid circuits, it's able to identify an open or shorted circuit quickly and accurately. The computer is also programmed to shut the solenoid circuit off to save the computer from possible damage.

4R44E, 4R55E, 5R55E

Solenoid Circuit Failure Codes (continued)

Diagnostic Suggestions (continued)

Amperage testing is much more accurate than resistance testing. Always use amperage testing to verify resistance testing.

- 3) To perform an amperage test, use a jumper to connect B+ to the positive solenoid feed terminal at the computer connector. Ground the solenoid negative wire to chassis ground through an ammeter. Use the following equation to calculate the expected amperage, or simply use the chart.

$$\text{Volts} \div \text{Resistance} = \text{Amperage}$$

Calculated Amperage

System Voltage	Solenoid Resistance					
	EPC Solenoid		TCC Solenoid		Shift Solenoids	
	3.1 Ohms	5.7 Ohms	8.9 Ohms	16 Ohms	22 Ohms	48 Ohms
12.5 Volts	4.03	2.19	1.40	0.78	0.57	0.26
13.0 Volts	4.19	2.28	1.46	0.81	0.59	0.27
13.5 Volts	4.35	2.37	1.52	0.84	0.61	0.28
14.0 Volts	4.52	2.46	1.57	0.88	0.64	0.29
14.5 Volts	4.68	2.54	1.63	0.91	0.66	0.30
15.0 Volts	4.84	2.63	1.69	0.94	0.68	0.31

4R44E, 4R55E, 5R55E

Ratio Errors

P0731, 645	1 st Gear Ratio Error
P0732, 646	2 nd Gear Ratio Error
P0733, 647	3 rd Gear Ratio Error
P0734, 648	4 th Gear Ratio Error
P0735	5 th Gear Ratio Error

Possible Related Codes

P1714, P0751, P1751	SS1 Functional Failure
P1715, P0756, P1756	SS2 Functional Failure
P1716, P0761, P1761	SS3 Functional Failure
P1717	SS4 Malfunction
P1762	SS3/SS4/OD Band Servo Failure

How the Codes Set

The computer constantly monitors the actual gear ratio by calculating the output speed and the engine RPM or the turbine speed sensor. When it sees a ratio that differs from the ratio it commanded, the computer sets the trouble code that represents the failure.

False Codes

False codes can be set by false signals from the transmission range sensor. For example: If the transmission range sensor signals OD range, but you're actually in manual low, the computer will expect to see an upshift.

Possible Causes

- 1) Internal components (see component failure chart for more detail)
- 2) Hydraulically bad shift solenoids
- 3) Sticky valves
- 4) Bad transmission range sensor

Common Causes

- 1) Low line pressure or poor line rise
- 2) Bad servos
- 3) Internal components

4R44E, 4R55E, 5R55E

Ratio Errors (continued)

The Quick Fix

For ratio errors there really is no quick fix. If you decide to throw parts at it, new OD and intermediate servos are a must. The rest is up to you. If you want to do it properly, follow the diagnostic suggestions.

Diagnostic Suggestions

Determine whether you're reading a false code or a real ratio error.

- 1) Drive the vehicle on the road until the code resets. Does the transmission have the gear in question?
- 2) Drive the vehicle on the rack with no load to see if the code sets.

Results when Code Sets		Probable Cause
Road Test	Rack Test	
Missing Gear	Missing Gear	Bad Solenoids; Sticky Valves; Internal Components
Missing Gear	Has Gear	Internal Components
Slips in Gear	Has Gear	Internal Components
Gear Feels Fine	No Code Sets	Internal Components
Gear Feels Fine	Has Gear	False Code

This chart is based on logic. For example, if you had a 4R44E setting a code P0734 (4th gear ratio error), it could be a control problem (sticky 3–4 shift valve or a bad SS3), an internal component (bad OD servo or a bad OD band) or it could be a false code (range sensor or even a computer).

- If it is missing or slipping in gear, it can't be a false code.
- If it has the gear at fault but slips it can't be a control problem or a false code.
- If it sets the code on the rack, it's very likely it's a false code, because on the rack there's no load.

Use the chart as a guide only.

4R44E, 4R55E, 5R55E

Ratio Errors (continued)

Component Failure Chart

This chart will help identify the major components that can cause each ratio code.

Code	4R44E / 4R55E	5R55E
P0731, 645	Low Sprag; Forward Clutch	Low Sprag; Forward Clutch
P0732, 646	Intermediate Band	Overdrive Band
P0733, 647	Direct Clutch	Intermediate Band
P0734, 648	Overdrive Band	Direct Clutch
P0735	N/A	Overdrive Band

Many things can set ratio codes. This chart only displays the major ones.

4R44E, 4R55E, 5R55E

TCC-Related Codes

P1740, P1743	TCC Stuck On, TCC Never Applied
P0741, P1744, 628	TCC Slip

How the Codes Set

P1740: The computer either sees no TCC apply when commanded or it sees TCC when it isn't commanded.

P1743: The computer detects lockup when it isn't being commanded.

P0741, P1744, 628: The computer sees an RPM drop indicating the converter is trying to lock up but it's slipping.

Possible Causes

- 1) Teflon seal ring on stator support
- 2) Pump volume problem
- 3) Bad TCC solenoid
- 4) Bad torque converter

Common Causes

- 1) Teflon seal ring on stator support
- 2) Pump volume problems

The Quick Fix

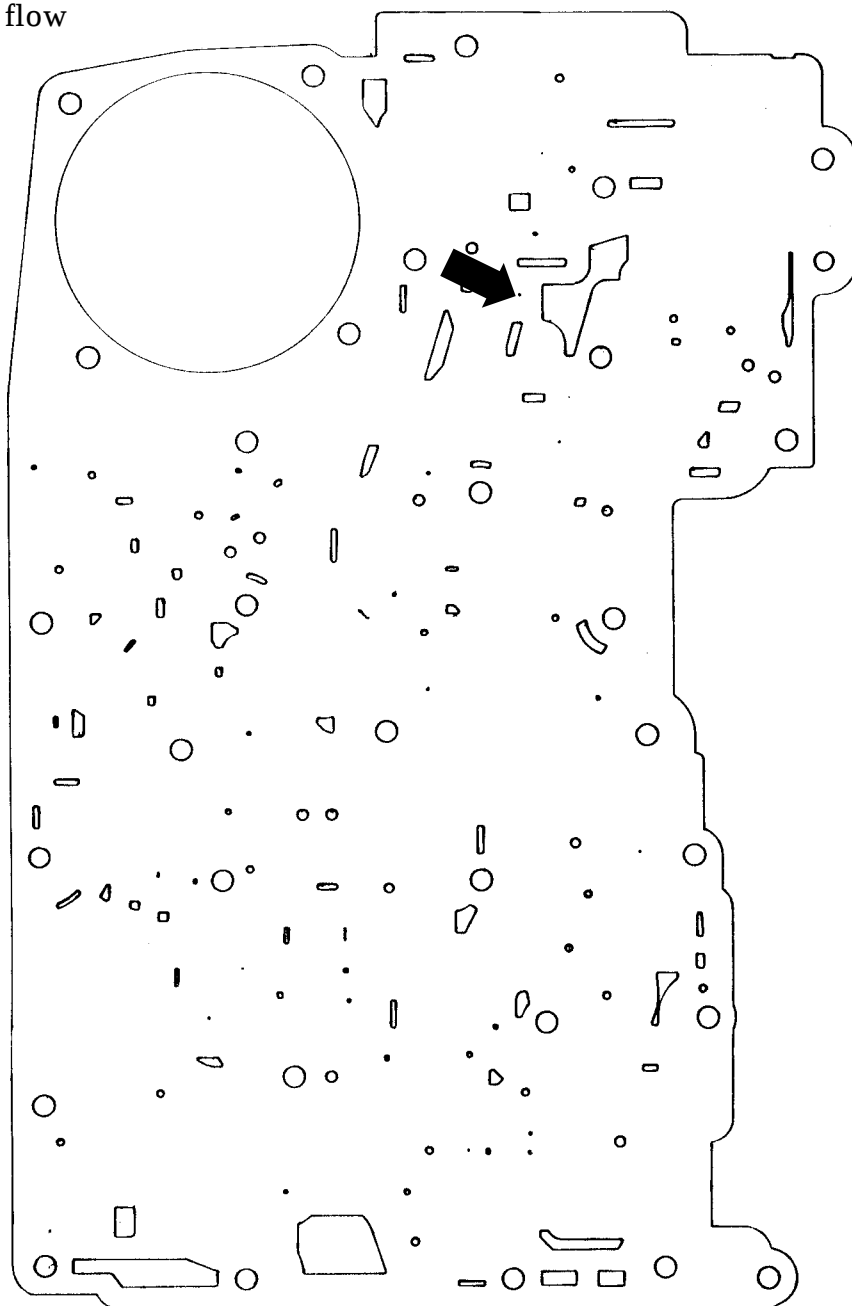
Try replacing the TCC solenoid.

4R44E, 4R55E, 5R55E

TCC-Related Codes (continued)

Diagnostics

- 1) If the code comes back and the transmission is still in the vehicle, check cooler flow. Remove the cooler return line: At normal operating temperature, cooler flow should be at least 1 quart in 20 seconds, in drive, at idle.
- 2) Check line pressure. If cooler flow is less than 1 quart in 20 seconds and line pressure is normal, try enlarging the converter feed hole to 0.060".



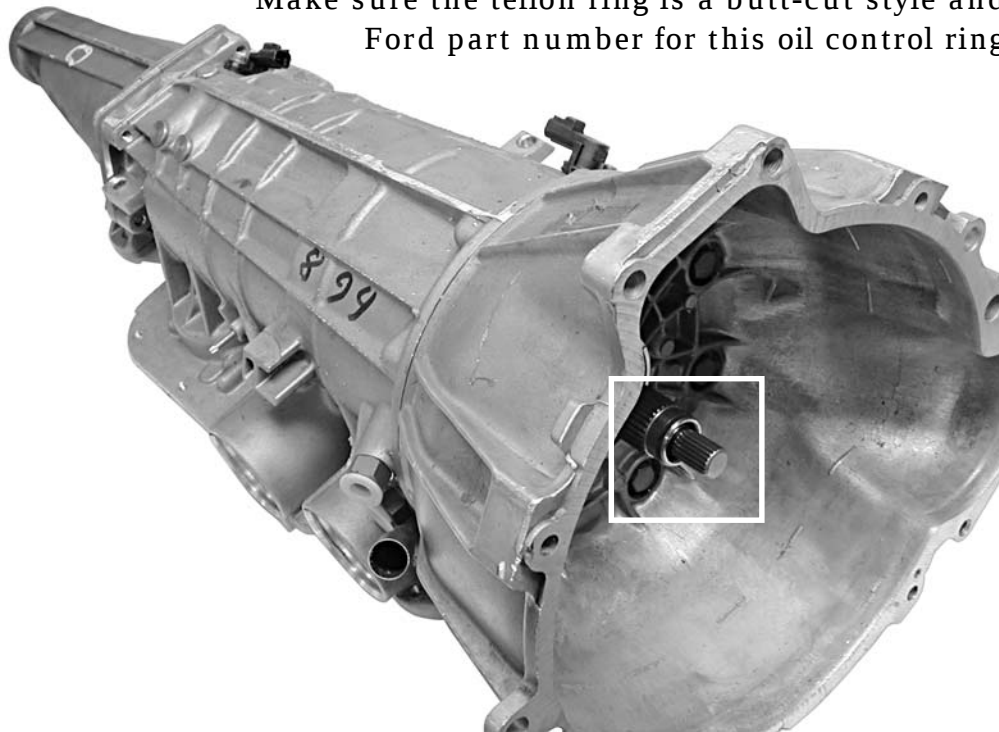
4R44E, 4R55E, 5R55E

TCC-Related Codes (continued)

Diagnostics (continued)

- 3) If the code continues to set with good cooler flow and a new TCC solenoid, the problem is probably either the torque converter or the teflon ring on the stator support.

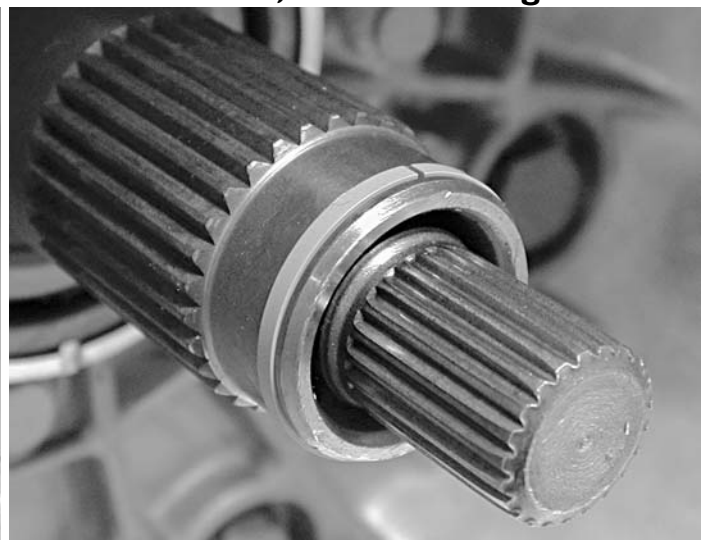
Make sure the teflon ring is a butt-cut style and not a scarf cut. The Ford part number for this oil control ring is F77Z-7L323-AA.



Early, Scarf-Cut Ring



Late, Butt-Cut Ring



4R44E, 4R55E, 5R55E

Temperature Sensor Codes

P0112, 112 Intake Air Temperature (IAT) Sensor Grounded
P0113, 113 Intake Air Temperature (IAT) Sensor Open
P0114, 114 Intake Air Temperature (IAT) Sensor Out of Range

Possible Causes:

- Bad sensor
- Bad wiring

Strategies: Either high or low EPC pressure (hard or soft shifts)

P0117, 117 Engine Coolant Temperature (ECT) Sensor Grounded
P0118, 118 Engine Coolant Temperature (ECT) Sensor Open
P1116, 116 Engine Coolant Temperature (ECT) Sensor Out of Range

Possible Causes:

- Bad sensor
- Bad wiring

Strategies: No lockup

P0712, 638 Transmission Fluid Temperature (TFT) Sensor Grounded
P0713, 637 Transmission Fluid Temperature (TFT) Sensor Open
P1711, 636 Transmission Fluid Temperature (TFT) Sensor Out of Range
P1783, 657 Transmission Fluid Temperature is Too High

Possible Causes:

- Bad sensor
- Bad wiring

Strategies: High EPC pressure (hard shifts)

Degrees C	Degrees F	Sensor Resistance	Signal Voltage
0 – 20	32 – 68	100.0k – 37.0k	3.90 – 3.10
21 – 40	69 – 104	37.0k – 16.0k	3.10 – 2.20
41 – 70	105 – 158	16.0k – 5.0k	2.20 – 1.00
71 – 90	159 – 194	5.0k – 2.7k	1.00 – 0.61
91 – 110	195 – 230	2.7k – 1.5k	0.61 – 0.36
111 – 130	231 – 266	1.5k – 0.8k	0.36 – 0.22
131 – 150	267 – 302	800 – 540	0.22 – 0.10

4R44E, 4R55E, 5R55E

Throttle Position Sensor (TPS) Codes

**P0121 – P0123, P1120, P1121,
P1124, P1125, 122 – 125, 167**

Throttle Position Sensor (TPS) Signal Error

Possible Causes:

- Bad sensor
- Bad wiring

Various Strategies

- 1) High EPC pressure
- 2) Abnormal shift scheduling
- 3) TCC cycling
- 4) No TCC

Throttle Opening	Approx. Voltage
Idle	0.50
1/8	0.95
1/4	1.44
3/8	1.90
1/2	2.37
5/8	2.84
3/4	3.31
7/8	3.78
WOT	4.24

Mass Airflow (MAF) Sensor Codes

**P0102, P0103, P1100,
P1101, 157 – 159, 184, 185**

Mass Airflow (MAF) Sensor Signal Error

Possible Causes:

- Bad sensor
- Bad wiring

Various Strategies

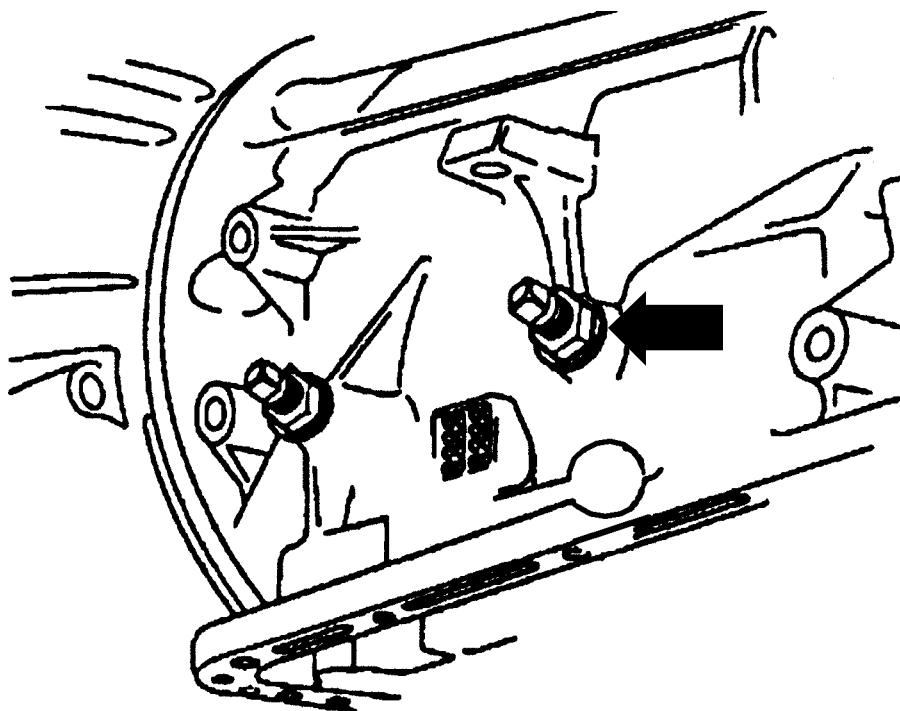
- 1) High EPC pressure, harsh shifts
- 2) Low EPC pressure, soft shifts
- 3) Abnormal shift scheduling
- 4) Incorrect TCC engagement scheduling

4R44E, 4R55E, and 5R55E

Diagnostic Code P0756 — Solenoid B Performance or Stuck Off

DTC P0756 sets when the computer commands the intermediate servo on and doesn't see a ratio change.

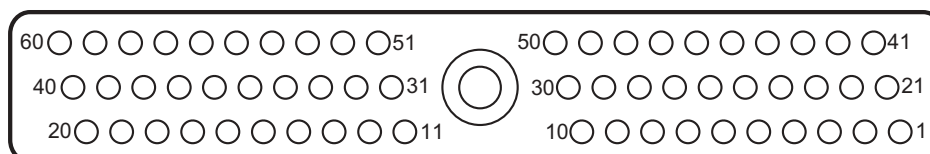
Before you jump into electrical testing or replace shift solenoid 2 (P0756 is a generic code for solenoid B. In this application the solenoid is referred to as SS2), first check to see if the intermediate band is broken. The best way to check for a broken band is to see if you can turn the band adjustment bolt in, until it's almost flush. If so, replace the band.



4R44E, 4R55E, 5R55E

Electrical Checks

1995 Explorer 4.0L VIN-X



Computer Connector

Terminal	Circuit Description	Signal Type	Conditions	Value
1	Keep-Alive Power (KAPWR)	DC Volts	Always	Battery Voltage
2	Brake On-Off Switch (BOO)	DC Volts	Brake Released	<0.10 Volts
			Brake Applied	Battery Voltage
3	Vehicle Speed Sensor (VSS+)	AC Frequency	30 MPH	65 Hz
			55 MPH	125 Hz
4	Ignition Diagnostic Monitor (IDM)	DC Frequency	Idle	21 – 31 Hz
5	Turbine Speed Sensor (TSS)	AC Frequency	880–910 RPM	118 – 122 Hz
			2200–2275 RPM	295 – 310 Hz
6	Vehicle Speed Sensor (VSS–)	DC Voltage	Always	<0.10 Volts
7	Engine Coolant Temperature Sensor (ECT)	DC Voltage	86° F	2.62 Volts
			230° F	0.36 Volts
8	Fuel Pump Monitor (FPM)	DC Voltage	Pump Off	<0.10 Volts
			Pump On	Battery Voltage
9	Mass Airflow Sensor Ground (MAF)	DC Voltage	Always	<0.10 Volts
10	A/C Cycling Clutch Switch	DC Voltage	A/C Off	<0.10 Volts
			A/C On	Battery Voltage
11	Canister Purge Solenoid (CANP)	DC Voltage	Idle	Battery Voltage
			55 MPH	<0.10 Volts
12	Fuel Injector 6 (INJ6)	Millisecond On-Time	Idle; Normal Operating Temp.	3.3 – 5.7 ms
13	Transmission Control Indicator Light (TCIL)	DC Voltage	TCIL Off	Battery Voltage
			TCIL On	<0.10 Volts
15	Fuel Injector 5 (INJ5)	Millisecond On-Time	Idle; Normal Operating Temp.	3.3 – 5.7 ms
16	Ignition System Ground (IGN GND)	DC Voltage	Always	<0.10 Volts
17	Self-Test Output (STO) and MIL	DC Voltage	MIL Off	Battery Voltage
			MIL On	<0.10 Volts

4R44E, 4R55E, 5R55E

Electrical Checks (continued)

1995 Explorer 4.0L VIN-X (continued)

Terminal	Circuit Description	Signal Type	Conditions	Value
18	Data Bus (+)	DC Voltage	Key Off; Scan Tool Removed	<0.10 Volts
			Key On; Scan Tool Removed	Battery Voltage
19	Data Bus (-)	DC Voltage	Always	<0.10 Volts
20	Computer Case Ground	DC Voltage	Always	<0.10 Volts
21	Idle Air Control Solenoid (IAC)	DC Frequency and Duty Cycle	Engine Running	Varying Voltage, Freq. and Duty
22	Fuel Pump Relay (FP)	DC Voltage	Pump Off	Battery Voltage
			Pump On	<0.10 Volts
24	Cylinder Identification (CID or CMP)	DC Frequency	Hot Idle	5 – 7Hz
25	Idle Air Temperature Sensor (IAT)	DC Voltage	86° F	2.62 Volts
			230° F	0.36 Volts
26	Reference Voltage (VREF)	DC Voltage	Key On	4.9 – 5.1V
27	Differential Pressure Feedback EGR (DPFE)	DC Voltage	Idle	0.4 Volts
			EGR Open	>0.4 Volts
29	Octane Adjust Switch	DC Voltage	Closed	<0.10 Volts
			Open	9.1 Volts
30	Manual Lever Position Switch (MLPS)	DC Voltage	P	4.2 Volts
			R	3.5 Volts
			N	2.8 Volts
			D	2.1 Volts
			2	1.4 Volts
			L	0.7 Volts
31	Fuel Flow Rate (Instrument Panel)	No Data Available		
32	Coast Clutch Solenoid	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
33	EGR Vacuum Regulator Solenoid	Duty Cycle	0%	0.00 – 0.75 in-Hg
			33%	0.55 – 2.05 in-Hg
			90%	5.69 – 6.95 in-Hg
34	Automatic Ride Control (ARC)	DC Voltage	Idle	4.3 Volts
35	Fuel Injector 4 (INJ4)	Millisecond On-Time	Idle; Normal Operating Temp.	3.3 – 5.7 ms
36	Spark Output (SPOUT) Signal	Variable Duty and Frequency	Engine Running	Varies with RPM and Load
37	Vehicle Power (VPWR)	DC Voltage	Key Off	<0.10 Volts
			Key On	Battery Voltage

4R44E, 4R55E, 5R55E

Electrical Checks (continued)

1995 Explorer 4.0L VIN-X (continued)

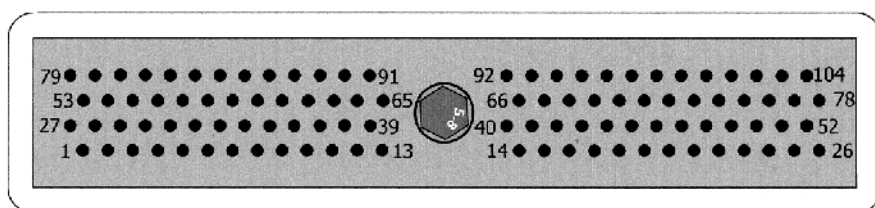
Terminal	Circuit Description	Signal Type	Conditions	Value
38	Electronic Pressure Control Solenoid (EPC)	Duty Cycle	Idle	4.2 Volts
			WOT	0.5 Volts
39	Fuel Injector 3 (INJ3)	Millisecond On-Time	Idle; Normal Operating Temp.	3.3 – 5.7 ms
40	Ground	DC Voltage	Always	<0.10 Volts
41	Transmission Control Switch (TCS)	DC Voltage	TCS and OD Off	Battery Voltage
			TCS and OD On	<0.10 Volts
43	Heated Oxygen Sensor, Left Side (HO2S-2)	DC Voltage	Engine Running	0–1V; Varies
44	Heated Oxygen Sensor, Right Side (HO2S-1)	DC Voltage	Engine Running	0–1V; Varies
46	Sensor Ground	DC Voltage	Always	<0.10 Volts
47	Throttle Position Sensor Signal (TP)	DC Voltage	Idle	0.5 – 0.9 Volts
			WOT	4.0 – 4.5 Volts
48	Self-Test Input Signal (STI)	DC Voltage	Normal	Battery Voltage
			Grounded	<0.10 Volts
49	Transmission Fluid Temperature Sensor (TFT)	DC Voltage	86° F	2.62 Volts
			230° F	0.36 Volts
50	Mass Airflow Sensor Signal (MAF)	DC Voltage	Engine Running	0–5 Volts; Incr. w/Throttle Opening
51	Shift Solenoid 1 (SS1)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
52	Shift Solenoid 2 (SS2)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
53	Torque Converter Clutch Solenoid (TCC)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
54	Wide-Open Throttle A/C Cutoff	DC Voltage	A/C On; Idle	Battery Voltage
			A/C On; WOT	<0.10 Volts
55	Shift Solenoid 3 (SS3)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
56	Profile Ignition Pickup Signal (PIP)	DC Frequency	Engine Running	Increases with Engine RPM
57	Vehicle Power (VPWR)	DC Voltage	Key Off	<0.10 Volts
			Key On	Battery Voltage
58	Fuel Injector 1 (INJ1)	Millisecond On-Time	Idle; Normal Operating Temp.	3.3 – 5.7 ms
59	Fuel Injector 2 (INJ2)	Millisecond On-Time	Idle; Normal Operating Temp.	3.3 – 5.7 ms
60	Ground	DC Voltage	Always	<0.10 Volts

4R44E, 4R55E, 5R55E

Electrical Checks (continued)

1995–97 Aerostar; 1995-on Ranger; 1996-on Explorer/Mountaineer

Because of the number of vehicles these charts cover, some of the terminals listed may not appear on the vehicle you're working on. But only terminal 64 changes function.



Computer Connector

Terminal	Circuit Description	Signal Type	Conditions	Value
1	Shift Solenoid 2 (SS2)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
2	Malfunction Indicator Lamp (MIL)	DC Voltage	MIL Off	Battery Voltage
			MIL On	<0.10 Volts
3	Digital Transmission Range Sensor (TR1) 1997- on	DC Voltage	P, R and N	<0.10 Volts
			D, 2 and L	9.5 Volts
11	Purge Flow Sensor (PF)	DC Voltage	Idle	<0.10 Volts
			30 MPH	1.0 – 4.9 Volts
13	Flash EPROM Power Supply	DC Voltage	Scan Tool Removed	0.5 – 0.6 Volts
14	4x4 Low Switch	DC Voltage	Switch Off	Battery Voltage
			Switch On	<0.10 Volts
15	Data Bus (–)	DC Voltage	Scan Tool Removed	<0.10 Volts
16	Data Bus (+)	DC Voltage	Scan Tool Removed	0.5 Volts
21	Crankshaft Position Sensor (+)	AC Frequency	Engine Off	0 Hz
			Engine Running	Increases w/RPM
22	Crankshaft Position Sensor (–)	DC Voltage	Always	<0.10 Volts
24	Ground (–)	DC Voltage	Always	<0.10 Volts
25	Case Ground (–)	DC Voltage	Always	<0.10 Volts
26	Ignition Coil Driver 1	Duty Cycle	Key Off	<0.10 Volts
			Key On	Battery Voltage
27	Shift Solenoid 1 (SS1)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
28	Coast Clutch Solenoid (CCS)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
29	Transmission Control Switch (TCS)	DC Voltage	TCS and OD Off	Battery Voltage
			TCS and OD On	<0.10 Volts

4R44E, 4R55E, 5R55E

Electrical Checks (continued)

1995–97 Aerostar; 1995-on Ranger; 1996-on Explorer/Mountaineer

Terminal	Circuit Description	Signal Type	Conditions	Value
30	Octane Adjust Switch		Closed	<0.10 Volts
			Open	9.3 Volts
31	Power Steering Pressure Switch	DC Voltage	Wheels Straight	<0.10 Volts
			Wheels Turning	2.0 – 4.0 Volts
33	Vehicle Speed Sensor (VSS–)	DC Voltage	Always	<0.10 Volts
35	Heated Oxygen Sensor, RR (HO2S-1,2)	DC Voltage	Engine Running	0–1V; Varies
36	Mass Airflow Sensor Ground (–)	DC Voltage	Always	<0.10 Volts
37	Transmission Fluid Temperature Sensor (TFT)	DC Voltage	86° F	2.62 Volts
			230° F	0.36 Volts
38	Engine Coolant Temperature Sensor (ECT)	DC Voltage	86° F	2.62 Volts
			230° F	0.36 Volts
39	Intake Air Temperature Sensor (IAT)	DC Voltage	86° F	2.62 Volts
			230° F	0.36 Volts
40	Fuel Pump Monitor (FPM)	DC Voltage	Pump Off	<0.10 Volts
			Pump On	Battery Voltage
41	A/C Cycling Clutch Switch	DC Voltage	A/C Off	<0.10 Volts
			A/C On	Battery Voltage
47	EGR Vacuum Regulator Solenoid	Duty Cycle	0%	0.00 – 0.75 in-Hg
			33%	0.55 – 2.05 in-Hg
			90%	5.69 – 6.95 in-Hg
48	Engine RPM Output	DC Frequency	Engine Off	0 Hz
			Engine Running	Varies with RPM
49	Digital Transmission Range Sensor (TR2) 1997-on	DC Voltage	P, R and 2	<0.10 Volts
			N, D and L	9.5 Volts
50	Digital Transmission Range Sensor (TR4) 1997-on	DC Voltage	P, N and Low	<0.10 Volts
			R, D and 2	9.5 Volts
51	Ground (–)	DC Voltage	Always	<0.10 Volts
52	Ignition Coil Driver 2	Duty Cycle	Key Off	<0.10 Volts
			Key On	Battery Voltage
53	Shift Solenoid 3 (SS3)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
54	Torque Converter Clutch (TCC) Solenoid	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
55	Keep-Alive Power (KAPWR)	DC Voltage	Always	Battery Voltage

4R44E, 4R55E, 5R55E

Electrical Checks (continued)

1995–97 Aerostar; 1995-on Ranger; 1996-on Explorer/Mountaineer

Terminal	Circuit Description	Signal Type	Conditions	Value
58	Vehicle Speed Sensor (VSS+)	AC Frequency	30 MPH	65 Hz
			55 MPH	125 Hz
59	*Overdrive Drum Speed Sensor	AC Frequency	Input Shaft Turning	Increases w/RPM
60	Heated Oxygen Sensor, RF (HO2S-1,1)	DC Voltage	Engine Running	0–1V; Varies
62	Fuel Tank Pressure Sensor	DC Voltage	0 PSI	2.6 Volts
64	Manual Lever Position Sensor (MLPS) 1995 and 96 only	DC Voltage	P	4.2 Volts
			R	3.5 Volts
			N	2.8 Volts
			D	2.1 Volts
			2	1.4 Volts
			L	0.7 Volts
	Digital Transmission Range Sensor TR3A 1997-on	DC Voltage	P, 2 and L	<0.10 Volts
			R, N and D	1.7 Volts
65	Differential Pressure Feedback EGR (DPFE)	DC Voltage	Idle	0.4 Volts
			EGR Open	>0.4 Volts
67	Evaporative Canister Purge Solenoid (EVAP)	DC Voltage	Solenoid Off	Battery Voltage
			Solenoid On	<0.10 Volts
69	Wide-Open Throttle A/C Cutoff	DC Voltage	A/C On; Idle	Battery Voltage
			A/C On; WOT	<0.10 Volts
71	PCM Power Relay	DC Voltage	Key Off	<0.10 Volts
			Key On	Battery Voltage
73	Fuel Injector 5 (INJ5)	Millisecond On-Time	Idle; Normal Operating Temp.	4.5 – 4.8 ms
74	Fuel Injector 3 (INJ3)	Millisecond On-Time	Idle; Normal Operating Temp.	4.5 – 4.8 ms
75	Fuel Injector 1 (INJ1)	Millisecond On-Time	Idle; Normal Operating Temp.	4.5 – 4.8 ms
76	Ground	DC Voltage	Always	<0.10 Volts
77	Ground	DC Voltage	Always	<0.10 Volts
78	Coil Driver 3	Duty Cycle	Key Off	<0.10 Volts
			Key On	Battery Voltage
79	Transmission Control Indicator Lamp (TCIL)	DC Voltage	TCIL Off	<0.10 Volts
			TCIL On	Battery Voltage

* When the Overdrive Drum Speed Sensor is disabled properly, there should be no signal on terminal 59.

4R44E, 4R55E, 5R55E

Electrical Checks (continued)

1995–97 Aerostar; 1995-on Ranger; 1996-on Explorer/Mountaineer

Terminal	Circuit Description	Signal Type	Conditions	Value
80	Fuel Pump Relay (FP)	DC Voltage	Pump Off	Battery Voltage
			Pump On	<0.10 Volts
81	Electronic Pressure Control Solenoid (EPC)	Duty Cycle	Idle	4.0 – 4.5 Volts
			WOT	0.5 – 0.8 Volts
83	Idle Air Control Solenoid (IAC)	DC Frequency and Duty Cycle	Engine Running	Varying Voltage, Freq. and Duty
84	Turbine Shaft Speed Sensor	AC Frequency	880 – 910 RPM	118 – 122 Hz
			2200 – 2275 RPM	295 – 310 Hz
85	Cylinder Identification Signal (CMP)	DC Frequency	Engine Off	0 Hz
			Engine Running	Varies w/RPM
87	Heated Oxygen Sensor, LF (HO2S-2,1)	DC Voltage	Engine Running	0–1V; Varies
88	Mass Airflow Sensor Signal (MAF)	DC Voltage	Engine Running	0–5 Volts; Incr. w/Throttle Opening
89	Throttle Position Sensor Signal (TP)	DC Voltage	Idle	0.5 – 0.9 Volts
			WOT	4.0 – 4.5 Volts
90	Reference Voltage	DC Voltage	Key On	4.9–5.1V
91	Sensor Ground	DC Voltage	Always	<0.10 Volts
92	Brake On/Off Switch Signal (BOO)	DC Voltage	Brake Released	<0.10 Volts
			Brake Applied	Battery Voltage
93	HO2S Heater; Right Front (HO2S-1,1)	DC Voltage	Heater Off	<0.10 Volts
			Heater On	Battery Voltage
94	HO2S Heater; Left Front (HO2S-2,1)	DC Voltage	Heater Off	<0.10 Volts
			Heater On	Battery Voltage
95	HO2S Heater; Left Rear (HO2S-2,2)	DC Voltage	Heater Off	<0.10 Volts
			Heater On	Battery Voltage
97	PCM Power Relay	DC Voltage	Key Off	<0.10 Volts
			Key On	Battery Voltage
99	Fuel Injector 6 (INJ6)	Millisecond On-Time	Idle; Normal Operating Temp.	4.5 – 4.8 ms
100	Fuel Injector 4 (INJ4)	Millisecond On-Time	Idle; Normal Operating Temp.	4.5 – 4.8 ms
101	Fuel Injector 2 (INJ2)	Millisecond On-Time	Idle; Normal Operating Temp.	4.5 – 4.8 ms
103	Ground	DC Voltage	Always	<0.10 Volts

4R44E, 4R55E, 5R55E

Turbine Sensor Adjustment

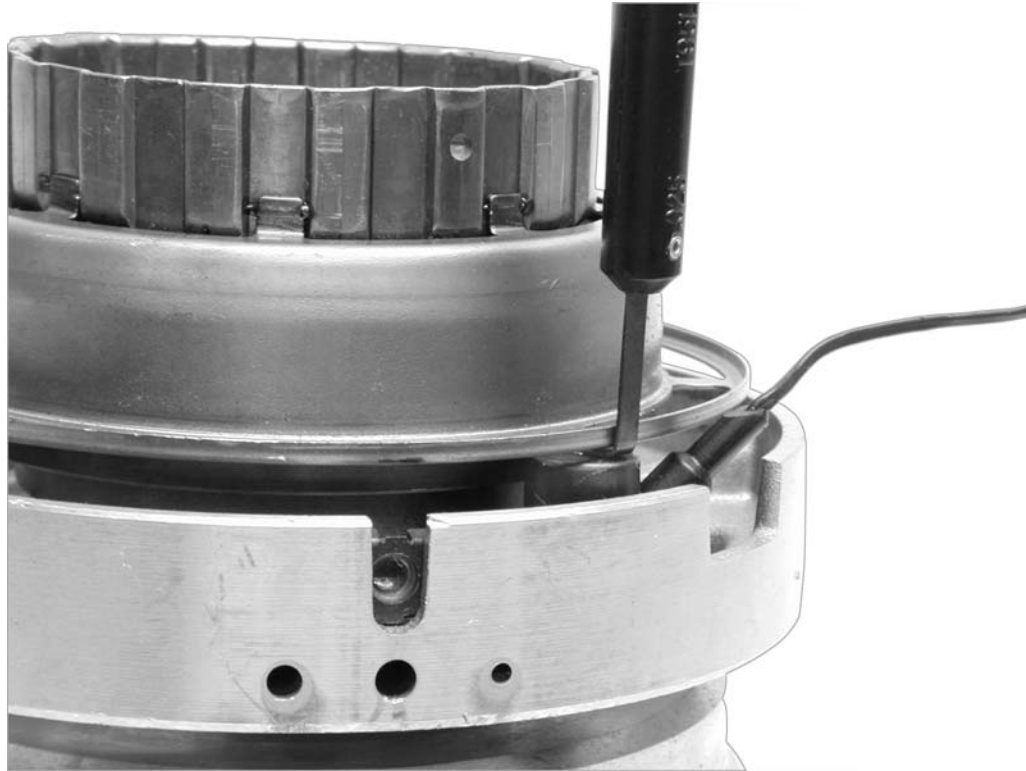
The exciter ring on the 4R44E, 4R55E, and 5R55E mounts to the overdrive planet. It's very delicate and is easily damaged by something as simply as washing or bumping it during teardown. If you damage the ring, you may have problems with the computer reading the turbine RPM correctly.



4R44E, 4R55E, 5R55E

Turbine Sensor Adjustment (continued)

During assembly, always check the clearance between the exciter ring and the turbine shaft sensor: The proper clearance is 0.025" to 0.072".



Ford has a tool that makes measuring this really easy. The part number for the tool is: T95L-70010-F.



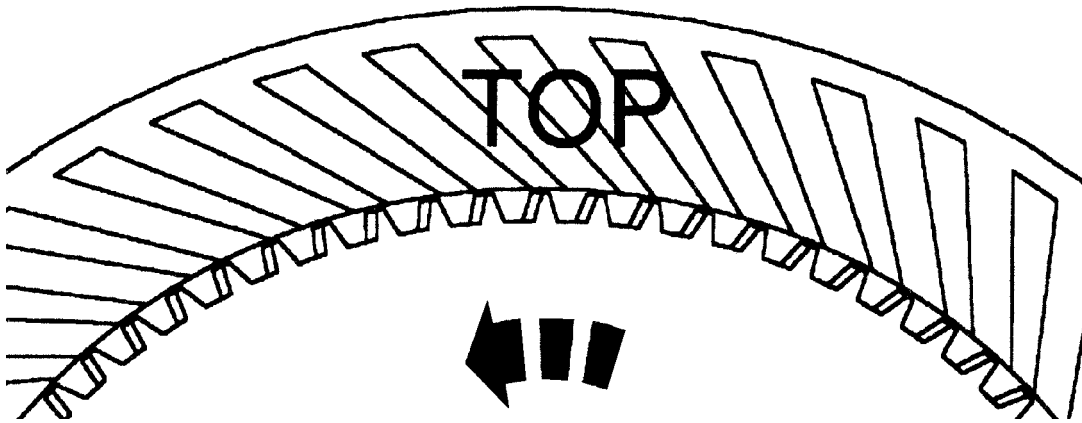
5R55E; 1997-On 4R44E

Directional Friction Installation

The friction plates in the 5R55E and 1997-and-later 4R44E transmissions are directional, and must be installed correctly to provide proper operation.

Forward Clutch

Install the friction plates into the forward drum with the word “Top” facing up, and the grooves pointing counterclockwise, from ID to OD.



Coast Clutch and Direct Clutch

Install the friction plates into the coast clutch and direct clutch drums facing opposite the forward clutch. The word “Top” should still be facing up, but now the grooves point clockwise, from ID to OD.

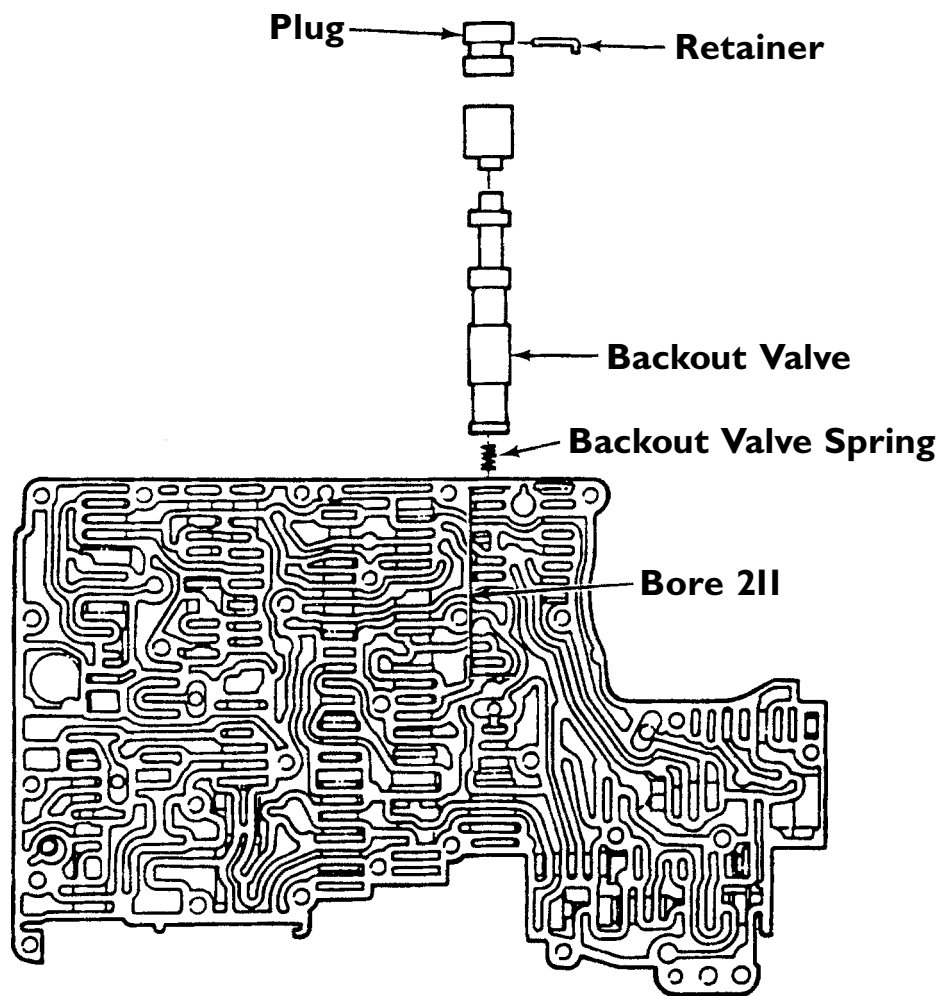


A4LD

Light Throttle 2-3 Flare

Some 1990 through '93 vehicles with the A4LD transmission may exhibit a 2-3 flare at light throttle. Ford has released a stronger 2-3 backout valve spring to address this problem.

The Ford part number for the new spring is F3TZ-7D230-A



A4LD

Light Throttle 2–3 Flare (continued)

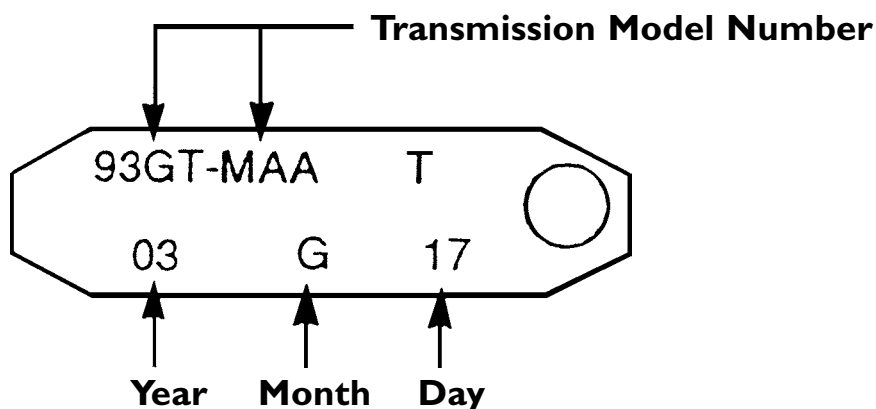
Vehicles Affected

Year and Model		Transmission Model #
1990	Aerostar RWD (Van)	90GT-FAA
	Aerostar RWD (Wagon)	90GT-FBA
	Aerostar AWD (Van)	90GT-AEA
	Aerostar AWD (Wagon)	90GT-AEE
	Ranger 4x2	90GT-DAA
	Ranger 4x4	90GT-BAA
1991	Aerostar RWD (Van)	91GT-HAA
	Aerostar RWD (Wagon)	91GT-SBA
	Aerostar AWD (Van)	91GT-SDA
	Aerostar AWD (Wagon)	91GT-SFA
	Ranger 4x2	91GT-LAA
	Ranger 4x4	91GT-NAA
	Explorer 4x2	91GT-BAB
	Explorer 4x4	91GT-EAB
1992	Aerostar RWD (Van)	92GT-AKA
	Aerostar RWD (Wagon)	92GT-AMA
	Aerostar AWD (Van)	92GT-ARA
	Aerostar AWD (Wagon)	92GT-ATA
	Explorer 4x2	92GT-CDA
	Explorer 4x4	92GT-CFA
	Ranger 4x2	92GT-DCA
	Ranger 4x4	92GT-DEA
1993 (built before 6/21/93)	Aerostar RWD (Van)	93GT-CBA
	Aerostar RWD (Wagon)	93GT-KBA
	Aerostar AWD (Van)	93GT-EBA
	Aerostar AWD (Wagon)	93GT-NBA
	Explorer 4x2	93GT-HAA
	Explorer 4x4	93GT-NAA
	Ranger 4x2 (ALT)	93GT-LAA
	Ranger 4x2 (CAL)	93GT-LBA
	Ranger 4x4 (ALT)	93GT-SAA
	Ranger 4x4 (CAL)	93GT-SBA

A4LD

Light Throttle 2-3 Flare (continued)

Look for the identification tag on the lower left extension housing bolt.



Year	Code
1990	00
1991	01
1992	02
1993	03

Month	Code	Month	Code	Month	Code
January	A	May	E	September	J
February	B	June	F	October	K
March	C	July	G	November	L
April	D	August	H	December	M

A4LD

New Design Center Support

Ford has released a new design center support that uses a needle bearing in place of the thrust washer in the #4 position. This new bearing is selective, and is available in four thicknesses.

The Ford part number for the new support is F5TZ-7A130-B.

You can use this support for the 1993–95 models with the snap shell. This is the same center support used for the 4R44E and 4R55E.



Selective Needle Bearings		
Part Number	Thickness	ID Notches
F5TZ-7L326C	0.091" – 0.096"	3
F5TZ-7L326B	0.083" – 0.090"	2
F5TZ-7L326A	0.075" – 0.082"	1
F3TZ-7L326A	0.071" – 0.075"	None

AODE and 4R70W

New 2–3 Accumulator Piston

The 2–3 accumulator piston has been replaced with a one-piece, stamped-steel piston. The new piston will retrofit earlier model transmissions.

The Ford part number for the new piston is F7AZ-7H292-AB.

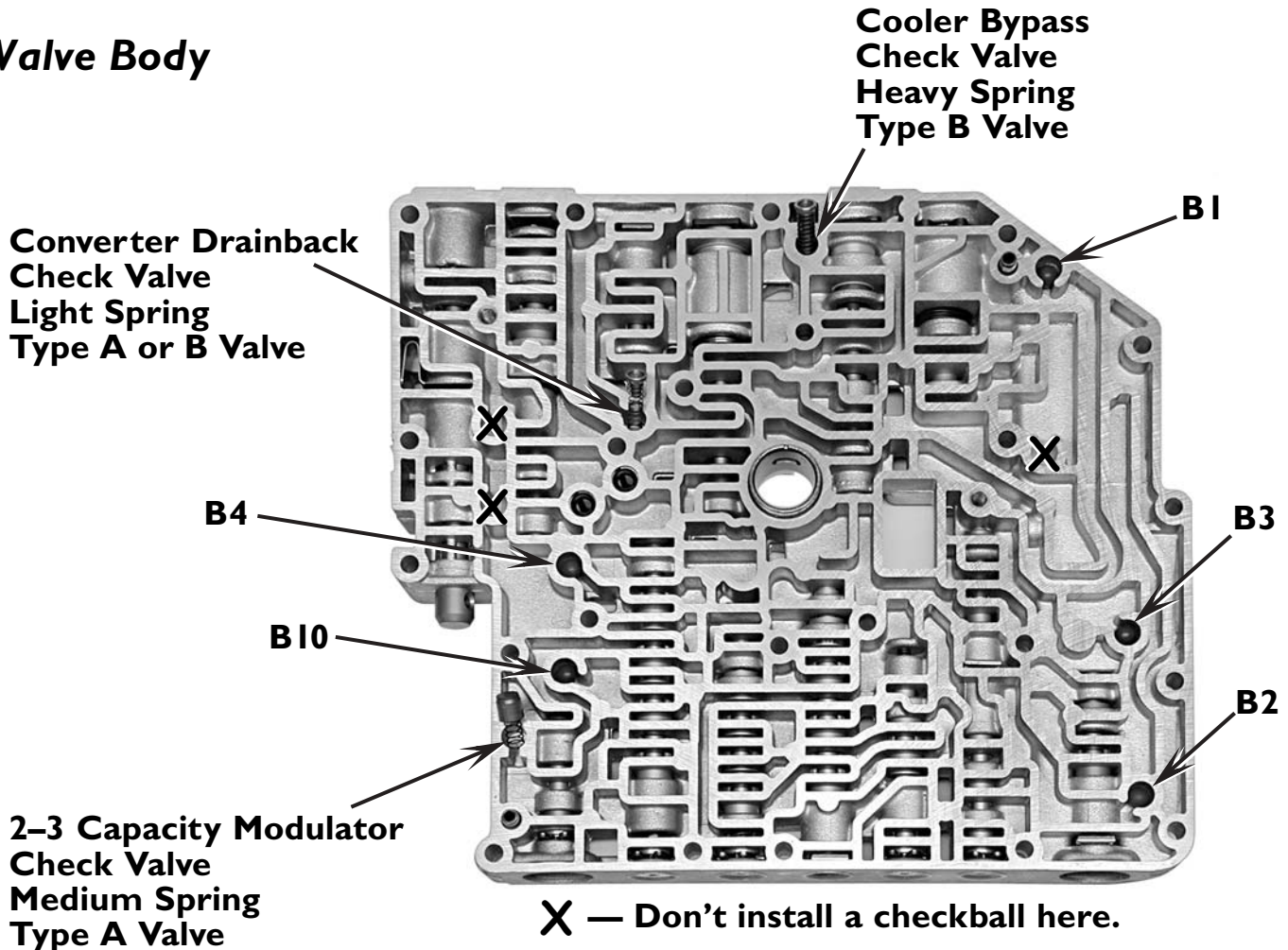


AX4N

Checkball and Check Valve Locations

The AX4N uses six checkballs and three check valves in the valve body. Each valve has a different weight spring. Use the graphic to identify which checkballs and which valve-and-spring combination go in which location.

Valve Body



Type A Valve

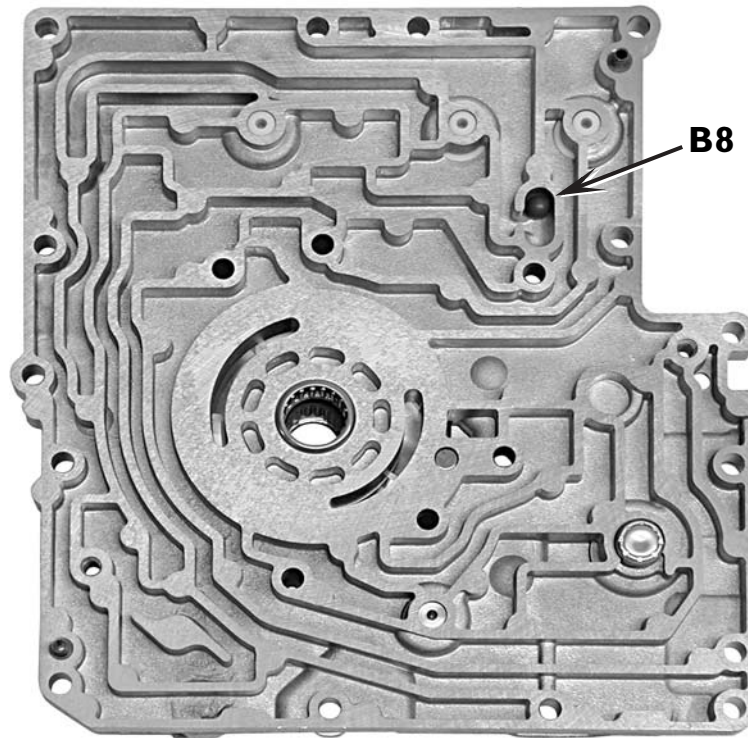


Type B Valve

AX4N

Checkball and Check Valve Locations (cont)

Pump

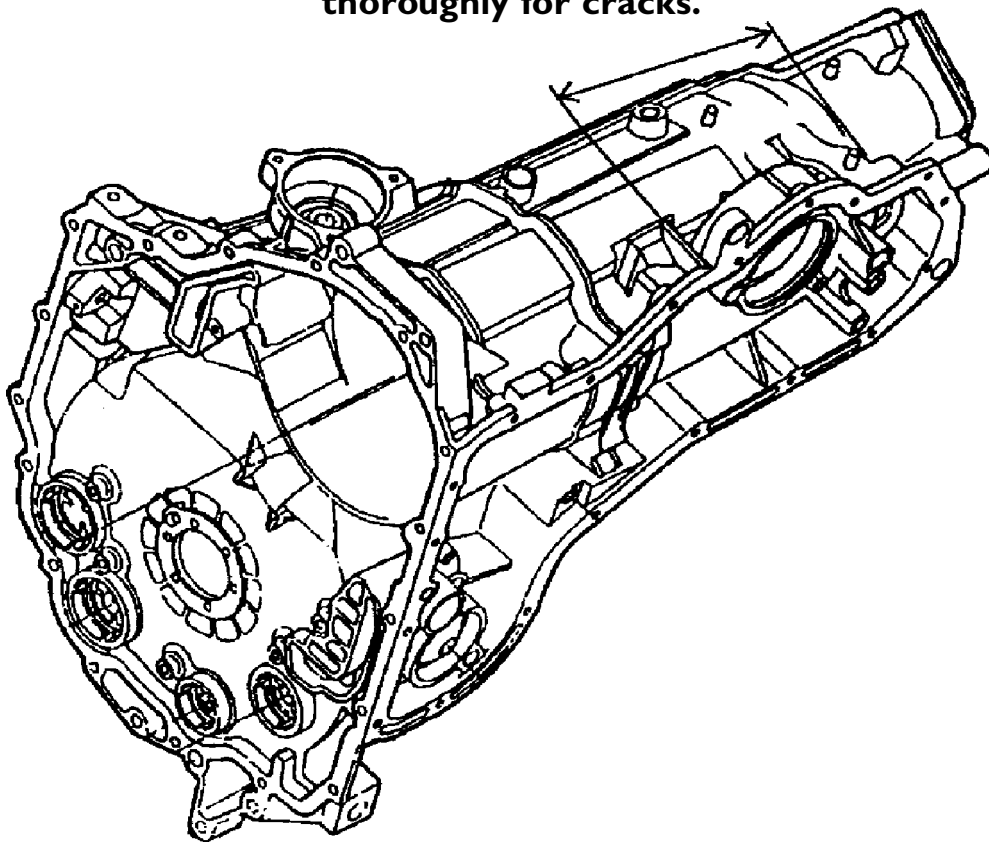


AX4N

Cracked Case; ATF Leaks

A leak from the coast servo area on these units can be due to a crack in the case. Always check the area indicated for hairline cracks; these cracks are fairly common, and may be present long before a leak occurs.

**Examine this area
thoroughly for cracks.**



AX4S

1991 Valve Body Interchange

The 1991 AX4S valve body is unique; it's the only year Ford used a simple on-off solenoid for lockup. The problem is that these valve bodies are becoming very difficult to find, so if you have one that's no good, you're out of luck... until now.

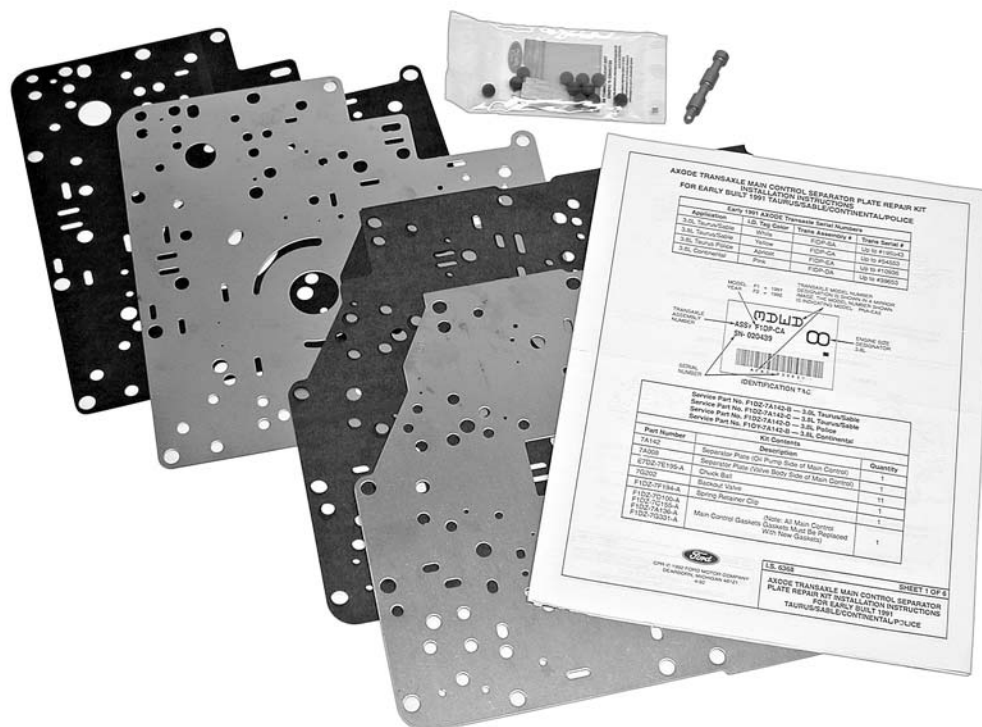
Ford released upgrade kits to convert the 1991 valve body hydraulics to the '92 model, but still keep the simple on-off solenoid. You can use one of these kits with a 92-and-later PWM valve body, while keeping the on-off solenoid. Although this wasn't Ford's original intent, it works great.

These kits contain a clip, some checkballs, gaskets, two separator plates, a new backout valve, and instructions. The backout valve in the kit is the same as the one in the PWM-type valve body, so you won't need to replace it.

Assemble the valve body as you normally would, using the two new plates. You can now install the on-off lockup solenoid and you're back in business.

There are three kits available, based on application:

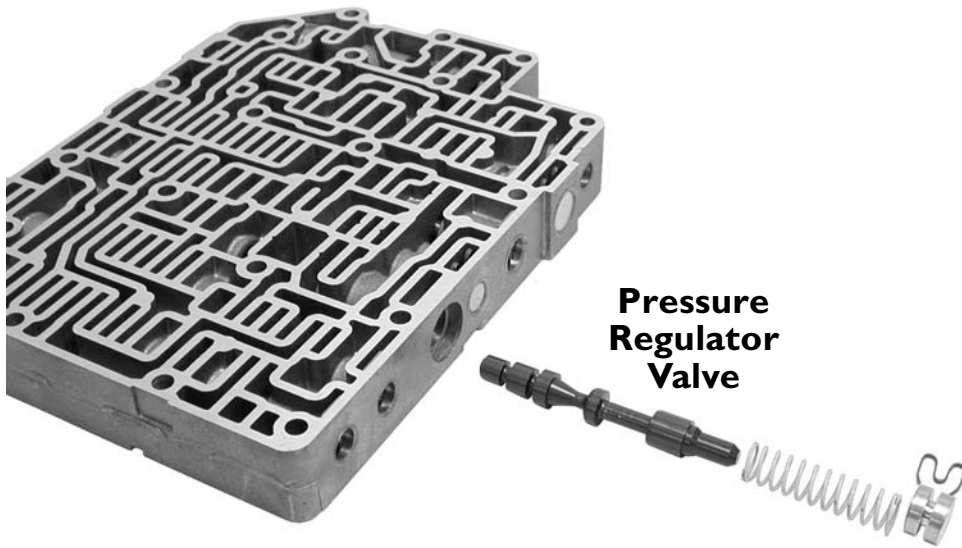
F1DZ-7A142B	3.0L
F1DZ-7A142C	3.8L
F1DZ-7A142D	3.8L Police



CD4E

Uncontrollable High Line Pressure

Uncontrollable high line pressure is responsible for many of the cracked forward/coast/direct clutch drum complaints. In many cases, this high line pressure problem is the result of a worn out pressure regulator valve, or regulator valve bore in the valve body. During rebuild, make sure you inspect the valve and bore carefully.

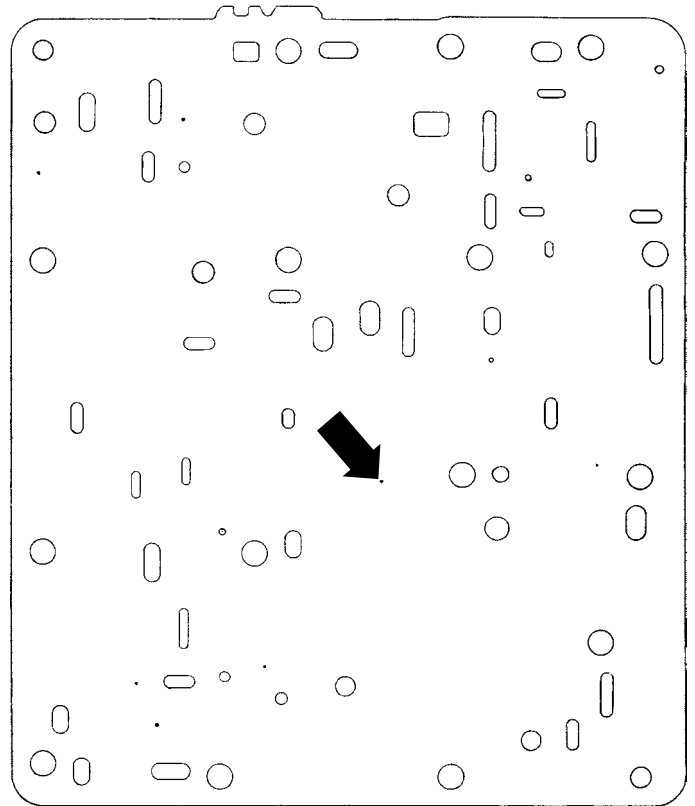
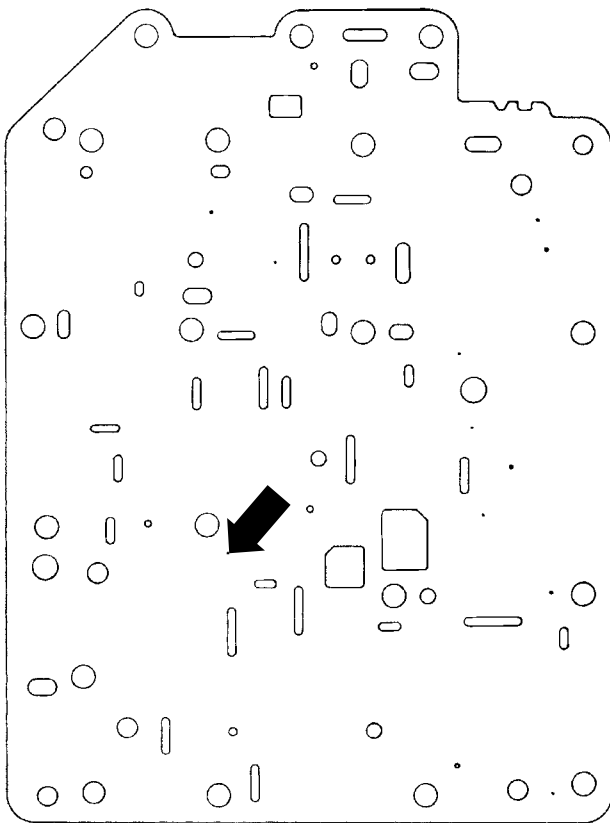


CD4E

Uncontrollable High Line Pressure (continued)

An effective countermeasure for this problem is to enlarge the PR balance holes in the separator plate. Enlarge these balance holes to 0.055".

If the valve or bore are worn excessively, enlarging the balance holes won't help the condition.



CD4E

No Forward

A CD4E that won't move forward can be caused by a misaligned rear ring gear shaft. This causes a side load on the gear train, popping the forward clutch snap ring loose.

If you run into this problem, replace the clutch drum and snap ring, naturally, but also replace the ring gear. There are two ring gears, based on which engine you have. The part numbers for these ring gears are:

F3RZ-7A153-B (2.0L)

F3RZ-7A153-A (2.5L)



CD4E

No Reverse

After a rebuild or repair, some CD4Es may not have reverse. This can be caused by installing the solenoid housing gasket backward.

To repair this condition, remove the housing, and make sure the gasket seals the oil passages properly.



Gasket Placed Properly



Improper Gasket Placement

E4OD/4R100

Checkball Locations

Ford has made several changes to the case and valve body on the E4OD (labeled the 4R100 starting in 1998). The first was in 1996. These models have a different case, separator plate and valve body, compared to 1990 through 95 models. Consequently, the checkball locations also changed.

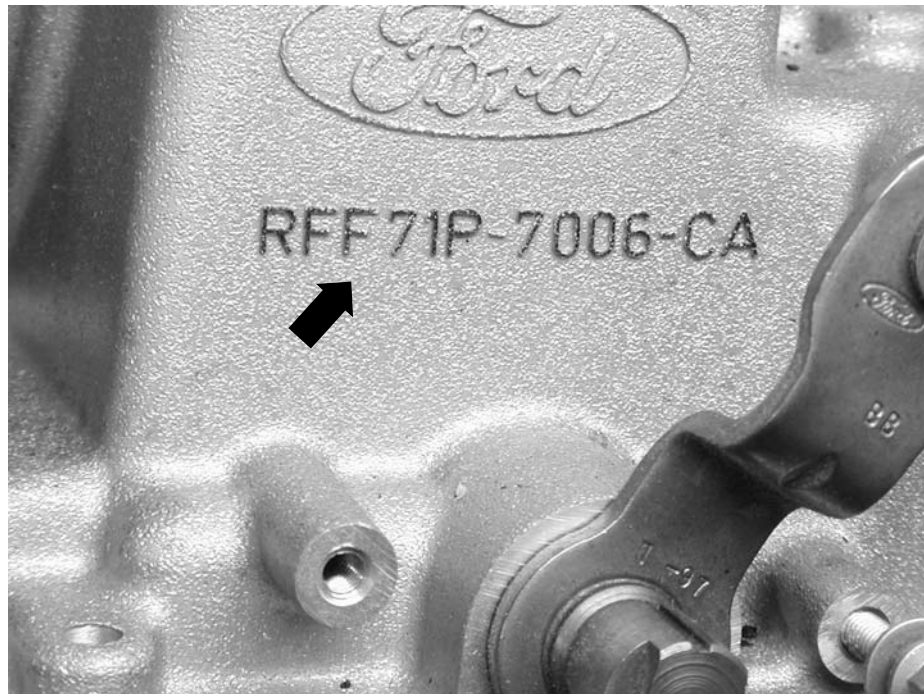
Identifying the case is easy: 1990 through 95 models had a Rough Forge number beginning with F0.



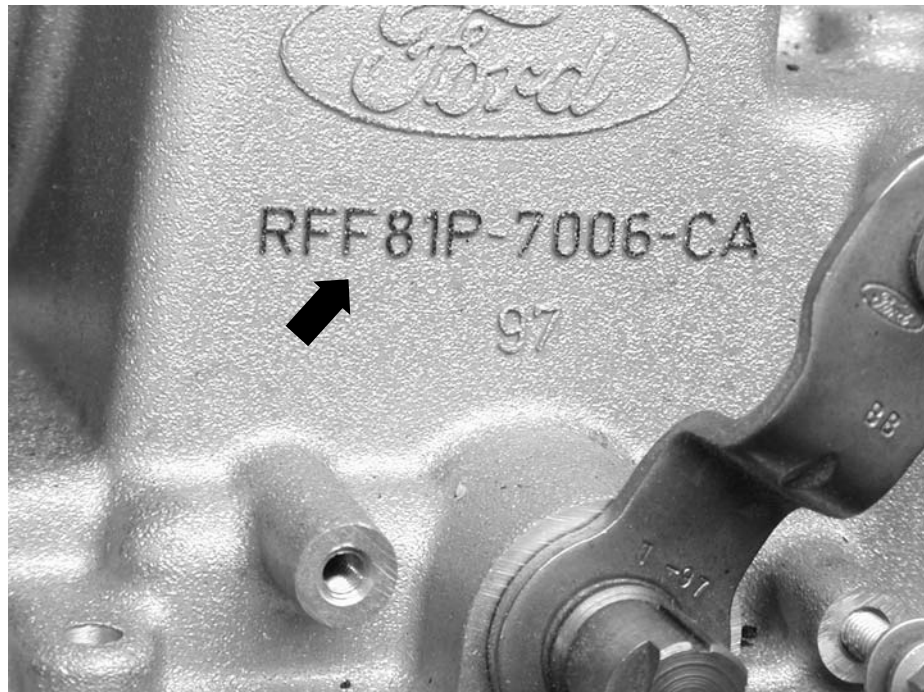
E4OD/4R100

Checkball Locations (continued)

The 1996 case has a Rough Forge number beginning with F7.



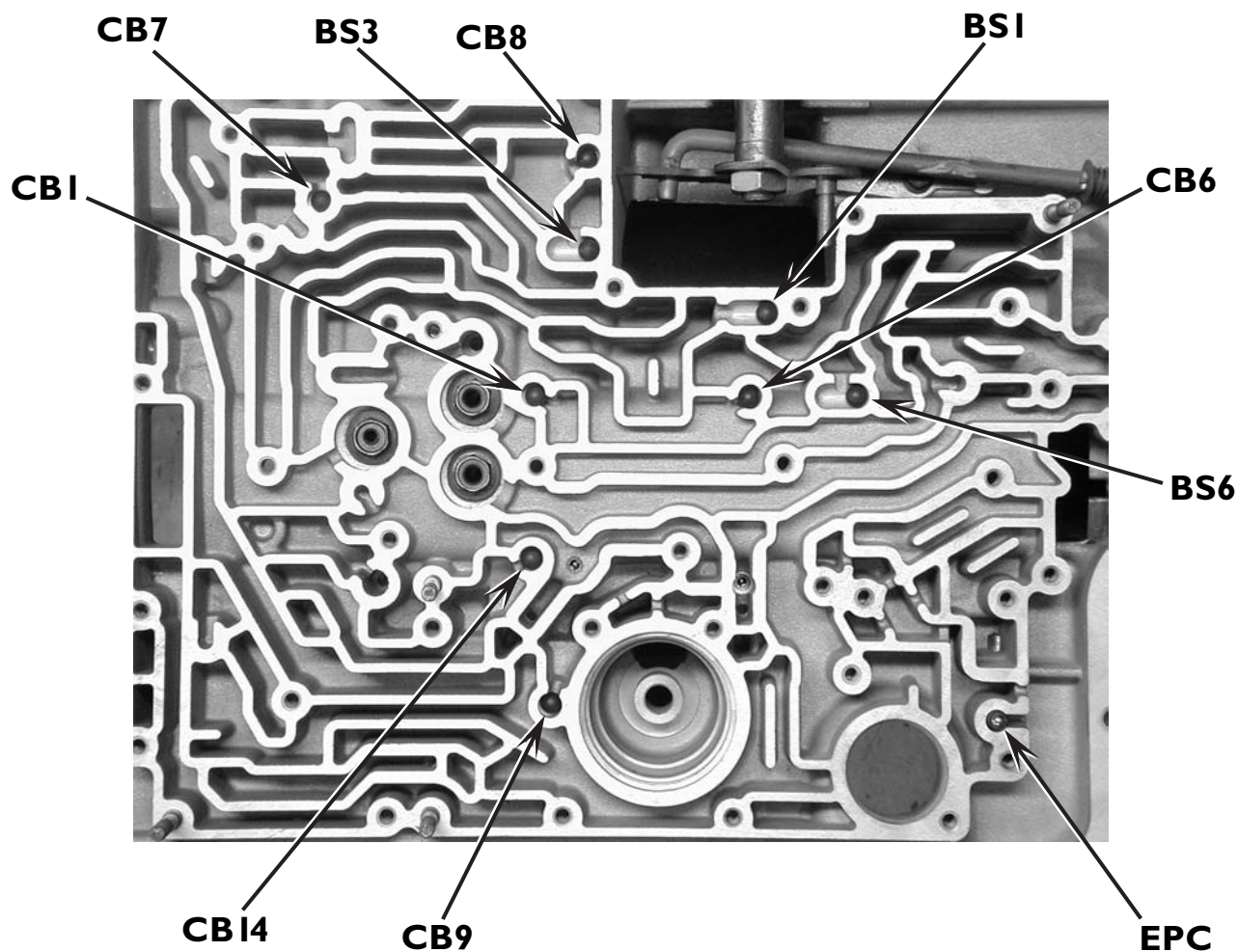
In 1998, the Rough Forge number became F8.



E4OD/4R100

Checkball Locations (continued)

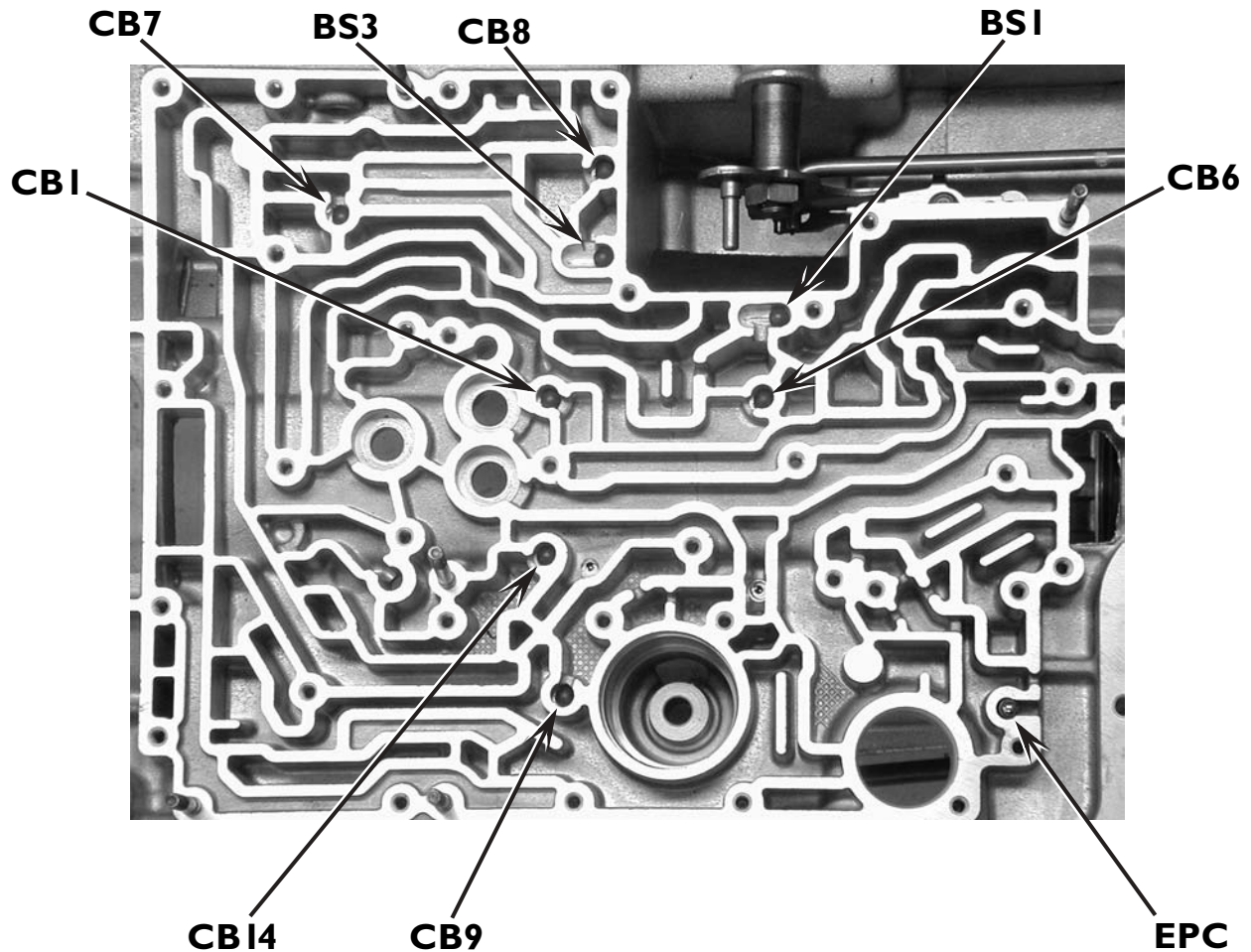
1990–95 Checkball Locations for F0 Cases



E4OD/4R100

Checkball Locations (continued)

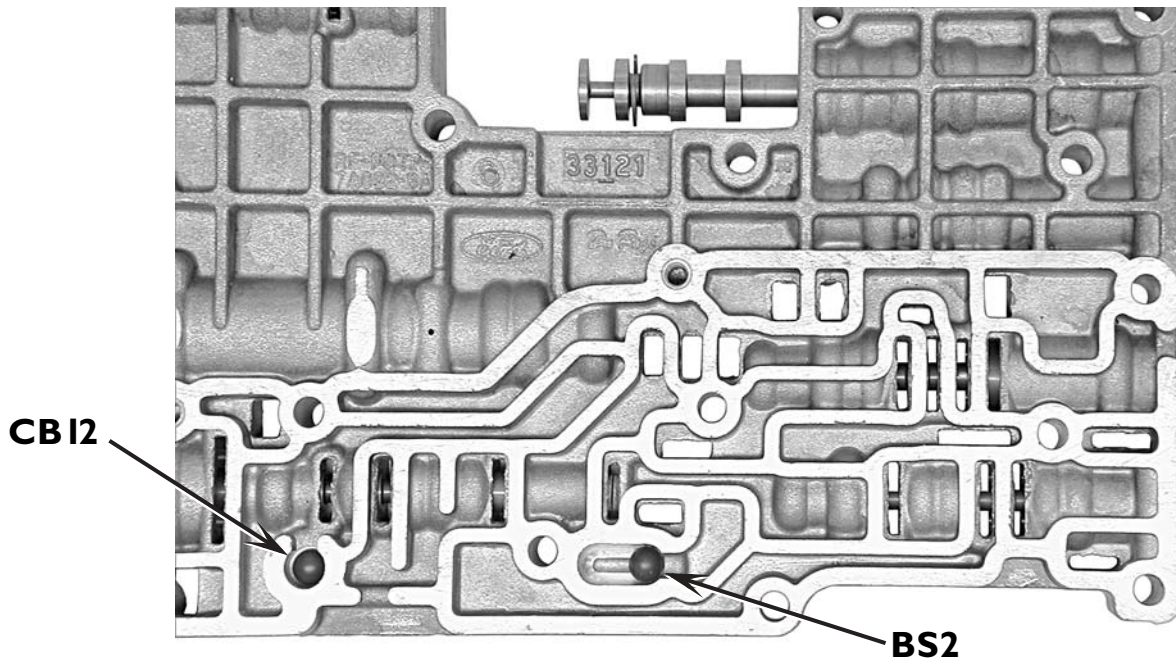
1996-On Checkball Locations for F7 and F8 Cases



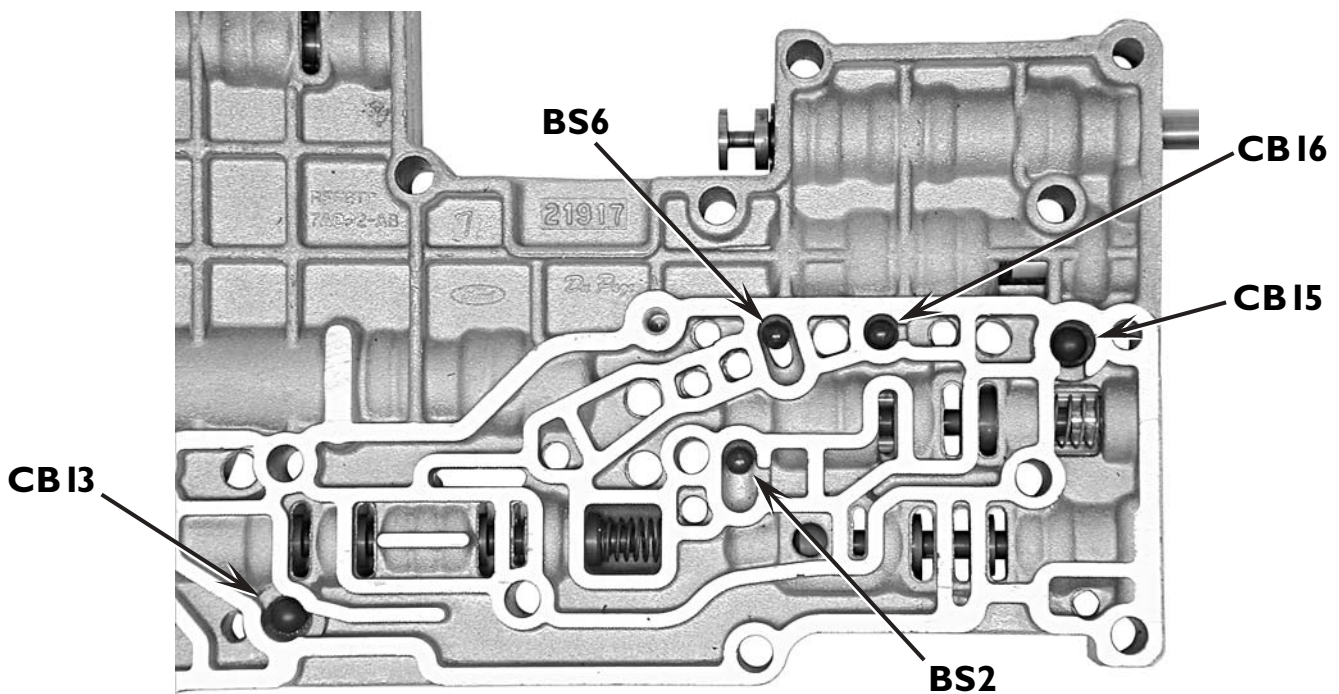
E4OD/4R100

Checkball Locations (continued)

1990–95 Valve Body Checkball Locations



1996-On Valve Body Checkball Locations



Ford

VSS Harness Repair Kit

It's not uncommon to replace the VSS on many vehicles during the rebuild, especially on those where the VSS is close to the exhaust and suffers heat damage. Although this is a great idea, an often-overlooked item is the vehicle harness connector. Ford offers a harness repair kit to replace the old VSS connector.

The Ford part number for the kit is F2PZ-14A464-A

Ford also offers these other repair kits you might find useful:

F2PZ-14A464-B	E4OD Solenoid
F2PZ-14A464-C	MLP
F2PZ-14A464-D	AXODE (91/92 Top)
F2PZ-14A464-E	AXODE (91/92 Side)
F2PZ-14A464-F	AXOD
F2PZ-14A464-G	AODE, AX4S (1993-on)



Chrysler Contents

41TE, 42LE

Transaxle Identification	126
Diagnostic Trouble Codes (DTC).....	130
Burnt Low/Reverse Clutch; Slips in Low and Reverse	132
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42RE/44RE and 46RE/47RE

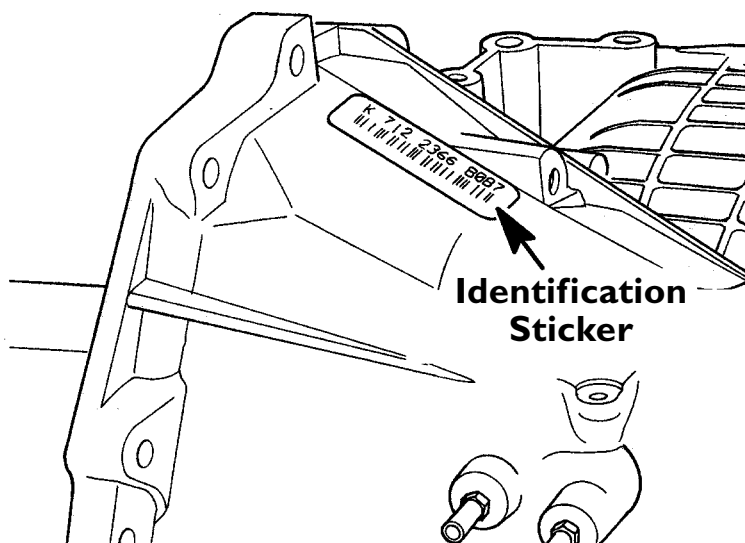
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41 TE

Transaxle Identification

The 41TE transaxle is used in many of Chrysler's front wheel drive vehicles. There are many different units, based on the application. One of the biggest differences in these variations is transfer gear and final drive ratios. Chrysler uses a sticker, located on top of the bell housing, to identify the unit.

The following chart shows transaxle application based on the ID code. The chart also shows the tooth counts of the output gear, transfer gear, pinion gear, and final drive ring gear. This is useful information, particularly if your working on a vehicle you suspect has the wrong transaxle.

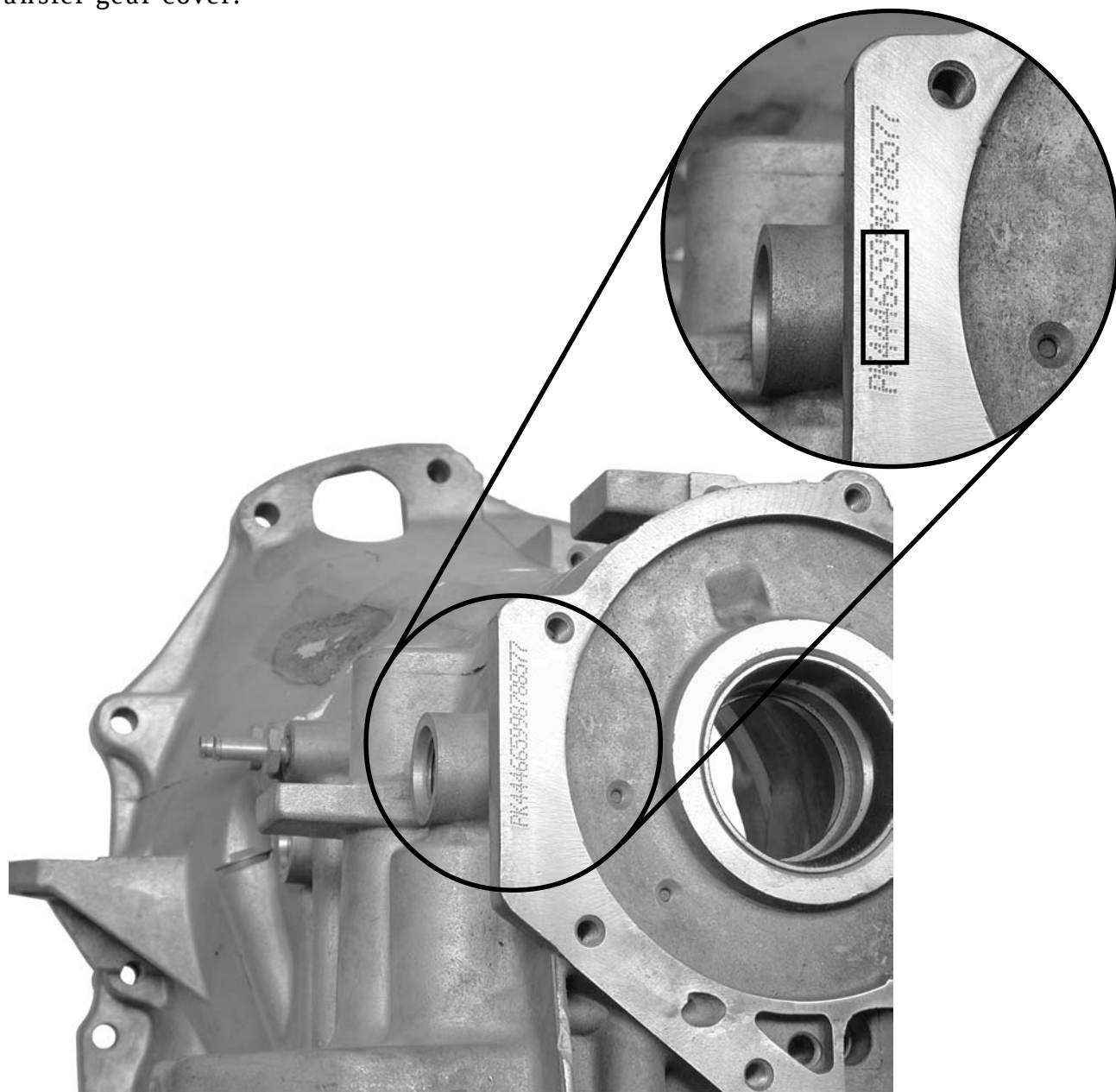


Model ID	Year	Vehicle
AA	1989–1995	Sprint/Acclaim/Lebaron
AC	1989–1993	Dynasty/New Yorker
AS/NS	1989–1998	Minivan
AY	1990–1993	Fifth Avenue/Imperial
AG	1990–1993	Daytona
AJ	1990–1995	Lebaron
AP	1993–1994	Shadow/Sundance
JA	1995–1998	Cirrus/Stratus/Breeze
JX	1996–1998	Sebring Convertible
FJ22	1995–1996	Sebring/Avenger
F24S	1995–1996	Eagle Talon

4ITE

Transaxle Identification (continued)

If the ID sticker is missing you can use the ID numbers stamped in the case near the transfer gear cover.



4I TE

Transaxle Identification (continued)

Year	Application	Production #	Transfer	Output	Pinion/Ring	Ratio	Notes
1989	3.0L	4446659	54	59	16/60	3.42	
1989½	3.0L	4531664	54	59	16/60	3.42	
1990	3.0L	4531551	54	59	16/60	3.42	
1990	3.3L	4531630	54	59	16/60	3.42	
1990¼	3.0L	4531681	54	59	16/60	3.42	
1990¼	3.3L	4531682	54	59	16/60	3.42	
1991	3.8L	4567847	54	59	17/59	3.17	AY Body
1991	3.0L	4567848	58	55	17/59	3.65	
1991	3.3L	4567849	58	55	17/59	3.65	
1991	3.3L-AWD	4567850	54	59	16/60	3.42	AWD AS Body
1992	3.8L	4659359	54	59	17/59	3.17	AY Body
1992	3.0L	4659360	58	55	17/59	3.65	
1992	3.3L	4659361	58	55	17/59	3.65	
1992	3.3L-AWD	4659362	58	55	17/59	3.65	AWD AS Body
1993	3.8L	4567645	46	50	17/59	3.19	
1993	3.0L	4567646	49	47	17/59	3.61	
1993	3.3L	4567647	49	47	17/59	3.61	
1994	3.0L	4659072	49	47	17/59	3.61	AJ, AP & AS Body
1994	3.3L	4659073	49	47	17/59	3.61	AS Body
1994	3.3L	4659074	49	47	17/59	3.61	AS Body
1994	3.8L	4659075	46	50	16/60	3.45	AS Body
1994	3.8L	4659076	46	50	16/60	3.45	AWD AS Body
1995	2.0L	4567500	50	46	16/60	4.07	JA, FJ22, F24S

4ITE

Transaxle Identification (continued)

Year	Application	Production #	Transfer	Output	Pinion/Ring	Ratio	Notes
1996	2.0L	4799717	50	46	16/59	4.07	JA
1996	2.4L	4799716	49	47	16/60	3.90	JA/JX,NS
1996	2.5L	4799718	49	47	16/60	3.90	JX
1996	3.3L	4567623	49	47	17/59	3.61	NS Up To 6-5-95
1996	3.3L	4799712	49	47	17/59	3.61	NA After 6-5-95
1996	3.8L	4567622	46	50	16/60	3.45	NS Up To 6-5-95
1996	3.3L	4567623	49	47	17/59	3.61	NS Up To 6-5-95
1996	3.8L	4799713	46	50	16/60	3.45	NS After 6-5-95
1996	3.8L	4799714	46	50	16/60	3.45	All Wheel Drive
1997	2.0L	4800636	50	46	16/60	4.07	JA
1997	2.4L	4800634	49	47	16/60	3.90	JA/JX
1997	2.4L	4800630	49	47	16/60	3.90	NS
1997	2.5L	4800635	49	47	16/60	3.90	JX
1997	3.3L	4800631	49	47	17/59	3.61	NS
1997	3.8L	4800632	46	50	16/60	3.45	NS
1998	2.0L	4800856	50	46	16/60	4.07	JA
1998	2.4L	4800485	49	47	16/60	3.90	JA/JX
1998	2.4L	4800850	49	47	16/60	3.90	NS
1998	2.5L	4800327	49	47	16/60	3.90	JX
1998	3.0L	4800859	49	47	17/59	3.61	NS
1998	3.3L	4800851	49	47	17/59	3.61	NS
1998	3.8L	4800852	46	50	16/60	3.45	NS

4ITE

Diagnostic Trouble Codes (DTC)

Code	Description	Limp-in?	Type of Failure
11	Internal TCM Failure	Yes	C
12	Battery was Disconnected	Yes	N/A
13	Internal TCM Failure	Yes	C
14	Transmission Relay Output Always On	Yes	C, E, S
15	Transmission Relay Output Always Off	Yes	C, E, S
16	Internal TCM Failure	Yes	C
17	Internal TCM Failure	Yes	C
18	Engine Speed Sensor Circuit	Yes	C, E, S
19	Bus Communication with Engine Module	Yes	C, E
20	Transmission Control Relay Output	Yes	C, E, S
21	OD Pressure Switch Sense Circuit	Yes (Pre-96)	C, E, S, T
22	2-4 Pressure Switch Circuit	Yes	C, E, S, T
23	2-4/OD Pressure Switch Circuit	Yes (Pre-96)	C, E, S, T
24*	LR Pressure Switch Sense Circuit	No	C, E, S, T
25	LR/OD Pressure Switch Sense Circuit	Yes (Pre-96) N/A (96-97)	C, E, S, T
26	LR/2-4 Pressure Switch Sense Circuit	Yes (Pre-96) N/A (96-97)	C, E, S, T
27	All Pressure Switch Sense Circuits	Yes (Pre-96) N/A (96-97)	C, E, S, T
28	Check Shifter Signal	No	C, E, S
29*	Throttle Position Sensor Signal	No	C, E, S
31	OD Hydraulic Pressure Switch Circuit	Yes	E, S, T
32	Loss of Prime	Yes	E, S, T
33	Fault Immediately after Shift	Yes	E, S, T
35	Loss of Prime	No	T
36	Fault Immediately after Shift	No	T

C = Controller E = Electrical S = Sensor/Actuator T = Transmission N/A = Not Applicable

* In 1997, codes 24, 29, 37, 38, 47 and 50 –58 can take up to 5 minutes to light the Malfunction Indicator Lamp (MIL). You can find these faults through your DRB-III under “OBD-II Diagnostics: One-Trip Faults.” They are OBD-II diagnostic trouble codes waiting to mature. Refer to the appropriate TSB for running changes to this feature.

4ITE

Diagnostic Trouble Codes (continued)

Code	Description	Limp-in?	Type of Failure
37*	Solenoid Switch Latched in TCC Position	No	T, S
38*	Torque Converter Clutch Control Circuit	No	T, S
41	LR Solenoid Circuit	Yes	C, E, S
42	2-4 Solenoid Circuit	Yes	C, E, S
43	OD Solenoid Circuit	Yes	C, E, S
44	UD Solenoid Circuit	Yes	C, E, S
45	Internal TCM Failure	No	C
46	3-4 Shift Abort	No	T
47*	Solenoid Switch Latched in L-R Position	Yes	T
48	TRD Link Communication Error	No	C, E
50*	Gear Ratio Error in Reverse	Yes	C, E, S, T
51*	Gear Ratio Error in 1 st	Yes	C, E, S, T
52*	Gear Ratio Error in 2 nd	Yes	T, S
53*	Gear Ratio in 3 rd	Yes	T, S
54*	Gear Ratio Error in 4 th	Yes	T, S
56*	Input Speed Sensor Error	Yes	C, E, S
57*	Output Speed Sensor Error	Yes	C, E, S
58*	Speed Sensor Ground Error	Yes	C, E
60	Inadequate Element Volume LR	No	T
61	Inadequate Element Volume 2-4	No	T
62	Inadequate Element Volume OD	No	T
70	Autostick Sensor Circuit	No	E, S
71	Manual Shift Overheat	No	N/A
73	Worn Out or Burnt Transaxle Fluid	No	T
74	Calculated Oil Temperature in Use	No	C, E, S
75	Repairing High Temperature Operations	No	N
76	Repairing Power-UP at Speed	No	C, E

C = Controller E = Electrical S = Sensor/Actuator T = Transmission N/A = Not Applicable

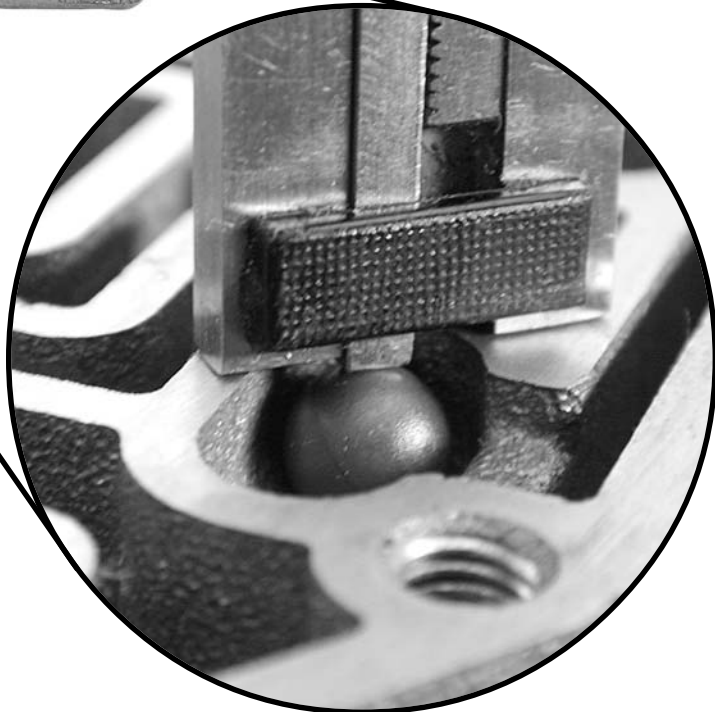
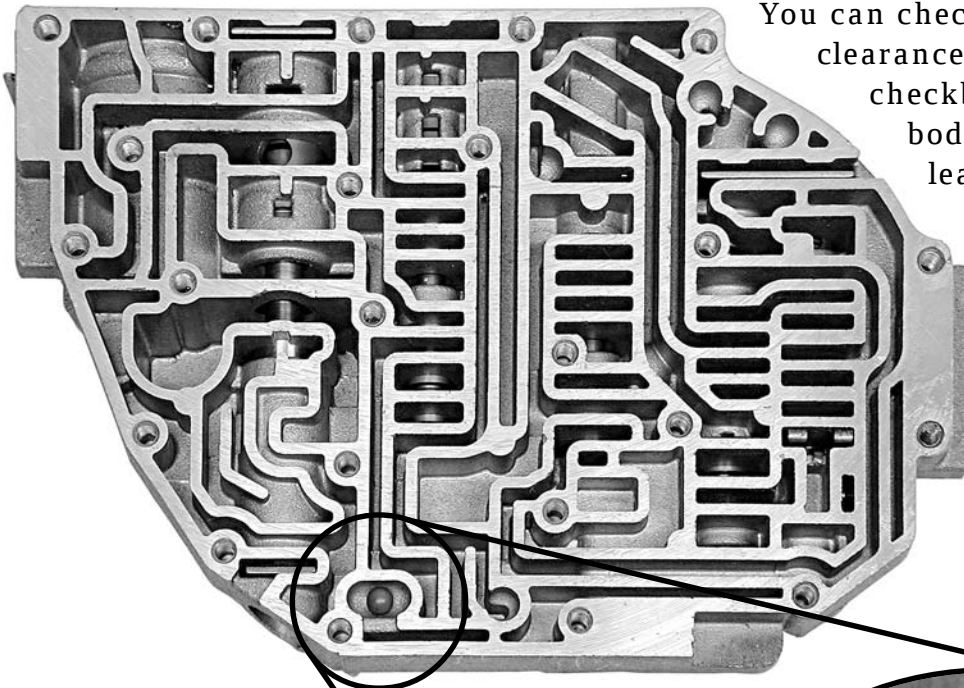
* In 1997, codes 24, 29, 37, 38, 47 and 50 –58 can take up to 5 minutes to light the Malfunction Indicator Lamp (MIL). You can find these faults through your DRB-III under “OBD-II Diagnostics: One-Trip Faults.” They are OBD-II diagnostic trouble codes waiting to mature. Refer to the appropriate TSB for running changes to this feature.

41TE

Burnt Low/Reverse Clutch; Slips in Low and Reverse

Some 41TE valve bodies have a bathtub for the #1 checkball that's too shallow. This can allow the checkball to stick, causing the low/reverse clutch circuit to leak.

You can check for this by measuring the clearance between the top of the checkball and the top of the valve body casting. You must have at least 0.007" of space for the checkball. If you have less than 0.007" clearance, replace the valve body.



4ITE

New Design Input and Output Sensors

The input and output speed sensors were redesigned for 1997-and-later units. The new sensors use O-rings with a smaller cross-section than the previous design. You can use the new sensors on earlier models; but always use the proper O-rings. Using the early O-ring on the late sensor won't allow the sensor to mount flush against the case; using the late O-ring on an early sensor may cause leaks.

The Chrysler part numbers for the two sensors are:

04800878 – Input

04800879 – Output

You can still use the harness repair kit for the new sensors, Chrysler part number 4419478. These sensors include the proper O-rings.

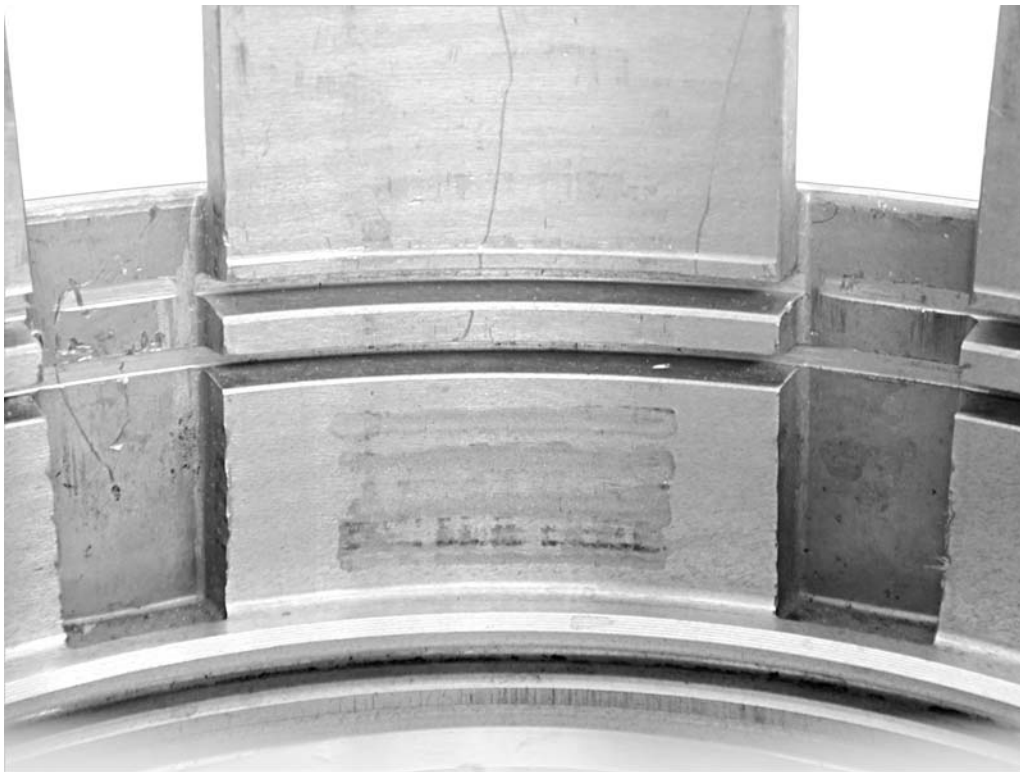


41TE, 42LE

Input Clutch Drum Retainer and Related Parts Changes

Chrysler has updated the input clutch drum, OD/UD reaction plate, and tapered snap ring several times since 1989. They have also changed the part numbers several times, without changing the part. Because of this, there's a lot of confusion as to which parts to use during a rebuild.

In 1997, Chrysler changed the thickness of the OD/UD tapered snap ring from 0.076" to 0.091". At the same time, they widened the groove for the snap ring. The thick snap ring won't fit the earlier retainer. The reason for the thicker snap ring was to help prevent it from breaking.

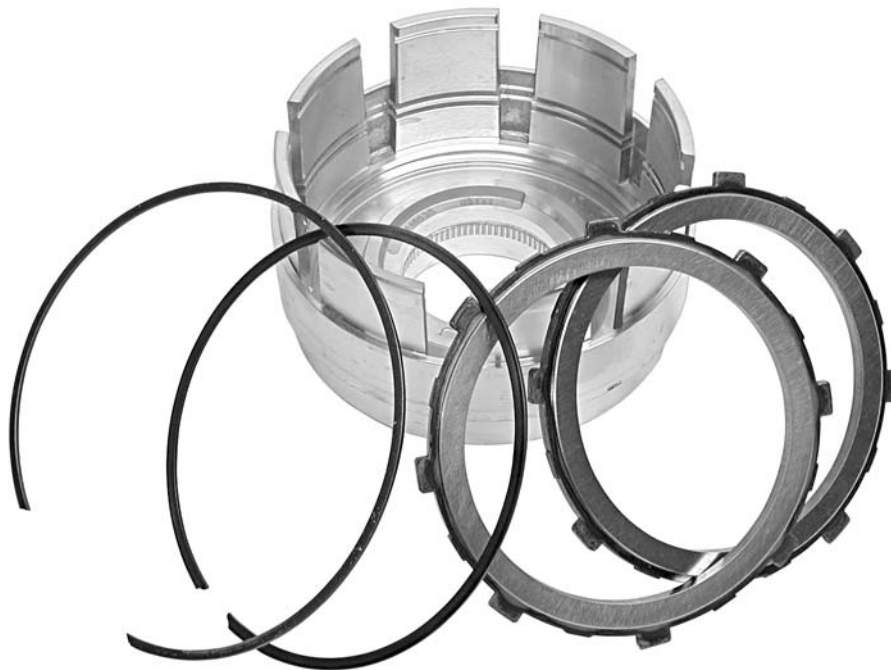


41TE, 42LE

Input Clutch Drum Retainer (continued)

If you have an earlier trans and you want to upgrade it with the new drum and related components, you'll want to order the update kit. The kit that includes the drum, two OD/UD pressure plates (0.233" thick, and 0.244" thick), and both the lower (flat) and upper (tapered) snap rings.

The Chrysler part number for the kit is 5016198AA



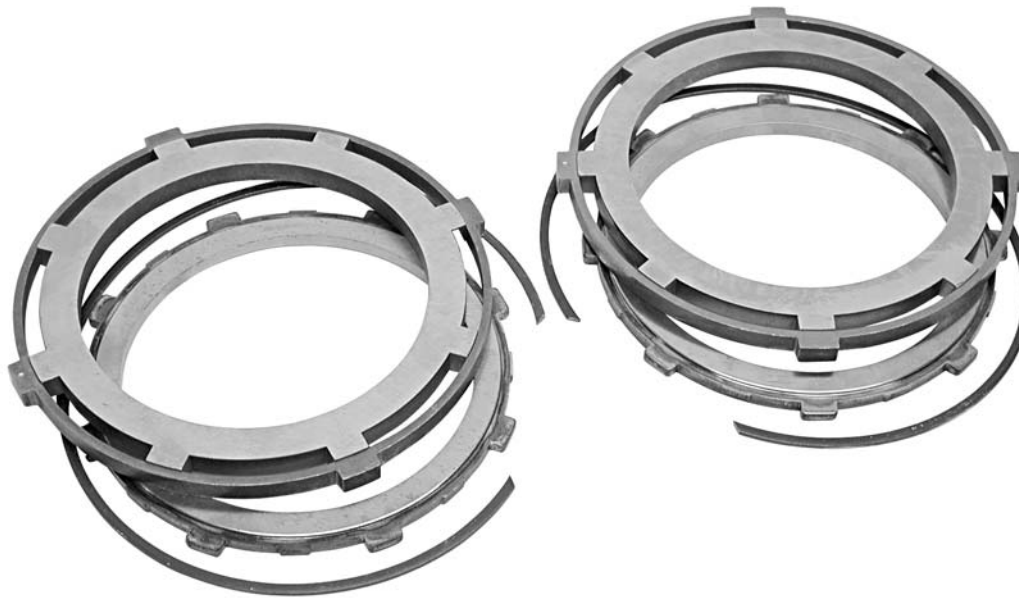
41TE, 42LE

Input Clutch Drum Retainer (continued)

There are also two plate kits available, but they include the earlier 0.076" tapered snap ring instead of the 0.091" snap ring. The 0.076" snap ring is only available with these kits; Chrysler no longer sells them separately. These kits include the OD/UD pressure plate, both snap rings for this plate, and the OD/Reverse pressure plate. The Chrysler part numbers for these kits are:

5017513 – Includes 0.232" OD/UD pressure plate

5017179 – Includes 0.256" OD/UD pressure plate



You can also purchase the 0.091" snap ring and three OD/UD pressure plates separately. The Chrysler part numbers for these are:

4659934 — 0.091" Snap Ring

4883013 — 0.232" Plate

4883014 — 0.244" Plate

4883015 — 0.256" Plate

These three plates also include the 0.091" snap ring.

41TE, 42LE; 1996-and-Later

Code 74: Calculated Oil Temperature in Use

After vehicle startup, the transmission may operate in 2nd and reverse for the first few minutes of operation and then resume normal shifting. The Transmission Control Module (TCM) may be sensing an open circuit in the transmission temperature sensor circuit, indicating the transmission is extremely cold (below -16° F). This false temperature signal will keep the transmission in 2nd gear until the transmission temperature signal indicates the temperature has risen above -12° F.

This condition usually sets transmission Diagnostic Trouble Code (DTC) 74 — Calculated Oil Temperature in Use. Once code 74 sets, the computer won't attempt to use the signal from the transmission temperature sensor, but will use the calculated oil temperature routine for all 41TE/AE and 42LE applications built before 1996.

The computer will continue to use the calculated oil temperature routine for 35 OBD-II drive cycles. If calculated oil temperature is used, the vehicle will operate normally; but the condition may return after 35 OBD-II drive cycles, when the computer tries to use the transmission temperature sensor for input again.

To diagnose code 74, there are a few things you must understand:

Conditions to Set Code 74:

The computer must detect intermittent or out-of-range data from the transmission temperature sensor circuit for three consecutive drive cycles before the code will set.

Setting code 74 will enable the calculated oil temperature routine to initialize the transmission oil temperature at startup for 35 OBD-II drive cycles.

After 35 OBD-II drive cycles, the computer will attempt to use the temperature sensor for every start until code 74 resets.

Invalid Temperature Data

If the computer detects intermittent or out-of-range data from the transmission temperature sensor *before* code 74 sets, it switches to the calculated temperature routine, starting from the last good temperature signal. This can cause 2nd and reverse only, if the transmission temperature sensor indicates a startup temperature below -16°F (which occurs if the temperature sensor circuit resistance is high, but not quite an open circuit).

No code sets unless it's the third consecutive start with invalid data. So you may not be sure whether the computer is using the temperature sensor signal or the calculated oil temperature routine for shift scheduling.

41TE, 42LE; 1996-and-Later

Code 74 (continued)

Clearing Code 74

Clearing the codes won't automatically enable the computer to use the transmission temperature sensor signal. The computer remembers the last time code 74 was set and won't attempt to use the temperature sensor signal until 35 OBD-II drive cycles have passed, regardless of whether the code is still in memory.

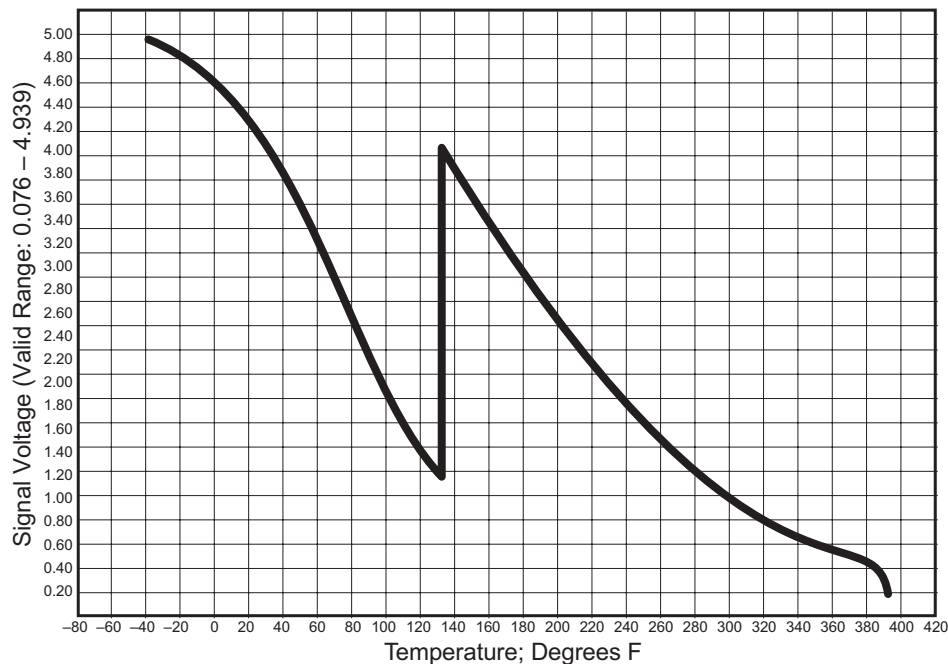
Disconnecting the battery, however, will enable the computer to use the transmission temperature sensor signal.

CAUTION Disconnecting the battery will clear all computer memories, including the clock, learned engine parameters, and radio anti-theft codes and presets. Make sure you take the necessary precautions before disconnecting the battery.

Three items can cause the computer to lose or receive an intermittent temperature sensor signal:

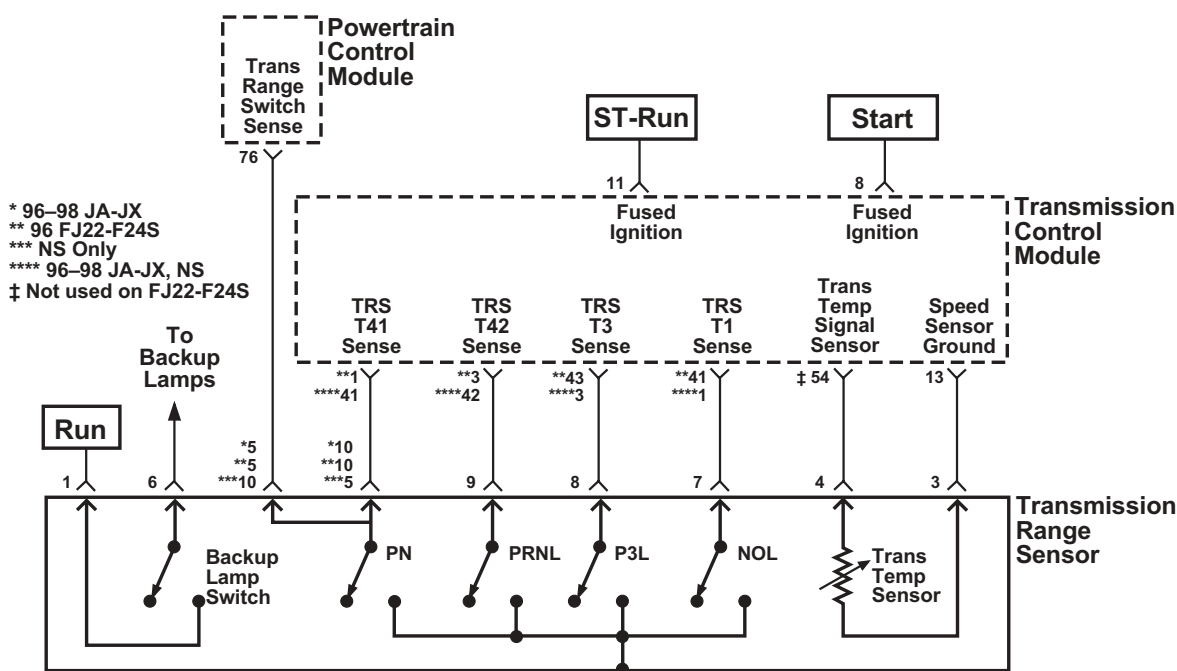
- Defective wiring between the temperature sensor and the transmission computer
- The temperature sensor
- The transmission computer

Use the illustrations as we go through the testing procedure. The pins you'll use will vary, depending on which model you're working on.



41TE, 42LE; 1996-and-Later

Code 74 (continued)

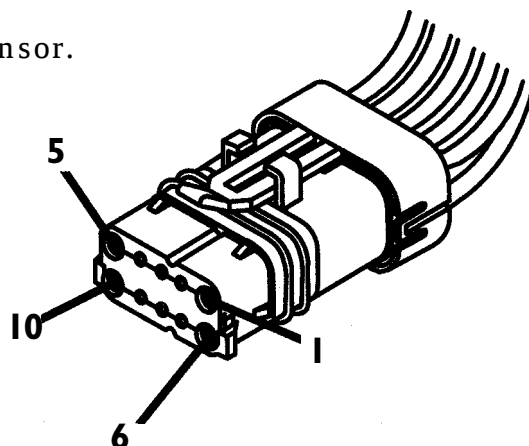


Checking Circuit Voltage

Measure the voltage at the temperature sensor wire, key on engine off (pin 53 or 54, depending on model); voltage should vary based on temperature. The voltage should never fall below 0.07 volts, or rise above 4.94 volts.

- If the voltage drops below 0.07 volts, look for a voltage supply problem or a bad temperature sensor.
- If the voltage goes above 4.94 volts, look for a grounding problem or a bad temperature sensor.

**Transmission Range Sensor Connector
(includes Transmission Temperature
Sensor Wiring)**



41TE, 42LE; 1996-and-Later

Code 74 (continued)

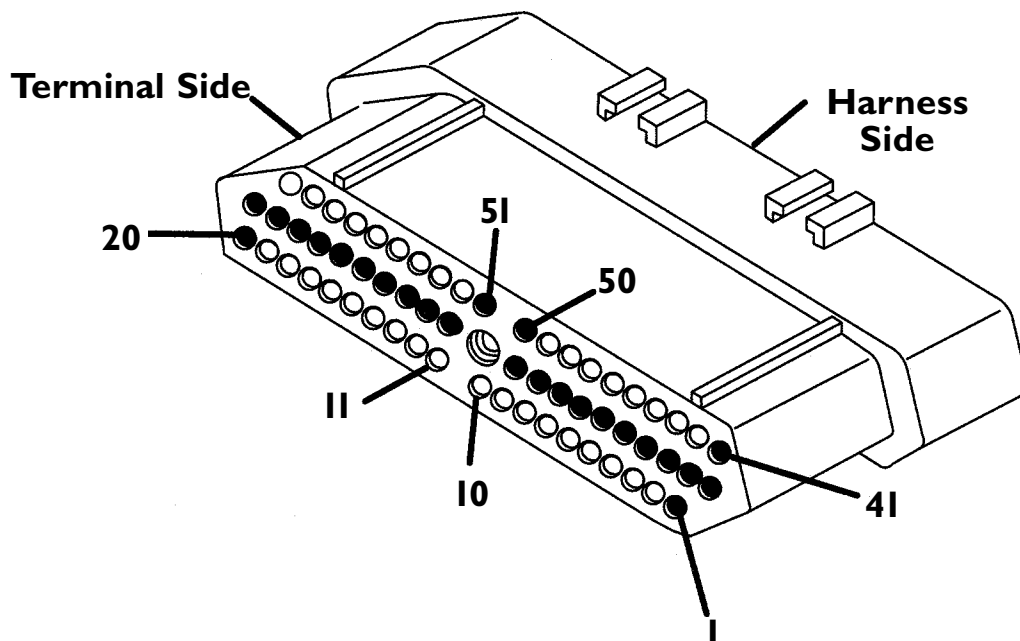
Checking the Ground Circuit

Measure the voltage on the ground side of the circuit, at the temperature sensor (key on, engine off). The voltage should be below 0.5 volts. If voltage is high, look for one of these problems:

- a broken wire to the computer
- an open ground circuit in the computer
- an open ground circuit to the computer.

To check the ground on the computer measure the voltage at the temperature sensor wire (pin 13 or 14, depending on model); it should be less than 0.5 volts.

- If the ground is okay, replace the wire to the temperature sensor.
- If the voltage is high, check for a bad ground to the computer (use the computer wiring charts to identify the grounds for the vehicle you're working on. The ground wires to the computer should be below 0.1 volts.



41TE, 42LE; 1996-and-Later

Code 74 (continued)

Checking the Voltage Feed Circuit

Measure the voltage to the temperature sensor (key on, engine off; harness connector unplugged); it should have at least 5.5 volts. If the voltage is low, check resistance. Look for an open or short-to-ground in the temperature sensor wire to the computer.

Measure the voltage at the computer (pin 53 or 54, depending on model).

- If the voltage at the computer is okay, replace the wire to the temperature sensor.
- If the voltage is still low, cut the wire about 3" from the computer and measure it again.
 - ☐ If the voltage is now okay, replace the wire.
 - ☐ If the voltage is still low, check the voltage supply, starting at the battery: With the key off, a fully-charged battery should have 12.6 volts. If the battery is low, charge or replace it before continuing. Voltage at the computer terminal should be within 0.1 volts of battery voltage.

4ITE

Computer Harness Wire Colors

Cavity	Color	Application	Function
1	LG/BK	AA 90, 92-95 AC, AY 92-93 AG 90-94 AJ 90-95 AP 93-94 AS 92-95 NS 96, 98	TRS T1 Sense
	LG/GY	JA, JX 95-98	
	YL/DG	F24S, FJ22 95-96	
	LG	AA 89, 91 AC, AY, AS 89-91	
2	TN/BK	AA, AS 89-95 AC 89-93 AG 90-93 AJ 90-95 AP 93-94 AY 90-93 NS 96-97	Backup Lights
	TN/GY	JA 95	
	WT/RD	F24S, FJ22 95	
3	VT	AA, AS 89-95 AC 89-93 AJ 90-95 AP 93-94 AY, AG 90-93 JA, JX 95-98 NS 96-98	TRS T3 Sense
	RD	F24S, FJ22 95-96	
4	WT/BK	AA 89-90, 92-95 AC 89-93 AP 93-94 AS 89-95 AY 90-95 NS 96-98	CCD Bus (-)
	WT	AA 91	
	WT/DG	JA-JX 95-98	
	WT/DB	F24S, FJ22 95-96	

4ITE

Computer Harness Wire Colors (continued)

Cavity	Color	Application	Function
5	BK/VT	AA 89 AS 89-91	CCD Bus (+)
	VT/BR	AA 90-91 AG, AJ 91	
	LB/BR	AA 92-95 AG, AJ 91	
	VT/BK	AP 93-94	
	BK/DR	JF22, F24S 95	
	BK/DR	JF22, F24S 96	Autostick Upshift Switch Sense
	YL/LB	JA, JX 96-97	
	LG/LB	JA, JX 98	
6	BK/YL	AA 93-95 AG, AJ 93-95 AP 93-94	Distributor Signal (+)
	GY/BK	AC, AY 93 AS EXC 3.0 93	Distributor Signal (+)
		JA, JX 95-98 NS 96-98	Crankshaft Position Sensor
	TN/YL	AG, AJ 90-91	Distributor Signal (+)
	DB/WT	F24S, FJ22 95	Crankshaft Position Sensor
	BK/RD	AS 3.0 93-95	Chassis Ground
	GY/VT	AS EXC 3.0 94-95	Distributor Signal (+)
7	PK	AS 95 FJ22, F24S 96 JA 98 NS 98	SCI Transmit (Scan Tool Data Line)
	PK/LG	JX 98	
8	YL	AA, AS 89-95 AC 89-93 AG, AY 90-93 AJ 90-95 AP 93-94	Ignition Switch Output (Start)
	YL/RD	NS 96-98	
	YL/OR	JA, JX 95-98	
	BK/RD	F24S, FJ22 95-97	

4ITE

Computer Harness Wire Colors (continued)

Cavity	Color	Application	Function
9	BK/LG	AA 89 AC 89-93 AS 89-90 AY 90-93 JA, JX 95-97	OD Pressure Switch Sense
	OR	AA 91	
	LG	F24S, FJ22 95-97	
	OR/BK	AA 90, 92-95 AG 90-93 AJ 90-95 AS 91-93 JA, JX 98 NS 96-98	
	OR/BR	AP 93-94 AS 94-95	
10	YL/DG	JA, JX 98 NS 97	Engine Load Signal
11	DB	AA 89-95 AG, AY 90-93 AJ 90-95 AP 93-94	Ignition Switch Output (Start/Run)
	DB/WT	AS 94-95 NS 96	
	RD/WT	NS 97	
	RD/VT	JA 95 JA, JX 98	
	BK/WT	FJ22, F24S 95-95 JA, JX 96-97	
12	OR/DB	AA 89, 91-95 AC 89-93 AG 90, 92-93 AJ 90, 92-95 AP 93-94 AS 89-93 AY 90-93 NS 96-98	Throttle Position Sensor Signal
	OR	AA 90	
	OR/BK	AG, AJ 91	
	OR/LB	JA, JX 95-98	
	BR/RD	F24S, FJ22 95-96	
	DB/OR	AS 94-95	

4ITE

Computer Harness Wire Colors (continued)

Cavity	Color	Application		Function
13	DB/RD	AA	89	Speed Sensor Ground
		AC	89-91	
	AS	89-90		
	AY	90-91		
	DB/BK	AA	90-95	
AC, AY		92-93		
AG		90-93		
AJ		90-95		
AP		93-94		
AS		91-95		
NS		96-98		
DB/BR	JA, JX	95-98		
GY/DB	F24S, F22S	95-96		
14	LG/WT	AA	89-95	Output Speed Sensor Signal
		AC	89-93	
		AG, AY	90-93	
		AJ	90-95	
AP		93-94		
AS		89-95		
NS		96-98		
LG/VT	JA, JX	95-98		
WT/YL	F24S, FJ22	95-96		
15	LG	AA, AS	89-95	EATX Relay Control
		AC	89-93	
		AG, AY	90-93	
AJ		90-95		
AP		93-94		
NS		96-98		
LG/YL	JA, JX	95-98		
DG/BK	F24S, FJ22	95-96		
16	RD	AA, AS	89-95	EATX Relay Output
		AC	89-93	
AG, AY		90-93		
AJ		90-95		
AP		93-94		
NS		96-98		
RD/BR		JA, JX	95-98	
17	RD	AA, AS	89-95	EATX Relay Output
		AC	89-93	
AG, AY		90-93		
AJ		90-95		
AP		93-94		
FJ22, F24S		95-96		
NS		96-98		
RD/BR		JA, JX	95-98	

4ITE

Computer Harness Wire Colors (continued)

Cavity	Color	Application	Function
18	LG/OR	AS 94-95	Overdrive Off Switch
19	WT	AA 90-95	2-4 Solenoid Control
		AC, AY 92-93	
		AG 90-93	
		AJ 90-95	
		AP 93-94	
20	LB	AS 91-95	L-R Solenoid Control
		JA 98	
		NS 96-98	
		AA 89	
		AC, AY 90-91	
41	BR/YL	AS 89-95	TRS T41 Sense
		AC 89-93	
		AG, AY 90-93	
		AJ 90-95	
		AP 93-95	
42	VT	JA, JX 95-97	TRS T42 Sense
		JX 98	
		F24S, FJ22 95-96	
		AA 91	
		AS 94-95	
43	BK/OR	JA, JX 95-98	TRS T43 Sense
		NS 96-98	
		FJ22, F22S 95-96	
		AA 90, 92-95	
		AC, AY 92-93	
44	BK/WT	AG 90-93	TRS T44 Sense
		AJ 90-95	
		AP 93-94	
		AS 92-95	
		NS 96-98	
45	BK/YL	JA, JX 95-98	TRS T45 Sense
		NS 96-98	
		FJ22, F22S 95-96	
		AA 90, 92-95	
		AC, AY 92-93	
46	VT/TN	AG 90-93	TRS T46 Sense
		AJ 90-95	
		AP 93-94	
		AS 92-95	
		NS 96-98	
47	RD/DG	JA, JX 95-98	TRS T47 Sense
		F24S, FJ22 95-97	
		AA 90, 92-95	
		AC, AY 92-93	
		AG 90-93	

4ITE

Computer Harness Wire Colors (continued)

Cavity	Color	Application	Function
43	BK/VT	AA 89, 91–92 AC 89 AS 89–90	CCD Bus (+)
	BK/BR	AA 90	
	VT/GR	AA 93–95 AC, AY 91–93 AG 90–93 AJ 90–95 AS 91–95 NS 96–97	
	BK	AC, AY 90	
	VT/BK	AP 93–94	
	BK/DB	JA, JX 95–97	
	VT/DG	F24S, FJ22 95–96	
	VT/BR	JA, JX 98 NS 98	
44	WT/BK	AA 89–90 AG, AJ 91 AS 89–91	CCD Bus (–)
	WT	AA 91	
	PK/BK	AA 92–95 AG 92–93 AJ 92–95 AP 93–94	
	WT/DB	FJ22, F24S 95–96	
	LG/LB	JA, JX 96–97	Autostick Downshift Switch Sense
	YL/LB	JA, JX 98	
45	GY/BK	AA 89–90, 92–95 AC, AS 89–93 AG 90–93 AJ 90–95 AP 93–94 AY 90–93	Distributor Signal (+)
	GY	AA 91	
	GY/VT	AS 94–95	
46	PK/LB	AC 89 JX 98 NS 96–98	SCI Receive (Scan Tool Input)
	DB/RD	JA, JX 95–97	
	PK/DG	FJ22, F24S 95–96 JA 98	

4ITE

Computer Harness Wire Colors (continued)

Cavity	Color	Application	Function
47	YL/BK	AA 89-90, 92-95	2-4 Pressure Switch Sense
		AC 89-93	
		AG 90-93	
		AJ 90-95	
		AP 93-94	
49	YL/DG	AS 89-93	OD Off Switch Sense
		AY 90-93	
		NS 96-98	
		AA 91	
		AS 94-95	
50	YL/GY	JA, JX 95-98	L-R Pressure Switch Sense
		FJ22, F24S 95-96	
		AS 94-95	
		AA, AS 89-95	
		AC 89-93	
51	DG	AG, AY 90-93	Sensor Ground
		AJ 90-95	
		AP 93-94	
		NS 96-98	
		AA, AS 89-95	
52	DG/TN	JA, JX 95-98	Input Speed Sensor Signal
		FJ22, F24S 95-96	
		AS 94-95	
		AA, AS 89-95	
		AC 89-93	
	DG/RD	AG, AY 90-93	
		AJ 90-95	
		AP 93-94	
		NS 96-98	
		AA, AS 89-95	
	BK/LB	JA, JX 95-98	
		FJ22, F24S 95-96	
		AS 94-95	
		AA, AS 89-95	
		AC 89-93	
	BK/DG	AG, AY 90-93	
		AJ 90-95	
		AP 93-94	
		NS 96-98	
		AA, AS 89-95	
	RD/BK	JA, JX 95-97	
		JA 98	
		FJ22, F24S 95-96	
		AS 94-95	
		AA, AS 89-95	
	RD/WT	AG, AY 90-93	
		AJ 90-95	
		AP 93-94	
		NS 96-98	
		AA, AS 89-95	
	OR/YL	JA, JX 95-97	
		JA 98	
		FJ22, F24S 95-96	
		AS 94-95	
		AA, AS 89-95	
	WT/DG	AG, AY 90-93	
		AJ 90-95	
		AP 93-94	
		NS 96-98	
		AA, AS 89-95	
	RD/YL	JA, JX 95-97	
		JA 98	
		FJ22, F24S 95-96	
		AS 94-95	
		AA, AS 89-95	

4ITE

Computer Harness Wire Colors (continued)

Cavity	Color	Application	Function
53	BK/YL	AA, AS 89-95 AC 89-93 AG, AY 90-93 AJ 90-95 AP 93-94 JA, JX 95-98 NS 96-98	Ground
	BK	F24S, FJ22 95-96	
54	BK/YL	AA, AC 89-92 AG, AJ 90-92 AS, AY 90-92	Ground
	VT/YL	JA, JX 96-97 JA 98	Transmission Temperature Signal
	VT/LG	NS 97-98	
	VT/WT	JX 98	
56	RD	AA 89-91 AC 89-91 AS 89-91 AY 90-91 NS 96	Fused Battery (+)
	RD/WT	AA 92-95 AG 90-93 AJ 90-95 AP 93-94 AS 92-93	
	BK/PK	AC, AY 92-93	
	RD/VT	AS 94-95	
	RD/DB	NS 97-98	
	PK/YL	JA, JX 95-98	
	RD/BL	F24X, FJ22 95-96	
57	BK/RD	AA 89-95 AC 89-93 AG, AJ 90-93 AP 93-94 AS, AY 90-95 JA, JX 95-98 NS 96-98	Ground
	BK	AS 89 F24S, FJ22 95-96	

4ITE**Computer Harness Wire Colors (continued)**

Cavity	Color	Application	Function
58	BK/RD	AA 89-91 AC 89-92 AG 90-92 AJ 90-93 AS 90-92 AY 90-92	Signal Ground
		BK AS 89	
	WT/OR	AA 92-95 AC, AY 93 AJ 94-95 AP 93-94 AS 93-95	
		AG 93 JA, JX 95-98 NS 96-98	Vehicle Speed Sensor Signal
	YL/WT	F24S, FJ22 95-96	
59	PK	AA, AJ 90-95 AC, AY 92-93 AG 90-93 AP 93-94 AS 92-95 NS 96-98	UD Solenoid Control
		PK/YL AA 89 AC 89-91 AS 90 AY 90-91	
		BK AS 91	
		BK/YL AS 89	
		PK/DB JA, JX 95-98	
		DG/YL F24S, FJ22 95-96	
60	BR	AA 89-95 AC 89-93 AG, AY 90-93 AG, AJ 90-95 AP 93-94 NS 96-98	OD Solenoid Control
		BK AS 89	
		BR/TN JA, JX 95-98	
		LG/RD F24S, FJ22 95-96	

42LE

Buzz or Rattling Noise

This buzzing or rattling noise is most often present while accelerating *lightly* from a stop, and then driving through the 10–15 MPH range. This noise doesn't vary with turns. Chrysler has a redesigned chain snubber to address this problem.

The Chrysler part number for the snubber is 4778989.

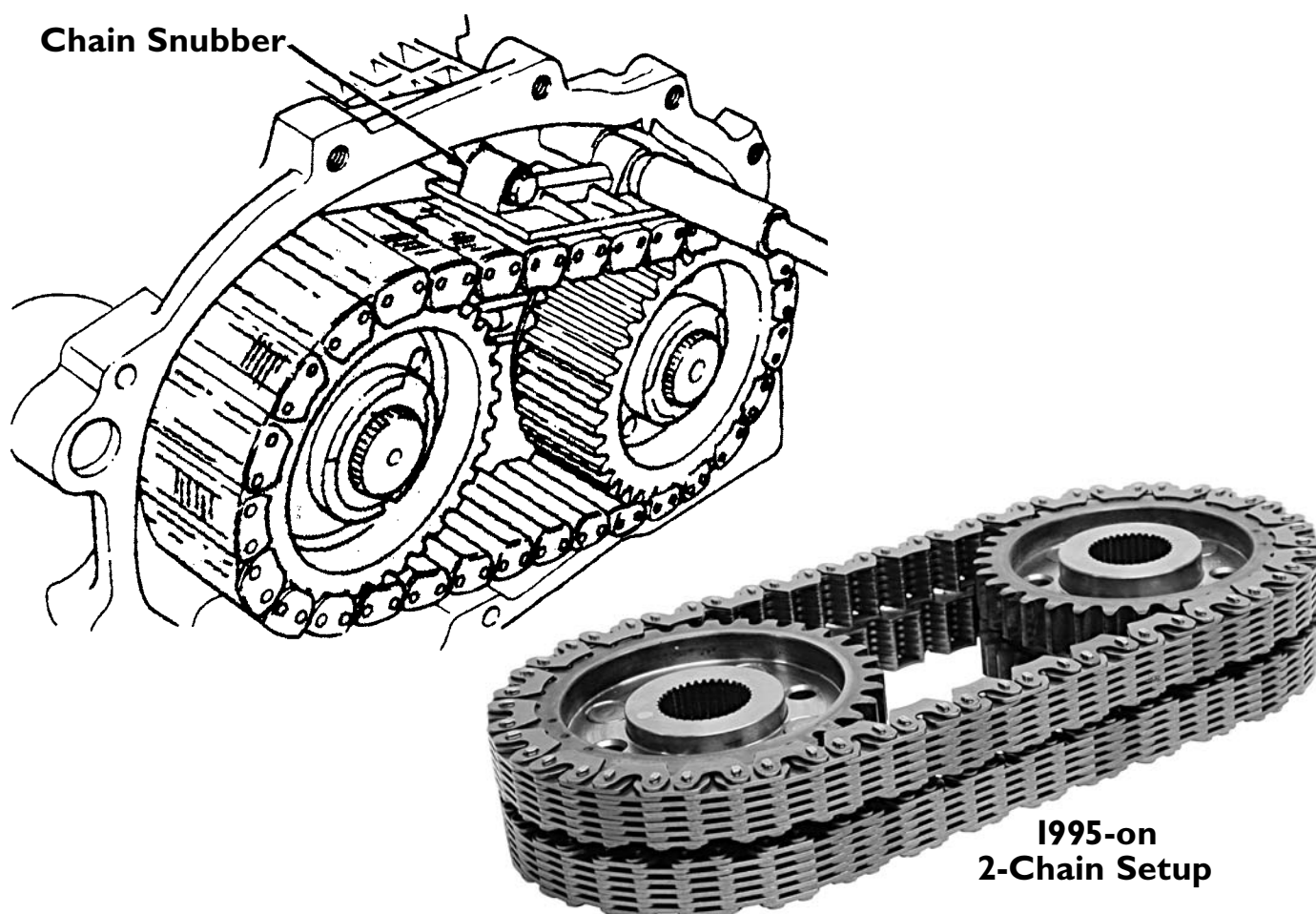
1993 and 94 models use a wide single chain. In 1995, Chrysler began using two narrow chains; the sprocket teeth are offset, and operate more quietly than the single chain. If you're working on a trans with the single chain, consider upgrading to the two-chain setup.

The part numbers for the sprockets are:

Output Shaft Sprocket 4659232

Transfer Shaft Sprocket..... 4659233

NOTICE Chrysler chains are very expensive; you can buy the same chains through the aftermarket for much less.

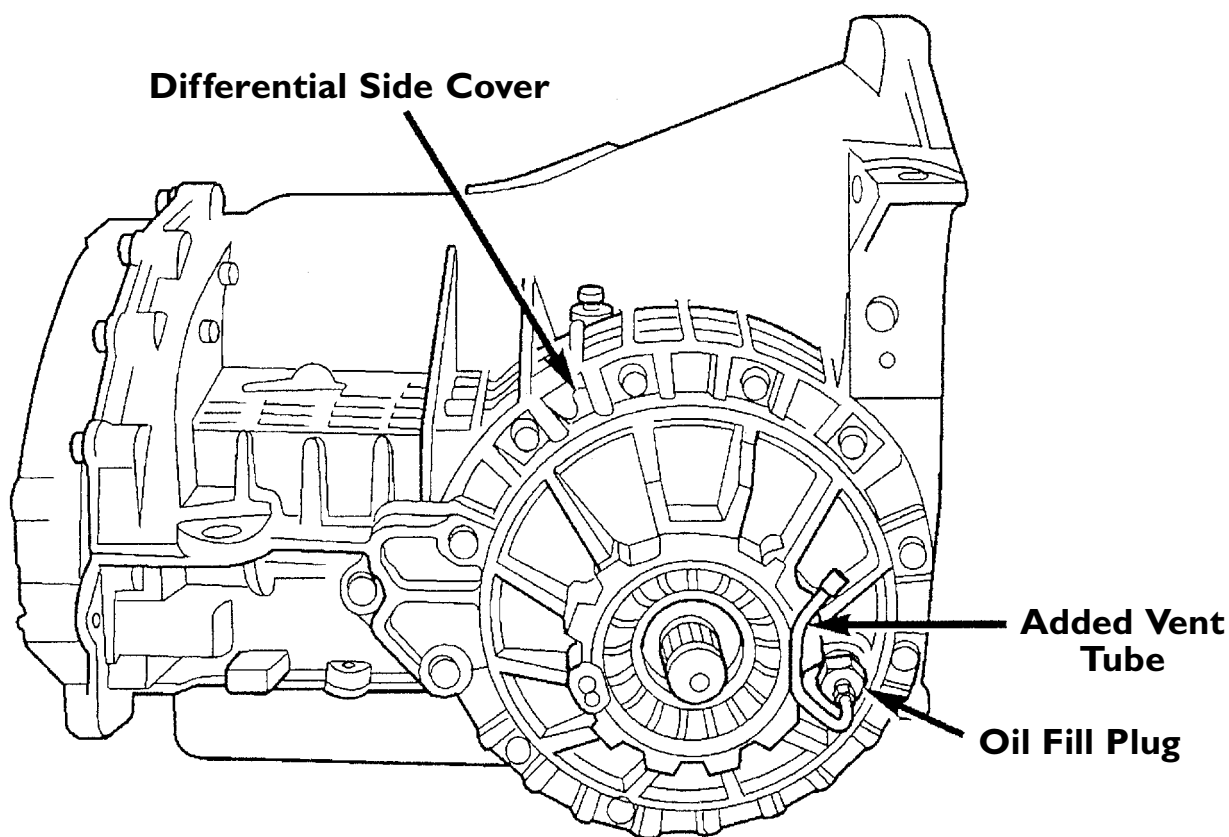


42LE

Gear Lube from the Vent

During certain conditions, it's not uncommon for gear lube to blow out the vent. Chrysler has introduced an additional vent to resolve the problem. This new vent replaces the existing fill plug.

The Chrysler part number for the new vent is 05011589AA.



42RE/44RE and 46RE/47RE

Introduction

The 42RE and the 44RE are based on the A500 (42RH). The 46RE and the 47RE are based on the A518/A618 (46RH/47RH) transmissions. For the most part, all of these units are controlled in the same manner. We'll refer to them as the 42RE and the 46RE.

Although the computer controls shift timing, it does so in an unusual way. These transmissions still use a lockup solenoid and an OD solenoid. The main difference is the addition of the governor pressure control solenoid and the governor pressure transducer.

Governor pressure is no longer controlled by centrifugal force that increases with output shaft speed. On these units, the computer reads output shaft speed from the VSS, and then creates governor pressure electronically, using the governor pressure control solenoid. The governor pressure transducer provides a feedback signal, to indicate to the computer how much governor pressure is actually being produced. Because of this, adjusting the TV pressure can still alter shift timing.

Clutch and Band Application

Range	Forward Clutch	Front Clutch	Intermediate Band	Low/Rev Band	Direct Clutch	Overdrive Clutch	Low Sprag	Overdrive Sprag
P/N								
Reverse								
Drive; OD On	1 st							*
	2 nd						F/W	*
	3 rd						F/W	*
	4 th						F/W	F/W
Drive; OD Off	1 st							*
	2 nd						F/W	*
	3 rd						F/W	*
2	1 st						F/W	*
	2 nd						F/W	*
L	1 st						F/W	*

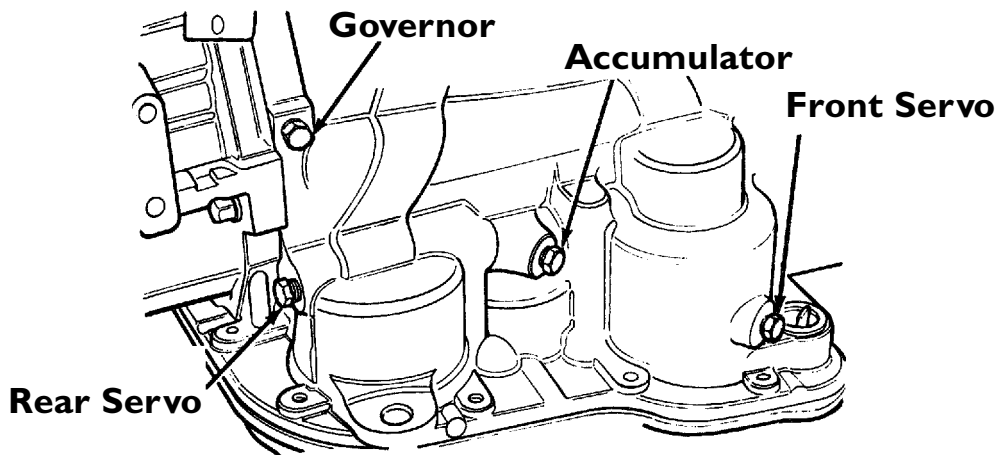
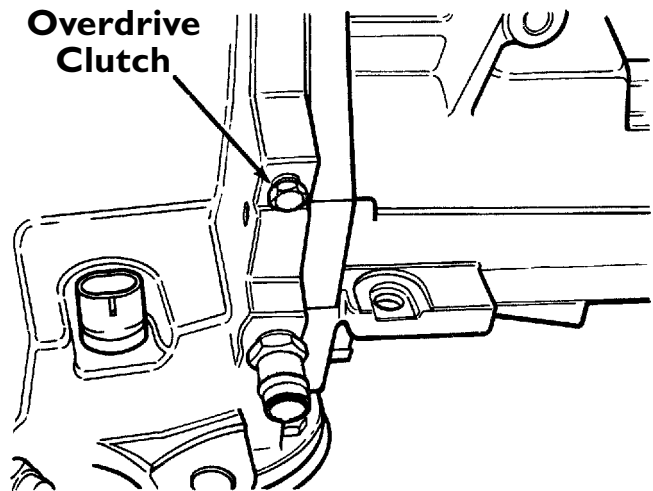
 — Applied F/W — Freewheeling

* The OD Sprag is only necessary to prevent a flare during the 3–4 shift.

42RE/44RE and 46RE/47RE

Pressure Testing

The 42RE and 46RE transmissions have several pressure ports to choose from. In many cases, it's a good idea to have two pressure gauges. Keep in mind that in reverse the pressure can exceed 250 PSI, so always use a 0–300 PSI gauge when testing reverse pressure. Despite the number of pressure taps, there is no mainline pressure tap. Use the chart to compare your results to the factory specifications.



Range		Accumulator		Front Servo		Rear Servo		OD Clutch		Governor Pressure
		Idle	WOT	Idle	WOT	Idle	WOT	Idle	WOT	
P/N		0	0	0	0	0	0	0	0	0
R		0	0	145–175	230–280	145–175	230–280	0	0	0
Drive	1 st	55–60	90–100	0	0	0	0	0	0	Pressure should be zero at a stop, and increase about 1 PSI per MPH.
	2 nd	55–60	90–100	0	0	0	0	0	0	
	3 rd	55–60	90–100	55–60	90–100	0	0	0	0	
	4 th	55–60	90–100	55–60	90–100	0	0	55–60	90–100	
2		55–60	90–100	0	0	0	0	0	0	
L		55–60	90–100	0	0	55–60	90–100	0	0	

42RE/44RE and 46RE/47RE

Wrong Gear Starts

Occasionally wrong gear starts are caused by stuck shift valves; more often they're caused by high governor pressure.

Connect a 0–100 PSI pressure gauge to the governor port. Pressure should be 0 PSI at a stop, and increase about 1 PSI for every 1 MPH of vehicle speed (12 PSI at 12 MPH, 45 PSI at 45 MPH, and so on). If governor pressure is good, the wrong gear start is caused by a stuck shift valve. If governor pressure is high, the shift valves are okay.

Causes of High Governor Pressure

- 1) Any transmission trouble code (very common)
- 2) Bad governor pressure control solenoid (very common)
- 3) Bad governor pressure transducer (very common)
- 4) Poor connections to the governor pressure solenoid and transducer (rare)
- 5) Bad computer (rare)

Quick Fix

If it's Friday night and you only have time for a guess, try replacing the governor pressure solenoid and transducer. Replace both with brand new, OEM-quality replacement parts.

42RE/44RE and 46RE/47RE

Wrong Gear Starts (continued)

Diagnostic Suggestions

When a trouble code sets, the computer shuts off the 12-volt supply to the transmission, keeping the transmission in 3rd gear.

Repair the trouble codes first. If the high governor pressure is high without trouble codes, you'll need to perform further diagnosis: While watching governor pressure with a gauge, use a scan tool to monitor "Desired Governor Pressure" and "Actual Governor Pressure." All three should read about the same. Unless the computer is bad or there's a bad input to the computer, the desired pressure should follow vehicle speed fairly closely.

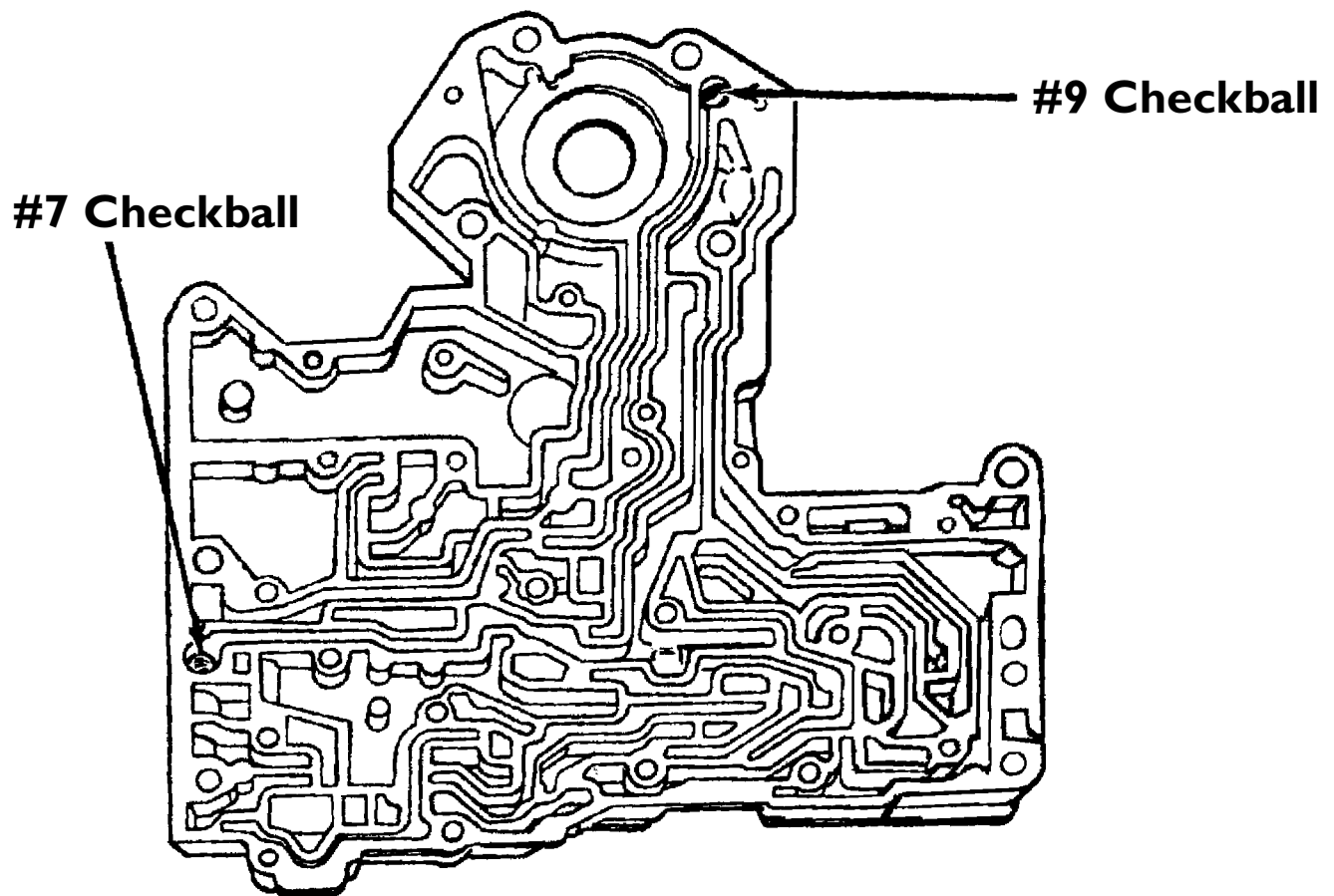
- 1) If the pressure transducer is good, but a bad governor pressure control solenoid is causing the high governor pressure, the "Actual Governor Pressure" and the pressure gauge reading should read the same, both of which will be higher than expected. However, the "Desired Governor Pressure" won't match the "Actual Governor Pressure" or the pressure gauge reading.
- 2) If the pressure transducer is lying to the computer, the "Desired Governor Pressure" and the "Actual Governor Pressure" may or may not be the same. However, the pressure gauge reading will definitely not be the same as the "Desired Governor Pressure."
- 3) If the governor pressure control solenoid and the pressure transducer are bad, the only reading you can trust is from your pressure gauge. If the scan tool readings make no sense, try changing both the transducer and the solenoid.

42RE/44RE and 46RE/47RE

Checkball and Tube Locations

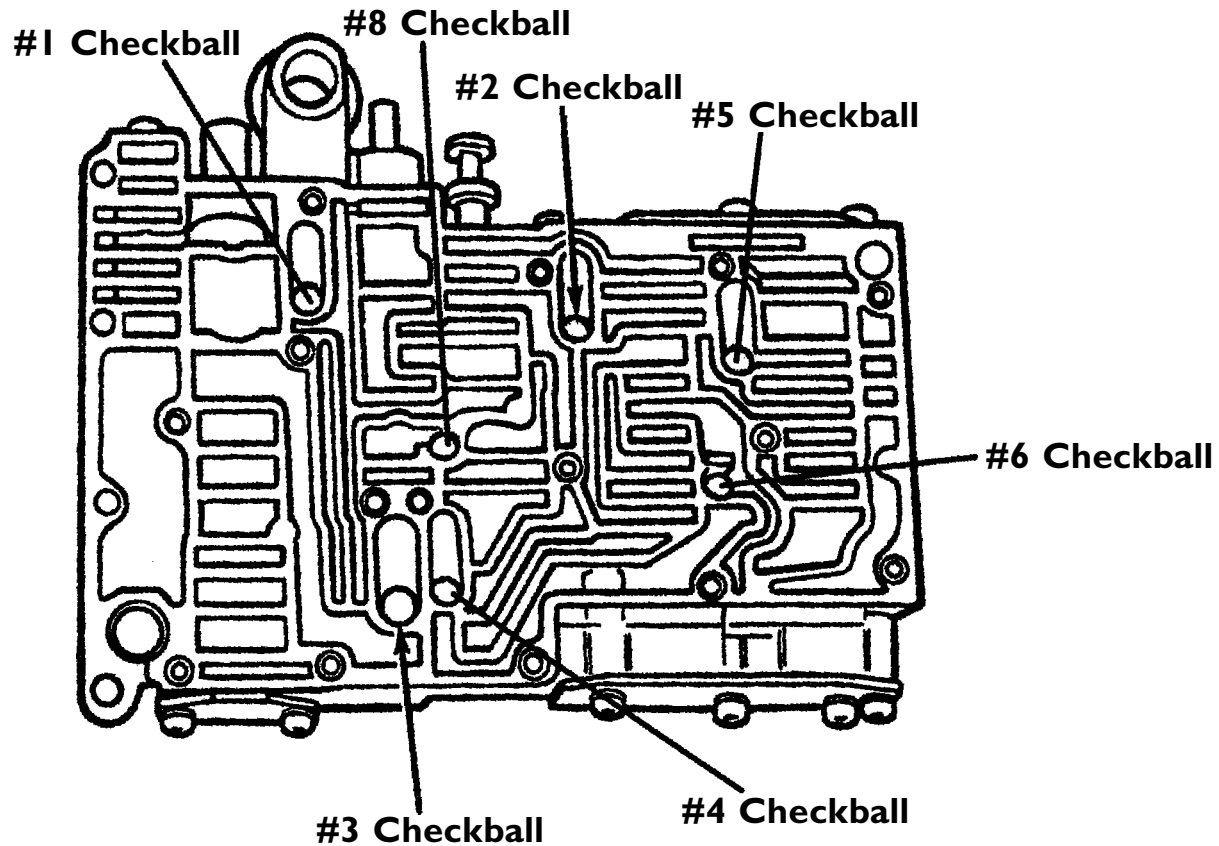
The 42RE was introduced in 1993 and was used only with Jeeps. Chrysler began using the RE versions in 1996. Several changes have occurred to the valve body over the years, including changes in the checkballs and the addition of a boost tube. These illustrations will detail those changes.

Not all models will use the #7 and #9 checkballs. Models that use these checkballs will have two holes in the separator plate above the checkballs. Using a #7 checkball on a valve body that wasn't designed for it will prevent the unit from going into forward ranges. Using a #9 checkball in a valve body that isn't designed for it will prevent the unit from going into reverse.



42RE/44RE and 46RE/47RE

Checkball and Tube Locations (continued)

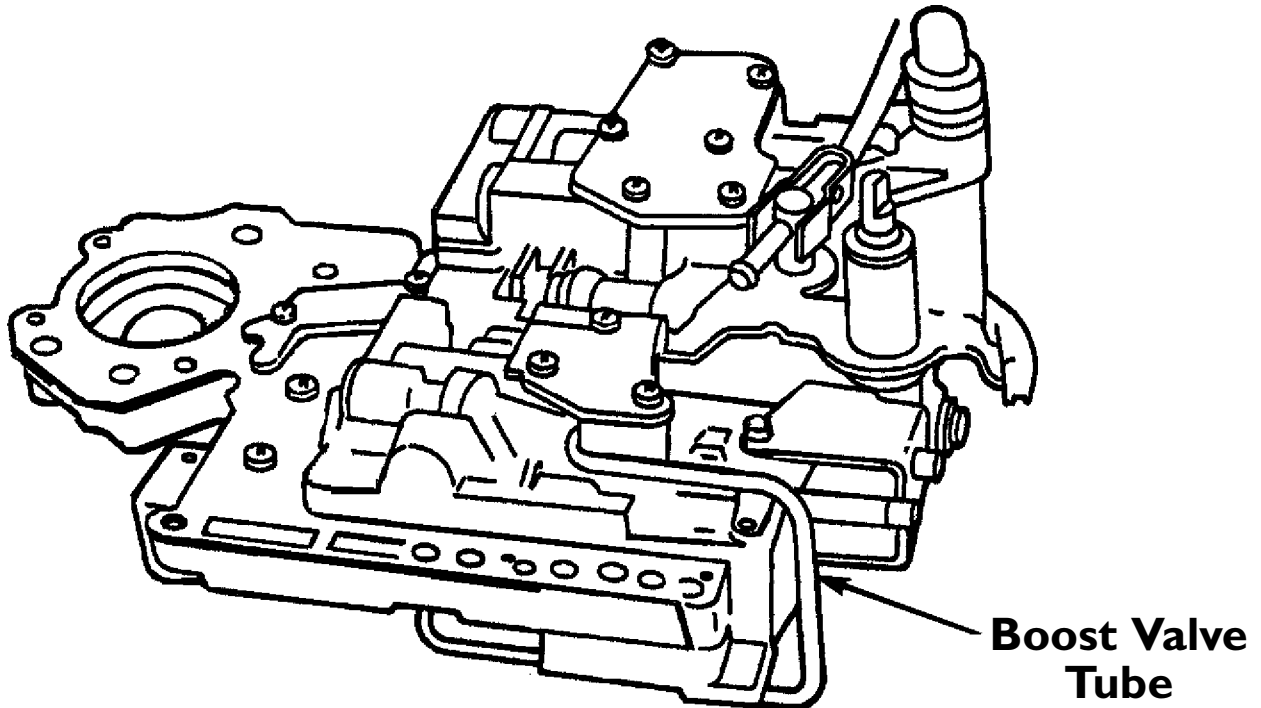


42RE/44RE and 46RE/47RE

Checkball and Tube Locations (continued)

1994-On

1994-on models have an added boost valve tube. These valve bodies offer slightly higher line pressure while the torque converter clutch is applied.

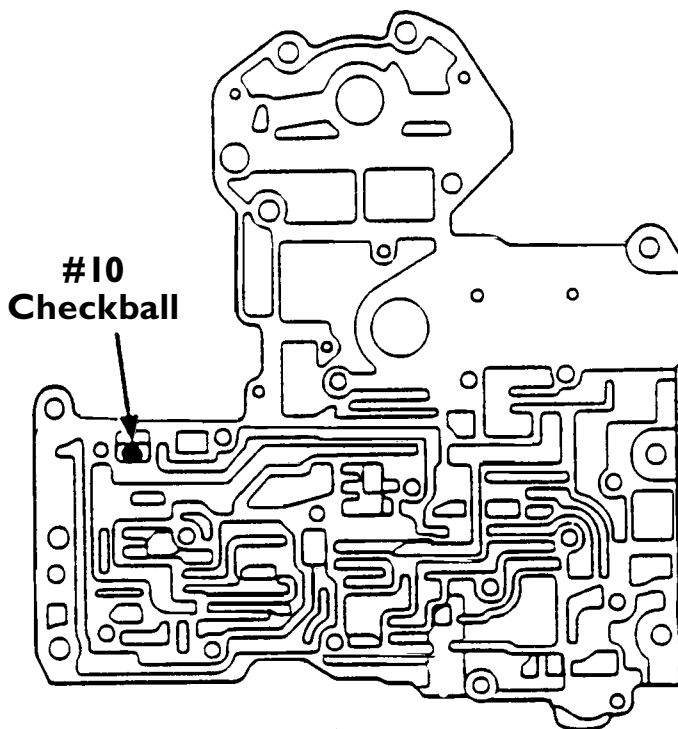


42RE/44RE and 46RE/47RE

Checkball and Tube Locations (continued)

1998-On

1998-on models have an additional checkball. These valve bodies won't shift 4-3 or 3-2 while the converter clutch is applied.



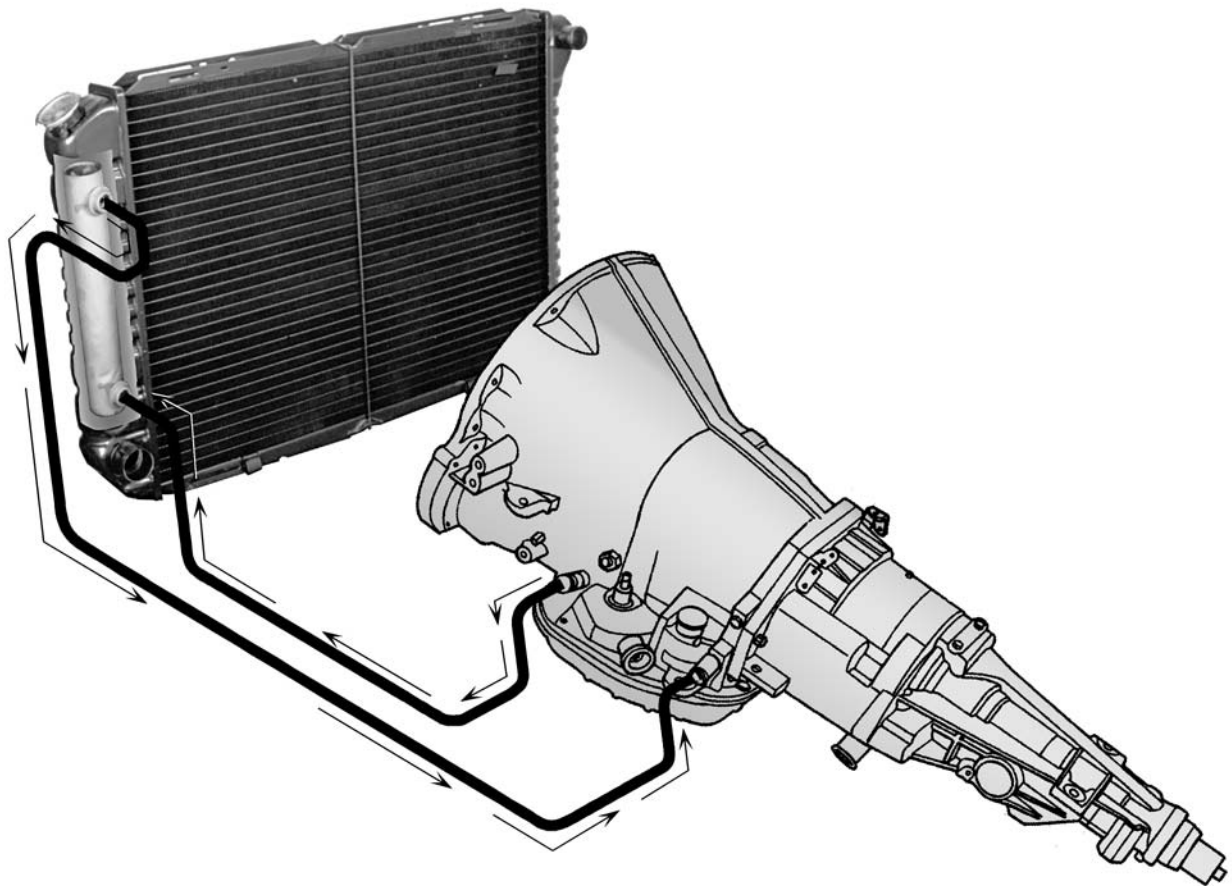
42RE, 46RE, and 47RE

Planet Failure

One of the more common reasons for planet failure is a restricted cooler. One of the cooler-related problems is using an in-series auxiliary cooler. A better way to install an auxiliary cooler is to install it in parallel. The illustrations show the difference between the OE cooler configuration, a series-fed cooler and a parallel-fed cooler.

OE Cooler Configuration

Here's the standard OE cooler configuration. Fluid goes from the transmission to the cooler, and back to the trans.

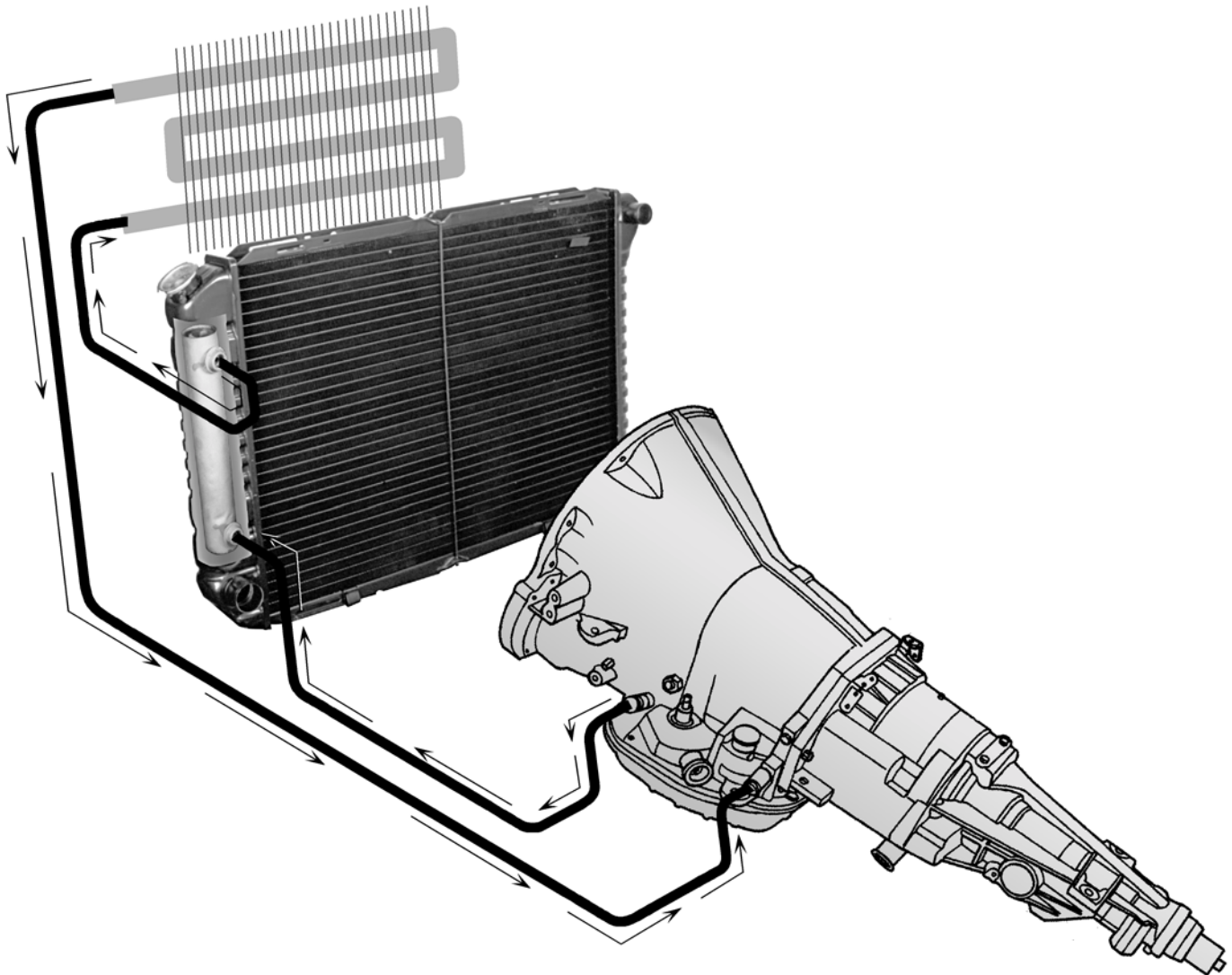


42RE, 46RE, and 47RE

Planet Failure (continued)

Series-Fed Coolers

Here's how most technicians add an auxiliary cooler, by connecting it in series with the OE cooler. While this provides additional cooling, it can also increase backpressure, and reduce overall cooler flow.

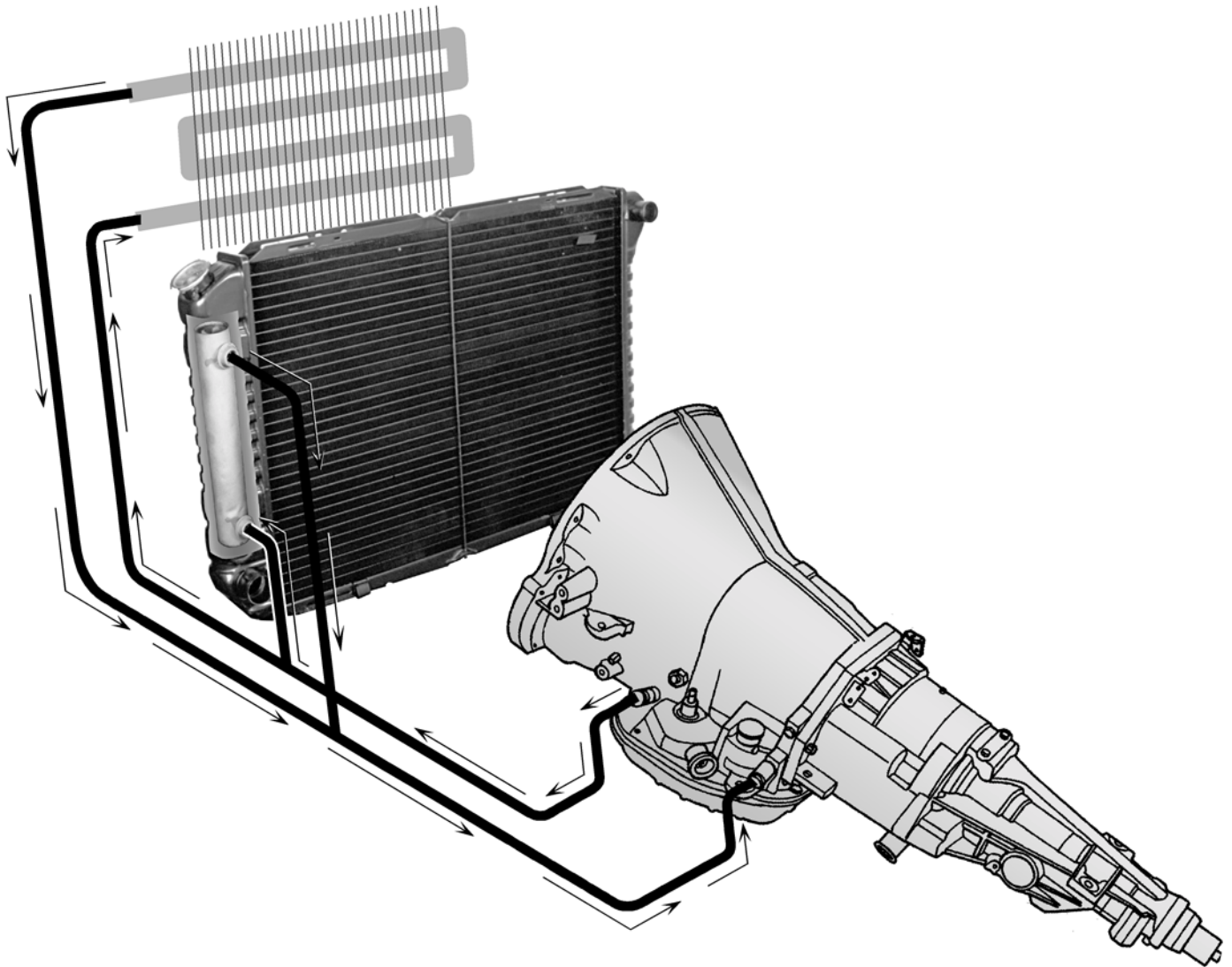


42RE, 46RE, and 47RE

Planet Failure (continued)

Parallel-Fed Coolers

For many applications, connecting the coolers in parallel is a better choice. This prevents the additional backpressure, while providing the additional cooling necessary.



42RE, 46RE, and 47RE

Planet Failure (continued)

Cooler Check Valve Kit

Another cooler related failure is a clogged cooler check valve. Some radiators have a one-way check valve on the return line, from the cooler to the transmission. If the check valve is clogged, it's best to replace it.

The Chrysler part number for the check valve is 4778670.



42RE, 46RE, and 47RE

Planet Failure (continued)

Cooler Bypass Kit

Chrysler also offers a bypass kit for vehicles that operate in very cold areas. The kit consists of several plumbing pieces. This kit is designed for vehicles that operate in areas that see temperatures *under* -15°F .

The Chrysler part number for the bypass kit is 4874284.

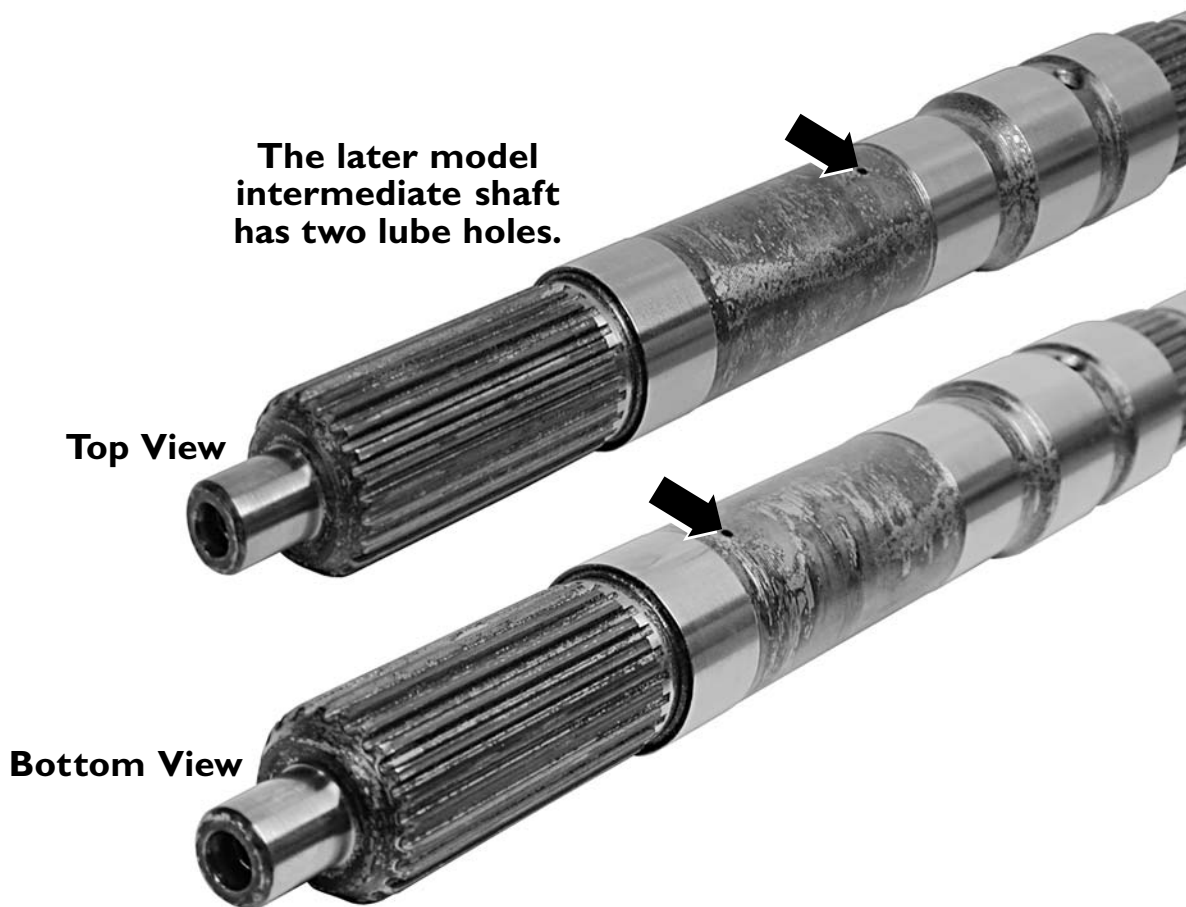


42RE, 46RE, and 47RE

Planet Failure (continued)

Intermediate Shaft

Early models have only one lube hole in the intermediate shaft; later units have two.



42RE, 46RE, and 47RE

Planet Failure (continued)

NOTICE

Chrysler offers a five-pinion planet for the OD section. This is a great improvement for heavy-use vehicles. Make sure you price this planet before offering it to your customer: The retail price is over \$400.

Chrysler's part number for the five-pinion OD planet is 4761011.



Another consideration for rough service 46 and 47REs is the five-pinion steel front planet. When you change the planet you will also need a Teflon bushing and five-tab washer.

The Chrysler part numbers for these items are:

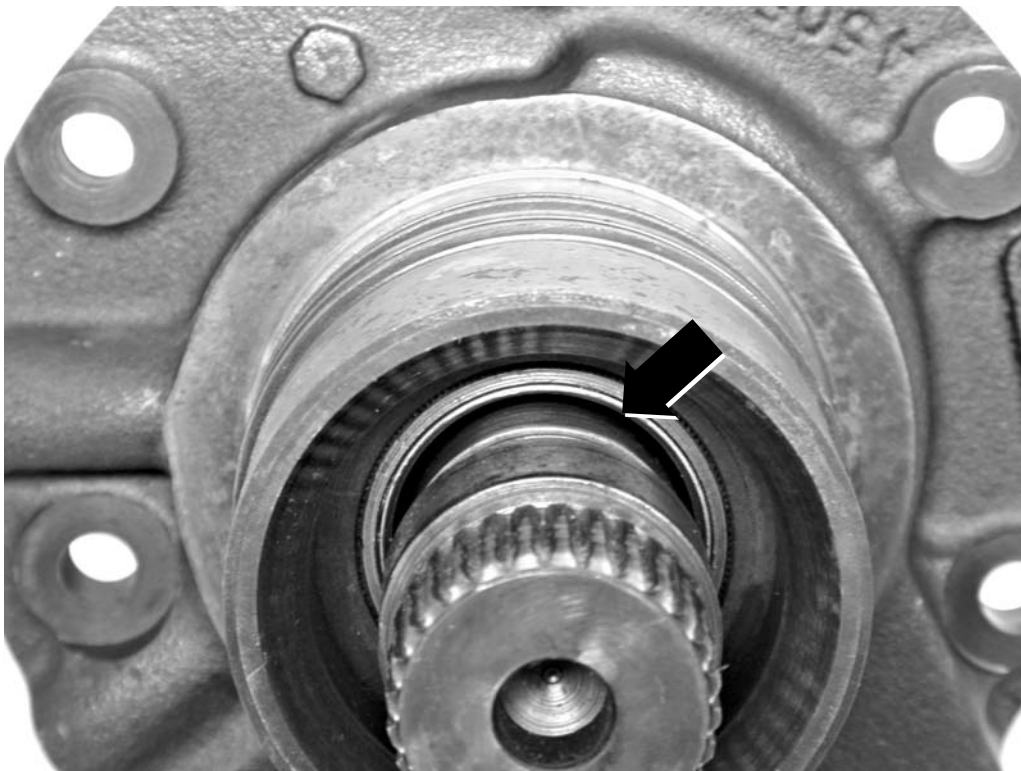
- 04617998 – Planet
- 04617951 – Teflon Bushing
- 04539129 – Washer



46RE and 47RE

Drives Forward in Neutral, Binds in Reverse

The 46RE and 47RE have two different shaft diameters. One has a bushing journal diameter of 1.170"; the other is 1.124" in diameter. Using the smaller shaft in a stator support designed for the larger shaft will allow converter charge oil to feed the rear clutch, applying the rear clutch in all ranges except park (there is no converter charge in park).



42/44RE and 46/47RE

OD Selective Washer Setup

One important (yet commonly overlooked) rebuild procedure is selecting the washer between the overdrive piston and direct clutch hub. This washer isn't for setting endplay; rather, it's used to coordinate the release of the direct clutch with the apply of the overdrive brake.

If the washer is too thin, it can cause a bindup during the 3-4 shift. If the washer is too thick, it can prevent the direct clutch from applying all the way. This will cause a slip in reverse, or no reverse at all.

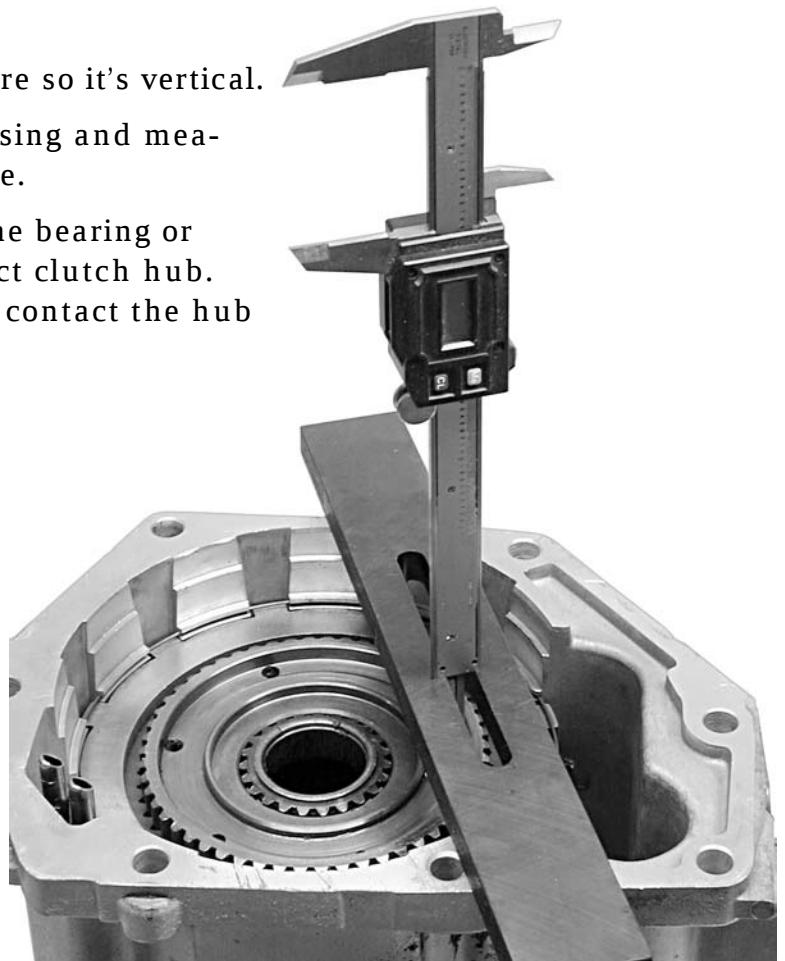
There are two ways you can use to select the proper washer: The factory way, and Cliff's way.

Let's first look at the factory method:

Factory Method

1. Place the overdrive section in a fixture so it's vertical.
2. Place a straight edge across the housing and measure from the top of the straight edge.

CAUTION Make sure you don't have the bearing or selective washer on the direct clutch hub. Your dial indicator needs to contact the hub directly.



42/44RE and 46/47RE

OD Selective Washer Setup (continued)

3. Take a measurement in four places, about 90° apart.
4. Average the four measurements. For example: Let's say your four measurements were 1.812", 1.818", 1.815", and 1.817". Here's the formula:

$$1.812 + 1.818 + 1.815 + 1.817 = 7.262$$

$$7.262 \div 4 = 1.8155"$$
 We'll round this to 1.816"
5. Subtract the thickness of the straightedge. If you had a straightedge that's 0.500" thick, then $1.816 - 0.500 = 1.316$
6. Find a washer from the chart that comes closest to your measurement.

Measurement	Spacer P/N	Spacer Thickness
1.250" – 1.264"	4431730	0.108" – 0.110"
1.265" – 1.279"	4431585	0.123" – 0.125"
1.280" – 1.294"	4431731	0.138" – 0.140"
1.295" – 1.309"	4431586	0.153" – 0.155"
1.310" – 1.324"	4431732	0.168" – 0.170"
1.325" – 1.339"	4431587	0.183" – 0.185"
1.340" – 1.354"	4431733	0.198" – 0.200"
1.355" – 1.369"	4431588	0.213" – 0.215"
1.370" – 1.384"	4431734	0.228" – 0.230"
1.385" – 1.399"	4431590	0.243" – 0.245"

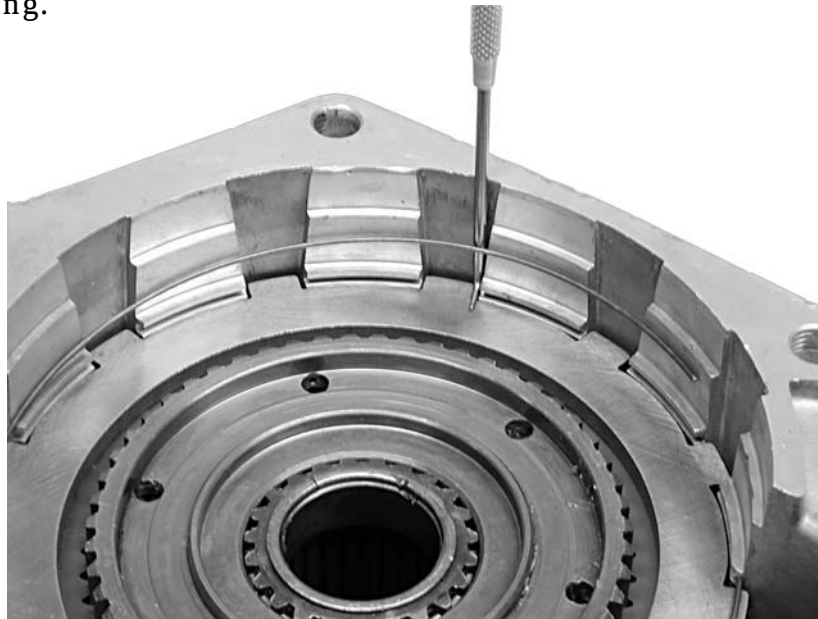
This is a very reliable and accurate method, but some consider it a bit time consuming. Now let's look at "Cliff's method":

42/44RE and 46/47RE

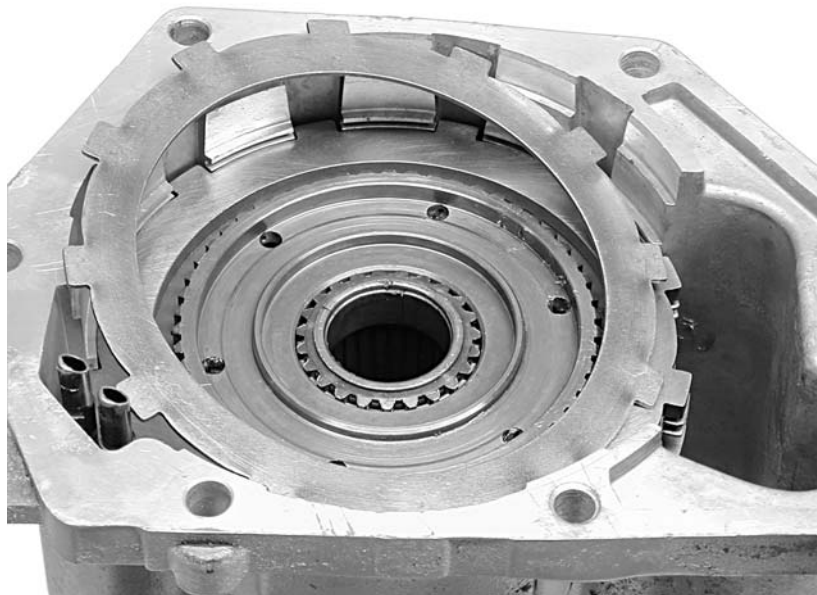
OD Selective Washer Setup (continued)

Cliff's Method

Place the overdrive section in a fixture, just like you did in the factory method. Before you begin your measuring process you need to make a couple of changes. First remove the wire snap ring.



Now add an extra overdrive steel plate.



42/44RE and 46/47RE

OD Selective Washer Setup (continued)

Select your washer:

1. Get the OD piston, bearing, and any selective washer you choose and stack them as they would fit in the overdrive section.



Make sure you install the bearing and washer before you place the piston on top of the OD section.

2. While pressing down on the piston check for about 0.010" of "jiggle" in the extra steel you placed in the OD section. Increase or decrease the thickness of the selective until you get about 0.010" of play in the OD pack.
3. Once you have the correct selective washer, remove the extra OD steel place and reinstall the wire snap ring.

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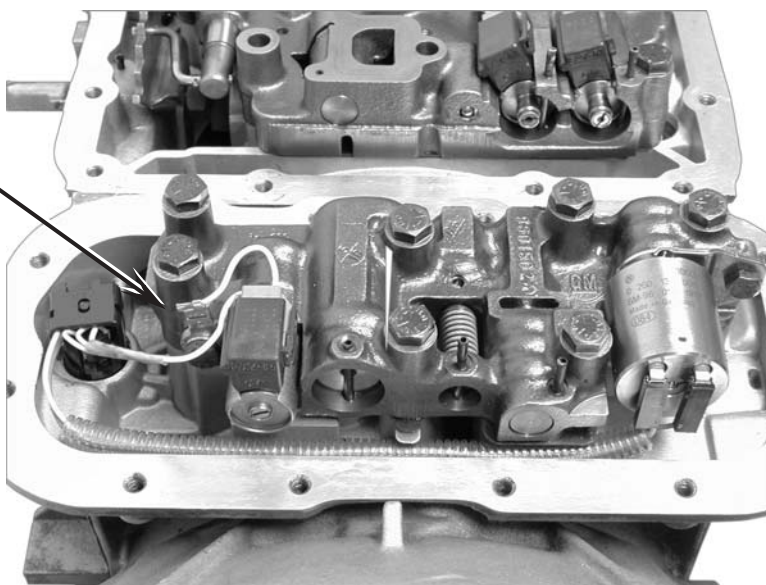
Isuzu 4L30E

Solenoid Grounding Kit

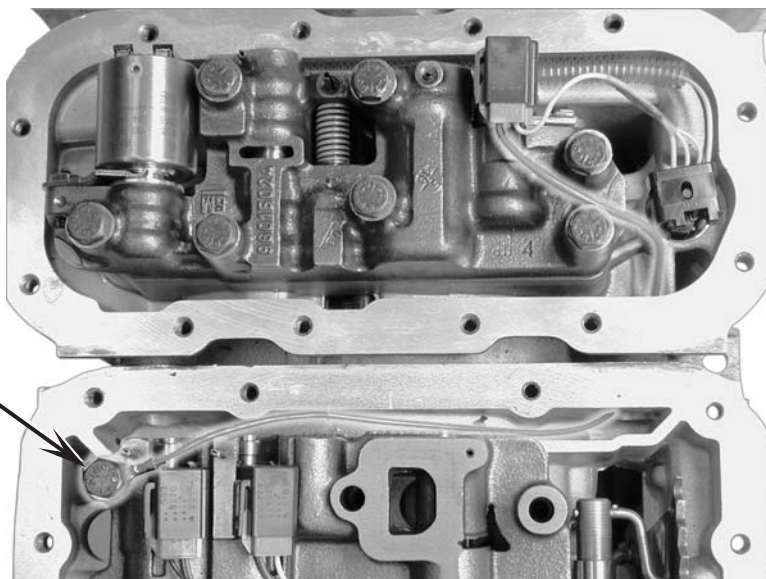
Bad grounds are a real problem, especially with the 4L30E. The standard grounding method for the solenoids is a simple spade connector.

Isuzu has a harness kit that includes an eyelet you bolt on the valve body. This new ground is far superior to the spade connector, and it's a good idea to use one on every rebuild. The Isuzu part number for the kit is 8-96041-331-0.

Early units used a spade connector to provide solenoid ground. These units often suffered from bad grounds.



Isuzu offers a harness that provides a more positive ground for the solenoids.

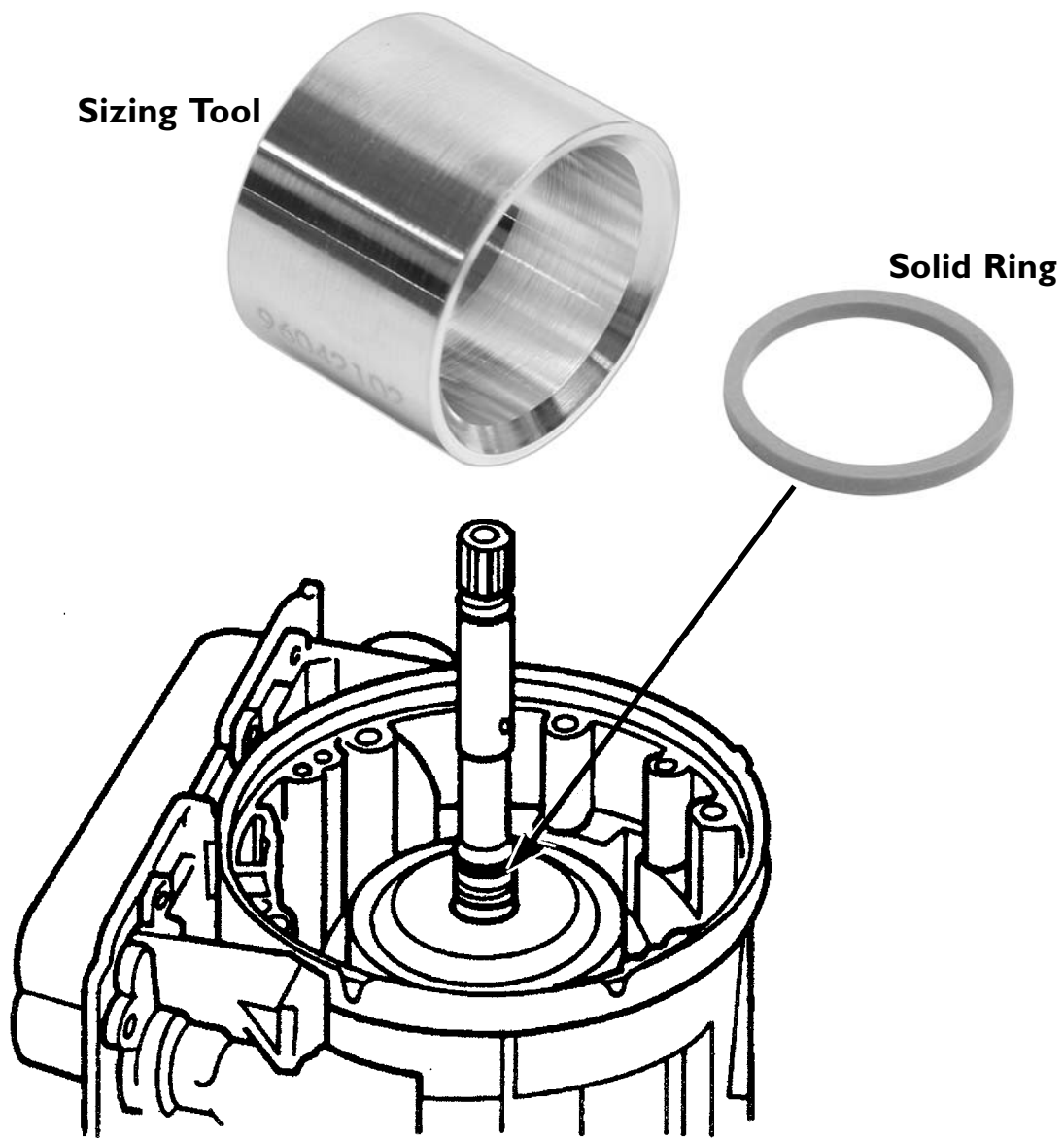


Isuzu 4L30E

Converter Drainback

Converter drainback can be caused by a leak at the intermediate shaft sealing ring. Isuzu now uses a solid Teflon sealing ring for this location.

Isuzu part number 8-96041-327-0 includes the solid ring and sizing tool. The ring isn't available through Isuzu separately; if you already have the sizing tool, check with your local aftermarket supplier to see if they can supply you with the ring.



Isuzu 4L30E

Delays Forward

A forward delay is usually caused by poor feed to the servo. In many cases this is caused by a restricted band solenoid. The solenoid screen breaks apart and gets stuck in the solenoid, restricting flow to the servo. It's a good idea to replace the band solenoid and screen during every rebuild.



The Isuzu part numbers for the solenoid and screen are:

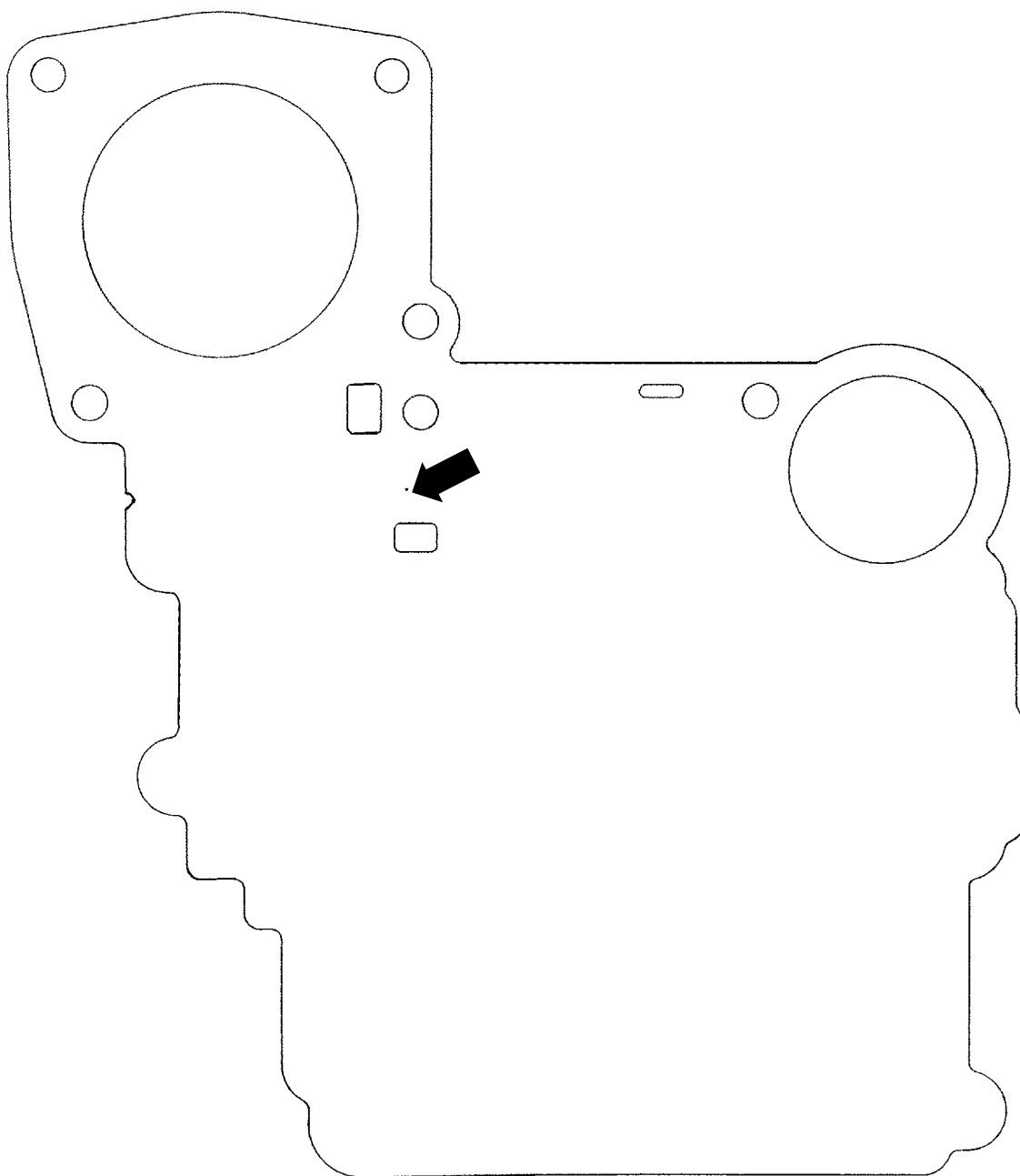
8-96042-006-0	(Solenoid)
8-96041-012-0	(Screen)



Isuzu 4L30E

Delays Forward (continued)

You may also find it helpful to enlarge the servo feed orifice in the separator plate to increase servo feed. The original orifice is 0.040" in diameter. Enlarging it to 0.050" will help reduce the delay.



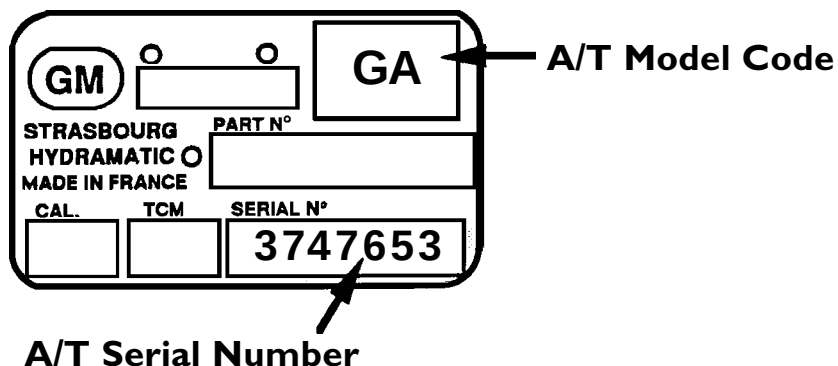
4L30E

Code 41: Ratio Error

A code 41 is typically caused by clutch slip. If you're working on a 1990 or '91 Trooper II, 1992 or '93 Trooper, or 1991 through '93 Rodeo, be aware that some units were made with poorly machined overdrive housing castings. The machining problem was where the 4th brake piston outer seal rides, and where the 4th accumulator piston seal rides.

If you have a wiped out 4th clutch, make sure you check these areas very closely for a rough surface where the seals ride. If you need to replace the housing you have two choices: Use a 1994-or-later housing, or replace it with an update kit. The kit contains a new housing, a replacement plate with gaskets, and two accumulator setups (for various models). The Isuzu part number for the kit is 8-96041-192-0.

If you use the update kit, check the ID tag to make sure you use the right accumulator setup. The ID tag is located just above the manual linkage shaft on the driver's side of the trans.

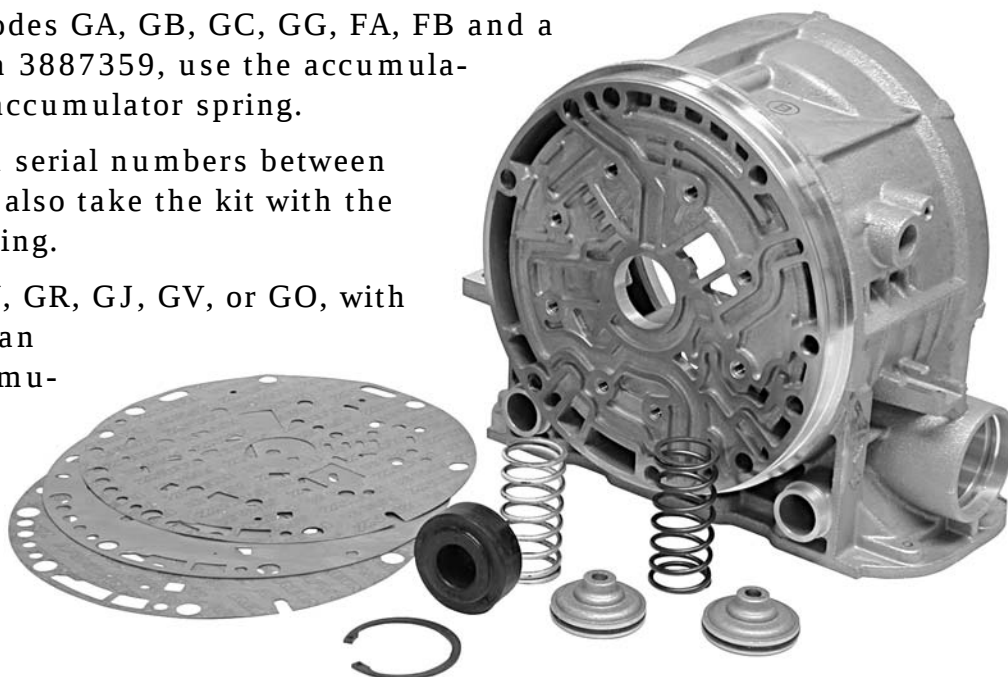


Check for these two items: the model code and serial number.

For units with model codes GA, GB, GC, GG, FA, FB and a serial number less than 3887359, use the accumulator kit with the longer accumulator spring.

Models FD and FE with serial numbers between 3887359 and 4072977 also take the kit with the longer accumulator spring.

Models FF, FG, GE, GN, GR, GJ, GV, or GO, with a serial number less than 4072977, use the accumulator kit with the shorter spring.

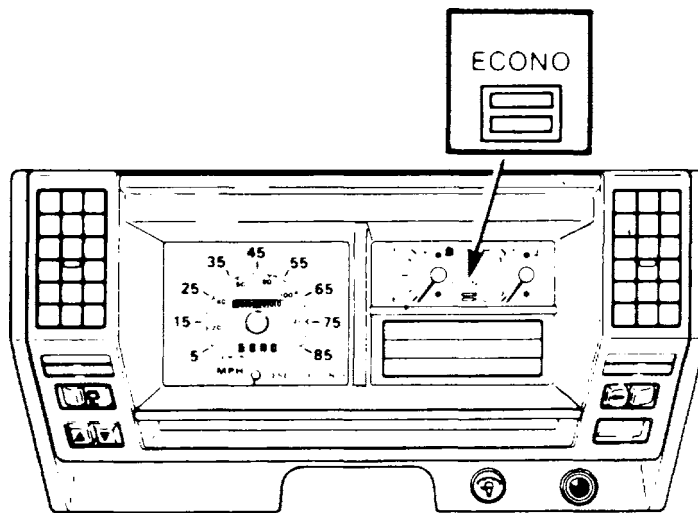


Isuzu NPR

Diagnostic Trouble Codes

Problem Indication

The JR403E control system indicates problems in the computer system through the Economy light on the dash. When you first turn the key on, the light will flash 16 times, to indicate a diagnostic trouble code stored in memory.



To indicate a computer system problem or display diagnostic trouble codes, Isuzu trucks flash the Economy light on the dash.

Once you know there's a code in memory, there are two different procedures for retrieving and reading the codes, depending on vehicle year. The easiest way to determine which procedure to follow is to try the procedure for early systems: If the system displays codes, you chose correctly; if not, look for the diagnostic link connector, required for the second procedure.

On each system, the computer displays the codes by flashing the Economy light on the dash.

Retrieving the Codes; Early Systems

To retrieve the codes on early vehicles, set the parking brake. You'll have to put the vehicle in gear during the procedure, and this will prevent it from rolling.

To prepare to retrieve the codes:

- Turn the ignition key off.
- Put the shift selector in D.
- Set the Economy/Drive switch to "normal."

Now you're ready to begin the procedure to display diagnostic trouble codes:

Isuzu NPR

Diagnostic Trouble Codes (continued)

Problem Indication (continued)

- Step 1:** Turn the key on, engine off.
- Step 2:** Move the shift selector to 2.
- Step 3:** Move the Economy/Drive switch to “economy.”
- Step 4:** Move the shift selector to 1.
- Step 5:** Move the Economy/Drive switch back to “normal.”
- Step 6:** Hold the throttle all the way to the floor.

The computer will begin displaying diagnostic codes by flashing the Economy light on the dash.

Reading the Codes; Early Systems

Isuzu trucks display diagnostic trouble codes using an 11-flash sequence. The light flashes 11 times in a row; the sequence always starts with a long flash — about two seconds long. It's followed by 10 shorter flashes.

If there are no problems in the system, all ten flashes will be very short — about 0.1 seconds each.



But if the computer identifies a problem in the system, one of those 10 flashes will be longer — nearly a half second long. Count the flashes: The long flash identifies the code in memory.

For example, if the first flash after the two second flash is the long one, you're looking at code 1.



Isuzu NPR

Diagnostic Trouble Codes (continued)

Problem Indication (continued)

If the fourth flash is the longer one, you're looking at code 4.



If there's more than one code in memory, the computer displays all of the codes in the same pass. Here's how a system would display codes 1, 4 and 8 at the same time:



Code Definitions; Early Vehicles

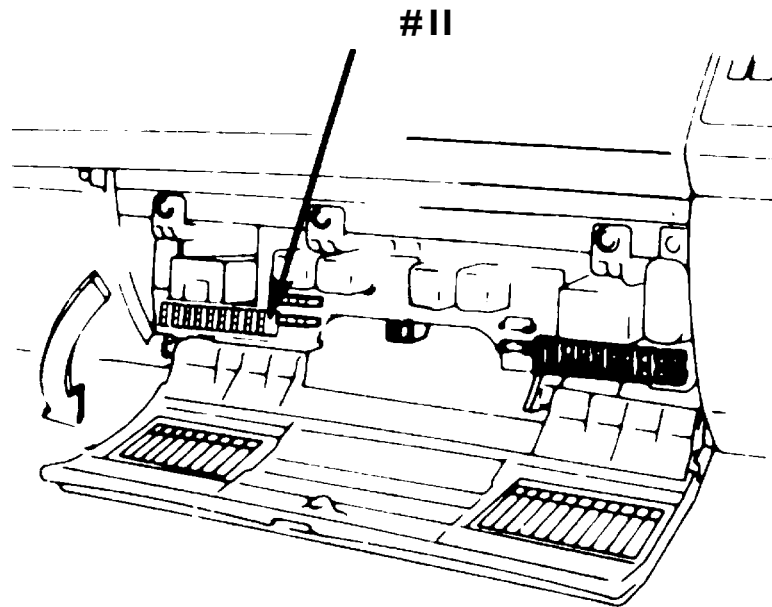
Code	Definition
1	Vehicle speed sensor — transmission circuit open or shorted.
2	Vehicle speed sensor — speedometer circuit open or shorted.
3	Throttle position sensor circuit open or shorted.
4	Shift solenoid A circuit open or shorted.
5	Shift solenoid B circuit open or shorted.
6	Overrun clutch solenoid open or shorted.
7	Lockup clutch solenoid open or shorted.
8	ATF temperature sensor circuit is open or the computer power source is insufficient.
9	Engine RPM signal circuit open or shorted.
10	Line pressure solenoid open or shorted.

Isuzu NPR

Diagnostic Trouble Codes (continued)

Clearing the Codes

Once you've repaired any problems in the system, you can clear the codes from memory by disconnecting the #11 fuse for at least 10 seconds. Then replace the fuse.

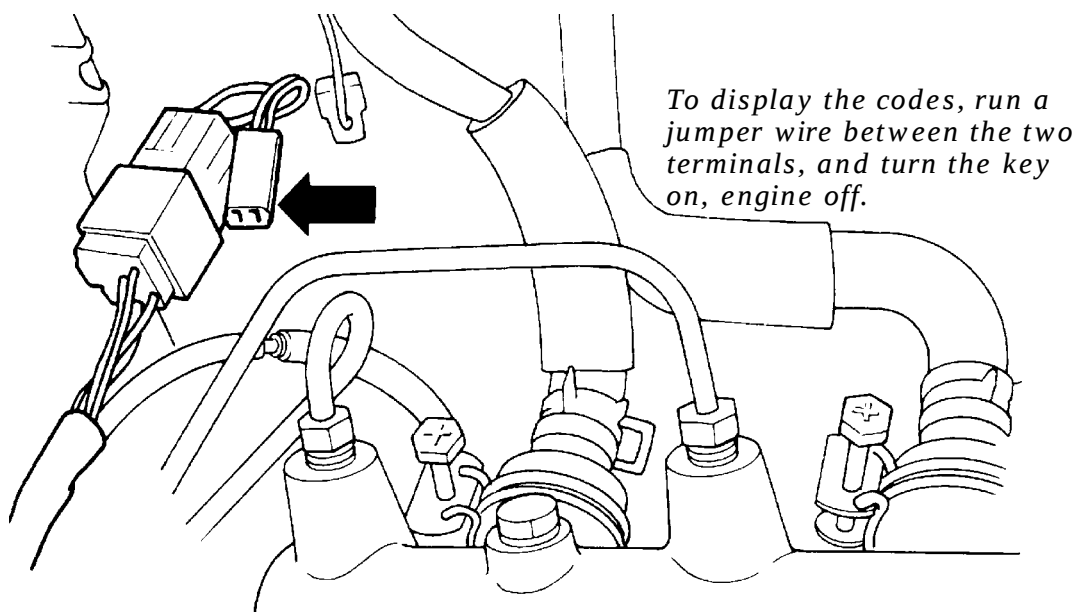


Isuzu NPR

Diagnostic Trouble Codes (continued)

Retrieving the Codes; Late Systems

The procedure for retrieving codes on late model Isuzu trucks involves jumping between the two terminals on the diagnostic link connector. Look for the connector just below the brake fluid reservoir, in the engine compartment.



Connect a jumper between the two terminals on the connector, and turn the key on, engine off. The computer will begin flashing the Economy light on and off to display the codes.

Reading the Codes; Late Systems

Late model Isuzu trucks display codes using a two digit format: The first series of flashes indicates the tens digit, and the second series indicates the ones digit. Here's how code 32 would appear:



If there is more than one code in memory, the codes will display in order, from lowest number to highest. Each code will display three times, then the system goes on to the next code in memory.

If there are no codes, the computer will flash the Economy light on and off, in a regular, even pattern.

Isuzu NPR

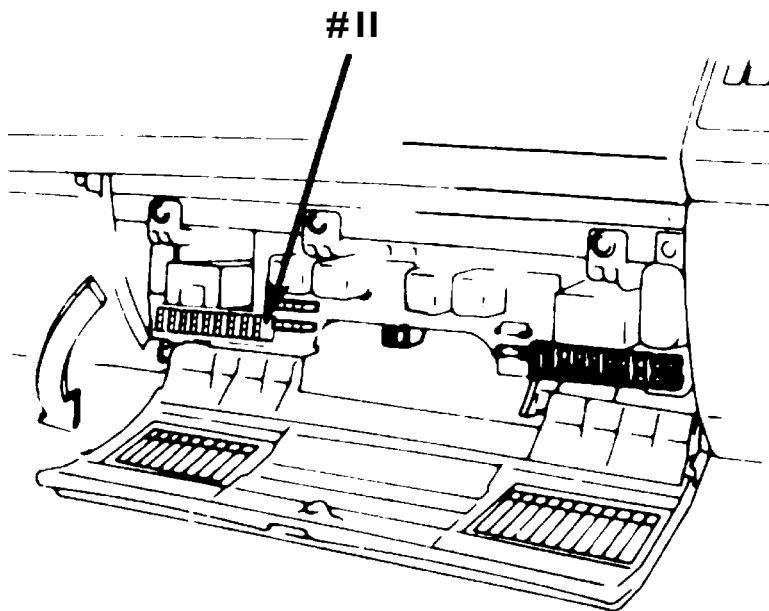
Diagnostic Trouble Codes (continued)

Code Definitions; Late Vehicles

Code	Definition
11	Vehicle speed sensor — transmission circuit open or shorted.
13	Engine RPM signal circuit open or shorted.
15	ATF temperature sensor circuit is open or the computer power source is insufficient.
17	Inhibitor switch circuit open or shorted
21	Throttle position sensor circuit open or shorted.
24	Vehicle speed sensor — speedometer circuit open or shorted.
31	Shift solenoid A circuit open or shorted.
32	Shift solenoid B circuit open or shorted.
33	Overrun clutch solenoid open or shorted.
34	Lockup clutch solenoid open or shorted.
35	Line pressure solenoid open or shorted.

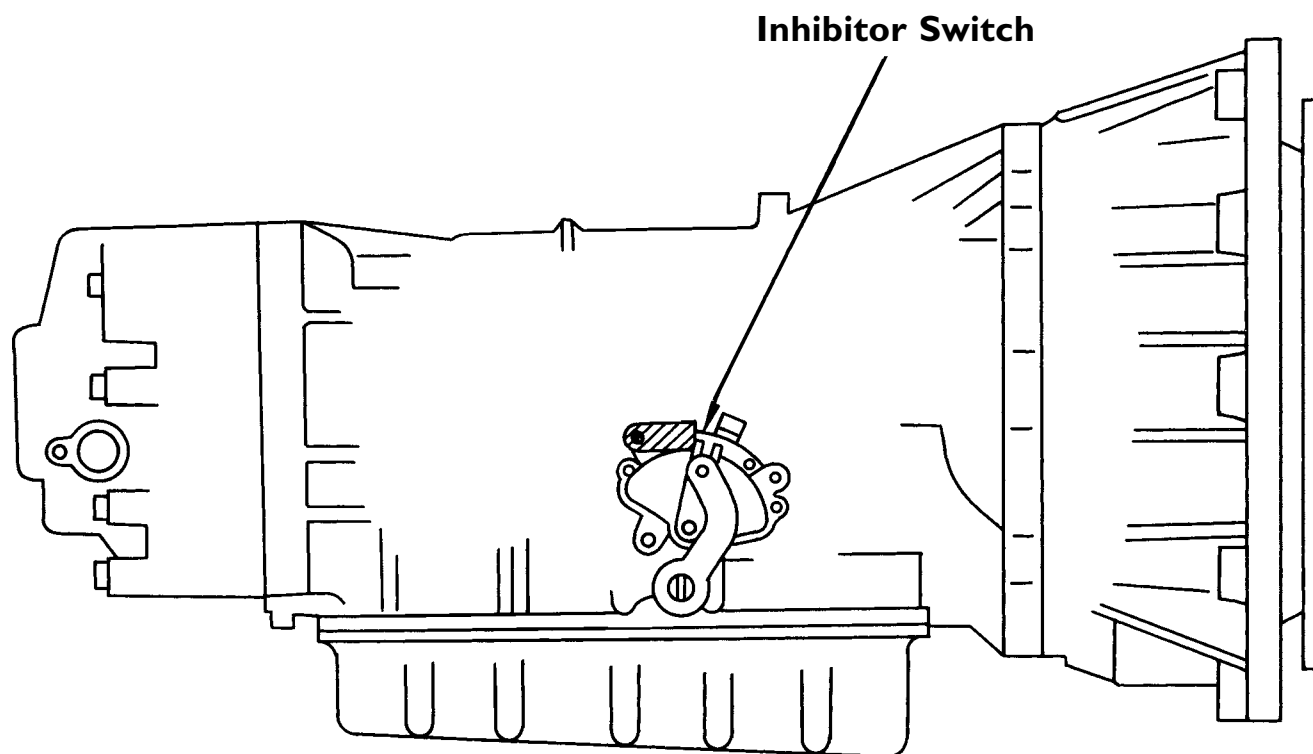
Clearing the Codes

Once you've repaired any problems in the system, you can clear the codes from memory by disconnecting the #11 fuse for at least 10 seconds. Then replace the fuse.



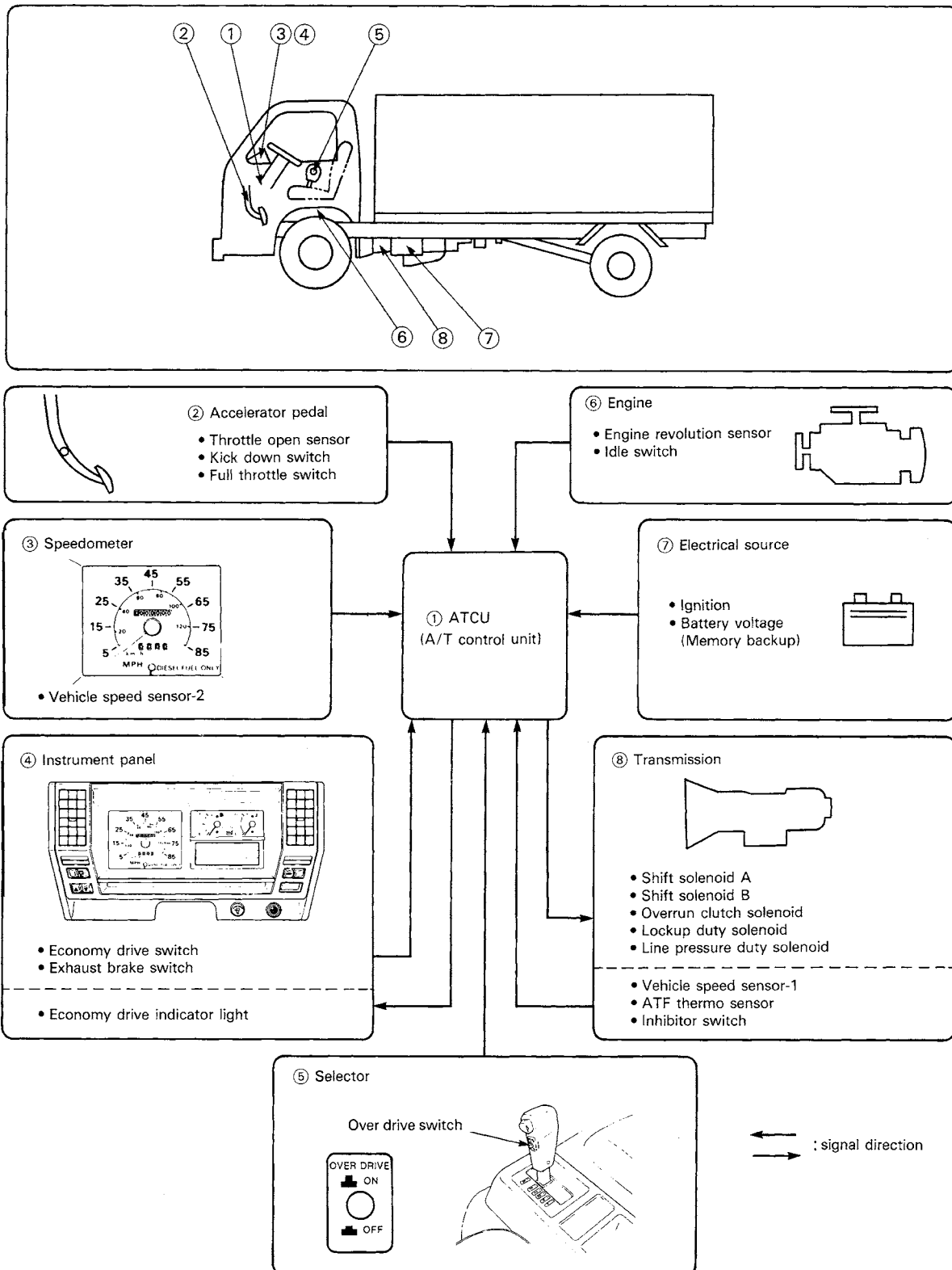
Isuzu NPR

Component Locations



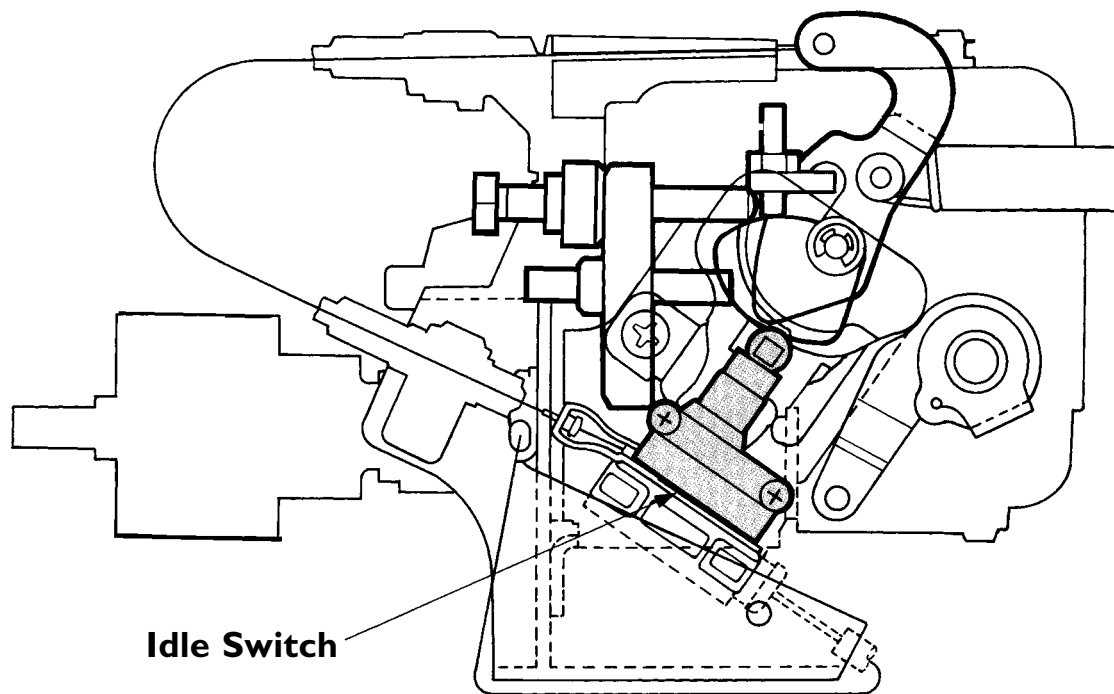
Isuzu NPR

Component Locations (continued)



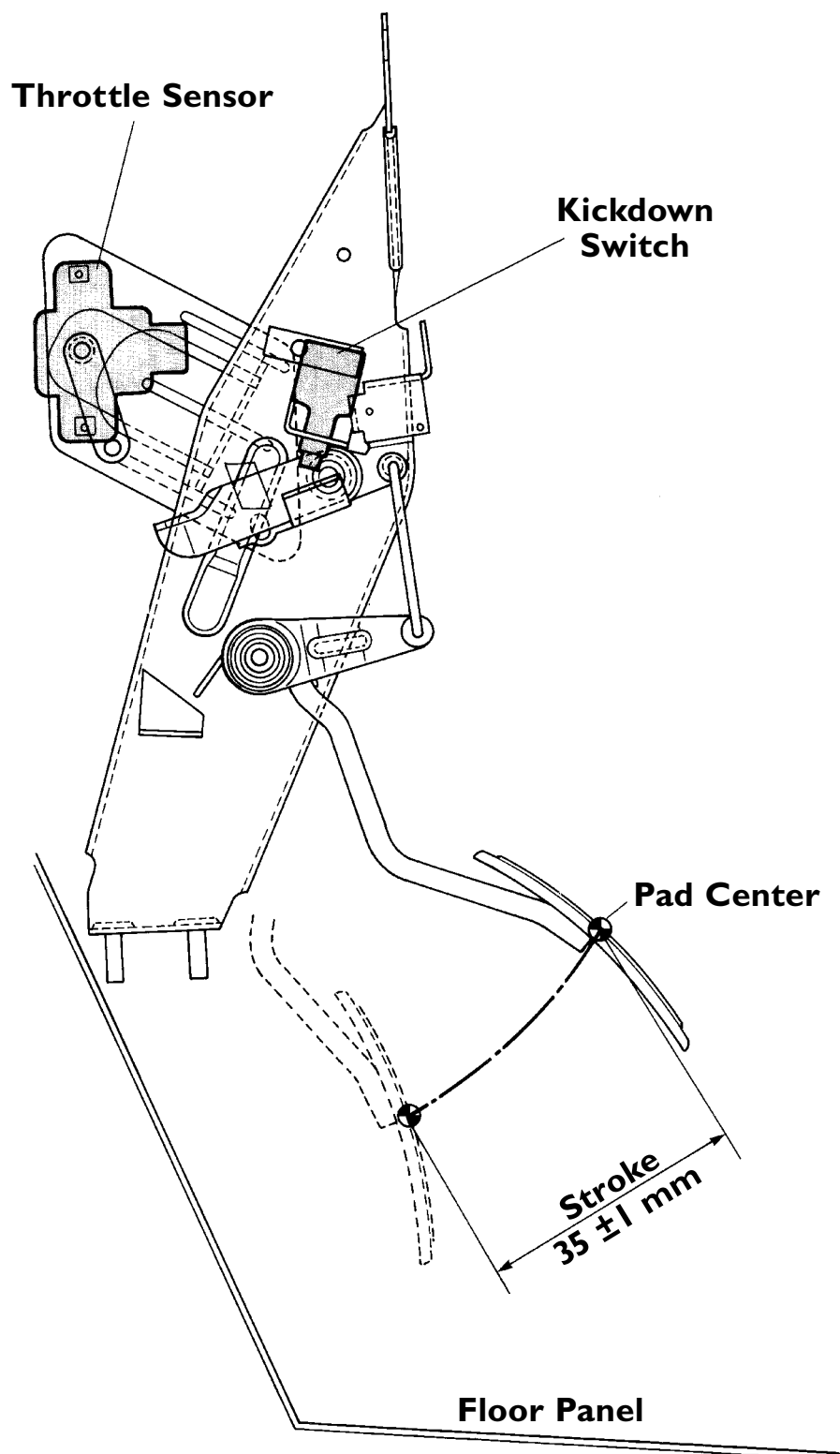
Isuzu NPR

Component Locations (continued)



Isuzu NPR

Component Locations (continued)



Isuzu NPR

Computer Terminal Identification

Early Systems

1	2	3	4		6	7	X	9	10	21	22	23	24	25	26	X	28
11	12	X	14	15	16	17	X	19	20	29	30	31	32	33	34	35	36

Pin No.	Function
1.	2 range switch
2.	1 range switch
3.	Exhaust brake signal
4.	Idle switch
5.	—
6.	Overdrive switch
7.	Kick-down switch
8.	—
9.	Economy drive switch
10.	Throttle sensor voltage (5V out)
11.	Throttle sensor
12.	ATF Thermosensor
13.	—
14.	Idle switch voltage
15.	Throttle sensor ground
16.	Vehicle speed sensor 1
17.	Full throttle switch
18.	—

Pin No.	Function
19.	Nutral range switch
20.	D range switch
21.	Overrun clutch solenoid
22.	Lock-up duty solenoid
23.	Economy drive indicator
24.	Vehicle speed sensor 2
25.	Engine revolution sensor
26.	Reverse range switch
27.	—
28.	Battery back-up voltage
29.	Ignition voltage
30.	Ignition voltage
31.	Ground
32.	Ground
33.	Duty solenoid (Dropping register)
34.	Duty solenoid (Line pressure)
35.	Shift solenoid A
36.	Shift solenoid B

Isuzu NPR

Computer Terminal Identification (continued)

Late Systems

1	2	3	4	5	6	7	×	9	10	21	22	23	24	25	26	×	28
11	12	×	14	15	16	17	×	19	20	29	30	31	32	33	34	35	36

Pin No.	Function
1.	2 range switch
2.	1 range switch
3.	Exhaust brake signal
4.	Idle switch
5.	Diagnosis terminal
6.	Overdrive switch
7.	Kick-down switch
8.	—
9.	Economy drive switch
10.	Throttle sensor voltage (5V out)
11.	Throttle sensor
12.	ATF Thermosensor
13.	—
14.	Idle switch voltage
15.	Throttle sensor ground
16.	Vehicle speed sensor 1
17.	Full throttle switch
18.	—

Pin No.	Function
19.	Nutral range switch
20.	D range switch
21.	Overrun clutch solenoid
22.	Lock-up duty solenoid
23.	Economy drive indicator
24.	Vehicle speed sensor 2
25.	Engine revolution sensor
26.	Reverse range switch
27.	—
28.	Battery back-up voltage
29.	Ignition voltage
30.	Ignition voltage
31.	Ground
32.	Ground
33.	Duty solenoid (Dropping register)
34.	Duty solenoid (Line pressure)
35.	Shift solenoid A
36.	Shift solenoid B

Isuzu NPR

Circuit Testing

Pin	Function	Operating Conditions	Measurement
1	Inhibitor Switch; Manual 2 Input	In Manual 2	Battery Voltage
		All Ranges Except Manual 2	Zero Volts
2	Inhibitor Switch; Manual L Input	In Manual L	Battery Voltage
		All Ranges Except Manual L	Zero Volts
3	Brake Switch	Brake Pedal Applied	Battery Voltage
		Brake Pedal Released	Zero Volts
4	Idle Switch	Accelerator Pedal Applied	Less than 1.0 Volt
		Accelerator Pedal Released	8 – 15 Volts
5	Early — N/A		
	Late — Diagnostic Link		
6	Overdrive Switch	Overdrive Switch Off	Battery Voltage
		Overdrive Switch On	Less than 1.0 Volt
7	Kickdown Switch	Accelerator Pedal Applied	Less than 1.0 Volt
		Accelerator Pedal Released	3 – 8 Volts
8	N/A		
9	Economy Switch	Switch Set to Normal	3 – 8 Volts
		Switch Set to Economy	Less than 1.0 Volt
10	TPS Reference	Key On	4.5 – 5.5 Volts
11	TPS Signal	Idle	4.0 – 4.9 Volts *
		Wide-Open Throttle	0.1 – 1.8 Volts *
12	ATF Temperature Sensor	At 50° F (10° C)	About 1.8 Volts
		At 104° F (40° C)	About 1.1 Volts
13	N/A		
14	Idle/Full Throttle Ref.	Key On	8 – 15 Volts
15	Sensor Ground	Always	Less than 0.1 Volts
16	VSS1 (at Transmission)	With Output Shaft Rotating	Square Wave DC Signal
17	Full Throttle Switch	Idle	Less than 1 Volt
		Accelerator More than Halfway Down	8 – 15 Volts

* On some models, TPS voltage is low at idle and increases with throttle opening.

Isuzu NPR

Circuit Testing (continued)

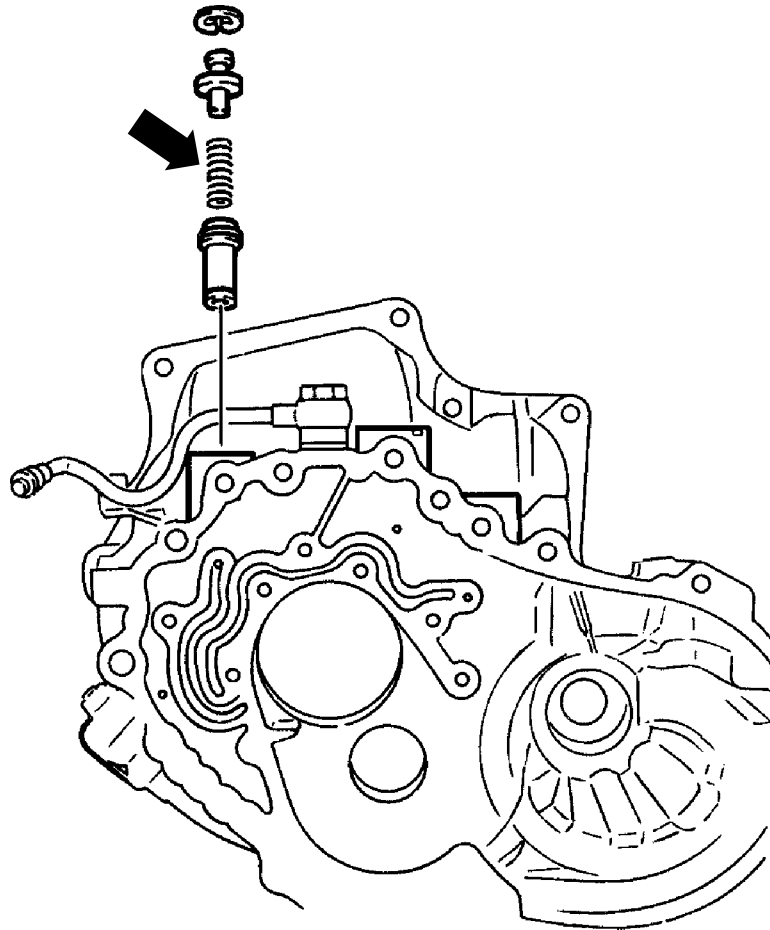
Pin	Function	Operating Conditions	Measurement
18	N/A		
19	Inhibitor Switch; Neutral Input	In Neutral	Battery Voltage
		All Ranges Except Neutral	Zero Volts
20	Inhibitor Switch; Drive Input	In Drive	Battery Voltage
		All Ranges Except Drive	Zero Volts
21	Overrun Clutch Solenoid	Solenoid On	Battery Voltage
		Solenoid Off	Zero Volts
22	Lockup Solenoid	Converter Clutch Applied	8 – 15 Volts
		Converter Clutch Released	Less than 1.0 Volt
23	Economy Switch	Switch in Normal Position; Key On	Battery Voltage
		Switch in Economy Position; Key On	Less than 1.0 Volt
24	VSS2 (in Speedometer)	With Speedometer Cable Rotating	Square Wave DC Signal
25	Engine RPM Sensor	Engine Off	Zero Volts AC
		Engine Running	Varying Volts AC
26	Inhibitor Switch; Reverse Input	In Reverse	Battery Voltage
		All Ranges Except Reverse	Zero Volts
27	N/A		
28	Keep-Alive Power	Always	Battery Voltage
29	Ignition	Key On	Battery Voltage
30	Ignition	Key On	Battery Voltage
31	Ground	Always	Less than 0.1 Volt
32	Ground	Always	Less than 0.1 Volt
33	Line Pressure Control Solenoid	Idle	1.5 – 2.5 Volts
		Full Throttle	Less than 0.5 Volts
34	Line Press. Control Sol. w/Dropping Resistor	Idle	5 – 14 Volts
		Full Throttle	Less than 0.5 Volts
35	Shift Solenoid A	Solenoid On	Battery Voltage
		Solenoid Off	Zero Volts
36	Shift Solenoid B	Solenoid On	Battery Voltage
		Solenoid Off	Zero Volts

Mazda F4AEL

1-2 Slide-Bump

Mazda has a replacement 1-2 accumulator spring for resolving a 1-2 slide-bump complaint. The replacement accumulator spring replaces both the large and small original springs.

The Mazda part number for the spring is FU68-21-227C.



Mazda G4AEL

2-3 Flare

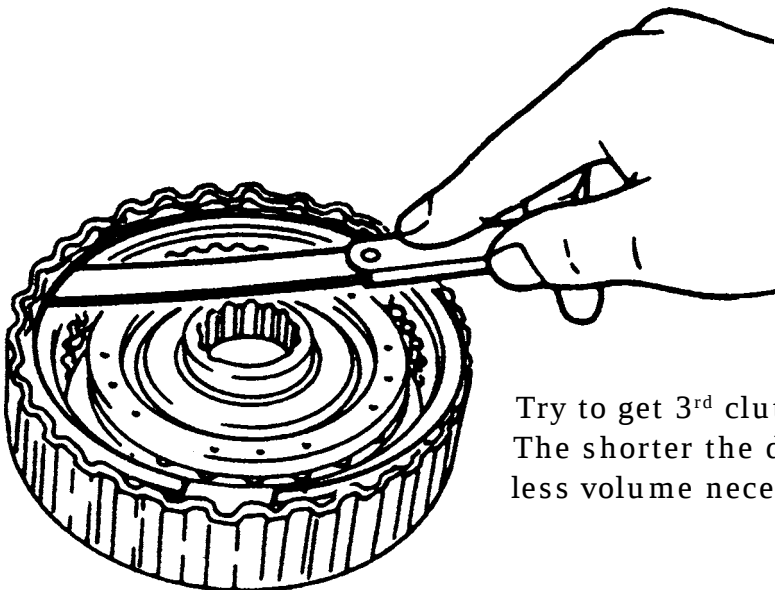
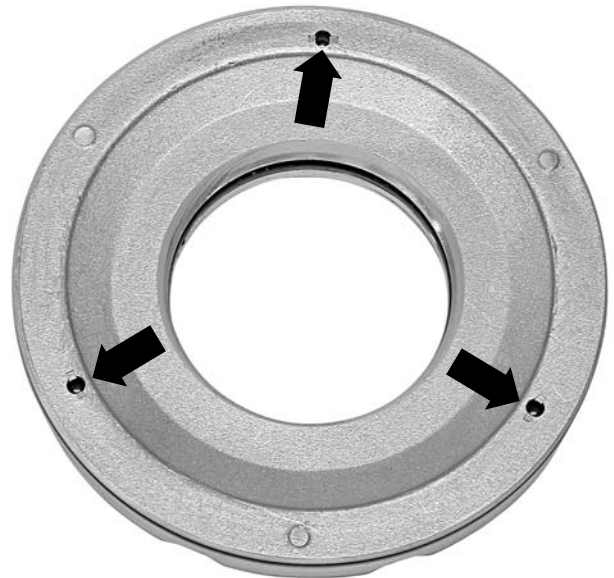
A 2-3 flare in a G4AEL can be very difficult to diagnose. To add to the frustration, you have the customer, the center manager, and maybe even the dog pressuring you to fix it... now! Because of the additional pressure, you're often forced to do things that won't really fix the problem; rather, they simply overcome it or cover up the problem. One of two things is almost certain:

- It'll probably come back fried within 6 months, and...
- Since you never really found the problem, it's very likely that the next five G4AEL transmissions you rebuild will do the same thing.

There are a number of things that cause problems in the 3-4 clutch drum. Many of them can be prevented during the original rebuild.

Step 1: The Drum

Leak check the air bleeds with solvent. If they leak, try reseating them by tapping them carefully with a small punch. If that fails to correct the leak, throw the drum away or machine it for a new checkball capsule.



Try to get 3rd clutch clearance between 0.030"–0.045". The shorter the distance the piston has to travel, the less volume necessary to apply the clutch.

Mazda G4AEL

2-3 Flare (continued)

Step 2: The Differential

Take the extra 15 minutes to disassemble the differential completely. The output gear has two Teflon rings that seal the 3rd clutch drum.

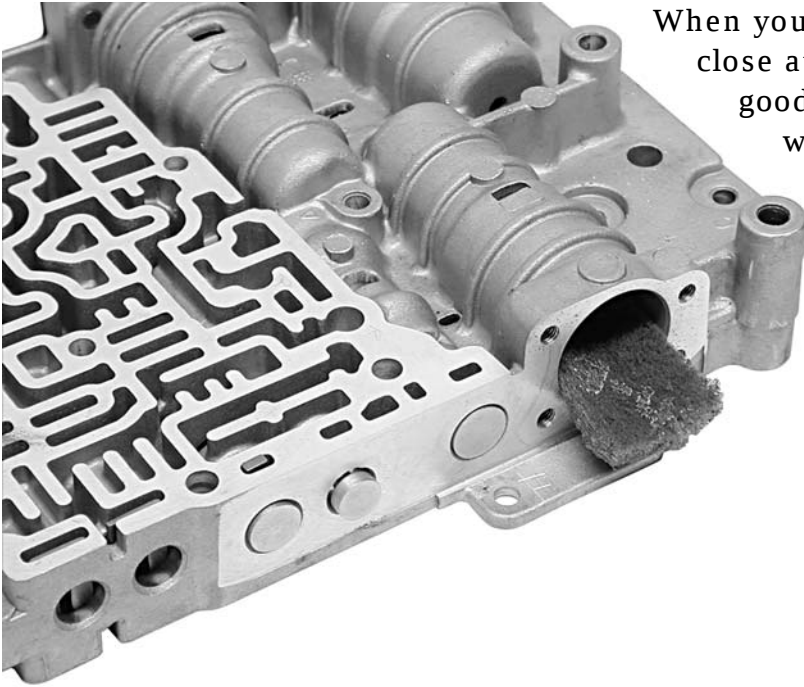
The best working ring available for this application is machined Teflon. You can identify these rings by their absence of molding marks; all you should see are machining marks. Because these rings are machined, they're held to a much tighter tolerance.



Mazda G4AEL

2-3 Flare (continued)

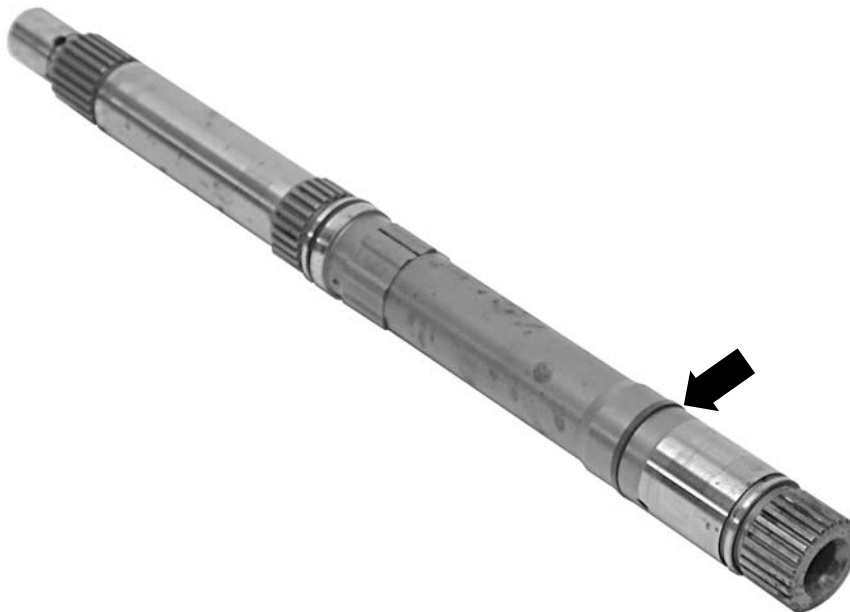
Step 3: The Accumulators



When you reassemble the differential, pay close attention to the 2-3 accumulator. A good quality Teflon or rubber ring will work well. The main point is *good quality*.

IMPORTANT Always Scotchbright the bores when using rubber rings.

One of the most critical parts of the 3rd clutch circuit is the Teflon ring on the input shaft. It can be difficult to find a ring to fit properly. Sometimes the only alternative is to custom fit your own. Butt cut a larger ring to fit.



Mazda G4AEL

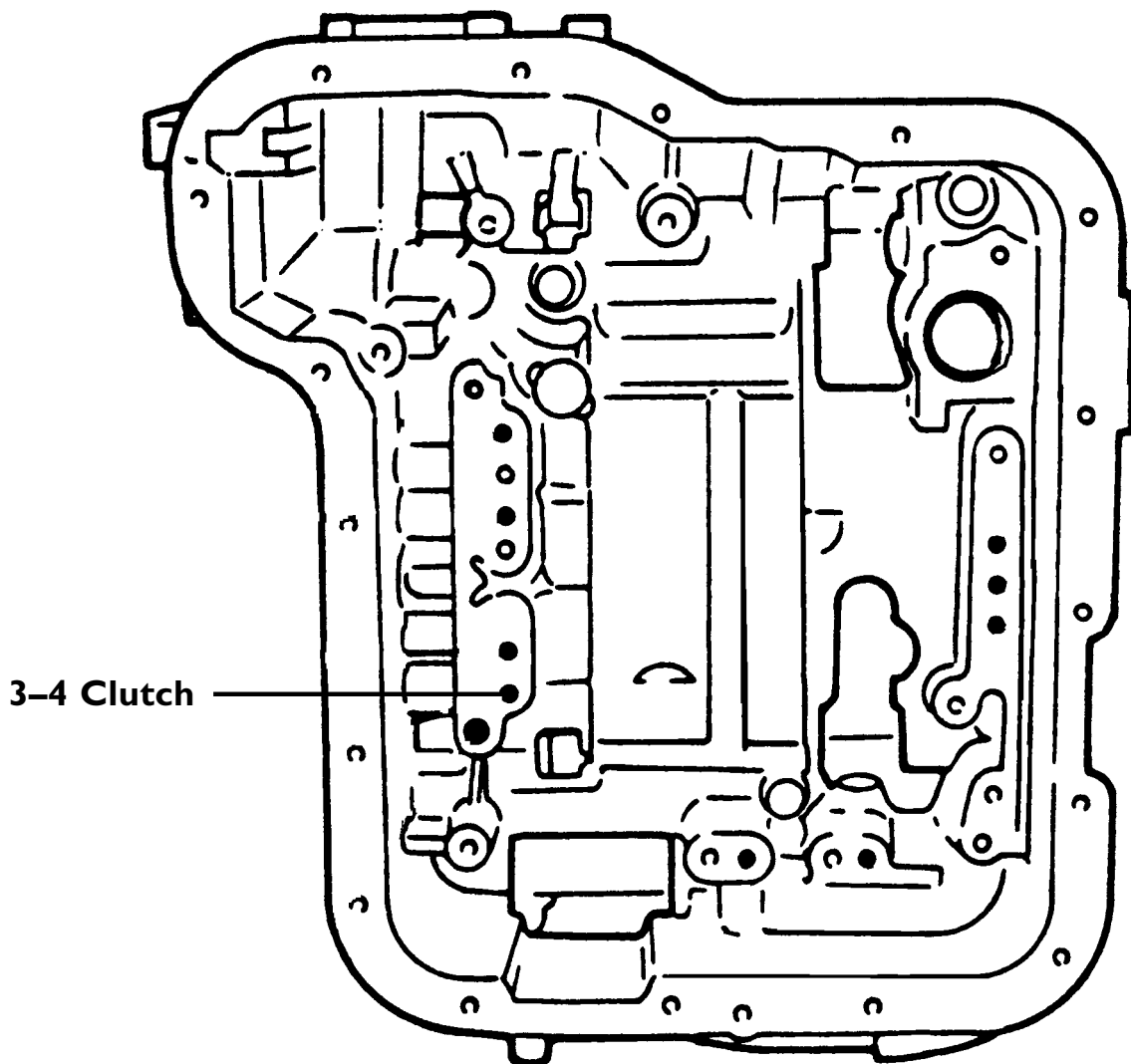
2-3 Flare (continued)

Step 4: Air Testing

Air checking the 3rd clutch is critical to avoid a 2-3 flare. If you don't air check the 3rd clutch properly, you can easily create a problem.

The transmission must be completely assembled with the pump bolted to the case before you apply any air to the 3rd clutch.

If you try to air check the 3rd clutch before bolting the pump in place, air pressure will force the input shaft upward. This allows the Teflon ring to come out of its bore and separate. When the drum comes back down the ring is cut. In some cases you won't notice the cut ring.



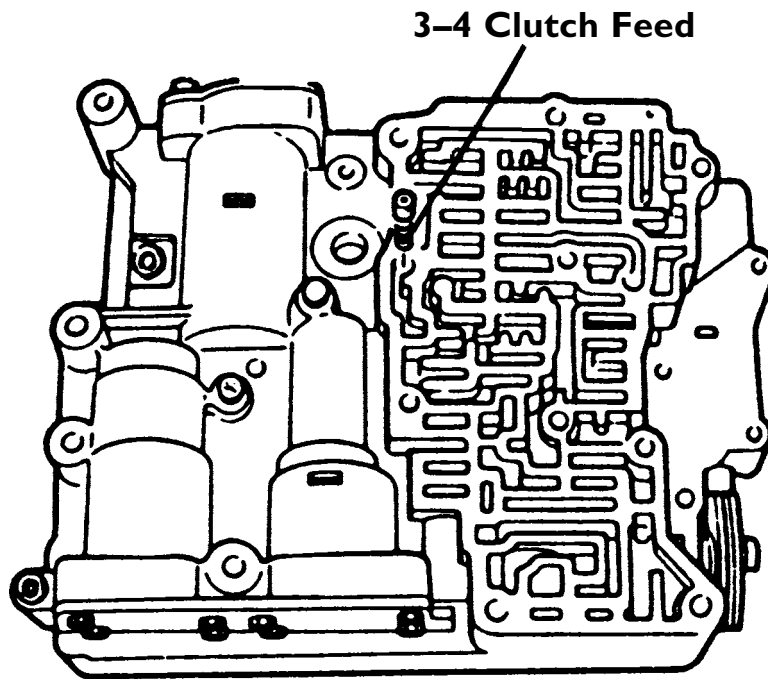
Mazda G4AEL

2-3 Flare (continued)

Step 5: The Valve Body

While you're rebuilding the valve body, there are some things that should become part of your normal rebuild procedure.

- Flat sand all surfaces of the valve body with 180–220 grit sandpaper. Use a machined surface or a thick piece of glass; never use a file. Many of the circuits inside the small channel cover and directly below it are for 3rd gear pressure, making this a very critical area for flatness.
- Enlarge the 3rd clutch apply orifice to 0.041".

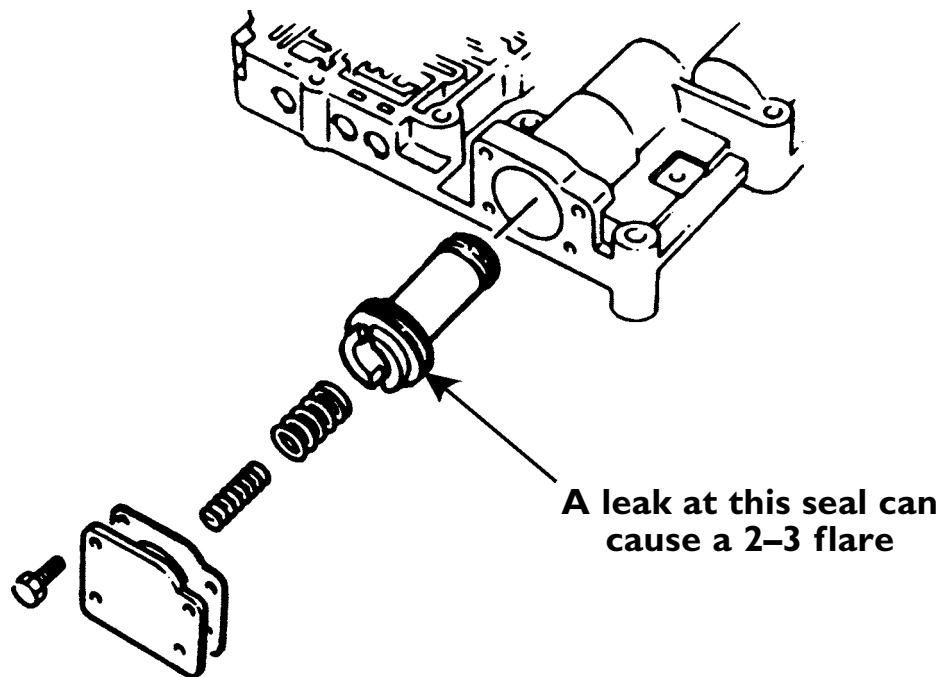


Mazda G4AEL

2-3 Flare (continued)

The 1-2 accumulator is commonly overlooked when dealing with a 2-3 flare. 3rd clutch pressure routes between the two O-rings of the 1-2 accumulator.

During the 2-3 upshift, the computer turns the 1-2 shift solenoid off, which exhausts 2nd apply pressure. This computer strategy causes some hard-to-find problems.



One of those hard-to-find problems is a 2-3 flare. This occurs when the 1-2 shift solenoid hydraulic circuit reacts faster than 2-3 shift solenoid hydraulic circuit. This releases the band before the 3rd clutch has even begun to apply. This is a difficult problem to identify when it's in the vehicle, and impossible to find if someone yanked out the transmission before it was diagnosed properly.

Mazda G4AEL

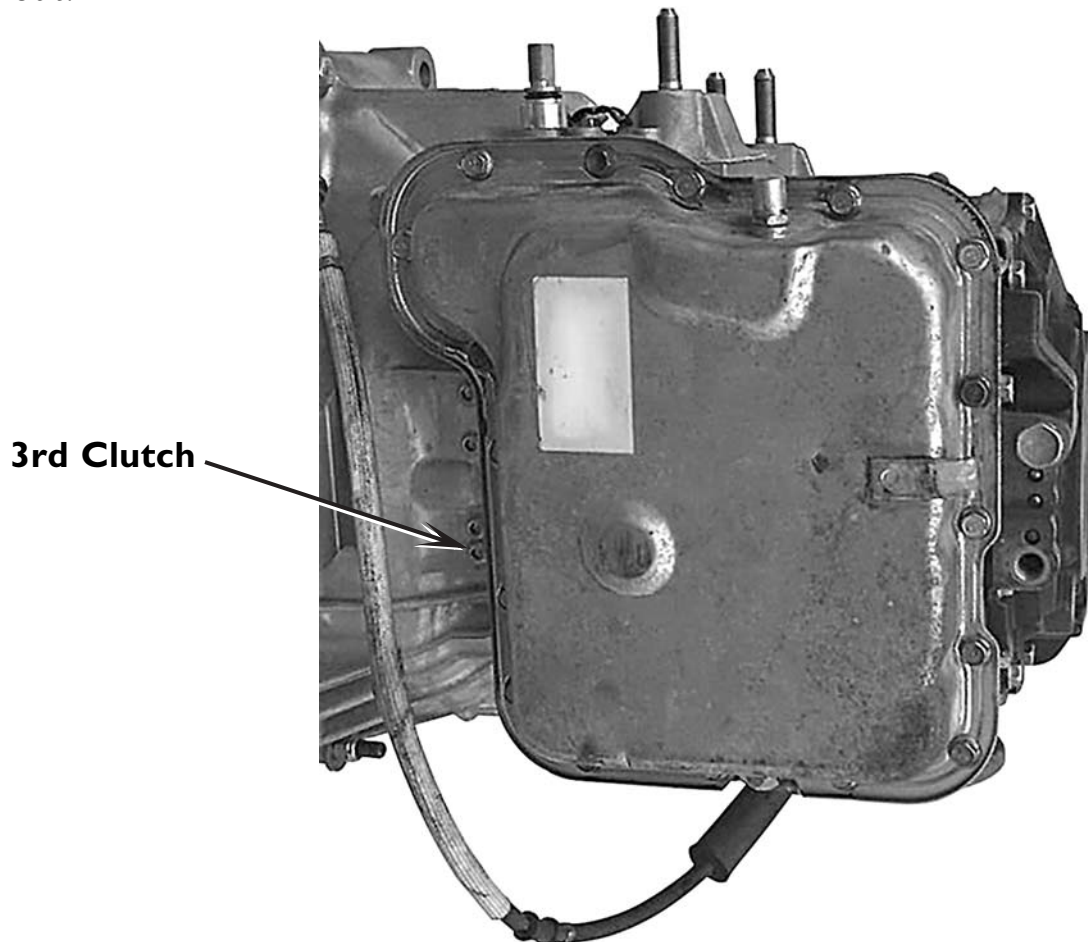
2-3 Flare (continued)

Step 6: The Last Resort

There is no accurate test for a 2-3 flare, because the only test that works depends greatly on your judgement.

With a 0-100 PSI gauge on the 3rd gear pressure tap, monitor how the pressure rises during the very beginning of the flare. If you see about 30 PSI, the problem is usually internal. But if there's 0 PSI at the beginning of the flare, it's because the 1-2 shift valve downshifted quicker than the 2-3 shift valve.

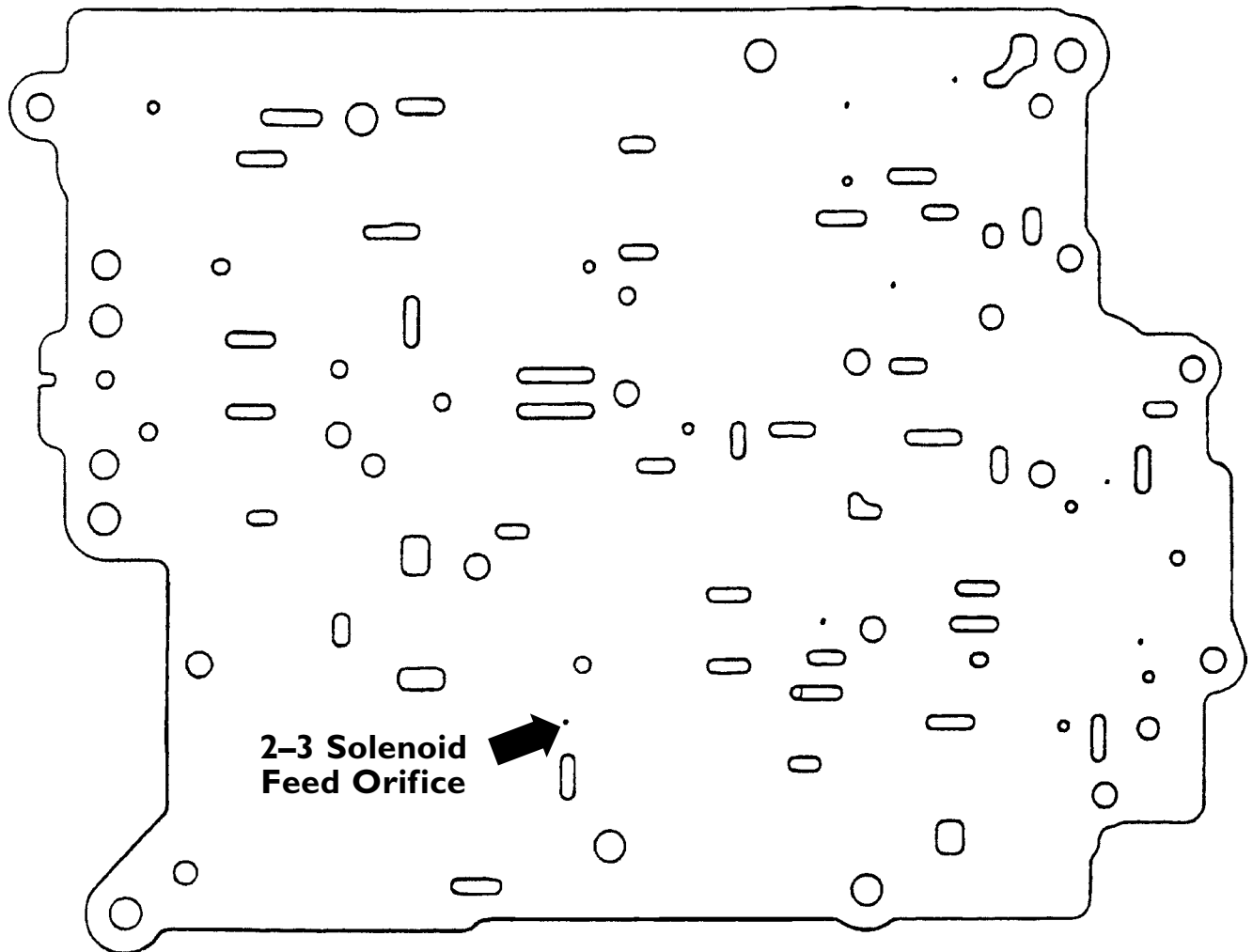
There's another way you can identify whether a 2-3 flare is due to a shift valve timing problem or an internal leak: If the 2-3 flare is caused by an internal leak, it will usually get worse as the transmission gets hot. A 2-3 flare caused by shift valve timing problems tend to get less noticeable when hot, because the shift solenoids receive more volume as the oil thins out.



Mazda G4AEL

2-3 Flare (continued)

While the 2-3 shift solenoid *can* cause a 2-3 flare, it's highly unlikely. Don't waste your time and money on a set of new shift solenoids; it's very rare to find a bad solenoid. To correct a shift valve timing problem, you can enlarge the 2-3 solenoid feed hole to 0.041". This will lessen the time the 2-3 shift valve takes to move after the solenoid closes.

**CAUTION**

Never modify this plate unless you're faced specifically with a 2-3 flare. If you perform this modification on a unit that's working properly, it could cause a 2-3 bind.

Mazda G4AEL

Double Engagement into Reverse

A double engagement into reverse on a G4AEL occurs when the reverse clutches apply before the low/reverse clutches.

Because the reverse clutch assembly uses a bellville spring to release the apply piston, clutch clearance should be 0.015"–0.020" for a two-friction clutch assembly, and 0.020"–0.025" for three-friction clutch assembly. The tight clearances are to make sure the bellville spring doesn't overtravel.



Because reverse clutch clearances are so tight, the low/reverse clutch pack must also maintain a tight clearance. Total clearance on the low/reverse clutch should be 0.030"–0.040".



Mazda G4AEL

Misdiagnosed Problems

The G4AEL computer never reads actual vehicle speed during normal operation (no codes in memory). That's because the computer only uses the signal from the output speed sensor if the input speed sensor fails. Instead, the computer calculates vehicle speed from the input RPM, based on the gear command.

This works just fine as long as the transmission is working properly. But when internal problems occur, such as forward clutch slip or sticking shift valves, to name a few, the computer can no longer calculate vehicle speed accurately. What's more, the computer doesn't look for ratio errors. Because of this, many symptoms that may seem to be caused by a computer-commanded electrical problem are actually misdiagnosed or overlooked internal problems.

Problems such as 2nd gear starts, 3-4 shift hunting, shifts 4-2-3-1, or shifts 1-3-4 can be very difficult to diagnose without looking at the signals the computer receives. This chart shows the vehicle speed, based on input RPM and gear range. This will allow you to see what the computer sees. The difference is that you, unlike the computer, are smart enough to recognize a problem when you see it. We'll refer to this chart when discussing these types of symptoms.

Input Shaft RPM	Pulse Generator Frequency (Hz)	Vehicle Speed (MPH)			
		1 st Gear	2 nd Gear	3 rd Gear	4 th Gear
50	10	0.3	0.6	0.9	1.3
100	20	0.7	1.2	1.9	2.6
200	40	1.3	2.4	3.7	5.3
300	60	2.0	3.6	5.5	7.9
400	80	2.6	4.8	7.4	11.0
500	100	3.3	6.0	9.2	13.0
1000	200	6.6	12.0	19.0	26.0
2000	400	13.0	24.0	37.0	53.0
3000	600	20.0	36.0	55.0	79.0
4000	800	26.0	48.0	74.0	106.0
5000	1000	33.0	60.0	92.0	132.0
6000	1200	39.0	72.0	111.0	159.0

Mazda G4AEL

Misdiagnosed Problems (continued)

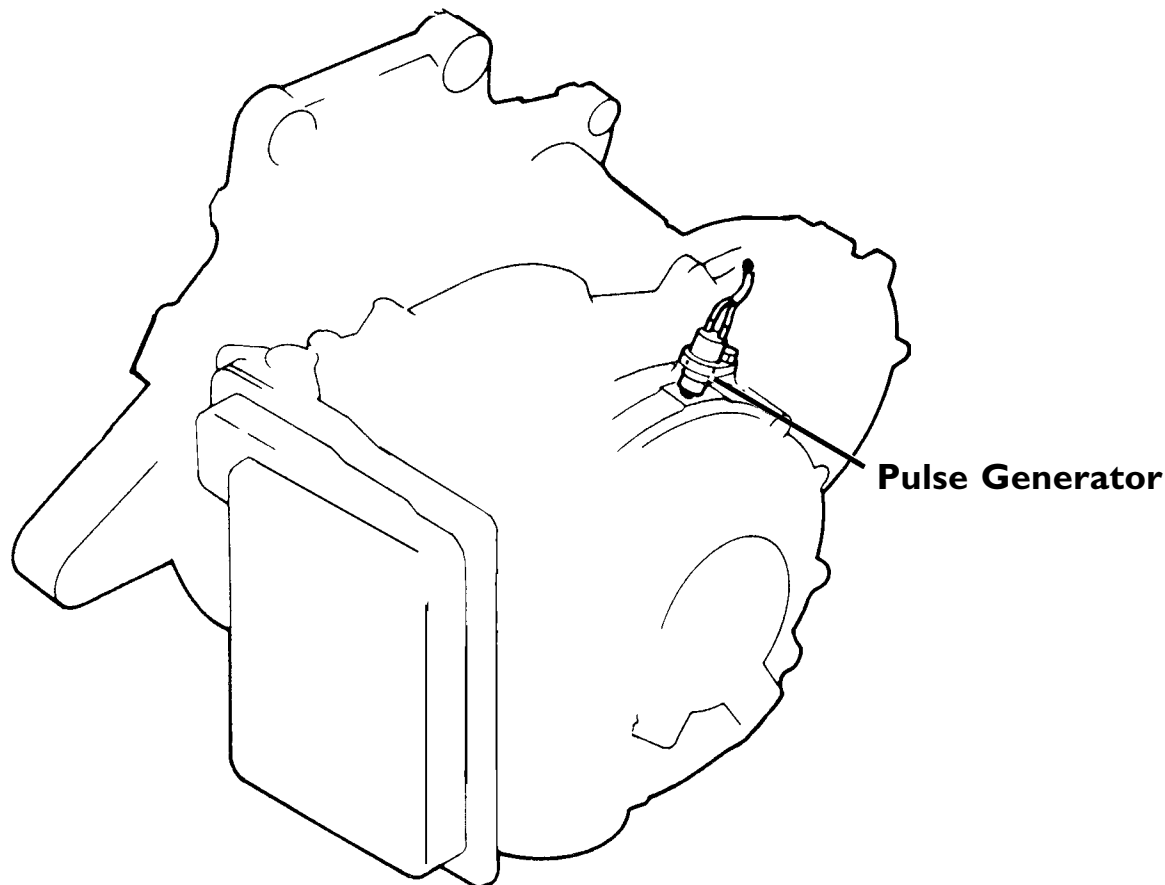
Computer-Commanded 2nd Gear Starts; Forward Clutch Slip

Common Cause

A computer-commanded 2nd gear start is usually caused by forward clutch slip. If the forward clutch slips while the vehicle is stopped, the computer will assume the vehicle is moving. Remember, the computer calculates vehicle speed from input RPM and gear range: If the forward clutch slips enough, the computer will command second gear.

Quick Verification

Disconnect the input speed sensor (pulse generator) located on top of the case. This will create a code 55, forcing the computer to use the output speed sensor. If the computer now commands 1st gear starts, the problem is a slipping forward clutch.



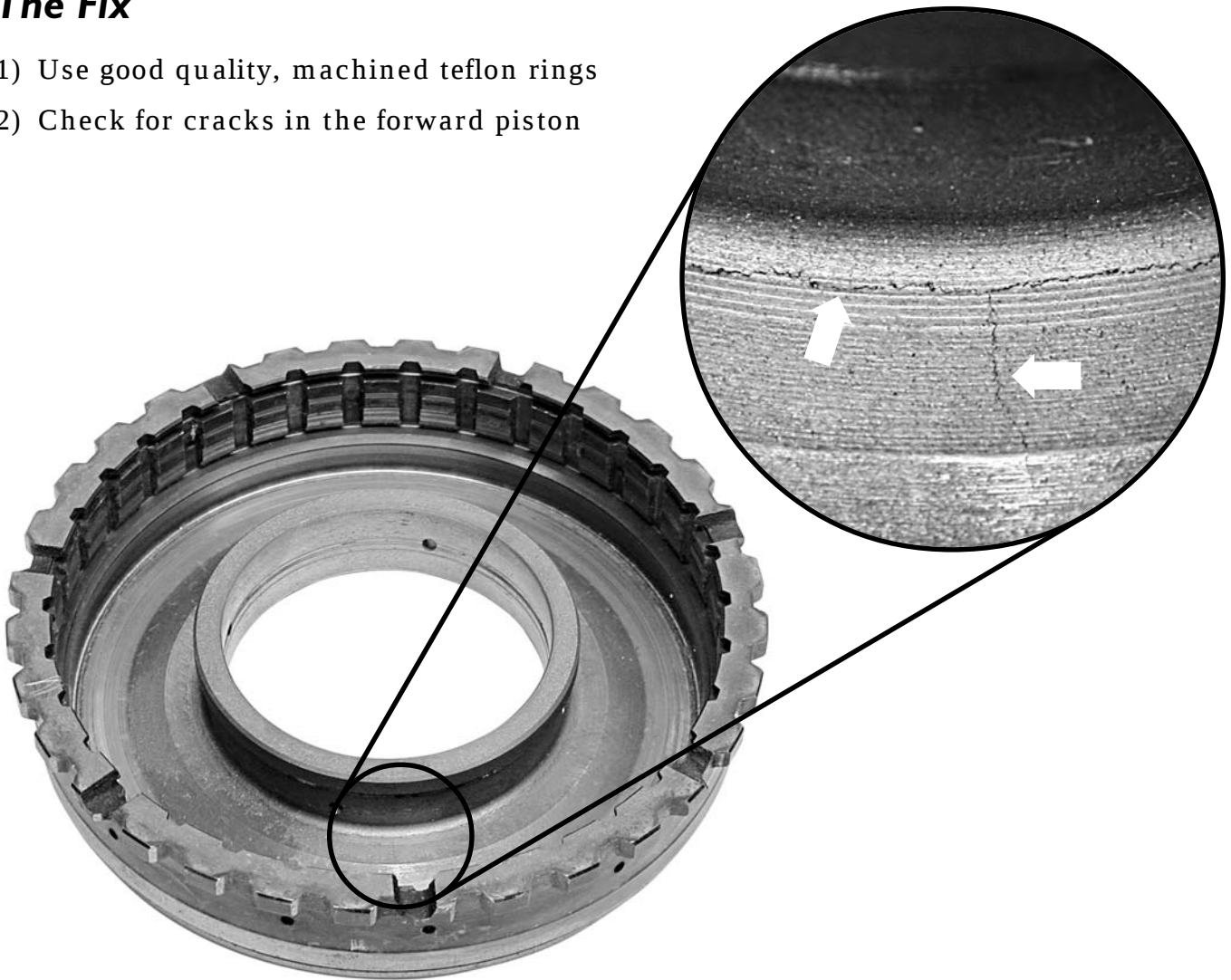
Mazda G4AEL

Misdiagnosed Problems (continued)

Computer-Commanded 2nd Gear Starts; Forward Clutch Slip (continued)

The Fix

- 1) Use good quality, machined teflon rings
- 2) Check for cracks in the forward piston

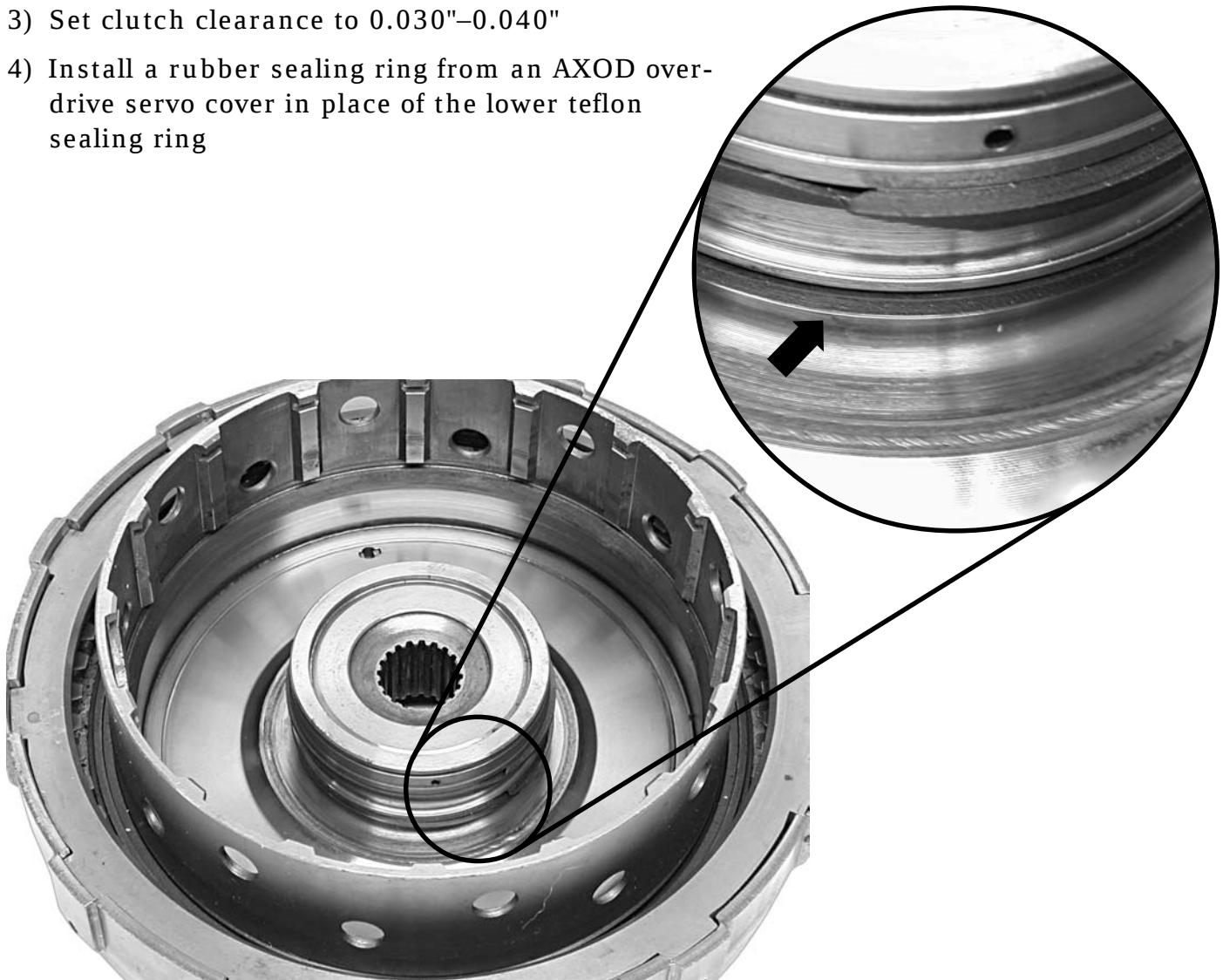


Mazda G4AEL

Misdiagnosed Problems (continued)

Computer-Commanded 2nd Gear Starts; Forward Clutch Slip (continued)

- 3) Set clutch clearance to 0.030"–0.040"
- 4) Install a rubber sealing ring from an AXOD over-drive servo cover in place of the lower teflon sealing ring



Mazda G4AEL

Misdiagnosed Problems (continued)

3-4 Shift Hunt

Common Cause

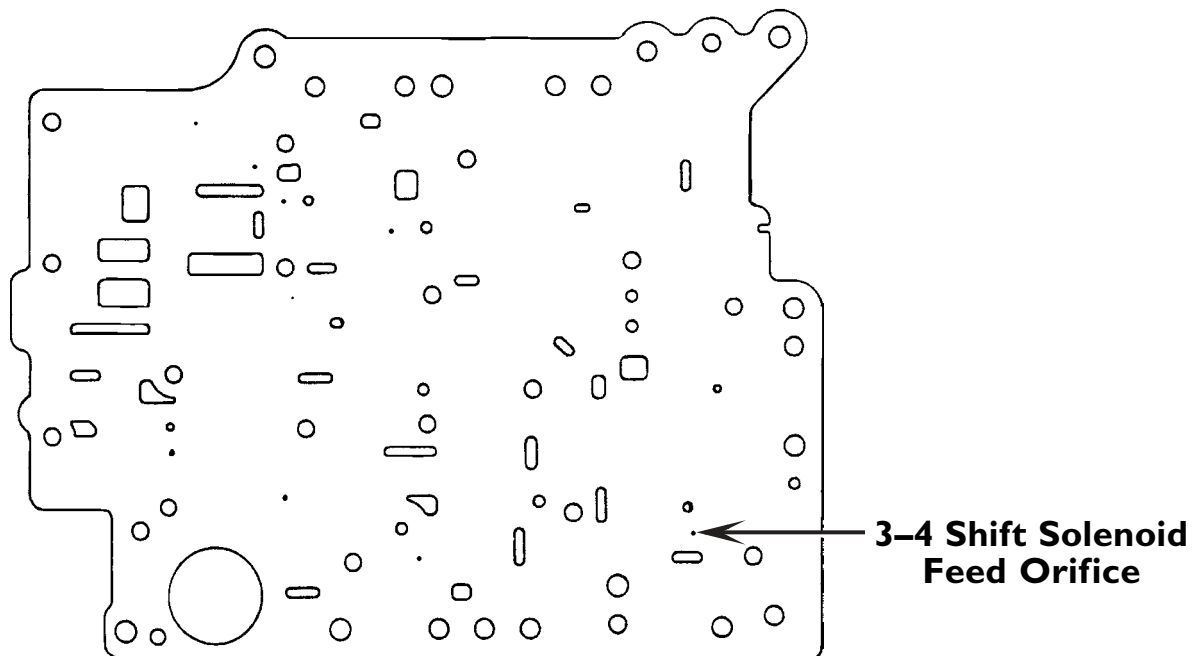
Even though this condition appears to be commanded by the computer, the problem is usually caused by a very small piece of dirt stuck in the 3-4 shift solenoid feed circuit.

Quick Verification

Monitor the 1-2 shift solenoid signal. If the 1-2 shift solenoid is the only one being commanded to cycle on and off, the problem is in the 3-4 shift solenoid feed circuit.

The Fix

Because the problem is usually caused by a very small piece of dirt stuck in the 3-4 shift solenoid feed circuit, disassemble the valve body and inspect the 3-4 shift solenoid feed orifice. If the hole isn't plugged, try enlarging it to 0.041". This should overcome any small leaks caused by normal wear.



Other Possible Causes

Other possible but unlikely causes could be a bad 3-4 shift solenoid or a cracked end plug for the 3-4 shift valve.

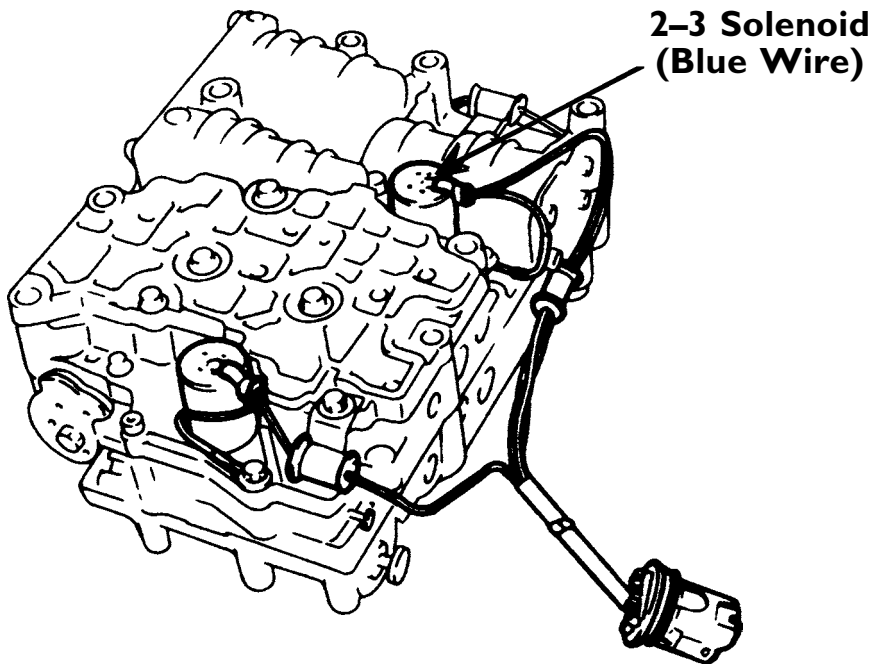
Mazda G4AEL

Misdiagnosed Problems (continued)

Shifts 4-2-3-1

Common Cause

A 4-2-3-1 upshift is usually caused by the 1-2 and the 2-3 shift solenoids wiring being crossed. The picture shows the proper placement for the two shift solenoids.



Quick Verification

Use the shift solenoid pattern command chart with the ratio chart to see which patterns give you the proper gear ratios. If you use your imagination while looking over your results you'll be able to verify whether you have the wires crossed to the 1-2 and 2-3 shift solenoids.

The Fix

If the valve body cover is off, switch the wiring for the 1-2 and 2-3 shift solenoids to their proper positions (green wire on top, blue wire in the center).

If the side cover is still bolted to the case and you're in a hurry, simply cut the 1-2 and the 2-3 solenoid wires and cross them.

Mazda G4AEL

Misdiagnosed Problems (continued)

Shifts 1–3–4

Common Cause

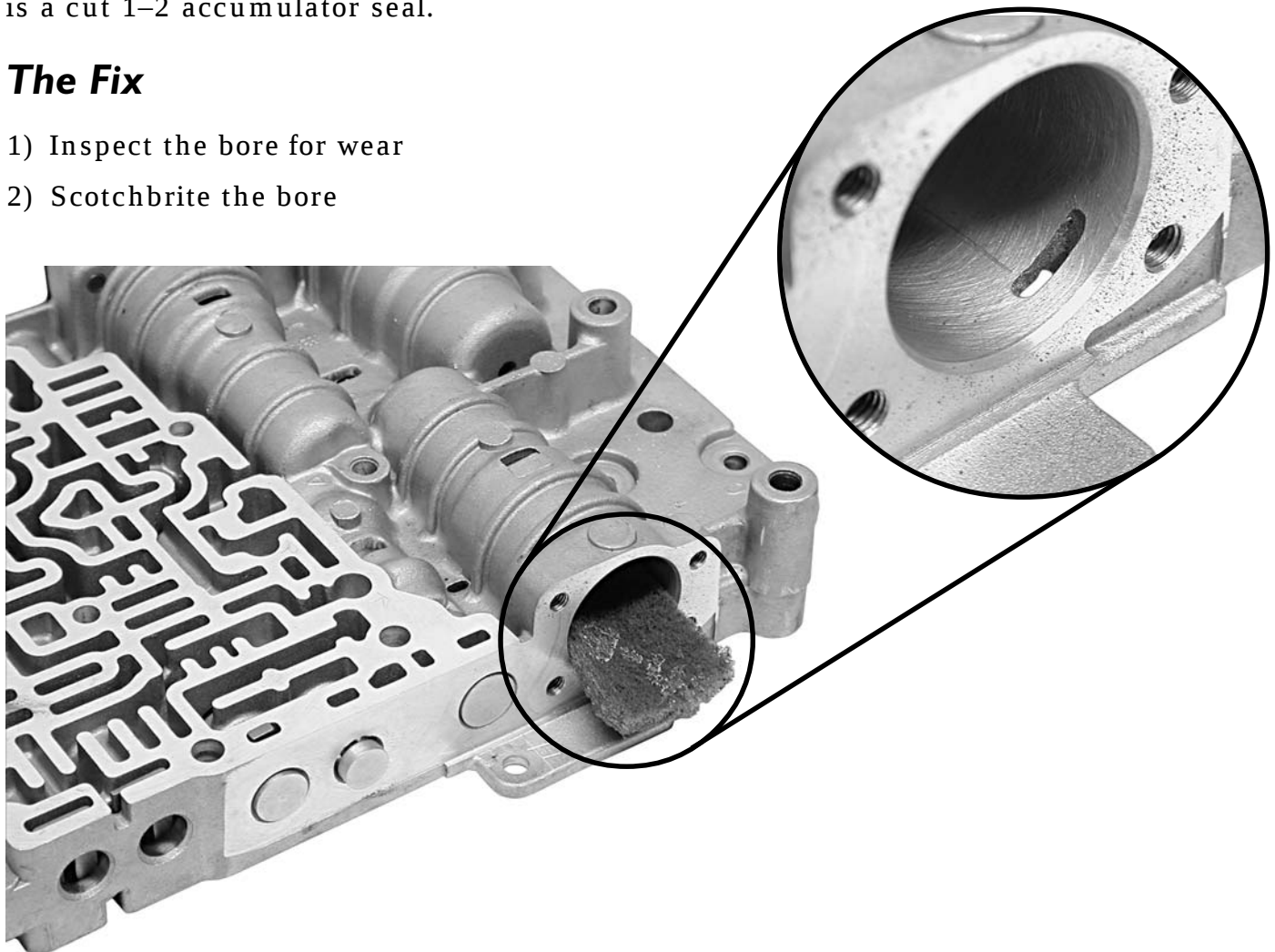
If the computer is commanding 1–2–3–4 but the transmission is shifting 1–3–4, it can only be caused by a leak at the large diameter seal on the 1–2 accumulator. Since 3rd clutch apply pressure feeds between the two sealing rings on the 1–2 accumulator, servo apply pressure can only leak past the large diameter ring if 3rd gear apply pressure isn't there to stop the leak. Once in 3rd gear, servo apply pressure doesn't leak.

Quick Verification

Verify the computer is commanding 2nd gear and that 4th gear is good. If so, the problem is a cut 1–2 accumulator seal.

The Fix

- 1) Inspect the bore for wear
- 2) Scotchbrite the bore

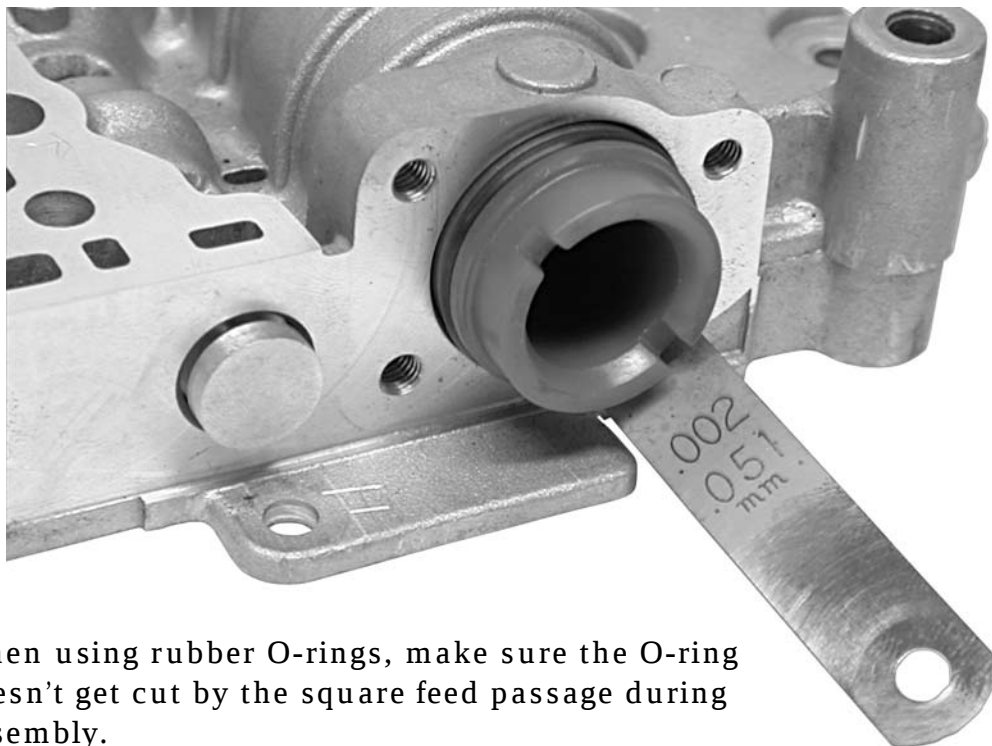


Mazda G4AEL

Misdiagnosed Problems (continued)

Shifts 1–3–4 (continued)

3) Install a good quality rubber O-ring

**CAUTION**

When using rubber O-rings, make sure the O-ring doesn't get cut by the square feed passage during assembly.

Mazda G4AEL

Misdiagnosed Problems (continued)

4-2 and 4-3 Flare

Common Cause

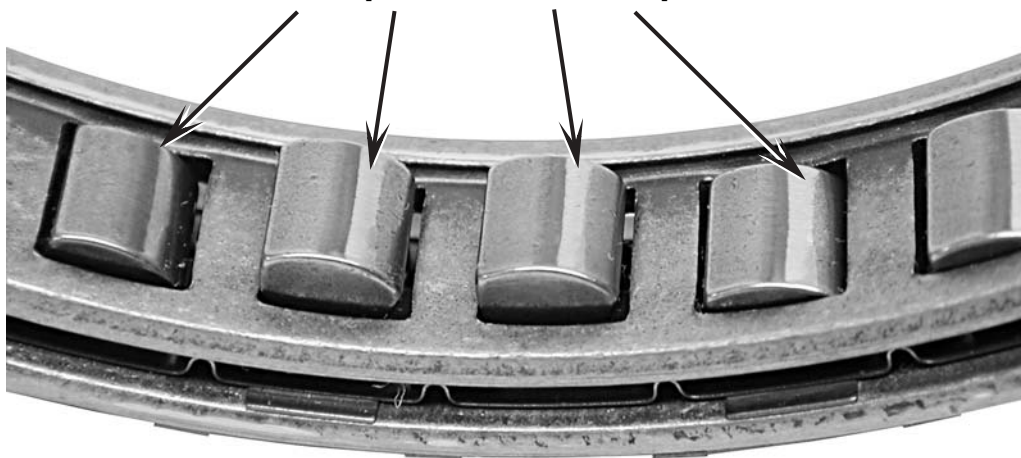
Although a 4-2 flare is much more common, 4-2, 4-3 and 3-2 flares can all be caused by a worn forward sprag.

Quick Verification

To verify whether the sprag is at fault, disconnect the 3-4 shift solenoid electrical connector. When the 3-4 solenoid is off, the coast clutch stays applied in 1st, 2nd and 3rd gears, which helps support the forward sprag. Although this won't allow 4th gear, drive the vehicle making several 3-2 kickdowns. If the flare has improved, the sprag is bad.

NOTICE While inspecting the forward sprag assembly, keep in mind a little wear goes a long way. Be extremely picky.

Flat Spots Aren't Acceptable



Mazda G4AEL

Codes, Common Causes and Computer Strategies

Almost every trouble code in every vehicle causes the system to switch to an alternate operating strategy of one form or another. Many of these can be used to your advantage, as long as you can recognize them. Here's a list of common strategies and fixes for the most common transmission-related codes.

Code 06

Definition: VSS (output speed sensor)

Sensor Location: Either on the differential, driven directly from the speedometer gears, or inside the speedometer in the dash.

How the Code Sets: The computer must see all of these conditions to set a code 06.

- 1) Receive a Manual D, S, or L signal from the inhibitor switch.
- 2) Receive a signal from the input speed sensor (pulse generator).
- 3) Receive no signal from the output speed sensor.

Common Causes: Melted speedometer gears, bad wiring, blown dash fuse (in some applications).

Causes of False Codes:

- 1) An inhibitor switch that signals Manual D, S or L while the transmission is actually in neutral or park. Forward clutch slip can easily set this code.
- 2) When retrieving codes, 6 short flashes represent a code 06 while 6 slightly longer flashes represent a code 60. Most code 06 problems are actually a misread code 60. (This is when knowing computer code strategies can really help you).

Computer Strategy: When a code 06 sets, the *only* action the computer takes is to flash the Hold or Manual light.

Mazda G4AEL

Codes... (continued)

Code 12

Definition: TPS (Throttle Position Sensor)

Sensor Location: Mounted on the side of the throttle body.

How the Code Sets: The computer must see one of these conditions to set a code 12.

- 1) Less than about 0.02 volts
- 2) More than about 4.8 volts

Common Causes: Bad TPS, no 5.0V reference signal from the computer to the TPS, bad ground wire, and bad connections.

Causes of False Codes: None

Computer Strategy: Very late upshifts.

Mazda G4AEL

Codes... (continued)

Code 55

Definition: Pulse generator (input speed sensor)

Sensor Location: On top of the case, directly in line with the forward drum.

How the Code Sets: The computer must see both of these conditions to set a code 55.

- 1) Signal from the output sensor.
- 2) No signal from the pulse generator; the minimum AC threshold voltage for the input speed sensor is about 0.5 volts AC.

Common Causes: Bad pulse generator, poor connections.

Causes of False Codes: Other than coasting downhill with key on, engine off, there are no false codes possible.

Mazda G4AEL

Codes... (continued)

Code 60, 61, 62 and 63

Definition:

Code 60: 1-2 shift solenoid open or shorted circuit.

Code 61: 2-3 shift solenoid open or shorted circuit.

Code 62: 3-4 shift solenoid open or shorted circuit.

Code 63: Lockup solenoid open or shorted circuit.

Solenoid Location: On the valve body.

How the Code Sets: The computer must see one of these conditions to set a code 60, 61, 62 or 63:

- 1) Less than 0.20 amps through the solenoid circuit.
- 2) More than 1.5 amps through the solenoid circuit.

Common Causes: Pinched wires inside the transmission, bad section in harness wiring (especially in the area around the battery box), bad connection at the solenoids or at the computer.

Causes of False Codes: None

Computer Strategy: The computer simply stops using the solenoid that set the code. Solenoids without codes are used normally. This presents some very odd shift complaints as shown below.

Code 60: 1st and 3rd gear only.

Code 61: Shifts 3-4-3-4.

Code 62: No 4th gear, 2-3 flare in some cases.

Code 63: No lockup.

The Fix: Only a few things cause shift solenoid codes.

- 1) Bad solenoid... very uncommon.
- 2) Bad computer... very uncommon.
- 3) Bad wiring or connections... almost every time.

The easy fix: run four brand new wires from the computer connector all the way to the shift solenoid connector.

Mazda G4AEL

Rebuild Procedures, Technical Tips and Review

The Transmission

- 1) Stay as far away from internal parts interchange as you can.
- 2) Always use good quality machined Teflon rings.
- 3) If you custom cut rings to reduce leaks, use a butt cut instead of a scarf cut.

The Valve Body

- 1) Remove all valves.
- 2) Flat sand each casting.
- 3) Thoroughly clean all components before reassembly.
- 4) Enlarge the TV balance to 0.055".
- 5) Enlarge the TV feed orifice to 0.075".
- 6) Enlarge the 3–4 clutch apply orifice to 0.041".
- 7) Scotchbrite the accumulator bores and install rubber rings.
- 8) Be careful assembling the accumulators; make sure the square feed passages don't cut the rubber rings.
- 9) Leave out the checkballs under the thin cover on all applications.
- 10) Check the TV cam for wear. If it's worn, don't worry; a new one is available from Mazda P/N FU01-21-369A.
- 11) With the exception of the accumulator retaining plates, leave all of the valve body gaskets out. Tests have shown that leaving these gaskets out allows the valve body to maintain its torque, and the valve body won't warp as easily at high temperatures.
- 12) Torque the valve body bolts to 70–80 inch-pounds.

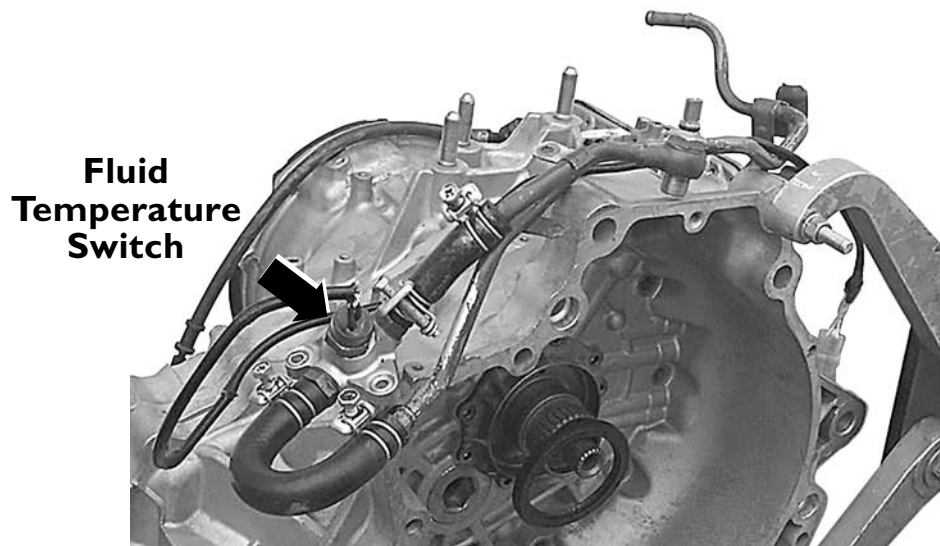
Mazda G4AEL

Kill the Hold Mode

When selected, the Hold Mode tells the computer to provide 2nd gear starts and shift into 3rd at a very low speed. In this mode you will also have no kickdown and, if driven long enough, the transmission will likely die. The only usable function is to cancel overdrive. Unfortunately many customers like to use this feature, not realizing what they're doing to the transmission.

During some extensive research, we wanted to see what strategies the fluid temperature switch would cause. It took 2 hours of driving to realize what this switch would do when shorted. It turned the wicked Hold Mode into a sweet OD cancel switch. Whether or not it's a secret input created by Mazda engineers (because they hate the Hold Mode too)... who cares? We've tested it on enough models to feel confident that it's not a fluke.

If you want to turn the Hold Mode into an OD cancel switch, disconnect the fluid temperature switch and short the two wires from the harness connector together.



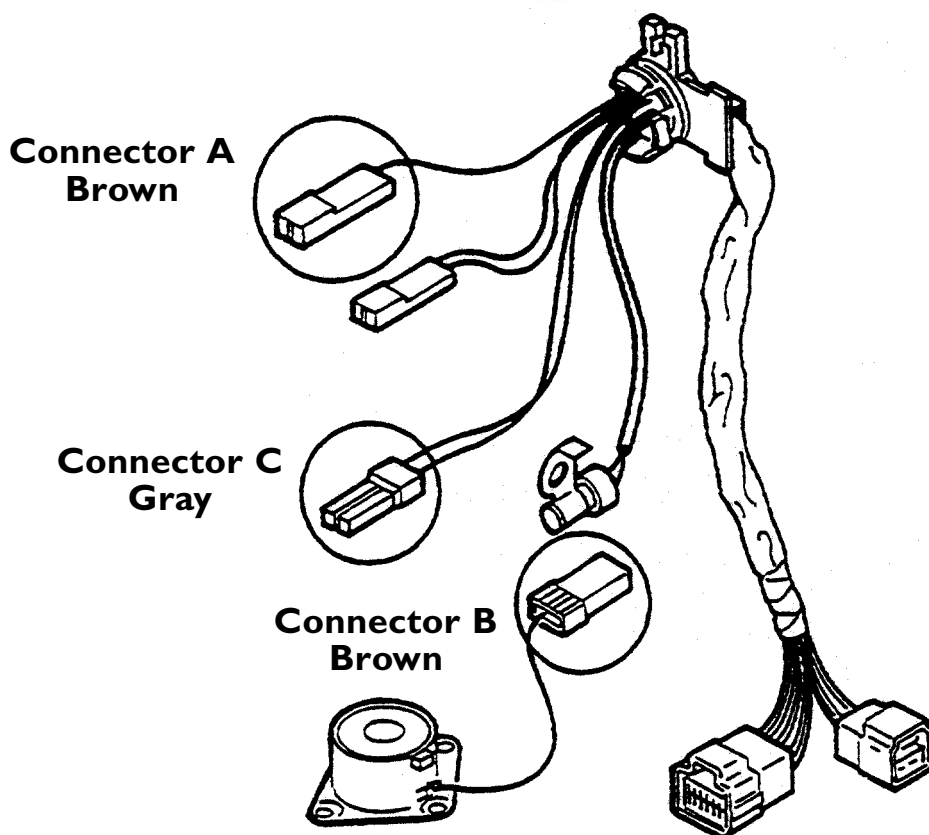
Mazda R4AEL; Nissan RE4R01A

Replacement Solenoid Connectors

It's not uncommon for the solenoid connectors on these units to get brittle and break. Mazda offers replacement connectors to address this. The Mazda part numbers for these connectors are:

BV36-19-010 Brown Connector

BV36-19-01X Gray Connector



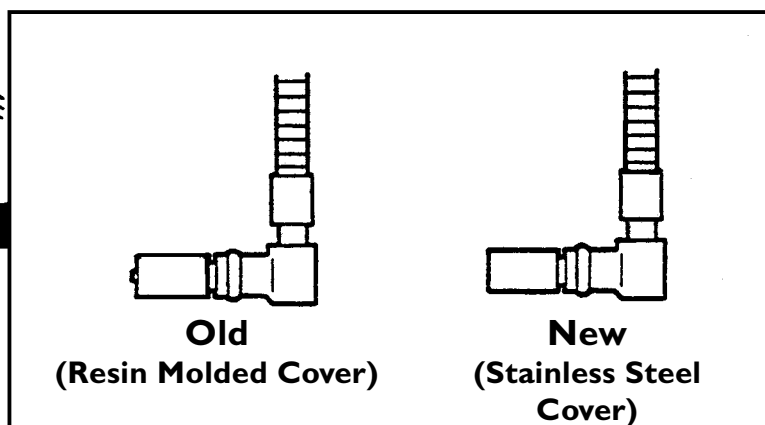
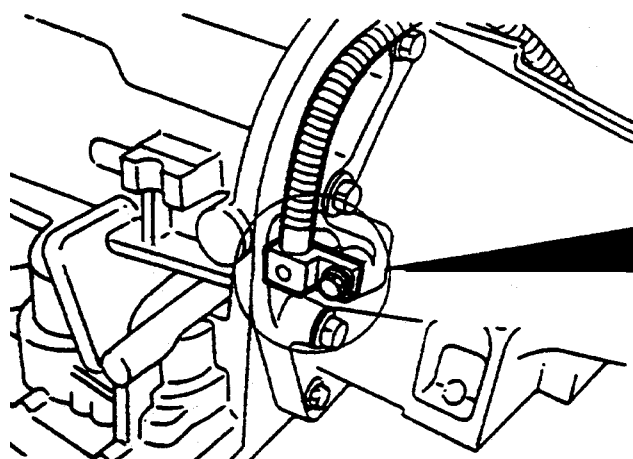
Mazda R4AEL

New Design Output Speed Sensor

The original design output speed sensor had a molded resin body that would crack over time. This problem usually sets a code 6. The new design sensor has a steel body, and is much more durable. The Mazda part number for the new sensor is:

BV72-21-5H2 (2WD)

BV74-21-5H2 (4WD)



Mazda R4AEL; Nissan RE4R01A, 3A

No Turbine Sensor Signal

Some Mazda R4AELs and Nissan RE4R01As and 3As use a turbine shaft sensor. This sensor accesses the turbine shaft through a hole in the stator support.

The turbine shaft used on these models have splines machined into the shaft, which allows the sensor to measure its RPM. If you need to replace the turbine shaft make sure the replacement shaft has the machined splines. The splines are not very large, and are easy to miss.

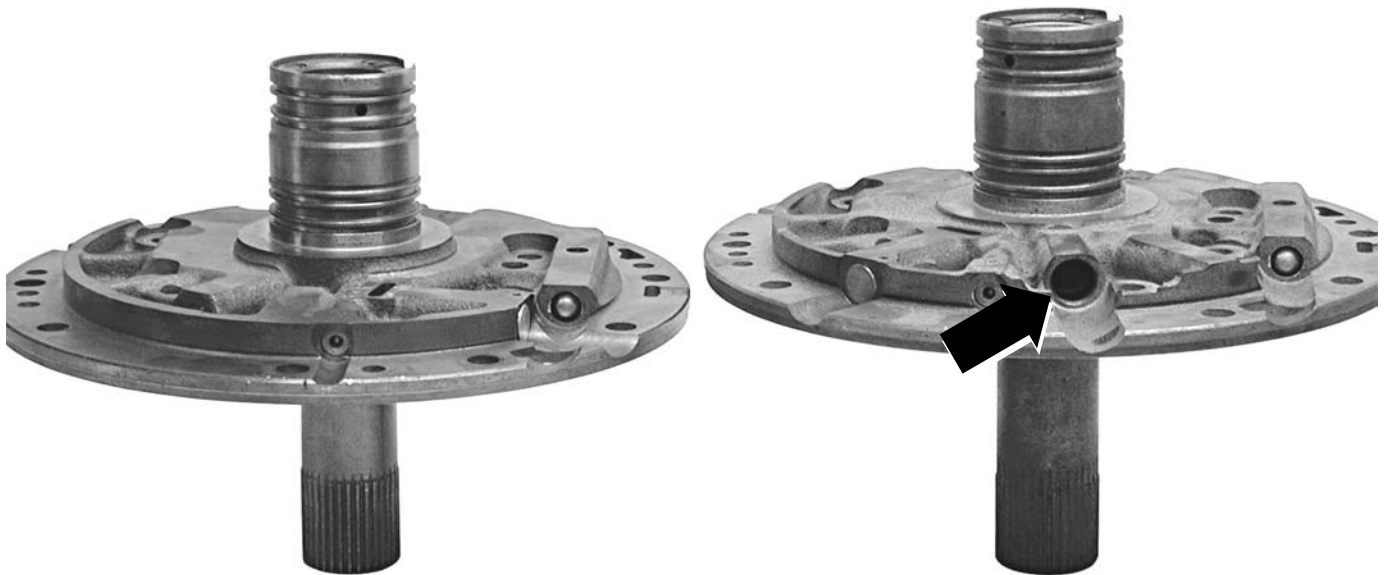
Using a non-machined turbine shaft in an application that uses the sensor will set a “no turbine shaft signal” code.



Mazda R4AEL; Nissan RE4R01A, 3A

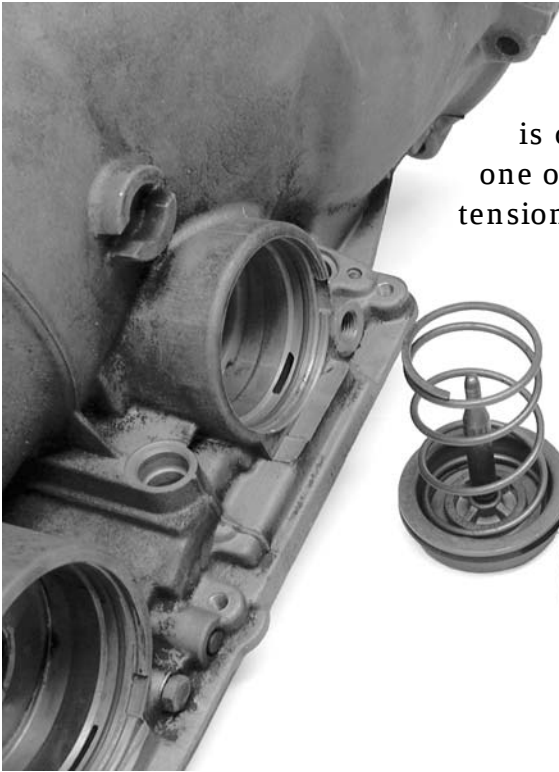
No Converter Charge

Some Mazda R4AELs and Nissan RE4R01As and 3As use a turbine shaft sensor. This sensor accesses the turbine shaft through a hole in the stator support. Using a stator support with an access hole on models that don't use the sensor will prevent the converter from developing the necessary converter charge.



Mercedes 722.3 and 4

2-3 Flare



During the 2-3 shift, the B1 band releases while the K1 clutch engages. If working (mainline) and modulator pressures are normal, and the band adjustment is correct (0.3 mm) you can fix a 2-3 flare by removing one of the B1 release springs. Both springs are similar in tension, so it doesn't matter which one you remove.

An effective measure against 2-3 flare problems is to use the self-adjusting servo. The part number for the self-adjusting B1 servo is 124 270 12 32.

If you upgrade to the self-adjusting servo you must also use the later-model servo guide. The part number for the later-style guide is 140 277 08 40.



Early Style Servo and Guide

Self-Adjusting Servo and Guide

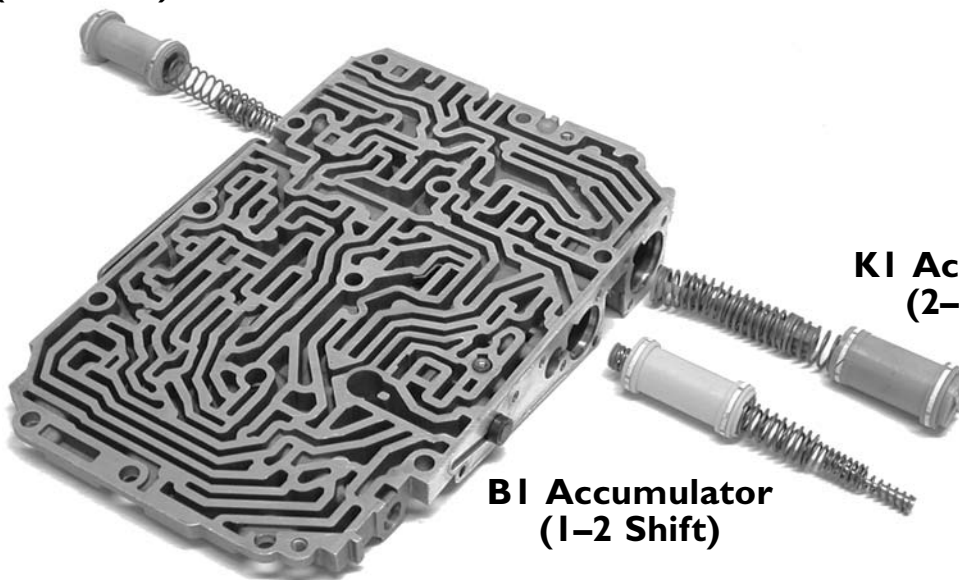
Mercedes 722.403 and 414

Harsh 1-2, 2-3 or 3-4 Shifts

Mercedes has released new accumulator assemblies for the 722.403 (190D 2.2L) and 414 (190D 2.5L) units to combat harsh shift complaints. You can resolve these complaints by using these parts:

Harsh 1-2 Shift	124 270 00 35
Harsh 2-3 Shift	126 270 03 35
Harsh 3-4 Shift (722.403).....	126 270 04 35
Harsh 3-4 Shift (722.414).....	126 270 05 35

**K2 Accumulator
(3-4 Shift)**



**K1 Accumulator
(2-3 Shift)**

**B1 Accumulator
(1-2 Shift)**

Mercedes 722.3 and 4

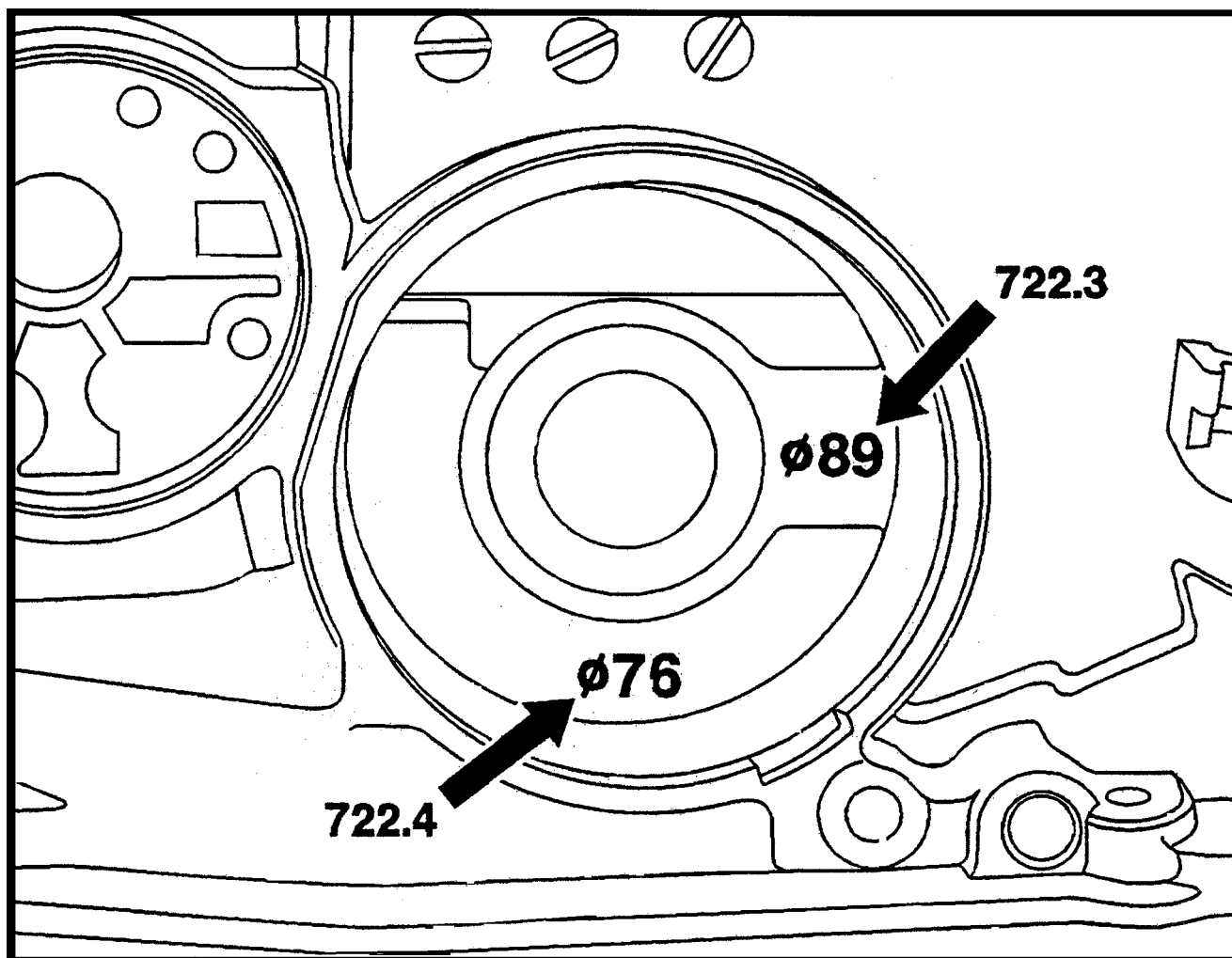
Oversized B2 Servo Seal

Transmissions remanufactured by Mercedes may have an oversized B2 servo bore. Mercedes addresses worn B2 servo bores by machining them larger. If you get one of these units, you'll need to use the oversized sealing ring. Machined cases will have ID numbers (89 for 722.3, and 76 for 722.4) stamped in the bottom of the servo bore.

The Mercedes part numbers for the oversized rings are:

140 277 01 55 (722.3)

202 277 00 55 (722.4)



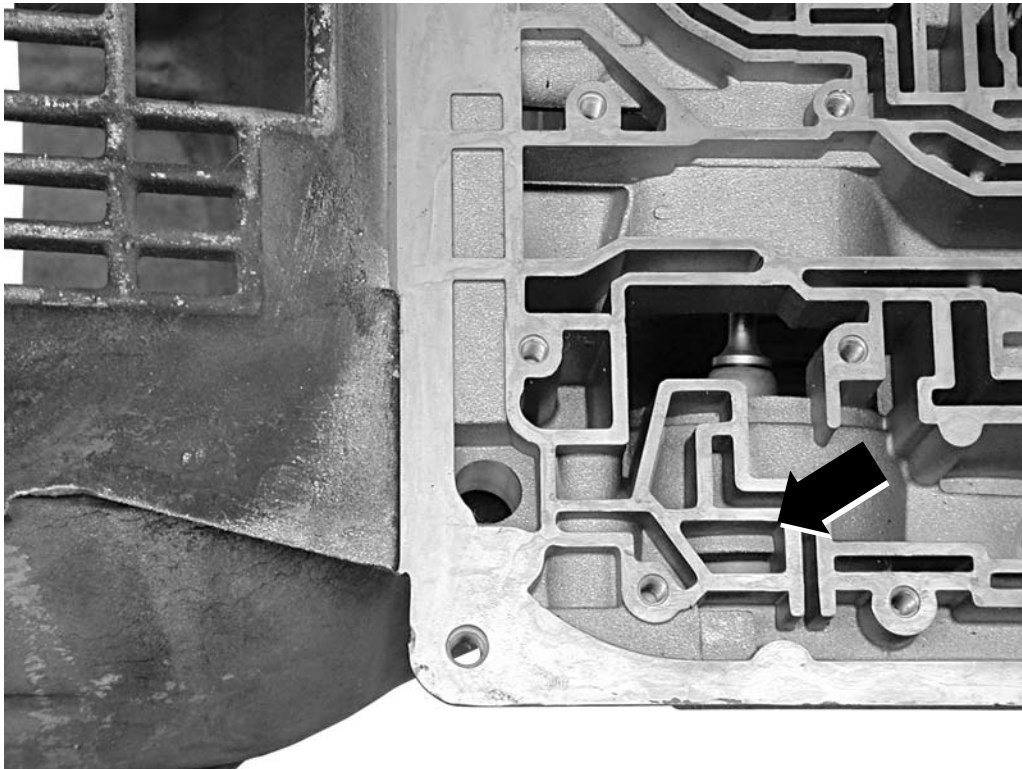
Mercedes 722.3, 4 and 5

Self-Adjusting B1 Servo

Starting in 1991, Mercedes used a self-adjusting B1 servo. You may use this servo in any 722.3 – 5 transmission. But if the unit you're working on already has a self-adjusting servo, you may run into problems reusing the servo. Resetting the self-adjusting servo isn't so easy.

Servo Disassembly

- Fully extend the servo: The best way is to put the servo in the case — without the servo guide and spring — and blast the servo with air. This will move the servo to the fully-applied position, and allow you to release the cover. You don't need to secure the servo with the snap ring to extend the servo; the servo extends just fine without the snap ring.

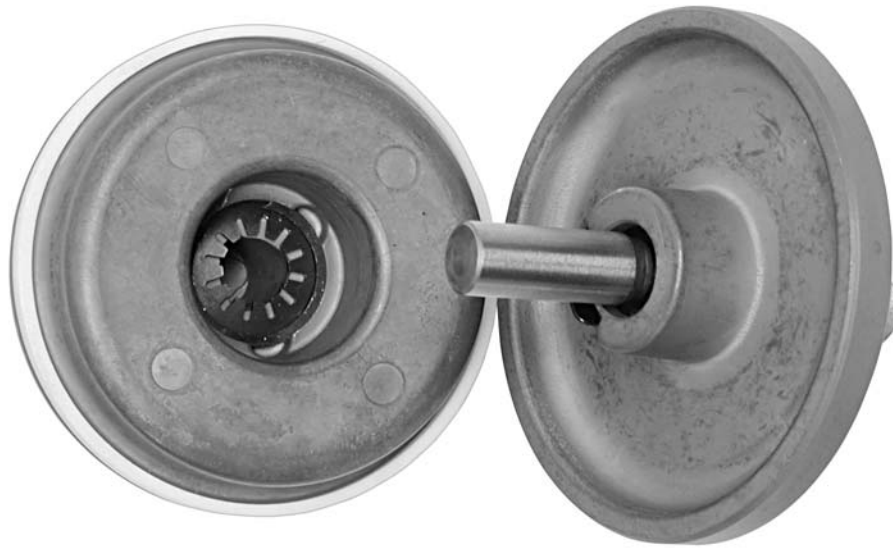


Mercedes 722.3, 4 and 5

Self-Adjusting BI Servo (continued)

Servo Disassembly (continued)

- Once the servo extends, remove the assembly from the case. Now you should be able to separate the cover and pin from the servo.



- Use narrow snap ring pliers to open the pin-lock mechanism in the servo cover.



Mercedes 722.3, 4 and 5

Self-Adjusting BI Servo (continued)

Servo Disassembly (continued)

- Remove the snap ring that secures the diaphragm spring.



Servo Reassembly

- Drop the servo pin into the servo, with the rounded end facing up.



Mercedes 722.3, 4 and 5 Self-Adjusting BI Servo (continued)

Servo Reassembly (continued)

- Place the diaphragm spring over the pin.



- Use a ½" deep well socket to push the diaphragm spring onto the pin, and down to the seat.



Mercedes 722.3, 4 and 5

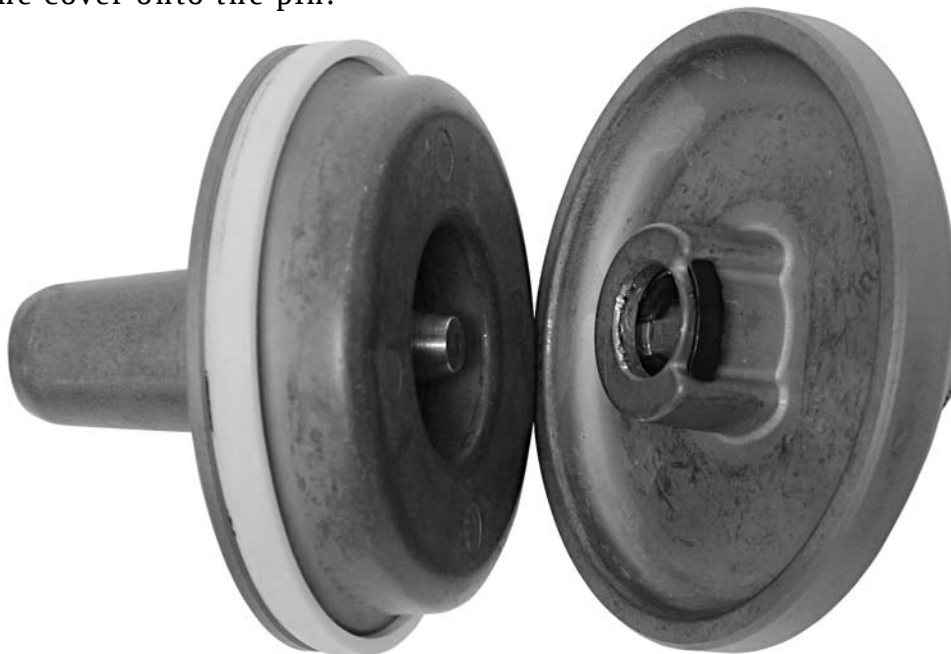
Self-Adjusting BI Servo (continued)

Servo Reassembly (continued)

- Install the snap ring into the servo, securing the diaphragm spring.



- Snap the cover onto the pin.



- Assemble the servo and cover assembly into the case.

Mercedes 722.3 and 4

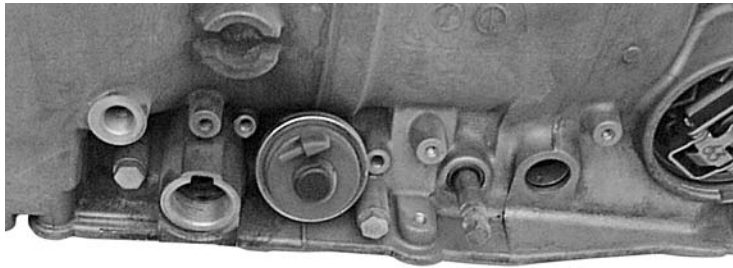
Slips on 4–3 or 3–2 Kickdown

Mercedes uses a complex system for reapplying the B2 band for a 4–3 kickdown, and the B1 band for a 3–2 kickdown. An often-overlooked aspect of this system is the reaction valves in the case.

The reaction valves control servo apply. If the reaction valves leak, the bands won't apply fully.

Testing the reaction valves is easy:

- Remove the valves from the case.



B1 Reaction Valve



B2 Reaction Valve



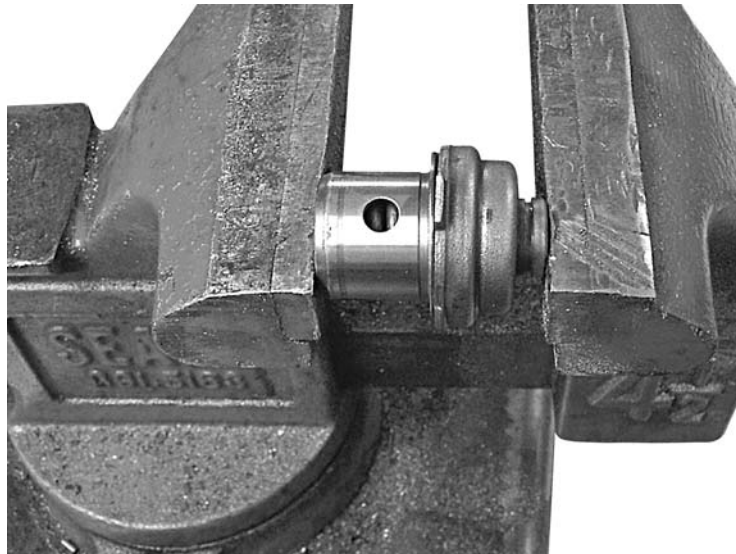
Mercedes 722.3 and 4

Slips on 4–3 or 3–2 Kickdown (continued)

- Remove the pin retainer.



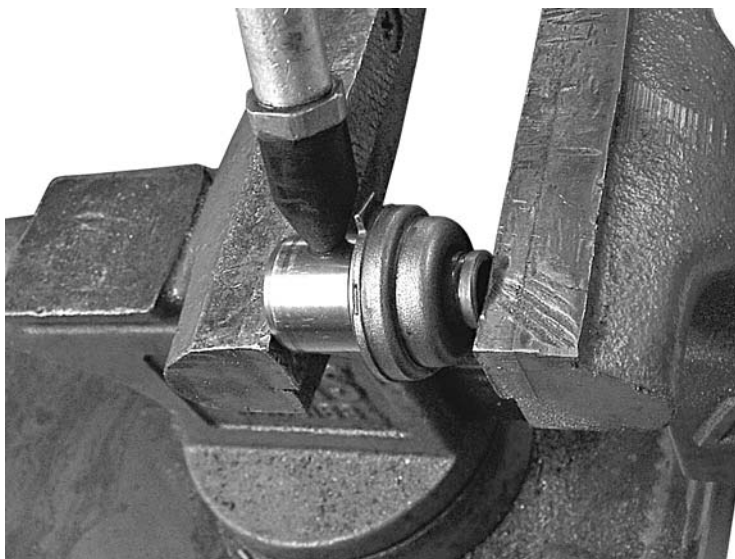
- Blow compressed air into the feed holes; air should blow out the exhaust port.
- Compress each reaction valve in a vise. Never overtighten the vise; it doesn't require a lot of force to close the valves.



Mercedes 722.3 and 4

Slips on 4–3 or 3–2 Kickdown (continued)

- With the reaction valve compressed, blow compressed air into the feed hole.



Air shouldn't leak out of the exhaust port. If the reaction valve leaks, replace it.

Mitsubishi

F4A2, 3, W4A3, F4A4 and 5

No 3rd or 4th Gear; Late Shifts

Starting in 1991, Mitsubishi incorporated several temperature-related modified shift strategies. Depending on the model and ATF temperature, the modified strategies range from late shifts, to no 3rd and 4th gear, or simply no 4th gear.

If you experience any of these conditions, check the temperature sensor reading with a scan tool and see if it's accurate, and if it falls within the specifications detailed in this text.

DIAGNOSTIC TIP The temperature sensor reading should be at room temperature first thing in the morning, after the car has sat for several hours.

Affected Vehicles

Models equipped with F4A automatic transaxle:

- 1991-98 3000GT
- 1992-98 Diamante
- 1994-98 Galant
- 1995-98 Eclipse
- 1992-96 Expo and Expo LRV
- 1993-98 Mirage

The following chart shows which models have which strategy. Also notice that some models have what's called "fuzzy logic" and "Invecs II." These are self-tailoring strategies that vary shift timing based on the driver's driving habits.

Vehicle	Engine	Shift Mode at:		
		Normal Temperature	High Temperature	Low Temperature
1991-98 3000GT	3.0L	Power/ECONO	High Temp Mode I	Low Temp Modes I & II
1992-96 Diamante	3.0L	Power/ECONO	High Temp Mode I	Low Temp Modes I & II
1997-98 Diamante	3.5L	INVECS-II	High Temp Mode II	Low Temp Mode II
1995-98 Eclipse	2.0L Turbo	Fuzzy Logic	High Temp Mode I	Low Temp Modes I & II
1998 Eclipse	2.4L SOHC	Fuzzy Logic	High Temp Mode I	Low Temp Modes I & II
1996-98 Eclipse Spyder	2.0L Turbo	Fuzzy Logic	High Temp Mode I	Low Temp Modes I & II
1996-97 Eclipse Spyder	2.4L SOHC	Fuzzy Logic	High Temp Mode I	Low Temp Mode I
1992-96 Expo/Expo LRV	1.8L, 2.4L	Standard	High Temp Mode I	Low Temp Modes I & II
1994-98 Galant	2.4L	Fuzzy Logic	High Temp Mode I	Low Temp Modes I & II
1993-96 Mirage	1.8L	Standard	High Temp Mode II	Low Temp Modes I & II
1997-98 Mirage	1.8L, 1.5L	INVECS-II	Not Applicable	Not Applicable

Mitsubishi F4A2, 3, W4A3, F4A4 and 5

No 3rd or 4th Gear; Late Shifts (continued)

POWER/ECONO Modes

The POWER or ECONO light on the instrument panel will come on when using these shift modes. ECONO (meaning ECONomy) is used for most driving situations and provides the best fuel mileage. Pressing the A/T MODE button on the shift indicator puts the transaxle in POWER mode. When in the POWER mode, the transaxle generally stays in lower gears longer before upshifting, and also downshifts more quickly during deceleration.

Fuzzy Logic Mode

On F4A transaxles that use fuzzy logic, the transmission control module (TCM) modifies shift timing for smooth shifting when traveling up and down hills. Artificial intelligence is built into the TCM to automatically simulate the natural shift patterns that a driver would use with a manual transmission. The TCM analyzes inputs from the brake switch sensor, throttle position sensor, and vehicle speed sensor. In addition to the normal A/T shift pattern, “fuzzy” shift controls have multiple shift patterns to suit five different driving conditions:

1. level roads (same as standard A/T mode)
2. uphill at low speeds
3. uphill at high speeds
4. downhill in 3rd gear
5. downhill in 2nd gear

When driving uphill in fuzzy logic shift mode, the transaxle will stay in a lower gear range to maintain power instead of hunting between gears. The TCM takes frequent samples of vehicle speed and throttle opening. It compares each sample with a previous sample to know when to prevent upshifts that would detract from climbing performance.

When driving downhill, the TCM downshifts to provide engine braking without the driver repeatedly pressing the brake pedal. This automatic downshifting is sometimes experienced even when driving on short, gradual slopes or flat roads.

The transaxle won't enter fuzzy logic shift mode if the selector lever is not in “D” or if the ATF reaches temperatures specified for High Temperature Mode or Low Temperature Mode. Also, the fuzzy logic mode isn't used if the TCM judges the throttle position sensor to be operating improperly, or if the transaxle enters the failsafe mode.

Mitsubishi F4A2, 3, W4A3, F4A4 and 5

No 3rd or 4th Gear; Late Shifts (continued)

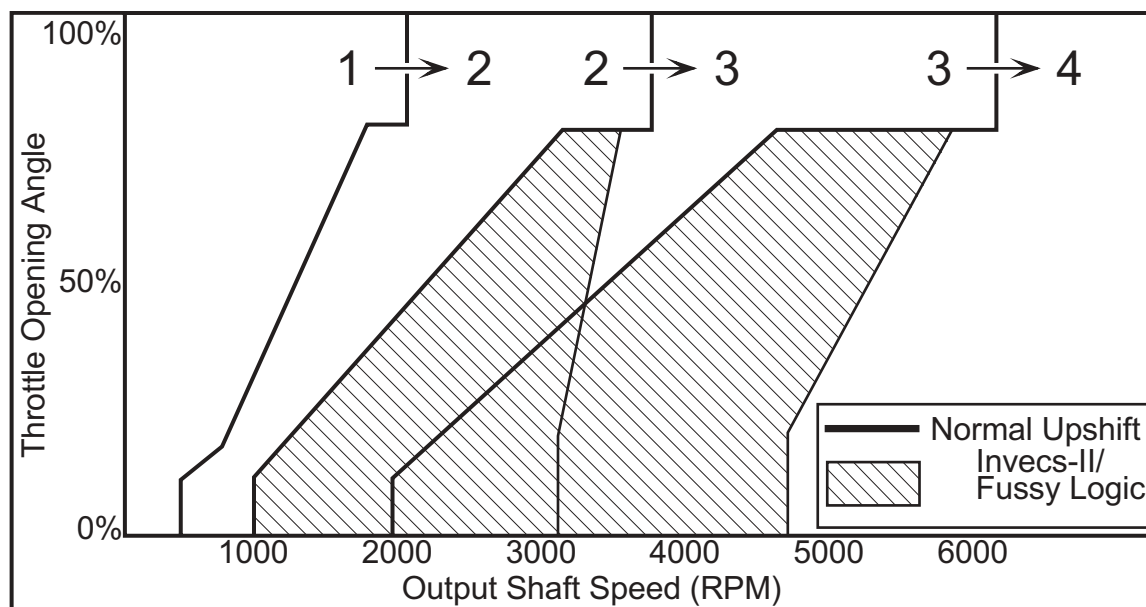
INVECS-II (Intelligent Vehicle Control System II) Mode

Used only on 1997 and later Mirage and Diamante models, INVECS-II shift control operates similar to fuzzy logic. It has an added feature of learning the driver's shift pattern preferences.

Shift control patterns are modified to favor the driver's style of driving. For drivers who prefer a vigorous style of driving, the transaxle stays in a lower gear until the engine speed becomes relatively high, to provide a sporty feel. For drivers who prefer a more leisurely driving style, upshifting occurs at lower engine speeds. For drivers who frequently press the brake pedal when driving downhill, the transaxle downshifts earlier than normal.

If the battery is disconnected, INVECS-II must relearn the driver's shift pattern preference.

For diagnosis, INVECS-II can be disabled with a scan tool, provided the scan tool has the proper software.



This upshift pattern chart demonstrates shifting differences with fuzzy logic and INVECS-II. The heavy lines indicate normal A/T up shift patterns. The shaded areas indicate the range of speeds at which “fuzzy logic” and INVECS-II controls shifting.

Mitsubishi F4A2, 3, W4A3, F4A4 and 5 No 3rd or 4th Gear; Late Shifts (continued)

High Temperature Mode I

To avoid ATF overheating, the transaxle enters this shift mode when the ATF temperature reaches above 125° C (257° F) at vehicle speeds below 70 KPH (44 MPH). Under these conditions, the transaxle will shift between 1st and 2nd gears only, not into 3rd gear. When the ATF temperature decreases to 110° C (230° F) or below, the transaxle returns to normal shift mode.

NOTICE On Eclipse models, the ATF temperature for entering High Temperature Mode I is 115° C (239° F). The transaxle returns to normal shift mode when the ATF temperature is 105° C (221° F) or below.

High Temperature Mode II

To avoid ATF overheating, the transaxle enters this shift mode when the ATF temperature reaches above 125° C (257° F) at vehicle speeds below 65 KPH (40 MPH). Under these conditions, the transaxle will only shift between 2nd and 3rd; not into 4th gear. When the ATF temperature decreases to 110° C (230° F) or below, the transmission returns to normal shift mode.

Low Temperature Mode I

When the ATF temperature reaches 20° C (68° F) and below, upshifts are delayed to compensate for the reduced power that normally accompanies lower operating temperatures. The transmission returns to normal shift mode when the ATF temperature reaches above 20° C (68° F).

Low Temperature Mode II

When the ATF or engine coolant is cold, upshifts between 2nd and 3rd and between 3rd and 4th are delayed to help the catalytic converter warm up more quickly. This condition lasts only one or two minutes after engine startup.

Mitsubishi F4A2, 3, and W4A3

Harsh 1-2 Shift

A harsh 1-2 shift is often caused by a shorted servo switch. One of the more common reasons for this is having the wrong E-clip on the servo pin. The proper clip is very narrow. Using a standard clip for a shaft the size of the servo pin will short the switch. The computer uses the servo switch to initiate the shift-feel strategy of the pressure control solenoid.

The E-clip isn't available separately; if yours is missing, you'll have to purchase a new servo.

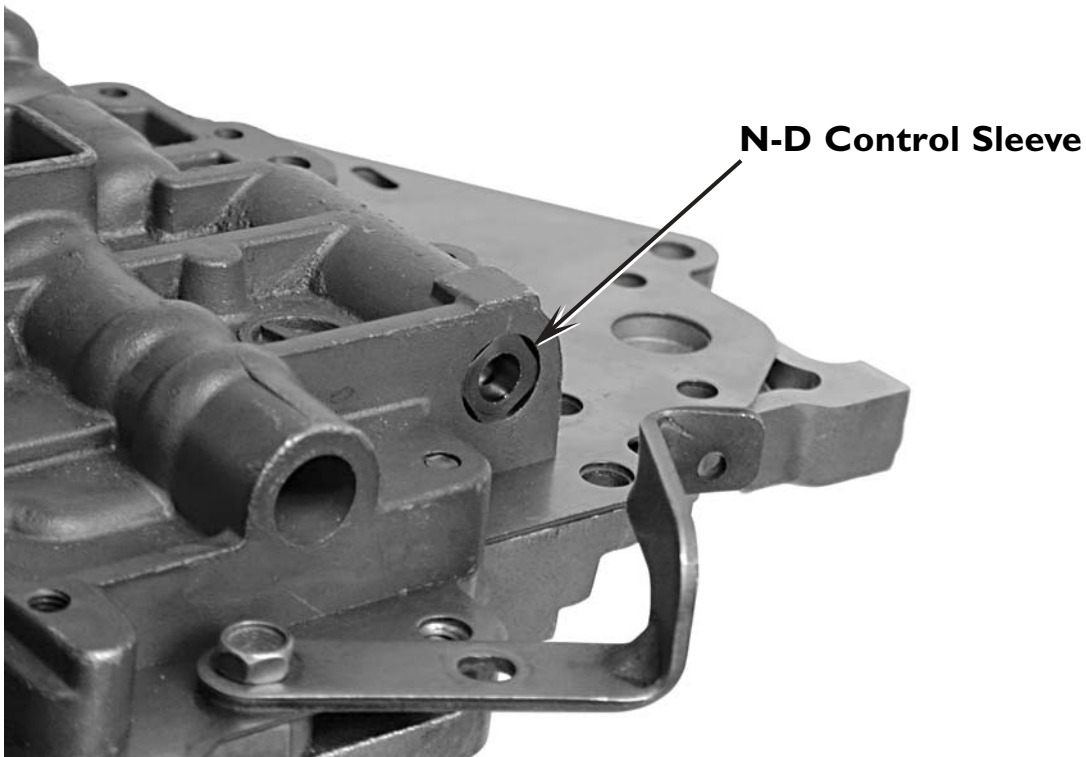


Mitsubishi KM Series

No Forward, or Falls out of Forward

A KM-series unit with no forward ranges, or falls out of forward, can be caused by a stuck N-D control valve, or an N-D control valve sleeve that is installed backward. There are other problems that can cause this condition, such as a bad sprag or rear clutch leaks. Here's a simple test to help find the problem:

1. See if the trans goes in gear in manual low. If it still doesn't move forward, suspect a rear clutch leak, such as sealing rings or a missing checkball in the pump body.
2. If the vehicle moves, shift to manual second.
 - If the trans shifts to second, suspect a bad sprag.
 - If the trans binds up, the sprag is in backward.
 - If the trans shifts to second and then quickly falls out of gear, the N-D control valve is either stuck or the sleeve is installed backward.



Mitsubishi F4A2, 3, and W4A3

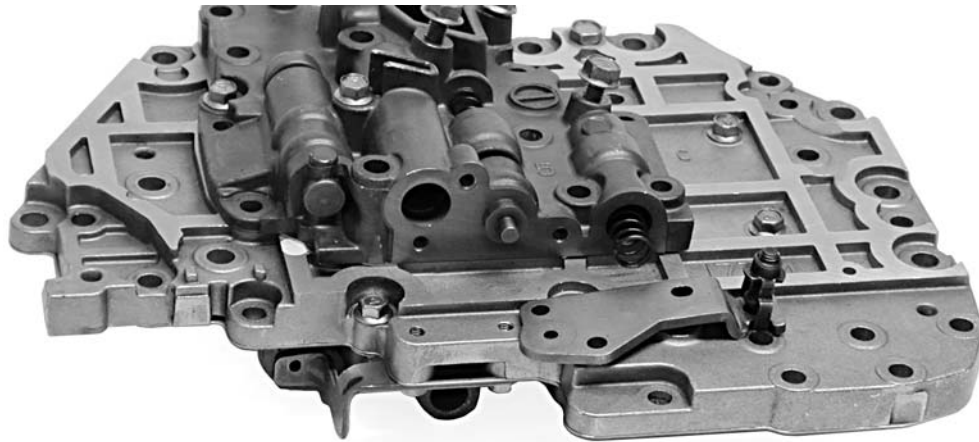
Planet Failure

There are three main factors involved in planet failures on these units:

1. A stuck damper clutch control valve: Overtightening the valve body or filter can cause the damper clutch control valve to stick. Make sure you don't overtighten the valve body and filter bolts. The torque specs for these bolts are:

Valve Body Bolts 36 – 48 in-lbs

Filter Bolts 48 – 60 in-lbs



**Damper Clutch
Control Valve**

Mitsubishi F4A2, 3, and W4A3

Planet Failure (continued)

2. A clogged turbine shaft: Make sure you blow out the turbine shaft if you suspect a torque converter failure or have an existing planet failure problem. You can remove the plug at the end clutch end of the shaft to make it easier to blow out the shaft. Replacement plugs are available at the dealer.

MF665531 — 10 mm (0.400") 1989–1992

MD712132 — 8 mm (0.320") 1992–1998



Mitsubishi F4A2, 3, and W4A3

Planet Failure (continued)

3. A clogged radiator: If the planet fails on one of these units, consider replacing the radiator. These radiators have a habit of clogging with converter clutch material. Unfortunately, a cooler flow test won't always reveal a clogged filter. All too often, the cooler will flow fine for awhile, and then later restrict cooler flow.

If you must replace the planets, make sure they are the exact same version as those that came out of the unit. You can have all sorts of slipping and ratio-error codes as a result of using the wrong planets.

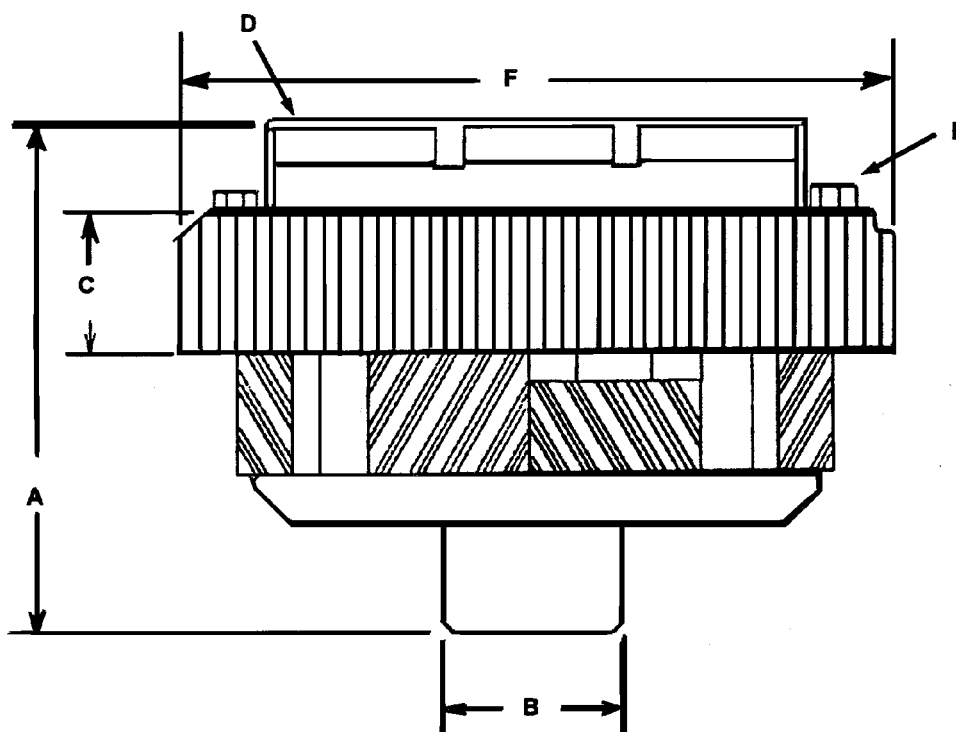
These charts and illustrations show the details of the different planetaries.

Planetary Gear Ratios		
Gear	Wide Ratio	Close Ratio
1 st	2.846	2.551
2 nd	1.581	1.488
3 rd	1.000	1.000
4 th	0.685	0.685
Reverse	2.176	2.176

The information on these pages was provided courtesy of Bob Nuttall of Nuttman, Inc.

Mitsubishi F4A2, 3, and W4A3

Planet Failure (continued)



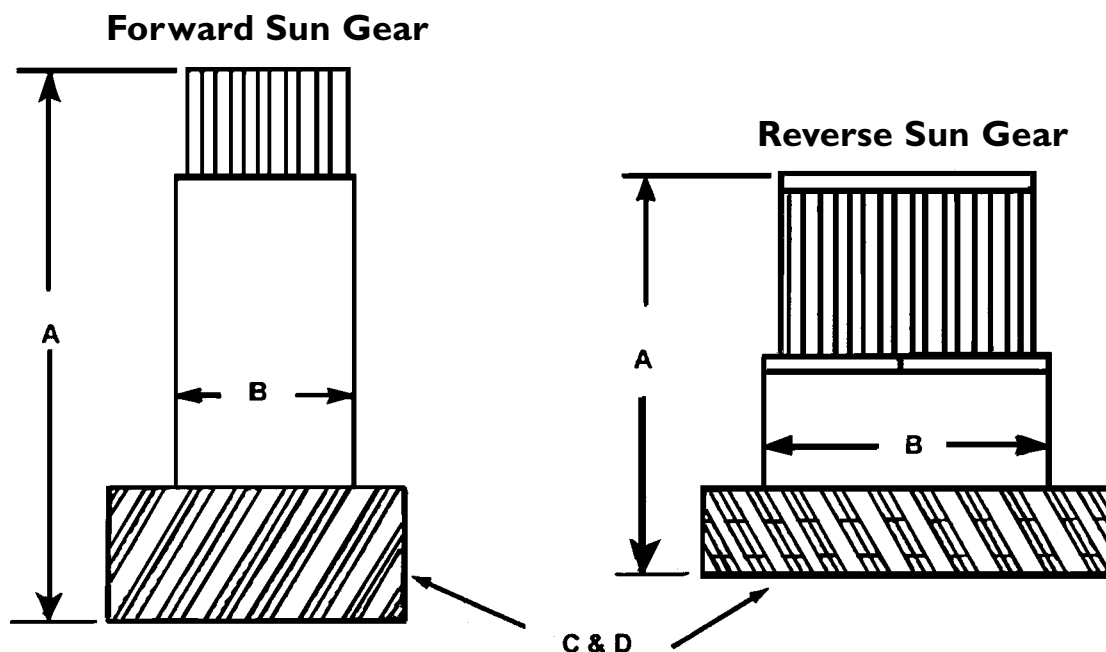
Planetary Carrier							
Trans Type	Ratio	A	B	C	D	E	F
		Overall Height	Journal OD	Spline Height	Tin Plate	Bolts	Spline Diameter
KM175-1	Wide	3.299"	1.180"	0.910"	Flat	Raised	4.893"
KM176-5	Wide	3.350"	1.295"	0.850"	Stepped	Raised	5.185"
KM177-0	Close	3.350"	1.295"	1.150" *	Flat	Recessed	5.185"
F4A21	Wide	3.360"	1.295"	0.850"	Stepped	Raised	5.185"
KM175-5, F4A22, F4A32, W4A32	Wide	3.433"	1.295"	0.952"	Stepped	Raised	5.185"
KM177-8, F4A23, W4A32	Close	3.433"	1.295"	1.135" *	Stepped	Recessed	5.185"
F4A33 & W4A33	Close	3.629"	1.295"	1.150" **	Flat	Rivited	5.456"

* Step cut in around the top instead of a chamfer.

** Elongated chamfer cut around the top.

Mitsubishi F4A2, 3, and W4A3

Planet Failure (continued)



Forward Sun Gear					
Trans Type	Ratio	A	B	C	D
		Overall Height	Journal OD	Tooth Count	ID Groove
KM175-1	Wide	3.192"	1.020"	26	None
KM176-5	Wide	3.015"	1.096"	26	None
KM177-0	Close	3.200"	1.096"	29	1
F4A21	Wide	3.015"	1.096"	26	None
KM175-5 & F4A22	Wide	3.200"	1.096"	26	None
KM177-8, F4A23, W4A32	Close	3.195"	1.096"	29	1
F4A32 & W4A32	Wide	3.195"	1.096"	26	1
F4A33 & W4A33	Close	3.440"	1.096"	29	None
Reverse Sun Gear					
KM175-1	Wide	2.287"	1.570"	34	None
KM176-5	Wide	2.270"	1.545"	34	None
KM177-0	Close	2.267"	1.545"	34	1
F4A21	Wide	2.270"	1.545"	34	None
KM175-5 & F4A22	Wide	2.267"	1.545"	34	2
KM177-8, F4A23, W4A32	Close	2.267"	1.545"	34	1

Mitsubishi F4A2, 3, and W4A3

Repeat Pump Bushing Failure

There are several possible causes for repeat pump bushing failure. Some of the things you should check are:

1. Proper case ground. The best way to check for a proper ground is to measure the case for voltage.
 - Start the engine and turn a bunch of accessories on.
 - Connect the negative lead of your voltmeter to the negative battery post.
 - Connect the positive lead of your voltmeter to the transmission case.

If you have more than 0.01 volts at the case, add a ground strap.

You may also have a poor connection at the negative post of the battery. Make sure the connection is clean and tight.

2. A missing torque converter pilot bushing: The crankshaft has a bushing that works as a pilot for the torque converter. It's not uncommon for this bushing to seize to the converter pilot; when you remove the trans, the pilot comes out with the torque converter. Then, when you install the replacement converter, the crankshaft has no pilot bushing, so the converter mounts off-center. Always make sure the converter you send out for rebuild doesn't have a pilot bushing stuck to it. And more importantly, make sure the bushing *is* in the crankshaft when you install the transmission.



**Mitsubishi has a
number of different
pilots available**

Mitsubishi F4A2, 3, and W4A3

Repeat Pump Bushing Failure (continued)

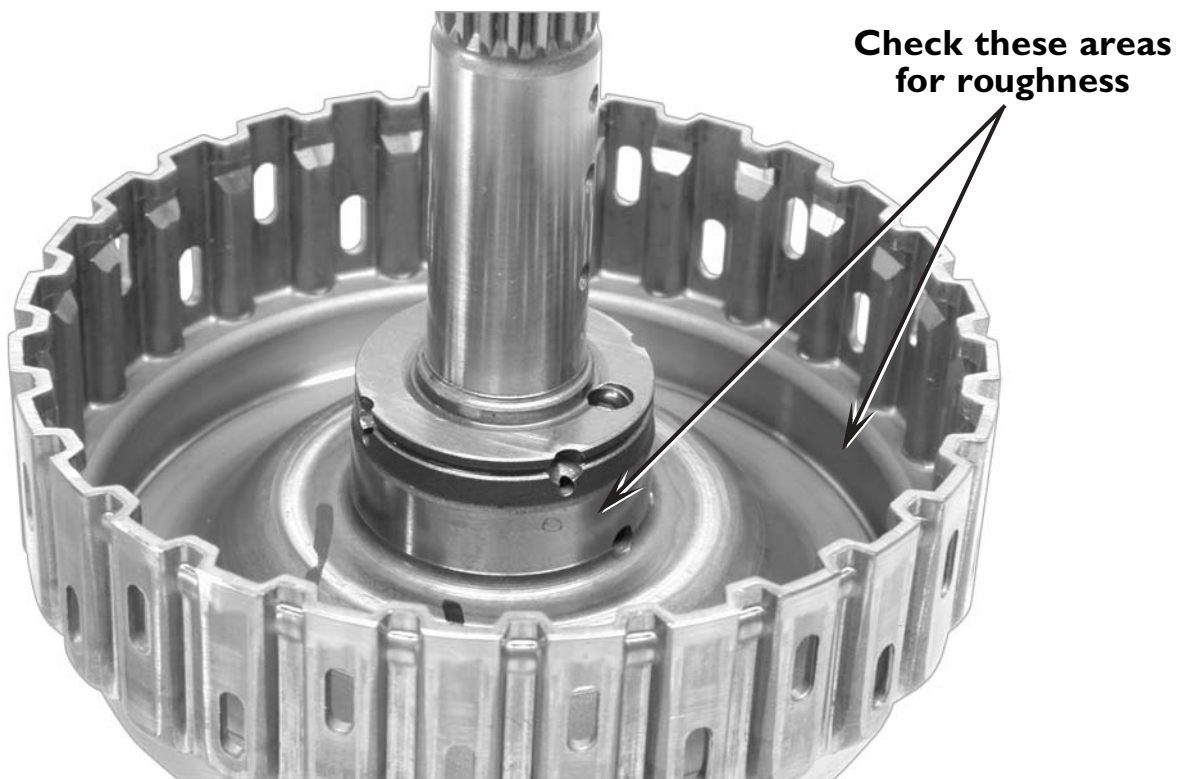
3. If all else fails, you can remove the O-ring from the inner pump gear. This will allow for more pump bushing lubrication.



Nissan RE4F04A

No 3rd or 4th Gear

A complaint of no 3rd or 4th gear is often caused by a worn outer piston seal in the high clutch drum. This can occur just weeks after rebuilding the unit. The problem could be caused by the type of seal you use, or the inside surface of the drum may be too rough for the seal. Nissan has a replacement drum with a smoother seal surface. The Nissan part number for the drum is 31412-80X07.



If you still have this problem after replacing the drum, consider using factory seals. The part number for the seals are:

Inner Seal 31527-80X01

Outer Seal..... 31527-80X02

Nissan RE4F04A

Reverse Drum Snap Ring Pops Out

The reverse drum snap ring can pop out of its groove, causing the unit to lose reverse. Nissan has a replacement drum with a design change to address this problem. When you replace the drum, replace the snap ring, too. The replacement drum uses two dished cushion plates.

The Nissan part numbers are:

Drum	31511-80X03
Snap Ring	31506-80X12
Dished Cushion Plate	31535-80X07



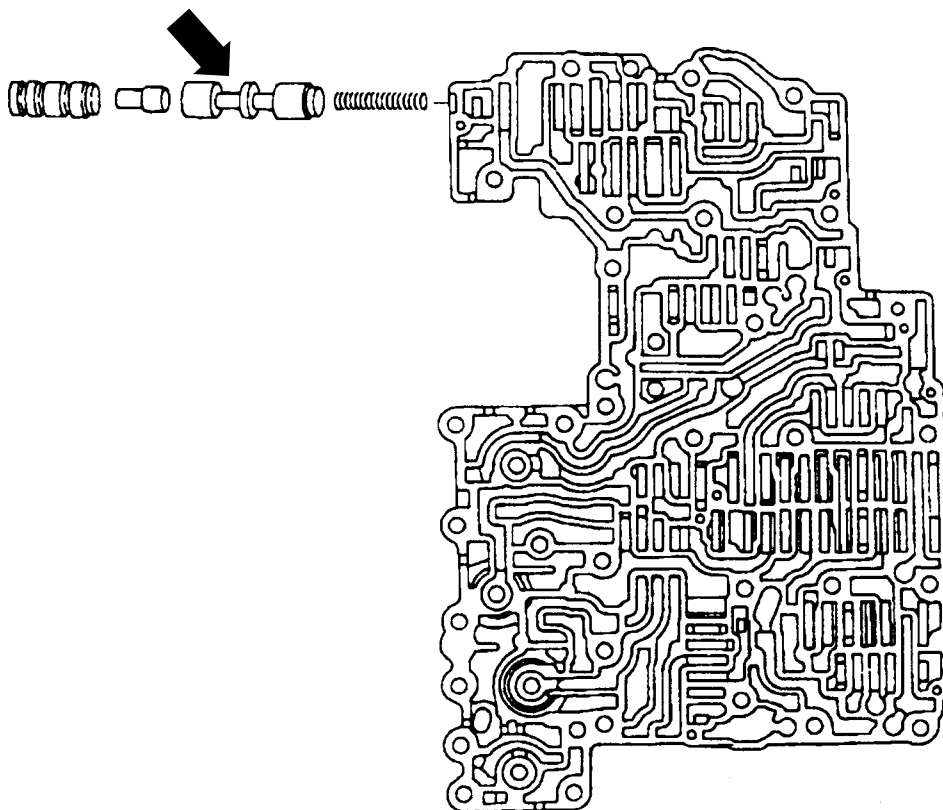
Subaru 4EAT

Kills the Engine in Gear

A misassembled lockup control valve will apply the converter clutch in every gear. This will kill the engine when you put the transmission in gear.

Some service manuals show the lockup valve arrangement incorrectly. Make sure you assemble the lockup valve with the spring installed into the valve body first, then the valves.

Lockup Control Valve



Subaru 4-Speed AWD

Chatters/Binds on Slow, Sharp Turns

A problem in the transfer clutch on these units can cause the vehicle to chatter or buck while turning a corner slowly while braking.

The computer inputs that can affect transfer clutch operation are:

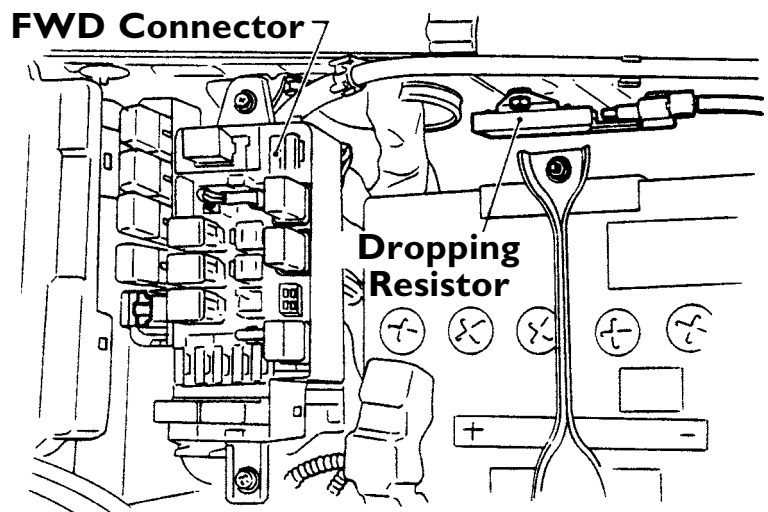
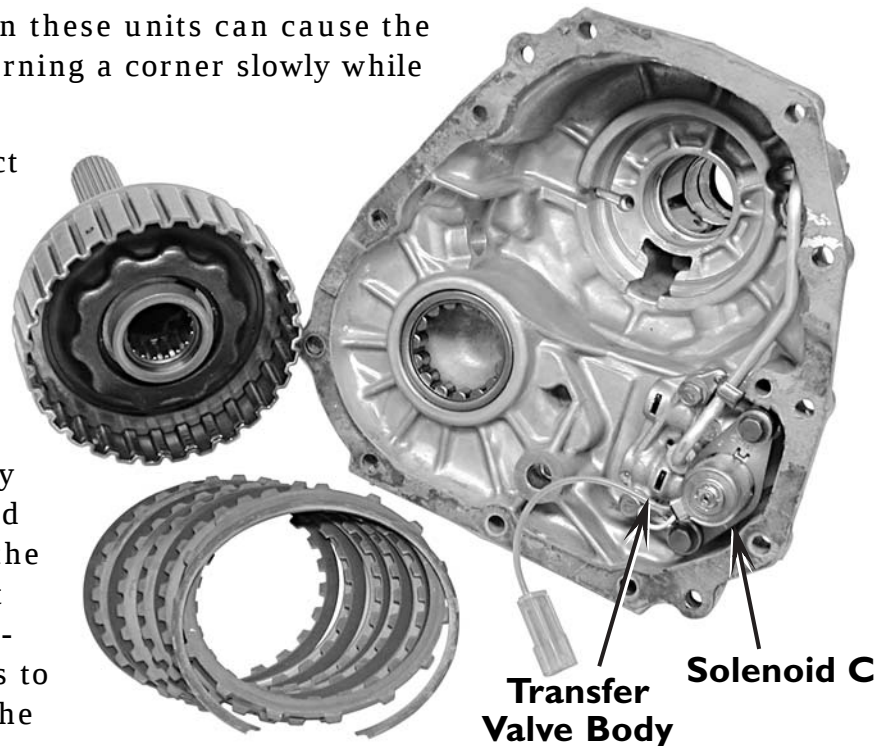
- Vehicle Speed Sensor (VSS)
- Throttle Position Sensor (TPS)
- Inhibitor Switch
- Manual Switch

The transfer clutch is controlled by duty solenoid C. When the solenoid receives a 95% duty cycle signal, the transfer clutch is fully released; at 25% the transfer clutch is fully applied. During failsafe or power loss to the system, the solenoid will put the unit into full time all-wheel drive.

Here's how to check the transfer clutch system on these vehicles:

Step 1: Check for diagnostic trouble codes (DTCs). The procedure for checking trouble codes varies from year to year, and model to model. Always check your shop manual for the proper procedure for the vehicle you're working on.

Step 2: Disable the transfer clutch. Insert a 15-amp, blade-type fuse in the FWD switch, as shown in the graphic.



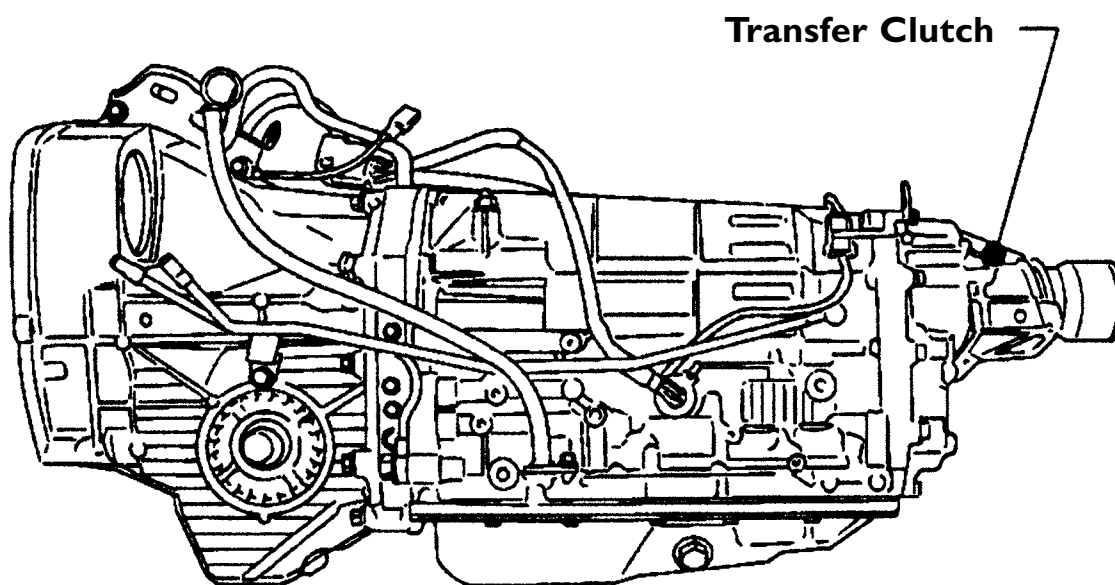
Subaru 4-Speed AWD

Chatters/Binds on Slow, Sharp Turns (cont)

Now check the vehicle: If the chatter is gone, you know there's a problem in the AWD control system (electrical or hydraulic). If the problem is still there with the fuse in place, the problem is probably internal; the transfer clutch is probably seized.

Here's how to check the system operation:

- Connect a pressure gauge to the transfer clutch tap.



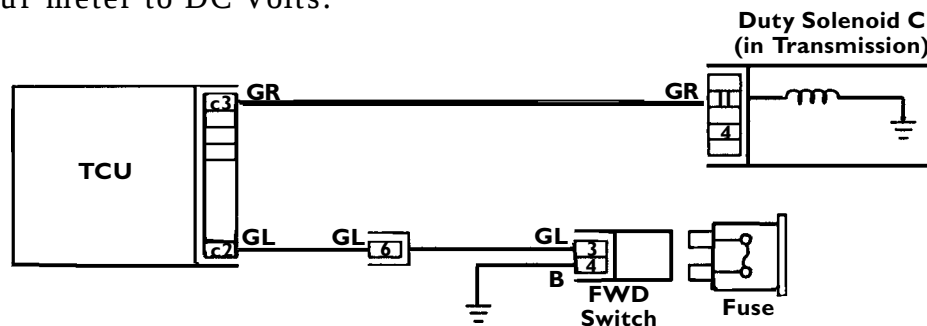
- Connect the positive lead of your digital voltmeter to transmission harness terminal 11.

4	3	2	1
8	7	6	5
12	11	10	9
16	15	14	13

Subaru 4-Speed AWD

Chatters/Binds on Slow, Sharp Turns (cont)

- Connect the negative lead of your digital meter to a good ground.
- Set your meter to DC Volts.



Check 1: Engine idling and the fuse inserted in the FWD switch.

You should see 8–14 volts at duty solenoid C, and have zero PSI to the transfer clutch circuit.

Check 2: Engine idling and the fuse removed from the FWD switch.

Transfer clutch voltage and pressure should vary with throttle opening: Pressure should be low at idle, and increase as you open the throttle. Duty solenoid C voltage should be high at idle, and drop as the throttle opens. Compare your readings to the chart.

Selector Range	AWD Mode		FWD Mode
	Idle (600 – 800 RPM)	Stall	Stall
Reverse	7 – 11 PSI	104 – 114 PSI	0 PSI
Drive	7 – 11 PSI	104 – 114 PSI	0 PSI
Accelerator	Released	WOT	WOT

- If the voltage doesn't respond properly to throttle opening, check the circuit between the solenoid and the computer.
- If the voltage responds properly to throttle opening but pressure doesn't, look for a bad solenoid or a sticking transfer clutch valve.
- If the voltage and pressure respond properly to throttle opening, look for a damaged transfer clutch assembly; the transfer clutches are probably seized.

DIAGNOSTIC TIP A condition that feels somewhat similar can be caused by a variation in tire size, such as one new tire with three old ones. Always check the tire sizes and condition before beginning a major repair to correct a chatter in turns.

Computer Reprogramming Bulletin Listings Contents

GM Bulletin Listings	254
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GM Bulletin Listings

Year	Model	Complaint	Fix	TSB#
1994-96	Trucks C, K, P and G; Oshkosh; Spartan	Failsafe after Cold Start; Intermittent DTC 87	Replace the EPROM	9674L80E-01A
1996-97	Trucks C, K and G	Surge or Chuggle on TCC Apply; No DTCs	Reprogram Computer	9774L60E-13A
1996-97	P Trucks	Won't Downshift to 1 st Manually over 25 MPH; Won't Downshift to 2 nd Manually over 40 MPH; Upshifts to 2 nd at 30 MPH with Selector in Manual 1; Upshifts to 3 rd at 40 MPH with Selector in Manual 1 or 2	Reprogram Computer	9774L80E-02
1997	Camaro; Firebird	TCC Slips or Sets DTC P1870	Reprogram Computer	9774L60E-19
1998	Buick Lesabre, Park Avenue; Olds 88; Pontiac Bonneville	Shudder after Slowing, and then Reapplying more than 50% Throttle	Reprogram Computer	99-07-30-007
1998	Olds Intrigue	Buzz on Deceleration during Coast Downshift, at 17–21 MPH	Reprogram Computer	99-07-30-008
1999	Trucks C, K	Harsh 1–2 Upshift at Light to Medium Throttle or on 3–2 Forced Downshift	Reprogram Computer	99-07-30-009
1999	Trucks C, K	Vibration or Growl in Driveline; TCC Engages Too Early	Reprogram Computer	99-07-30-010A
1999	Trucks C, K	Harsh 1–2 caused by Insufficient Line Pressure	Reprogram Computer	99-07-30-002
Saturn				
1996–97	Saturn	Bump or Ratcheting Sound in 1 st Gear under Light Throttle	Reprogram Computer	97-T-05

Ford Bulletin Listings

Year	Model	Complaint	Fix	TSB#
1992-97	Crown Victoria; Grand Marquis; Town Car	Shudder or Vibration in 3 rd or 4 th at Light to Moderate Acceleration, Over 35 MPH	Additional Cooler; Reprogram Computer	98-4-10
1995	Explorer	DTCs 645-648	Check for Damaged Int. or O/D Piston Seal; Faulty Throttle Position Sensor; Replace Computer	98-3-21 98-5-16
1995-97	Contour; Mystique	DTCs P0133 and P0153; Stalls on Transmission Engagement when Cold; Forward Surge on Engagement	Reprogram Computer	98-17-14
1996	Taurus; Sable	Harsh 3-2 and Flare on Light Throttle Downshift between 10-15 MPH; Harsh 3-2 Downshift while Coming to a Stop	Reprogram Computer	99-1-4
1996	Taurus; Sable	Harsh Engagement; Stalls on Engagement; Surge Between 35-45 MPH	Check DTCs, Repair as Necessary; Reprogram Computer	99-7-1
1996-97	F Super Duty	Erratic Shift Hunting between 3 and 4 on Grade; No 3-4 after Grade	Reprogram Computer	98-21-19
1997	Ranger	2-3 Flare after a WOT 3-2 or 4-2	Reprogram Computer	98-12-14
1997-98	Econoline	Harsh 1-2 at Light Throttle	Reprogram Computer	98-4-23 98-7-10
1997-99	Explorer; Mountaineer	Harsh 3-1 Downshift Coming to a Stop; 3 rd Gear Starts after Stopping; Hesitation on Acceleration; No Power	Reprogram Computer	99-8-7
1998	Contour; Mystique; Cougar	Harsh 1-2 at Light Throttle; Harsh 3-2 after a 1-3 Upshift	Replace Intermediate Servo; Reprogram Computer	98-13-11
1998-99	Contour; Mystique; Cougar	Some of these vehicles may require computer reprogramming after replacing CD4E transaxle.	Reprogram Computer	98-24-2
1999	F250 HD; Super Duty F Series	Squawking Noise while Backing Up on a Grade, Caused by Low Reverse Pressure	Reprogram Computer	98-24-4
1999	Super Duty F Series	2-3 or 3-4 Flare	Replace Solenoid Body; Reprogram Computer	99-5-2 99-8-1
1999	F150	4-3 Coastdown Clunk from 20-30 MPH	Reprogram Computer	99-12-4
1999	Super Duty F Series	3-4-3 Hunt with Cruise Control Engaged	Reprogram Computer	99-16-9

Chrysler Bulletin Listings

Year	Model	Complaint	Fix	TSB#
1996	Ram Truck	No Upshift after a 3–2 Downshift	Reprogram Computer	21-04-96
1996	FJ; GS; JA; JX; LH; NS	Reduced Sensitivity to Failsafe for Intermittent DTCs 15, 22, 50–54, 56–58	Reprogram Computer	21-05-96
1996	AB; AN; BR; ZJ	False DTC Hex A4 (37); Unable to Perform TCC Actuator Test	Reprogram Computer	21-07-96
1996-97	FJ; GS; JA; JX; LH; NS	Overly Sensitive to Intermittent Faults; Various Driveability Complaints	Reprogram Computer	21-02-98 Rev A
1997	Wrangler	DTC P1794 Caused by Late Upshift	Reprogram Computer	21-14-96
1998	Concord, Intrepid	4–3 Coastdown Shift Speed Too High	Reprogram Computer	21-08-98
1998	FJ; GS; JA; JX; LH; NS	Overly Sensitive to Intermittent Faults; Various Driveability Complaints	Reprogram Computer	21-03-98

Mitsubishi Bulletin Listings

Year	Model	Complaint	Fix	TSB#
1995	Eclipse RS and GS	TCC Shudder; Harsh TCC Engagement	Reprogram Computer; Replace EATX Harness	TSB-95-23-002
1996-97	Eclipse	DTC 21-27, 31-33, 50-58; Won't Shift Manually between Forward Gears; 2 nd Gear Starts, Won't Shift Cold, DTC 74; Delayed Upshift on Grades; Poor Mid-Throttle Performance on 1996 Models	Reprogram Computer; Replace EATX Harness	TSB-98-23-003REV
1997	Diamante	Harsh 2-3 at Low to Moderate Acceleration	Replace Transmission Computer	TSB-97-23-014
1997-98	Galant; Eclipse Spyder	Harsh 3-2 Downshift below 30 MPH	Replace Transmission Computer	TSB-97-23-013
1997-98	Galant; Eclipse Spyder (Also earlier vehicles with replacement transaxles)	Harsh 3-2 Downshift below 30 MPH	Replace Transmission Computer	TSB-98-23-014
1998	Eclipse	Failsafe below -16°F (-27°C); Long 3-2 Coastdown Cold; 2 nd Gear Starts; Hesitates Cold at Light Throttle; Delayed Upshift on Grades	Reprogram Computer; Replace EATX Harness	TSB-98-23-002REV

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Conversion Tables

Area		
Multiply	By	To Obtain
In ²	645.2	mm ²
In ²	6.452	cm ²
In ²	0.0069	Ft ²
Ft ²	0.0929	m ²
Ft ²	144.0	In ²
m ²	10.764	Ft ²
cm ²	0.155	In ²
mm ²	0.00155	In ²
area of a circle = πr^2 area of a cylinder = $\pi r^2 h$		
$\pi = 3.14$ r = Radius h = Height		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

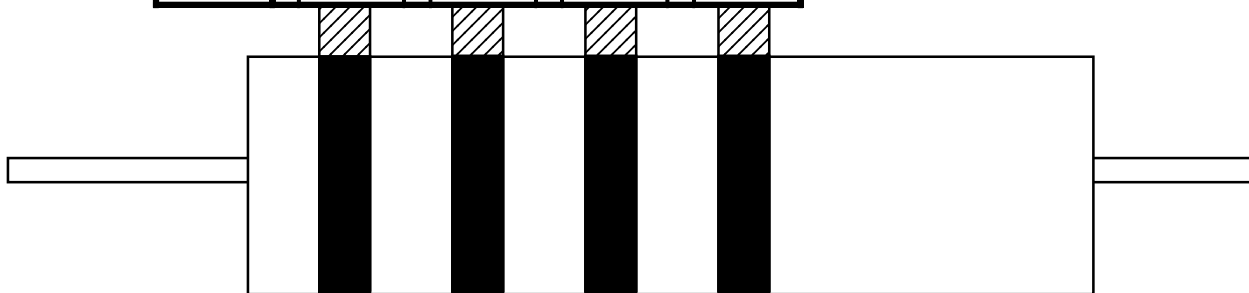
* The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	0	—
Brown	1	1	1	—
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Brown	—	—	—	1%
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%



So if the bands are:

Blue Green Yellow Silver
6 5 0,000 ±10%

Red Violet Brown Gold
2 7 0 ±5%

White Orange Violet Plain
9 3 0,000,000 ±20%

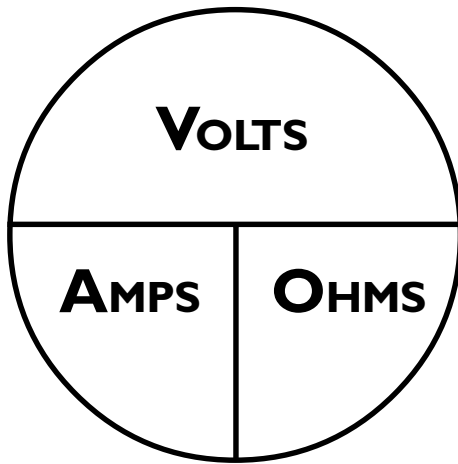
The resistor value is:

= 650 kΩ, ±10%

= 270 Ω, ±5%

= 930 MΩ, ±20%

Ohm's Law



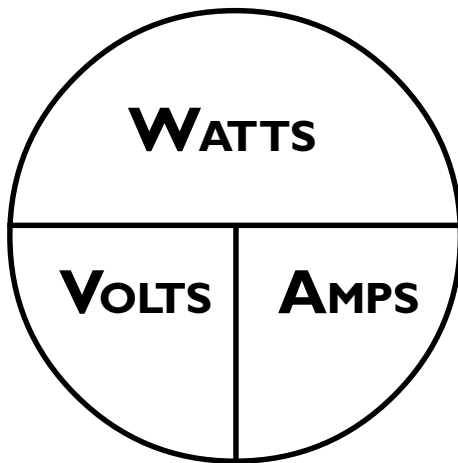
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

Multiple Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

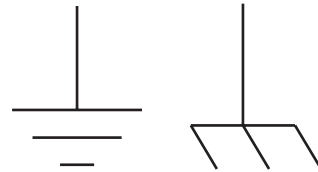
Schematic Symbols



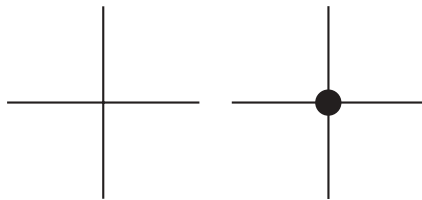
Battery



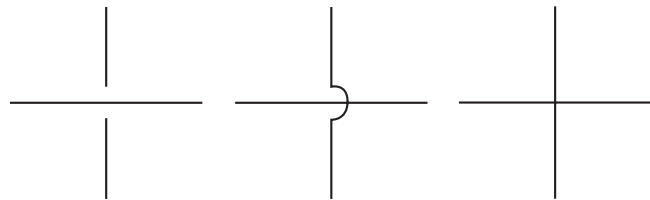
Power



Ground



Connected Wires



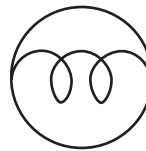
Unconnected Wires



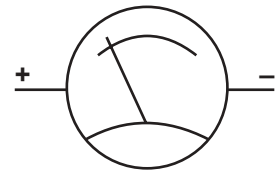
Fuse



Circuit Breaker



Bulb

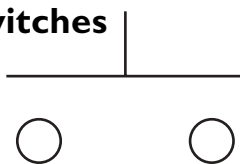


Meter

Pushbutton Switches



NC Switch

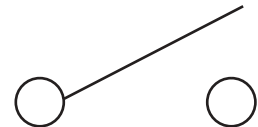


NO Switch

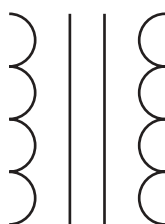
On/Off Switches



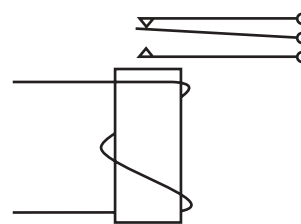
NC Switch



NO Switch

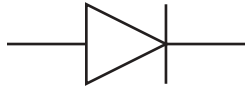
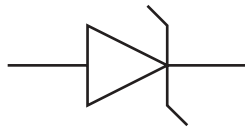
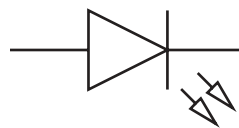
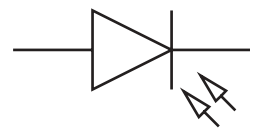
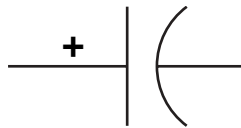
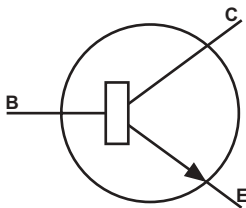
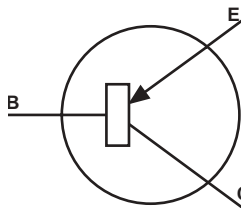
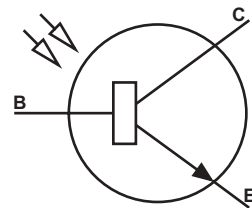
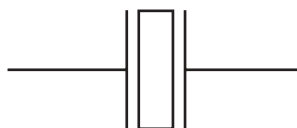


Transformer (Coil)



Relay

Schematic Symbols (continued)

**Fixed Resistor****Variable Resistor****Potentiometer****Diode****Zener Diode****LED****Photodiode****Fixed Capacitor****Fixed Capacitor (Polarized)****Variable Capacitor****NPN Transistor****PNP Transistor****Phototransistor****Crystal**

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates

that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition systems.

Glossary of Electrical Terms (cont)

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical

circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific direction, or the LED won’t light.

Glossary of Electrical Terms (cont)

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm's Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). $\text{Ohms} \times \text{Amps} = \text{Volts}$; $\text{Volts} \div \text{Ohms} = \text{Amps}$; $\text{Volts} \div \text{Amps} = \text{Ohms}$.

Open Circuit — An incomplete electrical path that won't provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won't operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component's operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won't prevent the other legs from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the voltage signal, based on its position

along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device controlling the circuit.

Glossary of Electrical Terms (cont)

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely be dealing with open and close to control hydraulic flow, to allow the transmission to shift gears, control lockup, and control line pressure.

Thermistor — A semiconductor that varies resistance based on temperature. There are two types of thermistor: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). The NTC thermistor is more common — as the temperature goes up, its resistance goes down.

Transistor — A semiconductor that operates as an electronic "relay." Transistors allow a low current circuit to control power or ground to a high current circuit.

Variable Resistor — A one- or two-wire sensor that modifies a voltage signal based on stress or temperature. Thermistors are the most common type of variable resistor in today's cars and trucks.

Voltage — The pressure in an electrical system, that pushes current through the circuit. One volt of pressure is necessary to push one amp of current through one ohm of resistance. Sometimes called the circuit's potential.

Voltmeter — Electrical test device that measures the voltage potential in a circuit. Displays its reading in volts.

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kV	Kilovolt
AC	Alternating current	kW	Kilowatt
B, b	Base electrode, units with single	kWH	Kilowatt hour
base		lb	Pound
°C	Degrees Celsius or centigrade	M	Mega; x1,000,000
C	Capacitance, capacitor	m	Milli; one-one thousandth; 1/1000;
C, c	Collector electrode	0.001	
cm	Centimeter	mf, mfd	Microfarad
cu	Cubic	MHz	Megahertz
db	Decibels	mm	Millimeter
DC	Direct current	NC	Normally closed
dm	Decimeter	Nm	Newton-meter
DPDT	Double-pole, double-throw switch	NO	Normally open
DPST	Double-pole, single-throw switch	R	Resistance; resistor
E, e	Emitter electrode	SPDT	Single-pole, double-throw switch
E, e	Voltage	SPST	Single-pole, single-throw switch
mf	Microfarad	t	Time
°F	Degrees Fahrenheit	T	Temperature
F, f	Frequency	V, v	Volt; voltmeter
flu	Fluid	V _{BB}	Base supply voltage (DC)
FM	Frequency modulation	V _{BC}	Base-to-collector voltage (DC)
g	Gram	V _{BE}	Base-to-emitter voltage (DC)
gnd, grd	Ground	V _{CB}	Collector-to-base voltage (DC)
Hg	Mercury	V _{CC}	Collector supply voltage (DC)
Hz	Hertz	V _{CE}	Collector-to-emitter voltage (DC)
I	Current	V _{EB}	Emitter-to-base voltage (DC)
I _B	Base current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _C	Collector current (DC)	v _{ee}	Emitter supply voltage (DC)
I _E	Emitter current (DC)	v _F	Forward voltage (DC)
k	x1000	W	Watt; work
kg	Kilograms	w	Watt
kHz	Kilohertz	wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	$\frac{1}{128}$	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	$\frac{15}{128}$	2.9769		
0.0156	$\frac{1}{16}$	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	$\frac{1}{8}$	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	$\frac{17}{128}$	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	$\frac{3}{128}$	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	$\frac{9}{64}$	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	$\frac{3}{16}$ -24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	$\frac{1}{32}$	0.7925			0.1484	$\frac{19}{128}$	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	$\frac{5}{32}$	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	$\frac{3}{16}$ -32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	$\frac{5}{128}$	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	$\frac{21}{128}$	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	$\frac{3}{64}$	1.1913		0-80 NF	0.1719	$\frac{11}{64}$	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	$\frac{7}{128}$	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	$\frac{23}{128}$	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1653		4.2000		5.5mm - 0.80
0.0625	$\frac{1}{16}$	1.5875			0.1820		4.6228	14	12-28 NF
0.0635		1.6129	52		0.1850		4.6990	13	12-32 NEF
0.0670		1.7018	51		0.1875	$\frac{3}{16}$	4.7625		
0.0700	$\frac{9}{128}$	1.7780	50	2-56 NC 2-64 NF	0.1890		4.8006	12	
					0.1910		4.8514	11	
0.0730		1.8542	49		0.1935		4.9149	10	14-20 NS
0.0760		1.9304	48		0.1953	$\frac{25}{128}$	4.9606		
0.0781	$\frac{5}{64}$	1.9837			0.1960		4.9784	9	
0.0785		1.9939	47	3-48 NC	0.1990		5.0546	8	
0.0810		2.0574	46		0.2010		5.1054	7	$\frac{1}{4}$ -20 NC 14-24 NS
0.0820		2.0828	45	3-56 NF					
0.0860	$\frac{11}{128}$	2.1844	44	4-36 NS	0.2031	$\frac{13}{64}$	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	$\frac{3}{32}$	2.3825		$\frac{1}{8}$ -32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	$\frac{1}{4}$ -24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	$\frac{27}{128}$	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	$\frac{1}{4}$ -28 NF
0.1015		2.5781	38	$\frac{1}{8}$ -40NF 5-40NC	0.2188	$\frac{7}{32}$	5.5575		$\frac{1}{4}$ -32 NEF
					0.2210		5.6134	2	
0.1016	$\frac{13}{128}$	2.5806			0.2266	$\frac{29}{128}$	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	$\frac{1}{4}$ -40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	$\frac{7}{64}$	2.7788			0.2344	$\frac{15}{64}$	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	²⁹ / ₆₄	11.5087		¹ / ₂ -20 NF
0.2422	³¹ / ₁₂₈	6.1519							¹ / ₂ -24 NS
0.2460		6.2484	D		0.4609	⁵⁹ / ₁₂₈	11.7069		
0.2500	¹ / ₄	6.3500	E		0.4688	¹⁵ / ₃₂	11.9075		
0.2570		6.5278	F	⁵ / ₁₆ -18 NC	0.4766	⁶¹ / ₁₂₈	12.1056		
0.2578	³³ / ₁₂₈	6.5481			0.4800		12.1920		14mm - 2.00
0.2610		6.6294	G		0.4844	³¹ / ₆₄	12.3038		⁹ / ₁₆ -12 NC
0.2656	¹⁷ / ₆₄	6.7462			0.4922	⁶³ / ₁₂₈	12.5019		
0.2660		6.7564	H		0.5000	¹ / ₂	12.7000		14mm - 1.50
0.2720		6.9088	I	8mm - 1.25	0.5039		12.8000		14mm - 1.25
				⁵ / ₁₆ -24 NF	0.5156	³³ / ₆₄	13.0962		⁹ / ₁₆ -18 NF
0.2734	³⁵ / ₁₂₈	6.9444			0.5312	¹⁷ / ₃₂	13.0962		⁵ / ₈ -11 NC
0.2770		7.0358	J		0.5469	³⁵ / ₆₄	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	⁹ / ₁₆	14.2875		
0.2813	⁹ / ₃₂	7.1450		⁵ / ₁₆ -32 NEF	0.5781	³⁷ / ₆₄	14.6837		⁵ / ₈ -18NF
0.2891	³⁷ / ₁₂₈	7.3431							³/₈-18NPT
0.2900		7.3660	L		0.5787		14.7000		16mm - 1.50
0.2950		7.4930	M		0.5938	¹⁹ / ₃₂	15.0825		¹¹ / ₁₆ -11 NS
0.2969	¹⁹ / ₆₄	7.5413			0.6094	³⁹ / ₆₄	15.4788		
0.3020		7.6708	N		0.6220		15.8000		18mm - 2.50
0.3047	³⁹ / ₁₂₈	7.7394			0.6250	⁵ / ₈	15.8750		¹¹ / ₁₆ -16 NS
0.3110		7.8994		9mm - 1.25	0.6406	⁴¹ / ₆₄	16.2712		
0.3125	⁵ / ₁₆	7.9375		³ / ₈ -16 NC	0.6562	²¹ / ₃₂	16.6675		³ / ₄ -10 NC
0.3160		8.0264	O		0.6614		16.8000		18mm - 1.50
0.3190		8.1026		9mm - 1.00	0.6719	⁴³ / ₆₄	17.0663		
0.3203	⁴¹ / ₁₂₈	8.1356			0.6875	¹¹ / ₁₆	17.4625		³ / ₄ -16NF
0.3230		8.2042	P		0.7008		17.8000		20mm - 2.50
0.3270		8.3058		9mm - 0.75	0.7031	⁴⁵ / ₆₄			¹/₂-14 NPT
0.3281	²¹ / ₆₄	8.3337			0.7187	²³ / ₃₂			
0.3320		8.4328	Q	³ / ₈ -24 NF	0.7344	⁴⁷ / ₆₄			
0.3359	⁴³ / ₁₂₈	8.5319			0.7500	³ / ₄			
0.3390		8.6106	R	¹/₈-27 NPT	0.7656	⁴⁹ / ₆₄			⁷ / ₈ -9 NC
0.3430		8.7122		10mm - 1.50	0.7812	²⁵ / ₃₂			
0.3438	¹¹ / ₃₂	8.7325			0.7969	⁵¹ / ₆₄			
0.3480		8.8392	S		0.8125	¹³ / ₁₆			⁷ / ₈ -14 NF
0.3500		8.8900		10mm - 1.25	0.8228		20.9000		22mm - 1.50
0.3516	⁴⁵ / ₁₂₈	8.9306			0.8281	⁵³ / ₆₄			⁷ / ₈ -18 NS
0.3580		9.0932	T	10mm - 1.0	0.8425		21.4000		24mm - 3.00
0.3594	²³ / ₆₄	9.1288			0.8437	²⁷ / ₃₂			
0.3672	⁴⁷ / ₁₂₈	9.3269			0.8594	⁵⁵ / ₆₄			
0.3680		9.3472	U	⁷ / ₁₆ -14 NC	0.8750	⁷ / ₈			1-8 NC
0.3750	³ / ₈	9.5250			0.8779		22.3000		24mm - 2.00
0.3770		9.5758	V		0.8906	⁵⁷ / ₆₄			
0.3820		9.7028		11mm - 1.50	0.9062	²⁹ / ₃₂			
0.3828	⁴⁹ / ₁₂₈	9.7231			0.9219	⁵⁹ / ₆₄			1-12 NF
0.3860		9.8044	W						³/₄-14 NPT
0.3906	²⁵ / ₆₄	9.9212		⁷ / ₁₆ -20 NF	0.9375	¹⁵ / ₁₆			1-14 NS
0.3970		10.0838	X		0.9531	⁶¹ / ₆₄			
0.3984	⁵¹ / ₁₂₈	10.1194			0.9687	³¹ / ₃₂			
0.4040		10.2616	Y		0.9844	⁶³ / ₆₄			
0.4063	¹³ / ₃₂	10.3200			1.0000	1			
0.4130		10.4902	Z	12mm - 1.75					
0.4141	⁵³ / ₁₂₈	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	²⁷ / ₆₄	10.7163		¹ / ₂ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	⁵⁵ / ₁₂₈	10.9144							
0.4375	⁷ / ₁₆	11.1125		¹/₄-18NPT					
0.4453	⁵⁷ / ₁₂₈	11.3106							

2001

Technical Seminar 2001



2001

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Lance Wiggins
Technical Director

GM Updates and Changes

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All Applications

DTC P0122: TP Sensor Circuit Low Input

Some 1999-2001 W-body vehicles (Regal, Grand Prix, Monte Carlo/Impala and Intrigue) with a 3.8L engine have been showing up with code P0122 in memory. They may also exhibit these additional symptoms:

- Engine and transmission driveability problems
- DTC P0452 — Fuel tank pressure sensor or circuit
- DTC P0462 — Fuel level sensor or circuit
- DTC P1635 — 5-volt reference circuit

With the key on, engine off, check the 5-volt reference at the TPS.

If there's no 5-volt reference, the problem may be the 5-volt reference wire is shorted to ground. The TP sensor shares its 5-volt reference circuit with several other components, including the fuel level sensor and the fuel tank pressure sensor.

Look for this wiring to be pinched near the rear seat belt retaining stud. This chafes the wire, shorting it to ground.



All Applications

Ratio Error DTCs

All computers that are programmed to set ratio errors work off the same basic strategy and need to know at least three basic things.

- **Input Speed:** One way could be as simple as reading the engine RPM signal; another can be to read true input shaft speed, such as the 4T40E.
- **Output Speed:** Once again, this data can be received from a few different locations. One would be at the final drive, while another could be directly from the output shaft, such as the 4L60E.
- **Calibration Knowledge:** The computer must know how to calculate data from the input and output speed sensors, and it must also know the ratios that are being used by the year, make and model of the vehicle.

Inaccuracy in any of these three areas will cause false ratio errors to be set.

Two Basic Causes

Cause 1: Miscalculated Ratios

One way to determine if a ratio error is set due to a miscalculation is to operate the transmission with the drive wheels off the ground. Typically, if a ratio error is due to a miscalculation, it will set the code even when there is no load on the transmission.

Possible causes:

- Incorrect PROM or calibration programming
- Wrong sprocket or final drive ratio (FWD only)
- Incorrect speed sensor reluctor tooth count
- Incorrect engine RPM reading
- EMI (Electromagnetic Interference)
- Incorrect PCM/TCM/VCM
- Faulty PCM/TCM/VCM

All Applications

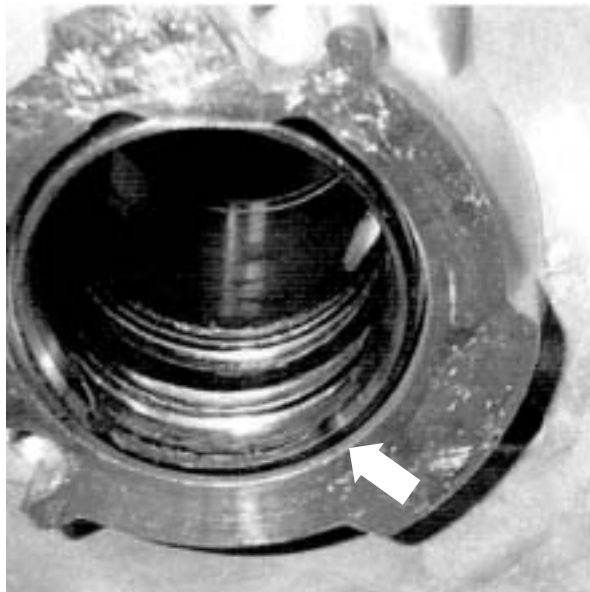
Ratio Error DTCs (continued)

Cause 2: Component Slipping

- Leaking, damaged or worn stator support bushings (4L60E) This is generally caused by a hardening problem with turbine shaft. The turbine shaft or input housing may require replacement. (Very common)

NOTICE An updated stator support bushing is now being used with the 4L60E HD.

- TCC pressure regulator valve is side loading or sticking (all applications): This condition causes low TCC apply pressure. Valve body updates have been issued to try to repair this condition. In addition, several aftermarket manufacturers have valve body repair kits to address this problem. (Very common)
- Front bearing failure (input or turbine shaft support bearing; 4T60E, 4T65E): The manufacture of this bearing was changed to eliminate this problem. When the bearing fails the customer may also complain of a whining noise in park or neutral. The channel plate sleeve is often damaged, which will also require replacement. (Very common)

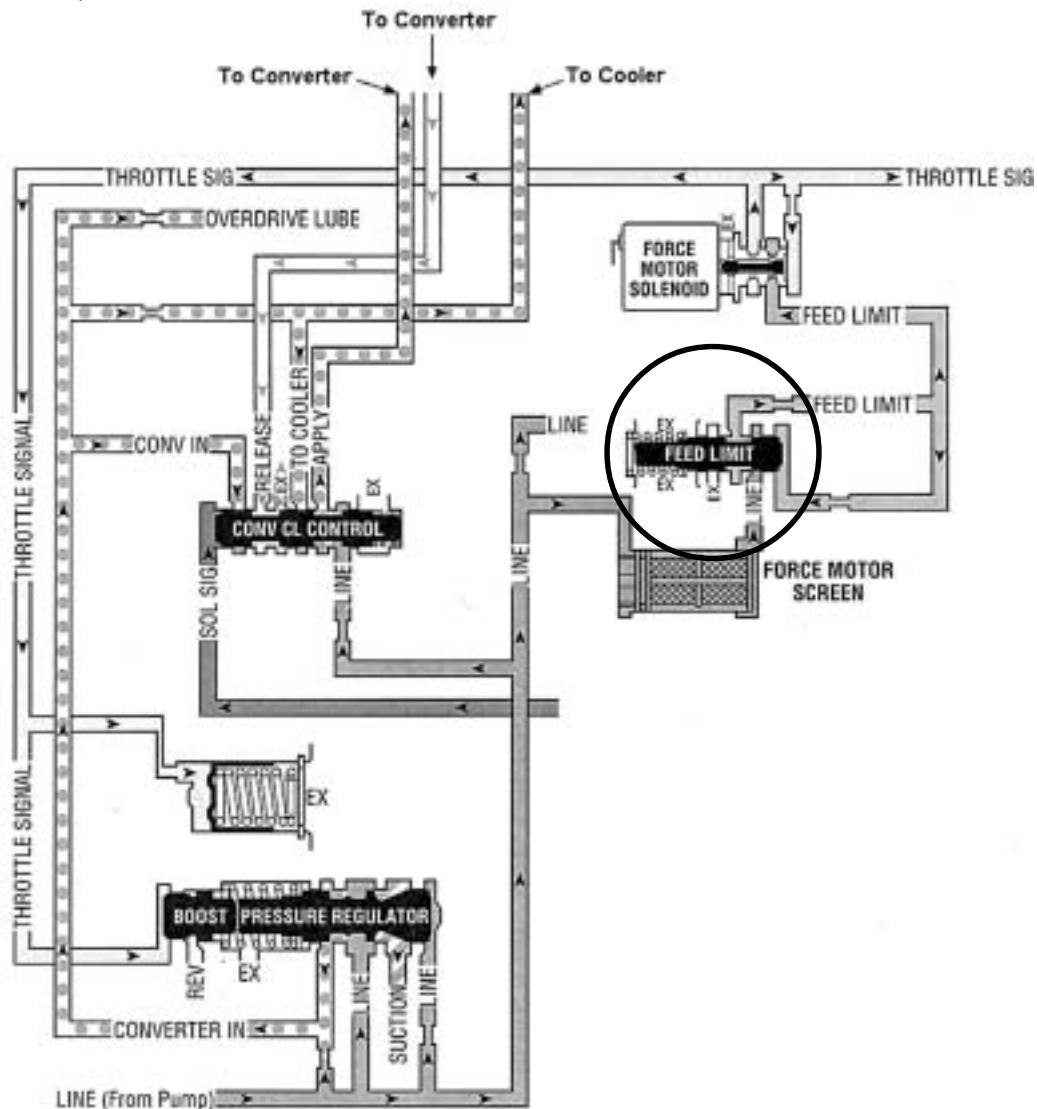


All Applications

Ratio Error DTCs (continued)

Cause 2: Component Slipping (continued)

- A worn, sticking or damaged actuator feed limit valve or bore (all applications with a PCS): This valve provides the feed oil for the PCS, so it controls line pressure boost. Many times problems with this valve or its bore will also cause the vehicle to start in a gear other than 1st gear. Generally the customer complaint will be that the transmission bumps as the vehicle first starts to move. What the customer is actually feeling is the transmission downshifting during acceleration. (Very common)



All Applications

Ratio Error DTCs (continued)

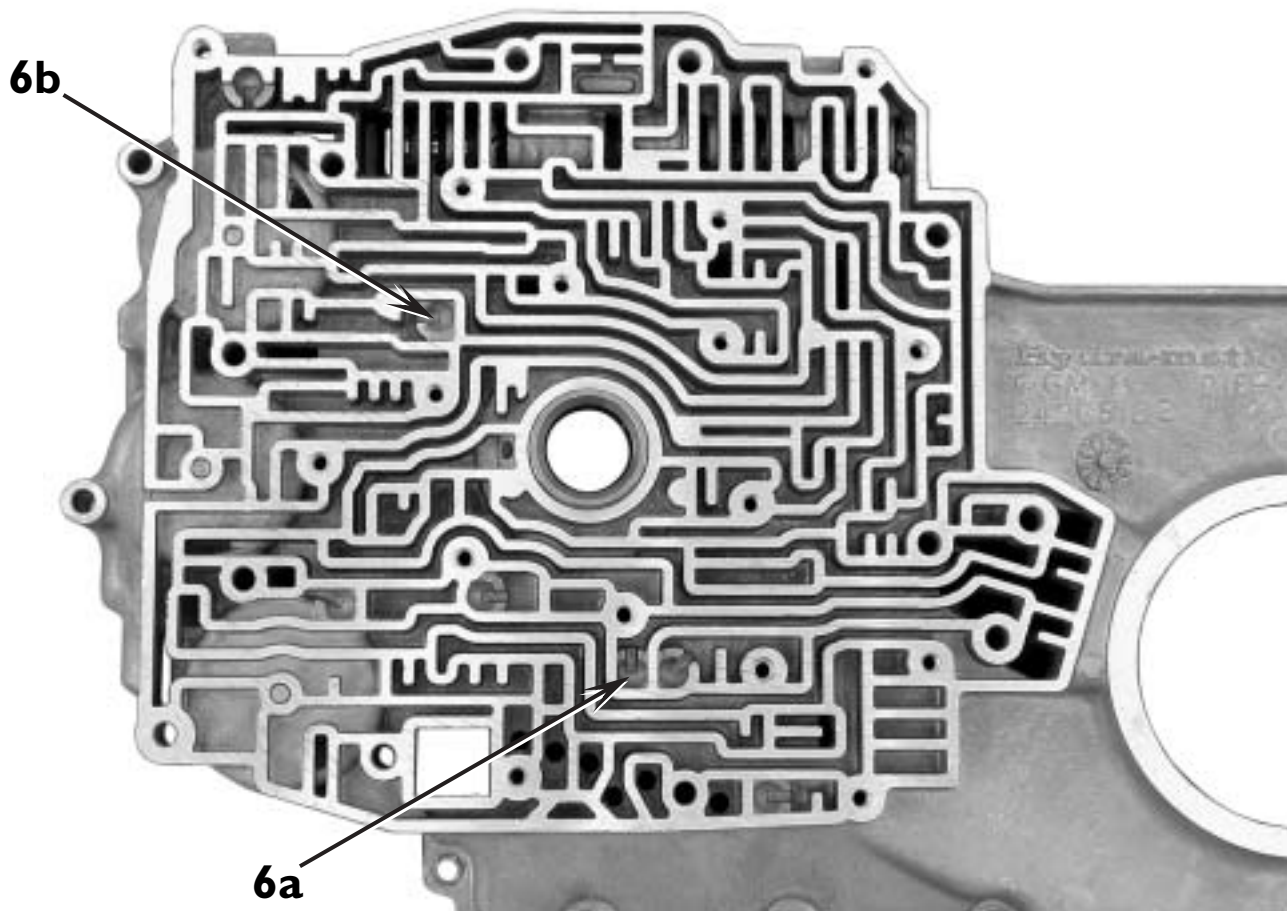
Cause 2: Component Slipping (continued)

- Slipping or damaged clutches or bands: Refer to the clutch/band apply chart for the unit you're working on to determine which clutch or band could cause the problem. Some of the GM computers can't determine what's actually slipping; for example, is it the TCC or a clutch or band? (Very common)
- Faulty torque converter clutch
- Faulty or damaged TCC PWM solenoid wiring
- Faulty TCC PWM or TCC apply solenoid. Check whether an updated solenoid is available for the unit you're working on.
- Leaking turbine shaft O-ring or sealing rings
- Plugged or restricted TCC or AFL screens
- Sticking, worn or damaged TCC apply valve
- Sticking or damaged PCS
- Sticking or damaged pressure regulator valve
- Valve body, channel plate or case damage (warped, cracked, dented, etc.)
- Low solenoid current flow due to high resistance. Correct current flow for the shift solenoids and the TCC apply solenoid is generally around 0.5–1.0 amp, depending on solenoid resistance. Correct current flow for a TCC PWM solenoid is generally around 1.2–3.0 amps, depending on duty cycle. Low current flow indicates high resistance in the solenoid, its wiring, or its feed or control circuits.

4T40E

Harsh or Soft 3–2 Downshift

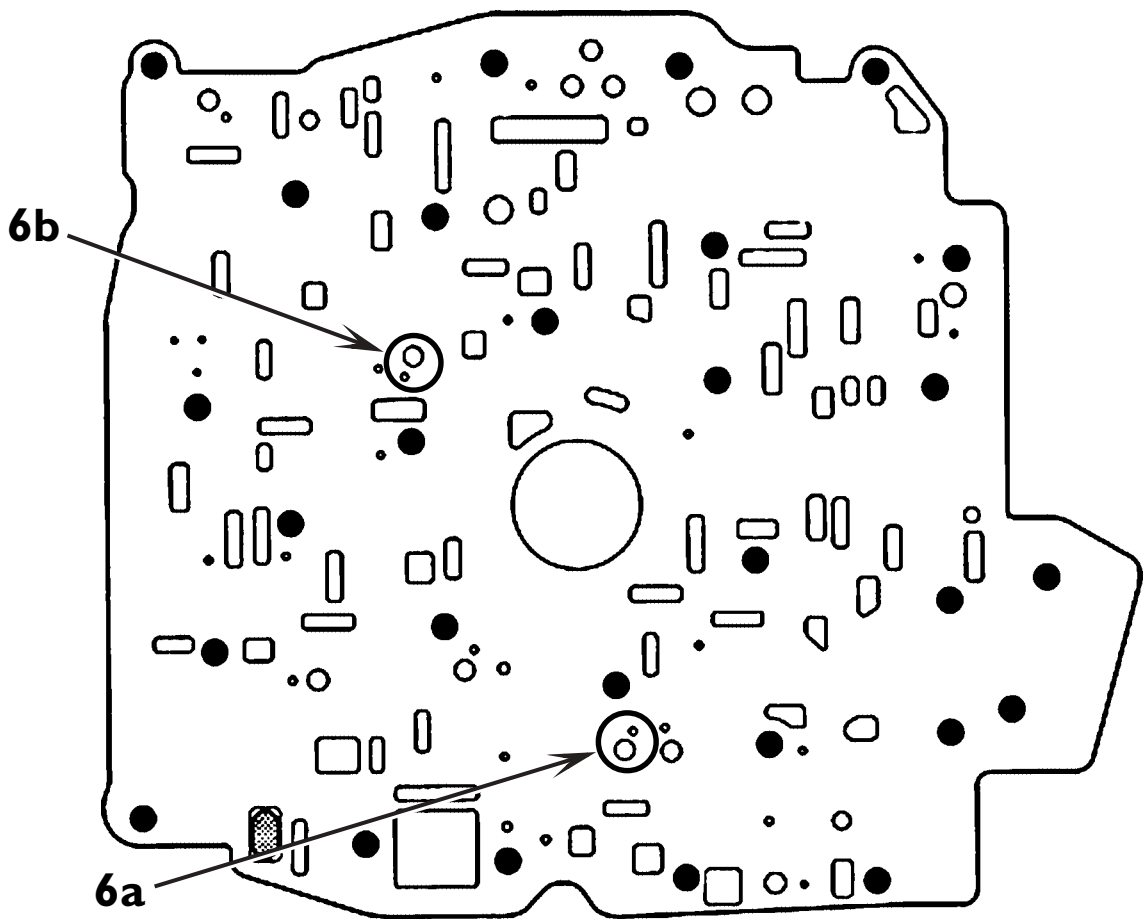
Depending on the configuration, these symptoms may be caused by a missing or mispositioned #6 checkball. As shown in the picture, the #6 checkball was moved from its original pocket (6a) to a different location in 1997, labeled 6b.



4T40E

Harsh or Soft 3-2 Downshift (continued)

The casting wasn't changed so unless you're certain of the year, the best way to tell which location to use is to look at the separator plate. For the checkball to function properly, there must be two holes in the separator plate.



If your plate is set up for both locations (which many were) you can install a checkball in either position. But in 6a the ball controls the drain rate of the direct clutch; in 6b the ball controls the drain rate of the 2-3 accumulator. Because of this, the 3-2 shift feel will be different, depending on the location.

- A checkball in location 6a will result in a softer 3-2 downshift.
- A checkball in location 6b will result in a firmer 3-2 downshift.

4T40E

Hard Upshifts with Possible Trouble Codes

The vehicle comes in suffering from harsh upshifts, and may have the malfunction indicator lamp (MIL) on. In addition, a number of codes may be stored in memory. This is primarily on Cavaliers, Aleros, Sunfires, Malibus and Grand Ams.

The most common codes are P0716 and P0717, which are turbine shaft speed sensor-related.

In most cases the problem is the transmission connector. What happens is the connector only gets latched on one side, creating bad connections on the opposite side. Depending on which pins have a bad connection, many intermittent diagnostic trouble codes will set.

To correct this problem, make sure the connector isn't damaged, and reconnect it properly. Clear any codes in memory, road test the vehicle, and check for any new codes. Remember to perform a complete drive cycle to give codes a chance to set.



4T40E / 4T60E

Intermittent Surge or Loss of Power

After operating the vehicle at fairly high throttle, suddenly it begins losing power or surging. The TCC may begin cycling off and on, and the transmission may even begin hunting between 3rd and 4th gears. The problem remains evident until the throttle drops back to idle, or maybe even until the engine's been shut off.

The problem is restricted to 1998 N-body (Grand Am, Achieva, Skylark) and U-body (Transport, Lumina, Venture and Silhouette) vehicles equipped with a V6 engine.

The problem usually traces back to part of the isolation tape (a heavy rubber tape used in the radiator core support area) losing its adhesion. The tape becomes loose, and the high air flow through the engine air intake pulls the end of the tape into the air intake.

This restricts the flow of air going into the engine, and past the mass airflow sensor (MAF). The engine loses power due to the restriction, and the computer receives a low reading from the mass airflow sensor. The low reading indicates the engine is under less of a load, so the computer adjusts engine performance and gear ratio accordingly.

Once you release the throttle or shut the engine off, the tape falls back out of the air intake, and the engine can run properly again... until the next time the tape gets sucked into the air intake.

Remove the loose piece of isolation tape.

4T60E

Hard Upshifts

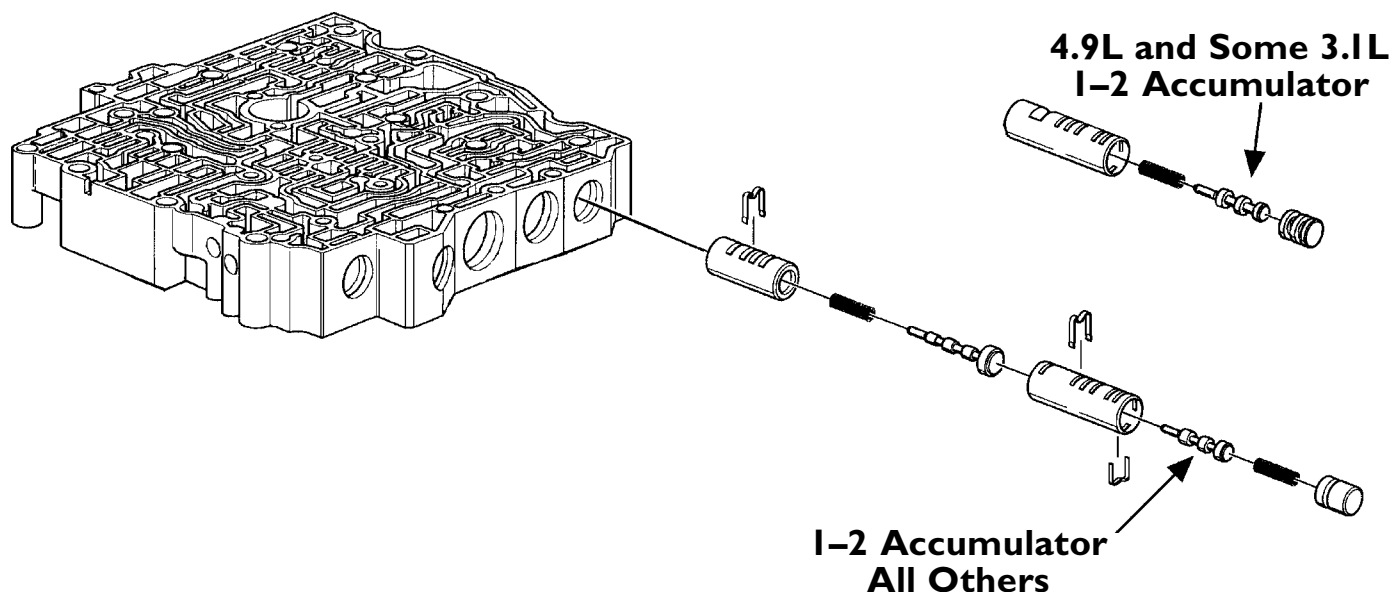
Vehicles equipped with a 4T60E transaxle may experience harsh upshifts for one or more of these reasons:

- A sticking accumulator valve — Clean and inspect the valve body.
- A sticking accumulator piston — Scotchbrite™ the bore and use a factory quality seal.

In addition, a missing, loose or mispositioned accumulator sleeve retainer will cause the sleeve to become misaligned with the valve body ports.

The bushing retainer was changed at the start of production for 1993. The 93-and-later retainer won't interchange with earlier models. The picture shows the two applications.

IMPORTANT All 4.9L and some 3.1L applications have a specific, unique 1-2 accumulator valve-and-spring line up, different from other 4T60E applications. Never assume that these applications have a harsh shift due to misassembly. The service manual may show the incorrect assembly for these applications. The picture shows the correct assembly for these applications.



4T65E

Moan after TCC Apply

Some 4T65Es may exhibit a moan or growl after TCC applies. The noise is generally worse at lower road speeds, just as TCC applies. Overriding TCC by stepping on the brake will usually eliminate the noise.

The problem is that a specific harmonic frequency is set up in the cooler line when TCC applies. The harmonic is transferred through the cooler lines and into the vehicle body.

Many manufacturers correct this type of problem by providing tuned cooler lines. Check with your local dealer to see if updated cooler lines are available for your particular application.

If an updated line isn't available, install the updated cooler line retaining bracket, #25714015. This bracket mounts to a support bar just behind the passenger-side cooling fan.



4T60E / 4T65E

Speedometer Reads MPH/KPH at a Stop

A number of 1997-98 G, C, H and W bodies (Riviera, Aurora, Park Ave, Lumina, Monte Carlo, Regal, Grand Prix) have been showing up with the speedometer showing the vehicle is moving... while it's fully stopped.

This is usually due to EMI (Electromagnetic Interference) being induced into the VSS wiring. The problem is that the VSS wires are routed too close to high voltage or high current wires.

Probable sources:

- Fuel injector wiring
- PCS (Pressure Control Solenoid) 4T65E only.
- Secondary ignition wires (spark plug and coil wires).
- Charging system. Try disabling the alternator and retest.

To correct this problem, reroute the VSS wires to the computer. Move them away from any source of interference.



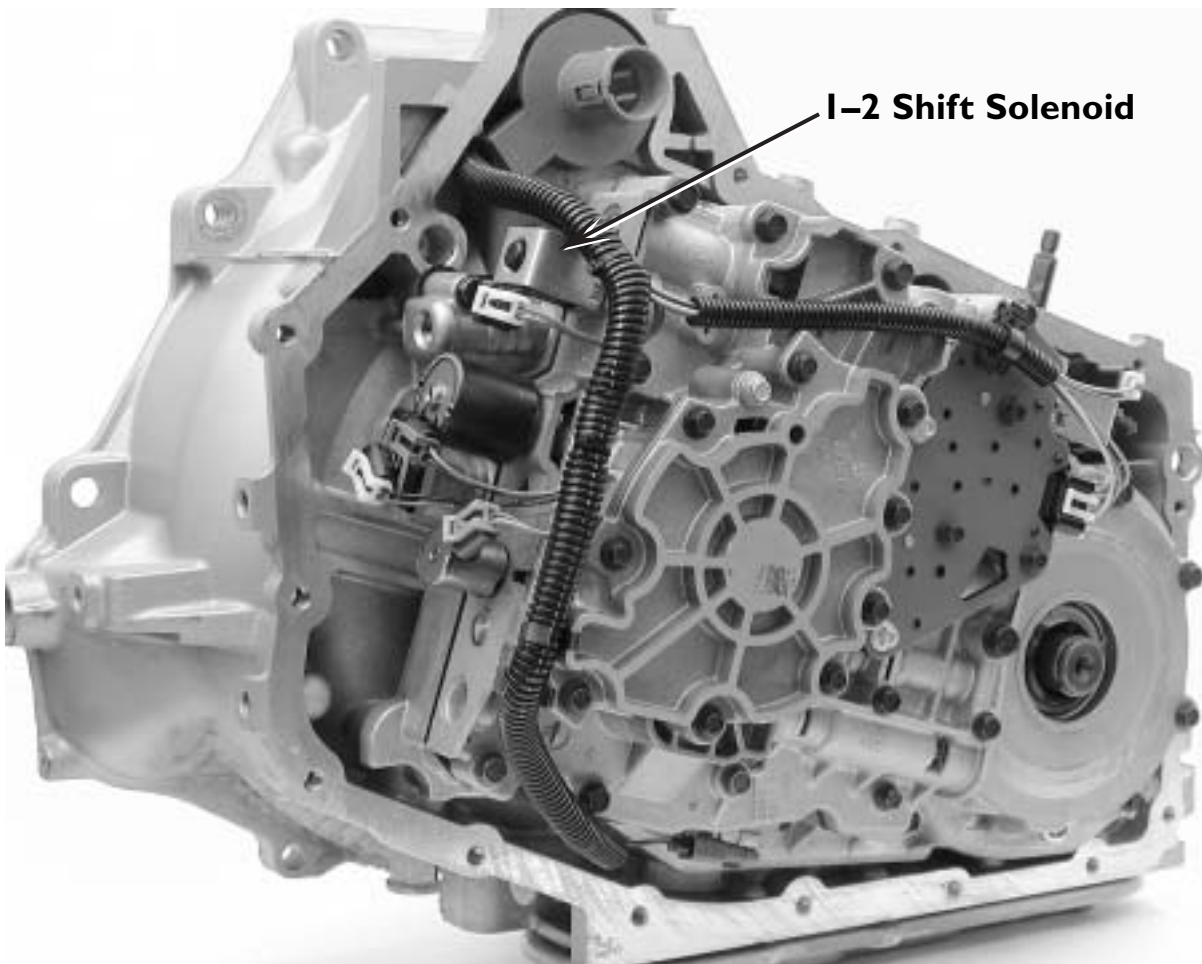
4T65E

Slip or Flare During 1–2 or 3–4 Upshift

1999–2001 vehicles with a 4T65E transaxle may exhibit a slip or flare on the 1–2 shift. This usually occurs during cold temperatures and disappears after the transmission reaches operating temperature. It may also slip or flare on the 2–3 upshift.

The 1–2 shift solenoid ball and seat may distort with changing fluid temperature, causing a leak when the solenoid is supposed to be closed.

To correct this problem, replace the solenoid with an updated one, part number 24219819.



4L60E

Engine Surges or Chuggles When TCC Applies

Many 1996–1997 C, K and G trucks and vans have been experiencing a surge or chuggle, especially when the converter clutch is applied.

Here's a list of the possible causes for this problem:

- Driving conditions: Wind, rough roads; speak with the customer about other possible adverse driving conditions; verify the complaint.
- Drive train: Inspect the tires for abnormal wear patterns, check driveshaft, wheel bearings, ball joints, bushings and other drive train components for wear.
- TCC apply: Use a scan tool to check for excessive converter slippage. Does the converter clutch have a smooth apply?
- Engine accessories: Check all belt-driven components. Turn off A/C heater system to eliminate the A/C clutch cycling from being a possible cause.
- Engine: Check for vibrations caused by out-of-balance components, such as the flywheel, harmonic balancer, bent pulleys, etc. Monitor engine misfire counters with a scan tool. Ignition or fuel problems can cause engine surges or misfires that are amplified when the TCC applies.
- Engine Calibration: Use a scan tool to make sure the latest engine calibration software has been installed.

Revised Calibrations:

If none of the conditions listed are present, and the engine calibration is the latest version, you may need to install the latest transmission calibrations.

Check with your local dealership for the latest calibration.

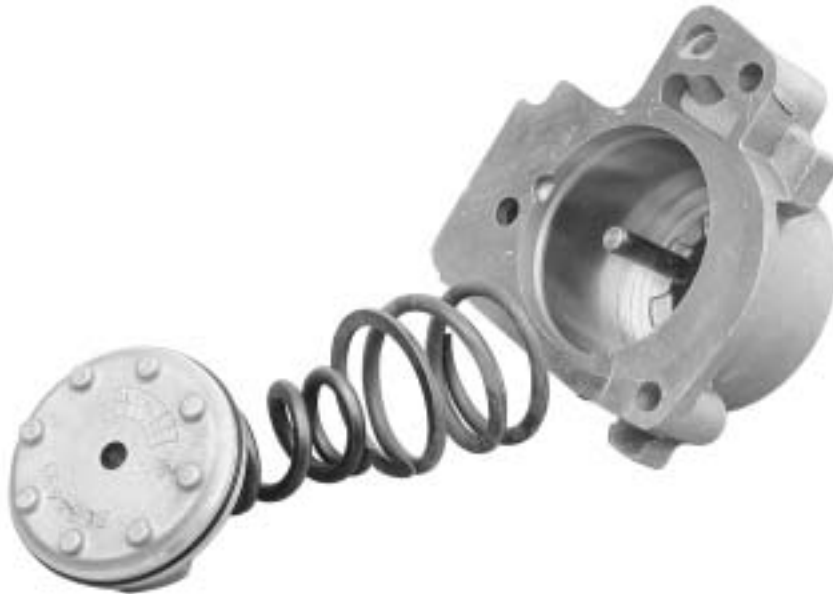
4L60E

2nd Gear Starts; Binds in Manual Low

There are three common causes for 2nd gear starts or a bind in manual low on a 4L60E transmission:

- Broken 1-2 accumulator, commonly caused by a broken spring
- Defective or worn 1-2 accumulator seal
- Worn or defective 1-2 accumulator pin or pin bore

To prevent this from occurring, replace the 1-2 accumulator springs during every rebuild.



4L60E

Updates for 2000

3-4 Clutch Backing Plate

The backing plate of the 3-4 clutch was updated to prevent it from being installed upside-down. This update eliminated the chamfer on the backing plate.

You can use the updated plate with earlier model units. Three selective thickness plates are available for adjusting clutch clearance:

4.2 mm	24217453
5.6 mm	24217516
5.9 mm	24212461



4L60E

Updates for 2000 (continued)

New TCC PWM Solenoid

The TCC PWM solenoid was updated in 2000. This solenoid will retrofit to all units using a PWM TCC. You can identify this solenoid by its gray connector, and its snout is now molded plastic instead of steel. The reason for the update was to reduce the possibility of valve body bore wear.

TCC PWM Solenoid..... 24212690



Early Solenoid



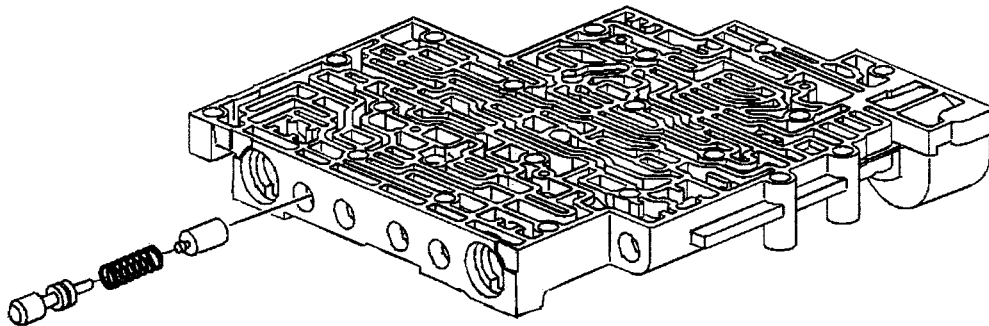
**Late Solenoid
w/Plastic Snout**

4L60E

Updates for 2000 (continued)

Updated Valve Body

Currently the most common 4L60E diagnostic trouble code is P1870 — Converter Clutch Slip. To correct this problem, GM has redesigned the TCC pressure regulator valve, isolator valve and spring. The valve lands are now longer to improve the support of the valve in the bore and to help reduce side-loading.



4L60E

Pump Interchange

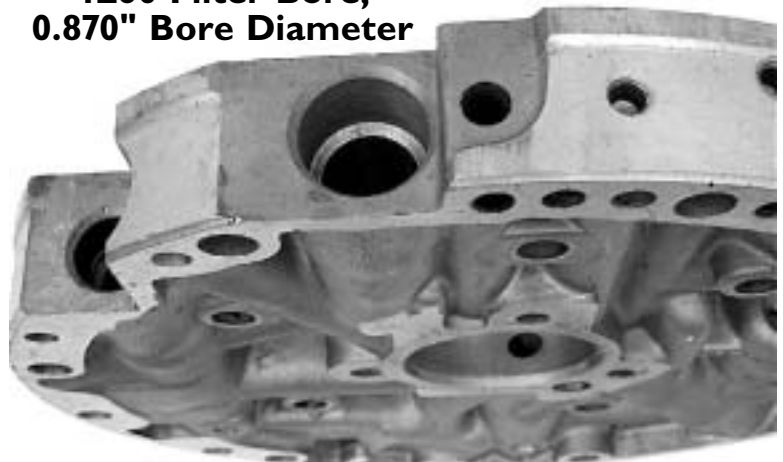
The non-PWM (pulse width modulated) pumps that were used only in the 93 to 94 model 4L60E are almost identical to the earlier 4L60 pumps. The main differences are the 4L60E pump stators don't have the D2 boost circuit drilled, and the bore for the filter is larger.

In fact, because the non-PWM pumps are becoming increasingly harder to find, some parts remanufacturers have been machining the filter bores of 4L60 stators to meet the demands. This works, if done properly, but there are a few more things you will need to do:

4L60 Stator



**4L60 Filter Bore,
0.870" Bore Diameter**



4L60E

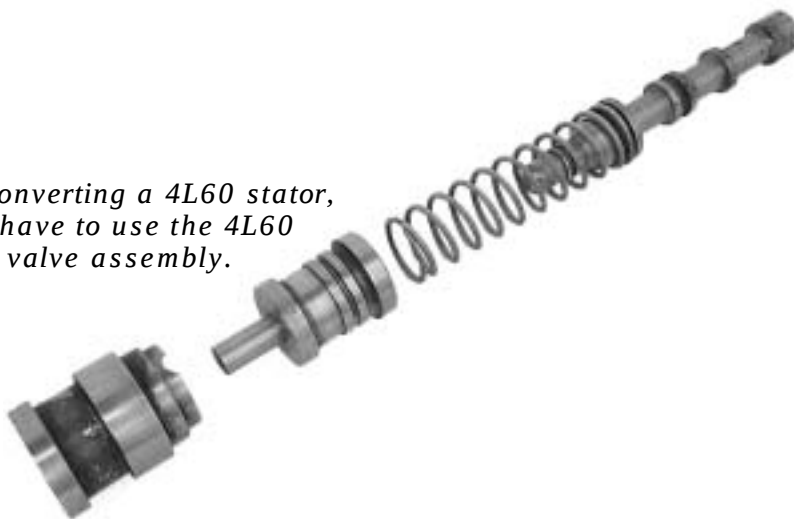
Pump Interchange (continued)

**4L60E Filter Bore,
0.970" Bore Diameter**



4L60E Stator

*When converting a 4L60 stator,
you'll have to use the 4L60
boost valve assembly.*

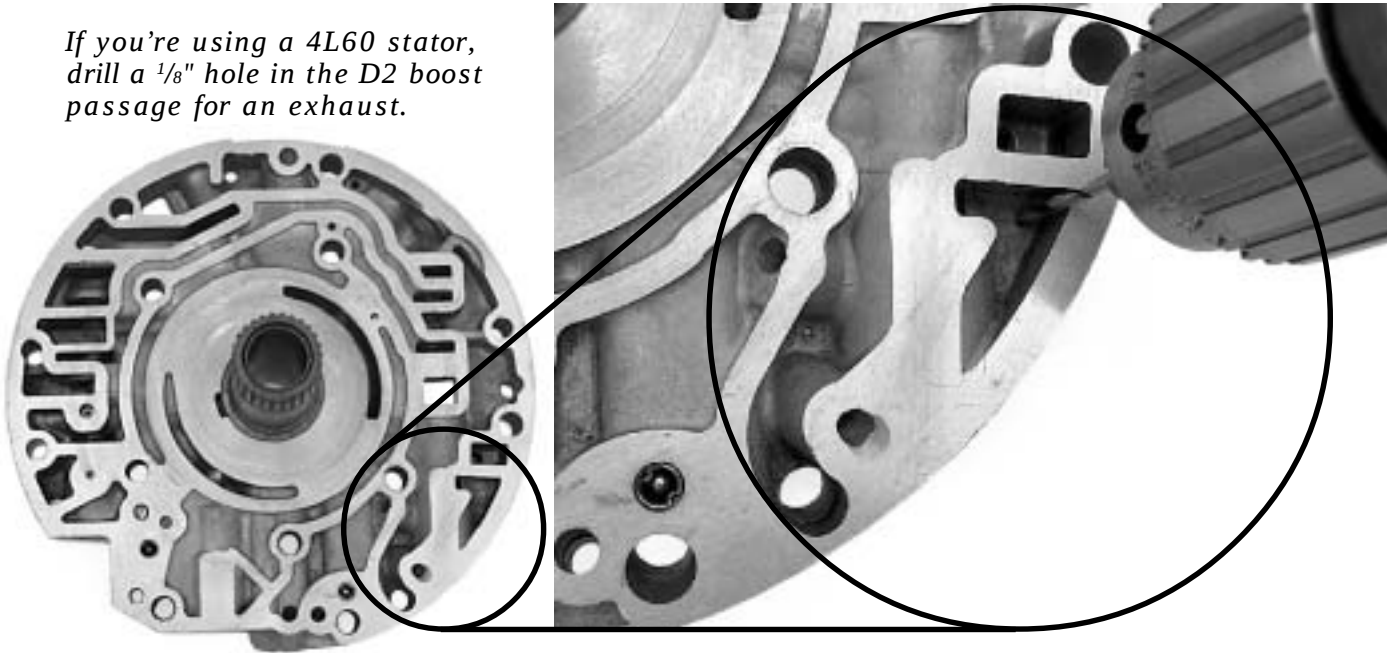


4L60E

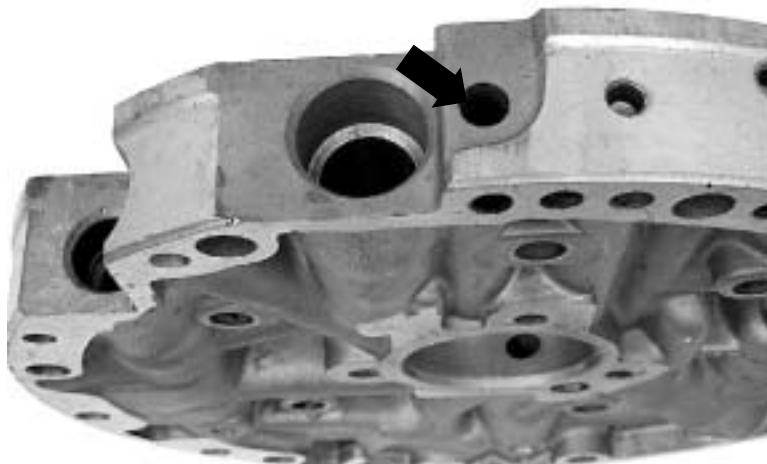
Pump Interchange (continued)

Make sure the D2 boost circuit has the necessary exhaust: Drill a vent hole about $\frac{1}{8}$ " diameter in the D2 boost passage.

If you're using a 4L60 stator, drill a $\frac{1}{8}$ " hole in the D2 boost passage for an exhaust.



If the stator was from a unit with an auxiliary valve body, plug the forward feed tube passage.



If you're using the stator from a unit with an auxiliary valve body, plug the forward feed tube passage.

4L60E

Pump Interchange (continued)

Does this sound like a can of worms just to replace a pump? Actually, the only reason we're covering this is in case you receive a rebuilt pump that was converted from a 4L60. We want you to know it *can* work, and show you what to check to make sure it *will* work.

There is a much easier way to replace a bad pump in a non-PWM 4L60E:

When GM introduced the PWM lockup system in 1995, the pump body and stator castings were redesigned.

But you can use a complete PWM pump assembly in the 93 and 94 non-PWM transmissions without any modification. The difference between the PWM and non-PWM pumps is that converter charge now feeds directly from mainline, which is the same thing that happens when a technician grinds the center land of the pressure regulator valve for the commonly-used "line-to-lube" modification.

CAUTION Never try to mix the halves from a PWM and a non-PWM assembly. A complete PWM pump assembly will work in a non-PWM transmission. But a non-PWM pump won't work in a PWM transmission.

The circles show where to look for the most obvious differences.



Non-PWM Stator



PWM Stator

4L60E

Pump Interchange (continued)

The circles show where to look for the most obvious differences.



Non-PWM Pump Body



PWM Pump Body

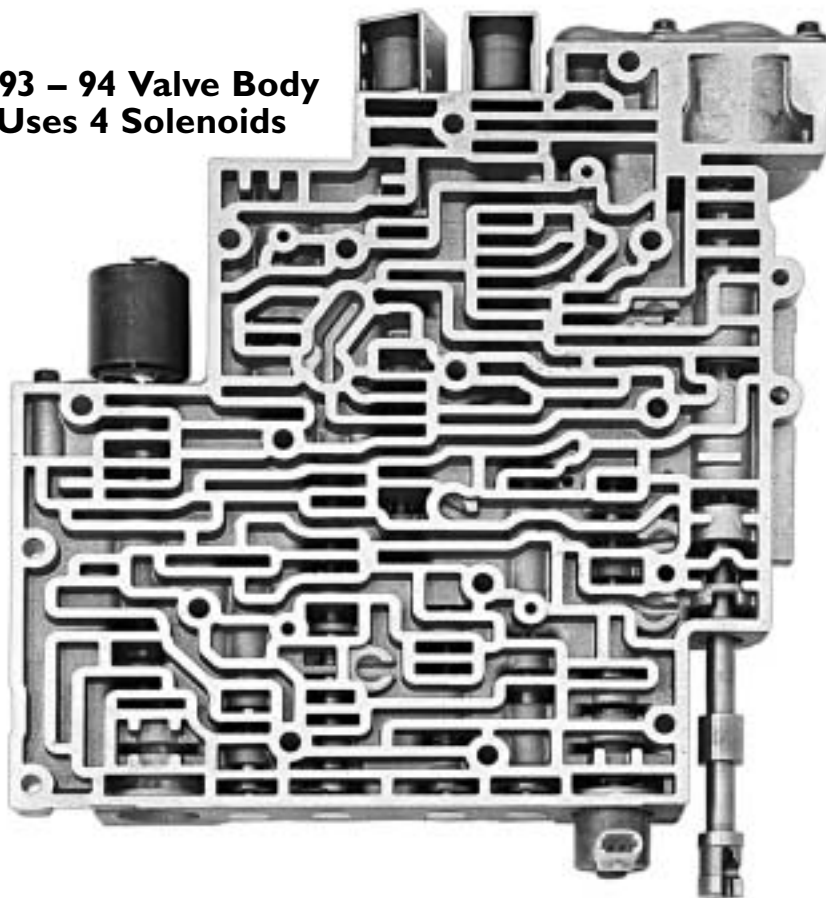
4L60E

Valve Body Changes

There are three basic versions of 4L60E valve bodies.

In 1993 and 1994 the 4L60E used a non-PWM converter clutch, which was the same as the one used on the 4L60. These valve bodies used 4 solenoids.

**1993 – 94 Valve Body
Uses 4 Solenoids**



4L60E

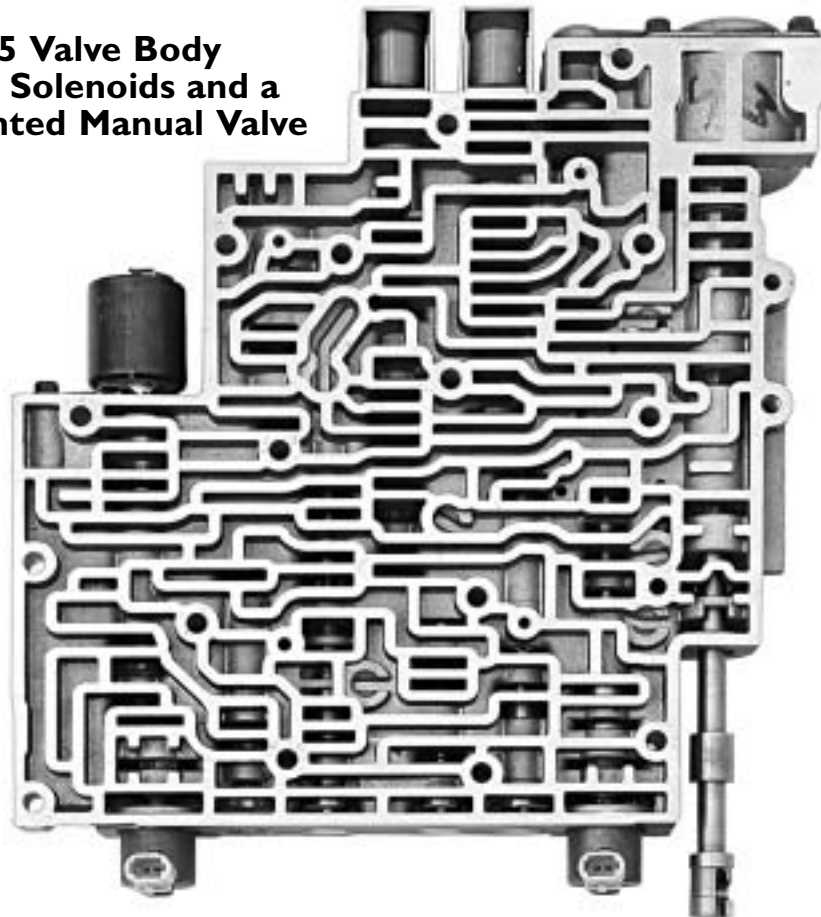
Valve Body Changes (continued)

In 1995, GM introduced the PWM converter clutch to the 4L60E. These valve bodies are exactly the same as the non-PWM valve bodies, except:

- they have an additional solenoid.
- the separator plate is different.
- they have a converter clutch regulator valve instead of a signal valve.

You can interchange these valve bodies with the earlier, non-PWM valve bodies as long as you swap the valves assembly and separator plate, and add the PWM solenoid.

**1995 Valve Body
Uses 5 Solenoids and a
Non-Vented Manual Valve**



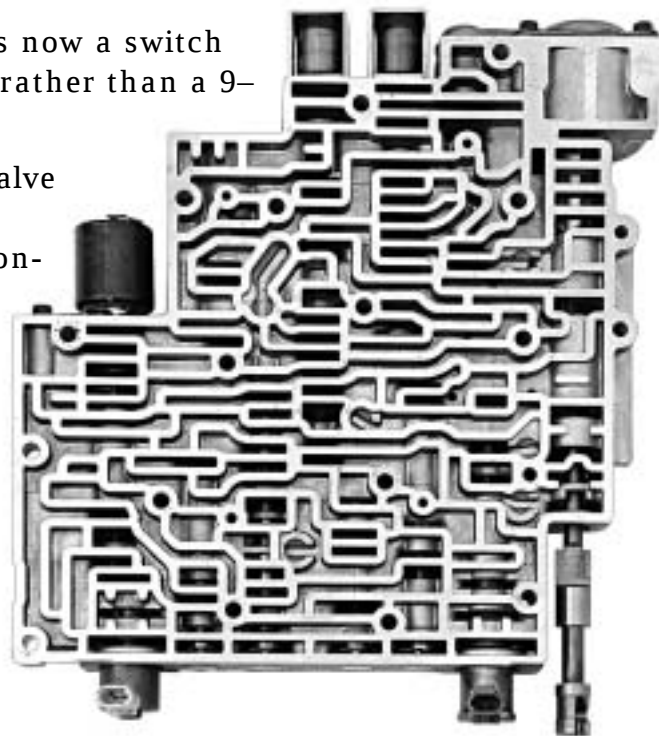
4L60E

Valve Body Changes (continued)

In 1996, GM modified the 3-2 control valve; it's now a switch valve, and uses a 19-24 ohm, on/off solenoid, rather than a 9-14 ohm PWM solenoid.

These valve bodies also use a *vented* manual valve bore. This provides a vent for the low/reverse clutch circuit while in the D4 range. Earlier, non-vented valve bodies trapped this circuit — any foreign oil in the circuit could apply the low/reverse clutch.

You can't benefit from this new vent by installing the manual valve on earlier valve bodies. The valve will work, but no differently than earlier valves. If you use an earlier manual valve on vented valve bodies,



**1996 – On Valve Body
Uses 5 Solenoids and
a Vented Manual Valve**

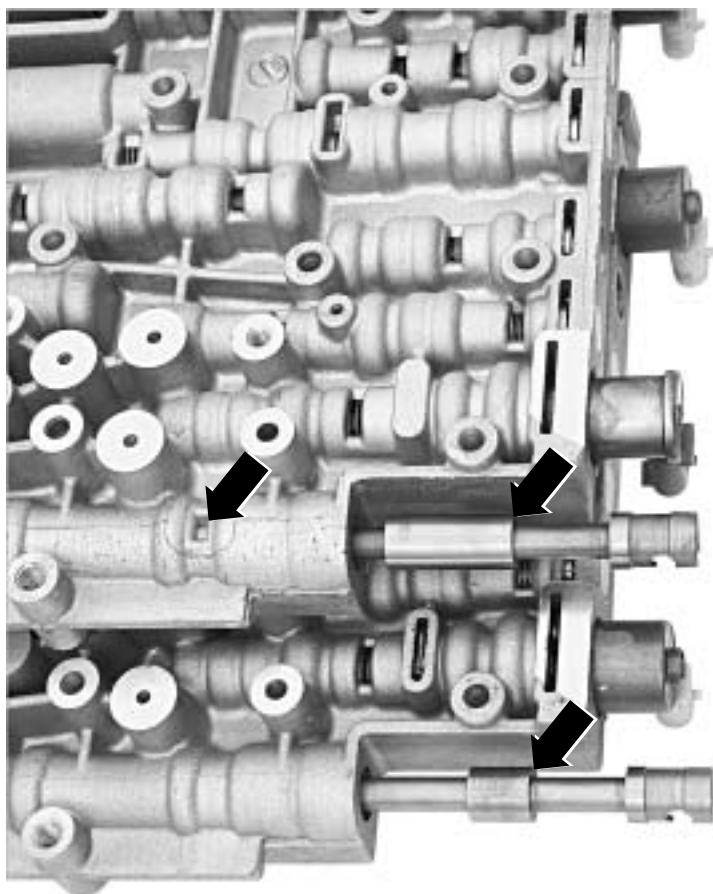
you'll lose all line pressure through the vent when the shifter is in park.

The separator plate for 1996-and-later valve bodies is different than both earlier plates.

Late (Vented)

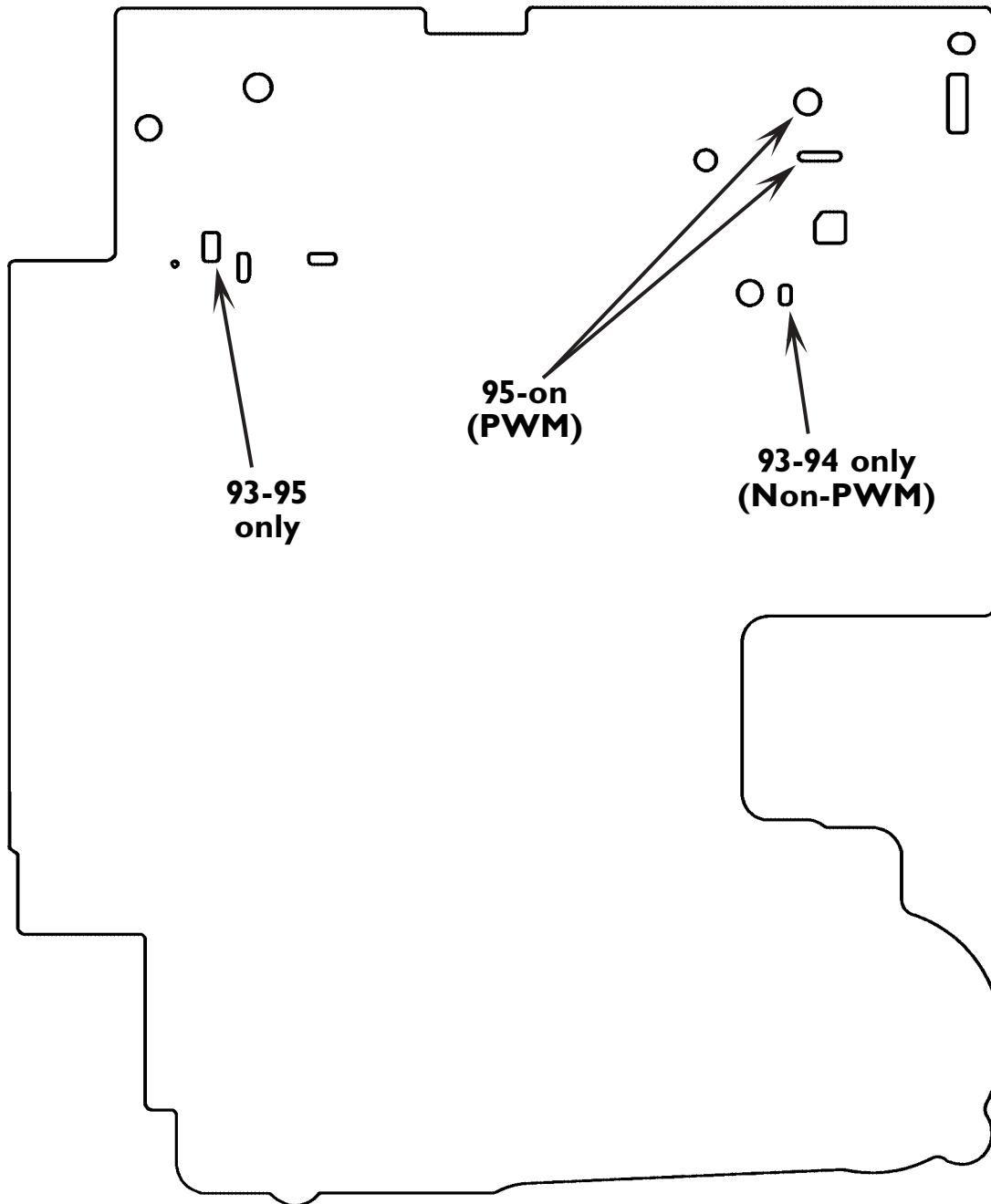
The vented manual valve has the longer second land. But it only provides a vent for the low/reverse clutch circuit when used with the vented valve body (arrow).

Early (Non-Vented)



4L60E

There are three different separator plates made for the 4L60E. Use this picture to identify which separator plate you have.



4L60E HD

2001 Models

Identification

- Model Tag: 1KZD
- RPO Code: M32

The 4L60E HD appears in sport utility vehicles with the 6.0L engine; these include the Grand Suburban, Denali, Denali XL, Centennial pickup, Yukon-XL and 2002 Cadillac Escalade.

New Features

- 5-pinion carriers made of powdered metal and assembled with bronze, bat-wing washers to support each pinion.

Reaction Carrier: Part # 24218069

Input Carrier: Part # 24218063

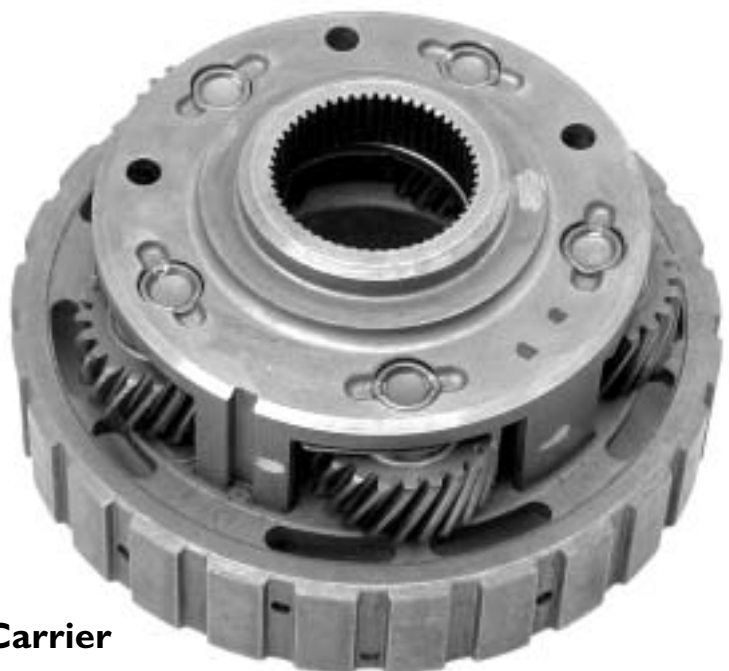
- Heavy duty sun shell and sun gear.

HD Sun Shell: Part # 24217145

HD Sun Gear: Part # 24218234

- A new, heavy duty output shaft that has been stress relieved through a shot-peening process during manufacturing, to increase durability.

HD output shaft: Part #24217157



Reaction Carrier

4L60E HD

2001 Models (continued)

- Thinner 3–4 frictions to make room for an extra clutch without changing the design of the input housing. Instead of six frictions, the drum now holds seven.
- Improved input and reaction shell thrust bearings were added to handle the increased thrust loads.
- Induction hardened turbine shaft. Induction hardening relieves internal stress and increases shaft strength.
- Heat-treated stator support splines reduce the tendency to strip under extreme loads. Aluminum bushings are used because they can handle higher loads than bronze.
- A heavy duty low roller clutch, with large rollers and an enhanced housing for increased load capacity.

Low Roller Clutch assembly (plate kit w/rear piston, steels, center support and roller clutch): Part # 8687996



Features Carried Over from 4L60E

- ECCC (Electronically controlled capacity converter clutch)
- Adaptive shift control
- Abuse and shift torque management.
- Shift stabilization
- Second gear starts in manual 2
- Tow/Haul mode
- Service transmission monitor

4L60E / 4L80E

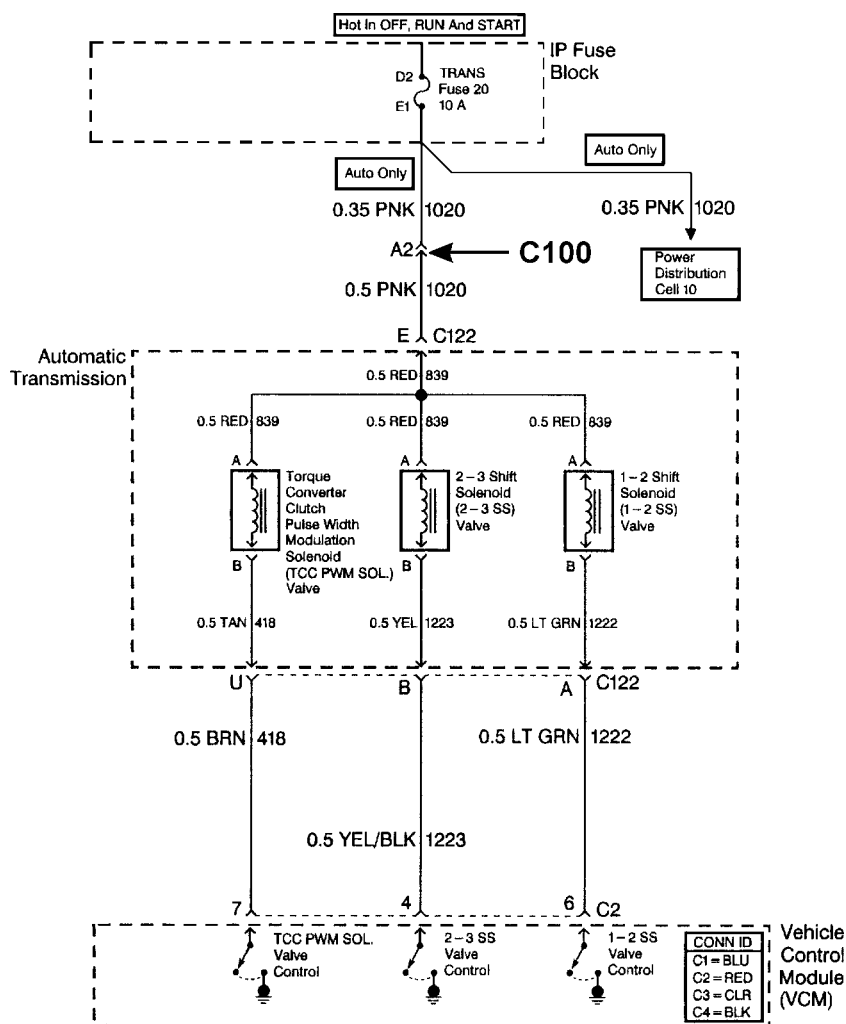
Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860

4L60E/4L80E transmissions may exhibit any or all of these trouble codes and driveability problems:

- P0740 — TCC Solenoid Electrical Fault
- P0753 — 1-2 Solenoid Electrical Fault
- P0758 — 2-3 Solenoid Electrical Fault
- P0785 — 3-2 Solenoid Electrical Fault
- P1860 — TCC PWM Solenoid Electrical Fault

- 4L80E applications fail to shift, or will drop into second gear intermittently. The customer may complain that the “vehicle is going to neutral at higher road speeds.”
- 4L60Es fail to shift and may drop or stay in 3rd gear when the shift lever is in the OD position.
- Any or all of these codes may set: P0758, P0785, P1860, P0753, P0740. If the problem is intermittent, the system may not set a code.

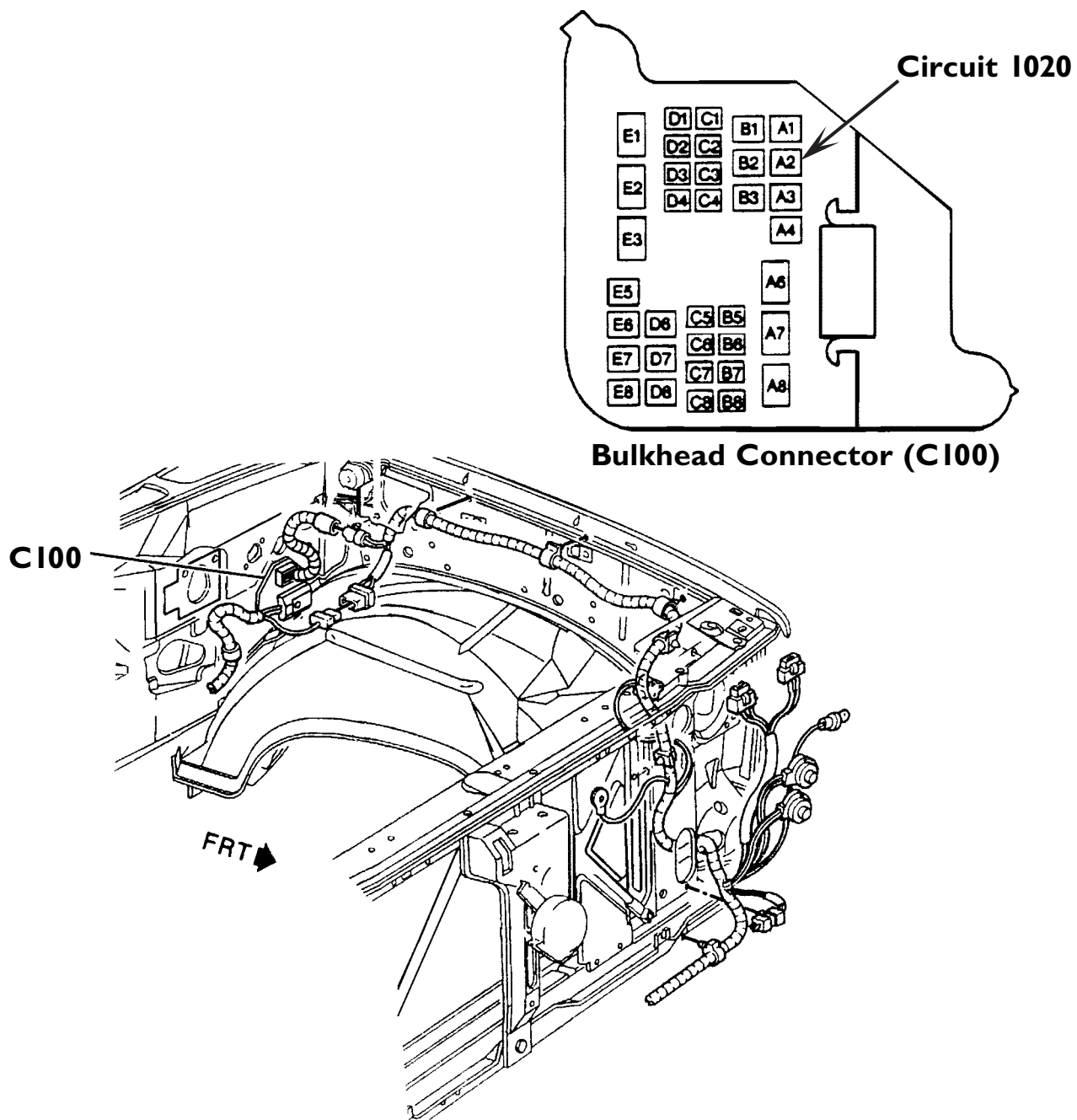
This problem is caused by a poor crimp on one of the terminals for circuit 1020.



4L60E / 4L80E

Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)

Generally the crimp problem is cavity A2 at the bulkhead connector or (C100) on later model applications at connector C2, pins E2 and F2 of the UBEC (Underhood Bussed Electrical Center, used on many trucks).

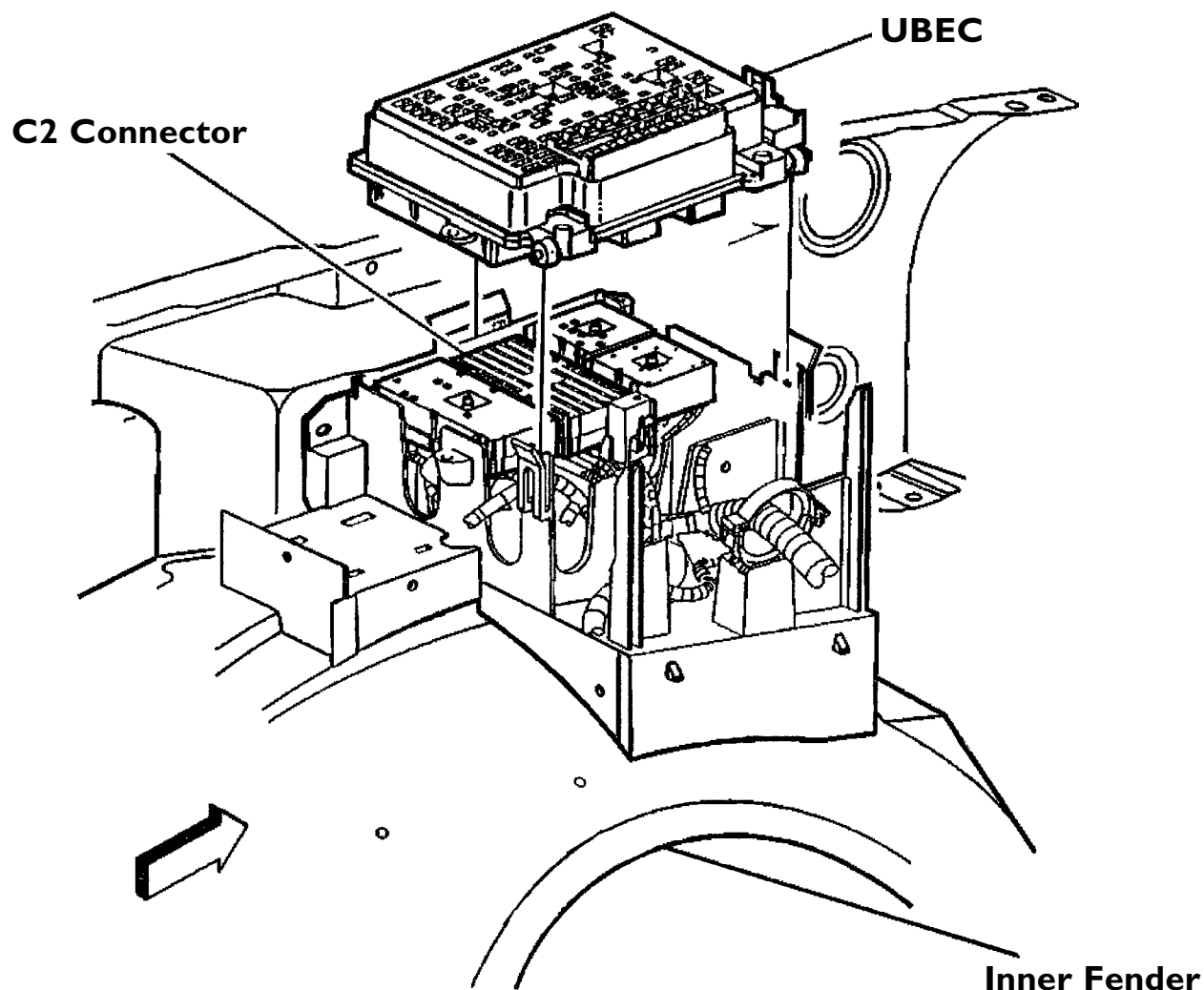


4L60E / 4L80E

Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)

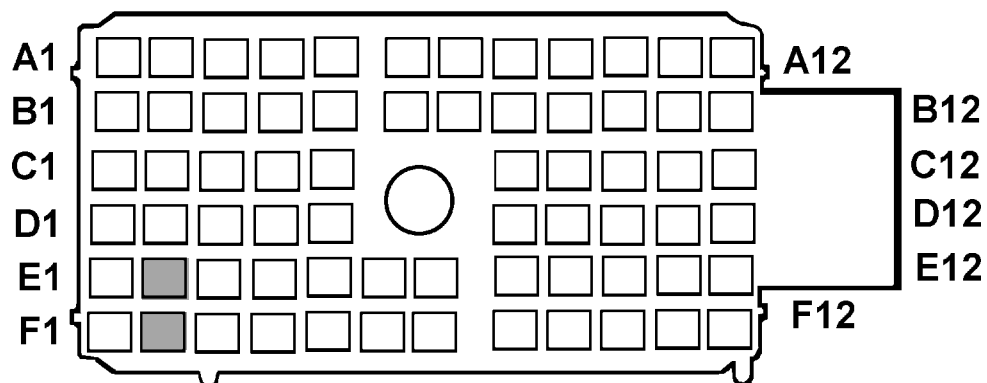
Starting with 1998 S-10 trucks and all other trucks and vans, GM began using the UBEC (Underhood Bussed Electrical Connector) rather than the simple bulkhead connector. The UBEC consists of several PC boards which connect a number of circuits, including the ignition switch to the transmission.

When the UBEC fails you'll lose power to the transmission, resulting in failsafe or transmission solenoid codes. Unfortunately, you can't repair the UBEC like you could the earlier bulkhead connector. Instead, you must either bypass the UBEC or replace it.

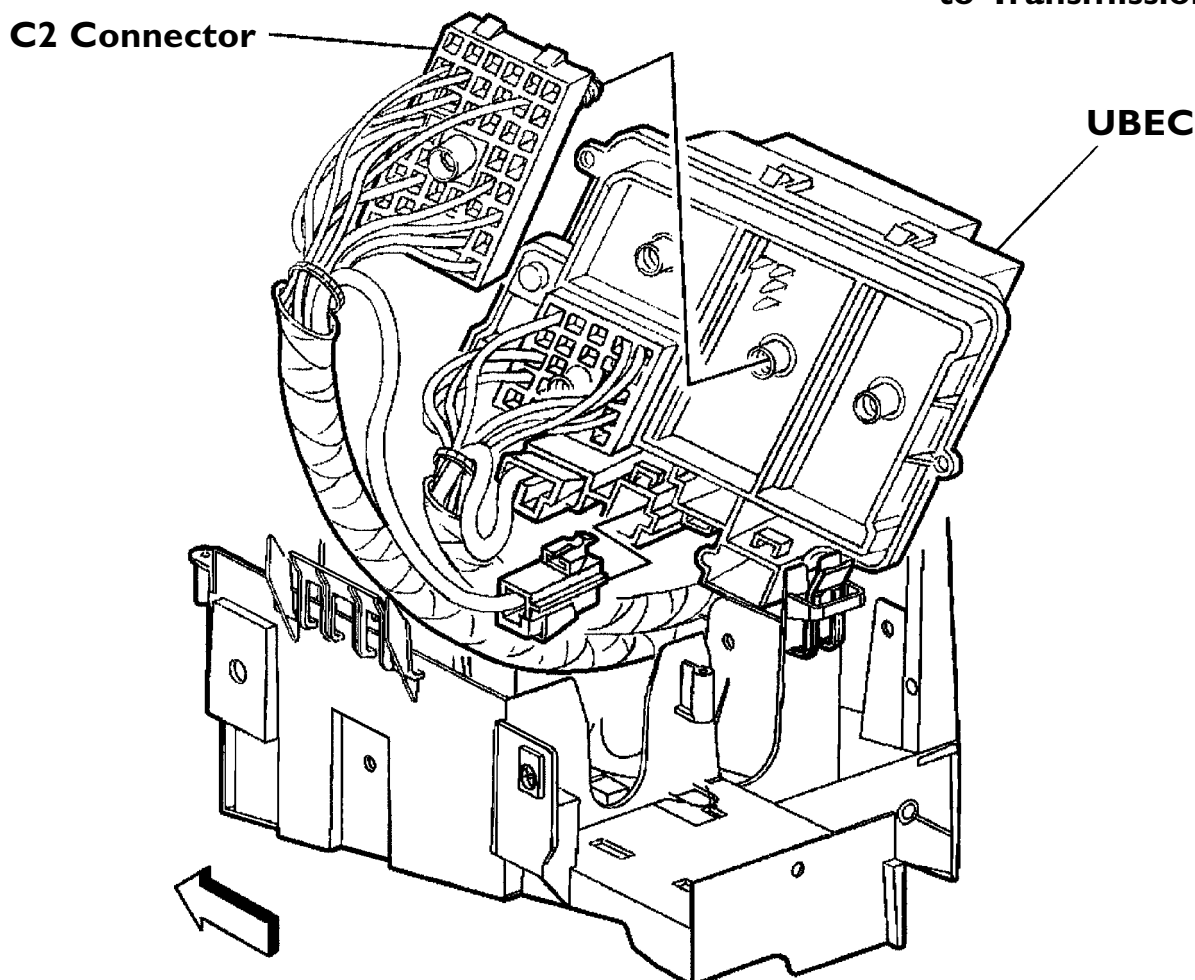


4L60E / 4L80E

Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)

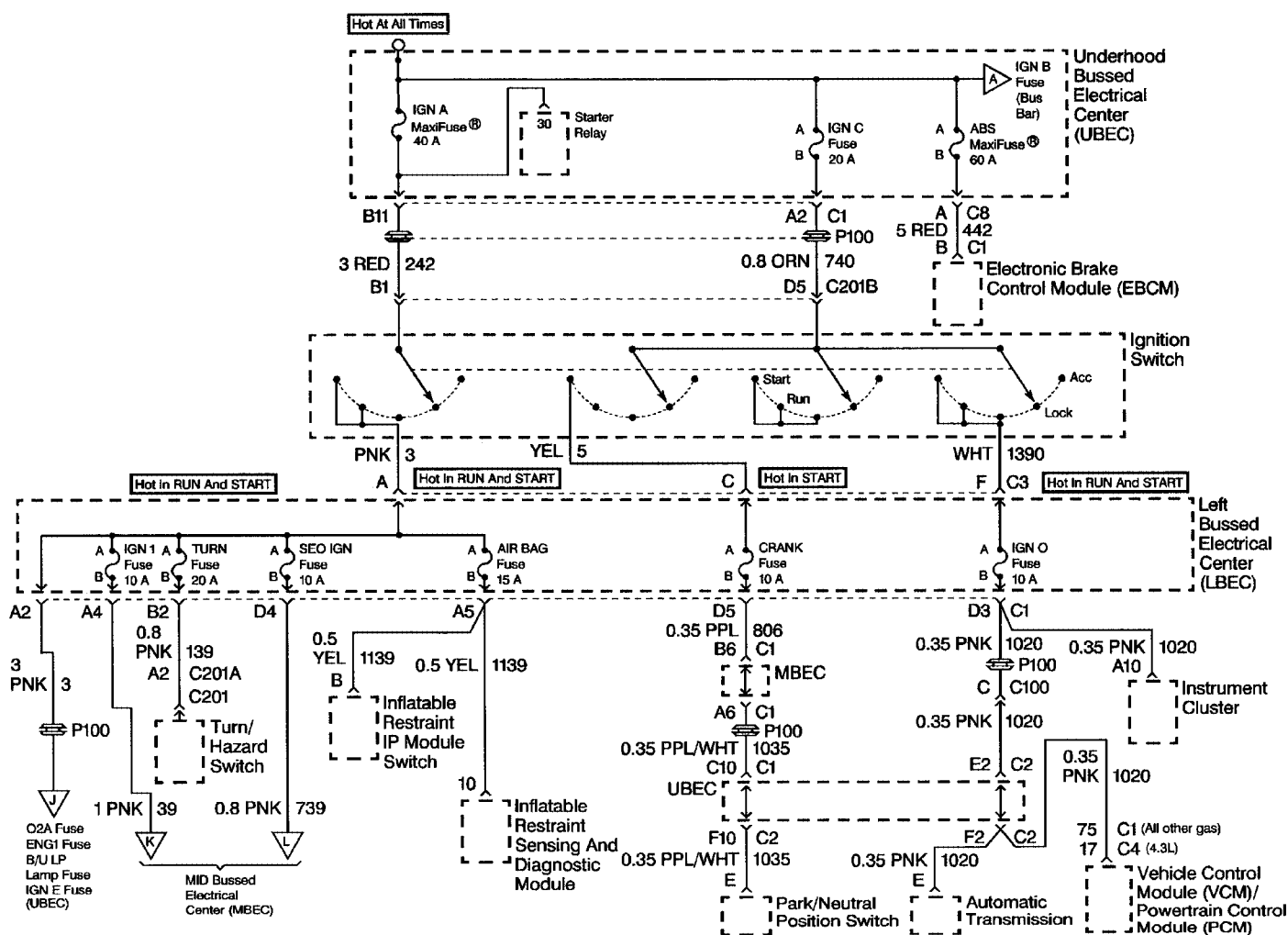


Terminal E2: Power to UBEC
Terminal F2: Power from UBEC to Transmission



4L60E / 4L80E

Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)



Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)



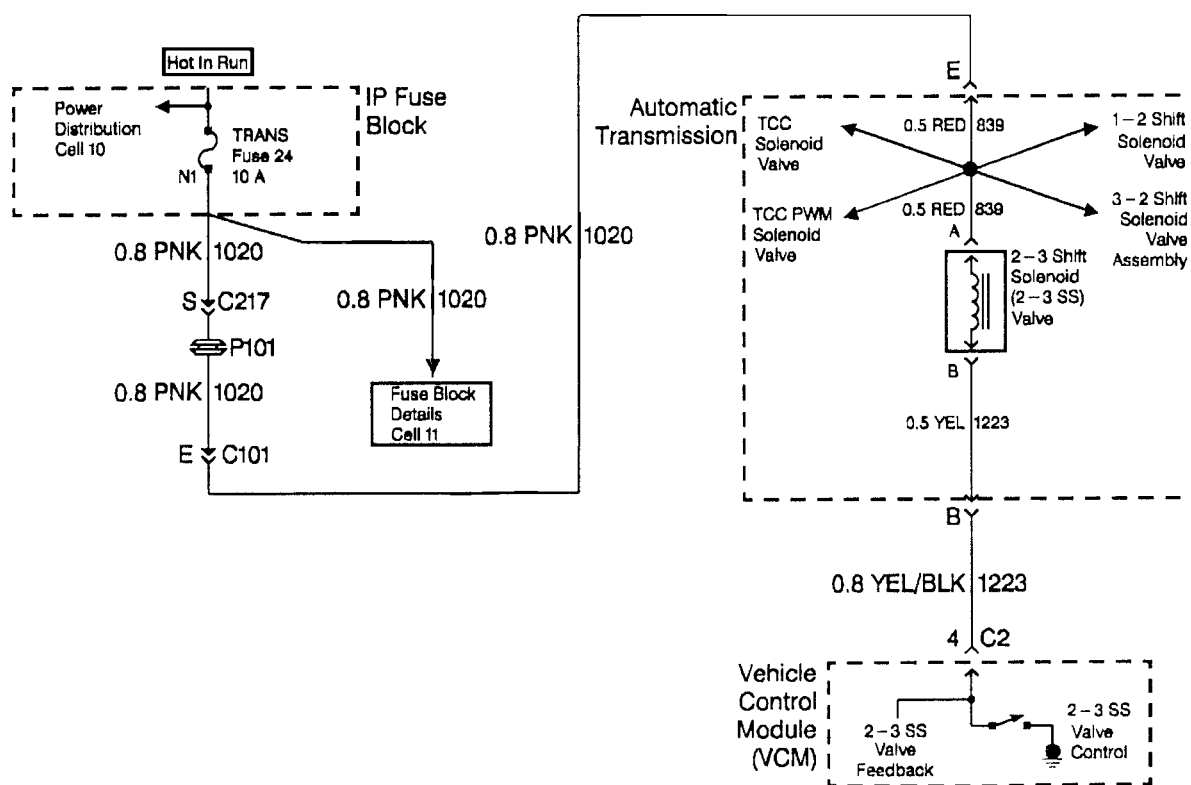
4L60E / 4L80E

Possible No Shifts or Codes P0740, P0753, P0758, P0785, P1860 (continued)

On VCM applications, if a code sets for only one or two solenoids or circuits, inspect the weatherpack seal at the VCM. You may find the seal is mispositioned, allowing water into the VCM connector. This may cause severe corrosion, which can degrade solenoid performance and cause codes to set. If corrosion is present, the VCM and the female terminals may require replacement.

The ignition switch is also a common source of any or all of these problems. This holds true for the redesigned, 3-contact ignition switches used on the S-10s.

To isolate this as a possible source of the problem, monitor pin voltage on circuit 1020 when the condition occurs. If the voltage drops below battery voltage, inspect the pins listed or the ignition switch for possible problems. If you find an open in the UBEC, you'll have to replace it, as it can't be disassembled and reassembled effectively.



4L60E / 4L80E

Delayed Engagements; Low Fluid Level

Some 4x4s with the 4L60E or 4L80E may experience delayed engagements, caused by low fluid level in the transmission. This could be due to external leaks, but in some cases may be caused by a leak in the seal that separates the transmission from the transfer case.

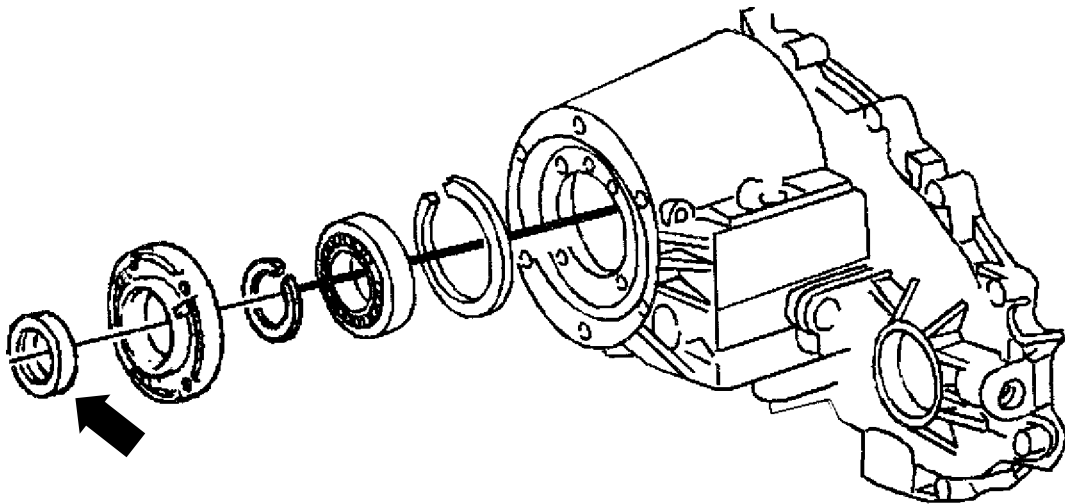
If you don't see any signs of major external leaks, check the transfer case fluid level: If it's high, the input shaft seal is probably the culprit.

Possible Causes:

- External leaks
- Damaged or improperly manufactured transfer housing input shaft seal: Check transfer case fluid level: If level is high, inspect the transfer case input shaft seal.

To correct the problem, examine the transfer housing input gear and bearing carefully. Replace any part that's worn or damaged.

Then replace the input shaft seal with part number 14095609. Remember to drain the transfer case, and refill with the proper fluid.



4L60E / 4L80E

Hard 1–2 Upshifts; 1999 Vehicles

Some 1999 vehicles equipped with the 4L60E or 4L80E transmissions may experience harsh 1–2 upshifts. This problem may be accompanied by one or both of these other problems:

- Hard 1–2 upshifts at heavy throttle.
- Shift may seem long with, a bump at the end.

One possibility for this problem may be a line pressure variation during the shift.

The correction is to reflash the VCM with an updated calibration. These calibrations include changes in the line pressure tables.

Calibration Update: Hard 1–2 Upshifts

Vehicle	Engine/Trans	Axle Ratio	Old Calibration Number	New Calibration Number
C/K 2500	6.0L/4L80E	3.73:1	16253293	16264187
		4.10:1	16253294	16264188
			16264138	16264205
			16264140	16264206
C/K 1500	4.8L/4L60E	3.42:1	16254164	16264165
		3.73:1	16254166	16264167
		4.10:1	16264200	16264243
	5.3L/4L60E	3.42:1	16264201	16264244
		3.73:1	16254202	16264245
		4.10:1	16246203	16264246

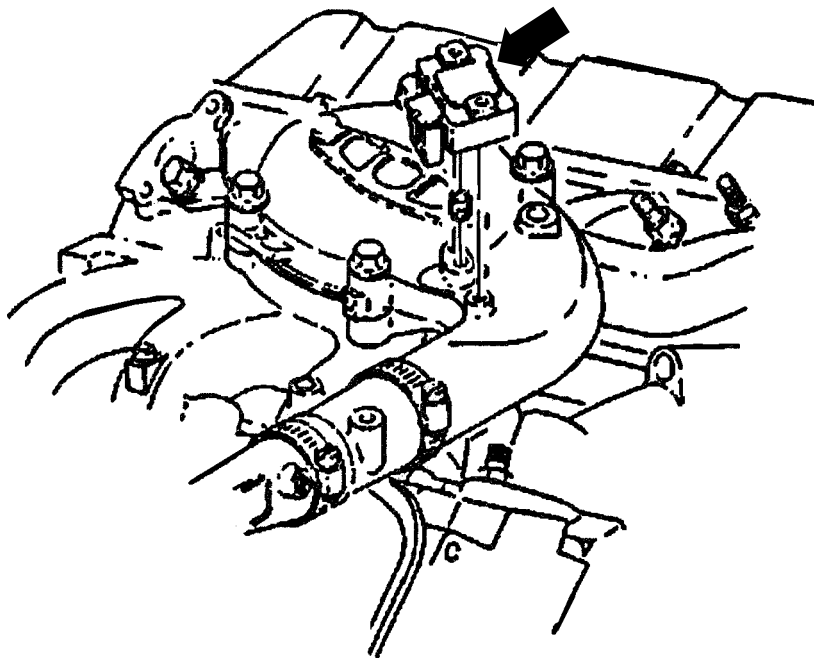
4L80E

Harsh Shifts, Possible DTC 63

Vehicles equipped with a 4L80E transmissions and diesel engines (mostly 6.5L models) may experience a harsh shift complaint. This may be accompanied by code 63 in memory. The problem could be the vehicle has the wrong (or a faulty) BARO/boost sensor.

Diesel applications use a BARO/boost sensor to determine altitude. Gasoline applications use a MAP sensor to determine manifold pressure. Although these sensors look identical, they're calibrated differently.

To correct this problem, install BARO sensor number 16006833 on diesel applications.



4L80E

Surge While Towing; 1996–1999 7.4L

A number of 1996–99 trucks with the 7.4L engine have been showing up with a surge while towing. Here are the symptoms you can expect:

- Vehicle surges only when pulling a trailer.
- How bad a surge varies based on vehicle speed, trailer weight, condition and type of suspension, and the trailer hitch location and configuration.
- Surge tends to reduce significantly or go away when the TCC releases.

To diagnose this problem:

- Monitor the MAP, MAF and TPS values with a scan tool while the problem is occurring. Look for fluctuations at steady throttle. If the MAP, MAF and TPS signals fluctuate under steady throttle, check for fuel- or emission-related problems such as EGR, fuel pressure, faulty or dirty injectors, and ignition problems.
- Monitor TCC slip and gear ratios.
- Inspect the trailer suspension and hitch for possible problems. Consider relocating the load in the trailer or relocating the position of the hitch (5th wheel applications).

If all other possibilities check out okay, a new calibration is available to change the TCC lockup speed. This will greatly reduce the surge. Use a scan tool to identify the current calibration and the chart below to select the proper calibration update.

Calibration Update: Surge While Towing		
Model Year	Old Scan Tool Calibration Number	New Scan Tool Calibration Number
1996	16227602	16241010
	16227603	16241011
1997	16243564	16241012
1998	16267332	16241013
	16216254	16241014
1999	16232743	16241015
	16232744	16241016

4L80E

2nd Gear Starts in Manual 2nd

A 1999 through 2001 vehicle equipped with a 4L80E starts in second gear when M2 range is selected.

This is normal operation: A calibration update was issued for the GMT800 Pickup/Suburban. To improve traction in slippery weather, the VCM was programmed to provide 2nd-gear-only operation in manual 2nd. This feature is identical to the 4L60E truck.

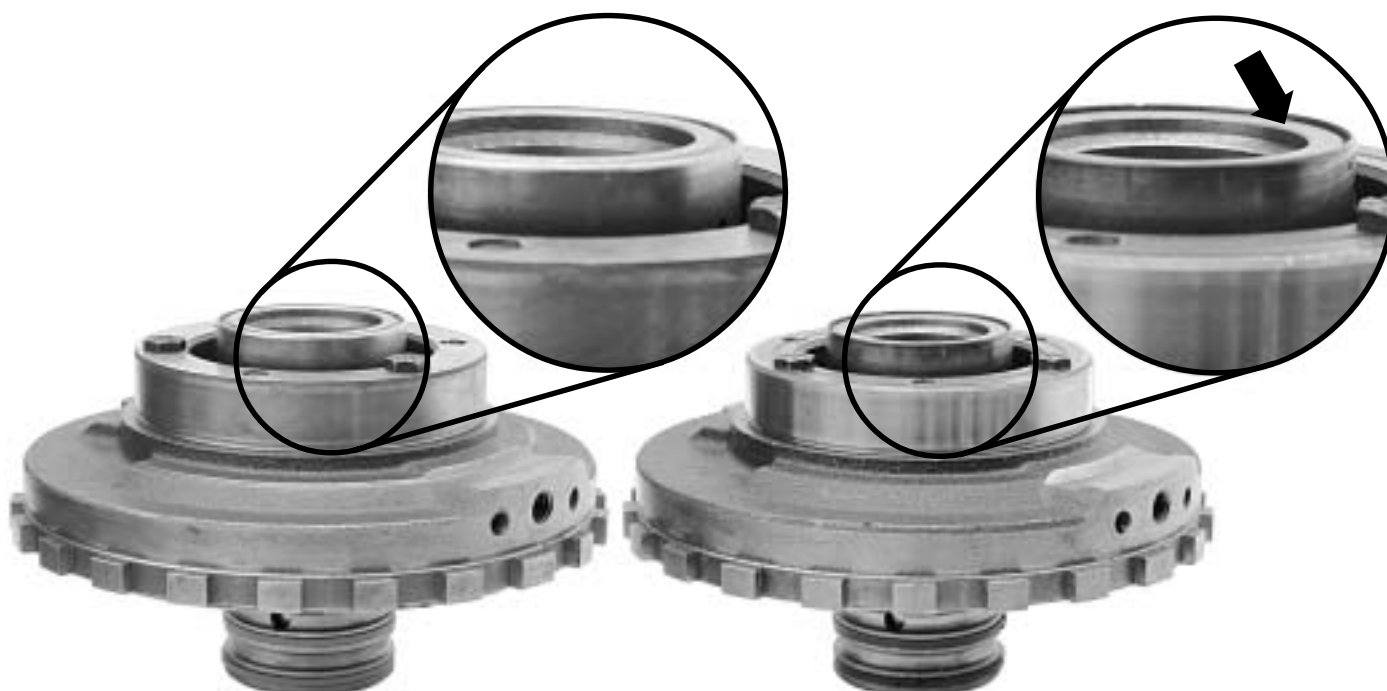
4L80E

1999-and-Later Center Support and Sun Gear Shaft Changes

In 1999, GM added a 0.041" shim under the rear ring gear bearing. This raised the height of the sun gear by 0.041".



To offset this difference, they made a 0.041" recess in the under side of the support, where the bearing race sits.



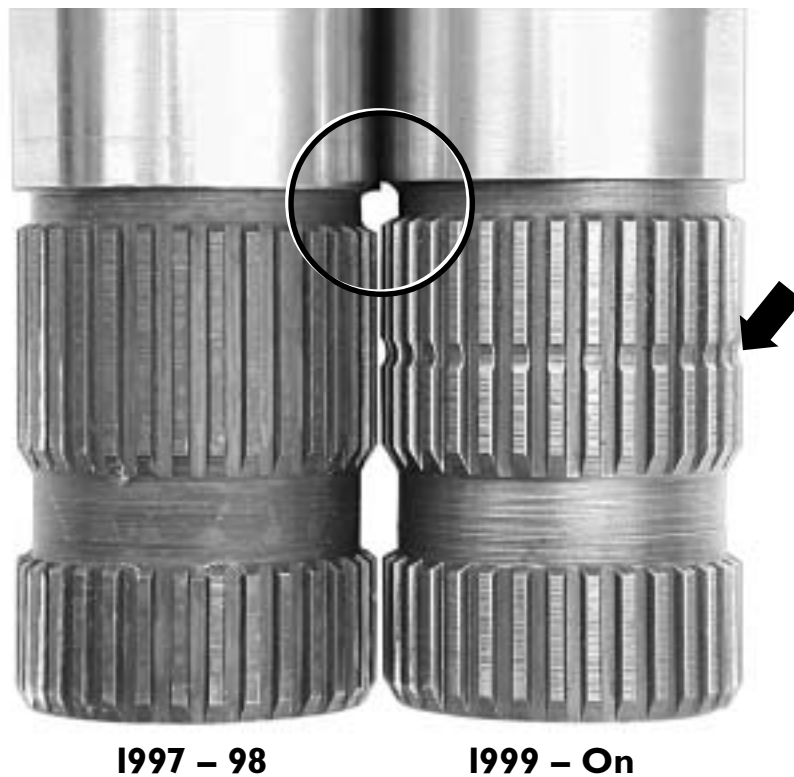
1997 - 98

1999 - On

4L80E

1999-and-Later Center Support and Sun Gear Shaft Changes (continued)

This also required a change in the sun gear shaft. The machined area that contacts the center support bushing is 0.041" shorter. The two tubes are easy to mix up, except that the 1999-and-later shaft has a machined groove in the splined area.



1997 - 98

1999 - On

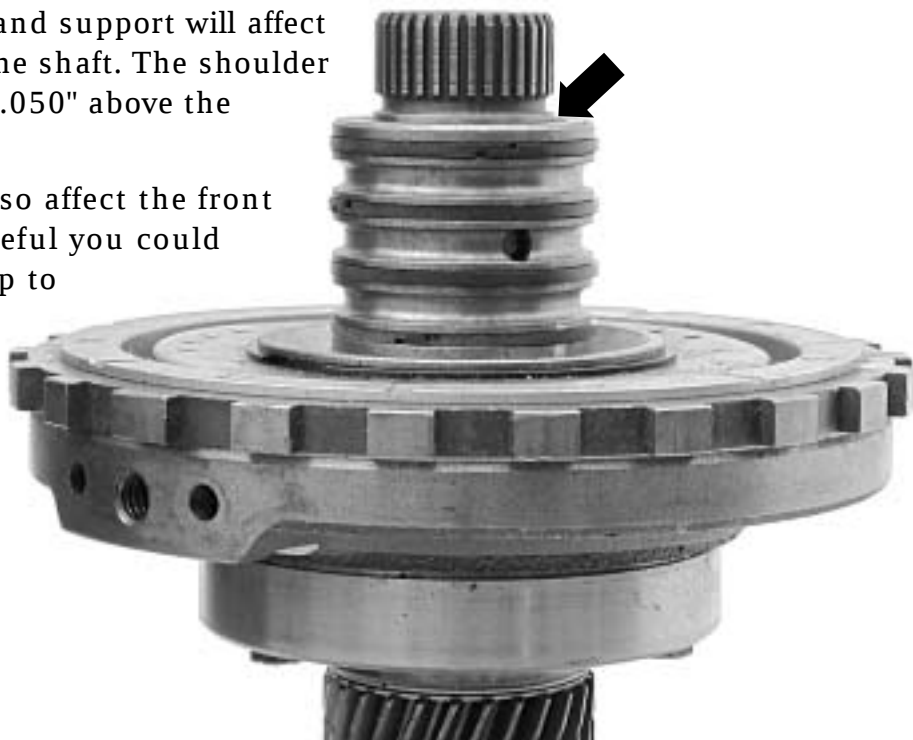
4L80E

1999-and-Later Center Support and Sun Gear Shaft Changes (continued)

You may interchange these components as a set but not individually. Obviously, if you omit the shim (or add it where it doesn't belong) you will affect the rear endplay.

Mixing up the sun gear shaft and support will affect the height of the shoulder of the shaft. The shoulder of the shaft should be about 0.050" above the center support ring tower.

Naturally, a mismatch will also affect the front endplay, but if you aren't careful you could change the shim on the pump to make up for it, without noticing the direct drum resting on the center support ring tower. You will notice it when it comes back.



Incorrect



**Late Shaft w/
Early Support
Shoulder is
almost flush
with the support**

Correct



**Matching Shaft
and Support
Shoulder is
about 0.050"
above support**

Incorrect



**Early Shaft w/
Late Support
Shoulder is
about 0.090"
above support**

Allison LCT 1000

Normal Operating Conditions

The Allison LCT 1000 appears in GM heavy duty applications equipped with 8.1L gas and 6.6L Duramax diesel engines.

Several conditions may be misdiagnosed as problems when in fact they are actually normal conditions, according to GM and Allison. Never attempt to repair any of these customer complaints:

- A clunk when shifting the transmission from reverse to park. This noise is simply the parking pawl engaging the park gear.
- A clunk or clicking noise in park during startup. This noise has been identified as hydraulic valve train movement or staging in anticipation of operation.
- A clunk when shifting from park while parked on a hill; a condition common to several transmissions.
- A light whine or humming noise when the vehicle is stopped with the engine idling. This is considered normal by Allison for the type of pump design they are using.
- A whining noise when the vehicle is moving. This is a typical planetary noise and is considered normal for the three-planetary design that Allison is using. The whine is most noticeable in 1st and 2nd gears.
- Shifts which aren't driver initiated are a common complaint. The TCM that Allison uses has the ability to command upshifts, downshifts and TCC apply or release without any input from the customer. The customer may notice that during deceleration, engine braking may occur while going down a grade. In addition, the customer may notice the transmission shifting even though they are decelerating down a hill or traveling in hilly terrain.
- Some customers may comment on the firm shifts the LCT 1000 provides. The LCT 1000 uses a clutch-to-clutch shift, so you'll feel a distinct firmness regarding both upshifts and downshifts.

GM uses the LCT 1000 in heavy duty applications only. This transmission is designed to withstand heavy use, so harsh shifts and certain noises are considered normal.

Ford Updates and Changes

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All Applications

False Codes P1729 or P1781

1999-2000 Econoline, Crown Victoria, Grand Marquis, and Town Cars may experience codes P1729 (4x4 Low Switch Error) or P1781 (4x4 Circuit Out of Self Test Range) in continuous memory. A check of the systems will show these to be false codes.

Codes P1729 and P1781 are stored in continuous memory; they won't cause any driveability problems, or cause the Malfunction Indicator Lamp (MIL) or Transmission Indicator Lamp (TCIL) to light.

Clear the codes from memory; if they return, ignore them. Repair any other codes per normal diagnostics. Don't replace or reflash the computer for these codes — there is no correction for this problem at this time.

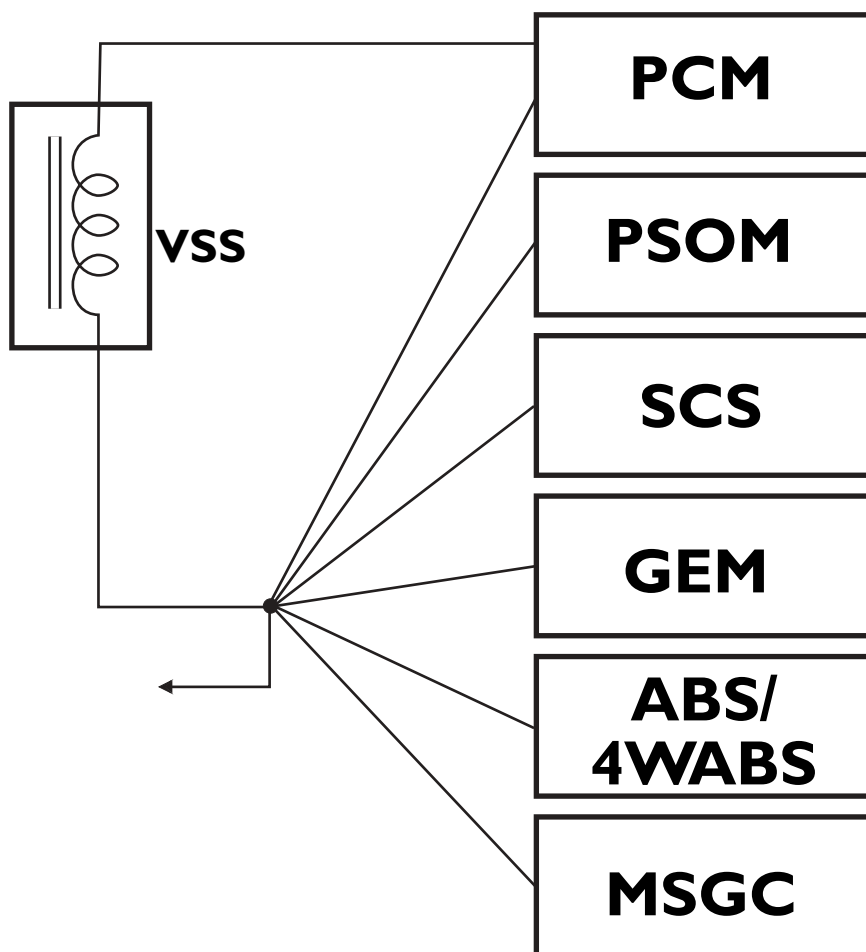
VSS / PSOM Problems

Codes 452 /P0500

There are a number of problems that can be related to the vehicle speed sensor (VSS). These problems can include:

- VSS related DTCs
- Hard upshifts
- Early or late upshifts
- No speedometer reading
- No speed reading with a scan tool

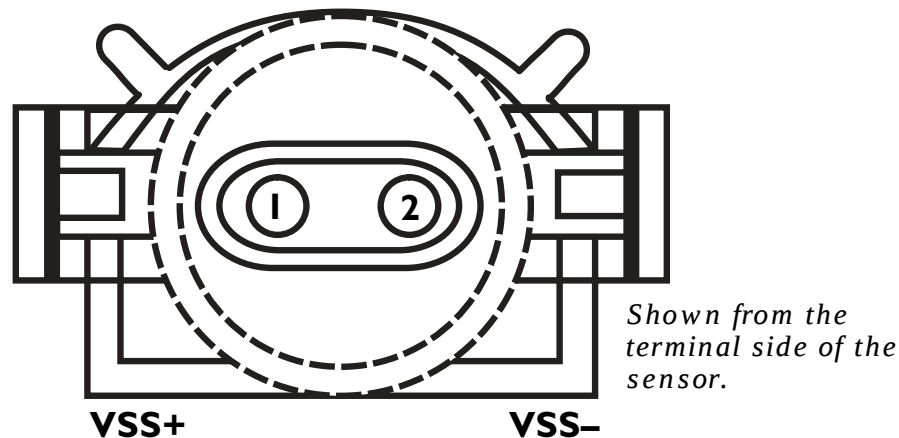
The first thing you need to do is to determine whether the problem is in the speed sensor itself, or if the signal is being altered by a problem in the circuit.



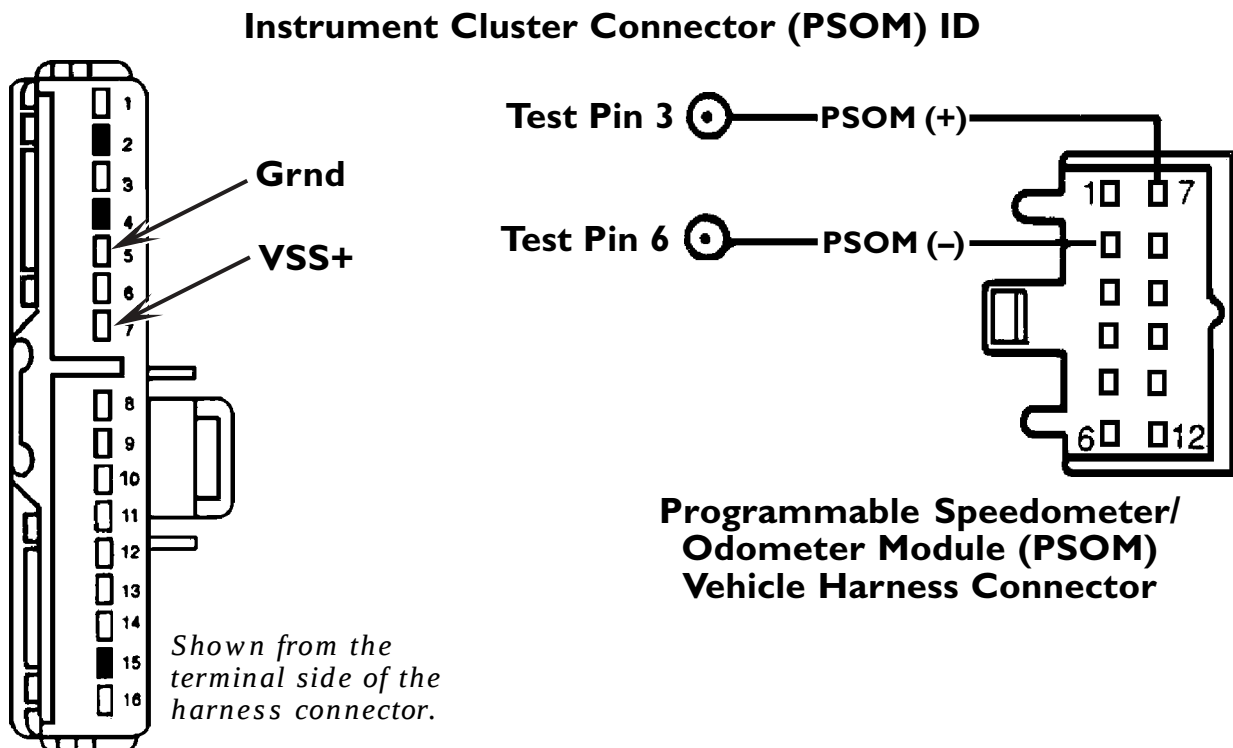
VSS / PSOM Problems

Codes 452 /P0500 (continued)

Check the signal at the VSS with it disconnected and the drive wheels spinning. Voltage should be a minimum of 0.5 VAC. If not, check the reluctor or gear; if everything else looks okay, replace the sensor.



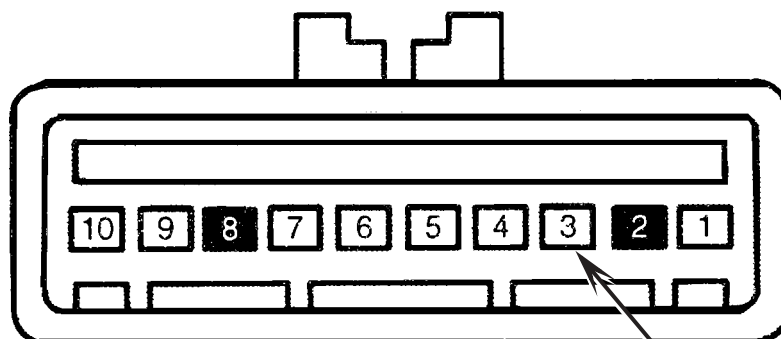
If the VSS checks out okay, the problem could be due to a failure in one or more of these modules. Each of these modules shares the VSS signal, so each has the capability of influencing the VSS circuit.



VSS / PSOM Problems

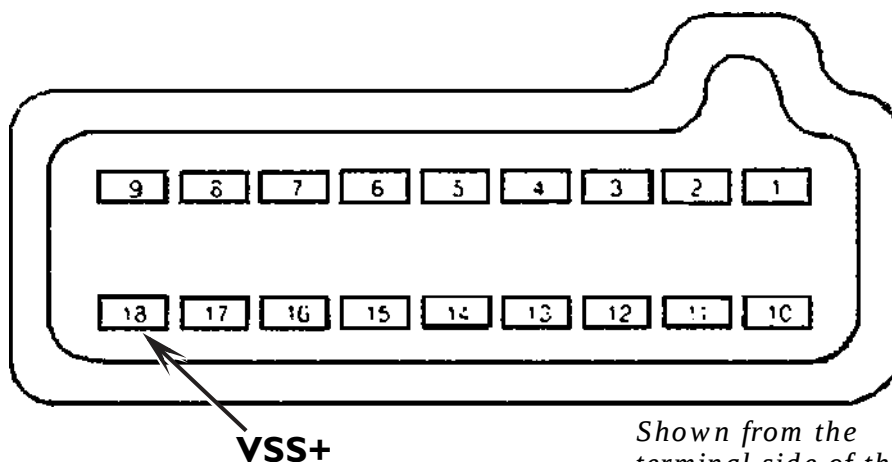
Codes 452 /P0500 (continued)

Speed Control Servo Connector ID



Shown from the terminal side of the harness connector.

GEM Module Connector ID

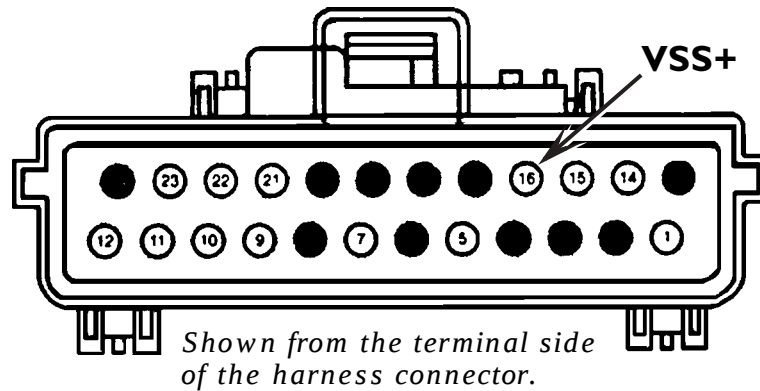


Shown from the terminal side of the harness connector.

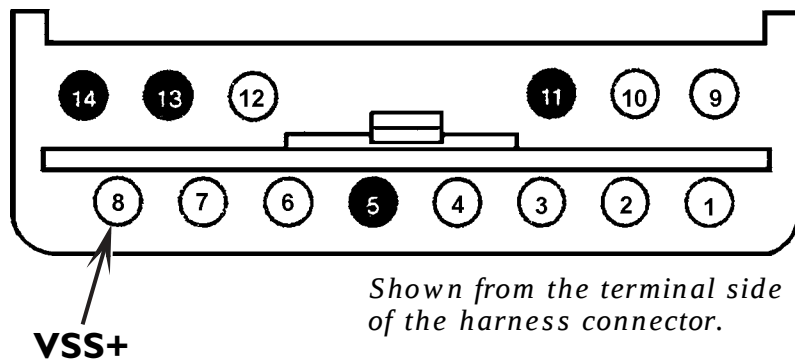
VSS / PSOM Problems

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ABS Connector ID



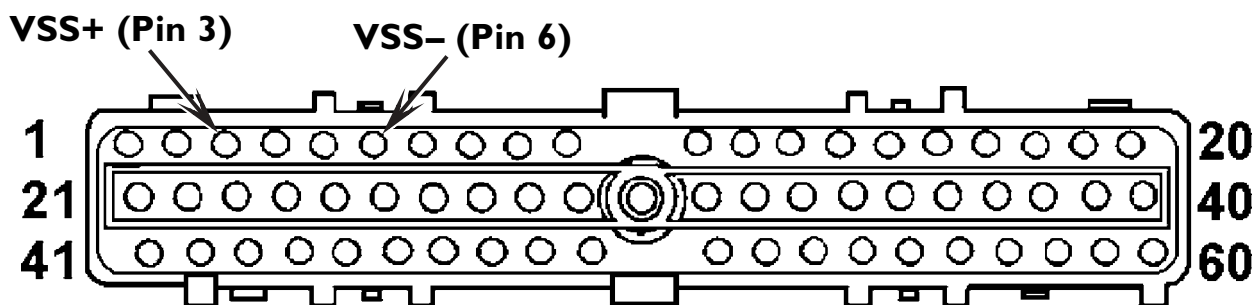
Message Center Connector ID



VSS / PSOM Problems

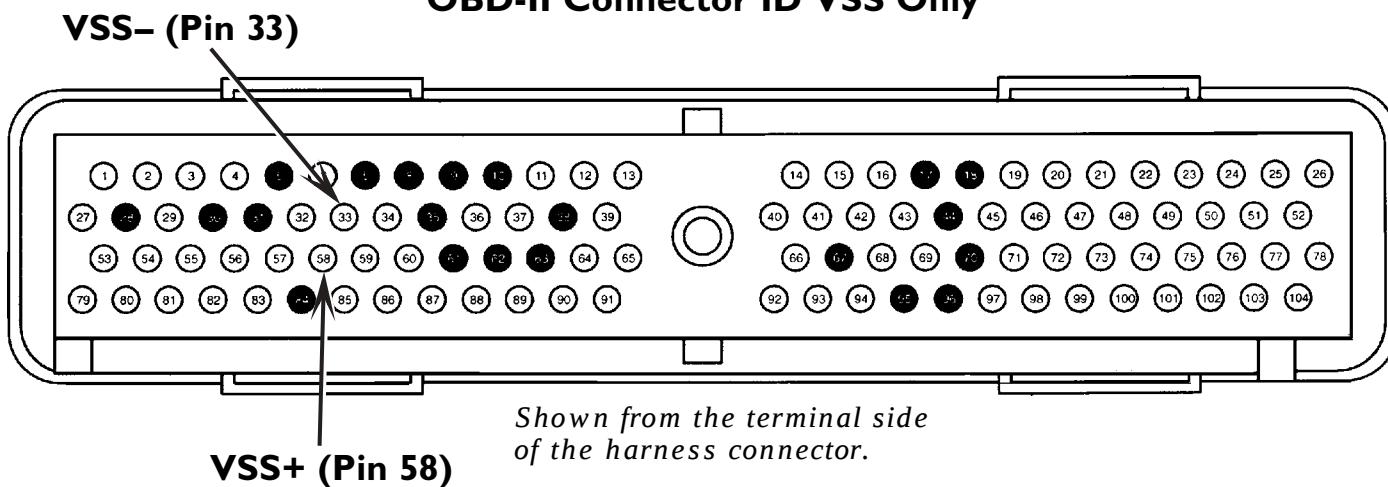
Codes 452 /P0500 (continued)

EEC-IV Connector ID VSS Only



*Shown from the terminal side
of the harness connector.*

OBD-II Connector ID VSS Only



*Shown from the terminal side
of the harness connector.*

4R100

Squawking Noise in Reverse Backing up a Hill

Models affected: 1999 F250 Heavy Duty and Super Duty F-series trucks with 5.4L or 6.8L gas engines.

This condition is often due to low line rise; the computer command for line rise isn't adequate for the conditions.

To correct this, Ford has issued an update computer calibration. Use the transmission tag number and calibration number to determine whether the truck you're working on requires this update.

Ford Computer Calibration Update		
Application	Transmission ID Tag	Calibration Number
5.4L 49 State	MER	9 VZA-AF
5.4L CA	NUY	9 VZA-BJ
6.8L 49 State	YHH	9 WAA-AA
	AEO	9 WAA-AC
	BIH	9 WAA-AF
	DOZ	9 WAA-AH
	MCM	9 WAA-AI
6.8L CA	EAP	9 WAA-BC
	FOT	9 WAA-BD
	JUR	9 WAA-BL
	JTY	9 WAA-BV
	MFG	9 WAA-BY
	NRR	9 WAA-BZ

4R100

No 3–4 Upshift or a 3–4 Shift Hunt When Using Cruise Control

Models affected: 1999 F-series Super Duty pickups with 7.3L diesel engines may experience a hunt between 3rd and 4th gears when using cruise control. In some cases, they may lose 4th gear entirely.

A calibration update has been issued to take care of this problem.

Ford Calibration Update			
Application	Climate	Transmission ID	Calibration Code
F-250/350 Federal	Warm	FIF	9DTA-AR
	Cold	NVK	9DTA-AU
F-450/550/650 Federal	Warm	AGD	9DTA-AS
	Cold	CNH	9DTA-AV
F-250/350 California	Warm	NSU	9DTA-BH
	Cold	FHP	9DTA-BK

4R100 / E4OD

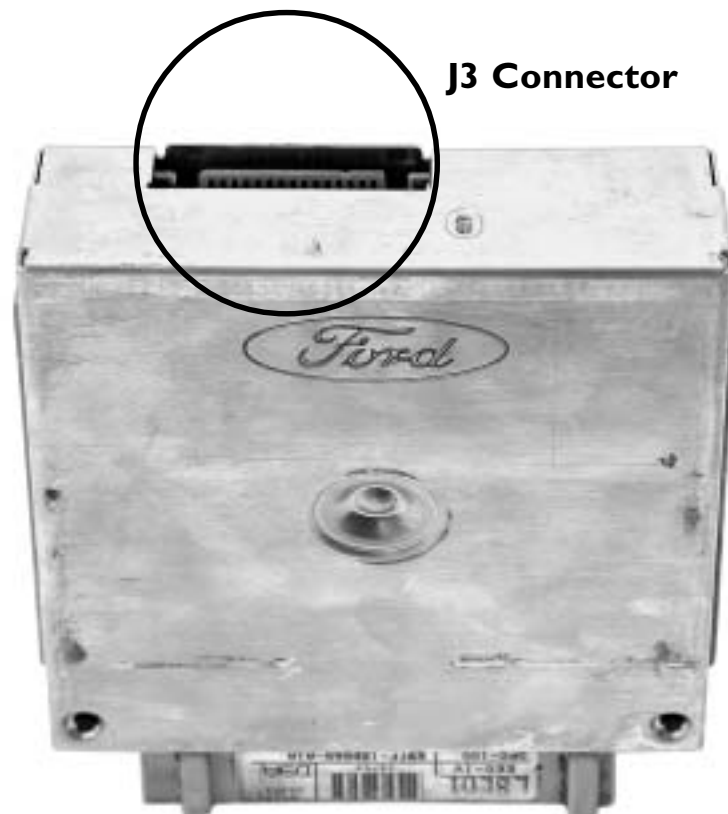
P0605 (RAM Test Error) or P0603 (KAM Test Error)

Some OBD-II vehicles equipped with a 7.3L DI Turbo diesel engines have been showing up with the MIL (Malfunction Indicator Lamp) on. When you pull the codes, either P0603 or P0605 will appear.

These codes may be caused by aftermarket devices designed to enhance engine and transmission driveability. Typically these devices plug into the harness between the computer and the vehicle harness, or on the J3 connector located at the back of the computer.

Some of the vehicles may exhibit poor driveability; others will seem to operate just fine. In either case, the MIL may be lit.

To repair the code, you'll need to remove the device and retest the vehicle for codes. If the problem doesn't return, the customer can then decide to leave it off, or return the vehicle to the person who originally installed device.



4R100 / E4OD

Valve Body Gasket and Separator Plate ID

Gasket ID

There are four sets of valve body gaskets that cover 1989-2001 E4OD/4R100. Here's how to choose the correct set of gaskets, by examining just the separator plate.

Step 1: Check location A.

- If it has a hole at A, use type 2 gaskets.
- If it doesn't have a hole at A, go to step 2.

Step 2: Check location B.

- If it doesn't have a hole at B, use type 4 gaskets.
- If it has a hole at B, go to step 3.

Step 3: Check location C.

- If it has a round hole at C, use type 1 gaskets.
- If it has a slot at C, use type 3 gaskets.

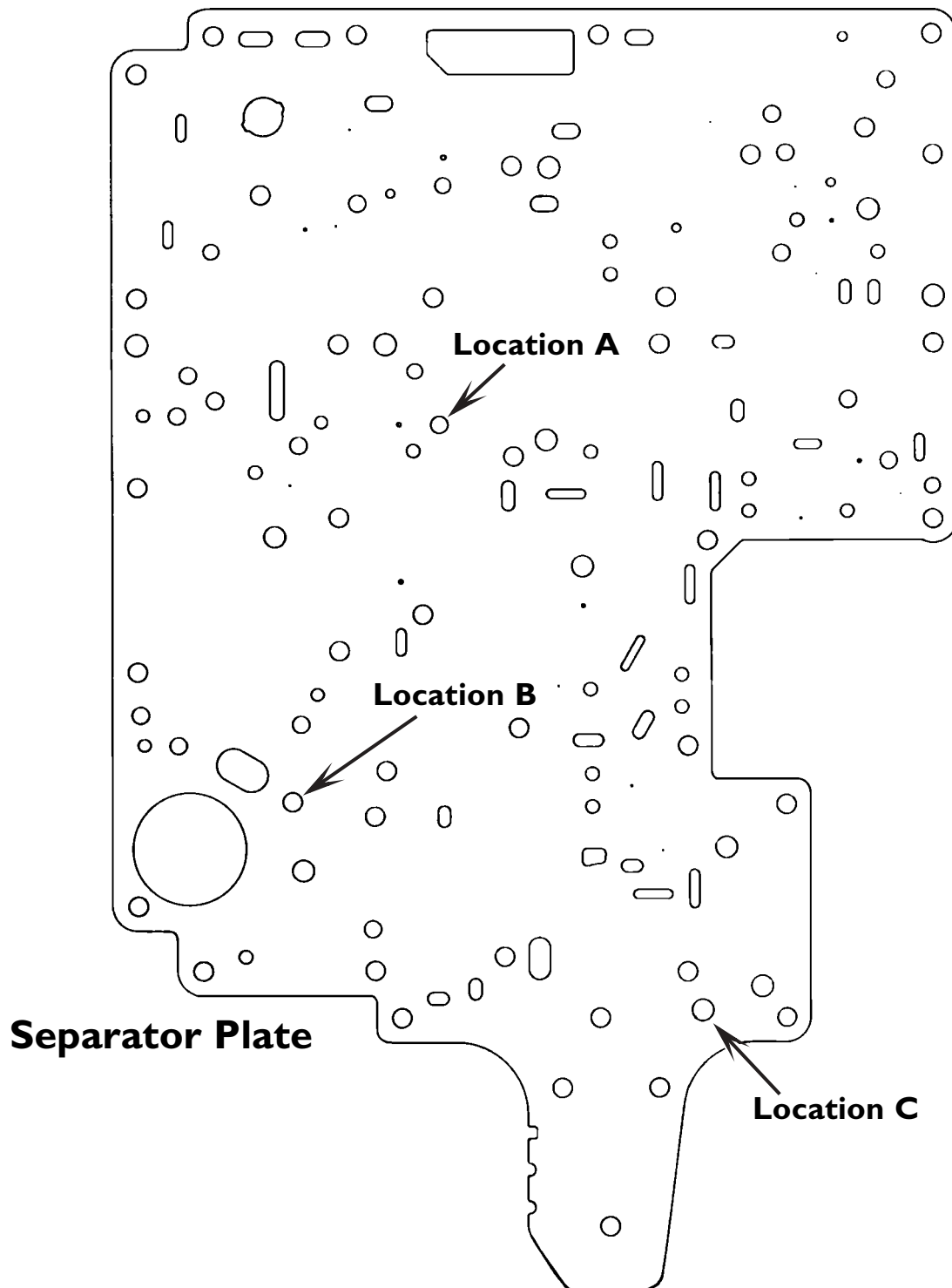
Separator Plate Identification

Plate	Location A	Location B	Location C
Type 1	No Hole	Hole	Round Hole
Type 2	Hole	Hole	Round Hole
Type 3	No Hole	Hole	Slot
Type 4	No Hole	No Hole	Slot

4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

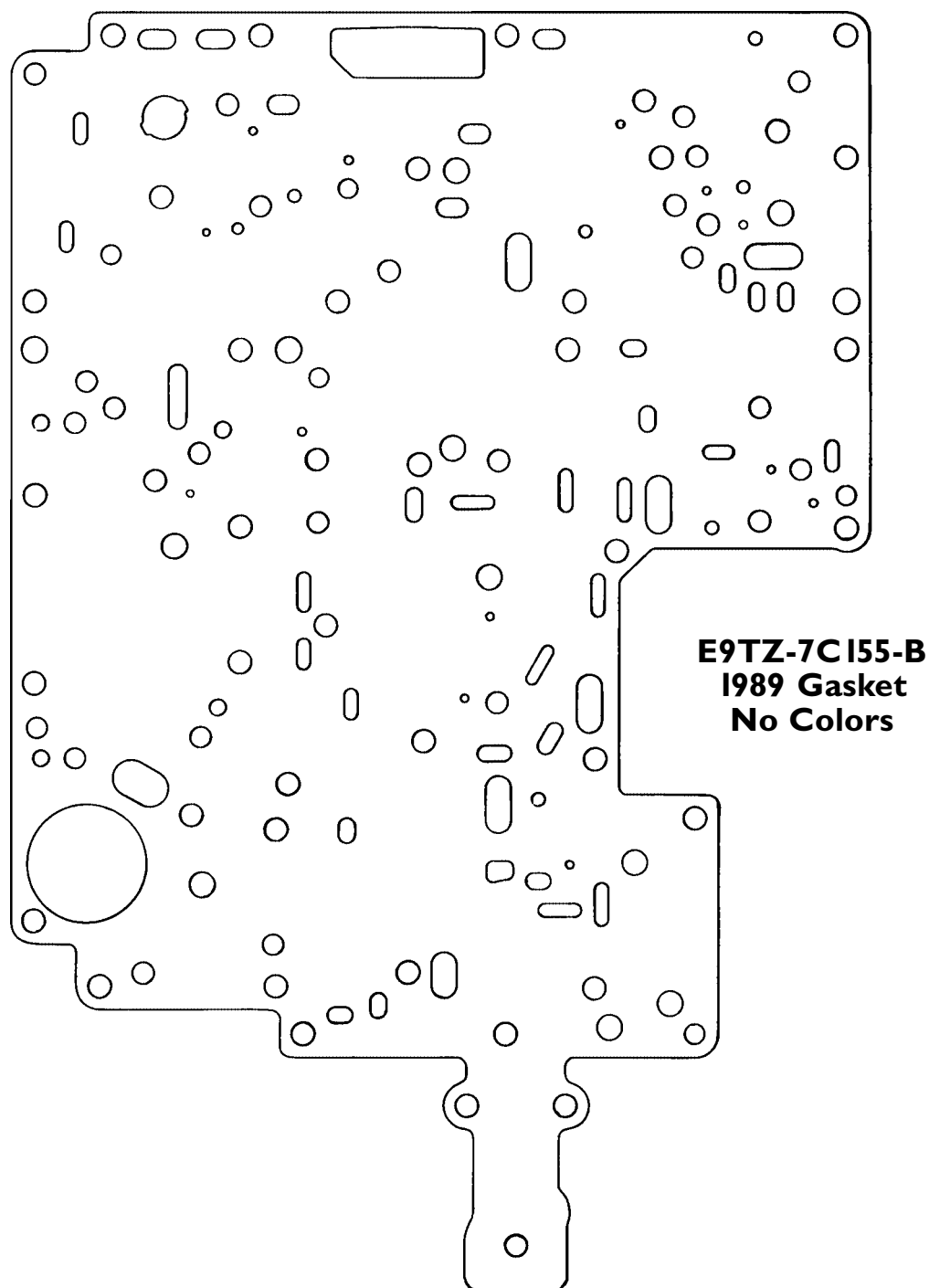


4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type I Case Gasket

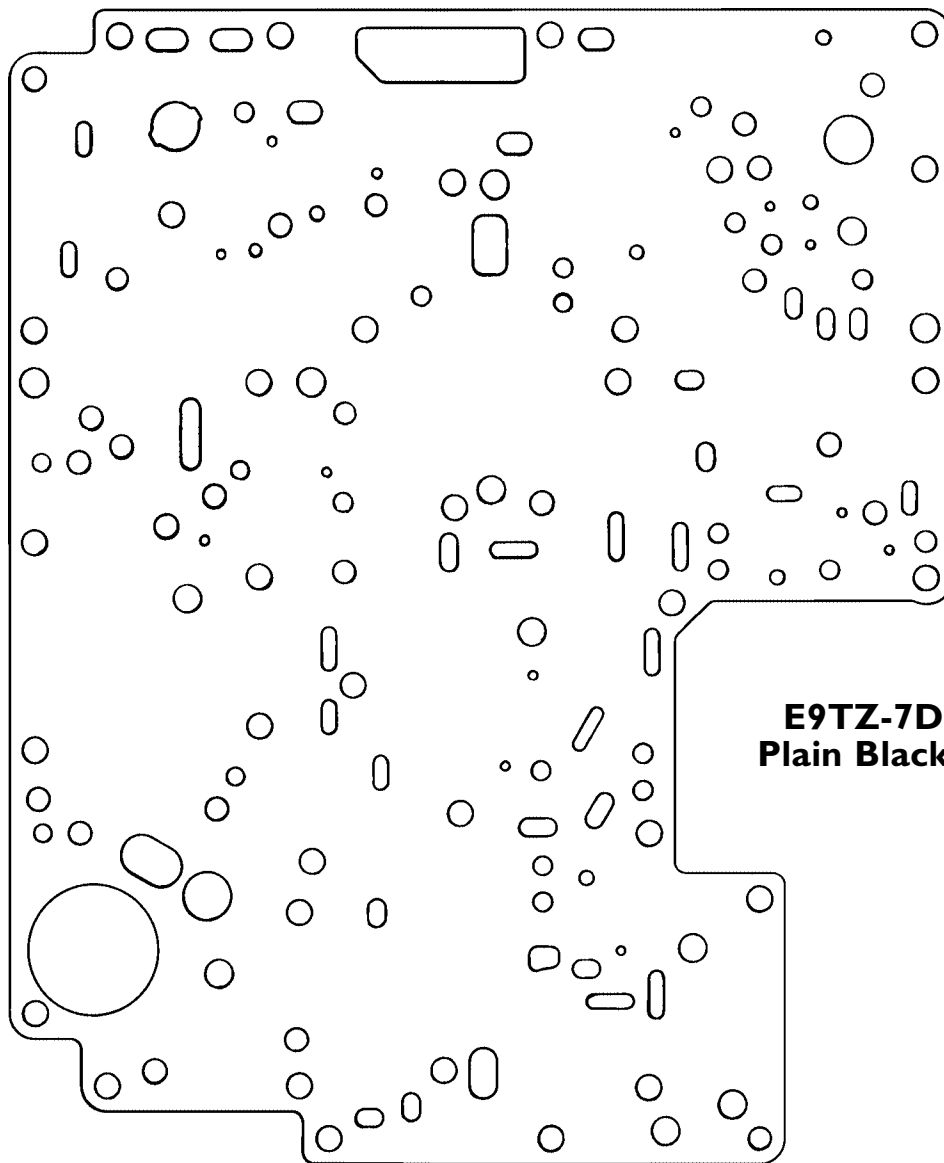


4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type I Valve Body Gasket



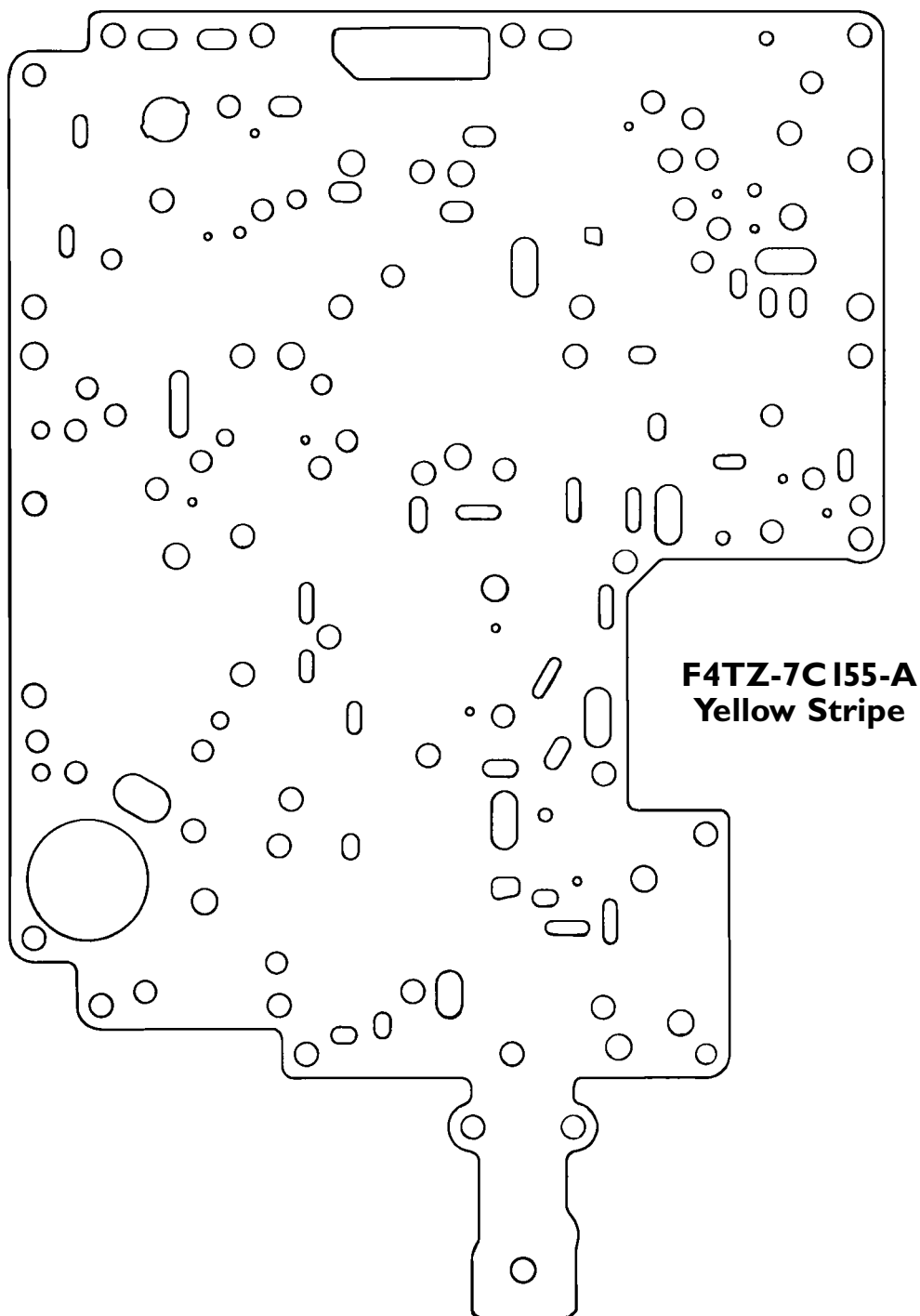
E9TZ-7D100-B
Plain Black Stripe

4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type 2 Case Gasket

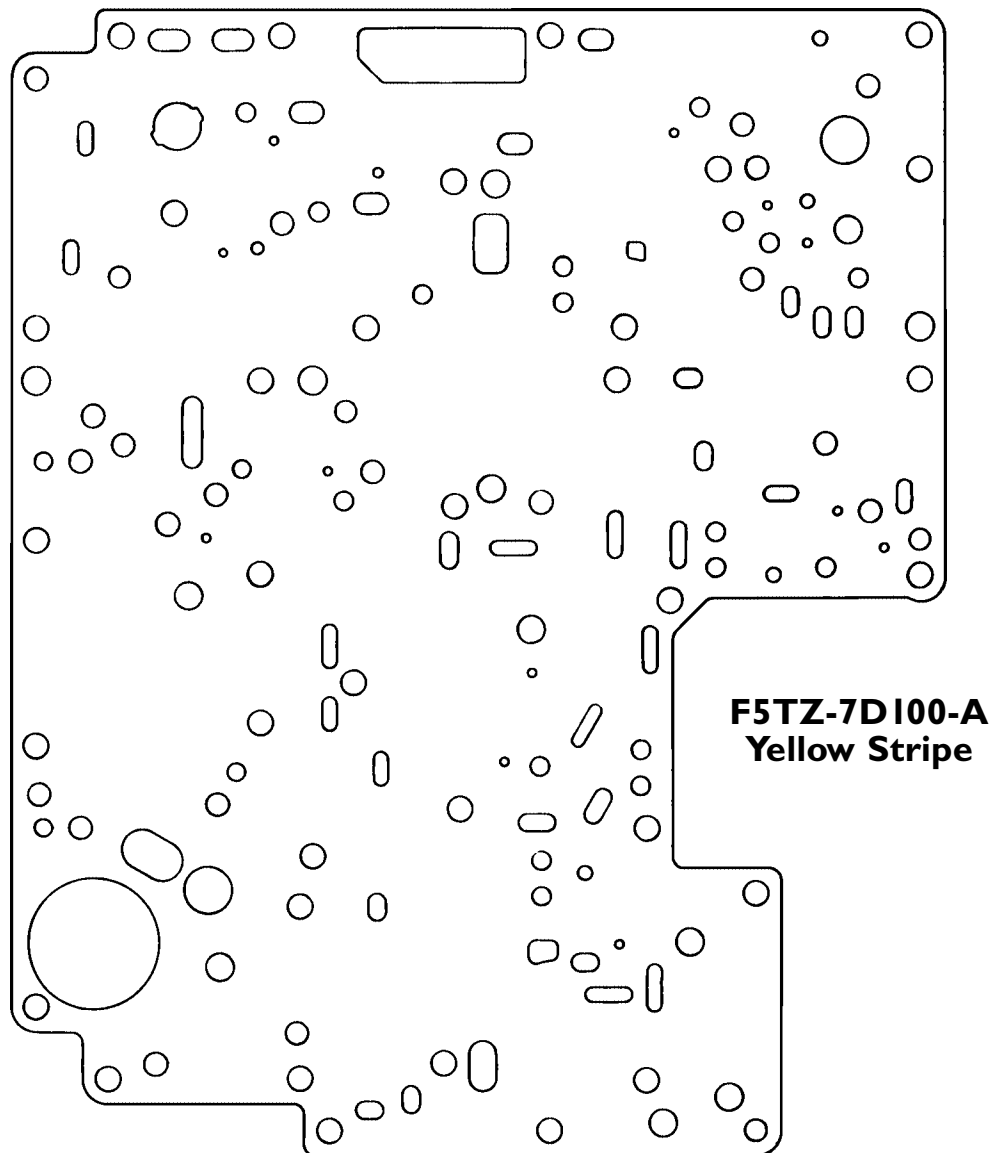


4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type 2 Valve Body Gasket

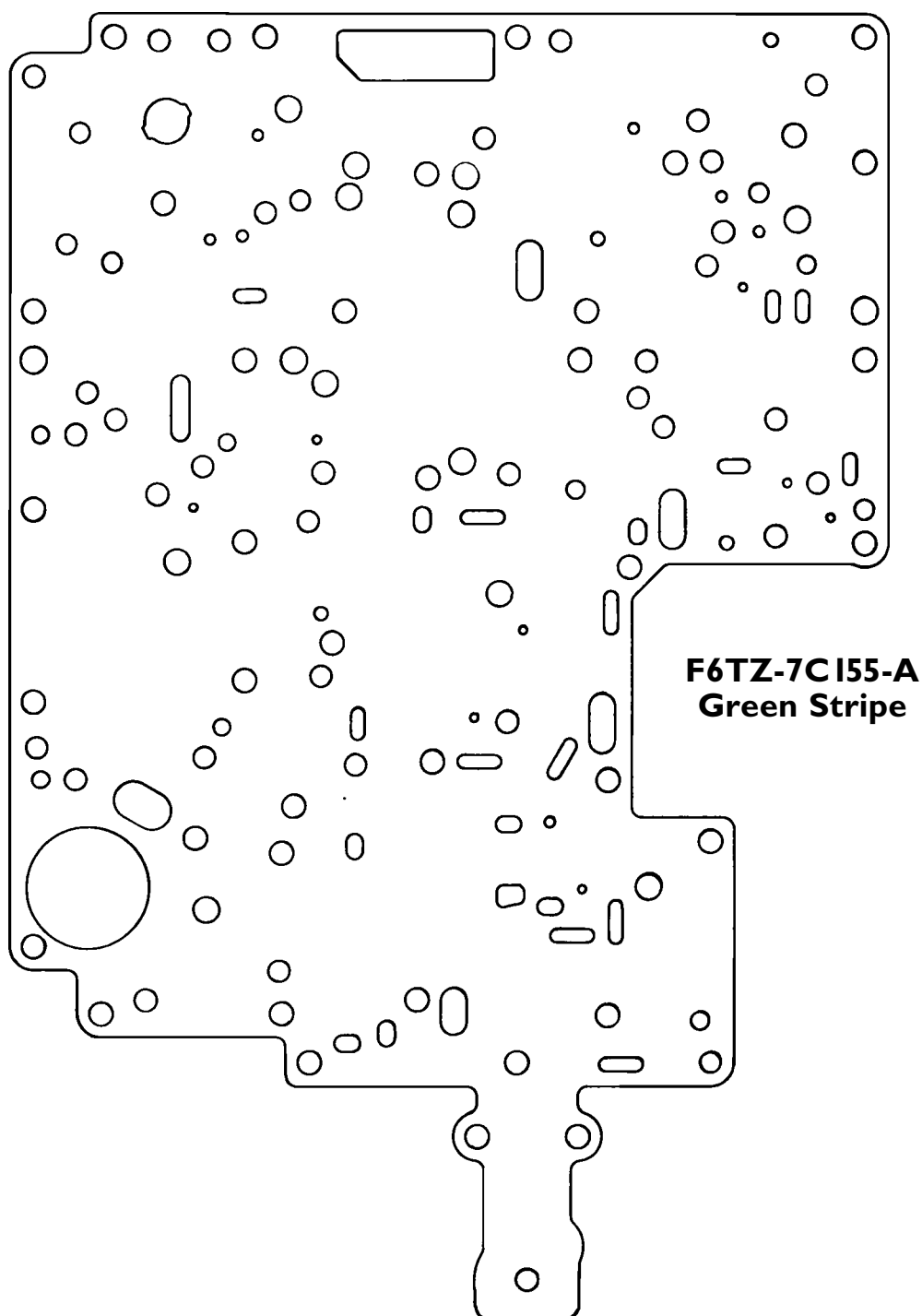


4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type 3 Case Gasket

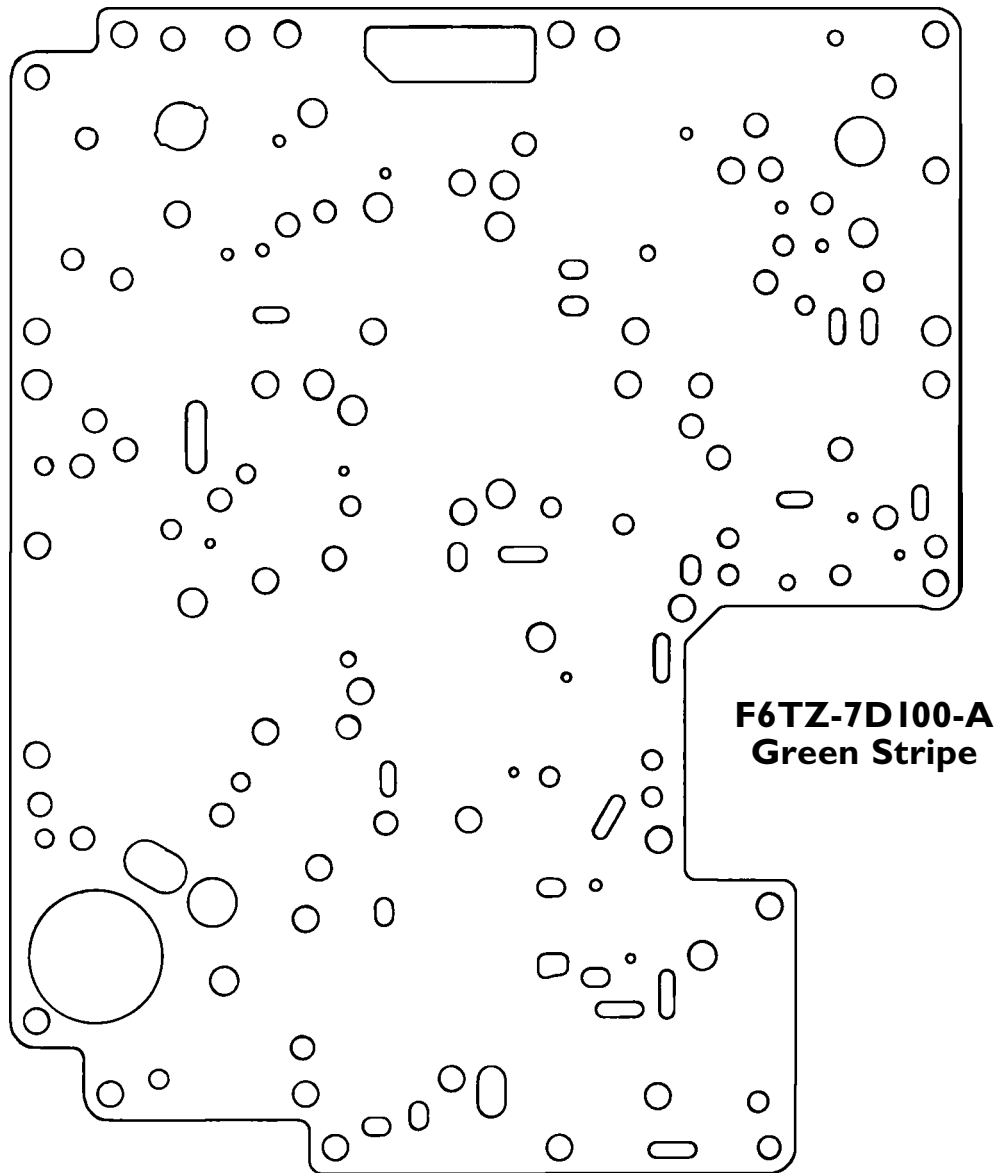


4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type 3 Valve Body Gasket

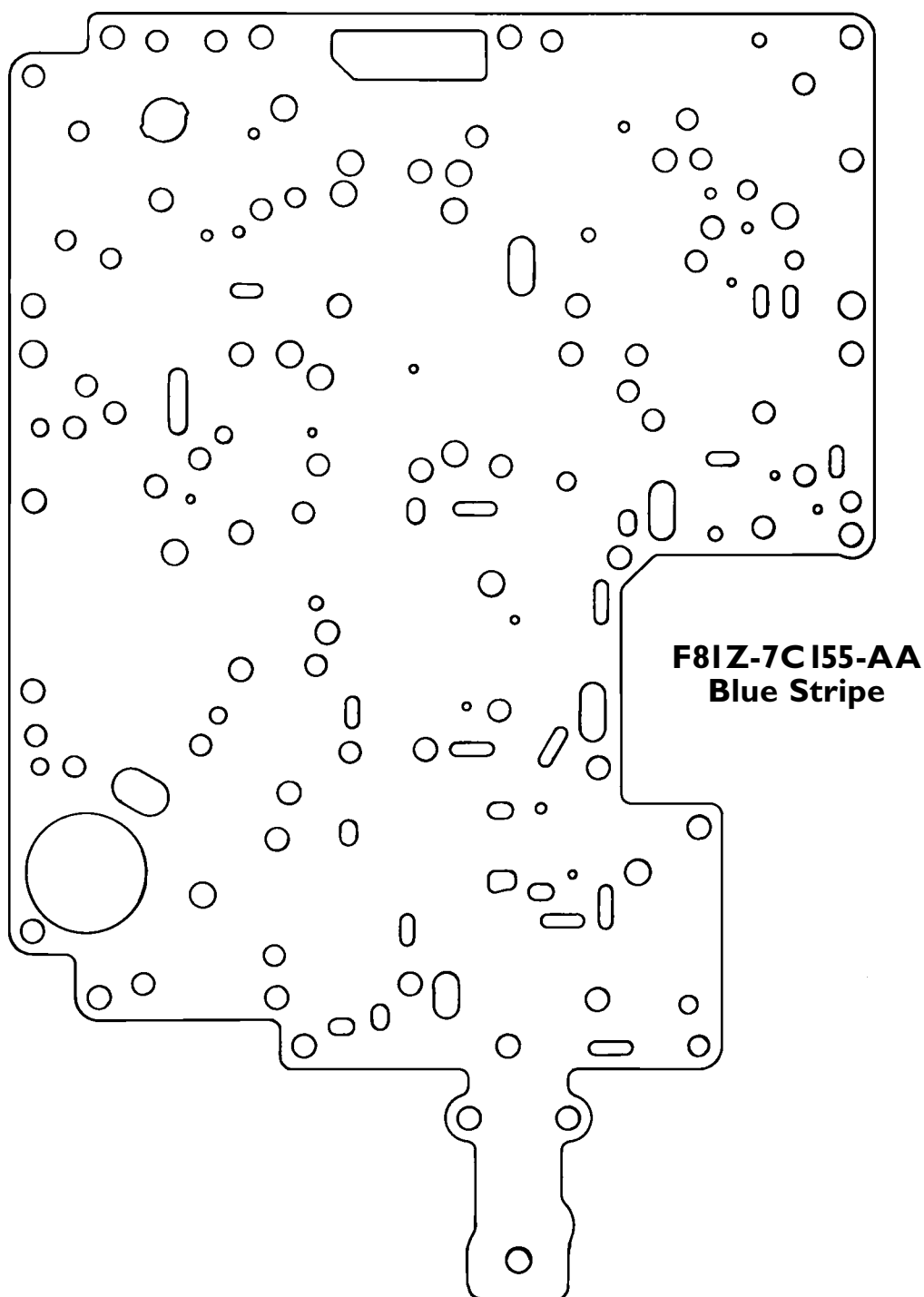


4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type 4 Case Gasket

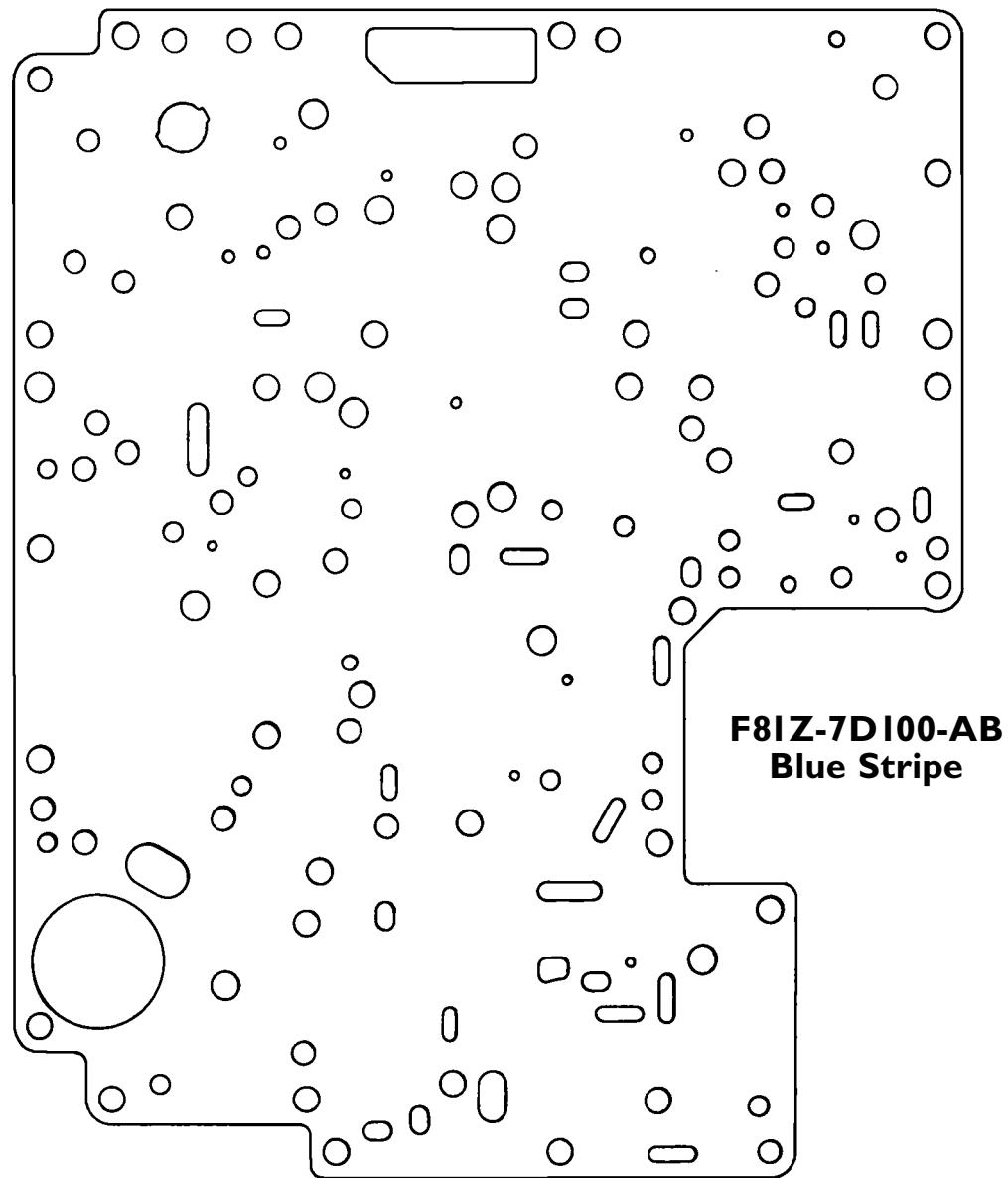


4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Gasket ID (continued)

Type 4 Valve Body Gasket



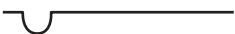
4R100 / E4OD

VB Gasket and Separator Plate ID (continued)

Plate ID

Even though there are only four different sets of gaskets to choose from, there are several separator plates.

This chart can help you identify the separator plate you have by its identification notches. On applications with more than one listing, either separator plate will work.

Separator Plate Application				
Year	Engine Size	Separator Plate	Plate ID	Gasket Type
1989	7.3L, 7.5L, 5.8L	E9TZ-7A008-A		1
1990–95	4.9L, 5.0L, 5.8L, 7.3L, 7.5L	F4TZ-7A008-A		2
		F5TZ-7A008-A		
1990–95	4.9L, 5.0L, 5.8L, 7.3L, 7.5L	F6TZ-7A008-B*		3
		F5TZ-7A008-B*		
1996	4.9L, 5.0L, 5.8L, 7.3L, 7.5L	F6TZ-7A008-B		4
		F7TZ-7A008-AA		
1997	6.8L	F7UZ-7A008-AA		4
		F8UZ-7A008-CA		
		F81Z-7A008-EA		
	4.2L, 4.6L, 5.4L, 7.3L	F7TZ-7A008-AA		4
1998	6.8L 7.3L (4R100 Only)	F8UZ-7A008-AA		4
	6.8L (E4OD)	F8UZ-7A008-BA		4
1998–2000	4.2L, 4.6L, 5.4L	F7TZ-7A008-AA		4
2000–2001	Transmission Tags H, J, L, M	F81Z-7A008-BA		4
1999–2001	Transmission Tags A, B, C, D, E, F	F81Z-7A008-DA		4

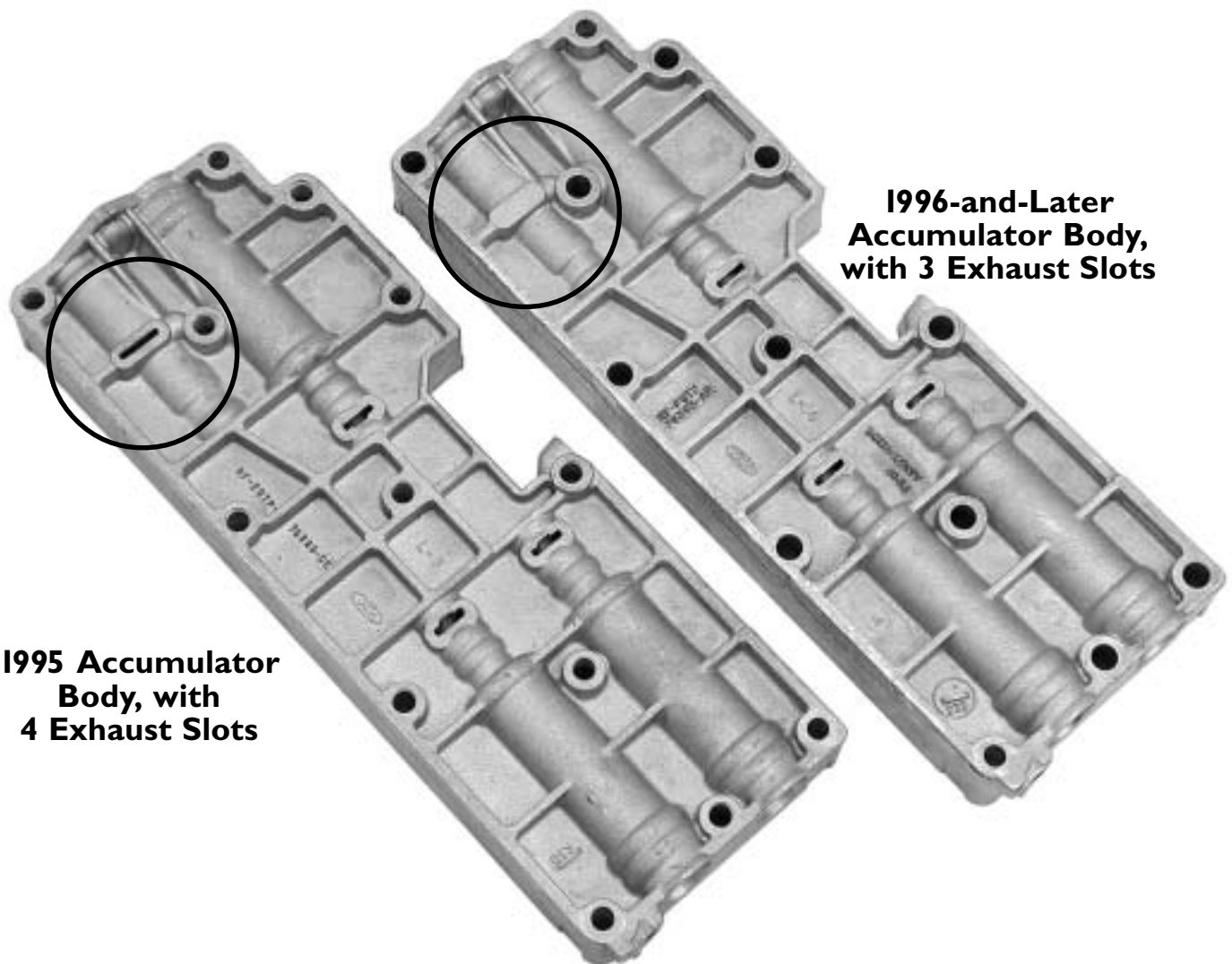
* These replacement separator plates will only retrofit if you update the entire valve body assembly to 1996 parts.

4R100 / E4OD

No Reverse, Slips in Reverse

The Ford 4R100 and E4OD early and late accumulator bodies aren't interchangeable. 1996-and-later accumulator bodies have only three exhaust slots; earlier bodies have four.

If you install a 1995 accumulator body with four slots on a later unit, reverse oil will exhaust through the line modulator exhaust slot.



**1995 Accumulator
Body, with
4 Exhaust Slots**

**1996-and-Later
Accumulator Body,
with 3 Exhaust Slots**

A4LD

No Cooler Flow after Bellhousing Change

If you install an A4LD pump and plate on an unmodified 4R44/55E bellhousing, you'll end up with no cooler flow. But you can easily modify the 4R44/55E bellhousing to work with the A4LD pump and plate.

IMPORTANT This is a one-way interchange; there's no easy way to modify the A4LD bellhousing to work with the 4R44/55E pump and plate.

To modify the 4R44/55E bellhousing:

- Extend the lube circuit passage through the additional bolt hole in the 4R44/55E bellhousing.
- Use the pump plate to make sure the lube passage is completely clear.

Before Modification



After Modification

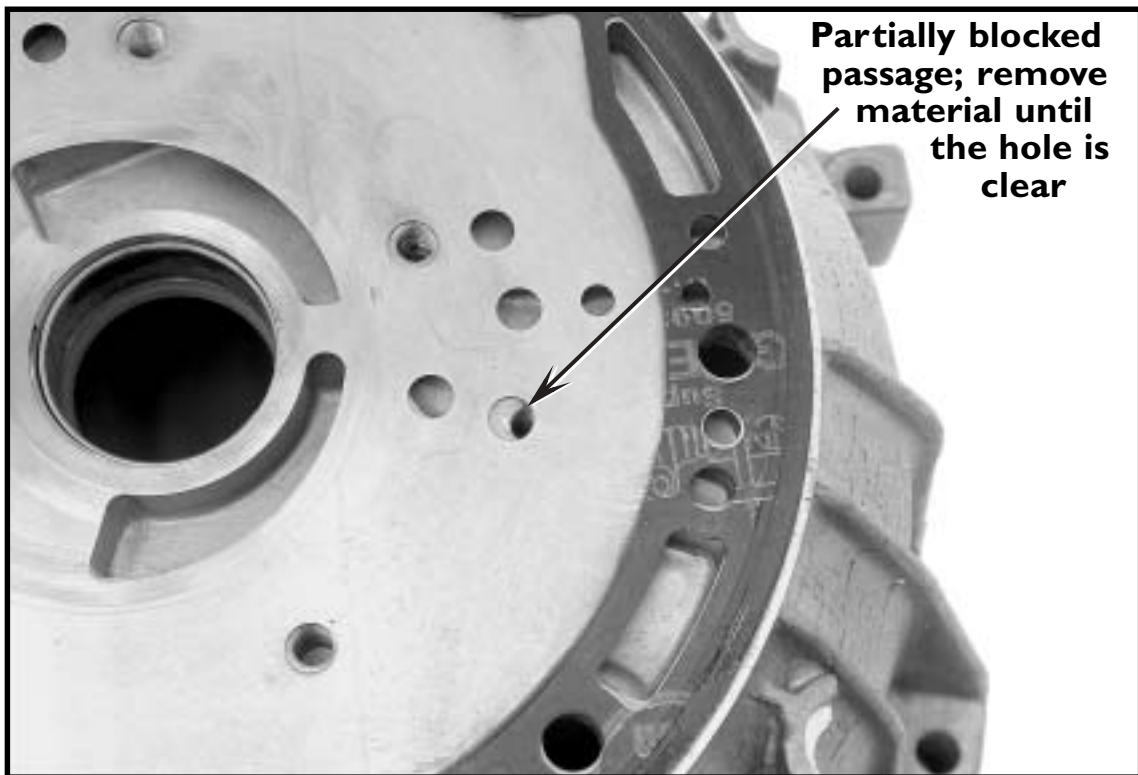


Remove the dam in the 4R44/55E bellhousing between the bolt hole and lube circuit.

A4LD

No Cooler Flow (continued)

Use the pump plate as a template to make sure the modified hole is extended enough to open the lube passage all the way through the plate.

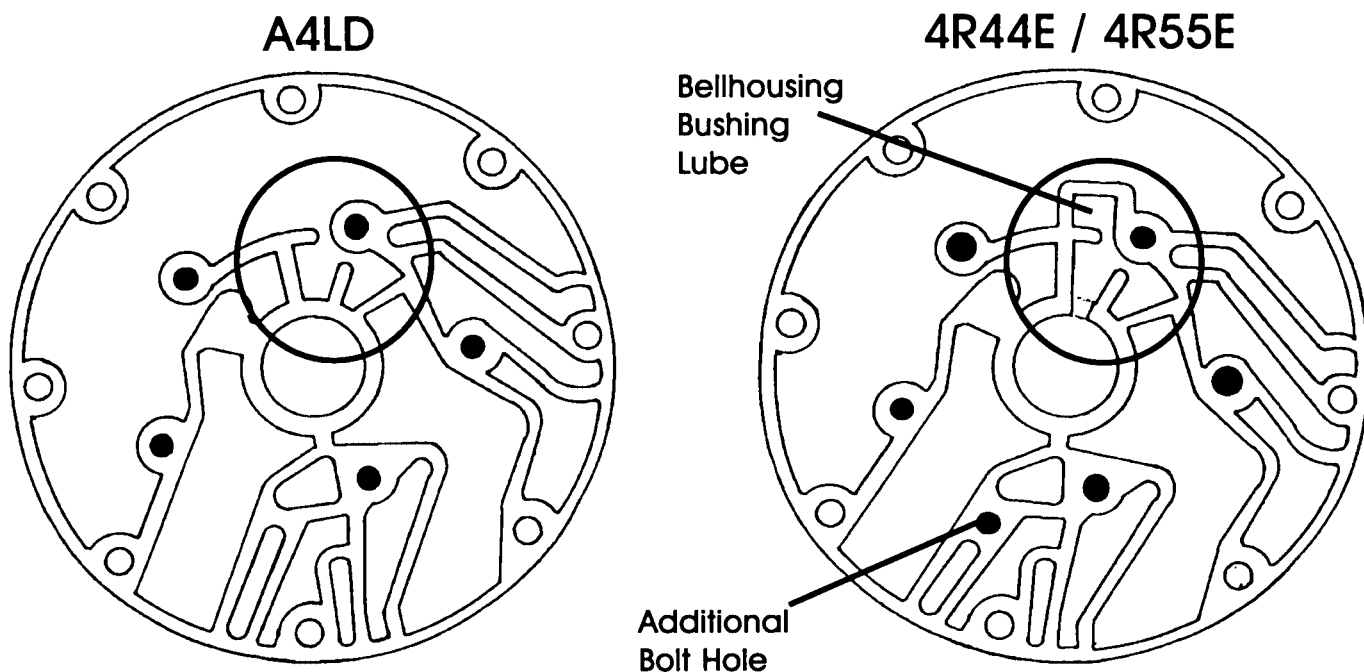


A4LD, 4R44E / 4R55E

Pump Identification

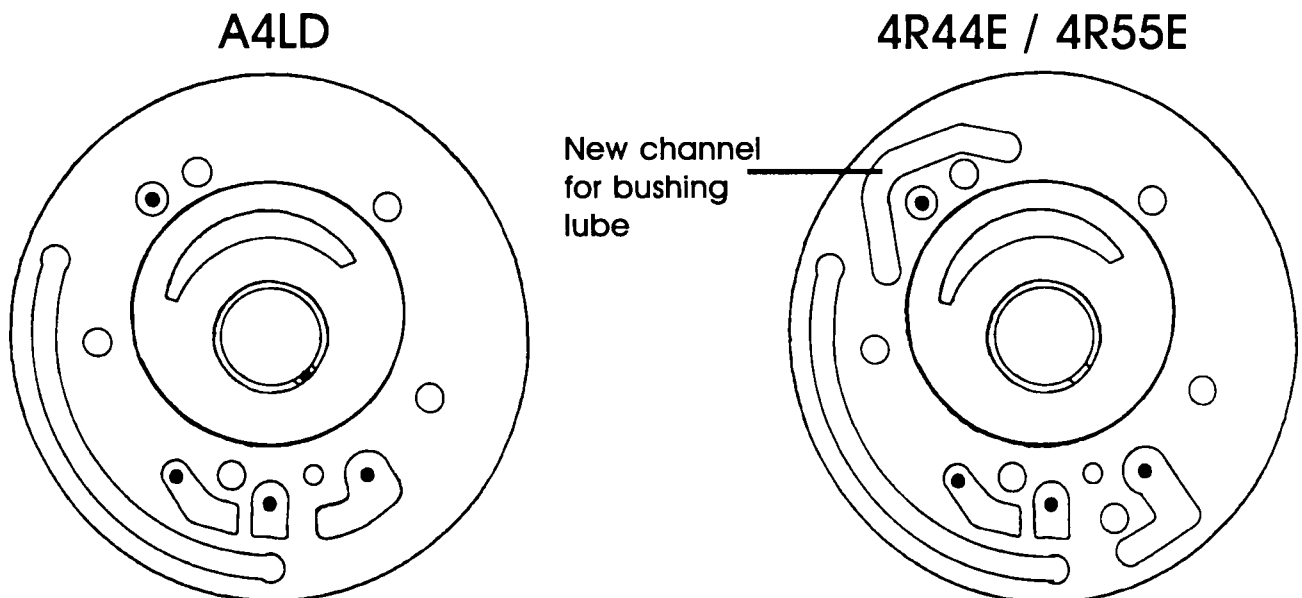
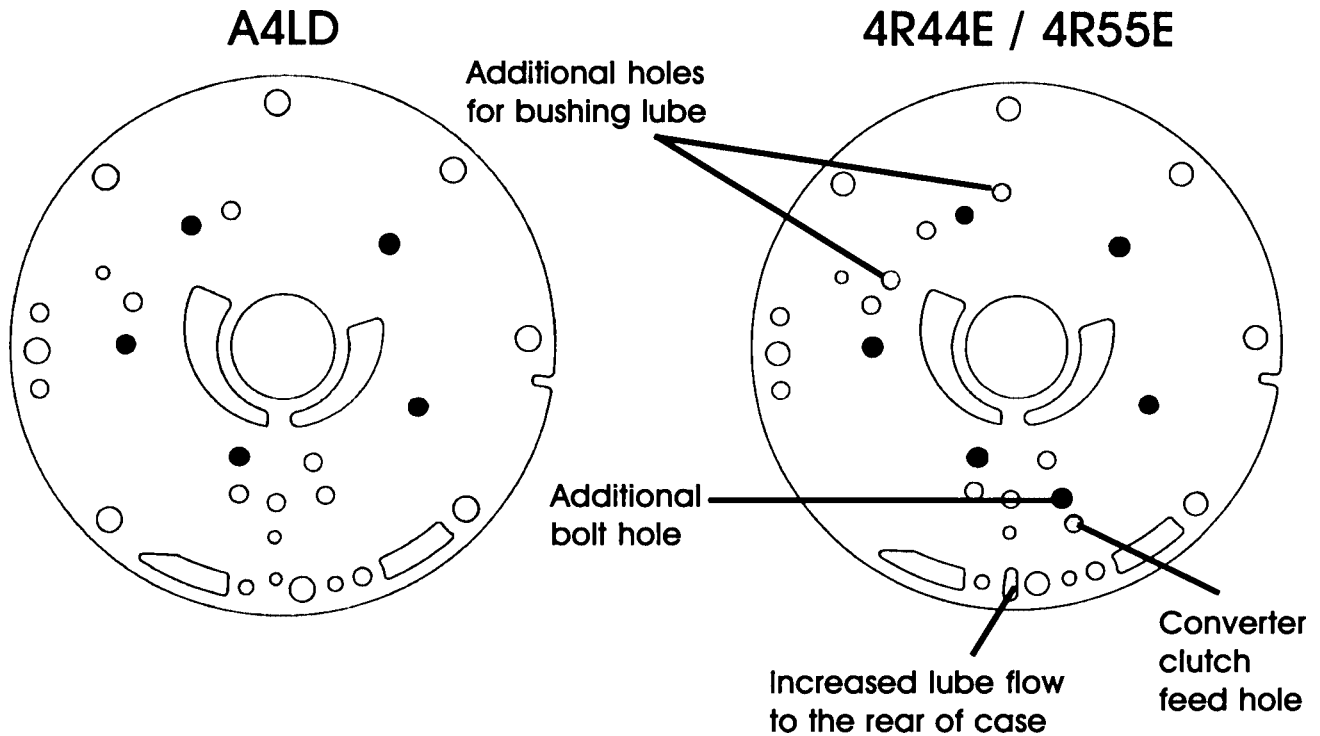
The 4R44E/4R55E bellhousing is the only individual part of the two pump assemblies that you can easily interchange, with just a simple modification. However, you can interchange the complete assemblies, as long as you keep the components together as a set.

The following illustrations identify the differences in these assemblies, to prevent mismatching components.



A4LD, 4R44E / 4R55E

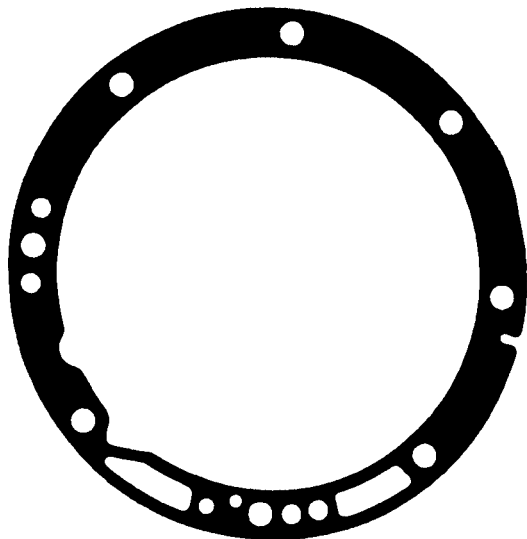
Pump Identification (continued)



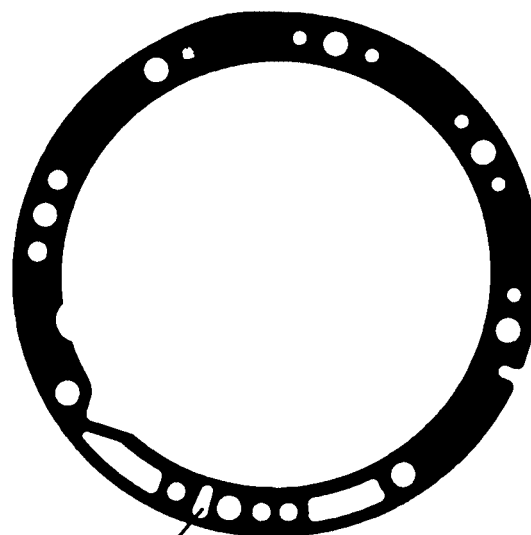
A4LD, 4R44E / 4R55E

Pump Identification (continued)

A4LD



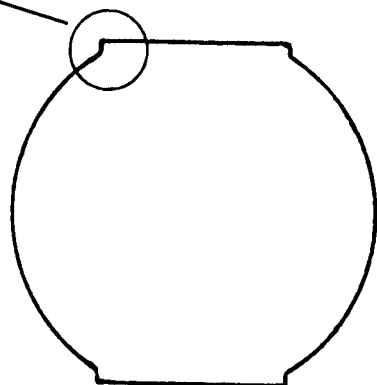
4R44E / 4R55E



Elongated Hole

A4LD

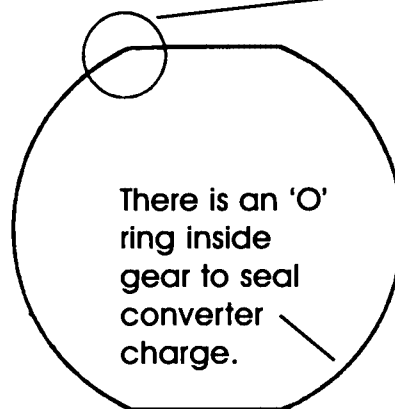
Loose fit on
converter
hub lube for
bellhousing
bushing
lube



4R44E / 4R55E

Tight or
perfect fit
on converter
hub. Lube
for the
bellhousing
bushing is
provided by
a new lube
passage in
bellhousing,
plate and
pump.

There is an 'O'
ring inside
gear to seal
converter
charge.



4R44E, 5R55E

4R44E: No 2nd, No 4th After Rebuild

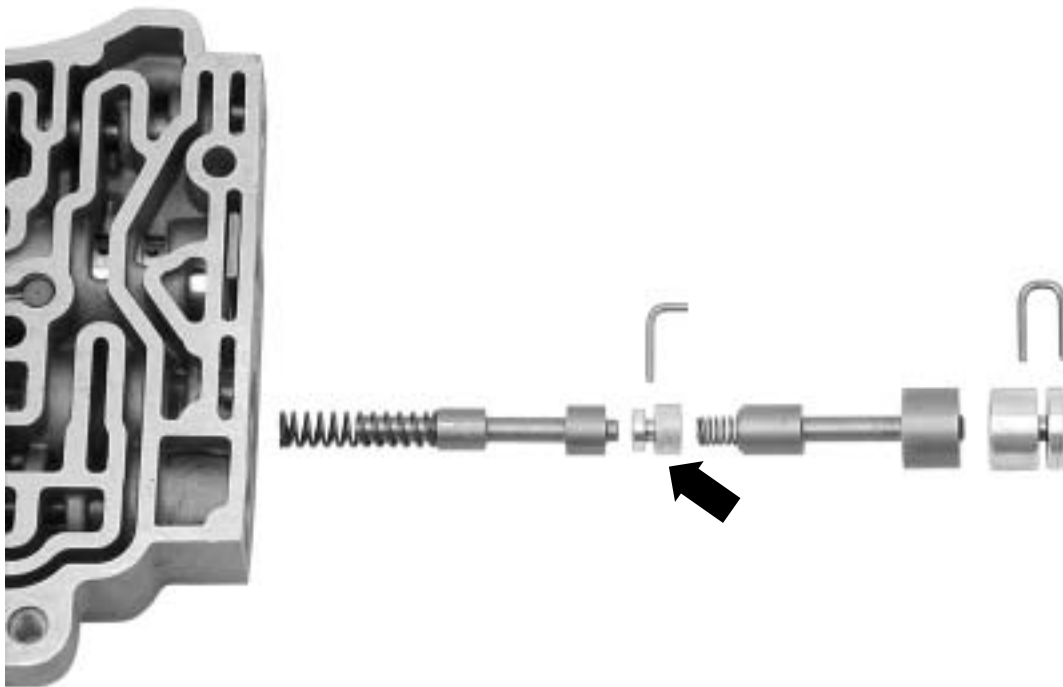
5R55E: No 3rd, No 5th After Rebuild

After a rebuild or valve body repair, some 4R44Es and 5R55Es may have some gears missing:

- 4R44E: No 2nd or 4th gears
- 5R55E: No 3rd or 5th gears

One likely cause for this problem is the plug between the EPC boost valve and the forward modulator valve is installed backward.

Use the photo to identify the correct way to install this plug.

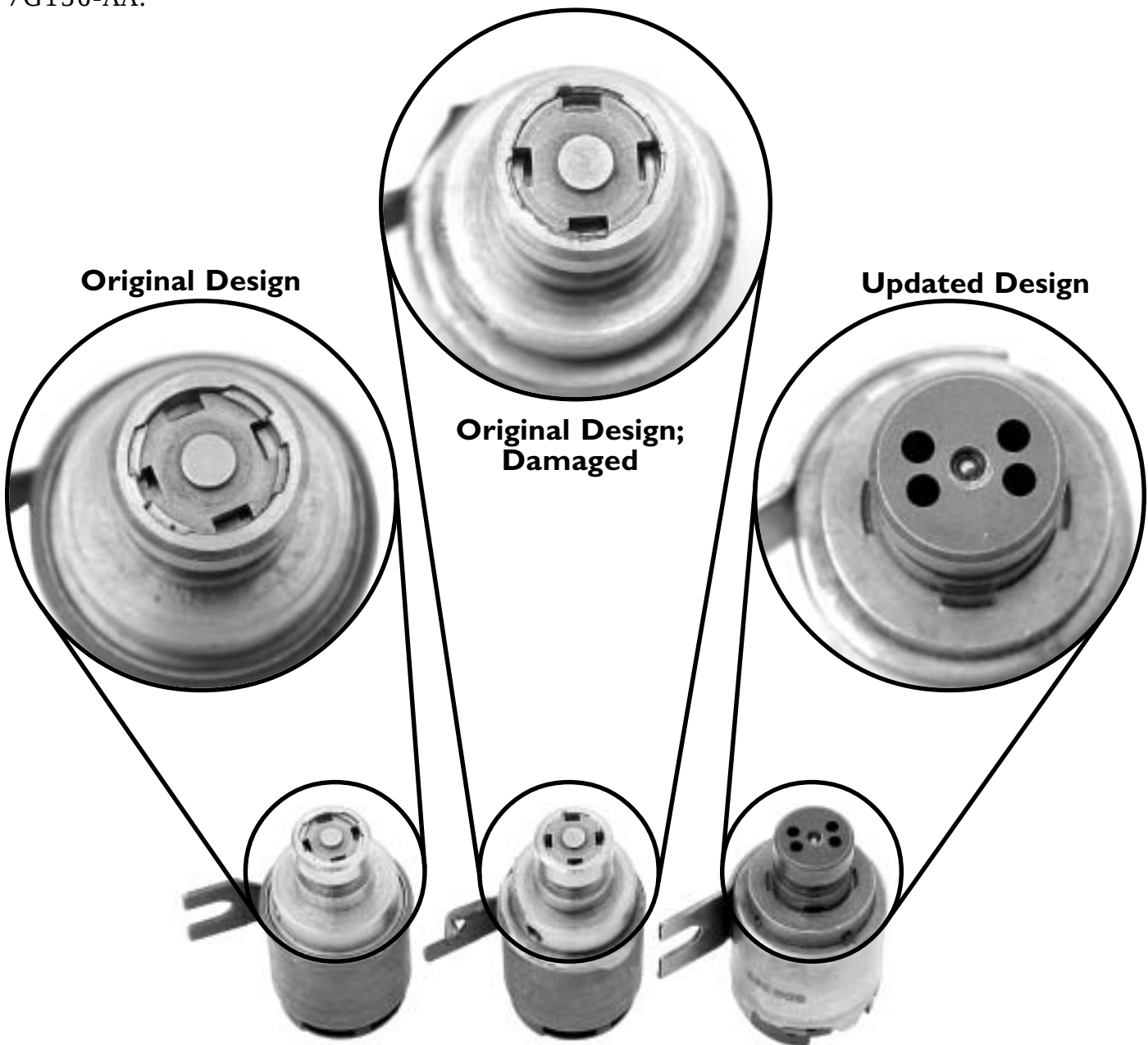


4R44E/4R55E

No TCC Apply

1995-96 model 4R44E/4R55E transmissions may experience no TCC application. This may be due to a broken tip on the TCC solenoid.

The repair is simple: Replace the solenoid. The updated solenoid part number is F77Z-7G136-AA.



4R44E / 4R55E / 5R55E

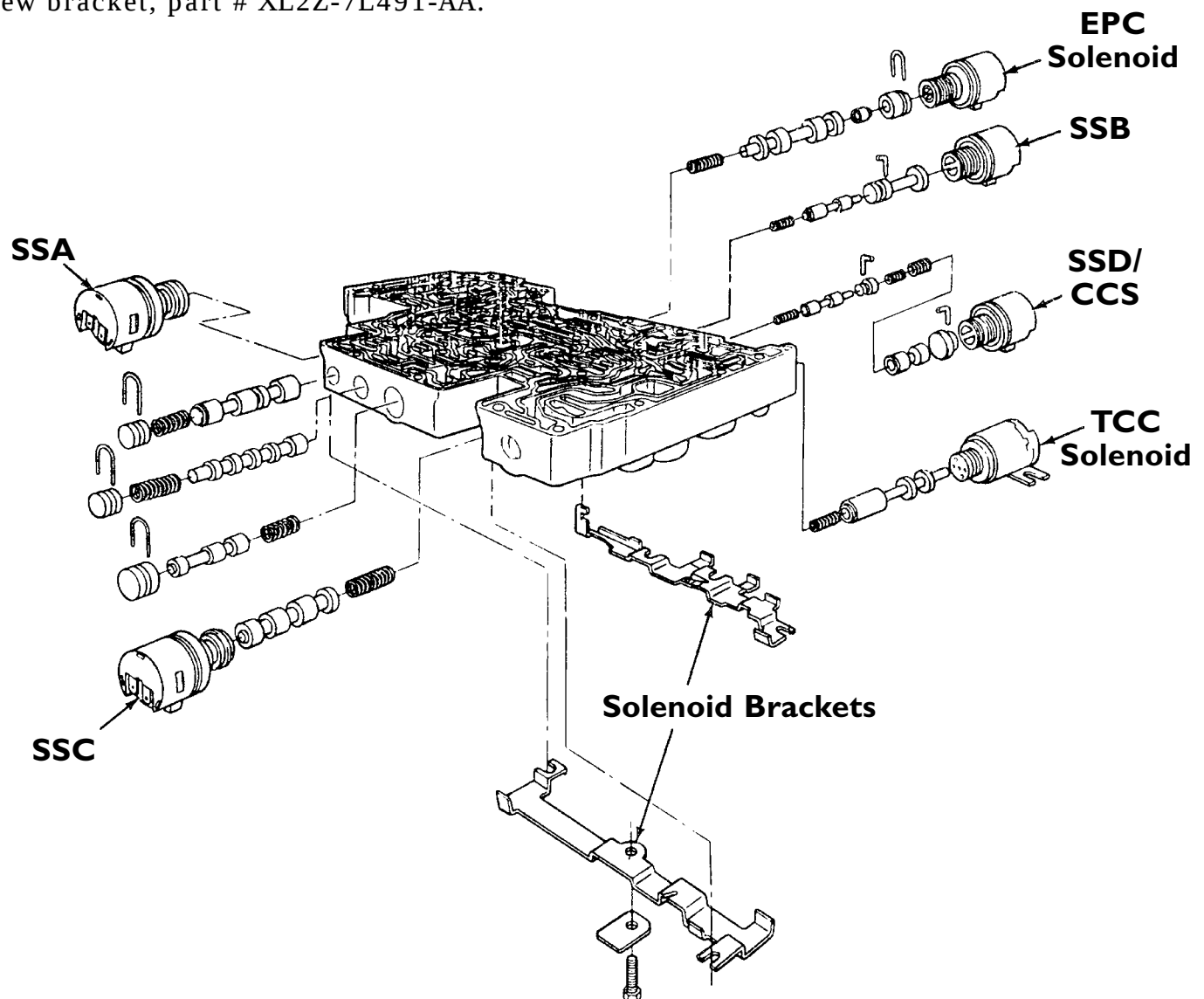
Low Line Pressure and No Line Rise

A number of 4R44E, 4R55E and 5R55E transmissions have been showing up with low line pressure and/or no line rise. Symptoms of these problems include:

- Soft shifts
- Slips on acceleration
- Ratio errors
- Burned clutches and bands

One common cause for this is a weak or bent EPC solenoid bracket. This allows the EPC solenoid to back out of the bore, causing line pressure to drop too low.

If you run into one of these units, check the bore and the solenoid for wear and install a new bracket, part # XL2Z-7L491-AA.



4R44E / 4R55E / 5R55E

Extension Housing Leaks

A number of 1998–2000 Rangers equipped with the 3.0L engine have been showing up with extension housing leaks. A further inspection reveals that the bushing has seized onto the driveshaft yoke, and spun in the housing.

One likely cause of this problem is the computer programming: These computers originally allowed the vehicle to reach speeds in excess of 95 MPH. The driveshaft yoke seizes in the bushing due to lack of lube at these speeds, which causes it to spin in the tail housing.

To correct the leak, replace the tail housing with part # F77Z-7A039-CA, and install an updated driveshaft.

To correct the actual source of the failure, have the processor reprogrammed to prevent the vehicle from reaching such high speeds.

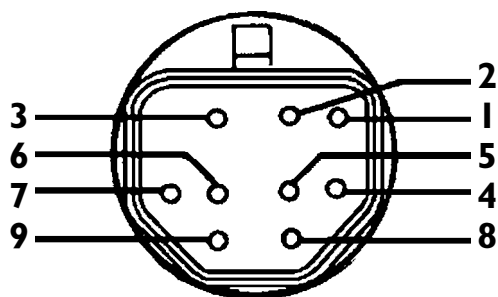
Updated Driveshafts	
Chassis Length	Ford P/N
112" Wheelbase	F87ZA-4602-AA
118" Wheelbase	F87ZA-4602-EA
126" Wheelbase	F87ZA-4602-PA

4R70W

Multiple Transmission Codes after Installing Exchange Transmission

In 1998 Ford's 4R70W changed its transmission connector. The illustrations show the terminal ID.

Pre-1998 Connector



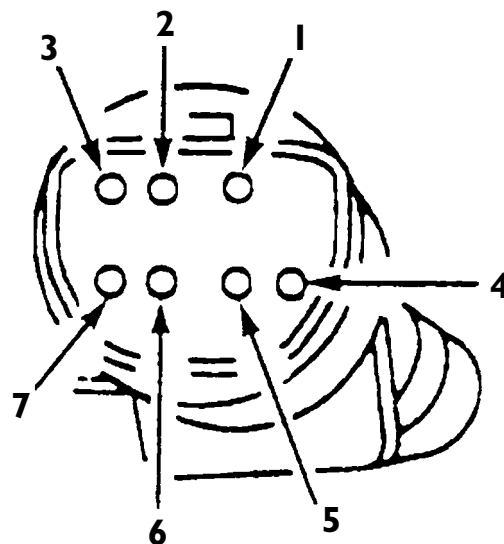
Pre-1998 4R70W Terminal Identification

Pin	Function	Pin	Function
1	Shift Solenoid 1	6	EPC B+
2	Shift Solenoid B+	7	TCC B+
3	TCC	8	TFT Ground
4	TFT	9	EPC Solenoid
5	Shift Solenoid 2		

1998-On 4R70W Terminal Identification

Pin	Function	Pin	Function
1	TFT Ground	5	EPC Solenoid
2	TCC Solenoid	6	Shift Solenoid 1
3	Solenoid B+	7	Shift Solenoid 2
4	TFT Signal		

1998-On Connector



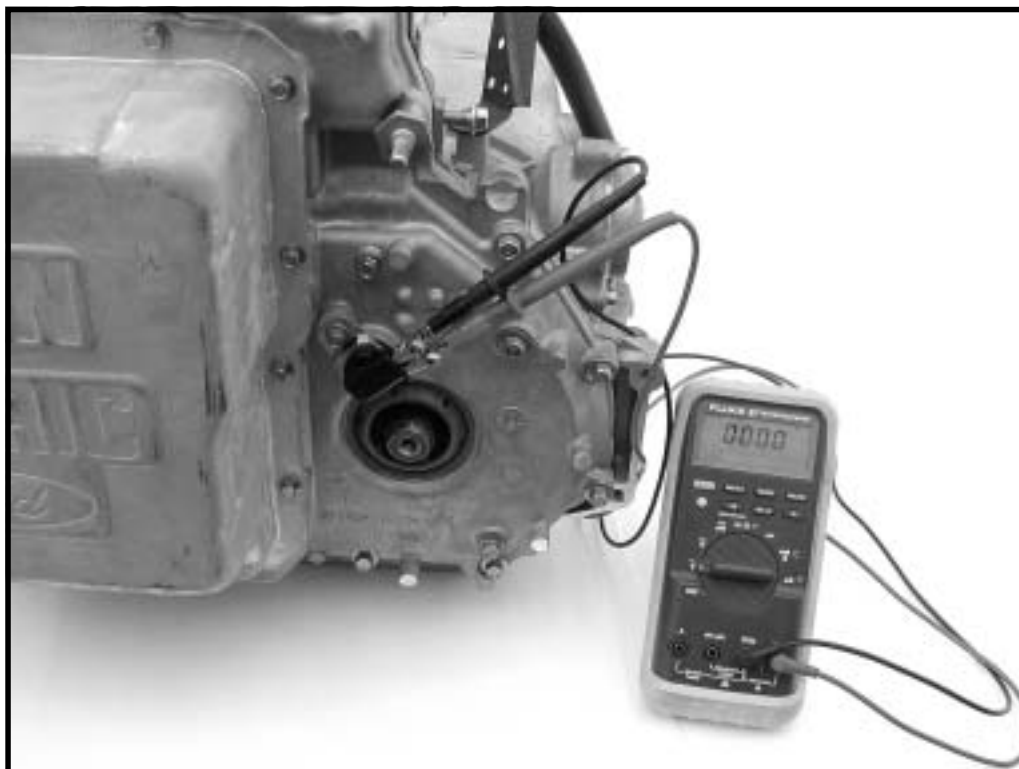
AX4N / AX4S

No Movement after Rebuild; Valve Body, Converter or Internal Problem

Whenever you're facing a unit that won't move after a rebuild, the first question is whether the problem is caused by the valve body, converter or an internal transmission problem.

The first step in this type of diagnosis is to monitor the signal from the input speed sensor with the transmission in gear and the drive wheels stopped. If you have a signal, the input shaft is turning, so the converter must be transmitting power: The problem has to be either in the valve body, or caused by an internal problem.

If there's no signal from the input speed sensor, the input shaft probably isn't turning. That means the problem is either in the valve body or converter; that's the problem we'll discuss here.



AX4N / AX4S

No Movement after Rebuild (continued)

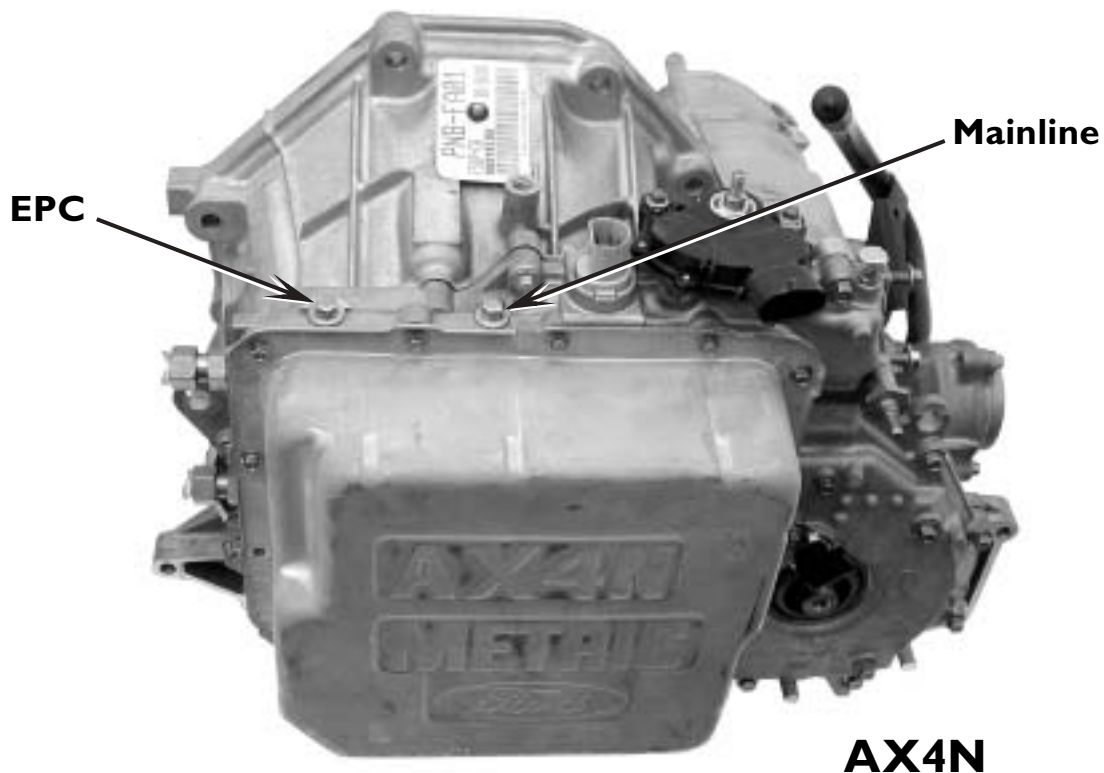
Converter or Control Problem?

Remove the cooler lines and start the engine. If cooler flow is good, the converter is full of oil. That means the valve body is doing its job, providing the oil necessary for the converter. So that solves the problem: The converter is the culprit.

If you get little or no cooler flow it means there's no converter charge. This can be caused by a pump volume problem or a sticking converter regulator valve.

Pump Volume Problem?

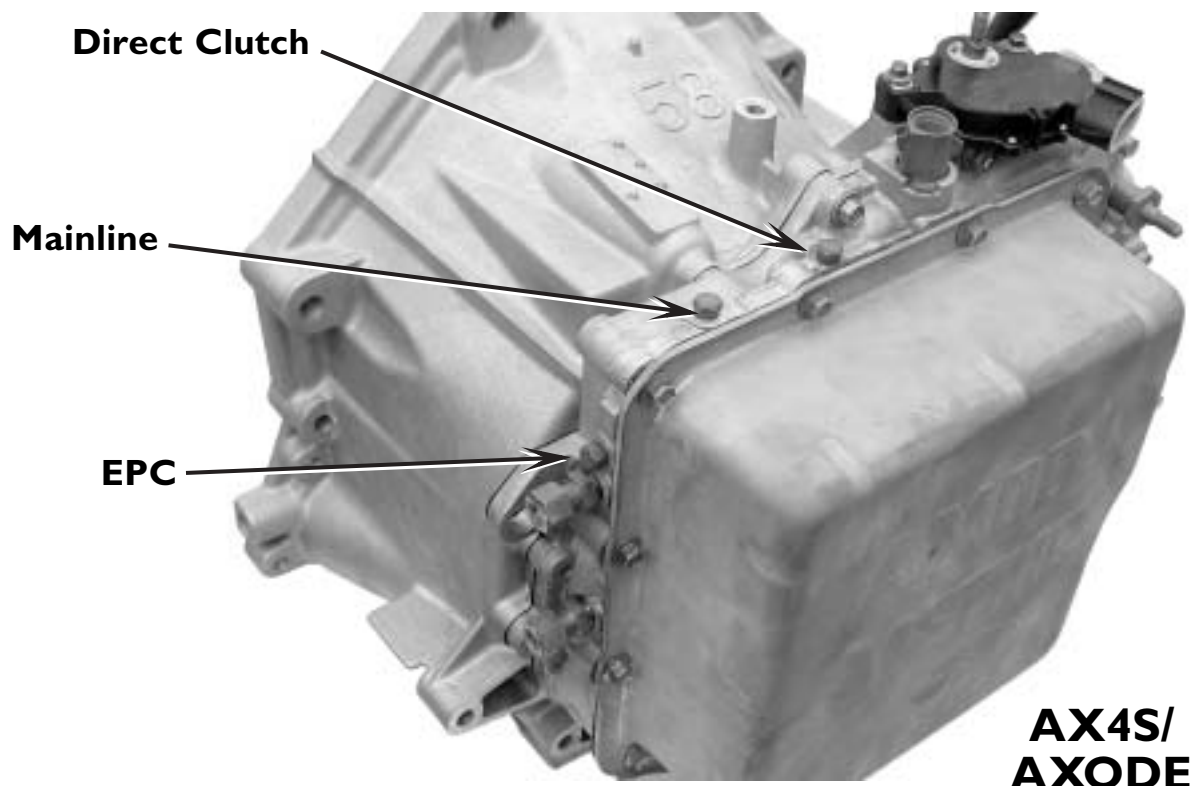
If the pump volume is unable to meet the demands of the pressure regulator valve, the mainline regulator valve will cut off converter charge to maintain as much pump volume as possible. Check mainline and EPC pressures.



AX4N / AX4S

No Movement after Rebuild (continued)

Pump Volume Problem (continued)



If mainline is extremely high, and...

- EPC Normal — May be a stuck pressure regulator valve.
- EPC High (up to but not over 100 PSI) — May be a bad EPC solenoid or electrical problem. Test accordingly.
- EPC High (over 100 PSI) — Remove the spring from the pressure failsafe valve and block the valve toward the retaining clip with a $\frac{5}{16}$ " rubber checkball.

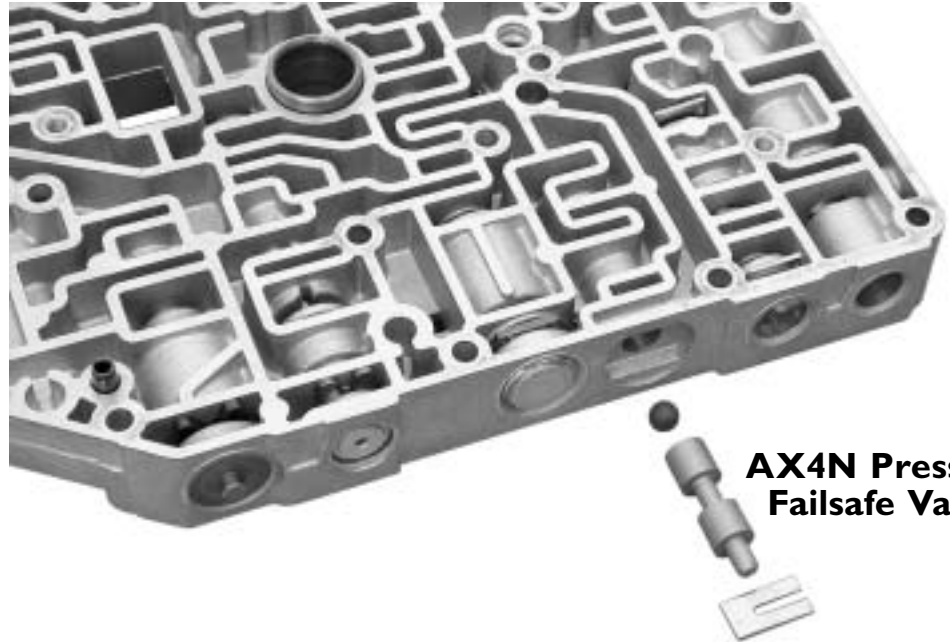
If mainline is extremely low, remove the side cover, and blow air into the mainline pressure tap. Look for signs of leaks in the mainline circuit. If there are no signs of leaks, you may have a bad pump.

AX4N / AX4S

No Movement after Rebuild (continued)

Pressure Problem

Remove the spring from the pressure failsafe valve and block the valve toward the retaining clip with a $\frac{5}{16}$ " rubber checkball.



AX4N Pressure Failsafe Valve



AX4S Pressure Failsafe Valve

AX4N / AX4S

No Movement after Rebuild (continued)

Converter Charge Problem

If mainline is normal, the converter charge passage in the pump shaft may be plugged, or the sleeve in the valve body rotated. Either of these conditions will cut off converter charge oil to the converter.

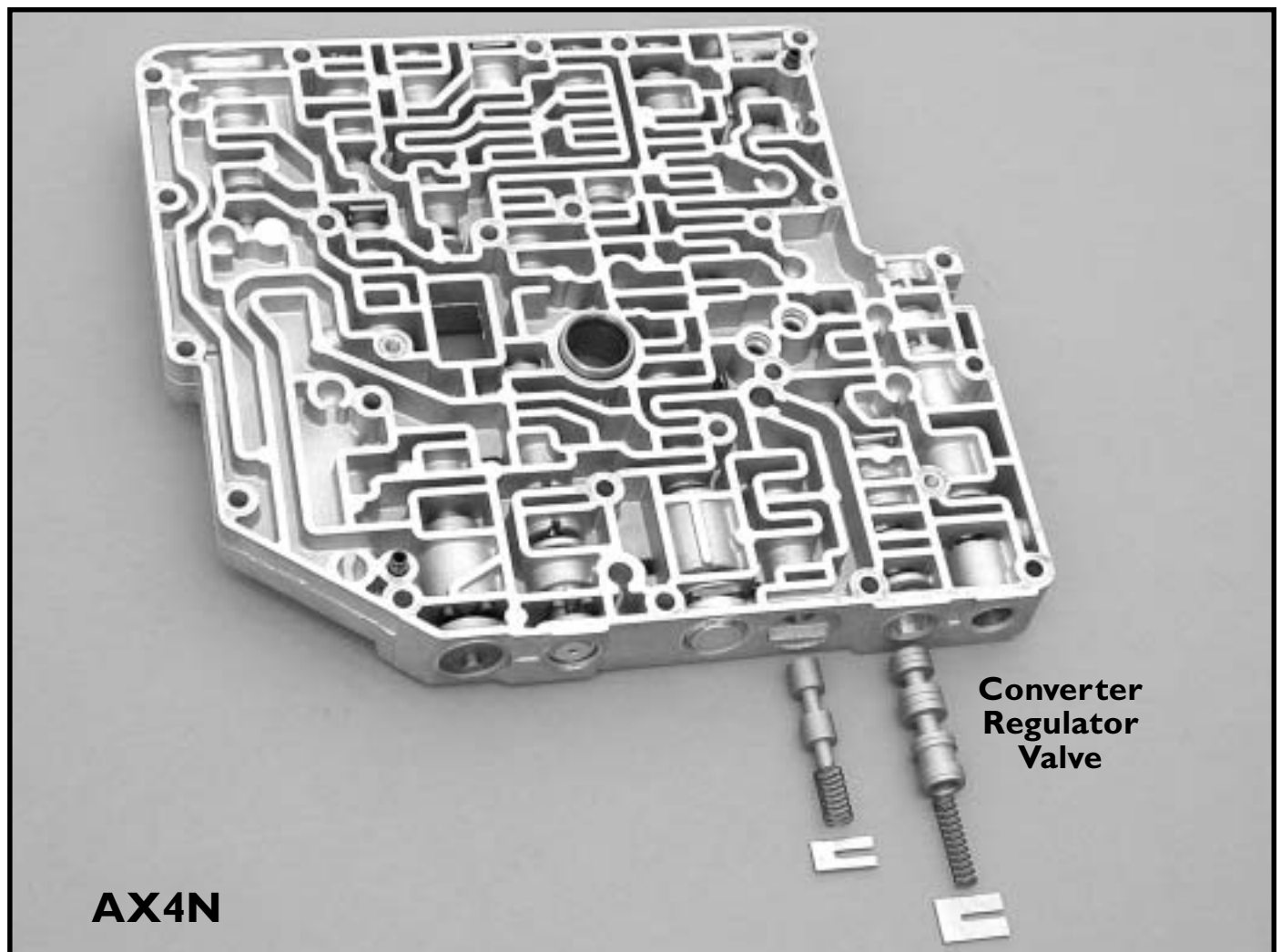


AX4N / AX4S

No Movement after Rebuild (continued)

Converter Charge Problem (continued)

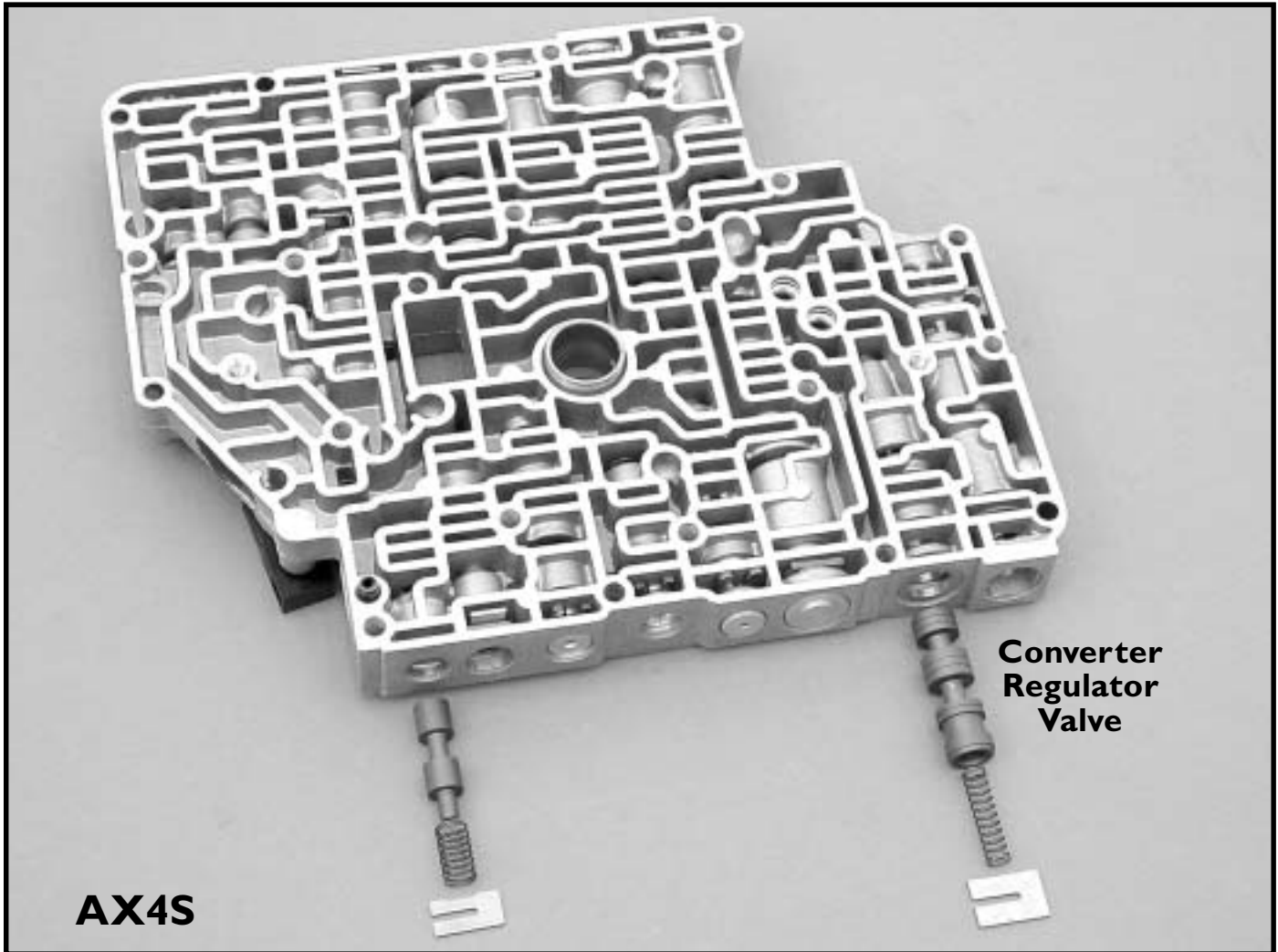
The most common cause of no converter charge is the converter regulator valve sticks and blocks converter charge oil. To correct this problem, install a 20%–30% heavier spring in the converter regulator valve.



AX4N / AX4S

No Movement after Rebuild (continued)

Converter Charge Problem (continued)

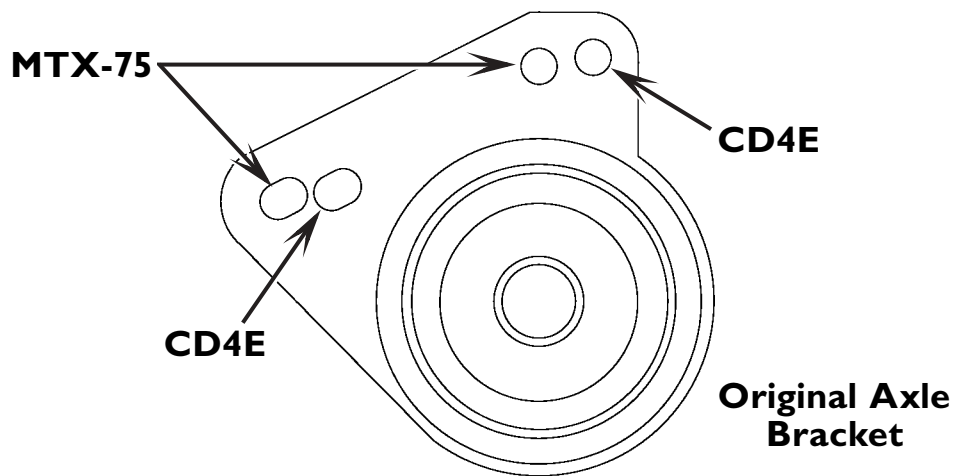


CD4E

Passenger Side Axle Seal Wear, Noise or Vibration

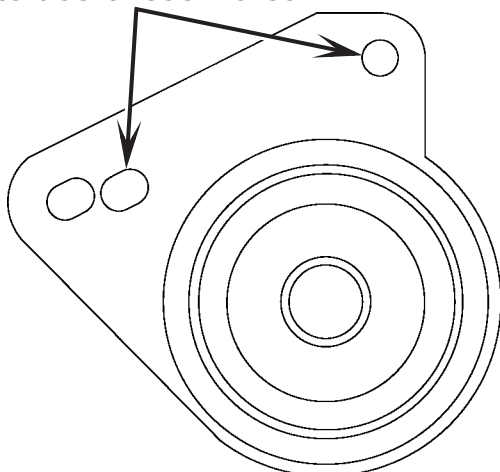
A number of 1995-96 Contours and Mystiques have been showing up with a noise or vibration when moving. An inspection usually reveals excessive wear on the passenger side axle seal.

A likely source of the problem is if the wrong bolt holes were used to mount the intermediate axle shaft bracket. The original bracket has two sets of bolt holes: One set is used for the MTX-75 (manual transaxle) and the other for the CD4E applications.



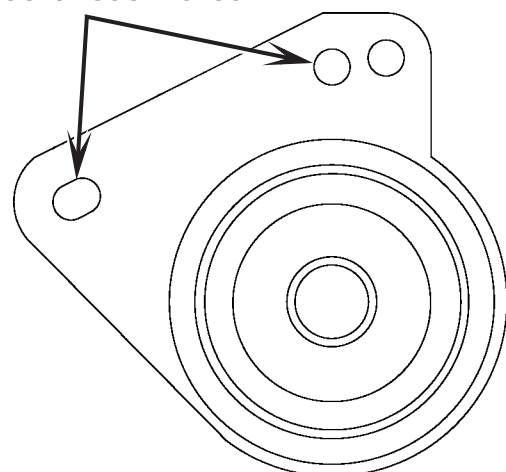
To prevent this from happening any more, two axle support brackets are now available: One is for the MTX-75, the other for the CD4E. But this only prevents the problem if you use the correct bracket.

The CD4E retainer bolts use these holes



CD4E: F5RZ-3A329-F

The MTX-75 retainer bolts use these holes



MTX-75: F5RZ-3A329-E

Chrysler Updates and Changes

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42LE

Differential Disassembly and Setup

In 1993, Chrysler introduced the 42LE in their Concord, Intrepid, and Vision models. In 1994 they added the New Yorker and LHS to the list.

Today the 42LE is becoming popular as a rebuild prospect, and with it come certain procedures that are critical for a successful rebuild. One of the most critical procedures is setting up the differential, pinion shaft, and output shaft.

The output shaft is simple; it's very similar to the 41TE. The pinion is similar to the 41TE, but because it's a helical-type arrangement you sometimes have to consider pinion depth. Finally, the differential; this is very similar to setting up the differential in a rear-wheel drive vehicle.

Output shaft preload, pinion preload, and differential preload and backlash are procedures you'll need to follow for every rebuild; we'll cover them later.

Setting pinion depth isn't necessary during most rebuilds. But sometimes you'll be faced with serious damage that requires replacement of the pinion bearings, or worse yet, replacement of the entire ring and pinion assembly. In either case, you must reset pinion depth. You must reset pinion depth anytime you replace the pinion shaft or pinion bearings.

And you'll need some special tools to set the pinion depth. Some of the tools are common, such as a dial indicator, bearing splitter, and miscellaneous hardware; you should already have these tools on hand.

But there are a few tools that are especially made just for this process; you'll need them as well. The picture shows all of the specialty tools we'll use for setting up the geartrain on this unit. Included are tools we'll use for setting the pinion depth, as well as all the procedures for adjusting preload and backlash.



42LE

Differential Disassembly and Setup (continued)

Differential Disassembly

Once you have the valve body, pump, clutch drums, clutch packs and planetary gearsets removed from the transaxle, removing the differential is easy and doesn't require any special tools:

- Remove the inner and outer differential adjuster ring clamps.



- Remove the outer differential adjuster ring from the differential side cover.
- Remove the differential side cover bolts, then carefully remove the side cover, without damaging the cover-to-case mating surfaces.



- Remove the differential, then remove the inner differential adjuster ring.

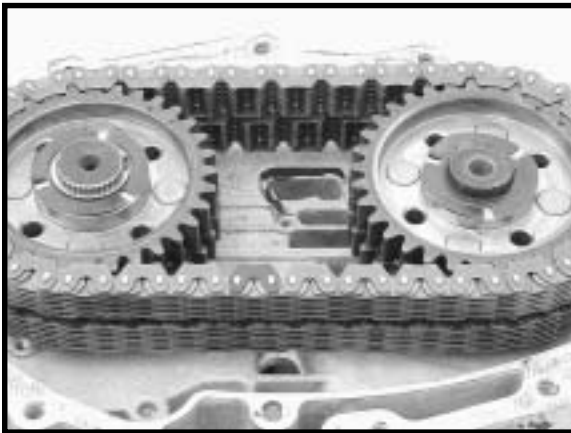
42LE

Differential Disassembly and Setup (continued)

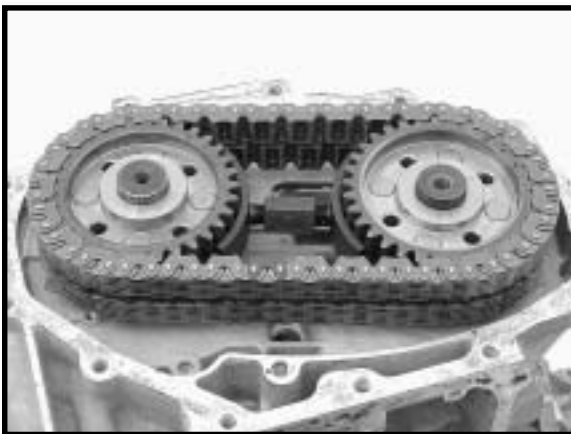
Differential Disassembly (continued)

The output shaft and pinion shaft are a bit more challenging. First you need to remove the drive chain:

- Measure the drive chain stretch to determine whether the chain is reusable (we'll discuss this procedure at the end of this section).
- Remove the snap ring and wave spring from each of the sprockets.



- Install the special sprocket spreader tool between the sprockets.



- Tighten the spreader until you can slide the sprockets up and off the output and pinion shafts easily.

42LE

Differential Disassembly and Setup (continued)

Differential Disassembly (continued)

- Remove and save the small plastic thrust washer from under the output sprocket.



The procedure for removing the nuts on the two shafts is the same:

- Grind or chisel the stake outward or off of each nut.
- Remove the nut from the shaft. Tools 6497 (nut wrench) and 6498 (shaft socket) make this easy. You may prefer using an impact gun to remove these nuts, but you'll need these tools during reassembly, so you might as well have them available.



42LE

Differential Disassembly and Setup (continued)

Differential Disassembly (continued)

Once you have the nuts removed from the shafts, press the two shafts out of the case. The output shaft pops right out through the case, usually requiring little more than a few good taps with a soft mallet to slide the shaft through the bearing. Locate and save the small selective metal shim from under the rear output shaft bearing.



The pinion shaft isn't quite as cooperative. Tap (or pound, if required) the pinion shaft toward the case to pop the rear bearing off the shaft.



But the rear bearing outer race — still in the case — prevents you from tilting the pinion shaft enough to remove it from the case. For this you'll need the bearing-race-removal tool (6577). This is a must-have tool; the race is almost impossible to remove without it. Here's how it works:

42LE

Differential Disassembly and Setup (continued)

Differential Disassembly (continued)

- Install the jaws of the tool on the bearing.
- Install the tool.
- Tighten the nut.

...and the race pops off. Retrieve the selective shim from under this bearing, too.



Remove the bearing shield plate from the case by gently tapping it out from behind, then you can easily remove the pinion shaft through the differential housing.



42LE

Differential Disassembly and Setup (continued)

Differential Disassembly (continued)

The next step is to remove the pinion shaft seals. For this you can simply use a large screwdriver or drift and drive them out through the rear of the case.



If the output shaft and front pinion shaft bearings and races are in good condition, there's no need to remove these three races from the case. The unit is now sufficiently disassembled, ready for parts inspection and cleaning.

NOTICE The bearing race bores in the case may have a layer of oxidation. This will cause an excessively tight fit when installing new bearing races. It's a good idea to lightly sand the case bores of any bearing races that you removed.

42LE

Differential Disassembly and Setup (continued)

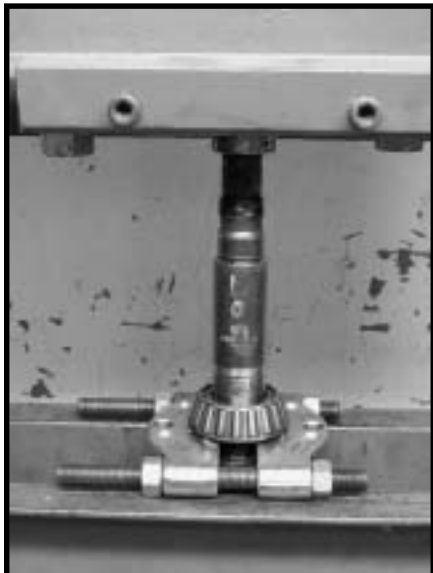
Checking and Adjusting Pinion Depth

There's no need to check the pinion shaft depth unless the pinion shaft bearings, pinion and ring gears, or case need to be replaced. If these parts are okay, skip ahead to the next section. If you do need to perform this check, we'll assume that you're replacing the pinion bearings too, so we'll also cover how to do that.

- Remove the pinion shaft front bearing race from the case using a drift or long punch.



- Lightly sand the race bore to remove any coating or oxidation.
- Remove the pinion bearing from the pinion shaft with a common bearing splitter and press.



42LE

Differential Disassembly and Setup (continued)

Checking and Adjusting Pinion Depth (continued)

There's a shim between the bearing and the pinion gear: This is the selective washer to check if you replace the pinion shaft or its bearings.

Install the new pinion shaft front bearing race into the case. You'll need to keep the pressing force on the race in line with the race bore, to keep the race from jamming partway into place. But this isn't always easy to do. Chrysler's special tool set (6494) is designed specifically for this purpose. It works great and ranks quite high on our 'Must Get' tools list. You also need part of this tool set to perform the actual pinion depth measurement, which we'll discuss next.



42LE

Differential Disassembly and Setup (continued)

Checking and Adjusting Pinion Depth (continued)

Make sure that the bearing race seats all the way down into its bore by trying to slip a thin feeler gauge between the race and the end of the case bore. If the feeler gauge goes in, the race isn't home yet. Keep pressing or bashing until the race is fully seated.

**IMPORTANT**

The tests and adjustments for pinion depth, differential preload, pinion shaft preload, and differential backlash must be performed in the order presented. Neither pinion depth nor pinion shaft preload can be checked with the differential in the case, differential preload can't be checked with the pinion shaft in the case, and so on.

42LE

Differential Disassembly and Setup (continued)

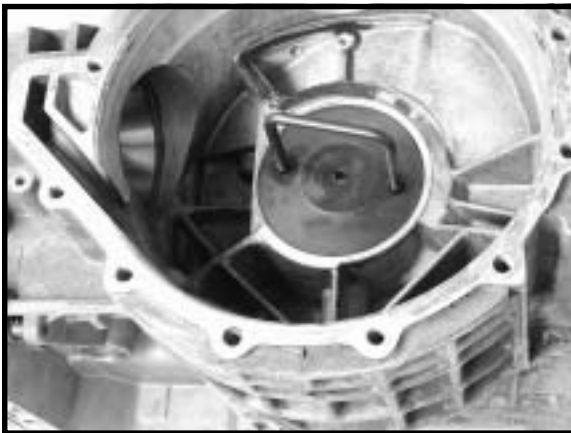
Setting Pinion Depth

You'll need special tool 6549 for this, which is actually a kit that includes several tools. You will also need tool 6494-2, which is a large, disk-shaped part of tool 6494, the tool used to press the front pinion bearing race into the case.



The procedure is fairly simple:

- Install the centering block into the case, making sure it bottoms out in the adjuster bore.

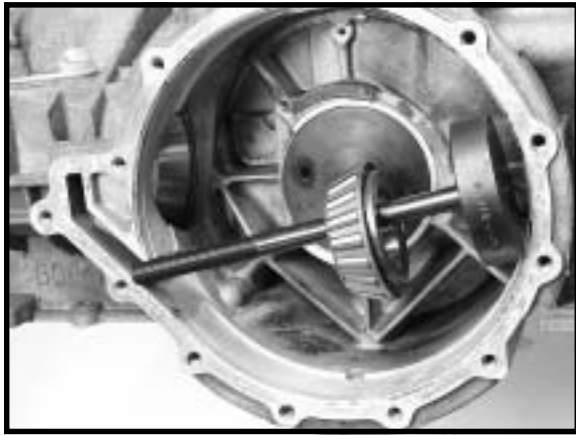


42LE

Differential Disassembly and Setup (continued)

Setting Pinion Depth (continued)

- Place the new pinion shaft front bearing on the gauge disk (6549-3) and threaded rod included in the kit, and slide them into the case.



- Set tool 6494-2 into the rear pinion bearing race bore, and run the special nut from the 6549 kit down the threaded rod, into tool 6494-2. Center the gauge disk on the bearing as you finger-tighten the nut.



42LE

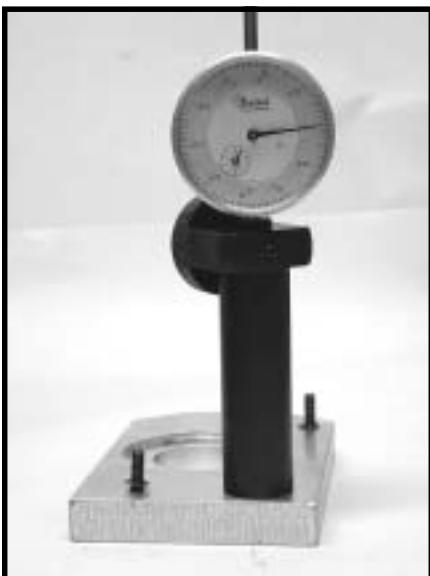
Differential Disassembly and Setup (continued)

Setting Pinion Depth (continued)

- Insert your dial indicator into the locating block from the kit, locking it into place with the block's set screw. Make sure that your indicator doesn't protrude beyond the back of the locating block. Remove the tip from your indicator and screw in the dial indicator extension from the kit.



- Zero-out your dial indicator, using the tube-shaped special tool from the kit. Place your dial indicator through the tube, and then lay the fixture on a flat surface. Press down on your indicator and zero the dial indicator, then lock or tape the dial face in place so it doesn't move.



42LE

Differential Disassembly and Setup (continued)

Setting Pinion Depth (continued)

- To make your measurement, insert the dial indicator locating block into the center hole of the centering block in the case. Holding the locating block against the centering block, slowly rotate the indicator, sliding the indicator peg back and forth across the gauge disk to achieve the reading closest to zero.



Interpreting Your Reading

Since different types of indicators use different types of scales, which can involve different ways of interpreting readings, it's easy to get confused when trying to figure out your actual measurement. We're going to try to make this a bit easier for you.

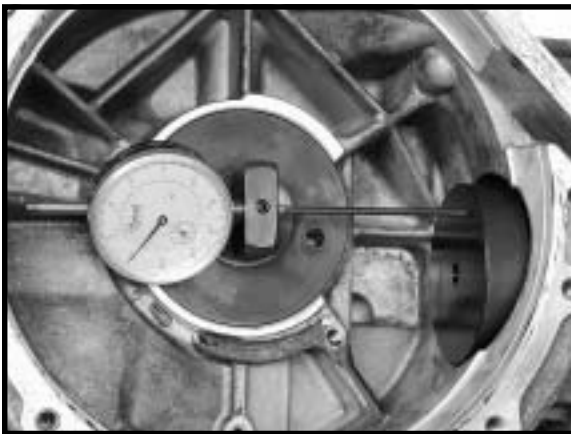
Most dial indicators rotate clockwise when you push the indicator peg toward the dial. If yours does, you're looking for how many thousandths of an inch counterclockwise your needle is from zero.

42LE

Differential Disassembly and Setup (continued)

Setting Pinion Depth (continued)

If your indicator rotates counterclockwise when you push it, count the thousandths clockwise from zero to the measurement. The indicator used in our example rotates clockwise.



Although the indicator needle is pointing to 0.060" on the dial, we're going to ignore that and count counterclockwise from zero, arriving at a measurement of 0.040".

One clue: Your measurement must be somewhere within the 0.023"–0.047" range. If your reading is substantially different, then either you're measuring improperly; interpreting your measurements wrong; or the pinion shaft front bearing, race or gauge disk is out of position. Check the bearing race; it may not be pressed all the way into its bore.

To select the proper pinion depth shim, you'll need two things:

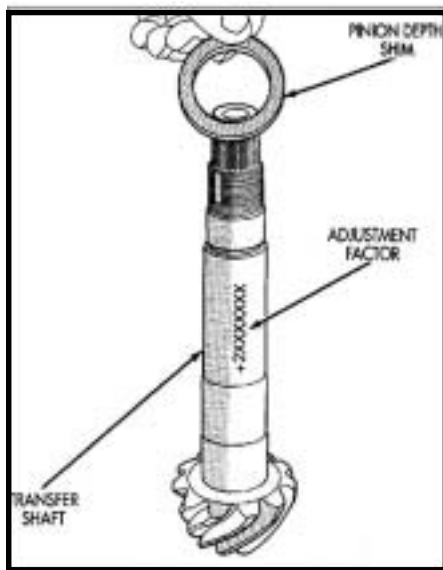
1. The measurement value from your dial indicator reading, and...
2. The pinion adjustment factor, which you'll add to or subtract from your measurement, to give you the required shim size.

42LE

Differential Disassembly and Setup (continued)

Setting Pinion Depth (continued)

The pinion adjustment factor is the number painted on the pinion shaft, with either a plus or a minus sign in front of it. If your shaft doesn't have a number on it, the factor is zero. Ready for some twisted logic?



- If the adjustment factor number on the shaft has a minus in front of it, *add* that number to your measurement to determine the shim size.
- If the shaft number has a plus, *subtract* that number from your measurement to determine the shim size.

The shaft used has a minus 3 printed on it, so we add 0.003" to the reading of 0.040", for a required shim size of 0.043".

There are 17 shims to choose from, in increments of about 0.001", from 0.027" to 0.045". Once you've installed the correct shim on the pinion shaft and pressed the bearing into place, you're done with pinion depth.

42LE

Differential Disassembly and Setup (continued)

Differential Preload

- Install the O-ring and seal onto the inner differential adjuster ring.

CAUTION Support the outside diameter of the inner adjuster while pressing the seal in, and only drive the seal in flush. It's easy to break the center out of the adjuster if you drive the seal too far into its bore.



- Lube the O-ring and adjuster threads with gear lube, and then install the adjuster into the case using special tool (6502C) until it's just flush with the differential side of the case.



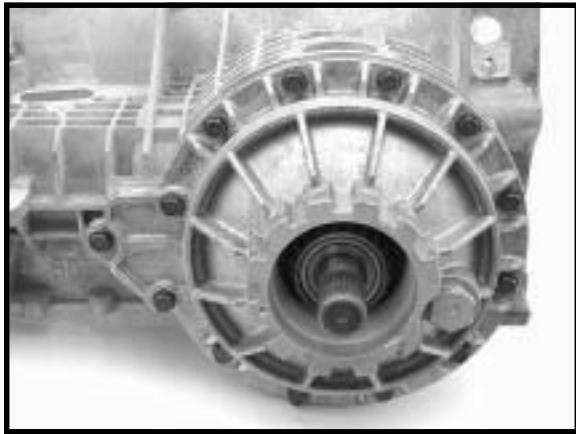
- Lube the differential bearings with gear lube, then place the differential carrier into the case.

42LE

Differential Disassembly and Setup (continued)

Differential Preload (continued)

- Check the cover and case mating surfaces for damage on the contact area. Repair any damage that would keep the cover from lying flat on the case.
- Install the differential cover without any sealer, and tighten the bolts to 20 ft-lbs.



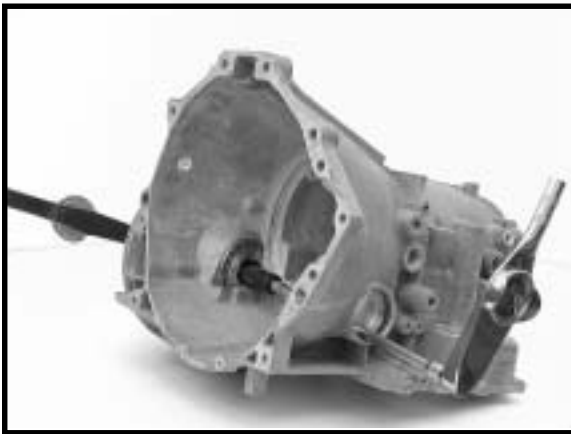
- Install the O-ring on the outer adjuster, but don't install the seal yet.
- Lube the O-ring and adjuster threads with gear lube.
- Install the outer adjuster into the case, being careful not to damage the O-ring as it enters the bore. You may want to use the side of a pick tip to help feed the ring into the bore.
- Use an inch-pound torque wrench with special tool 6503 to tighten the outer adjuster until you start to feel a bit of preload on the differential bearings. Using the torque wrench will make sense in just a moment.

42LE

Differential Disassembly and Setup (continued)

Differential Preload (continued)

Now you'll set the turning torque for the differential. This is a bit tricky so follow closely: Use tool 6548, with a long extension and an inch-pound torque wrench, to measure the differential turning torque.

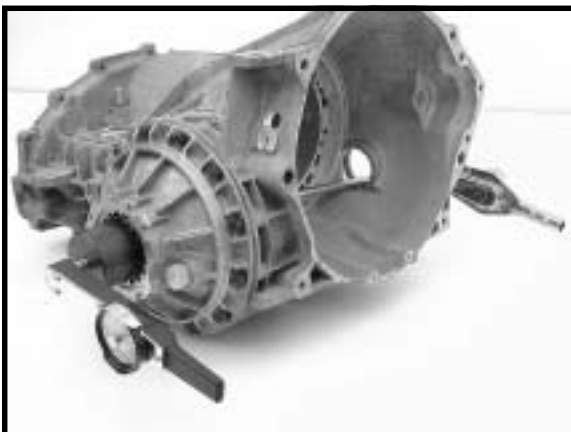


The proper turning torque for the differential carrier is:

- 19 to 23 inch-pounds for *new* bearings.
- 6 to 10 inch-pounds for *used* bearings.

Remember, you're checking for turning torque; in other words, the torque required to *keep* the differential turning, not starting torque, which is the torque required to *start* the differential turning.

While you're measuring the turning torque, tighten (or loosen) the outer adjuster to change the amount of turning torque.



42LE

Differential Disassembly and Setup (continued)

Differential Preload (continued)

Keep in mind that you're using an inch-pound torque wrench on the outer adjustment tool (6503). What you're doing is measuring how much torque it takes to tighten the outer adjuster to achieve the proper differential turning torque — usually requiring about 125–150 in-lbs of torque on the outer adjuster ring. Here's why you're checking this torque:

After you install the pinion shaft, you won't be able to measure the differential turning torque by itself, because the differential and pinion shaft will be engaged. But now we know how much adjuster torque is needed to achieve the correct differential turning torque! You'll use the torque applied to the outer adjuster to get back to the right differential turning torque, even though the pinion shaft is installed and engaged with the differential.

Once you've recorded the adjuster torque needed to achieve the correct differential turning torque, remove the outer adjuster from the differential cover. Then remove the differential cover and differential. There's no reason to remove the inner adjuster, so just leave it in the case.

42LE

Differential Disassembly and Setup (continued)

Pinion Shaft Preload

Set the pinion shaft into the case, and hold it in place with the support fixture tool (6595). Or you can use a substitute that will load the shaft against the front pinion bearing race firmly enough during seal installation.



- Slide the seal protector tool (6592) onto the pinion shaft so you don't damage the seals.
- Install the two pinion shaft seals one at a time using the special driver tool (6567A), which also controls the crucial seal installation depth.

42LE

Differential Disassembly and Setup (continued)

Pinion Shaft Preload (continued)

Notice that the two seals have a different outside diameter; install the smaller of the two seals with the ridges on one side of it first, closer to the differential. These ridges must face away from the differential, with the seal lip and garter spring facing toward the differential.



The larger seal installs with its back against the smaller seal back, seal lip and garter spring facing away from the differential.



- Install the bearing shield into the case.

42LE

Differential Disassembly and Setup (continued)

Pinion Shaft Preload (continued)

- Slide the selective shim over the pinion shaft. Don't worry about which selective washer you use just yet; use the washer that came with the unit.



- Drive the rear pinion shaft bearing race into the case bore, making sure it goes all the way down against the shoulder in the bore.
- Place the rear pinion bearing onto the shaft, then start a new pinion shaft nut on the shaft threads.

CAUTION Never beat on the bearing; the shaft is still being held by the support fixture at the other end of the shaft. You can use the nut to press the bearing into position on the shaft.



42LE

Differential Disassembly and Setup (continued)

Pinion Shaft Preload (continued)

To tighten the pinion shaft nut, you'll need the same two special tools used to remove it: the socket for turning the shaft (with a torque wrench this time), and the holding wrench for the nut.



The torque for the nut is 200 ft-lbs, and the turning torque for the pinion shaft is 1 to 8 inch-pounds. Measure the turning torque repeatedly as you tighten the nut.

- If you exceed the turning torque specification without reaching the tightening torque of the nut, stop and install a thicker selective washer.
- If you reach the 200 ft-lbs and have endplay on the shaft, you'll need a thinner selective washer.

Once you achieve both the proper turning torque and tightening torque, stake the nut so it won't back off. Chrysler has a special tool (6589) that makes staking the nut easy.



42LE

Differential Disassembly and Setup (continued)

Differential Backlash

To set differential backlash:

- Place the differential into the case.
- Clean and dry the differential side cover and case mating surface.
- Apply a thin bead of silicone to the side cover and install it onto the case.
- Tighten all the cover bolts to 20 ft-lbs.
- Tighten the outer adjuster until you get to the specification you recorded earlier. Remember, you can't check the turning torque of the differential, so you must tighten the adjuster to the specification you found earlier; this should provide the correct differential turning torque.



42LE

Differential Disassembly and Setup (continued)

Differential Backlash (continued)

Okay, once again the next part gets a bit tricky, so follow closely. You must now set the differential backlash:

- Place a dial indicator through the access hole, with the tip of the indicator resting on the side of one of the differential ring gear teeth.



- Reach into the access hole and move the differential ring gear back and forth while you check the indicator. Make sure the pinion shaft doesn't move while you're checking the backlash.

The proper backlash is 0.0045" to 0.0105".

If the backlash is incorrect, move the differential carrier closer to, or away from, the pinion shaft.

To move the carrier toward the pinion, turn the inner adjuster *away* from the carrier a small amount, then turn the outer adjuster *toward* the carrier the exact same amount, until you reach the proper adjuster torque. Check the backlash again.

- Moving the carrier closer to the pinion shaft *reduces* backlash.
- Moving the carrier away from the shaft *increases* the backlash.

42LE

Differential Disassembly and Setup (continued)

Differential Backlash (continued)

It's a pretty weird tool setup, so it may take some practice to get reliable readings. Once you have the backlash correct, recheck the tightening torque of the outer adjuster.



Remember, as you're adjusting the differential backlash, you're changing the turning torque on the differential, because you're moving the adjusters. Once you have both the backlash and adjuster torque set properly, you're finished with this part of the setup procedure: Secure the adjusters with the adjuster clamps.

Install the stub shaft seal protector over the differential stub shaft and install the seal into the outer adjuster.



42LE

Differential Disassembly and Setup (continued)

Output Shaft Preload

The next part of the process is setting up the output shaft. You must set the turning torque of the output shaft, just as you did the pinion shaft.

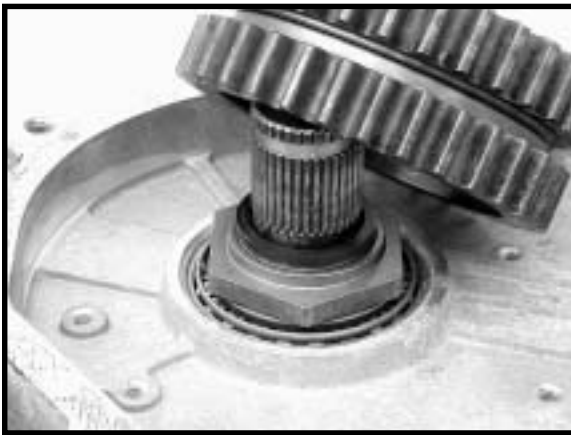
The procedure for setting the output shaft turning torque is exactly the same as it was for the pinion shaft. You use the same tools, the turning torque is the same, and you measure it the same way. And since the procedure is virtually identical, refer to the pinion shaft preload section for this procedure.

42LE

Differential Disassembly and Setup (continued)

Sprockets and Chain

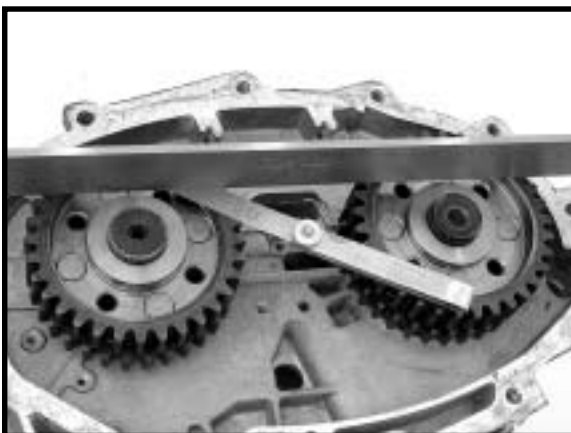
The output sprocket uses a selective shim under it to raise or lower the output sprocket to align the two sprockets.



To set up and install the sprockets and chain:

- Place the shim that came with the unit on the output shaft.
- Place the sprockets on their shafts, without the chain in place.
- Place a straightedge across the sprockets. Carefully press on the straightedge, first over one sprocket, then the other.

The sprockets may be perfectly aligned, but it's doubtful. You'll most likely find that when you press the straightedge over one sprocket, there's clearance between the other sprocket and the straightedge. If so, measure this clearance with a feeler gauge. You want less than 0.015" clearance between the sprocket and straightedge.



42LE

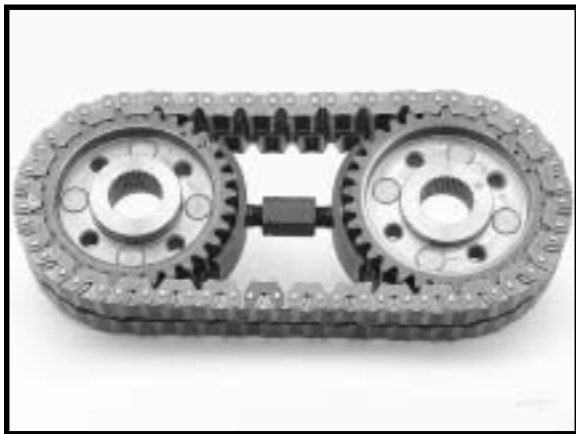
Differential Disassembly and Setup (continued)

Sprockets and Chain (continued)

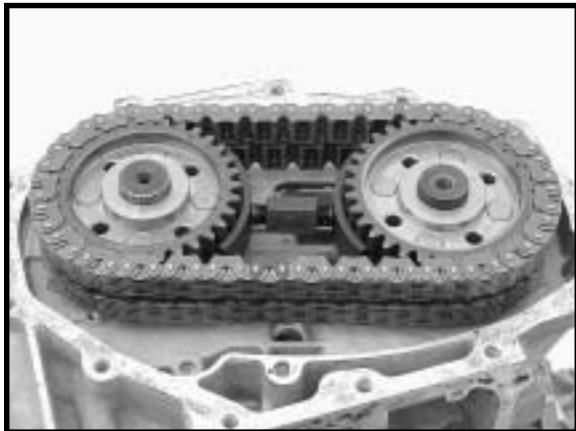
If the clearance is more than 0.015", replace the selective washer under the output sprocket with a different thickness washer, until you get the right clearance.

Once you have the sprockets aligned, it's time to install the chain:

- Place the chain on the sprockets.
- Use the special chain sprocket-spreading tool (6550) to spread the sprockets apart; tightening the chain and place this assembly on the shafts.



- Loosen the tool while you turn the two shafts. Once the splines of the sprockets and shafts line up, the sprockets and chain will slide right down onto the shafts.



- Install the spring washers and snap rings that secure the two sprockets.

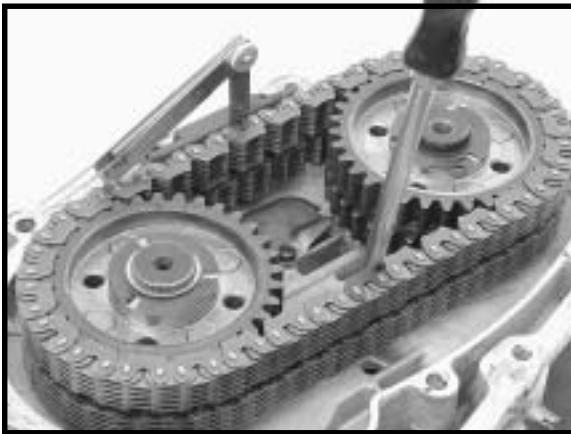
42LE

Differential Disassembly and Setup (continued)

Sprockets and Chain (continued)

The last measurement is the chain snubber clearance:

- Bolt the snubber in place.
- Tighten the chain by prying on the side of the chain opposite the snubber with a screwdriver or bar, then measure the clearance between the snubber and chain. Snubber-to-chain clearance should be 0.000"–0.030". If you have too much clearance, replace the snubber.



42LE

Differential Disassembly and Setup (continued)

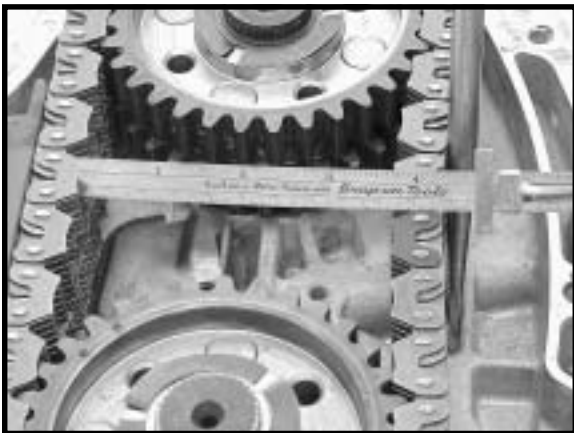
Sprockets and Chain (continued)

While we're at the chain, let's look at how you measure it for too much stretch:

- Pry on the chain the same way you did for checking snubber clearance.
- Measure the distance across the inside of the chain.



- Pry the same side of the chain in the opposite direction, and measure the distance across the inside of the chain again.



If you have a difference of more than 1" between the two measurements, replace the chain. Naturally, now isn't the time to check for chain stretch; you should have done that before you took the unit apart. But this is a great time for showing you how to do it.

42LE

Differential Disassembly and Setup (continued)

Sprockets and Chain (continued)

This last page of the section provides charts of the shim thicknesses available for the differential setup procedure.

Transfer Shaft Rear Shims (Inches)

0.139–0.140	0.150–0.150	0.161–0.162	0.173–0.174
0.140–0.141	0.151–0.152	0.163–0.163	0.174–0.175
0.141–0.142	0.152–0.153	0.164–0.165	0.176–0.176
0.142–0.143	0.153–0.154	0.165–0.166	0.177–0.178
0.143–0.144	0.154–0.155	0.166–0.167	0.178–0.179
0.144–0.144	0.155–0.156	0.167–0.168	0.179–0.180
0.145–0.146	0.157–0.158	0.169–0.169	0.180–0.181
0.146–0.147	0.158–0.159	0.170–0.171	0.181–0.182
0.147–0.148	0.159–0.160	0.171–0.172	0.183–0.183
0.148–0.149	0.160–0.161	0.172–0.173	0.184–0.185

Output Shaft Rear Shims (Inches)

0.203–0.204	0.213–0.214	0.222–0.223	0.232–0.233
0.205–0.205	0.214–0.215	0.223–0.224	0.233–0.234
0.206–0.207	0.215–0.216	0.225–0.226	0.234–0.235
0.207–0.208	0.216–0.217	0.226–0.227	0.235–0.236
0.208–0.209	0.218–0.218	0.227–0.228	0.237–0.237
0.209–0.210	0.219–0.220	0.228–0.229	0.238–0.239
0.211–0.211	0.220–0.221	0.230–0.230	
0.212–0.213	0.221–0.222	0.231–0.232	

Output Sprocket Spacer Shims (Inches)

0.104–0.112	0.120–0.128	0.145–0.153	0.162–0.170
0.112–0.120	0.137–0.145	0.153–0.161	

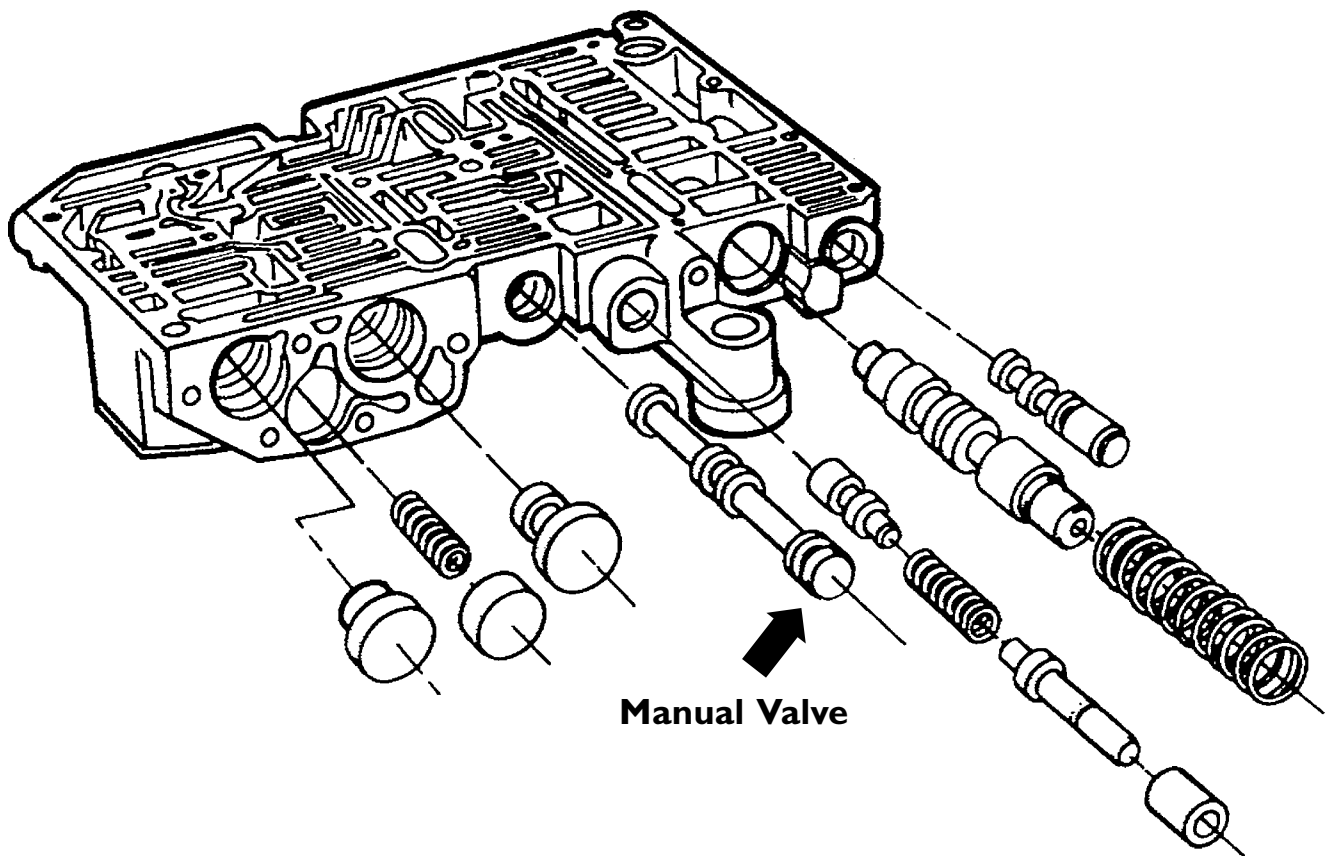
These procedures are time consuming and precise, but they really are necessary. The tools used in these procedures run about \$1000. Naturally you can improvise for some of them, but with others you'll have to get the tools, because the right tools will let you do the job right... the first time.

42RH

Worn Manual Valve

Dodge has a recall on 1991 and 92 Dakotas with the 42RH transmission. The problem has to do with the manual valve wearing out. Dodge offers a replacement valve under kit number CBMT8710.

You may not want to purchase the complete kit, since it includes the pan gasket, a filter and some other seals that you probably already have. But always check the manual valve for wear.



46RE / 47RE

Reverse Buzz

This complaint is very common. There have been a number of fixes designed to help combat this complaint, such as:

- Pressure Regulator Valve (Steel OEM): 4130169
- Brass Screen (Aftermarket): Ask your supplier
- Servo Kit (OEM: Reverse Band Anchor, Reverse Boost Valve and Plug): 04897877AA
- Reverse Boost Sleeve (OEM): 52118761
- Reverse Boost Plug (OEM): 52118763
- Worn Manual Valve: Replace the valve body or get a good valve

All these repairs have fixed the problem at one time or another... but none of them works every time.

Pay special attention to the pump gears: Any wear across the face of the teeth can and will cause a buzz. Using the higher volume pump on 46RE and 47RE units will usually take care of this problem.



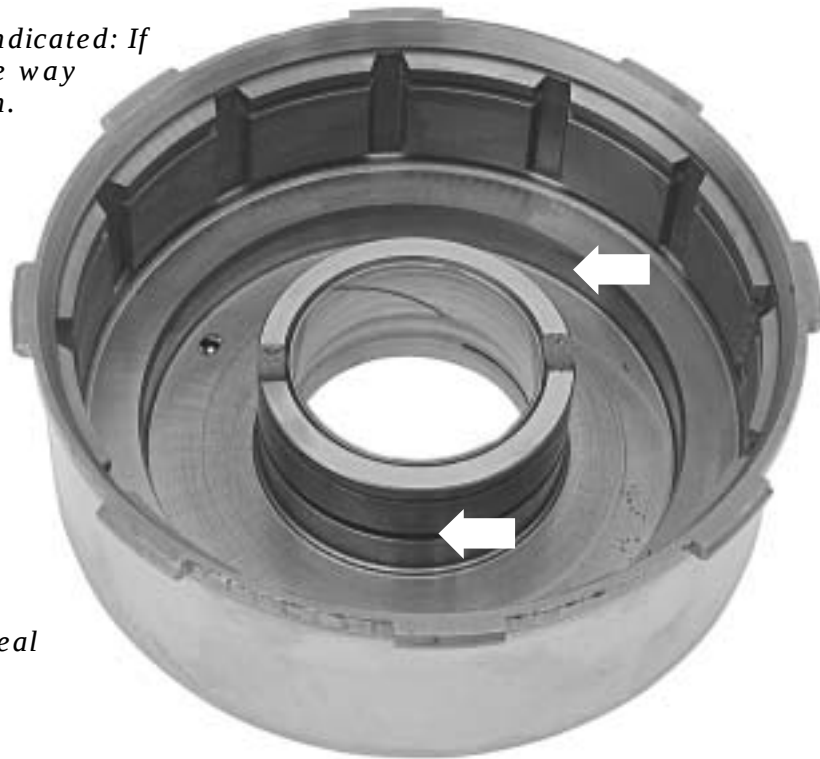
46RE and 47RE

Front Clutch Failure

Make sure you inspect the seal surface of the front clutch carefully during every rebuild. Some front clutch drums weren't finished properly, so they wear out the piston seal. If the seal surface isn't smooth all the way around, replace the front clutch drum.

And make sure the inner seal isn't recessed too deeply into the seal groove. Some drums have seal grooves that are cut too deep, which prevents the seal from making adequate contact with the piston.

Check the seal surface indicated: If they aren't smooth all the way around, replace the drum.



And make sure the seal protrudes slightly.

45RFE

New Product Information

The 45RFE is used in the 1999-on Jeep Grand Cherokee, equipped with the 4.7L engine. The 42RE is still used with the smaller 4.0L engine in the Jeep Grand Cherokee. This can lead to some problems when giving quotes for servicing these vehicles. Make sure of the engine size to determine which unit you're dealing with.

Clutch Application							
Shifter Position		Low/ Reverse	Second	Overdrive	Fourth	Underdrive	Reverse
Park							
Reverse							
Neutral							
Overdrive	1 st	★					
	2 nd						
	2 nd Prime						
	3 rd						
	4 th						
	Limp In						
Manual 2	1 st	★					
	2 nd						
	Limp In						
Manual Low							

★ L/R clutch is only applied when the output shaft speed is below 150 RPM.

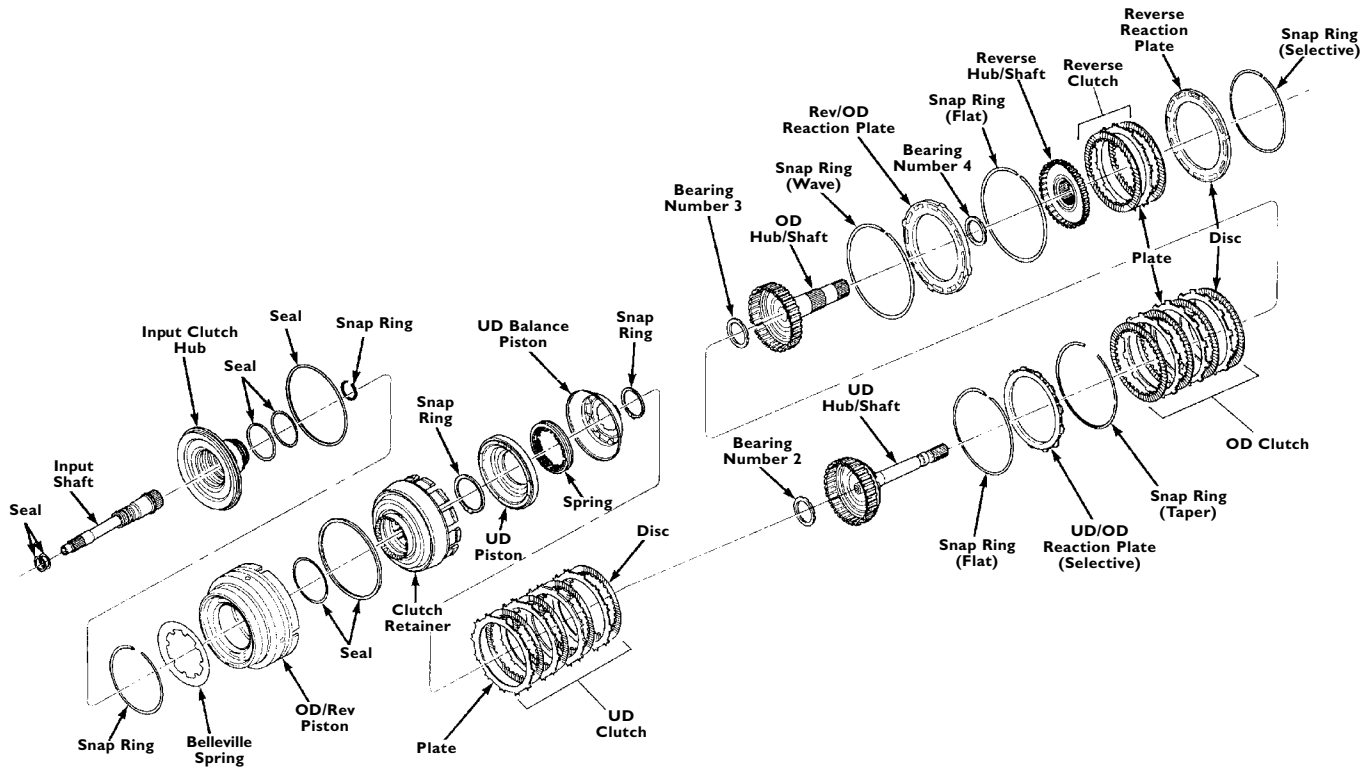
Gear Ratios	
Gear	Ratio
1 st	3.00:1
2 nd	1.67:1
2 nd Prime	1.50:1
3 rd	1.00:1
4 th	0.75:1
Reverse	3.00:1

45RFE

New Product Information (continued)

The primary mechanical components of the transmission are:

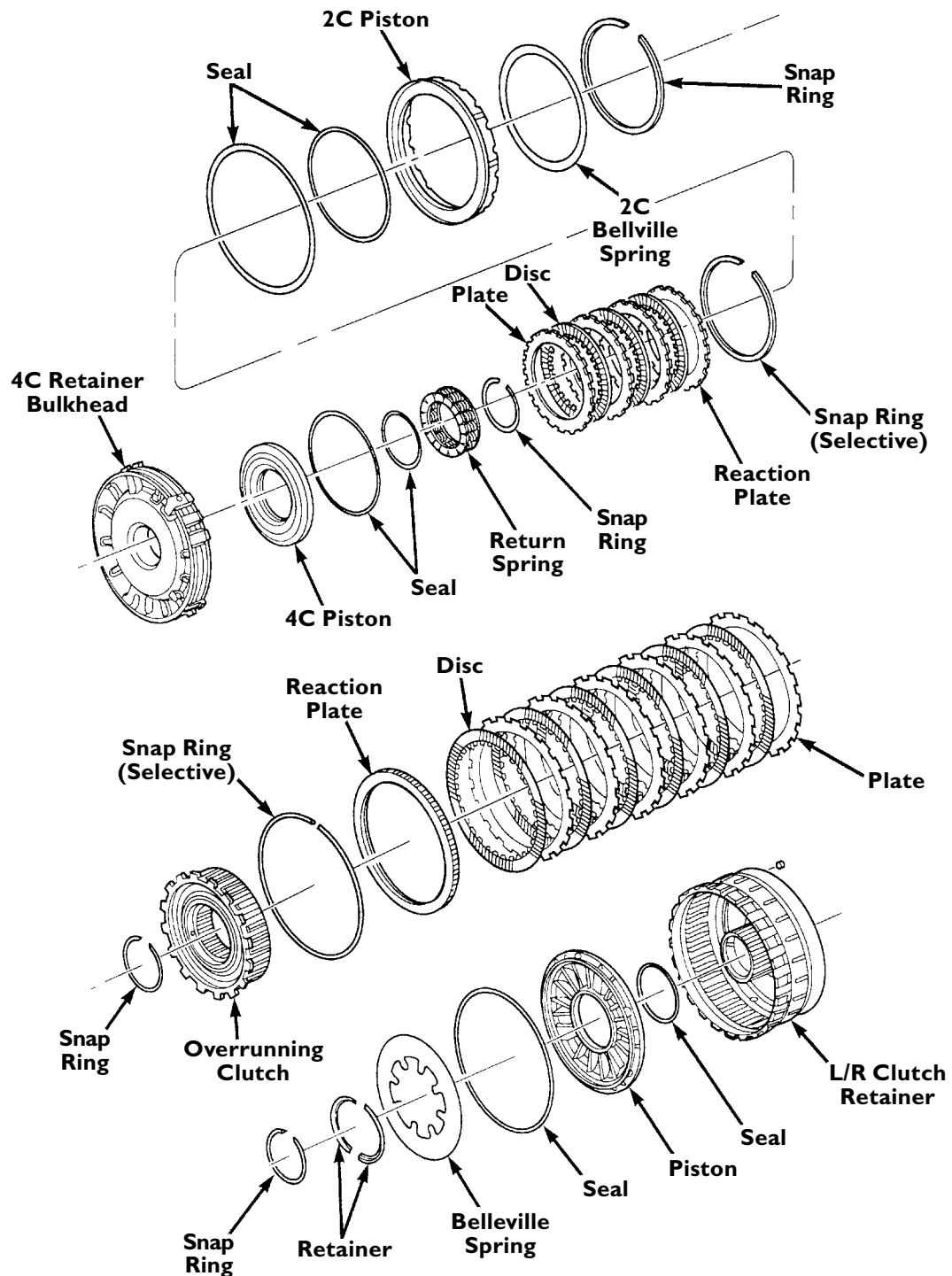
- Three multiple disc input clutches — underdrive, overdrive, and reverse.



45RFE

New Product Information (continued)

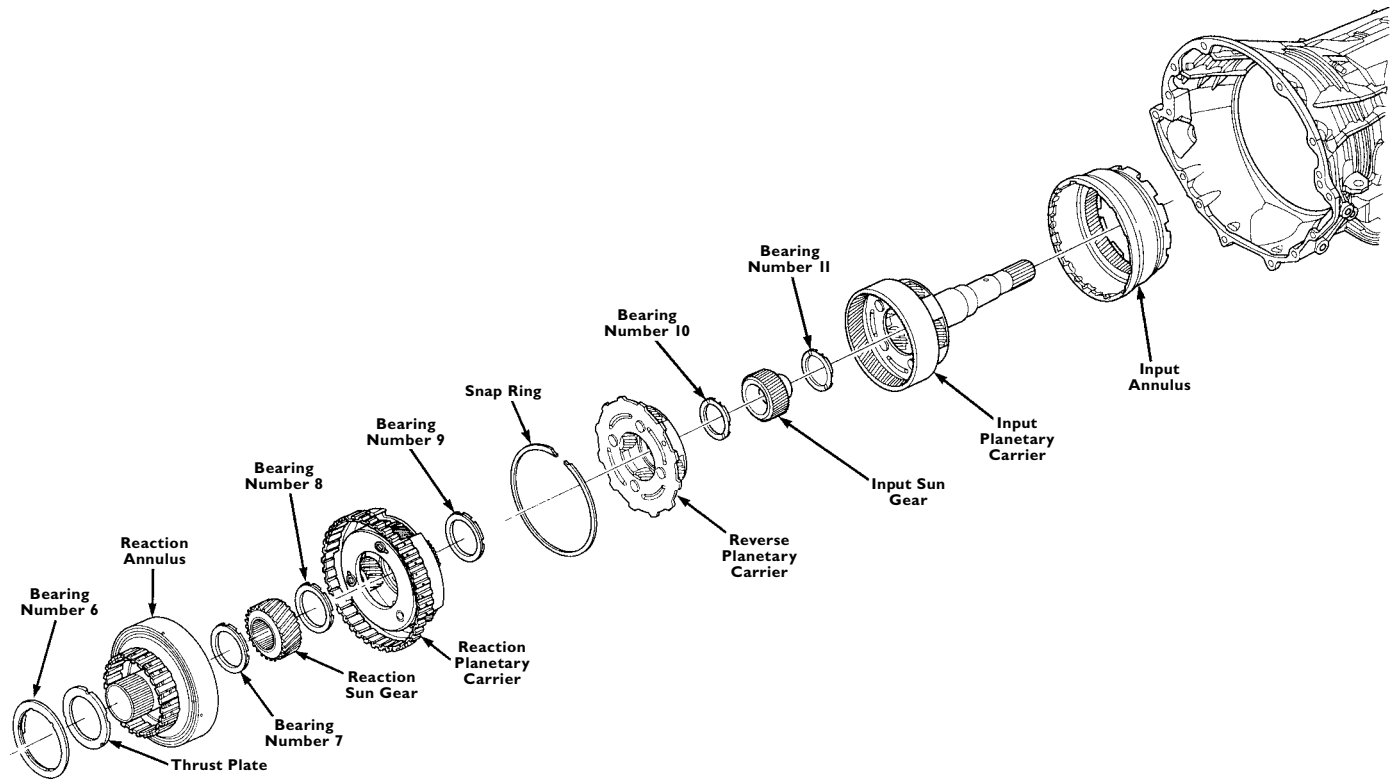
- Three multiple disc holding clutches — 2C, 4C and Low/Reverse).



45RFE

New Product Information (continued)

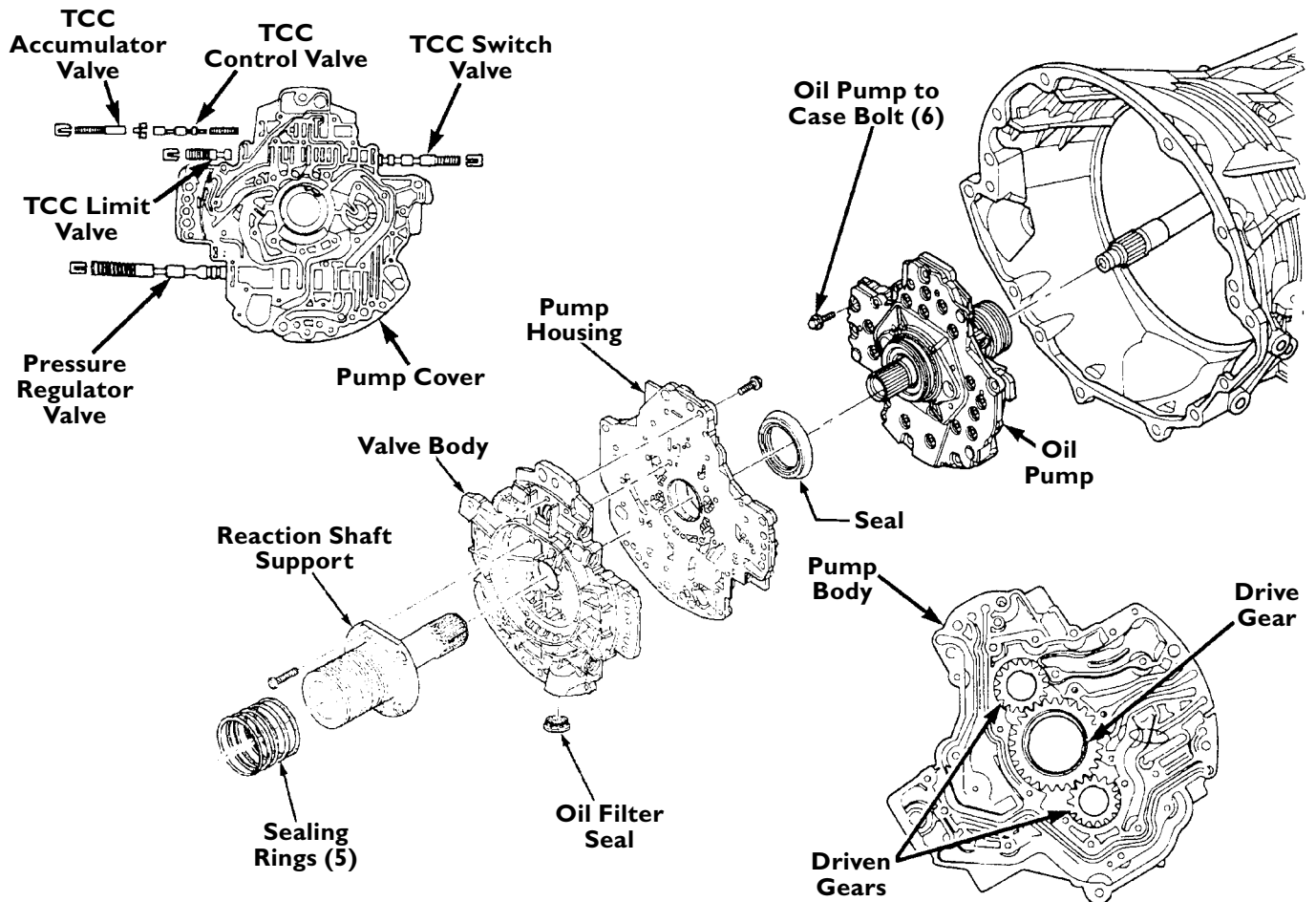
- Three planetary gear sets — reaction, reverse and input.



45RFE

New Product Information (continued)

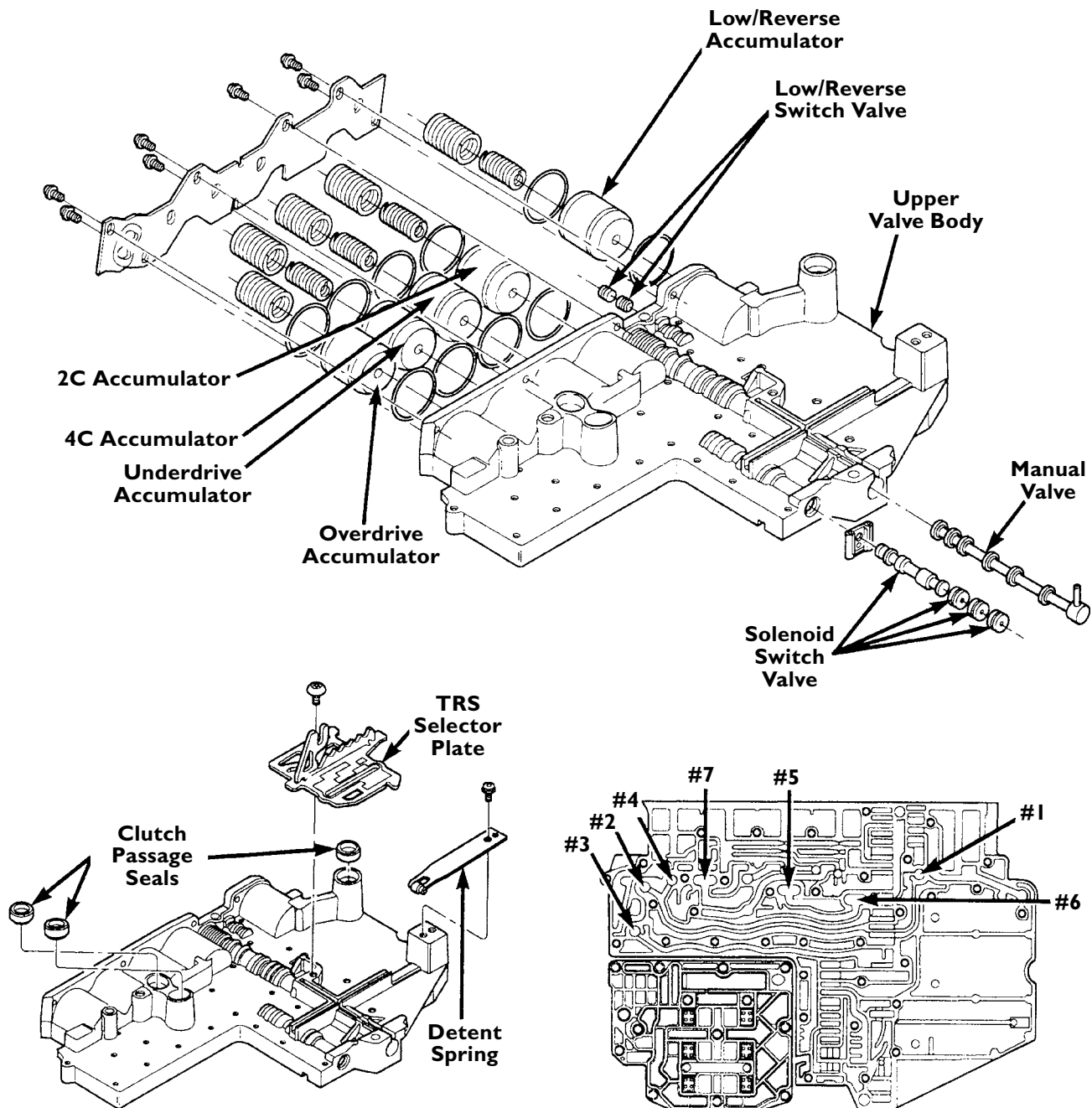
- Dual-stage hydraulic oil pump, consisting of four TCC valves, a pressure regulator valve, two pumps (primary and secondary), and a bolt-on stator.



45RFE

New Product Information (continued)

- Valve body — low/reverse switching valves, solenoid switch valves, 7 checkballs, and a manual valve. Features five hydraulic accumulators — overdrive, underdrive, 4C, 2C, and low/reverse.

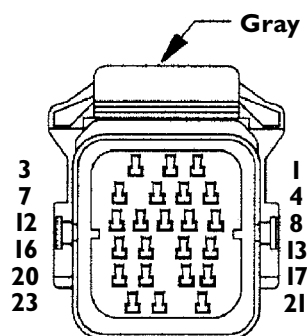


45RFE

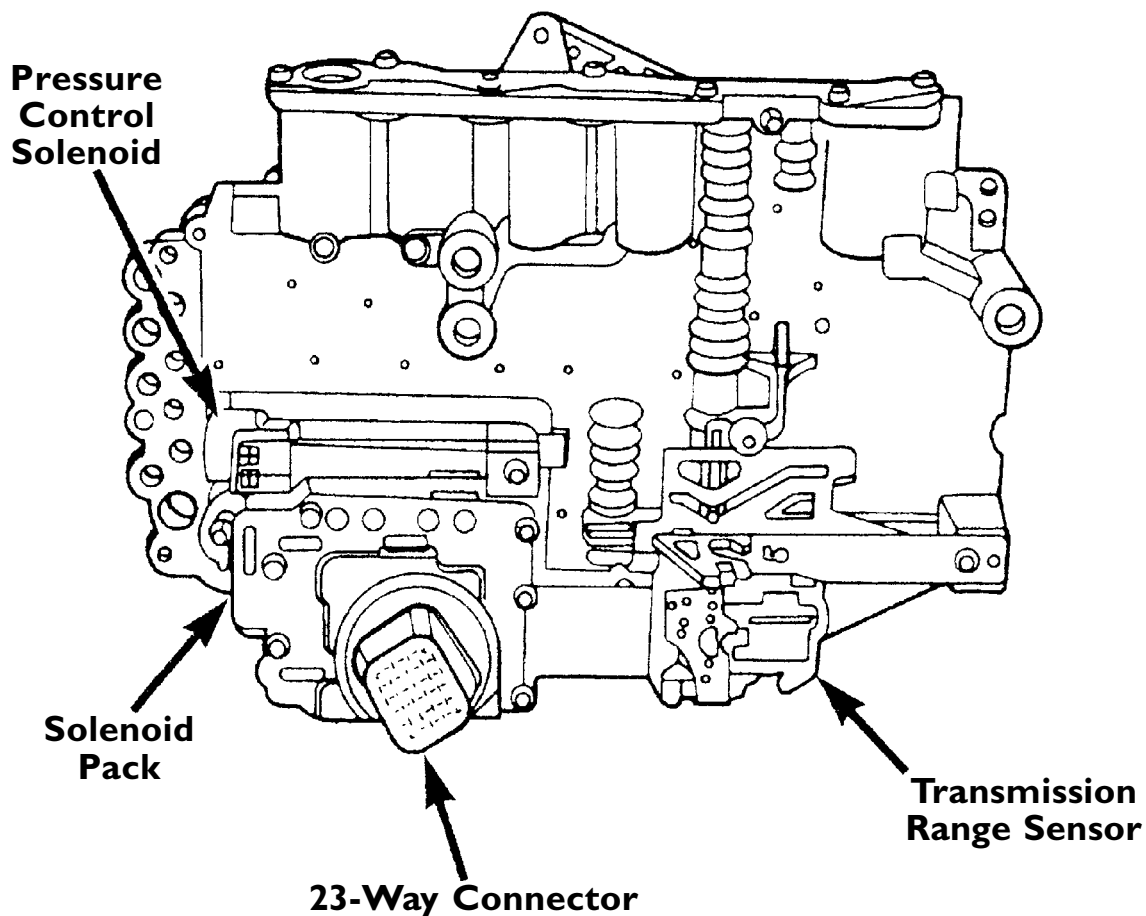
New Product Information (continued)

- Solenoid pack — solenoids, pressure switches, range selector, and temperature sensor. There are 23 pins in the connector.

Shown from the pin side of the harness connector



Transmission Terminal Identification			
Pin	Function	Pin	Function
1	Fused Ignition Switch Output (Run)	13	TRS T2 Sense
2	L/R Solenoid	14	L/R Pressure Switch
3	Engine Starter Motor Relay	15	2 nd Clutch Pressure Switch
4	TRS T41 Sense	16	Overdrive Pressure Switch
5	TRS T42 Sense	17	Underdrive Solenoid
6	Backup Lights	18	Underdrive Pressure Switch
7	Overdrive Solenoid	19	4 th Clutch Solenoid
8	TRS T3 Sense	20	2 nd Clutch Solenoid
9	TRS T1 Sense	21	MS Solenoid
10	Transmission Control Relay Output	22	Speed Sensor Ground
11	4 th Clutch Pressure Switch	23	Transmission Temperature Sensor
12	Pressure Control Solenoid		



45RFE

New Product Information (continued)

The Transmission Control Module (TCM) is the brain of the electronic control system and relies on information from various direct and indirect inputs (sensors, switches, etc.) to determine driver demand and vehicle operating conditions. With this information, the TCM can calculate performance in a timely manner, to optimize the shifts. Various output or control devices are used to achieve this, such as the solenoid pack, transmission control relay, etc.

TCM Operation

The 45RFE relies on full electronic control for all upshifts and downshifts. It features real-time adaptive closed-loop shift and pressure control.

Direct Inputs:

- Battery (B+) Voltage
- Ignition (On) Voltage
- Transmission Control Relay (Switched B+)
- Throttle Position Sensor
- Crankshaft Position Sensor
- Transmission Range Sensor
- Pressure Switches
- Transmission Temperature Sensor
- Input Shaft Speed Sensor
- Output Shaft Speed Sensor
- Line Pressure Sensor

Indirect inputs:

- Engine/Body Identification
- Manifold Pressure
- Target Idle
- Torque Reduction Confirmation
- Engine Coolant Temperature
- Ambient/Battery Temperature
- DRB Scan Tool Communications

45RFE

New Product Information (continued)

TCM Operation (continued)

Direct Outputs:

- Transmission Control Relay
- Solenoids
- Torque Reduction Request

Indirect Outputs:

- Transmission Temperature (to ECM)
- PRNDL Position (to BCM)

Other responsibilities and functions of the TCM are:

- Storing and maintaining Clutch Volume Indexes (CVIs).
- Storing and selecting appropriate shift schedules, depending on shift lever position, throttle position, engine load, fluid temperature, and software level.
- System Self-Diagnostics
- Diagnostic Capabilities (with DRB scan tool)

NOTICE If you replace the TCM, you'll have to perform the Quick Learn Procedure.

Clutch Volumes		
Clutch	Updated During...	Clutch Volume
Low/Reverse	2–1 or 3–1 Downshift	45 to 134
Second	3–2 Kickdown	25 to 85
Overdrive	2–3 Upshift	30 to 100
Fourth	3–4 Upshift	30 to 85
Underdrive	4–3 Kickdown	30 to 100

Now, with all that out of the way, let's get into some of the things that make this unit stand above others that are trying to achieve the same things.

45RFE

New Product Information (continued)

Torque Converter Lockup

The lockup torque converter has four different working modes:

- **No EMCC (Electronic Modulated Converter Clutch):** When the L/R solenoid is off, there's no EMCC. Several conditions can cause this, such as a failure in the transmission or the TCM simply determines that, because of the load, it isn't needed. This may be normal.
- **Partial EMCC:** The L/R solenoid is modulated (duty cycled) to obtain partial lockup. The TCM maintains partial EMCC until conditions are right for it to switch to full lockup. During partial EMCC, some slip occurs. Partial EMCC usually takes place at lower road speeds, low load and light throttle.
- **Full EMCC:** The TCM increases the L/R solenoid duty cycle to 100% (full on) only after partial EMCC. The TCM brings the transmission input speed within the desired slip range of the engine speed, relative to engine RPM.
- **Gradual-to-no EMCC:** This is to soften the change from full or partial EMCC to no EMCC. This occurs at mid-throttle. The TCM decreases the duty cycle on the L/R solenoid to achieve this.

To determine how to control lockup, the TCM uses coolant temperature, engine RPM, vehicle speed, throttle position, and manifold vacuum. The TCC can be engaged in third gear while in D range, and in fourth gear in OD range, depending on the position of the overdrive control switch.

45RFE

New Product Information (continued)

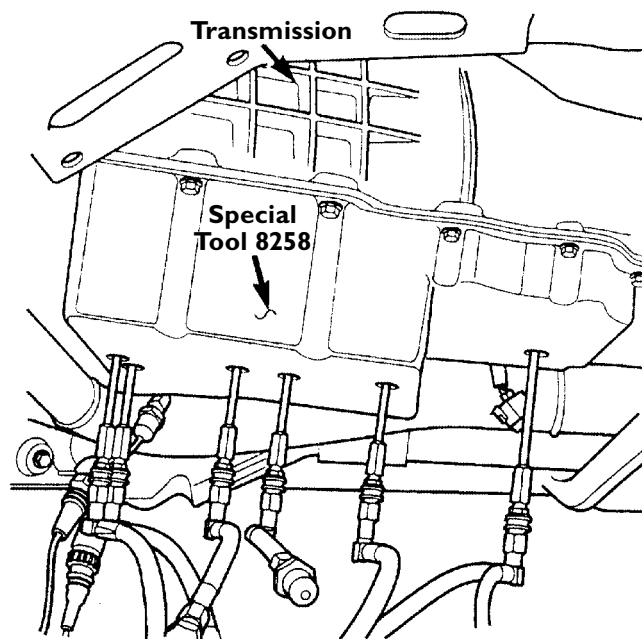
Pressure Testing

There are only three pressure tests you can perform from the *outside* of the 45RFE: T/C off (converter released), T/C on (converter applied), and line pressure, which requires a special adapter. This adapter allows you to check the integrity of the pressure transducer, as well as the working line pressure at idle. Compare the pressure reading on your scan tool to the gauge reading to determine whether the transducer is sending the correct signal to the TCM.

It's possible to check all of the clutch circuits by using a special oil pan that lets you hook into virtually every circuit in the transmission. This pan must be used when checking oil pressures.

The 45RFE uses closed loop control of the line pressure, so the pressure readings may vary greatly, but should always follow line pressure. The pressure specs are:

- Upshift/downshift pressure for all shifts except the 3-4, 4-3 and 4-2 prime is 120 PSI.
- Upshift/downshift pressure for the 3-4, 4-3, and 4-2 prime is 100 PSI.
- Garage shift pressure for N-R is 220 PSI.
- Garage shift pressure for R-N and N-1 is 120 PSI.



45RFE

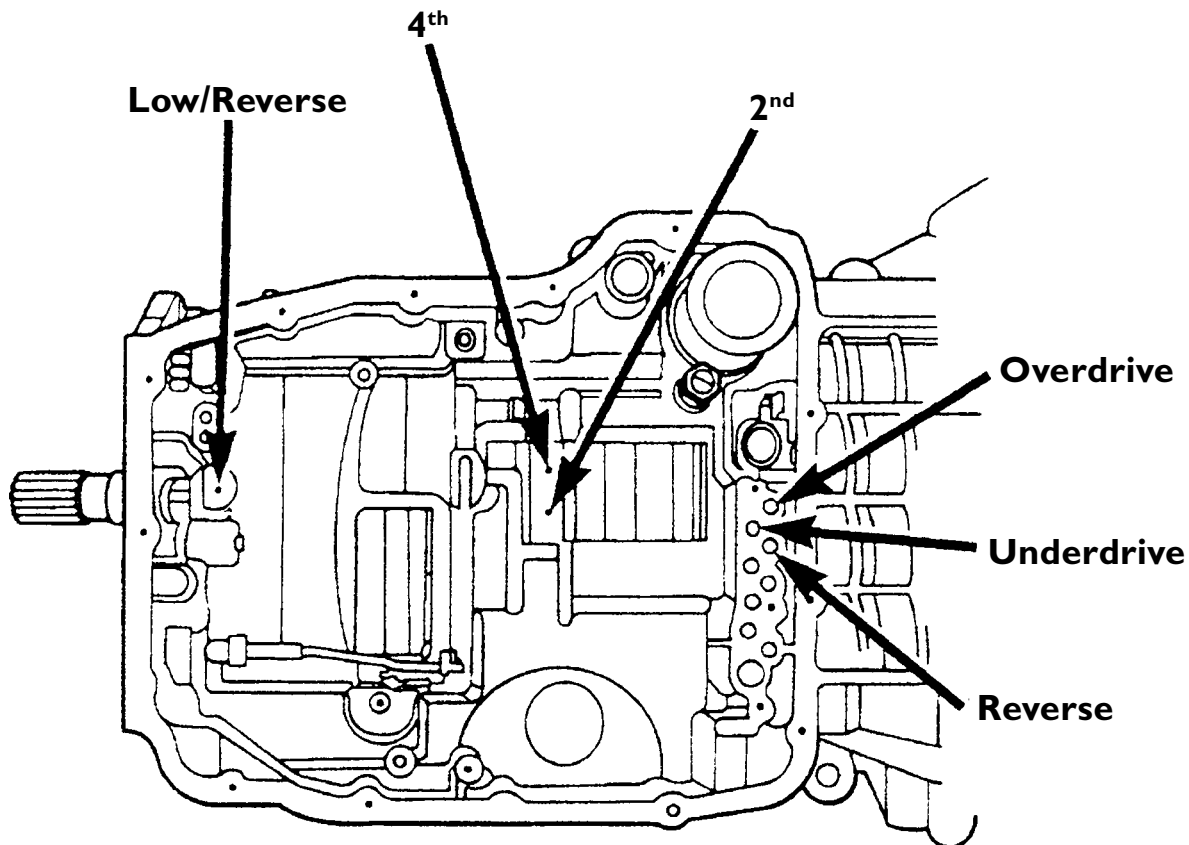
New Product Information (continued)

Pressure Testing (continued)

Air Pressure Tests

When air pressure testing, always regulate the air pressure to 30 PSI. You can perform these air pressure tests in the vehicle or on the bench when repairing this unit. Refer to for the different test port locations.

Air pressure tests will enable you to determine the holding ability of the clutch drum being used. If the clutches are damaged, the test won't let you determine the holding ability of that clutch, but it does let you identify problems in the apply circuit.



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Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure

It isn't uncommon for electronically-controlled Nissan transmissions to have problems with line pressure. Whether it's low mainline at idle, not enough line rise, or no line rise at all, the result will be soft shifts or burnt clutches and bands. It's a good idea to check pressures before any work is performed on the vehicle. But it's absolutely necessary to check pressures when you reinstall the unit, even if it seems to work great.

Most of these transmissions don't have a true line pressure tap. Instead, you can check line pressure by checking the forward clutch pressure when the unit's in D, S and L, and reverse clutch pressure when it's in reverse. But remember, if forward clutch pressure is 20 PSI at idle, it could be a mainline pressure problem... or it could be a leak in the forward clutch circuit. The point is, don't assume there's a problem with mainline pressure just because forward clutch pressure is low.

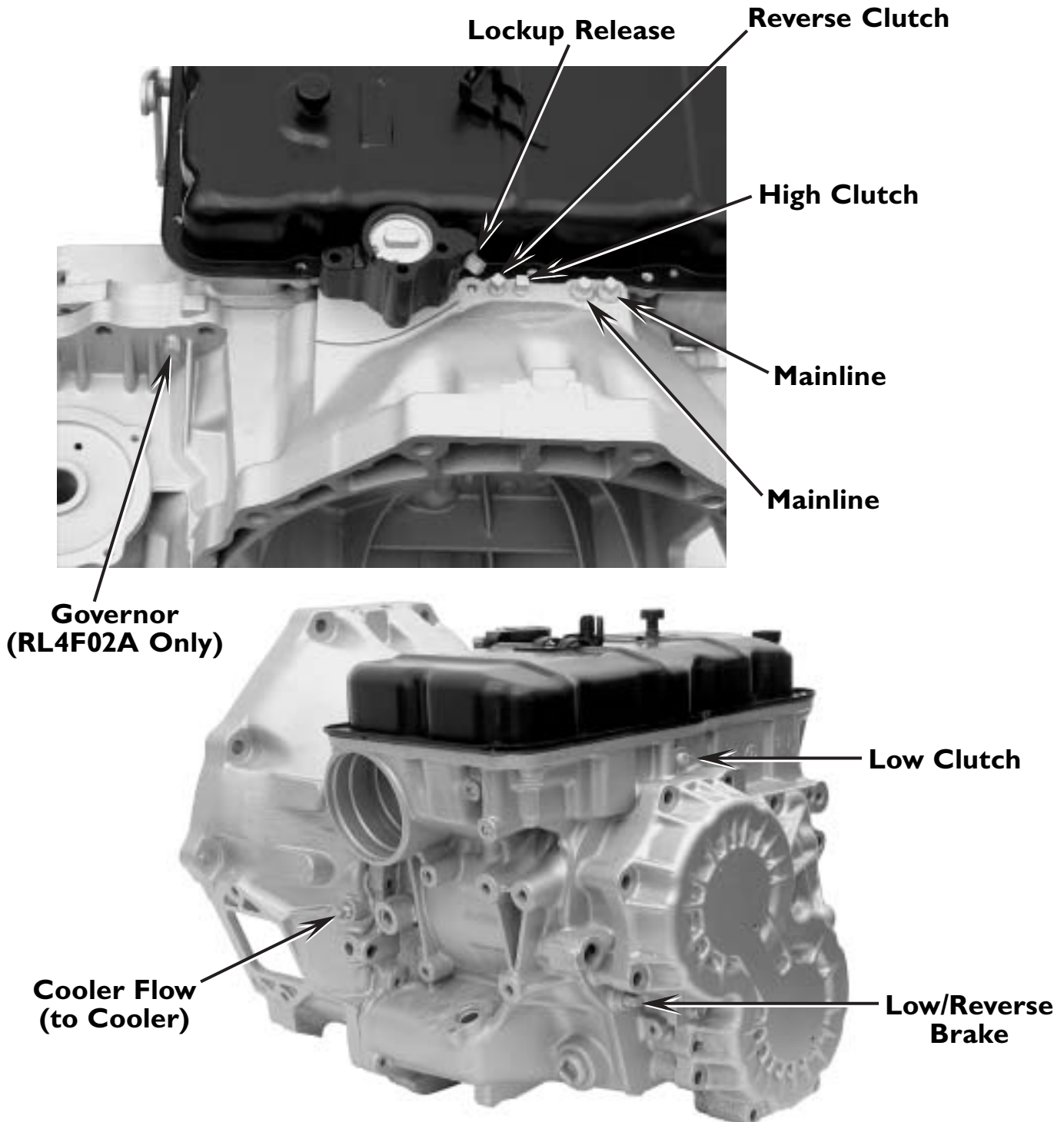
Mainline Pressure Specifications

Transmission	Vehicle	Pressure in Drive (PSI)		Pressure in Reverse (PSI)	
		Idle	Full	Idle	Full
RL4F02A	All	54–64	175–200	54–64	175–200
RE4F02A	All	55–61	186–198	55–61	186–198
RL4F03A	All	75–80	155–160	125–130	250–260
RE4F03A	All	70–75	155–160	120–125	265–275
RE4F04A / 4F20E	Quest / Villager	70–75	170–180	120–130	260–270
	All Others	70–75	155–165	120–130	245–260
RL4R01A	All	61–67	128–139	97–102	202–213
RE4R01A / RE4R03A	2WD	64–70	128–139	102–108	201–212
	4WD	68–74	148–159	95–101	206–218
R4A-EL / R4AX-EL	2WD	68–74	175–186	88–94	219–230
	4WD	57–74	148–159	102–108	206–218
Subaru 4-Spd	2WD / 4WD	64–82	164–182	85–100	206–230

Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

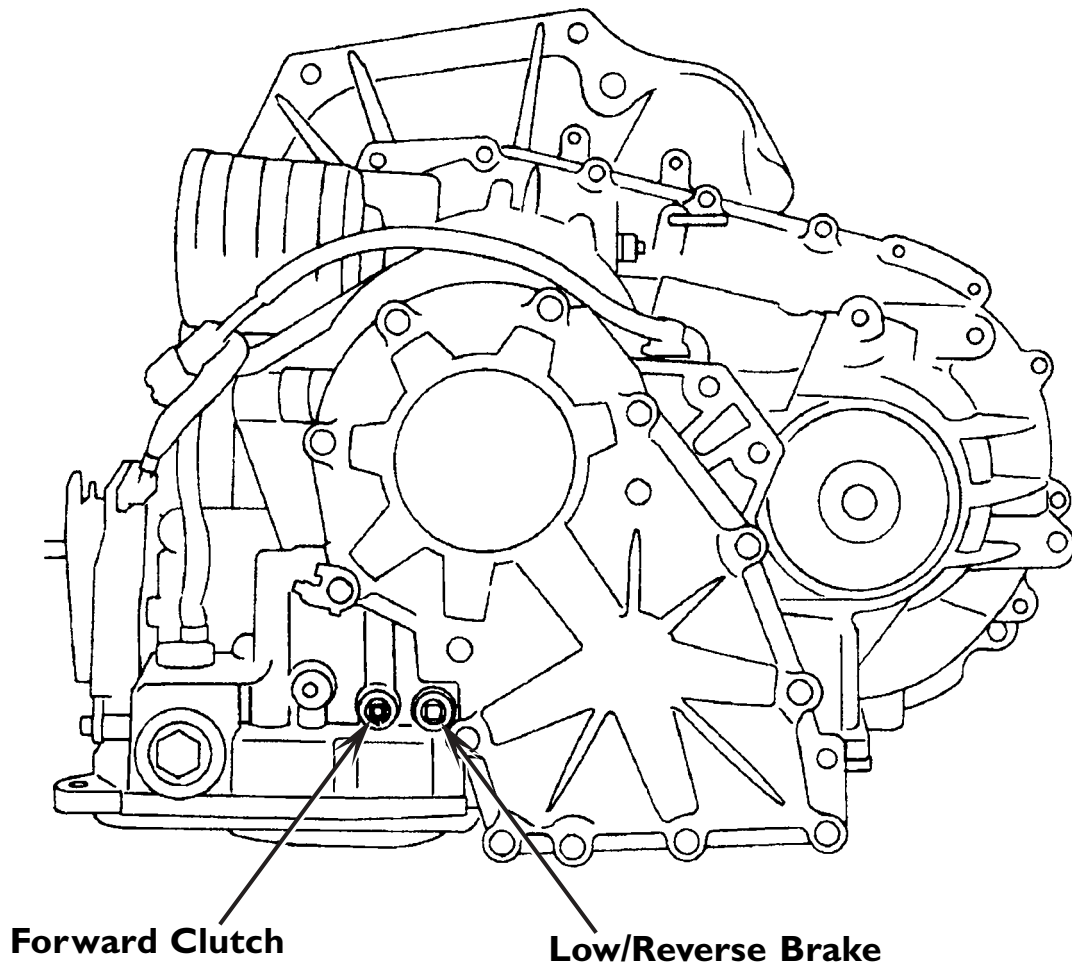
RE4F02A and RL4F02A



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

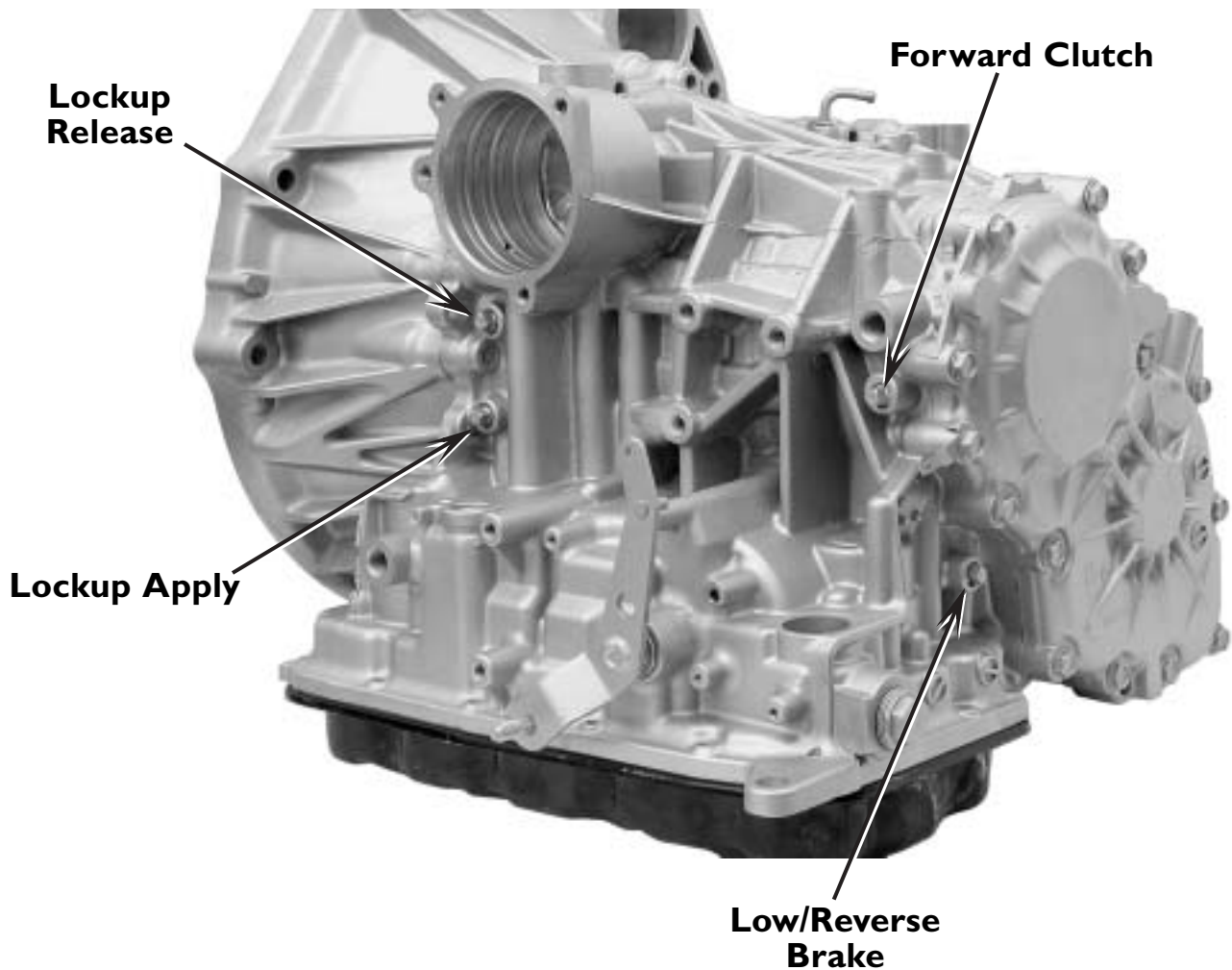
RE4F03A



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

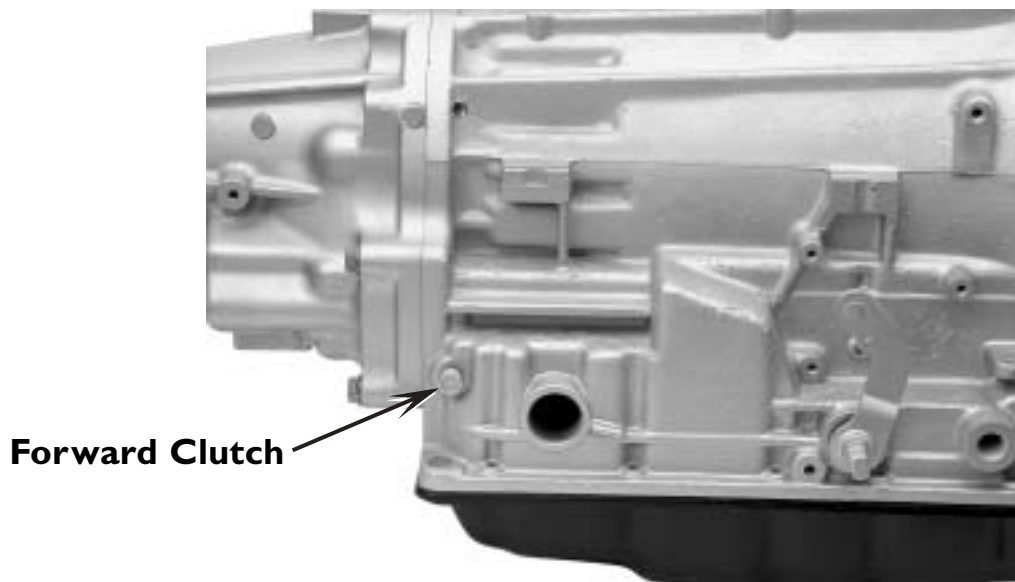
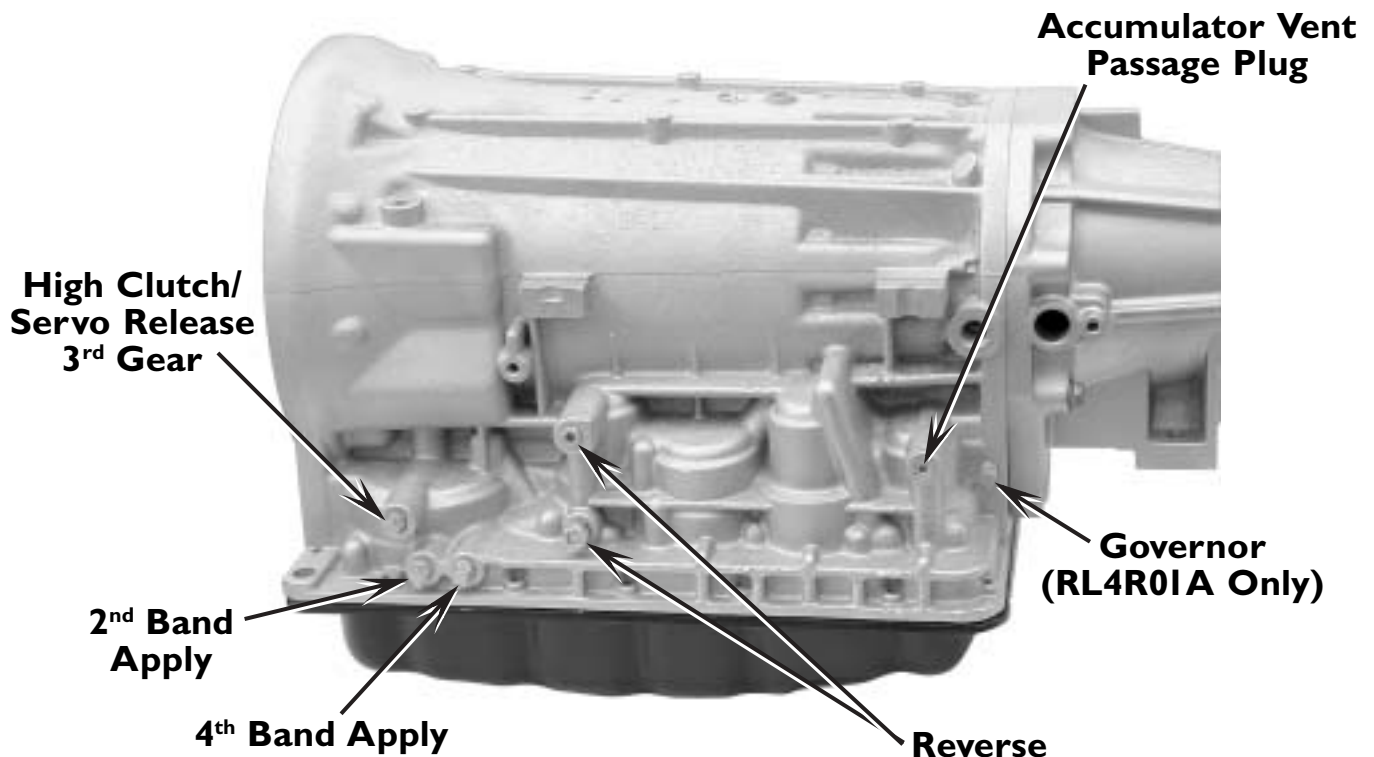
RE4F04A and 4F20E



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

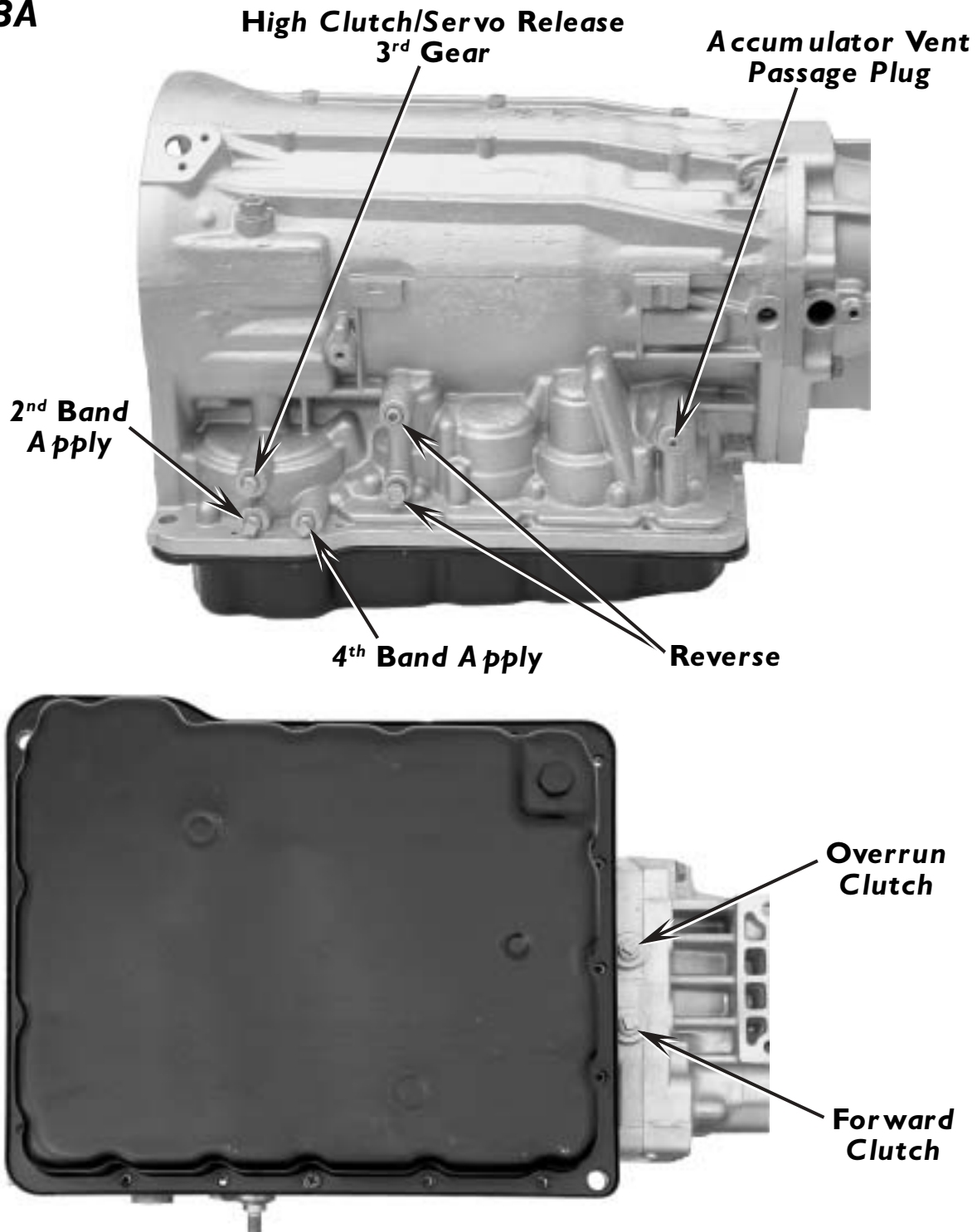
RL4R01A, RE4R01A, R4A-EL and R4AX-EL



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

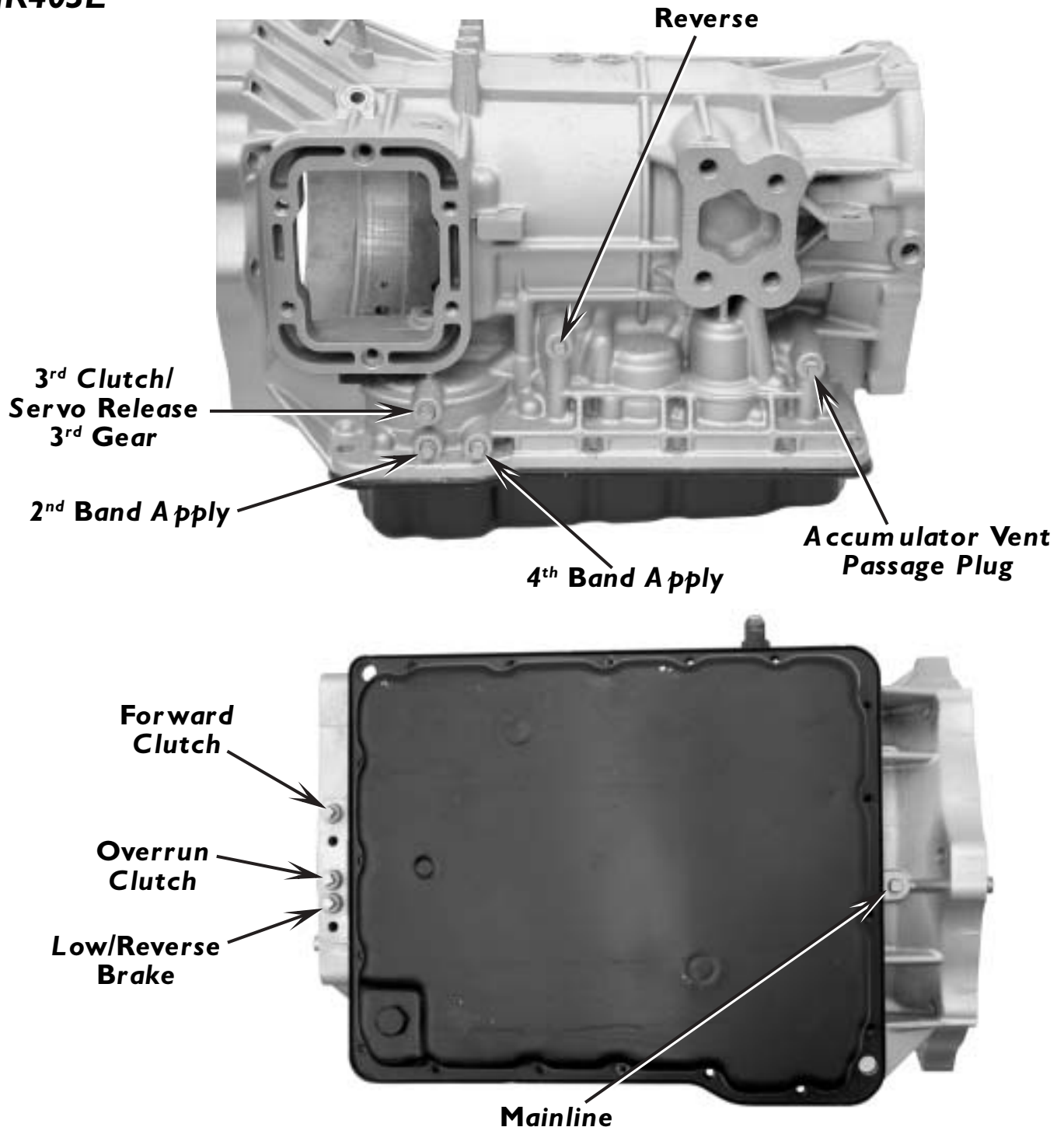
RE4R03A



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

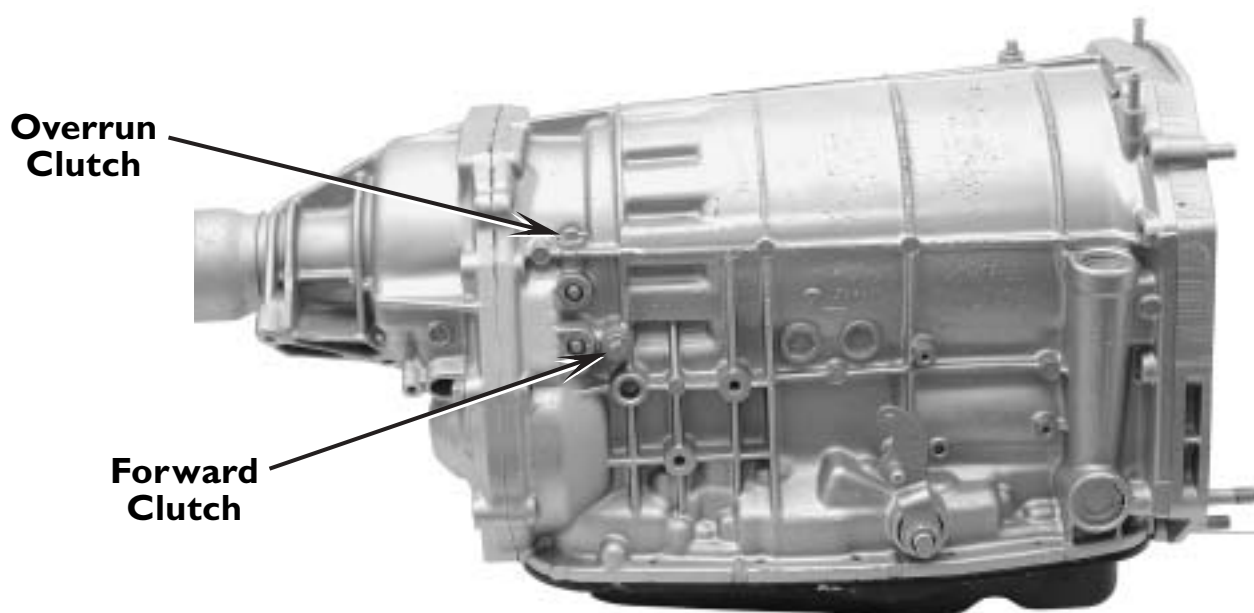
JR403E



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

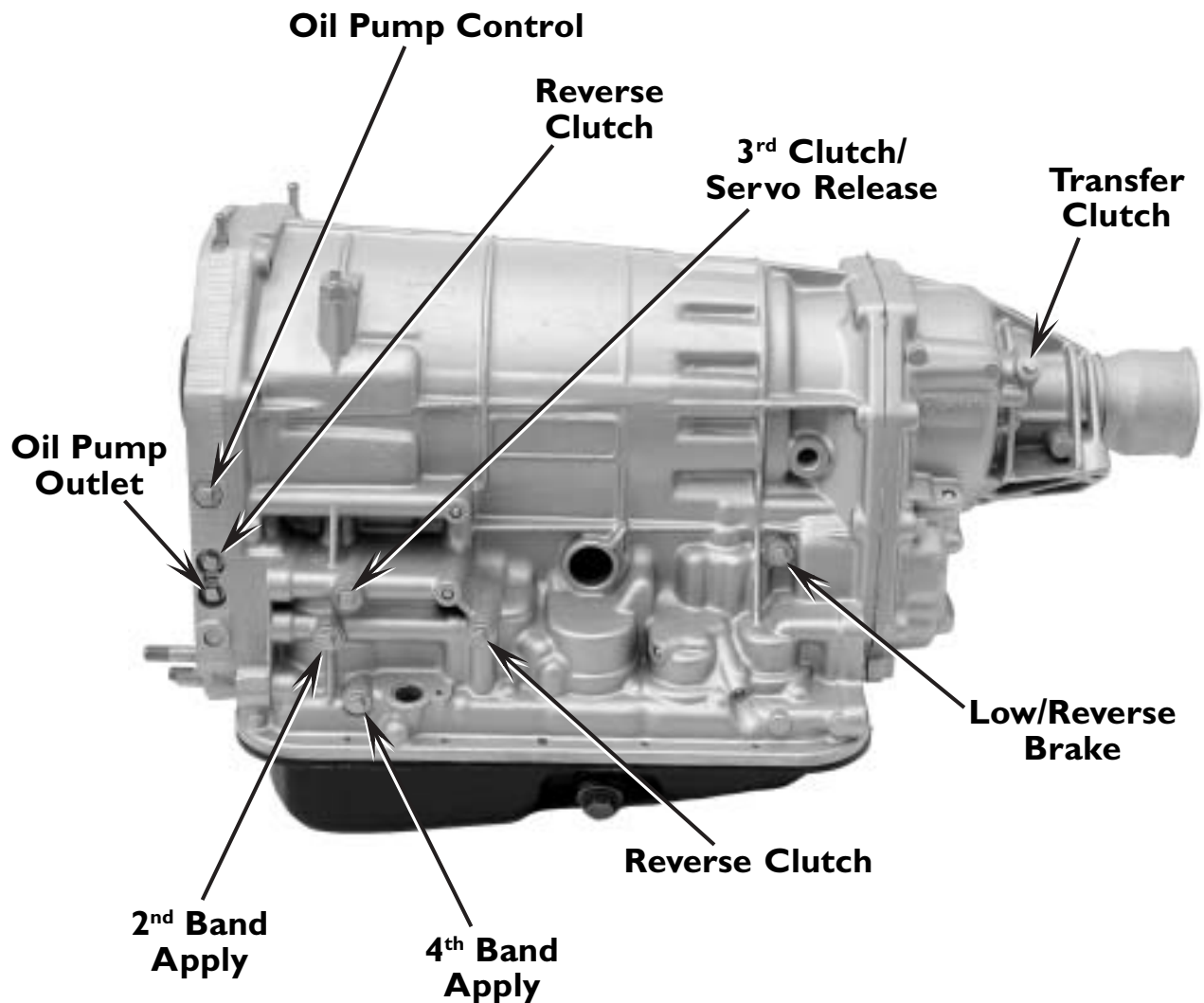
Subaru 4-Speed



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

Subaru 4-Speed (continued)



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

The most common reason for no line rise in Nissan transmissions with electronic pressure control is a bad line pressure control solenoid. The only way to purchase one of these solenoids separately is to order one for the RE4R01A, part # 31940-41X01. All Nissan line pressure control solenoids are the same, except for the bracket and wiring.

The bracket is held on to the solenoid by a snap ring. To use this solenoid on other units, simply use the original connector and bracket from the unit you're working on, and splice the wires to the original connector.

RE4R01A, RE4R03A, R4AEL, Subaru and JR403E Line Pressure Control Solenoid



RE4F02A Line Pressure Control Solenoid



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

RE4F03A, RE4F04A and 4F20E Line Pressure Control Solenoid



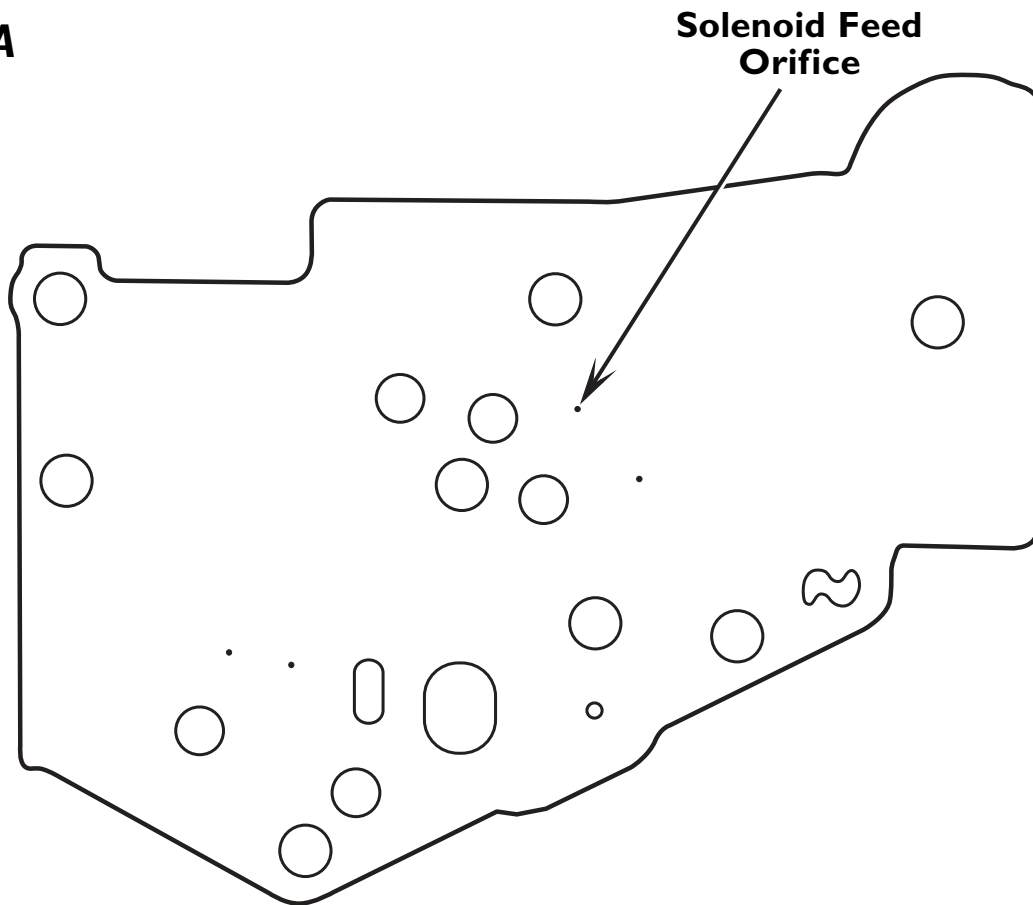
Subaru 4-Speed

Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

Another common reason for no line rise is insufficient feed to the line pressure control solenoid. Always enlarge the line pressure control solenoid feed orifice to 0.042", on every Nissan transmission you rebuild.

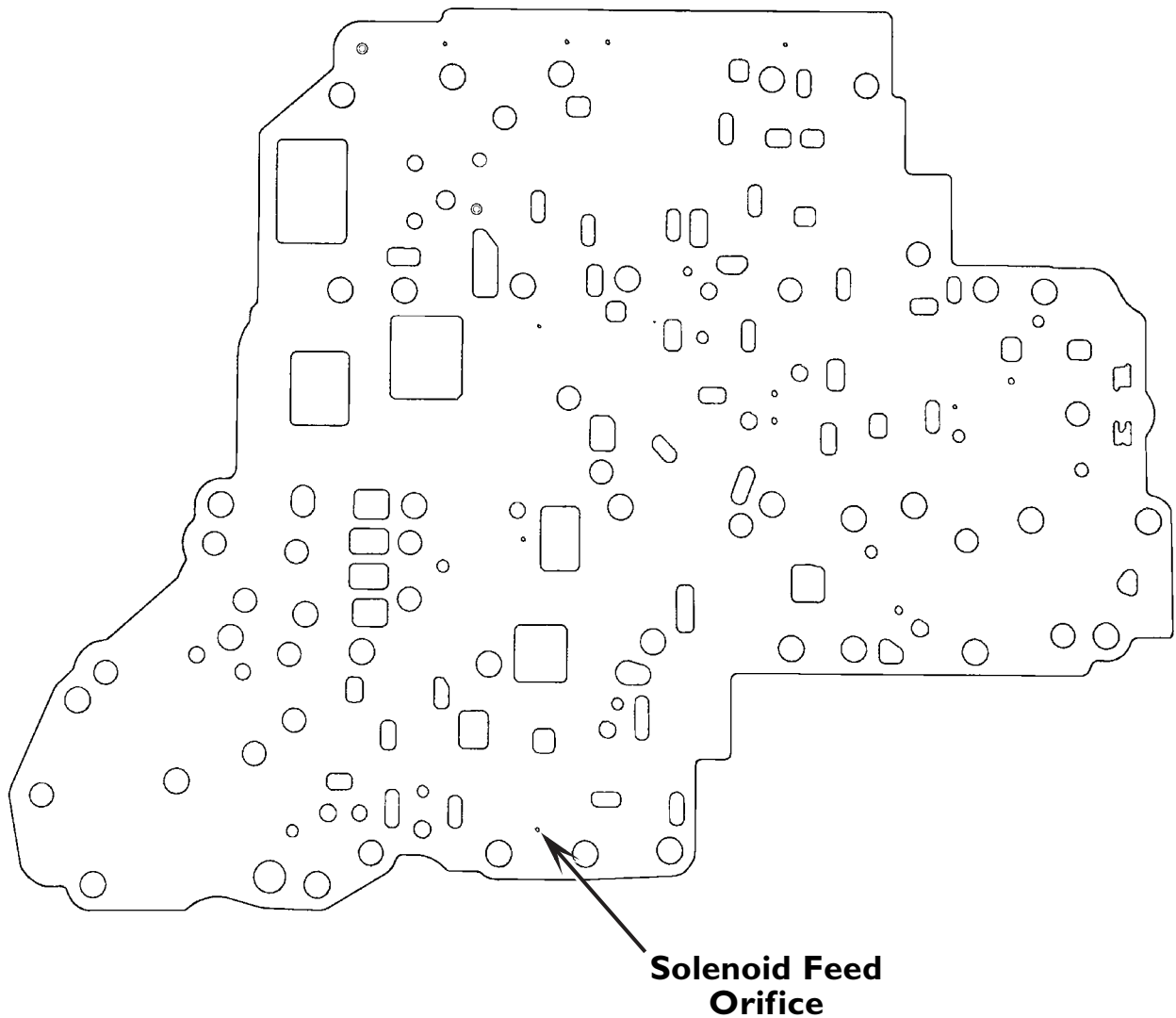
RE4F02A



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

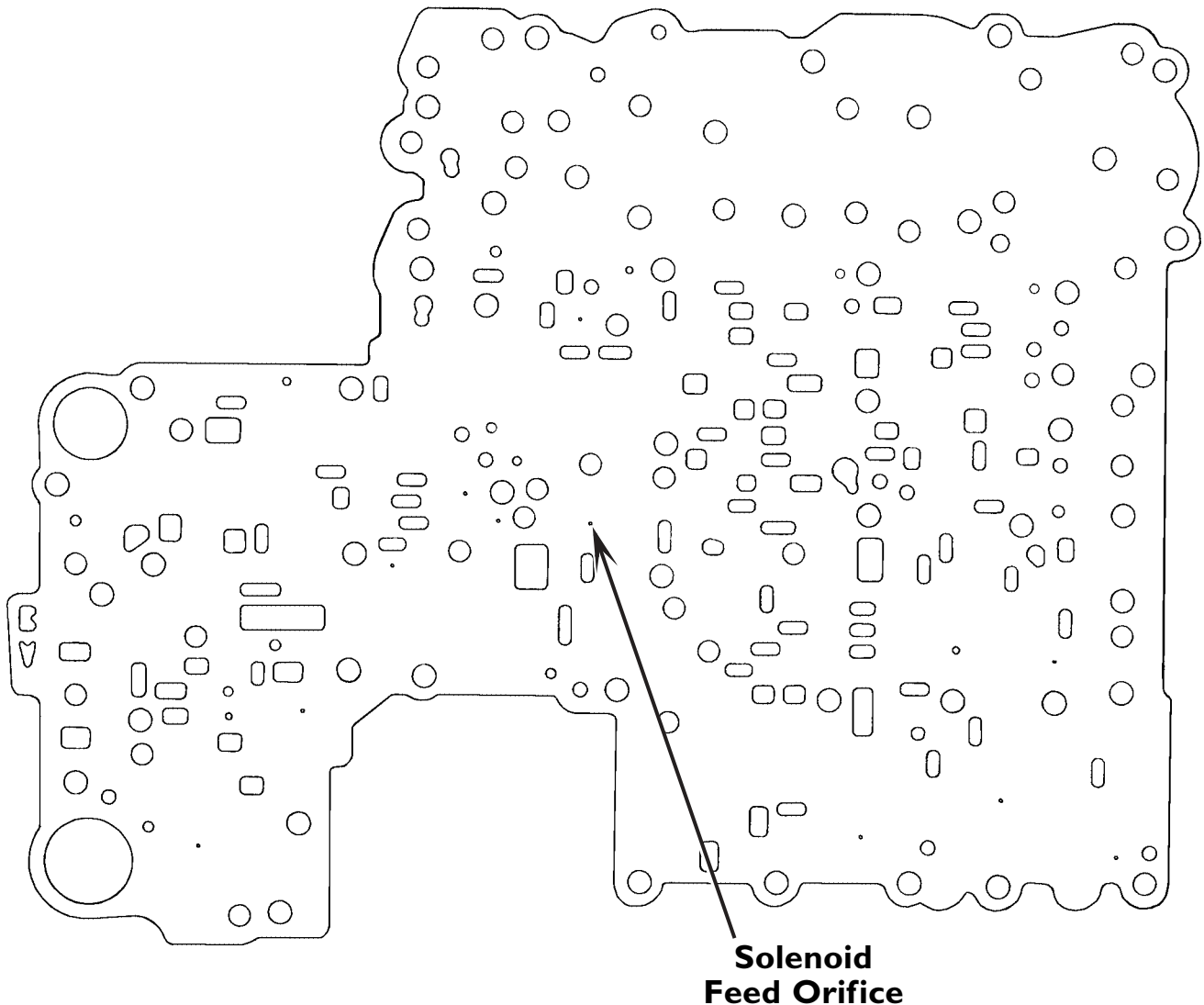
RE4F03A, RE4F04A and 4F20E



Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

RE4R01A, RE4R03A, R4A-EL, R4AX-EL, JR403E and Subaru 4-Speed

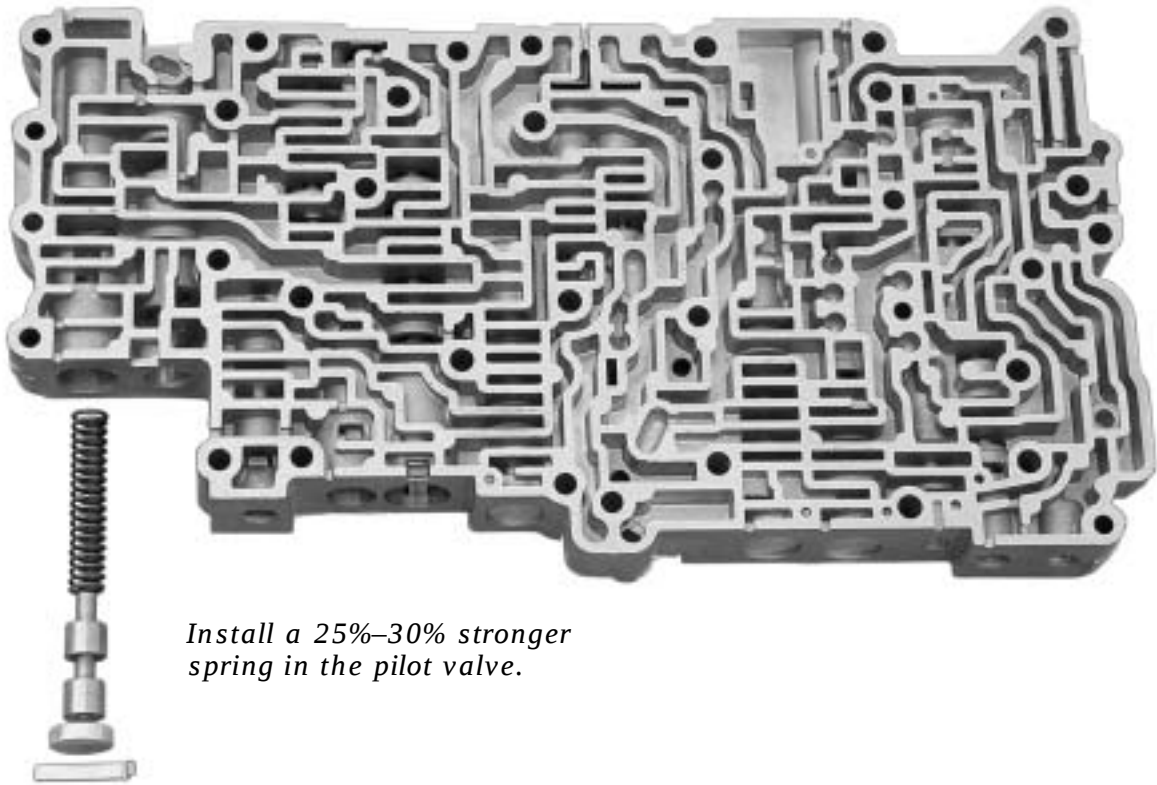


Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

If you are getting line rise — but not enough — on all Nissans except RE4F02A, install a 25%–30% stronger spring in the pilot valve and a 40%–45% stronger spring in the pressure modifier valve. The RE4F02A doesn't use a pressure modifier valve, but you can still add a 25%–30% stronger spring in the pilot valve. These modifications will greatly improve line rise and can be used as a normal rebuild procedure.

RE4F02A

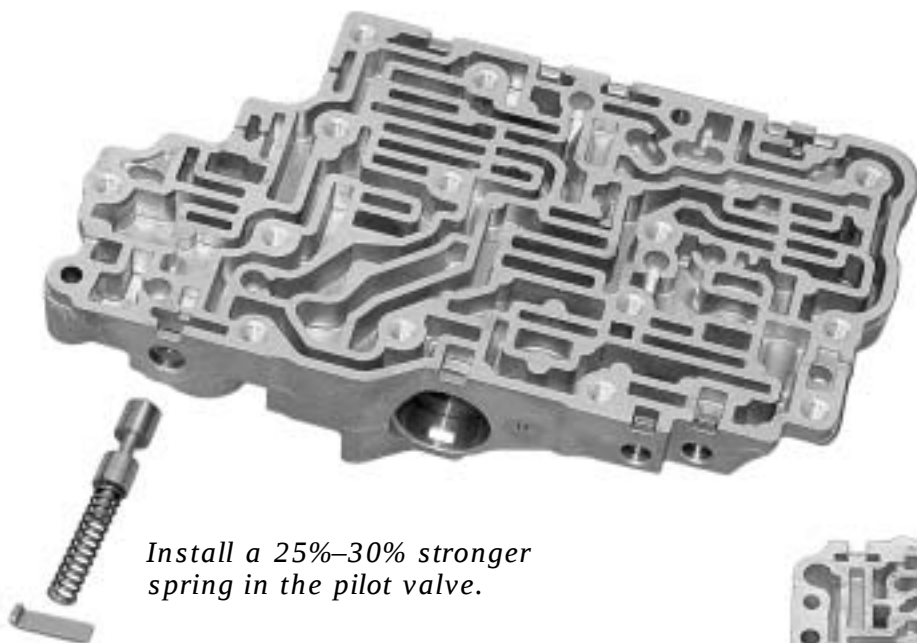


*Install a 25%–30% stronger
spring in the pilot valve.*

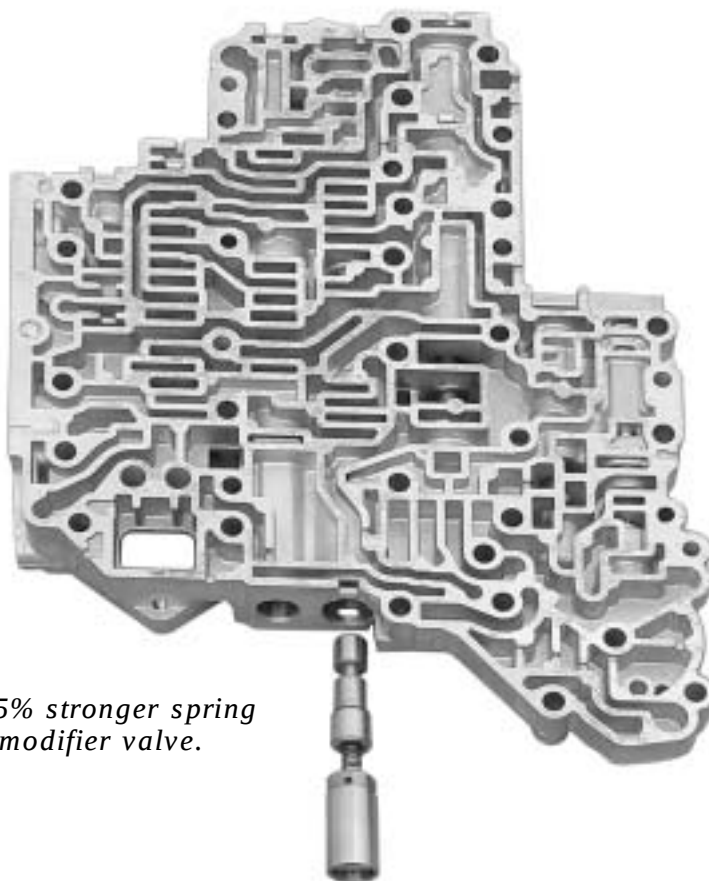
Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

RE4F03A, RE4F04A and 4F20E



Install a 25%–30% stronger spring in the pilot valve.

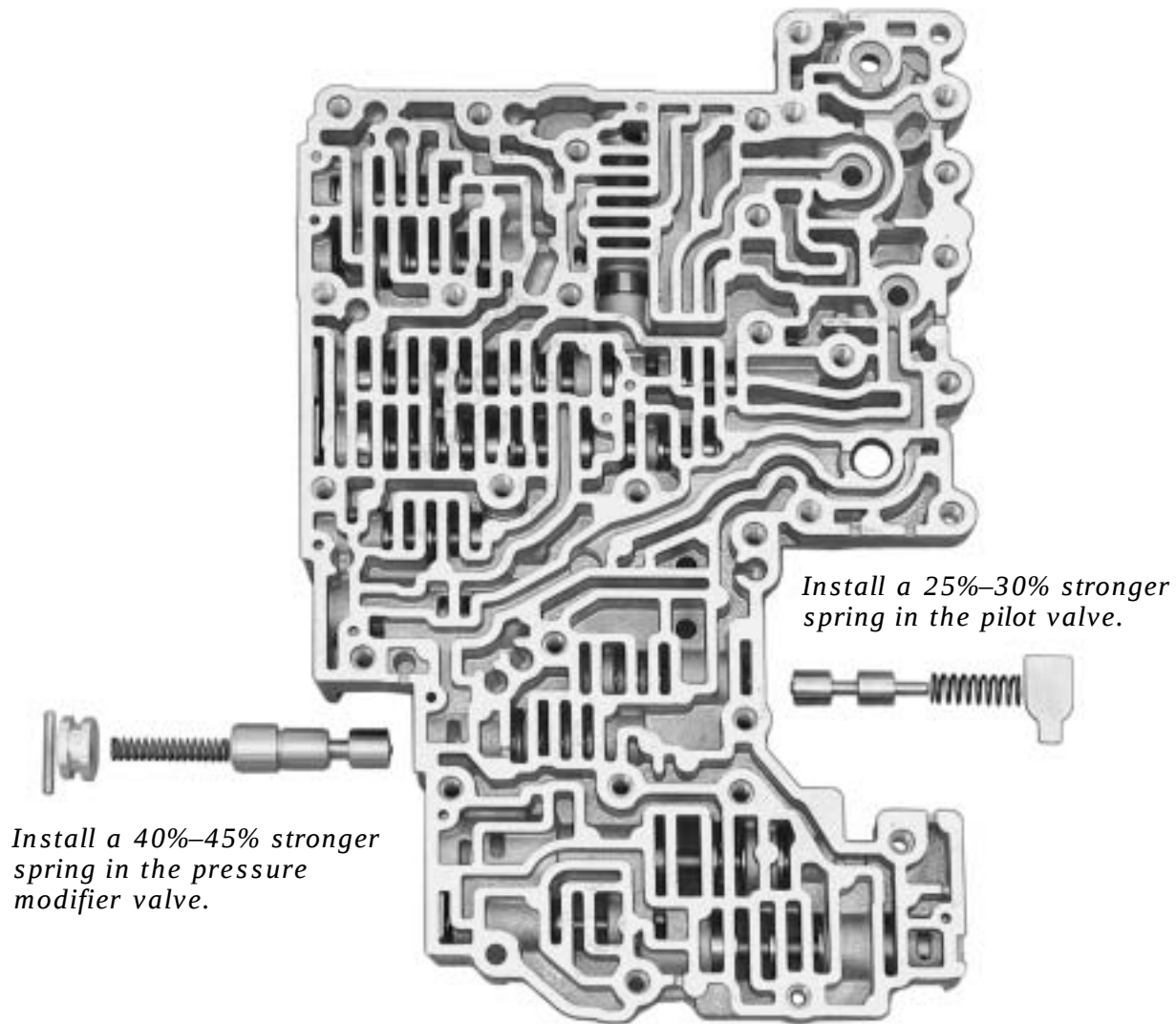


Install a 40%–45% stronger spring in the pressure modifier valve.

Nissan

Soft Shifts, Burnt Clutches and Bands, Poor Line Pressure (continued)

RE4R01A, RE4R03A, R4A-EL, R4AX-EL, JR403E and Subaru 4-Speed

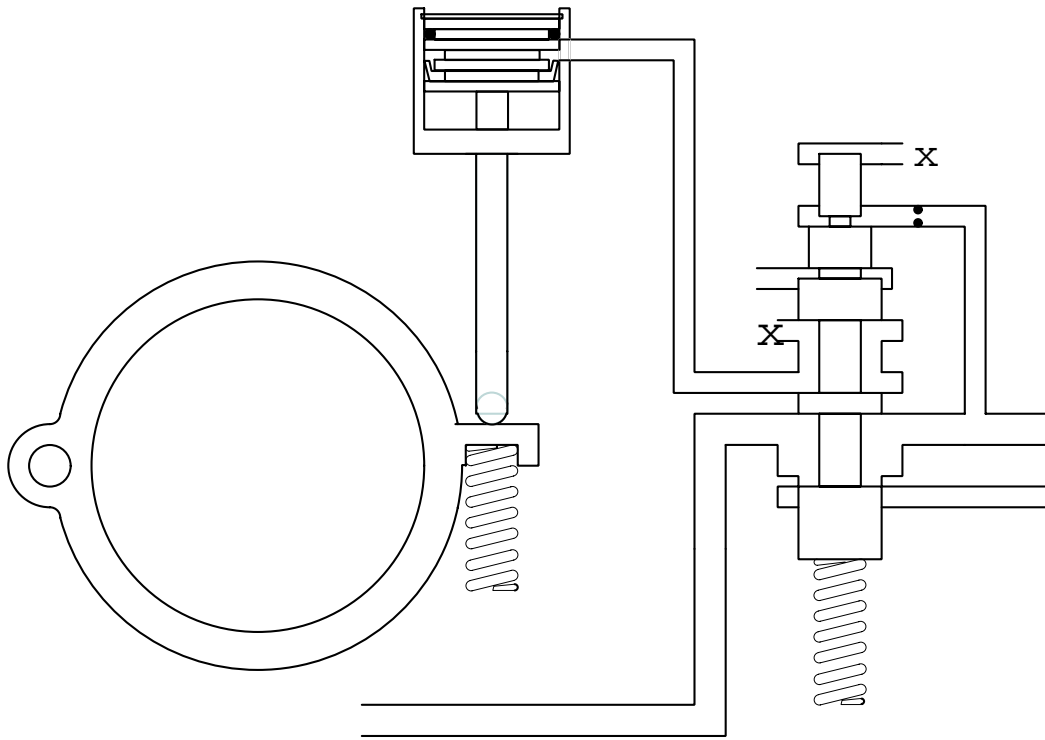


Nissan RE4F02A

Low Pressure at Idle

The RE4F02A has a unique way of controlling the pump slide.

The job of the mainline regulator valve is to control pressure by dumping pump volume when mainline pressure is too high. When the mainline pressure is too high, the valve moves toward the spring and opens a passage that sends the excess oil through the converter relief valve to the converter. If this isn't enough to regulate mainline pressure, the valve moves farther toward the spring, sending pressure to the control cylinder. The control cylinder pushes the pump slide to lower the output volume.



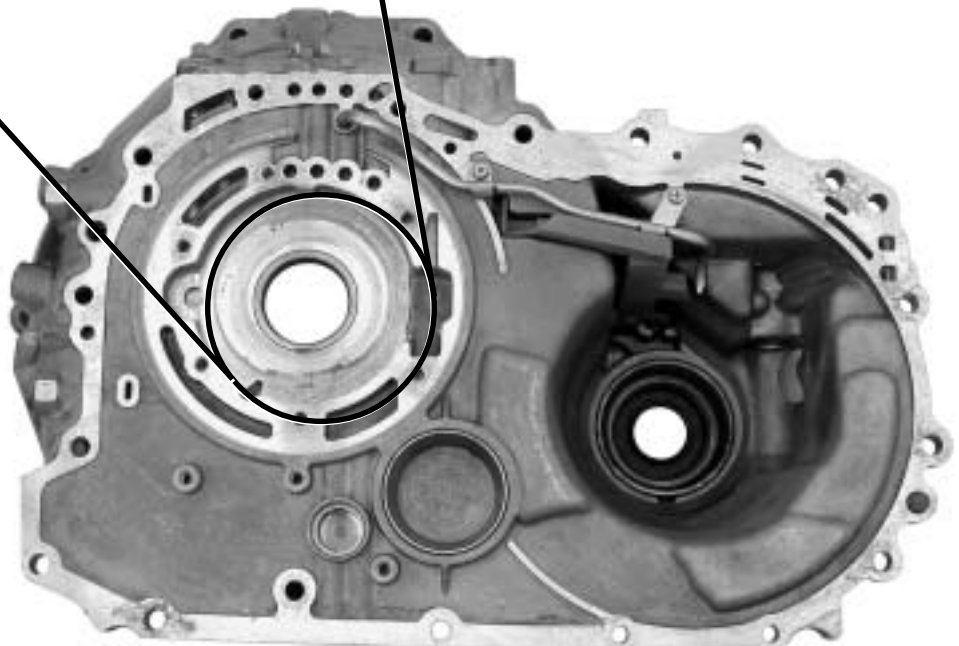
Nissan RE4F02A

Low Pressure at Idle (continued)

The problem occurs when the area where the pump slide contacts the pump is either worn or machined wrong. When this happens, the first time the control cylinder moves the slide, the slide sticks hydraulically in a low volume position. This will cause low line pressure at idle.



When the area that the slide contacts is worn or machined wrong, the slide can stick hydraulically in a low volume position.

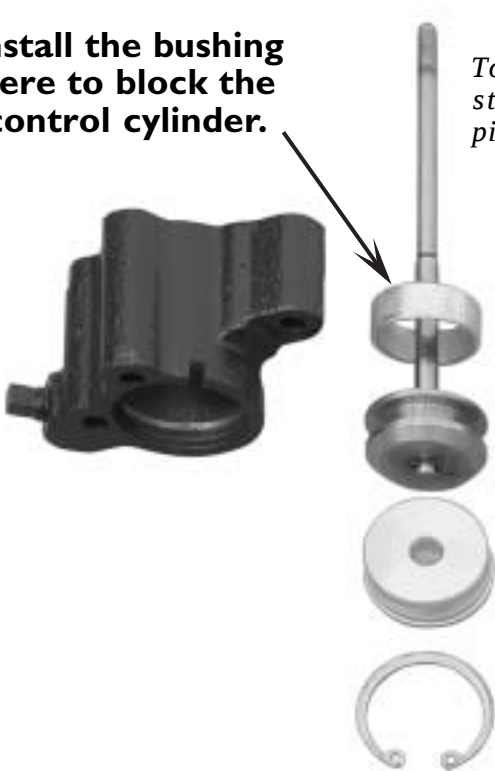


Nissan RE4F02A

Low Pressure at Idle (continued)

To correct or prevent the pump slide from sticking, block the control cylinder piston toward the cover. This will prevent the control cylinder from moving the pump slide. It's okay to do this during every RE4F02A rebuild.

Install the bushing here to block the control cylinder.



Single-seal type uses a THM 200-4R center support bushing.

To prevent the pump slide from sticking, block the control cylinder piston toward the cover.



Dual-seal type uses a THM 350 sun gear bushing.

Nissan RE4F04A and 4F20E

Slides Through 2nd Gear, Upshifts 1–3–4

We haven't found a *consistent* fix for these symptoms. Instead, there are a few modifications to cure the problems. You can perform these modifications, one by one, until the problem goes away, or you can perform them all at once.

Step 1: Check mainline, and make sure it's operating properly (covered in the previous section.)

Step 2: Install a lighter spring in the 2–4 servo.

Return Spring

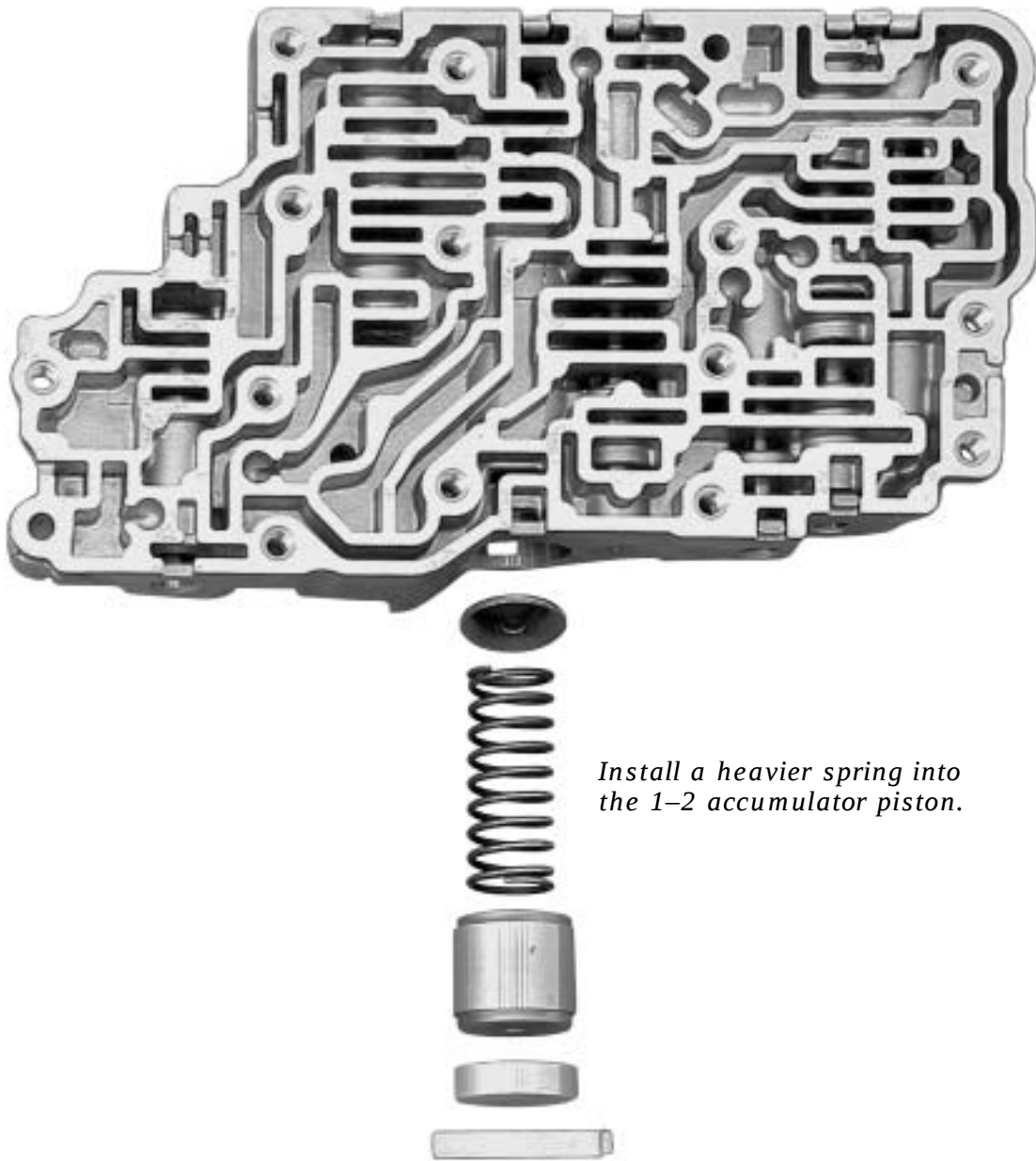


*Install a lighter spring
in the 2–4 servo*

Nissan RE4F04A and 4F20E

Slides Through 2nd Gear, Upshifts 1-3-4 (continued)

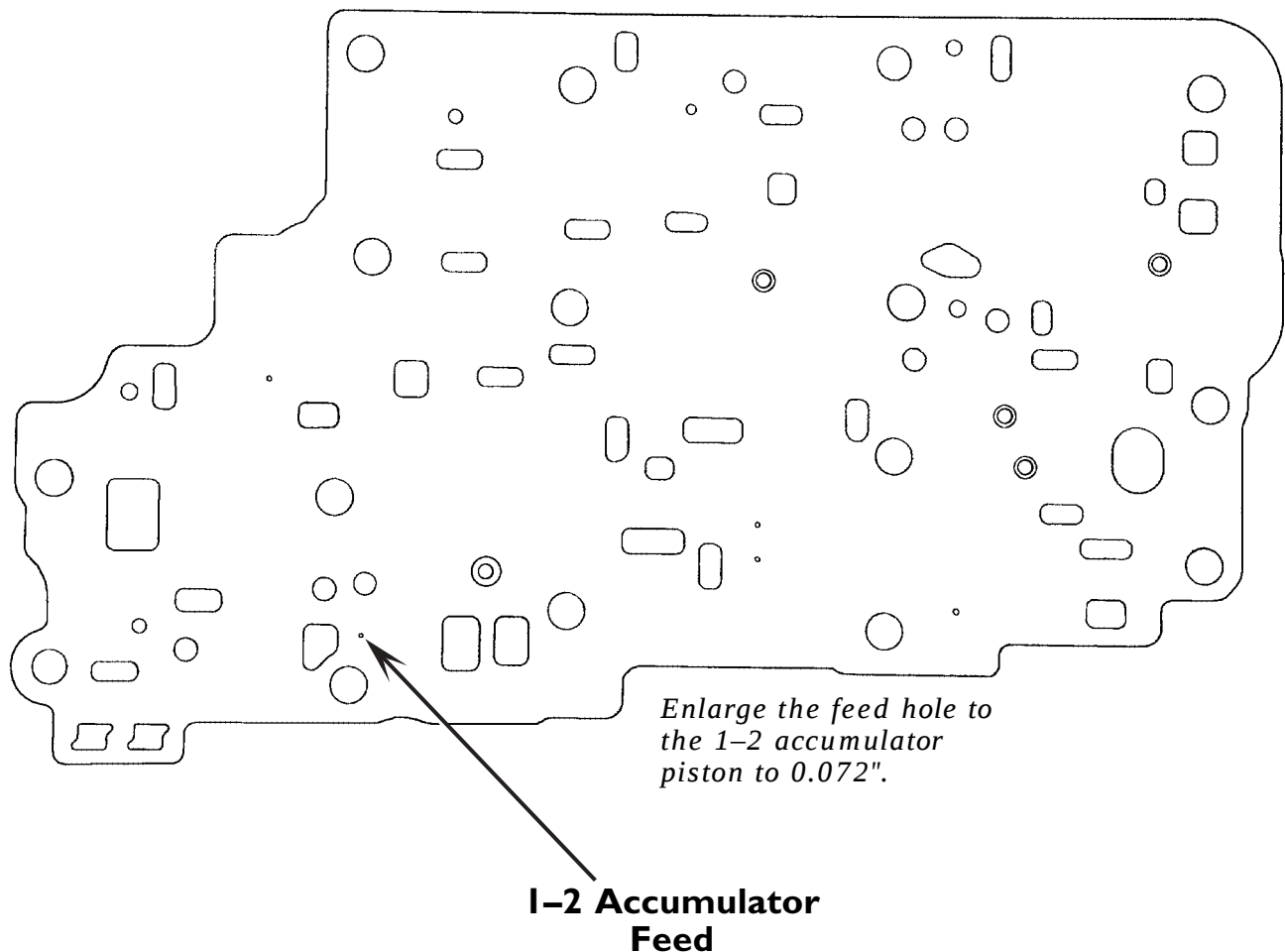
Step 3: Install a heavier spring in the 1-2 accumulator piston.



Nissan RE4F04A and 4F20E

Slides Through 2nd Gear, Upshifts 1-3-4 (continued)

Step 4: Enlarge the feed hole to the 1-2 accumulator piston to 0.072".



Nissan Trouble Code Diagnosis

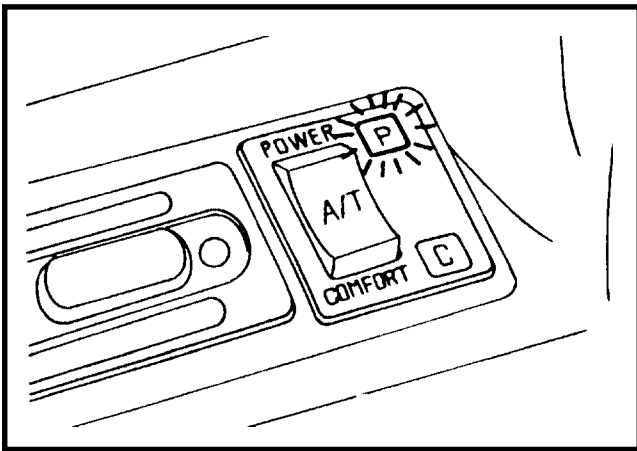
Code Retrieval Procedures

Nissan and Infinity provide diagnostic trouble codes through one of four ways:

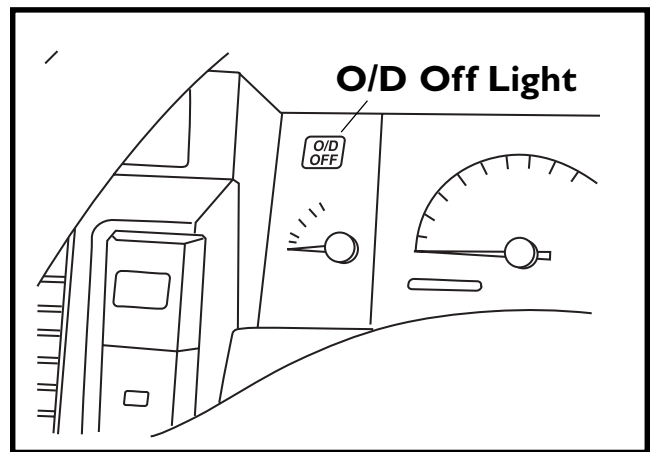
- Power (or Power Shift) Light
- O/D Off Light
- A/T Check Light
- Digital readout at the diagnostic information display

These systems indicate there are codes in memory by flashing the light 16 times every time you start the engine.

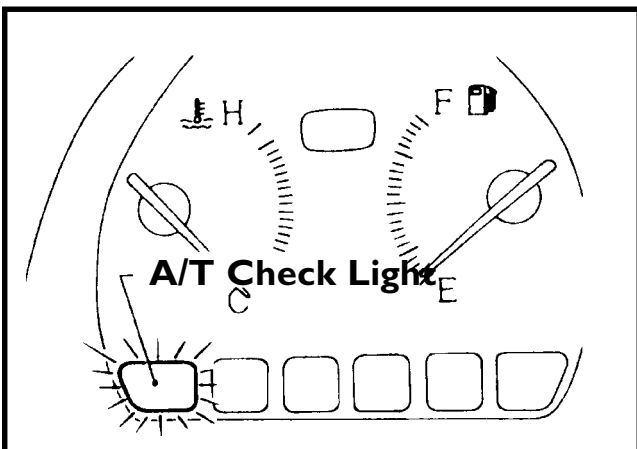
The light used to indicate and display codes depends on the specific vehicle you're working on.



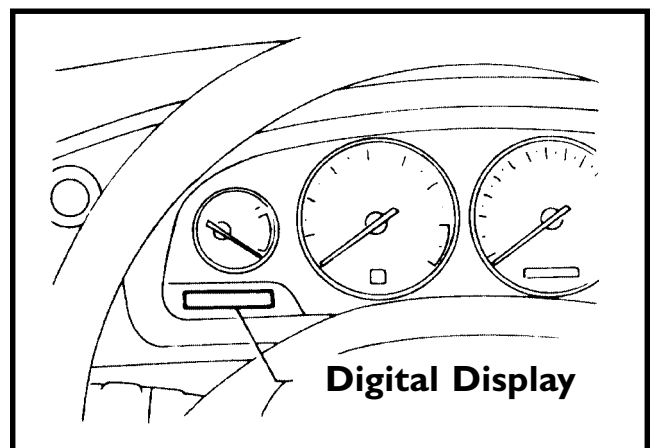
If the vehicle has a Mode switch, it indicates codes through the Power or Power Shift light.



Some Nissans and Infinities display trouble codes through the O/D Off light.



The 300 ZX and J30s display diagnostic trouble codes through the A/T Check light.



Q45s display diagnostic trouble codes through a digital display.

Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

Preliminary Check

To enable Nissans to display any diagnostic trouble codes stored in memory, you have to run through a specific procedure. This puts the system into the mode to display diagnostic trouble codes.

Before you can begin the code procedure, you must first run through a preliminary check, to prepare the vehicle for self-diagnosis, and to make sure the lights are working properly.

Here's how to prepare the system to deliver codes.

Step 1: Bring the engine to normal operating temperature.

Step 2: Turn the key off.

Step 3: Set the parking brake.

Step 4: Turn the key on, engine off.

Now you're ready to check the display light, to make sure it's capable of working. This applies to all vehicles except the Q45.

This procedure depends on what type of light and switches the vehicle uses:

Step 1: Put the switch in the proper position:

- If the vehicle has an O/D Off button, work the button to make sure the O/D Off light comes on. Then work the button again to turn the light off.
- If the vehicle has a Mode button, work the button to make sure the Power or Power Shift light comes on. Then work the button again to turn the light off.

Step 2: Turn the key off, and wait a few seconds.

Step 3: Turn the key on, engine off.

The indicator light on the dash should come on for a few second, then turn off. This is to check the light circuit, to make sure it's capable of indicating codes. If the light doesn't come on now, check the light circuit's operation before continuing the test procedure.

Step 4: Turn the key off.

Step 5: Move the shifter to D.

Step 6: Turn the O/D Off switch off.

Now you're ready to begin the specific procedure to retrieve codes. The procedure depends on which vehicle you're working on.

Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

All, Except J30, Q45 and Quest

Here's how to set the system to display diagnostic trouble codes, on all Nissans and Infinities, except the J30, Q45 and Quest:

Step 1: Turn the key on, engine off, and wait for a few seconds.

Step 2: Move the shifter to 2.

Step 3: Turn the O/D switch on (light off).

Step 4: Move the shifter to 1.

Step 5: Turn the O/D switch off (light on).

Step 6: Press the throttle to the floor and release it.

Step 7: On vehicles that display codes through the O/D Off light, turn the O/D switch on.

After performing this procedure, the computer system will display any diagnostic trouble codes by flashing the appropriate light on the dash.

Quest Only

Here's how to set the system to display diagnostic trouble codes on the Quest:

Step 1: Hold the O/D Off button in, and turn the key on, engine off. Then wait for a few seconds, and release the button; at this point, the O/D Off light should be lit.

Step 2: Move the shifter to 2.

Step 3: Press and release the O/D Off switch; the O/D Off light should go out.

Step 4: Move the shifter to 1.

Step 5: Press and release the O/D Off switch; the O/D Off light should come back on.

Step 6: Press the throttle to the floor and release it.

After performing this procedure, the computer system will display any diagnostic trouble codes by flashing the O/D Off light on the dash.

Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

J30 Only

Here's how to set the system to display diagnostic trouble codes on the J30:

Step 1: Turn the key on, engine off, and wait for a few seconds.

Step 2: Move the shifter to 3.

Step 3: Press the throttle to the floor, then release it.

Step 4: Move the shifter to 2.

Step 5: Press the throttle to the floor, then release it.

Step 4: Move the shifter to the right — this puts the shifter into Manual 1.

Step 5: Press the throttle to the floor, then release it.

After performing this procedure, the computer system will display any diagnostic trouble codes by flashing the A/T Check light on the dash.

Q45 Only

Here's how to set the system to display diagnostic trouble codes on the Q45:

Step 1: Turn the odometer reset counter knob counterclockwise, and hold it there for the next step.

Step 2: Turn the key on, engine off, and then release the odometer reset knob — the odometer display should display "AT CHECK."

Step 3: Move the shifter to 3.

Step 4: Press the throttle to the floor, then release it.

Step 5: Move the shifter to 2.

Step 6: Press the throttle to the floor, then release it.

Step 7: Move the shifter to the right — this puts the shifter into Manual 1.

Step 8: Press the throttle to the floor, then release it.

After performing this procedure, the computer system will display any diagnostic trouble codes on the digital odometer display.

Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

Reading Codes – Most Systems

Nissans and M30 Infinities display diagnostic trouble codes using an 11-flash sequence. The light flashes 11 times in a row; the sequence always starts with a long flash — about two seconds long. It's followed by 10 shorter flashes.

If there are no problems in the system, all ten flashes will be very short — about 0.2 seconds each.

Here's how Nissans and most Infinities indicate no diagnostic trouble codes in memory.



But if the computer identifies a problem in the system, one of those 10 flashes will be longer — nearly a full second long. Count the flashes: The long flash identifies the code in memory.

For example, if the first flash after the two second flash is the long one, you're looking at code 1.

Here's how Nissans and most Infinities display diagnostic trouble code 1.



If the fourth flash is the longer one, you're looking at code 4.

And here's how Nissans and most Infinities display diagnostic trouble code 4.



If there's more than one code in memory, the computer displays all of the codes in the same pass. Here's how a system would display codes 1, 4 and 8 at the same time:

This is how Nissans and some Infinities would display codes 1, 4 and 8 at the same time.



Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

Reading Codes – Most Systems (continued)

After the code displays, the light remains off for about 2½ seconds. If there are no other codes in memory, the computer repeats the code; if there are additional codes stored, the computer displays the next code in the sequence.

If the light flashes on and off, in regular, one-second intervals, it indicates the battery is low or was disconnected long enough to interrupt the computer memory.

If the battery is low, or was disconnected long enough to affect the computer's memory, the light will flash on and off in regular, one-second intervals.



If the light remains on or off, try performing the sequence again: You may have missed one of the steps in the procedure.

If the light still remains off, look for a problem in one of these systems or circuits:

- shift lever position (inhibitor) switch
- 1-range switch
- kickdown switch
- idle switch (closed throttle position switch)
- overdrive switch
- display circuit system
- computer

Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

Reading J30 Codes

Infinity J30s display diagnostic trouble codes using a 13-flash sequence. The light flashes 13 times in a row; the sequence always starts with a long flash — about two seconds long. It's followed by 12 shorter flashes.

If there are no problems in the system, all twelve flashes will be very short — about 0.2 seconds each.

Here's how J30s indicate there are no diagnostic trouble codes in memory.



But if the computer identifies a problem in the system, one of those 12 flashes will be longer — nearly a full second long. Count the flashes: The long flash identifies the code in memory.

For example, if the first flash after the two second flash is the long one, you're looking at code 1.

Here's how J30s display diagnostic trouble code 1.



If the fourth flash is the longer one, you're looking at code 4.

And here's how J30s display diagnostic trouble code 4.



If there's more than one code in memory, the computer displays all of the codes in the same pass. Here's how a system would display codes 1, 4 and 8 at the same time:

This is how the J30 computer would display codes 1, 4 and 8 at the same time.



Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

Reading J30 Codes (continued)

After the code displays, the light remains off for about 2½ seconds. If there are no other codes in memory, the computer repeats the code; if there are additional codes stored, the computer displays the next code in the sequence.

If the light flashes on and off, in regular, one-second intervals, it indicates the battery is low, or was disconnected long enough to affect the computer memory.

If the battery is low, or disconnected long enough to affect the computer memory, the light will flash on and off in regular, one-second intervals.



If the light remains on or off, try performing the sequence again: You may have missed one of the steps in the procedure.

If the light still remains off, look for a problem in one of these systems or circuits:

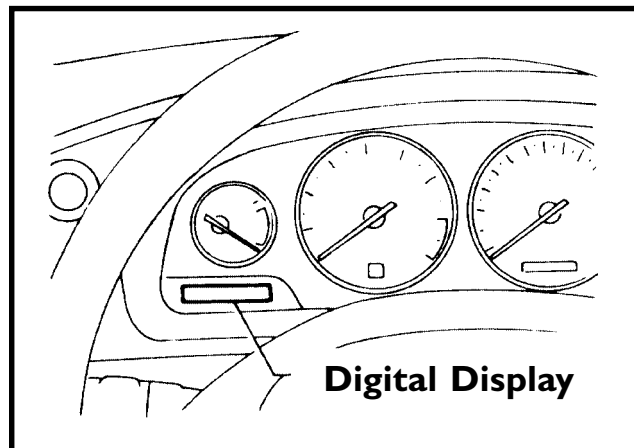
- shift lever position (inhibitor) switch
- 1-range switch
- kickdown switch
- idle switch (closed throttle position switch)
- display circuit system
- computer

Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

Reading Q45 Codes

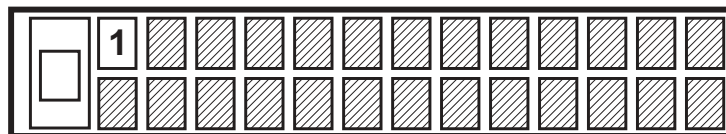
The Infinity Q45 indicates diagnostic trouble codes through a digital display. This display doubles as the odometer display. During the diagnostic trouble code retrieval, you have to turn the odometer reset knob counterclockwise; this changes the odometer display to read “AT CHECK.”



Q45s display diagnostic trouble codes through a digital display.

After you've gone through the diagnostic trouble code retrieval procedure, any codes in memory will display in a hexadecimal format; that is, it will display any codes as a 1 through 10, or as an A through D.

Here's how a Q45 would display diagnostic trouble code 1.



If there are no codes in memory, the odometer will display “OK.”

Here's how a Q45 indicates there are no codes in memory.



Nissan Trouble Code Diagnosis

Code Retrieval Procedures (continued)

Diagnostic Trouble Codes

Here is a list of the diagnostic trouble codes that apply to Nissans. Remember, never condemn a component based solely on a code; always check the circuit and component before replacing any parts.

Diagnostic Trouble Codes			Code Definition
All Except:	J30	Q45	
1	1	1	Vehicle Speed Sensor (Revolution Sensor) — Transmission Circuit Open or Shorted
2	2	2	Vehicle Speed Sensor — speedometer circuit Open or Shorted
3	3	3	Throttle Position Sensor Circuit Open or Shorted
4	4	4	Shift Solenoid A Circuit Open or Shorted
5	5	5	Shift Solenoid B Circuit Open or Shorted
6	6	6	Timing Solenoid or Overrun Clutch Solenoid Circuit Open or Shorted
7	7	7	Lockup Solenoid Circuit Open or Shorted
8	8	8	ATF Temperature Sensor circuit is Open, or the Computer Power Source is Insufficient
9	9	9	Engine RPM Signal Circuit Open or Shorted
10	—	—	Line Pressure Solenoid Circuit Open or Shorted
—	10	A	Turbine Shaft Speed Sensor is Open or Shorted
—	11	B	Line Pressure Solenoid Circuit Open or Shorted
—	12	C	Engine Control Circuit between Engine and Transmission Computers is Open or Shorted
Regular Flashing On and Off		D	Battery is Low, or Power was Disconnected Long Enough to Affect Computer Memory
Light Stays Off		AT CHECK	Inhibitor Switch, 1 Range Switch, Kickdown Switch, Idle Switch, Overdrive Switch, Display Circuit System or Computer

Clearing Diagnostic Trouble Codes

Nissan clears any codes in memory automatically after you've repaired the problem, and started the engine twice.

Nissan Trouble Code Diagnosis

Code I: Revolution Sensor

About the Sensor

The revolution sensor produces an AC signal that increases in voltage and frequency as output shaft speed increases. Typical voltage is about 0.5 VAC at a slow vehicle speed and can go as high as 15–20 VAC in some cases.

The sensor uses two wires, but the connector has three terminal cavities: terminal 3 is the ground wire for a shielded housing.

DIAGNOSTIC TIP While the computer uses the frequency to calculate vehicle speed, it won't recognize the signal if the voltage is below about 0.5 VAC. This is called the *threshold voltage*.

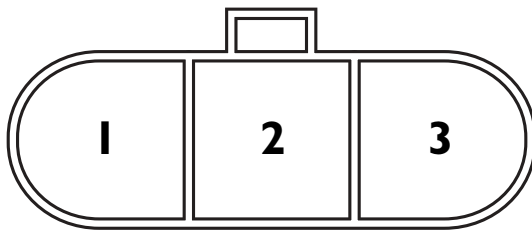
Nissan Trouble Code Diagnosis

Code I: Revolution Sensor (continued)

Conditions to Set Code

The computer must see a signal from the VSS while receiving no signal from the revolution sensor.

Testing the Revolution Sensor



Shown from the sensor side of the connector.

Pulse Generator Pin ID	
Pin	Function
1	Pulse Generator +
2	Pulse Generator –
3	Shield Ground

Resistance Test

The resistance should be between 500 – 600 ohms at normal operating temperature, but checking the resistance of the revolution sensor isn't a complete test. If the resistance is out of range, the sensor is bad. But even if the resistance is within specs, the sensor could still create insufficient voltage or a variation in frequency. That's why you should always check sensor output too.

Revolution Sensor Output Test

With the sensor either connected or disconnected, probe the two wires with your digital meter or scope.

With the drive wheels rotating, the signal voltage should be above 0.5 VAC. The frequency should be zero with the vehicle stopped, and should increase smoothly with vehicle speed.

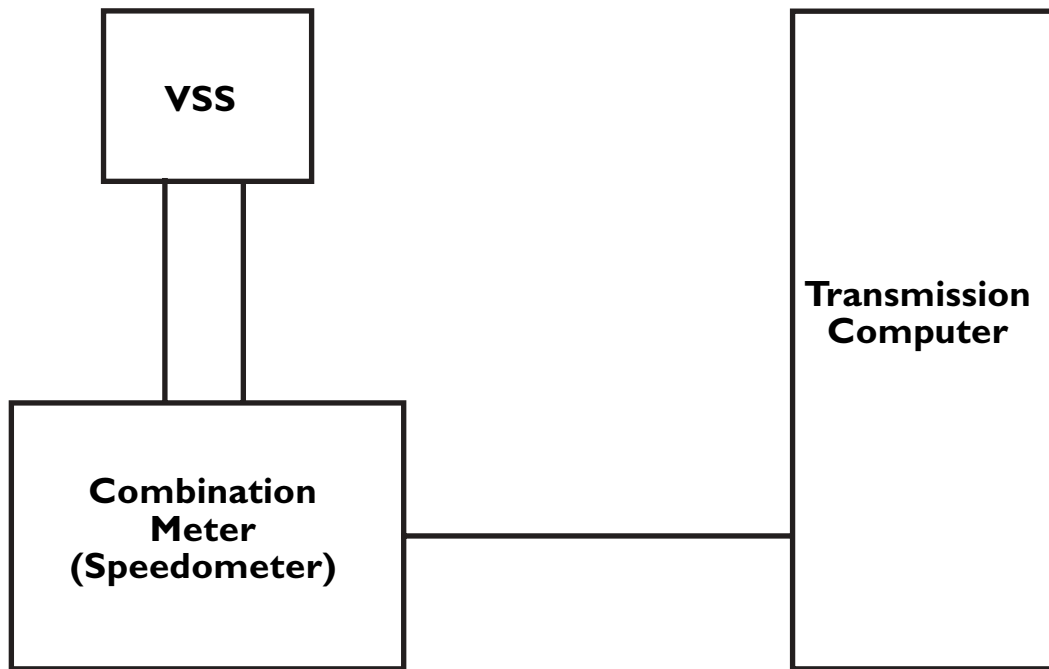
Nissan Trouble Code Diagnosis

Code 2: VSS (Vehicle Speed Sensor)

About the Sensor

The VSS produces an AC signal that increases in voltage and frequency with vehicle speed. Typical voltage is about 0.5 VAC at a slow vehicle speed and can go as high as 15–20 VAC in some cases.

The combination meter (speedometer) uses the AC signal to toggle a 5-volt DC reference, which the computer uses to calculate vehicle speed.



Conditions to Set Code

The computer must see a signal from the revolution sensor and receive no signal from the VSS.

Nissan Trouble Code Diagnosis

Code 2: VSS (continued)

Testing the Vehicle Speed Sensor

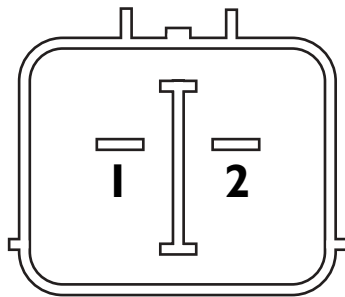
Resistance Test

The resistance should be about 200 ohms at normal operating temperature, but checking the resistance of the VSS isn't a complete test. If the resistance is out of range, the sensor is bad. But even if the resistance is within specs, the sensor could still create insufficient voltage or a variation in frequency. That's why you should always check sensor output too.

Sensor Output Test

With the VSS either connected or disconnected, probe the two wires with your digital meter or scope.

With the drive wheels rotating, the signal voltage should be above 0.5 VAC, and can rise as high as 15–20 VAC. The frequency should be zero with the vehicle stopped, and should increase smoothly with vehicle speed.



*VSS connector shown
from the sensor side
of the connector*

Nissan Trouble Code Diagnosis

Code 2: VSS (continued)

Testing the Vehicle Speed Sensor (continued)

VSS Signal to the Computer

While the VSS creates its own AC signal, the computer never actually receives that signal. Instead, the combination meter (speedometer) takes the AC signal, and creates a digital, 5-volt DC signal that varies in frequency; as the vehicle speed increases, the signal frequency increases with it. This is the signal that the TCM receives.

Testing the DC Signal

To check the DC signal at the TCM, you'll need a digital meter that reads DC frequency or an oscilloscope.

- Use the pin charts to find the VSS signal wire at the computer.
- Backprobe the VSS signal wire with your meter or scope's positive lead.
- Connect the negative lead to the computer signal ground.
- Rotate the drive wheels.

The signal from the speedometer should switch from zero to 5 volts. As you increase the wheel speed, the signal speed — or frequency of the pulses — should increase. On a meter, the signal voltage will average out to about 2.5 volts. The frequency of the signal should continue to increase with wheel speed.

If the signal isn't correct, check these three items before condemning the speedometer:

- Make sure the VSS signal to the speedometer is correct.
- Make sure you have a good 5-volt reference signal to the speedometer.
- Make sure you have a good ground to the speedometer.

If these three items check out okay, the speedometer is probably the source of the problem.

Nissan Trouble Code Diagnosis

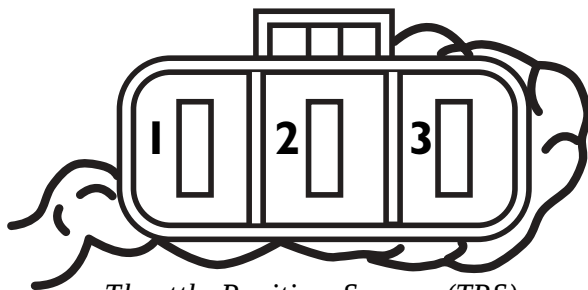
Code 3: TPS (Throttle Position Sensor)

About the Sensor

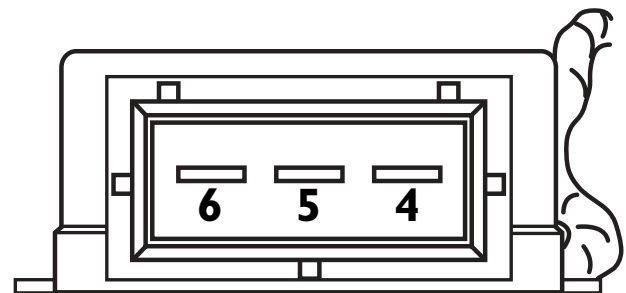
The TPS provides a varying voltage signal to the computer.

Inside the TPS are two additional switches: the idle switch and the full throttle switch. These switches supply the computer with a 12-volt signal, one at idle and the other at full throttle. But failure of the idle /full throttle switches will not set a code #3. The function and connector view is provided to avoid confusion while testing the TPS.

The TPS signal travels through the short harness attached to the side of the TPS; the idle/full throttle signals use the connector molded to the TPS housing.



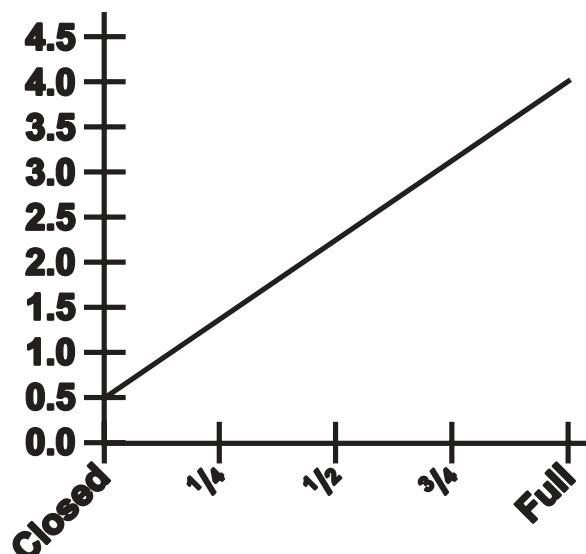
*Throttle Position Sensor (TPS)
harness connector shown from
the switch side of the connector*



*Idle / Full Throttle Switch harness
connector shown from the switch
side of the connector*

Conditions to Set Code

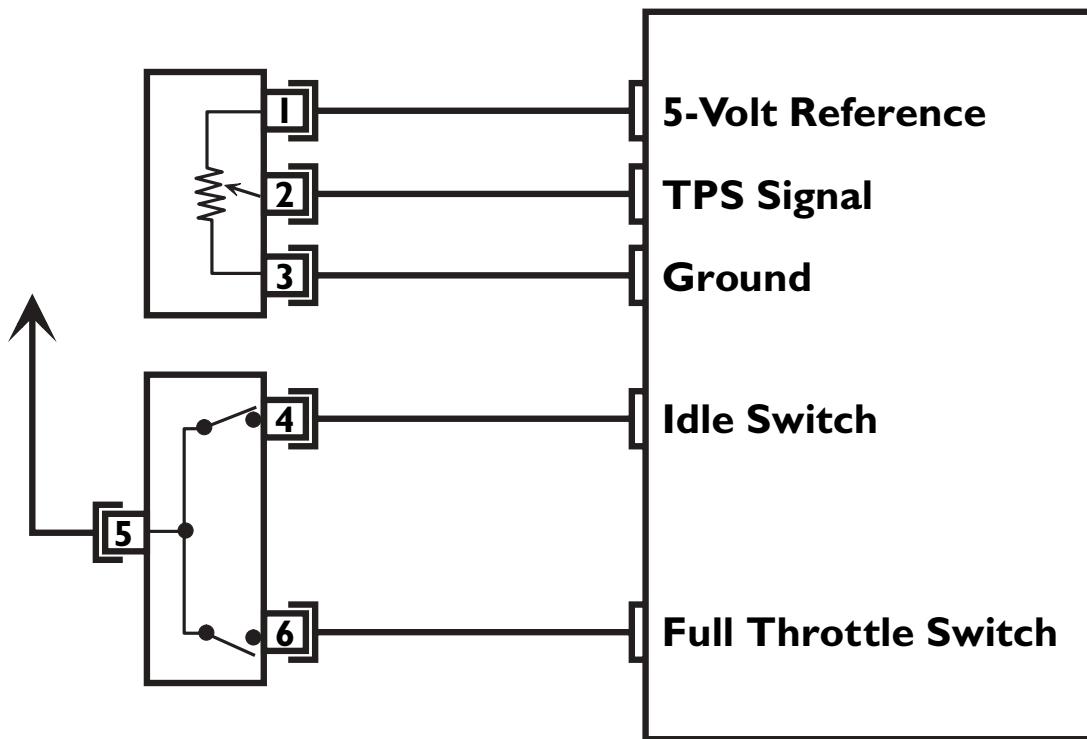
The computer must see a TPS signal below 0.2 volts or above 5 volts.



Nissan Trouble Code Diagnosis

Code 3: TPS (continued)

Testing the TPS



- Backprobe terminal #1 at the sensor.

Reference voltage should be about 5 VDC. If incorrect most Nissans supply reference voltage to the TPS from the TCM and the ECM. One of the computers should be able to provide the correct voltage. Splice in a new wire from the correct voltage source to the sensor.

- Backprobe terminal #3 at the sensor.

The ground circuit should have no more than 0.1 V. If incorrect, splice in a wire to the battery (–) terminal.

- Backprobe terminal #2 at the sensor.

Signal voltage should increase steadily with throttle opening. Any sudden drop-outs or glitches in the signal can indicate a faulty sensor or wire returning to the ECM or TCM.

Nissan Trouble Code Diagnosis

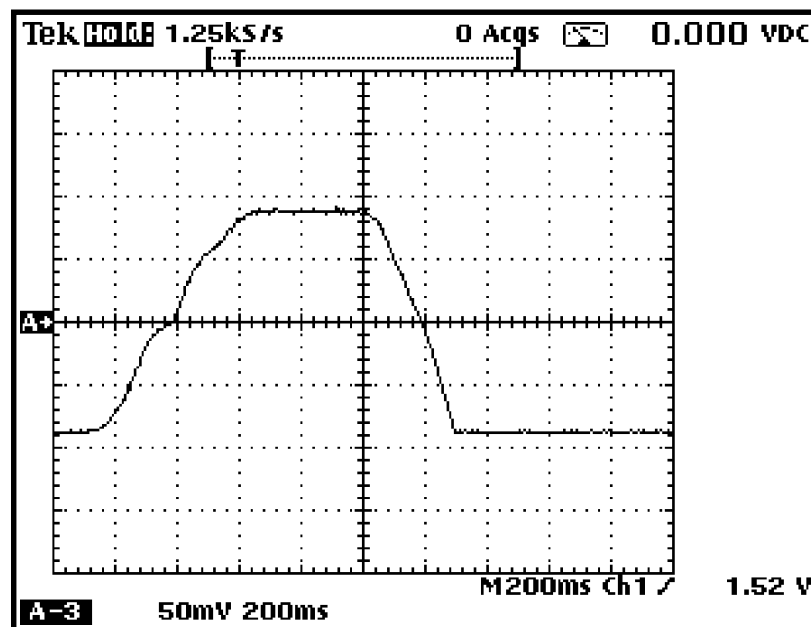
Code 3: TPS (continued)

Testing the TPS at the Computer

Testing the TPS signal return voltage at the TCM is a valid test. Knowing that the return circuit is typically wired to the ECM first, and then is an output to the TCM can shorten diagnostic time.

The circuit pin numbers and locations vary between vehicles at the computers.

Check the signal output from the ECM. If the signal is incorrect, splice in a new wire from the input at the PCM to the input at the TCM.



Nissan Trouble Code Diagnosis

Solenoid Codes

About the Solenoids

All but one Nissan transmission use five solenoids: two shift solenoids, an overrun solenoid to control engine braking, a lockup solenoid, and a line pressure control solenoid. The R4AEL in a Mazda 929 uses a 6th solenoid together with a lockup PWM; this is an on-off solenoid.

The chart indicates the code that each solenoid will set, and the specs for testing that solenoid.

Transmission Solenoid Specifications				
Solenoid	Normally	Resistance	Current @ 13.0 VDC	Code
A	Open	20–30 Ω	0.43–0.65 amps	4
B	Open	20–30 Ω	0.43–0.65 amps	5
Overrun Clutch	Open	20–30 Ω	0.43–0.65 amps	6
Lockup	Closed (PWM)	2.5–5.0 Ω	Varies with Duty Cycle	7
Line Pressure Control	Closed (PWM)	2.5–5.0 Ω	Varies with Duty Cycle	10
R4AEL Lockup Control	Open	20–30 Ω	0.43–0.65 amps	

Conditions to Set Code

As soon as the ignition turns on, the computer begins monitoring current flow through each of the solenoid circuits. The computer will identify a solenoid problem if the current is either too high or too low.

Solenoid Diagnostic Tips

Solenoid codes are easy to fix as long as you keep in mind that only one or more of the following items can cause a solenoid code to set:

Battery Voltage: Battery voltage directly affects current flow throughout all electrical circuits, including the solenoids. The system must maintain between 12.6 to 15.0 volts at all times.

Insufficient Ground: Make sure the transmission case is well grounded.

Poor Connections and Bad Wiring: Inspect the connectors first. If they're good, consider replacing the wire in question, from the computer to the solenoid.

Nissan Trouble Code Diagnosis

Solenoid Codes (continued)

Solenoid Diagnostic Tips (continued)

Bad Shift Solenoids: Shift solenoids don't go bad electrically that often. But if you suspect a bad solenoid, try connecting some known good solenoids to the harness, outside of the case, before pulling the pan.

Bad Computer: Before replacing the computer, try connecting a solenoid directly to the computer. Try to get as close to the computer connector as possible, cut the wire near the computer connector, and connect it directly to the known good solenoid (refer to pin chart).

Nissan Trouble Code Diagnosis

Code 8: Fluid Temperature Sensor Out of Range

About the Sensor

The fluid temperature sensor is a thermistor; a variable resistor that changes resistance based on temperature. The fluid temperature sensor is a Negative Temperature Coefficient (NTC) thermistor; that is, its resistance decreases as temperature increases.

The computer supplies a 5-volt reference to the sensor. When the sensor is cold, its resistance is high, so the signal voltage will be high. As the temperature increases, the resistance through the sensor to ground decreases, so the voltage also decreases.

Transmission Fluid Temperature Sensor Specifications

Fluid Temperature		Resistance	Voltage
°F	°C		
68	20	2.5 kΩ	1.56 V
176	80	0.3 kΩ	0.45 V

Conditions to Set Code

The computer must read a signal that is out of range (open or shorted signal).

Nissan Trouble Code Diagnosis

Code 8: Fluid Temperature Sensor (continued)

Testing the Fluid Temperature Sensor

The best way to test the fluid temperature sensor operation is to start when the system is cold, and then continue to monitor it as the system warms up. Here's how to check the sensor signal:

- Backprobe the fluid temperature sensor wire with the positive lead from your scope or digital meter.
- Connect the negative lead to a good ground.
- Start the engine, and check the signal. It should be high, depending upon the temperature outside.

Let the vehicle run with your meter connected. If possible, drive the vehicle while monitoring the sensor signal. As the transmission fluid warms up, the sensor signal voltage should continue to drop off smoothly.

When the transmission temperature reaches normal operating temperature, the sensor signal should have dropped below about half a volt.

If the sensor voltage is out of range, make sure you have a good connection to the sensor. If the connections are okay, but the sensor voltage drops off to zero or jumps to 5 volts, the sensor's probably bad.

Nissan Trouble Code Diagnosis

Code 9: Engine Revolution Signal

About the Signal

The engine revolution signal isn't like other signals to the computer. Instead of coming from a dedicated sensor, the engine revolution signal is created by the engine control module (ECM) for the transmission computer. It's based on the signal the ECM receives from the crankshaft sensor.

This is a digital signal that switches from zero to five volts. It varies in frequency based on engine RPM.

Testing the Engine Revolution Signal

Since the engine starts and runs, we have to assume the crankshaft sensor is working properly. Without the reference signal from the crankshaft sensor, the engine won't start.

So with that in mind, you can narrow down the engine revolution signal failure to a few areas:

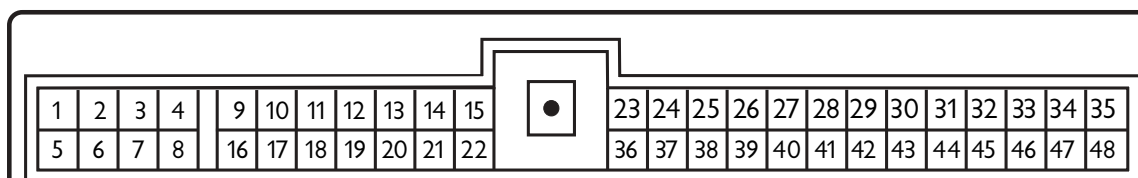
- The ECM isn't developing the proper signal.
- There's an open or short in the wiring between the ECM and the transmission computer.
- The transmission computer isn't acknowledging the signal properly.

Check the signal from the ECM at the transmission computer with the engine running, using a scope or digital meter.

- If you're getting a signal at the transmission computer, the TCM itself is most likely the problem.
- If you don't have a signal at the transmission computer, run a new wire from the ECM to the transmission computer.
- If you still don't get a signal, the problem is most likely in the ECM.

Nissan Computer Pin Charts

All Up to 1998 Except RWD Vans and Wagons



Pin	Function	Conditions	Signal
1	Line Pressure Control Solenoid	Idle	1.5–2.5 VDC
		Full Throttle	<0.5 VDC
2	Line Pressure Control Solenoid w/Drop Resistor	Idle	5–14 VDC
		Full Throttle	<0.5 VDC
3	O/D Off Light Or Power Indicator Light	O/D Off or In Power Mode	<0.5 VDC
		O/D On	B+
4	Ignition	Key Off	0 VDC
		Key On	B+
5	TCC Solenoid	Solenoid Off	<1.0 VDC
		Solenoid On	8–15 VDC
6	Shift Solenoid A	Solenoid Off	<0.5 VDC
		Solenoid On	B+
7	Shift Solenoid B	Solenoid Off	<0.5 VDC
		Solenoid On	B+
8	Overrun Clutch / 3-2 Control Solenoid	Solenoid Off	<0.5 VDC
		Solenoid On	B+
9	Ignition	Key Off	0 VDC
		Key On	B+
13	Inhibitor Switch P/N (Some Models)	In Park or Neutral	<1.0 VDC
		All Other Ranges	5.0 VDC
14	Idle Switch	Idle	B+
		Above Idle	<1.0 VDC
15	Ground	Always	<0.1 VDC
16	Inhibitor Switch 1	In Manual Low	B+
		All Other Ranges	<0.5 VDC
17	Inhibitor Switch 2	In Manual 2	B+
		All Other Ranges	<0.5 VDC
18	Inhibitor Switch D	In Drive	B+
		All Other Ranges	<0.5 VDC
19	Inhibitor Switch P or N	In Neutral or Park	B+
		All Other Ranges	<0.5 VDC

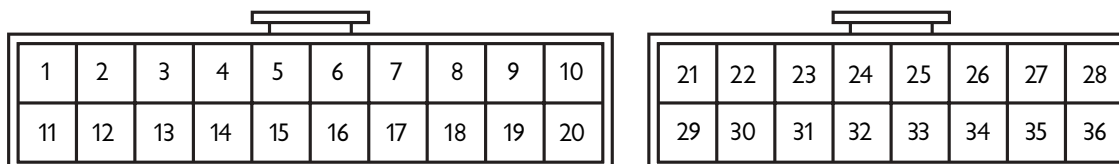
Nissan Computer Pin Charts

All Up to 1998 Except RWD Vans and Wagons (continued)

Pin	Function	Conditions	Signal
20	Inhibitor Switch R	In Reverse	B+
		All Other Ranges	<0.5 VDC
21	Full Throttle Switch	Full Throttle	B+
		All Other Throttle Openings	<0.5 VDC
23	Keep Alive Power	Key On	B+
		Key Off	B+
24	Engine Speed Signal	Engine Running: Voltage Should Rise with Engine RPM	0.6-2.5 VDC
25	Revolution Sensor	Wheels Rotating: Voltage Should Rise with Vehicle Speed	>0.5 VAC
27	Vehicle Speed Sensor	Vehicle Stopped	0 or 5 VDC
		Vehicle Moving	2.5 VDC
31	TPS Reference Voltage	Key Off	0 VDC
		Key On	5 VDC
33	Transmission Fluid Temperature Sensor	ATF @ 68° F (20° C)	1.56 VDC
		ATF @ 176° F (80° C)	0.45 VDC
34	TPS Signal	Idle	0.2–0.6 VDC
		Rises Gradually to Full Throttle	3.0–4.0 VDC
35	TPS Ground	Always	<0.1 VDC
36	A/T Power Switch (Some Models)	Switch in Power Position	B+
		Switch Not in Power Position	<1.0 VDC
37	Cruise Control Signal	ASCD Cruise Being Performed	B+
		ASCD Cruise Not Being Performed	<1.0 VDC
39	O/D Select Switch	O/D Switch On	5–14 VDC
		O/D Switch Off	<0.1 VDC
40	O/D Cut Signal from Cruise Control	ASCD Cruise Released	4.5-5.5 VDC
		ASCD Cruise Applied	<1.0 VDC
42	A/T Comfort Switch (Some Models)	Comfort Position On	B+
		Comfort Position Off	<1.0 VDC
48	Ground	Always	<0.1 VDC

Nissan Computer Pin Charts

All RWD Vans and Wagons Up to 1998



Pin	Function	Conditions	Signal
1	Inhibitor Switch 2	In Manual 2	B+
		All Other Ranges	<0.5 VDC
2	Inhibitor Switch 1	In Manual Low	B+
		All Other Ranges	<0.5 VDC
3	A/T Power Switch (Some Models)	Switch in Power Position	B+
		Switch Not in Power Position	<1.0 VDC
4	Idle Switch	Idle	B+
		Above Idle	<1.0 VDC
6	O/D Cut Signal from Cruise Control	ASCD Cruise Released	4.5–5.5 VDC
		ASCD Cruise Applied	<1.0 VDC
7	Full Throttle Switch	At Full Throttle	B+
		All Other Throttle Openings	<0.5 VDC
8	Cruise Control Signal	ASCD Cruise Being Performed	B+
		ASCD Cruise Not Being Performed	<1.0 VDC
9	O/D Select Switch	O/D Switch On	5–14 VDC
		O/D Switch Off	<0.1 VDC
10	TPS Reference Voltage	Key Off	0 VDC
		Key On	5 VDC
11	TPS Signal	Idle	0.2–0.6 VDC
		Rises Gradually to Full Throttle	3.0–4.0 VDC
12	Transmission Fluid Temperature Sensor	ATF @ 68° F (80° C)	1.56 VDC
		ATF @ 176° F (80° C)	0.45 VDC
15	TPS Ground	Always	<0.1 VDC
16	Revolution Sensor	Wheels Rotating: Voltage Should Rise with Vehicle Speed	>0.5 VAC
17	Full Throttle Switch	At Full Throttle	B+
		All Other Throttle Openings	<0.5 VDC
19	Inhibitor Switch N or P	In Neutral or Park	B+
		All Other Ranges	<0.5 VDC
20	Inhibitor Switch D	In Drive	B+
		All Other Ranges	<0.5 VDC

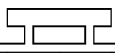
Nissan Computer Pin Charts

All RWD Vans and Wagons Up to 1998 (continued)

Pin	Function	Conditions	Signal
21	Overrun Clutch / 3-2 Control Solenoid	Solenoid Off	<0.5 VDC
		Solenoid On	B+
22	TCC Solenoid	Solenoid Off	<1.0 VDC
		Solenoid On	8–14 VDC
23	O/D Off Light or Power Indicator Light	O/D Off	<0.5
		O/D On or in Power Mode	B+
24	Vehicle Speed Sensor	Vehicle Stopped	0 or 5 VDC
		Vehicle Moving	2.5 VDC
25	Engine Speed Signal	Engine Running: Voltage Should Rise with Engine RPM	0.6–2.5 VAC
26	Inhibitor Switch R	In Reverse	B+
		All Other Ranges	<0.5 VDC
28	Keep Alive Power	Key On	B+
		Key Off	B+
29	Ignition	Key Off	0 VDC
		Key On	B+
30	Ignition	Key Off	0 VDC
		Key On	B+
31	Ground	Always	<0.1 VDC
32	Ground	Always	<0.1 VDC
33	Line Pressure Control Solenoid w/Drop Resistor	Idle	5–14 VDC
		Full Throttle	<0.5 VDC
34	Line Pressure Control Solenoid	Idle	1–1.5 VDC
		Full Throttle	<0.5 VDC
35	Shift Solenoid A	Solenoid Off	<0.5 VDC
		Solenoid On	B+
36	Shift Solenoid B	Solenoid Off	<0.5 VDC
		Solenoid On	B+

Nissan Computer Pin Charts

1999-On



1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21				22	23	24



25	26	27	28	29	30	31	32	33
34	35	36	36	38	39	40	41	42
43	44	45				46	47	48

Pin	Function	Conditions	Signal
1	Line Pressure Control Solenoid	Idle	1.5–2.5 VDC
		Full Throttle	<0.5 VDC
2	Line Pressure Control Solenoid w/Drop Resistor	Idle	5–14 VDC
		Full Throttle	<0.5 VDC
3	TCC Solenoid	Solenoid Off	<1.0 VDC
		Solenoid On	8–14 VDC
10	Ignition	Key Off	0 VDC
		Key On	B+
11	Shift Solenoid A	Solenoid Off	<0.5 VDC
		Solenoid On	B+
12	Shift Solenoid B	Solenoid Off	<0.5 VDC
		Solenoid On	B+
13	O/D Off Light	O/D Off	<0.5 VDC
		O/D On or In Power Mode	B+
16	Idle Switch	Idle	B+
		Above Idle	<1.0 VDC
17	Full Throttle Switch	Full Throttle	B+
		All Other Throttle Openings	<0.5 VDC
18	O/D Cut Signal from Cruise Control	ASCD Cruise is Released	4.5–5.5 VDC
		ASCD Cruise is Applied	<1.0 VDC
19	Ignition	Key Off	0
		Key On	B+
20	Overrun Clutch / 3–2 Sontrol Solenoid	Solenoid Off	<0.5 VDC
		Solenoid On	B+
22	O/D Select Switch	O/D Switch On	5–14 VDC
		O/D Switch Off	< 0.1 VDC
24	O/D Cut Signal from Cruise Control	ASCD Cruise is Released	4.5–5.5 VDC
		ASCD Cruise is Applied	<1.0 VDC
25	Ground	Always	<0.1 VDC

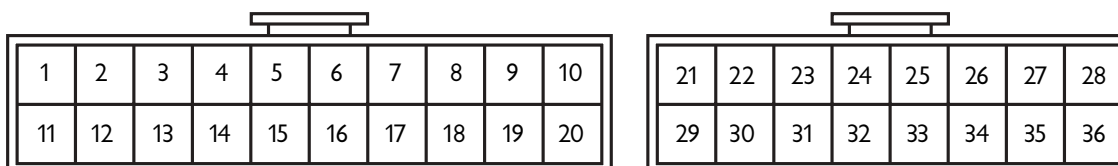
Nissan Computer Pin Charts

1999-On (continued)

Pin	Function	Conditions	Signal
26	Inhibitor Switch 1	In Manual Low	B+
		All Other Ranges	<0.5 VDC
27	Inhibitor Switch 2	In Manual 2	B+
		All other ranges	<0.5 VDC
28	Keep Alive Power	Key On	B+
		Key Off	B+
29	Revolution Sensor	Wheels Rotating: Frequency Should Rise with Vehicle Speed	>0.5 VAC
30	ECM		
31	ECM		
32	TPS Reference Voltage	Key Off	0 VDC
		Key On	5 VDC
33	ECM		
34	Inhibitor Switch D	In Drive	B+
		All Other Ranges	<0.5 VDC
35	Inhibitor Switch R	In Reverse	B+
		All Other Ranges	<0.5 VDC
36	Inhibitor Switch N or P	In N or P	B+
		All Other Ranges	<0.5 VDC
39	Engine Speed Signal	Engine Running: Frequency Should Rise with Engine RPM	0.6–2.5 VDC
40	VSS	Vehicle Stopped	0 or 5 VDC
		Vehicle at Speed (DC Frequency)	2.5 VDC
41	TPS Signal	Idle	0.2–0.6 VDC
		Rises Gradually to Full Throttle	3.0–4.0 VDC
42	TPS Ground	Always	<0.1 VDC
45	Brake Switch	Brake Pedal Applied	B+
		Brake Pedal Released	0 VDC
47	Transmission Fluid Temperature Sensor	ATF @ 68° F (20° C)	1.56 VDC
		ATF @ 176° F (80° C)	0.45 VDC
48	Ground	Always	<0.1 VDC

Subaru Computer Pin Charts

Early Models



Pin	Function	Conditions	Signal
1	Inhibitor Switch 3	In Manual 3	<0.1 VDC
		All Other Ranges	B+
2	Inhibitor Switch 2	In Manual 2	<0.1 VDC
		All Other Ranges	B+
3	Brake Switch	Brake Pedal Applied	B+
		Brake Pedal Released	<1.0 VDC
4	Idle Switch	Idle	B+
		Above Idle	<1.0 VDC
5	Speed Sensor 2	Drive Wheels Stopped	<0.1 or 5 VDC
		Drive Wheels Rotating	5.0 V Pulses
6	O/D Cut Signal from Cruise Control	ASCD Cruise Released	4.5–5.5 VDC
		ASCD Cruise Applied	< 1.0 VDC
8	Cruise Control Signal	ASCD Cruise Being Performed	B+
		ASCD Cruise Not Being Performed	<1.0 VDC
9	1 st Gear Hold Switch	Switch On	5–14 VDC
		Switch Off	< 0.1 VDC
10	FWD Switch	FWD On	<0.1 VDC
		FWD Off	B+
11	TPS Signal	Idle	0.2–0.6 VDC
		Rises Gradually to Full Throttle	3.0–4.0 VDC
12	Transmission Fluid Temperature Sensor	ATF @ 68° F (20° C)	1.56 VDC
		ATF @ 176° F (80° C)	0.45 VDC
13	Manual 2 Indicator Light	In Manual 2	<0.1 VDC
		All Other Ranges	B+
14	Inhibitor Switch Park	In Park	<0.1 VDC
		All Other Ranges	B+
15	TPS Ground	Always	<0.1 VDC
16	Revolution Sensor	Wheels Rotating: Frequency Should Rise with Vehicle Speed	>0.5 VAC
18	Keep Alive Power	Key Off	B+
		Key On	B+

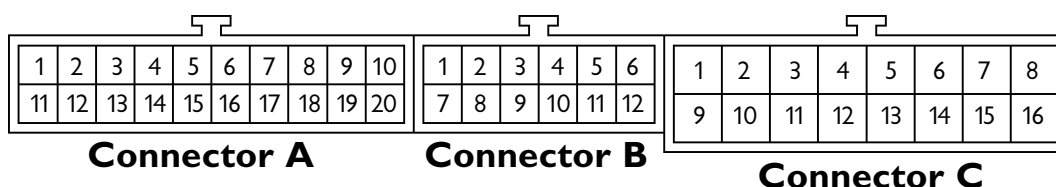
Subaru Computer Pin Charts

Early Models (continued)

Pin	Function	Conditions	Signal
19	Inhibitor Switch N	In Neutral	<0.1 VDC
		All Other Ranges	B+
20	Inhibitor Switch D	In Drive	<0.1 VDC
		All Other Ranges	B+
21	Overrun Clutch / 3-2 Control Solenoid	Solenoid Off	<0.5 VDC
		Solenoid On	B+
22	TCC Solenoid	Solenoid Off	<1.0 VDC
		Solenoid On	8-14 VDC
23	O/D Off Light or Power Indicator Light	Off	<0.5 VDC
		On or in Power Mode	B+
24	Transfer Clutch Solenoid	2WD Mode	<0.1 VDC
		4WD Mode	Varies
25	Engine Speed Signal	Engine Running: Frequency Should Rise with Engine RPM	0.6-2.5 VDC
26	Inhibitor Switch R	In Reverse	<0.1 VDC
		All Other Ranges	B+
28	Oil Temperature Light	Light On	<0.1 VDC
		Light Off	B+
29	Ignition	Key Off	0 VDC
		Key On	B+
30	Ignition	Key Off	0 VDC
		Key On	B+
31	Ground	Always	<0.1 VDC
32	Ground	Always	<0.1 VDC
33	Line Pressure Control Solenoid w/Drop Resistor	Idle	5-14 VDC
		Full Throttle	<0.5 VDC
34	Line Pressure Control Solenoid	Idle	5-14 VDC
		Full Throttle	<0.5 VDC
35	Shift Solenoid A	Solenoid Off	<0.5 VDC
		Solenoid On	B+
36	Shift Solenoid B	Solenoid Off	<0.5 VDC
		Solenoid On	B+

Subaru Computer Pin Charts

Late Models



Pin	Function	Conditions	Signal
A1	Ground	Always	<0.1 VDC
A2	FWD Switch	Fuse Removed	B+
		Fuse Installed	<0.1 VDC
A3	Cruise Control Signal	ASCD Cruise Being Performed	B+
		ASCD Cruise Not Being Performed	<1.0 VDC
A5	ABS Signal	Switch On	<0.1 VDC
		Switch Off	6–10 VDC
A6	Manual Switch	Switch On	<0.1 VDC
		Switch Off	B+
A7	Brake Switch	Brake Pedal Applied	B+
		Brake Pedal Released	<0.5 VDC
A8	Inhibitor Switch N	In Neutral	B+
		All Other Ranges	<0.5 VDC
A9	Inhibitor Switch P	In Park	B+
		All Other Ranges	<0.5 VDC
A10	Inhibitor Switch R	In Reverse	B+
		All Other Ranges	<0.5 VDC
A11	VSS	Vehicle Stopped	0 or 5 VDC
		Vehicle at Speed (DC Frequency)	2.5 VDC
A14	Keep Alive Power	Key On	B+
		Key Off	B+
A16	Idle Switch	Idle	<0.1 VDC
		Off Idle	3–6 VDC
A20	Ground	Always	<0.1 VDC

Subaru Computer Pin Charts

Late Models (continued)

Pin	Function	Conditions	Signal
B1	Inhibitor Switch D	In Drive	B+
		All Other Ranges	<0.5 VDC
B2	Inhibitor Switch 3	In Manual 3	B+
		All Other Ranges	<0.5 VDC
B3	Inhibitor Switch 2	In Manual 2	B+
		All Other Ranges	<0.5 VDC
B4	Inhibitor Switch 1	In Manual 1	B+
		All Other Ranges	<0.5 VDC
B6	Ignition	Key Off	0
		Key On	B+
B7	Ground	Always	<0.1 VDC
B8	TPS Signal	Idle	0.2–0.6 VDC
		Rises Gradually to Full Throttle	3.0–4.0 VDC
B10	Transmission Fluid Temperature Sensor	ATF @ 68° F (20° C)	1.56 VDC
		ATF @ 176° F (80° C)	0.45 VDC
B12	Pulse Generator	Wheels Stopped	0
		Wheel Rotating	0.5 AC
C1	Ignition	Key Off	0
		Key On	B+
C3	FWD Solenoid	FWD Fuse In	B+
		FWD Fuse Out	0.5 VDC
C5	TCC Solenoid	Solenoid Off	<1.0 VDC
		Solenoid On	8–14 VDC
C7	Line Pressure Control Solenoid w/Drop Resistor	Idle	2.5 VDC
		Full Throttle	<0.5 VDC
C8	Line Pressure Control Solenoid	Idle	5–14 VDC
		Full Throttle	<0.5 VDC
C10	Ground	Always	<0.1 VDC
C13	Shift Solenoid B	Solenoid Off	<0.5 VDC
		Solenoid On	B+
C14	Shift Solenoid A	Solenoid Off	<0.5 VDC
		Solenoid On	B+
C15	Overrun Clutch / 3–2 Control Solenoid	Solenoid Off	<0.5 VDC
		Solenoid On	B+

Reference

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Conversion Tables

Area		
Multiply	By	To Obtain
In ²	645.2	mm ²
In ²	6.452	cm ²
In ²	0.0069	Ft ²
Ft ²	0.0929	m ²
Ft ²	144.0	In ²
m ²	10.764	Ft ²
cm ²	0.155	In ²
mm ²	0.00155	In ²
area of a circle = πr^2 area of a cylinder = $\pi r^2 h$		
$\pi = 3.14$ r = Radius h = Height		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

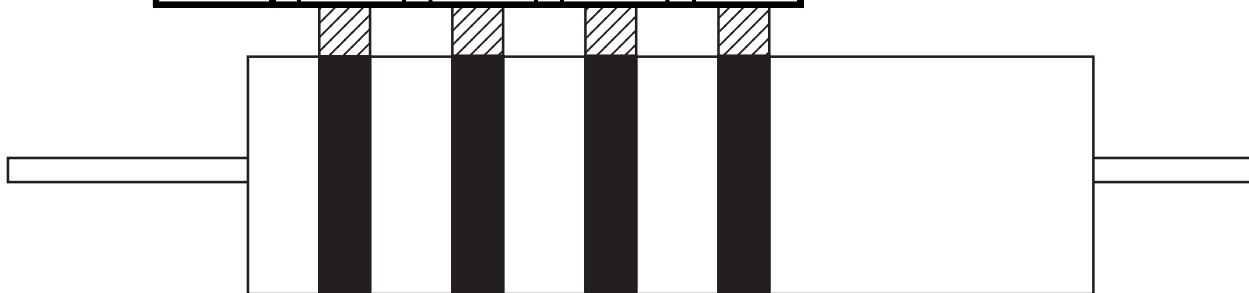
* The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	0	—
Brown	1	1	1	—
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Brown	—	—	—	1%
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%



So if the bands are:

Blue Green Yellow Silver
6 5 0,000 ±10%

Red Violet Brown Gold
2 7 0 ±5%

White Orange Violet Plain
9 3 0,000,000 ±20%

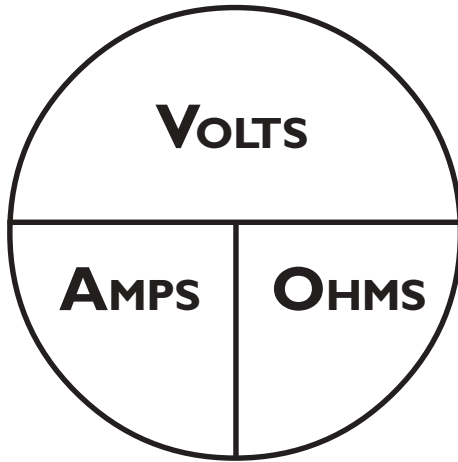
The resistor value is:

= 650 kΩ, ±10%

= 270 Ω, ±5%

= 930 MΩ, ±20%

Ohm's Law



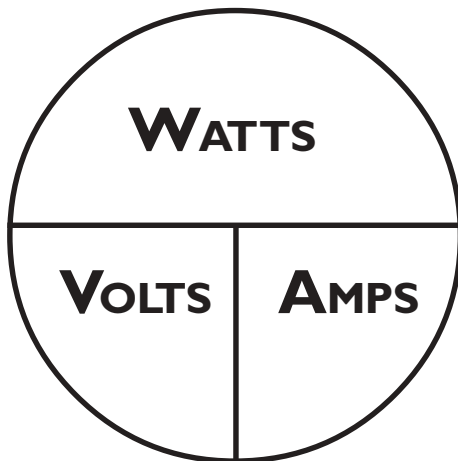
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

Multiple Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

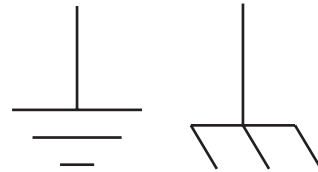
Schematic Symbols



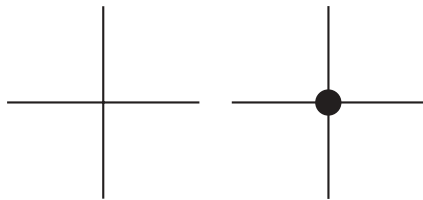
Battery



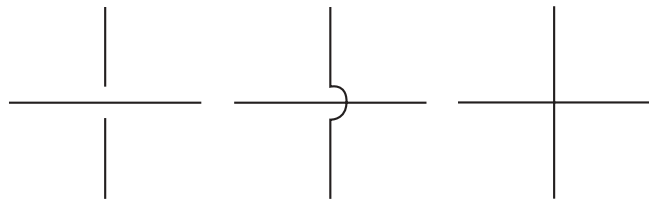
Power



Ground



Connected Wires



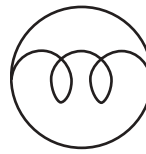
Unconnected Wires



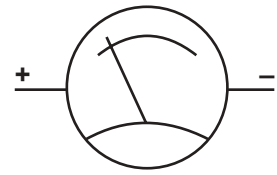
Fuse



Circuit Breaker



Bulb

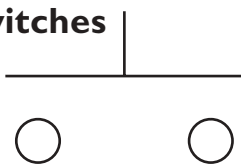


Meter

Pushbutton Switches



NC Switch

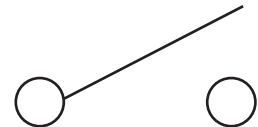


NO Switch

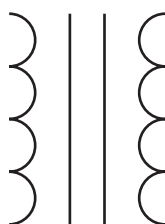
On/Off Switches



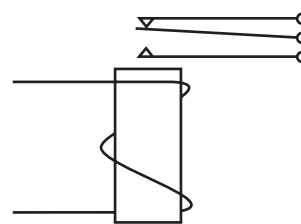
NC Switch



NO Switch

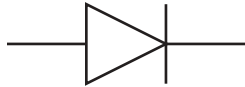
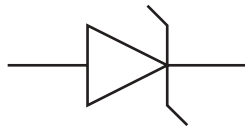
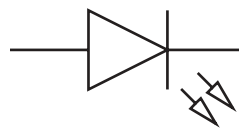
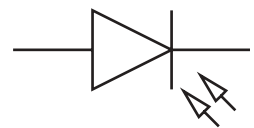
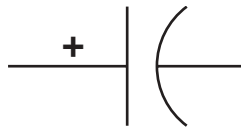
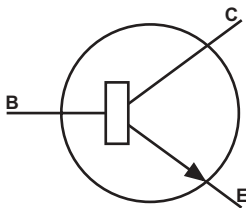
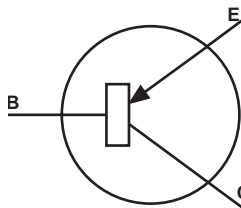
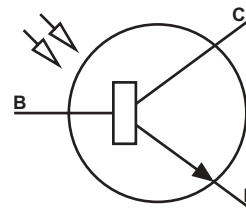
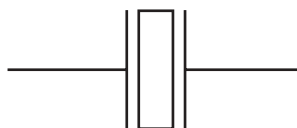


Transformer (Coil)



Relay

Schematic Symbols (continued)

**Fixed Resistor****Variable Resistor****Potentiometer****Diode****Zener Diode****LED****Photodiode****Fixed Capacitor****Fixed Capacitor (Polarized)****Variable Capacitor****NPN Transistor****PNP Transistor****Phototransistor****Crystal**

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates

that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition systems.

Glossary of Electrical Terms (cont)

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical

circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific direction, or the LED won’t light.

Glossary of Electrical Terms (cont)

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm's Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). $\text{Ohms} \times \text{Amps} = \text{Volts}$; $\text{Volts} \div \text{Ohms} = \text{Amps}$; $\text{Volts} \div \text{Amps} = \text{Ohms}$.

Open Circuit — An incomplete electrical path that won't provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won't operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component's operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won't prevent the other legs from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the voltage signal, based on its position

along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device controlling the circuit.

Glossary of Electrical Terms (cont)

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely be dealing with open and close to control hydraulic flow, to allow the transmission to shift gears, control lockup, and control line pressure.

Thermistor — A semiconductor that varies resistance based on temperature. There are two types of thermistor: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). The NTC thermistor is more common — as the temperature goes up, its resistance goes down.

Transistor — A semiconductor that operates as an electronic "relay." Transistors allow a low current circuit to control power or ground to a high current circuit.

Variable Resistor — A one- or two-wire sensor that modifies a voltage signal based on stress or temperature. Thermistors are the most common type of variable resistor in today's cars and trucks.

Voltage — The pressure in an electrical system, that pushes current through the circuit. One volt of pressure is necessary to push one amp of current through one ohm of resistance. Sometimes called the circuit's potential.

Voltmeter — Electrical test device that measures the voltage potential in a circuit. Displays its reading in volts.

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kV	Kilovolt
AC	Alternating current	kW	Kilowatt
B, b	Base electrode, units with single	kWH	Kilowatt hour
base		lb	Pound
°C	Degrees Celsius or centigrade	M	Mega; x1,000,000
C	Capacitance, capacitor	m	Milli; one-one thousandth; 1/1000;
C, c	Collector electrode	0.001	
cm	Centimeter	mf, mfd	Microfarad
cu	Cubic	MHz	Megahertz
db	Decibels	mm	Millimeter
DC	Direct current	NC	Normally closed
dm	Decimeter	Nm	Newton-meter
DPDT	Double-pole, double-throw switch	NO	Normally open
DPST	Double-pole, single-throw switch	R	Resistance; resistor
E, e	Emitter electrode	SPDT	Single-pole, double-throw switch
E, e	Voltage	SPST	Single-pole, single-throw switch
mf	Microfarad	t	Time
°F	Degrees Fahrenheit	T	Temperature
F, f	Frequency	V, v	Volt; voltmeter
flu	Fluid	V _{BB}	Base supply voltage (DC)
FM	Frequency modulation	V _{BC}	Base-to-collector voltage (DC)
g	Gram	V _{BE}	Base-to-emitter voltage (DC)
gnd, grd	Ground	V _{CB}	Collector-to-base voltage (DC)
Hg	Mercury	V _{CC}	Collector supply voltage (DC)
Hz	Hertz	V _{CE}	Collector-to-emitter voltage (DC)
I	Current	V _{EB}	Emitter-to-base voltage (DC)
I _B	Base current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _C	Collector current (DC)	v _{ee}	Emitter supply voltage (DC)
I _E	Emitter current (DC)	v _F	Forward voltage (DC)
k	x1000	W	Watt; work
kg	Kilograms	w	Watt
kHz	Kilohertz	wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	$\frac{1}{128}$	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	$\frac{15}{128}$	2.9769		
0.0156	$\frac{1}{16}$	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	$\frac{1}{8}$	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	$\frac{17}{128}$	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	$\frac{3}{128}$	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	$\frac{9}{64}$	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	$\frac{3}{16}$ -24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	$\frac{1}{32}$	0.7925			0.1484	$\frac{19}{128}$	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	$\frac{5}{32}$	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	$\frac{3}{16}$ -32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	$\frac{5}{128}$	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	$\frac{21}{128}$	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	$\frac{3}{64}$	1.1913		0-80 NF	0.1719	$\frac{11}{64}$	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	$\frac{7}{128}$	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	$\frac{23}{128}$	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1653		4.2000		5.5mm - 0.80
0.0625	$\frac{1}{16}$	1.5875			0.1820		4.6228	14	12-28 NF
0.0635		1.6129	52		0.1850		4.6990	13	12-32 NEF
0.0670		1.7018	51		0.1875	$\frac{3}{16}$	4.7625		
0.0700	$\frac{9}{128}$	1.7780	50	2-56 NC 2-64 NF	0.1890		4.8006	12	
					0.1910		4.8514	11	
0.0730		1.8542	49		0.1935		4.9149	10	14-20 NS
0.0760		1.9304	48		0.1953	$\frac{25}{128}$	4.9606		
0.0781	$\frac{5}{64}$	1.9837			0.1960		4.9784	9	
0.0785		1.9939	47	3-48 NC	0.1990		5.0546	8	
0.0810		2.0574	46		0.2010		5.1054	7	$\frac{1}{4}$ -20 NC 14-24 NS
0.0820		2.0828	45	3-56 NF					
0.0860	$\frac{11}{128}$	2.1844	44	4-36 NS	0.2031	$\frac{13}{64}$	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	$\frac{3}{32}$	2.3825		$\frac{1}{8}$ -32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	$\frac{1}{4}$ -24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	$\frac{27}{128}$	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	$\frac{1}{4}$ -28 NF $\frac{1}{4}$ -32 NEF
0.1015		2.5781	38	$\frac{1}{8}$ -40NF 5-40NC	0.2188	$\frac{7}{32}$	5.5575		
					0.2210		5.6134	2	
0.1016	$\frac{13}{128}$	2.5806			0.2266	$\frac{29}{128}$	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	$\frac{1}{4}$ -40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	$\frac{7}{64}$	2.7788			0.2344	$\frac{15}{64}$	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	²⁹ / ₆₄	11.5087		¹ / ₂ -20 NF
0.2422	³¹ / ₁₂₈	6.1519							¹ / ₂ -24 NS
0.2460		6.2484	D		0.4609	⁵⁹ / ₁₂₈	11.7069		
0.2500	¹ / ₄	6.3500	E		0.4688	¹⁵ / ₃₂	11.9075		
0.2570		6.5278	F	⁵ / ₁₆ -18 NC	0.4766	⁶¹ / ₁₂₈	12.1056		
0.2578	³³ / ₁₂₈	6.5481			0.4800		12.1920		14mm - 2.00
0.2610		6.6294	G		0.4844	³¹ / ₆₄	12.3038		⁹ / ₁₆ -12 NC
0.2656	¹⁷ / ₆₄	6.7462			0.4922	⁶³ / ₁₂₈	12.5019		
0.2660		6.7564	H		0.5000	¹ / ₂	12.7000		14mm - 1.50
0.2720		6.9088	I	8mm - 1.25	0.5039		12.8000		14mm - 1.25
				⁵ / ₁₆ -24 NF	0.5156	³³ / ₆₄	13.0962		⁹ / ₁₆ -18 NF
0.2734	³⁵ / ₁₂₈	6.9444			0.5312	¹⁷ / ₃₂	13.0962		⁵ / ₈ -11 NC
0.2770		7.0358	J		0.5469	³⁵ / ₆₄	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	⁹ / ₁₆	14.2875		
0.2813	⁹ / ₃₂	7.1450		⁵ / ₁₆ -32 NEF	0.5781	³⁷ / ₆₄	14.6837		⁵ / ₈ -18NF
0.2891	³⁷ / ₁₂₈	7.3431							³/₈-18NPT
0.2900		7.3660	L		0.5787		14.7000		16mm - 1.50
0.2950		7.4930	M		0.5938	¹⁹ / ₃₂	15.0825		¹¹ / ₁₆ -11 NS
0.2969	¹⁹ / ₆₄	7.5413			0.6094	³⁹ / ₆₄	15.4788		
0.3020		7.6708	N		0.6220		15.8000		18mm - 2.50
0.3047	³⁹ / ₁₂₈	7.7394			0.6250	⁵ / ₈	15.8750		¹¹ / ₁₆ -16 NS
0.3110		7.8994		9mm - 1.25	0.6406	⁴¹ / ₆₄	16.2712		
0.3125	⁵ / ₁₆	7.9375		³ / ₈ -16 NC	0.6562	²¹ / ₃₂	16.6675		³ / ₄ -10 NC
0.3160		8.0264	O		0.6614		16.8000		18mm - 1.50
0.3190		8.1026		9mm - 1.00	0.6719	⁴³ / ₆₄	17.0663		
0.3203	⁴¹ / ₁₂₈	8.1356			0.6875	¹¹ / ₁₆	17.4625		³ / ₄ -16NF
0.3230		8.2042	P		0.7008		17.8000		20mm - 2.50
0.3270		8.3058		9mm - 0.75	0.7031	⁴⁵ / ₆₄			¹/₂-14 NPT
0.3281	²¹ / ₆₄	8.3337			0.7187	²³ / ₃₂			
0.3320		8.4328	Q	³ / ₈ -24 NF	0.7344	⁴⁷ / ₆₄			
0.3359	⁴³ / ₁₂₈	8.5319			0.7500	³ / ₄			
0.3390		8.6106	R	¹/₈-27 NPT	0.7656	⁴⁹ / ₆₄			⁷ / ₈ -9 NC
0.3430		8.7122		10mm - 1.50	0.7812	²⁵ / ₃₂			
0.3438	¹¹ / ₃₂	8.7325			0.7969	⁵¹ / ₆₄			
0.3480		8.8392	S		0.8125	¹³ / ₁₆			⁷ / ₈ -14 NF
0.3500		8.8900		10mm - 1.25	0.8228		20.9000		22mm - 1.50
0.3516	⁴⁵ / ₁₂₈	8.9306			0.8281	⁵³ / ₆₄			⁷ / ₈ -18 NS
0.3580		9.0932	T	10mm - 1.0	0.8425		21.4000		24mm - 3.00
0.3594	²³ / ₆₄	9.1288			0.8437	²⁷ / ₃₂			
0.3672	⁴⁷ / ₁₂₈	9.3269			0.8594	⁵⁵ / ₆₄			
0.3680		9.3472	U	⁷ / ₁₆ -14 NC	0.8750	⁷ / ₈			1-8 NC
0.3750	³ / ₈	9.5250			0.8779		22.3000		24mm - 2.00
0.3770		9.5758	V		0.8906	⁵⁷ / ₆₄			
0.3820		9.7028		11mm - 1.50	0.9062	²⁹ / ₃₂			
0.3828	⁴⁹ / ₁₂₈	9.7231			0.9219	⁵⁹ / ₆₄			1-12 NF
0.3860		9.8044	W						³/₄-14 NPT
0.3906	²⁵ / ₆₄	9.9212		⁷ / ₁₆ -20 NF	0.9375	¹⁵ / ₁₆			1-14 NS
0.3970		10.0838	X		0.9531	⁶¹ / ₆₄			
0.3984	⁵¹ / ₁₂₈	10.1194			0.9687	³¹ / ₃₂			
0.4040		10.2616	Y		0.9844	⁶³ / ₆₄			
0.4063	¹³ / ₃₂	10.3200			1.0000	1			
0.4130		10.4902	Z	12mm - 1.75					
0.4141	⁵³ / ₁₂₈	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	²⁷ / ₆₄	10.7163		¹ / ₂ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	⁵⁵ / ₁₂₈	10.9144							
0.4375	⁷ / ₁₆	11.1125		¹/₄-18NPT					
0.4453	⁵⁷ / ₁₂₈	11.3106							

Technical Seminar 2002



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ATRA Technical Team



Dennis Madden
Chief Exsecutive Officer



Lance Wiggins
Technical Director

Creating a Great Seminar...

For most of you, a technical seminar is maybe half-a-dozen or so hours of intense technical information... and then, as quickly as it begins, it's over. But a lot of effort goes in ahead of time, researching, developing and designing a seminar, long before it's ready to play your town. Long days... late hours... frayed nerves... all part of the process to put a clean, carefully-choreographed presentation in front of a discriminating audience. The folks involved in developing this year's seminar are the leaders in the transmission repair industry. With over 200 years of combined technical experience, they've poured their heart and soul into every page and slide in this program. Whether their contribution involved technical expertise or organizational skills, the culmination of their efforts was an extraordinary educational experience that we're proud to call the ATRA 2002 Technical Seminar.

We hope your experience is as rewarding as it was for us to develop it.



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Senior Technical
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Pete Huscher
Technical Advisor

On behalf of the entire ATRA Technical team and myself I would like you to sit back and enjoy the 2002 ATRA Technical Seminar.

ATRA Technical Team

ATRA Staff

It's difficult enough getting the seminar book researched, written, pictured, edited, and printed let alone getting it out to the seminar attendees. This is where the ATRA Staff comes in.

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	Julia Garcia
	Robin Birdsong
	Joanna Book
	Jim Spitson

Without the ATRA team, it would be very hard to accomplish the task at hand. Please enjoy the seminar.

Lance Wiggins
ATRA, Technical Director

General Motors

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General Motors T-Truck

4WD Fails to Properly Release

The operation of the front axle for the Chevrolet, GMC and Oldsmobile T-Truck has changed on some 1999 and later vehicles. The primary difference deals with how the front axle receives vacuum. Vehicle's with RPO (Regular Production Operation) code "NP1" use the previous design while vehicles with RPO code "NP8" use the new design system. The NP8 systems use an electric vacuum solenoid which is mounted to the bulkhead/fender area. The TCCM energizes and de-energizes the vacuum solenoid, to control the flow of vacuum to the front axle actuator.

Concern: The vehicle will not come out of 4wd or it delays coming out of 4wd. This concern may likely be linked to previous engine compartment work (engine repairs, tune-ups etc.).

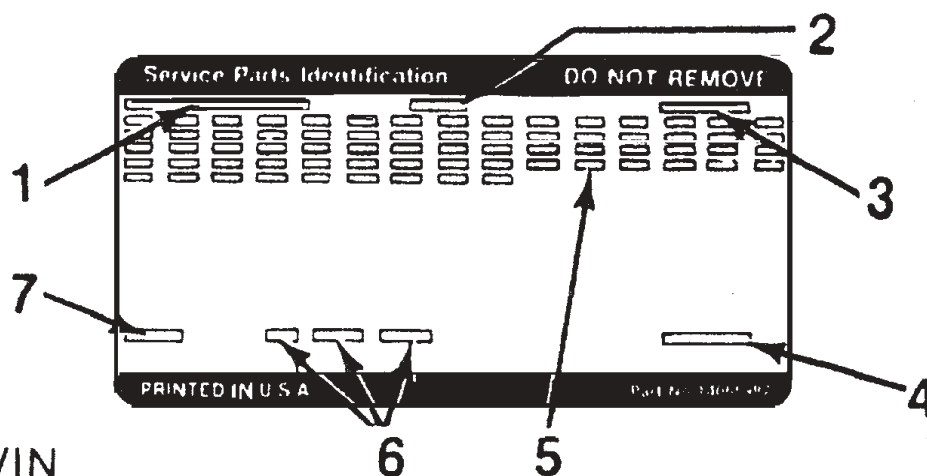
Common Cause: The vacuum lines on the vacuum solenoid are mixed up. This restricts atmospheric pressure from entering the system to release the front axle vacuum actuator.

Repair: Reinstall the hoses in their correct position on the vacuum solenoid valve.

RPO Locations:

- Center console
- Glove box
- Trunk
- Under hood
- Spare tire cover

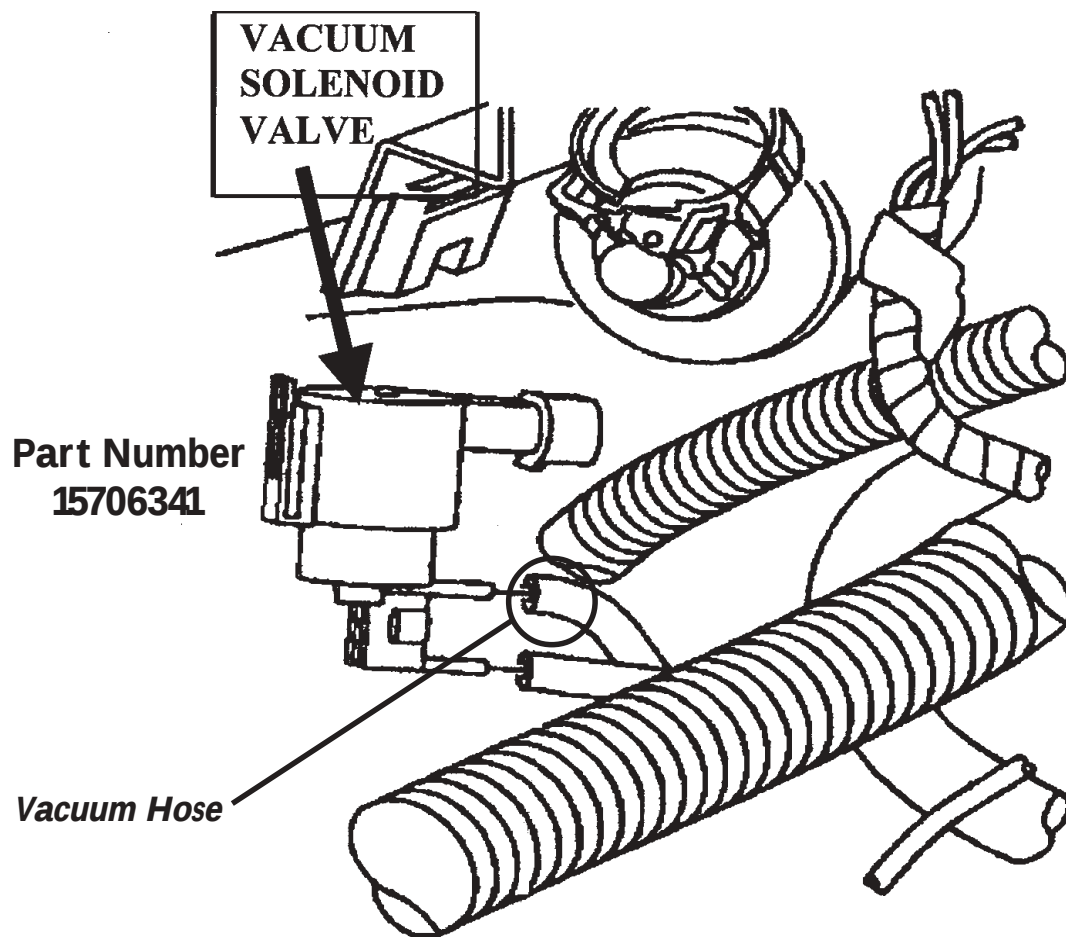
RPO Tag



- | | |
|-----------------|-----------------------------|
| 1. VIN | 5. RPO/SEO Codes |
| 2. Wheel Base | 6. Exterior Color WA Number |
| 3. Model Number | 7. Paint System |
| 4. Order Number | |

General Motors T-Truck (continued)

4WD Fails to Properly Release (continued)

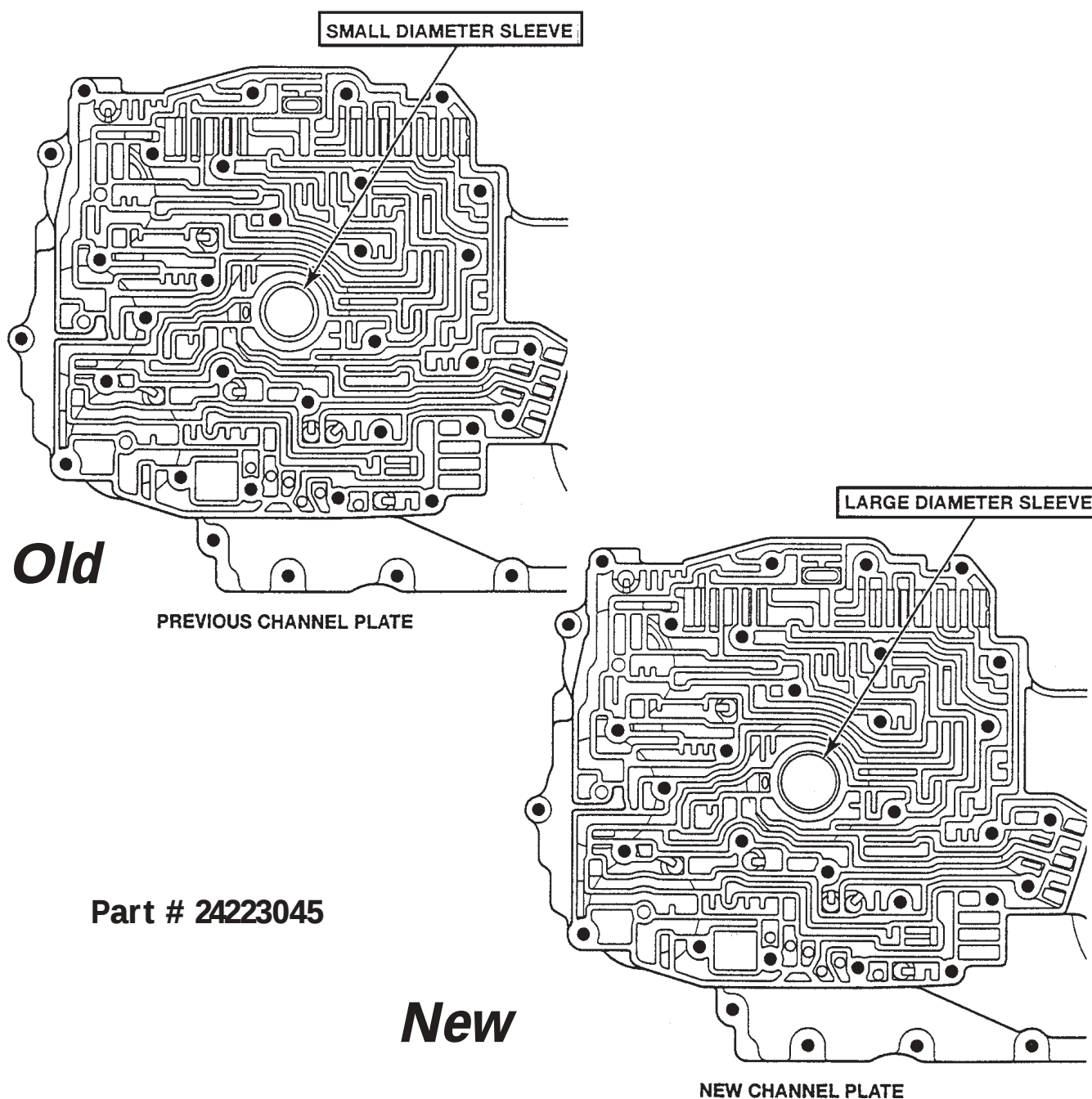


4T40E/4T45E

Updates

1997 model year

The channel plate under went some changes for the 1997 model year. This change involved increasing the diameter of the channel plate sleeve from 1.103" (28.01mm) to 1.128" (28.65mm).

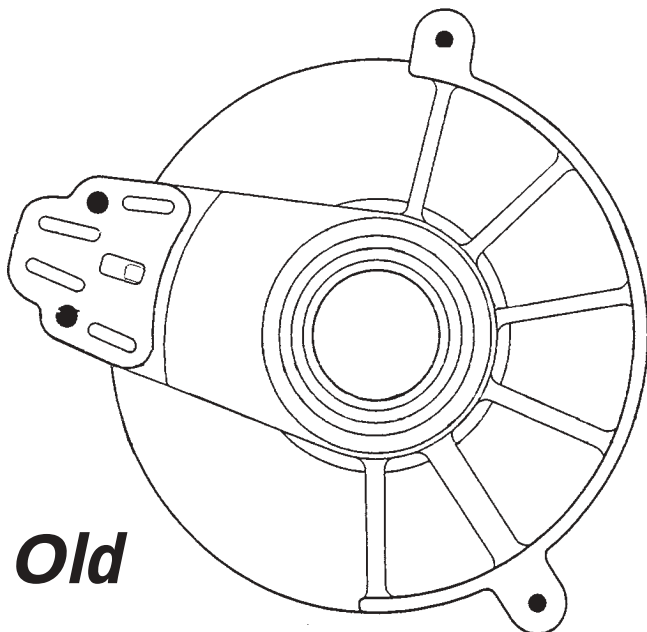


4T40E/4T45E

Updates (continued)

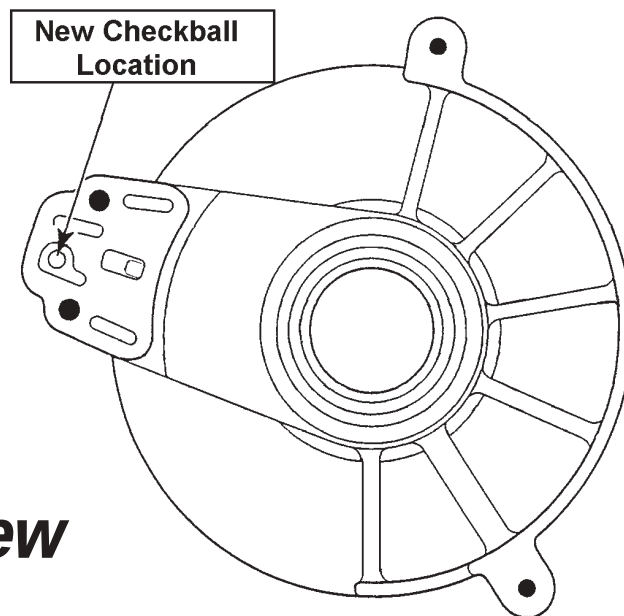
The driven sprocket support was updated by adding a check ball capsule to the support assembly. The check ball capsule is to help control the 3-2 downshift release timing of the direct clutch.

1995-1996



Old

1997-current



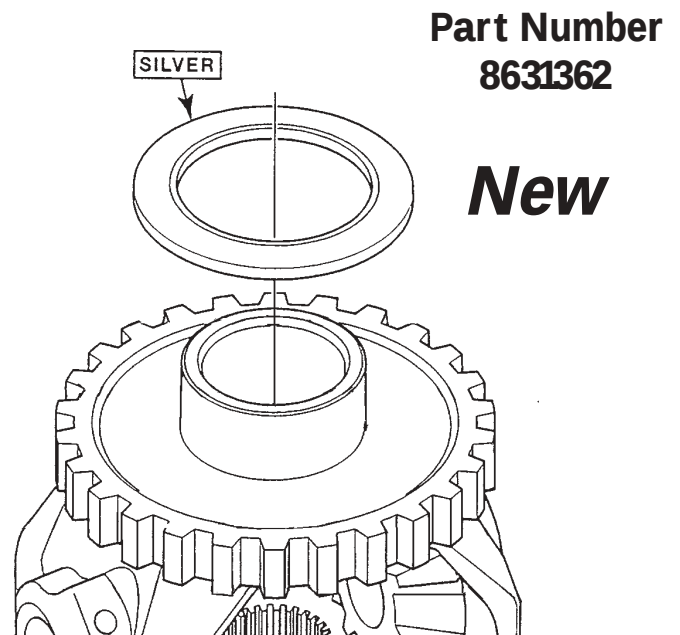
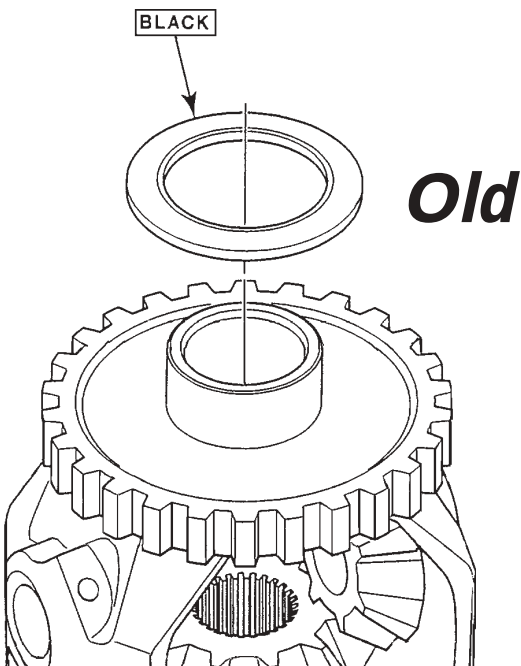
New

Part # 24207143

4T40E/4T45E

Updates (continued)

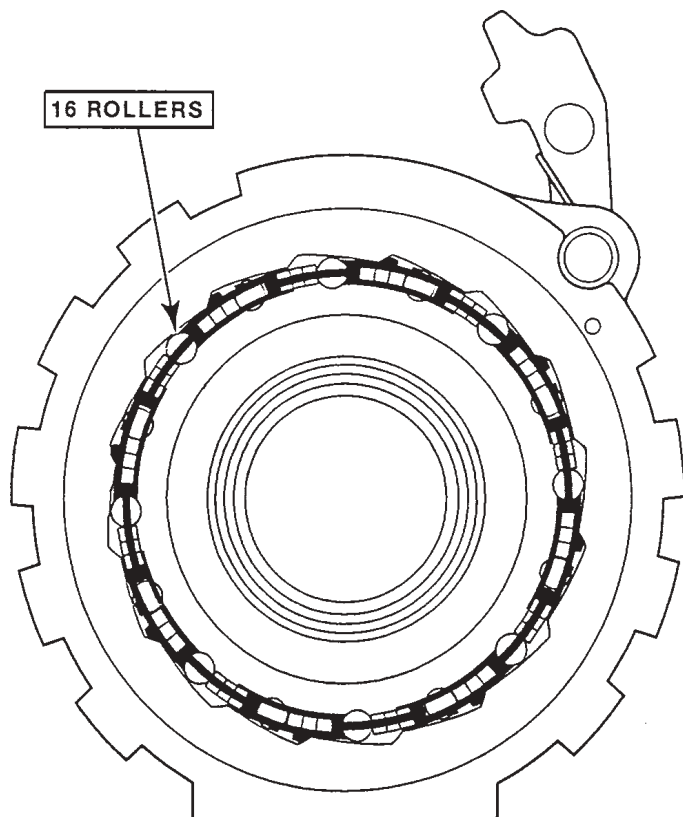
The final drive Torrington bearing was updated on all units manufactured in May of 1998 or later. The new design bearing can be identified by its color and size. The new bearing is “Silver” and the outside diameter is larger. The new bearing can be installed in previous design applications.



4T40E/4T45E

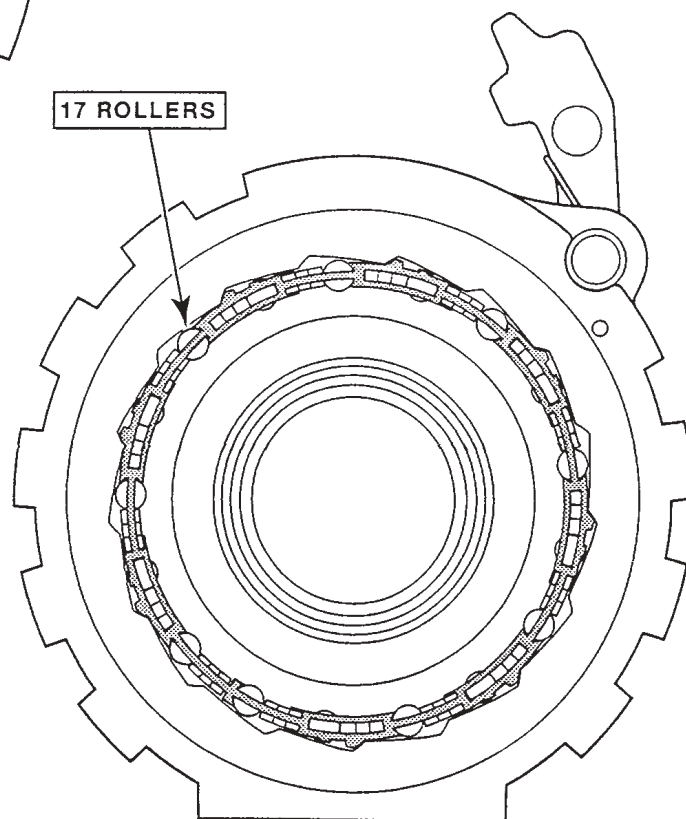
Updates (continued)

An additional roller was added to the low roller clutch. The roller clutch outer cam was cracking, leading to failure of the roller clutch assembly. The updated roller clutch can be installed as an assembly in previous year transaxles.



PREVIOUS FORWARD CLUTCH SUPPORT

**Roller clutch assembly
Part # 24212711**

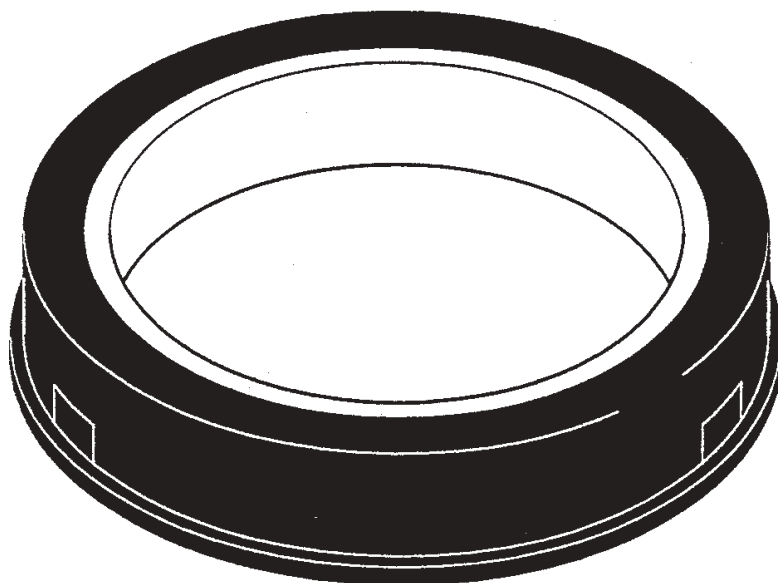
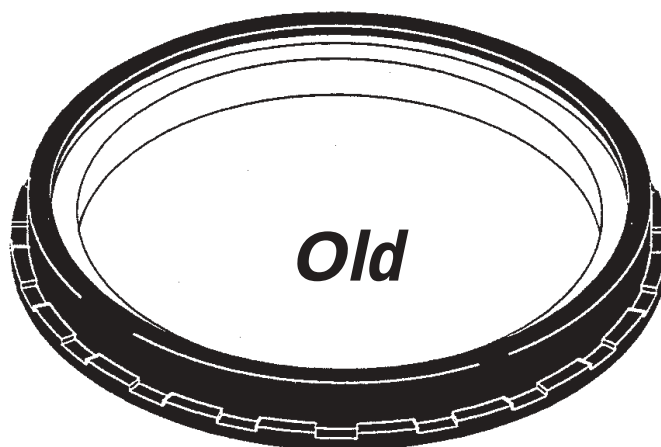


NEW FORWARD CLUTCH SUPPORT

4T40E/4T45E

Updates (continued)

Forward clutch inner seal update was made to reduce the engagement time for the forward clutch. The outside diameter of the inner seal was filled with bakelite, so the volume of fluid necessary to fill the clutch is less. The new design seal can be used in earlier model applications.



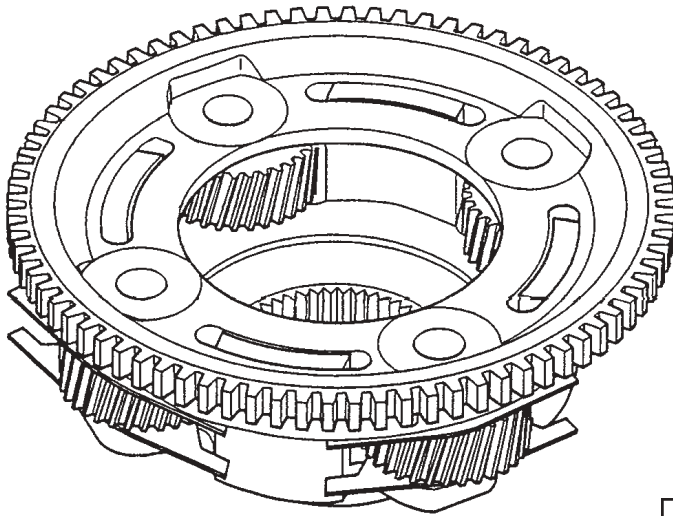
New

Part # 24208642

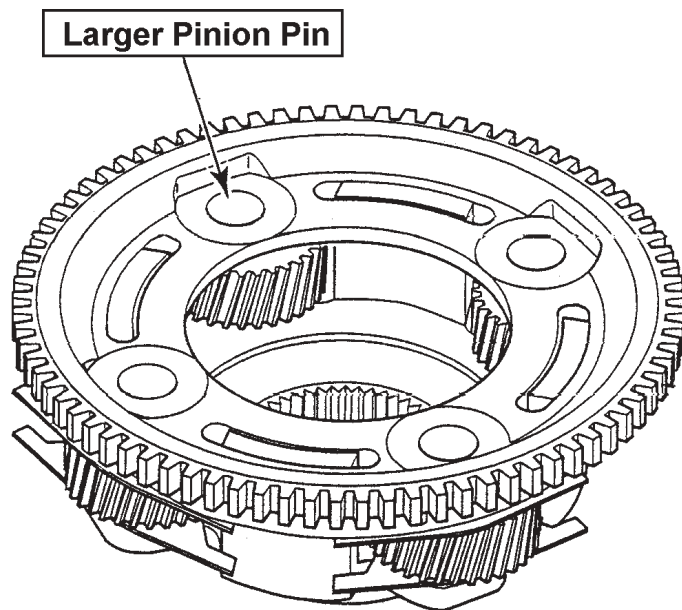
4T40E/4T45E

Updates (continued)

The input carrier pinion diameter was changed to reduce spalling concerns with the pinion needle bearings. In addition, another needle bearing was added to the carrier assembly. This change first took place with the 4T45E and is compatible with the 4T40E.



4T40-E INPUT CARRIER

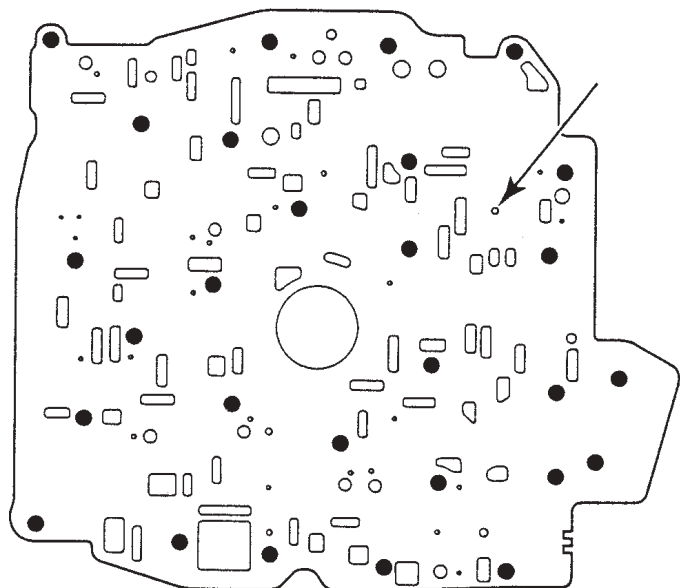
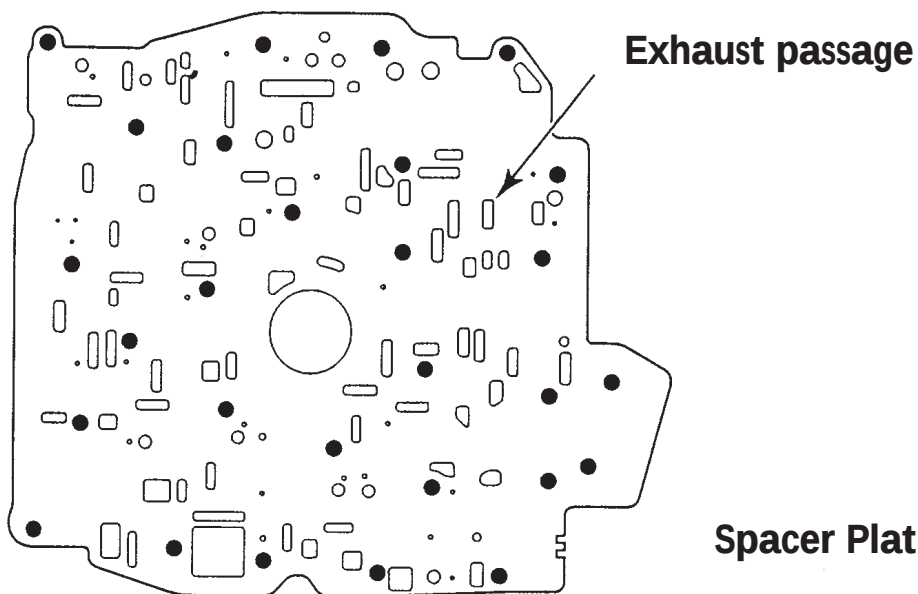


4T45-E INPUT CARRIER

4T40E/4T45E

Updates (continued)

This change was designed to address hard downshifts into 2nd gear on 1996/97 models. The previous design plate used a slotted exhaust hole while the update design uses a round hole.

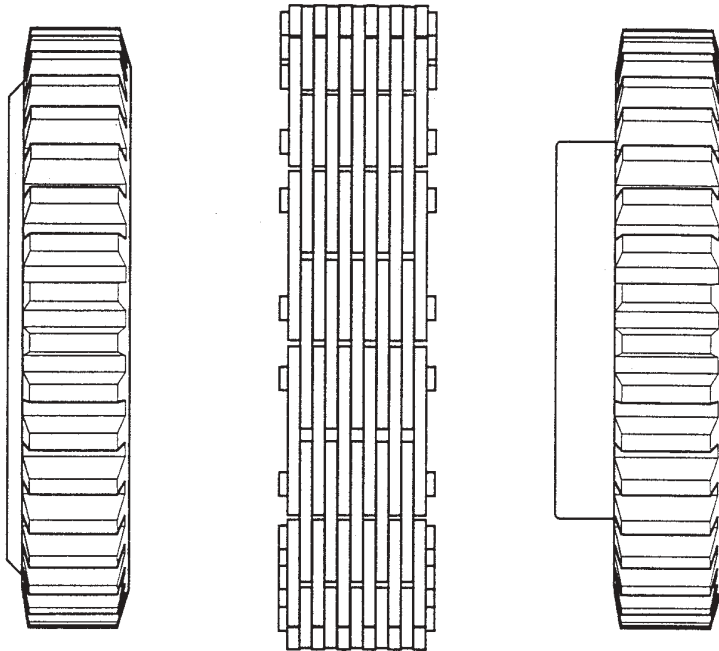


4T40E/4T45E

Updates (continued)

1999 model year

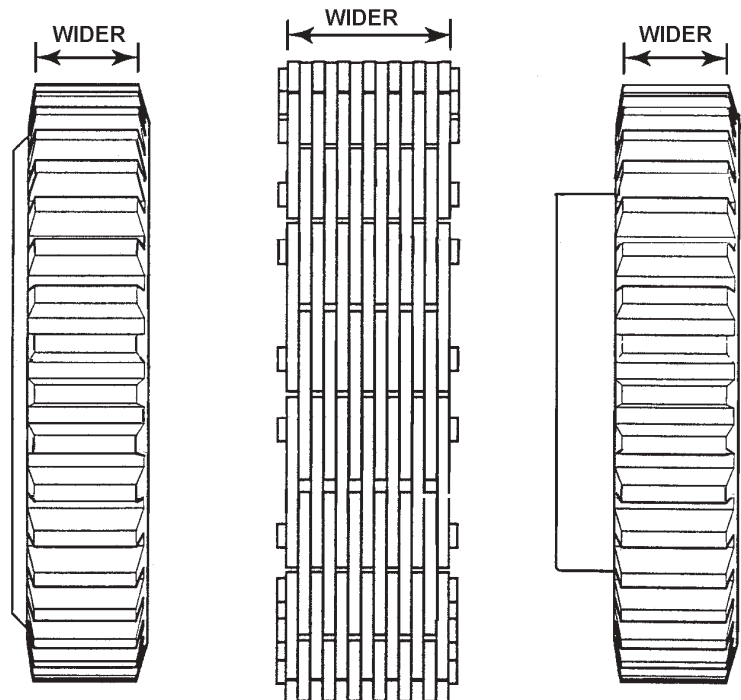
A wider chain and sprockets were added to the 4T45E application to increase its torque capacity. These sprockets are not interchangeable.



4T40E chain has eleven links

4T40E Chains and Sprockets

4T45E chain has thirteen links



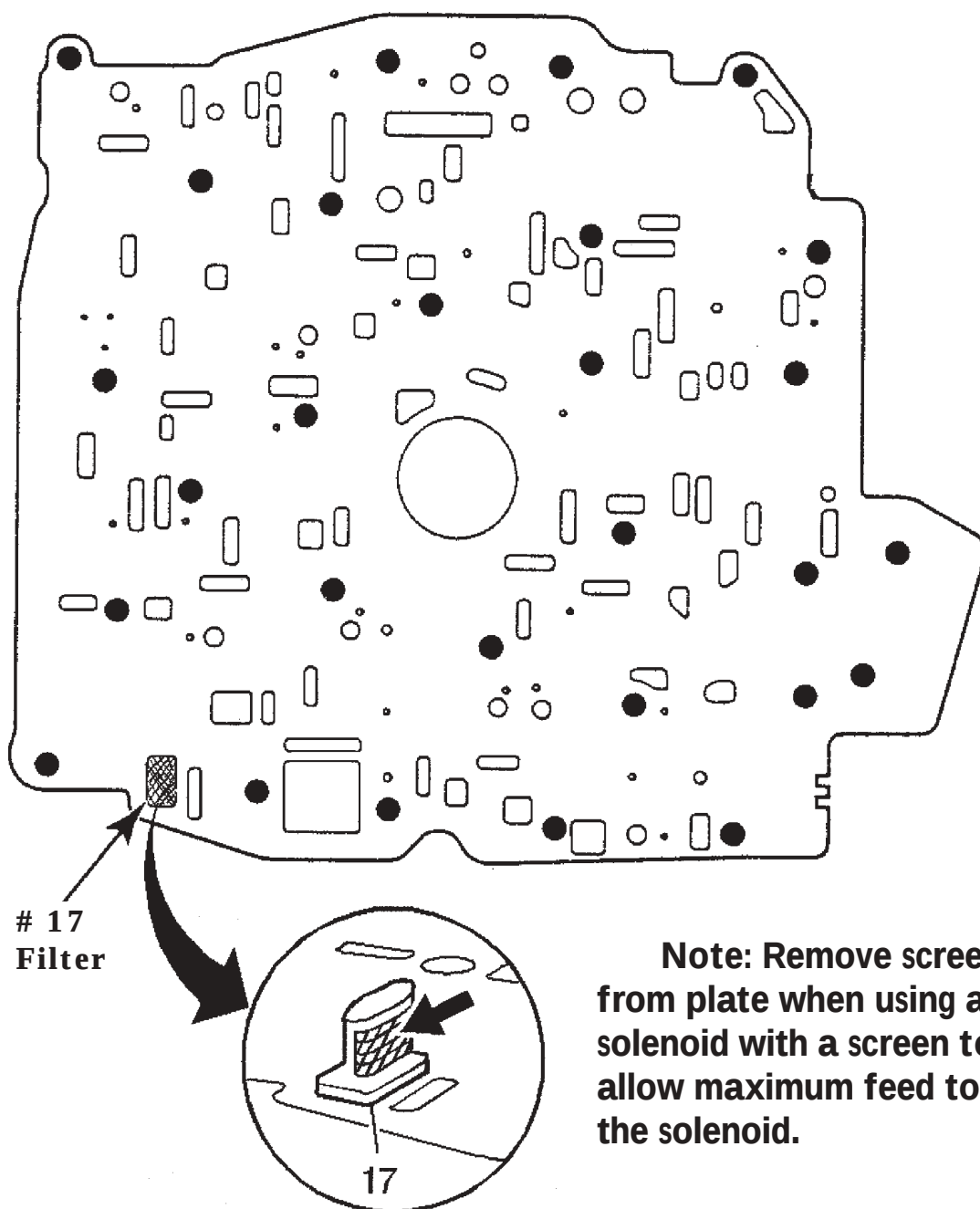
4T45E Chain and Sprockets

4T40E/4T45E

Updates (continued)

2001 Model Year

The TCC solenoid filter (#17) in the spacer plate was removed in late 2001 and all 2002 applications. This was done because it was determined that the screen was not necessary as the TCC PWM solenoid already had a screen.



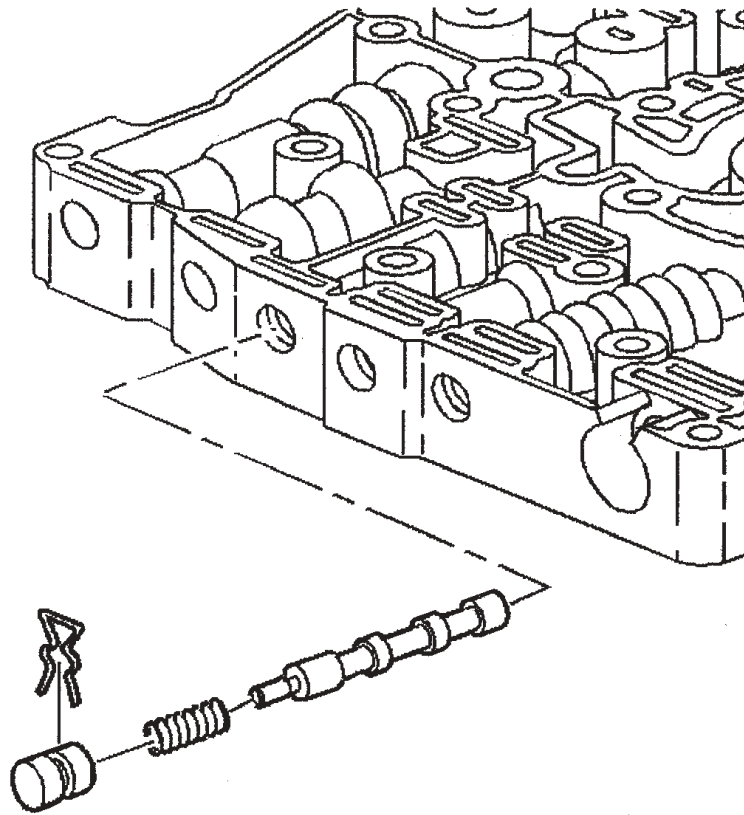
Note: Remove screen from plate when using a solenoid with a screen to allow maximum feed to the solenoid.

4T40E/4T45E

Updates (continued)

2002 Model Year Valve Body

The 2-3 accumulator valve train was eliminated from the valve body, there is no valve in this location.



4T40E/4T45E

Updates (continued)

2002 Model Year Valve Body

The Pressure regulator valve was previously cross drilled. The updated valve body no longer uses a cross drilled pressure regulator valve. An updated spacer plate is required for the new valve body. The valve body was not designed to retrofit previous model transmissions.

2002 and later with new design PR valve and no 2-3 accumulator valve train use plate kit 24214699

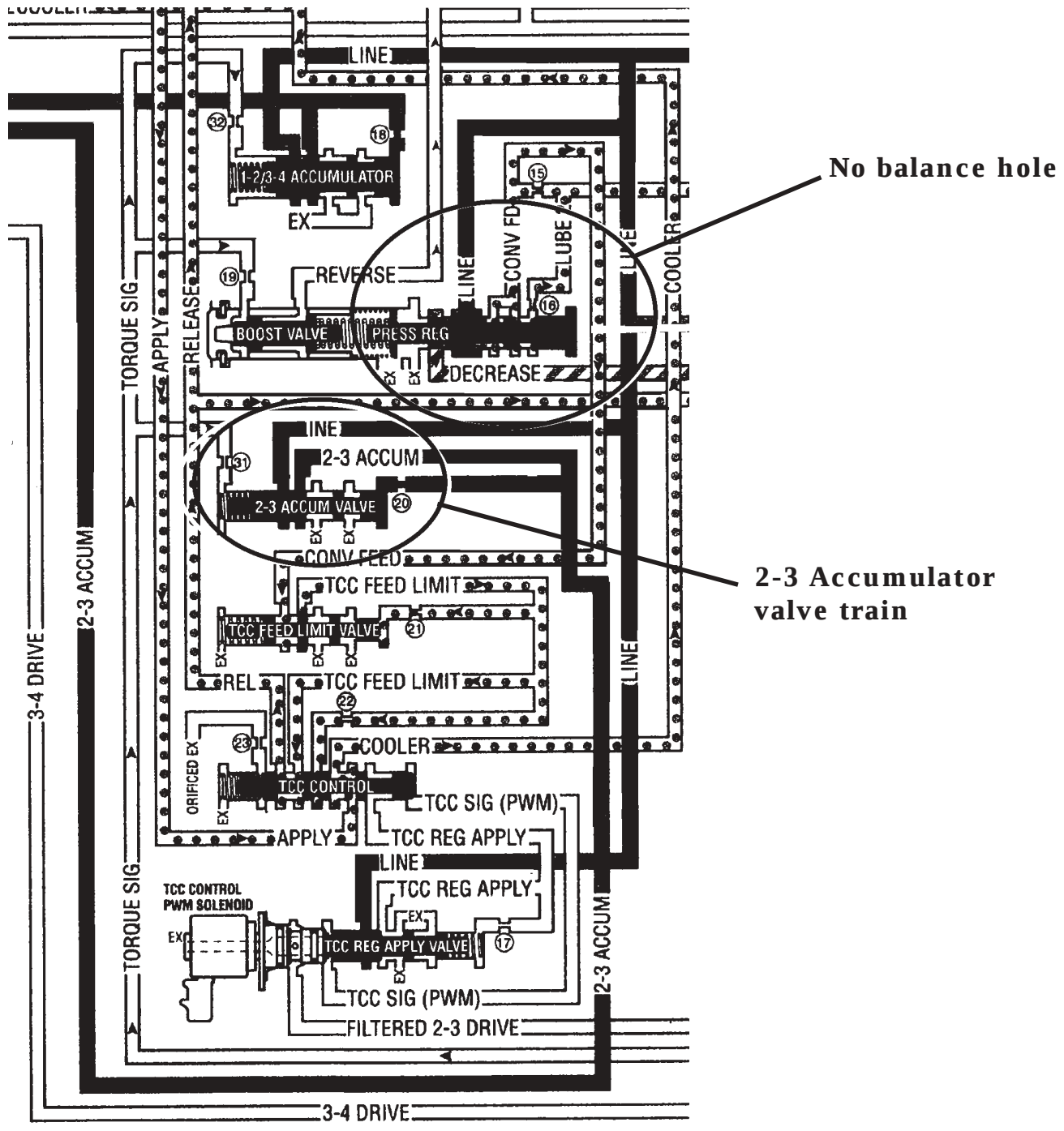
1999-2001 with PR update included but with no changes to the 2-3 accumulator valve train use plate kit 24221953

1998 and earlier: Use plate kit 24205050 with the round hole design change

4T40E/4T45E

Updates (continued)

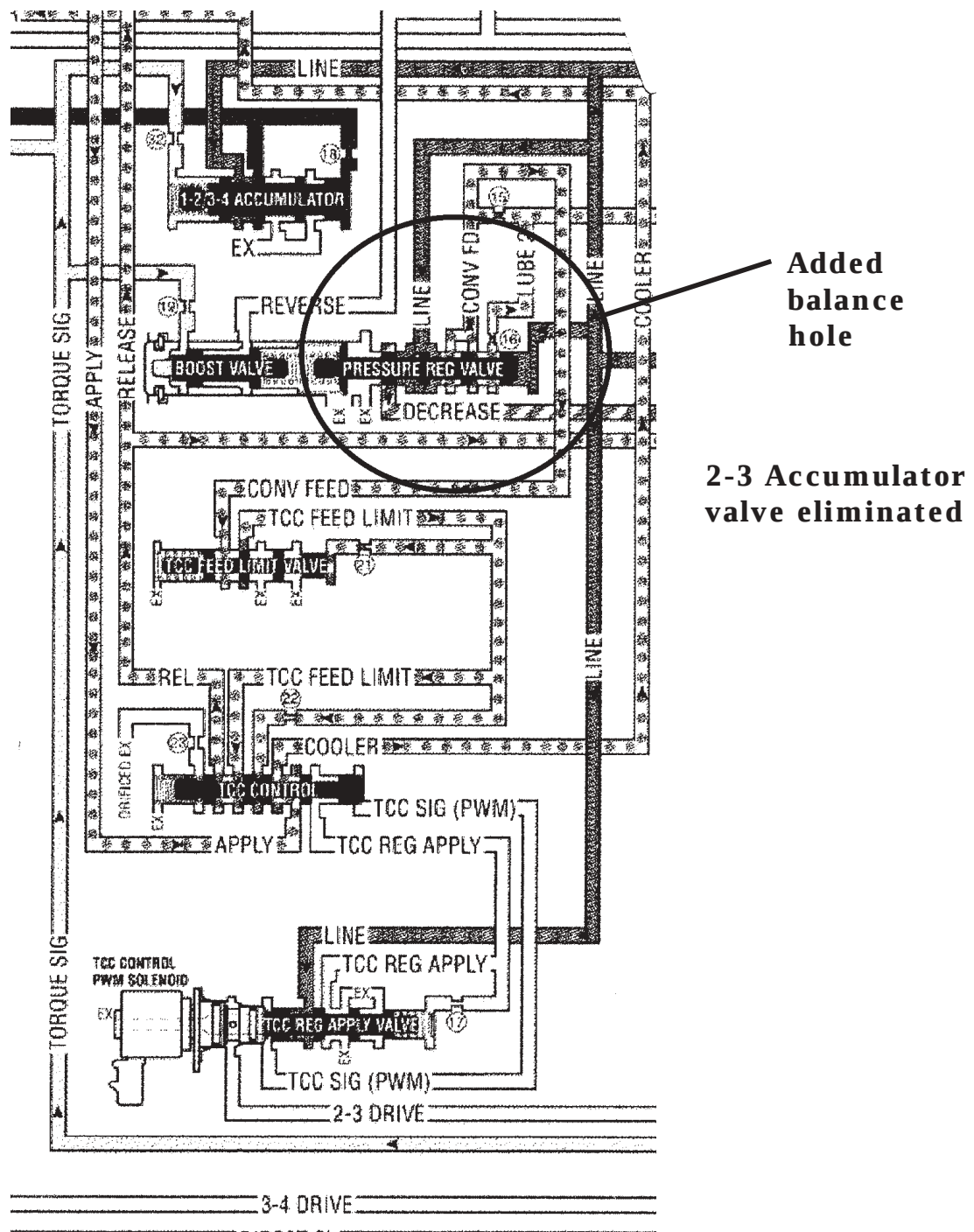
2002 Model Year Valve Body



4T40E/4T45E

Updates (continued)

2002 Model Year Valve Body

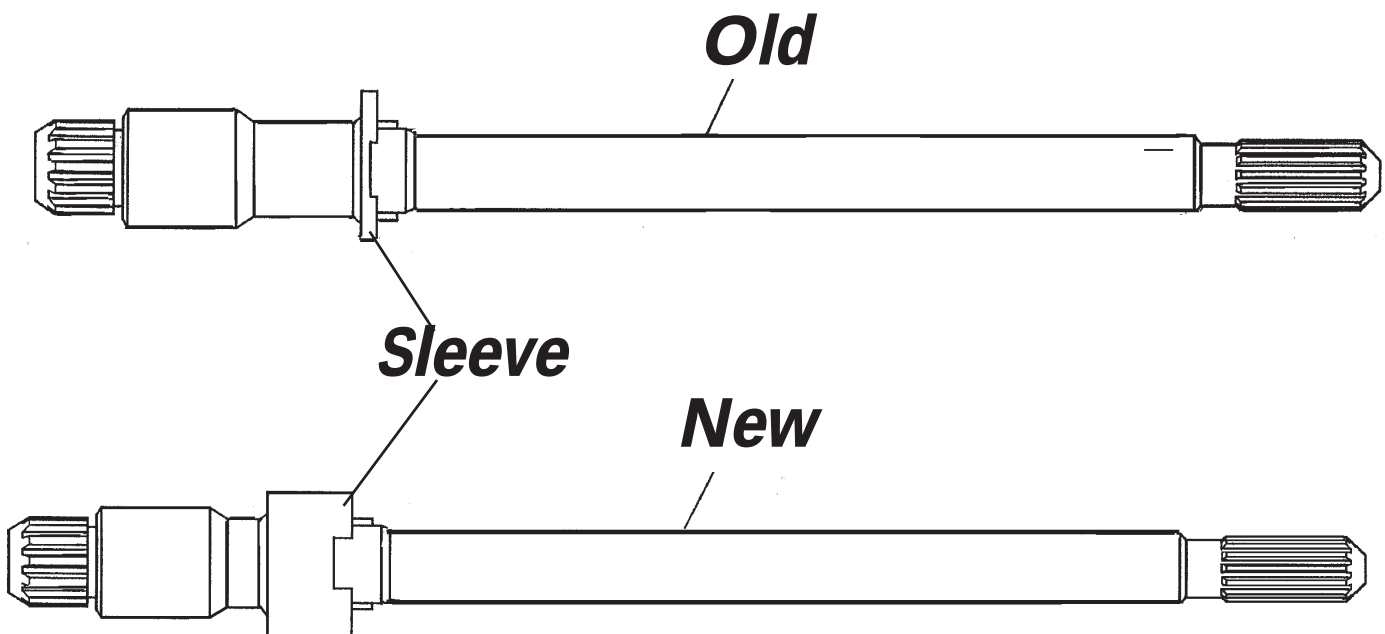


4T40E/4T45E

Updates (continued)

2002 Model Year Valve Body

A new design pump shaft has been introduced for all models. The shaft change was done because of shaft sleeve breakage. The new design shaft will retrofit previous model transmissions.



Part Number
8684255

4T40E

TCC Surge/Chuggle/Slip at 45-60 MPH

Some 2001 Chevrolet Cavaliers and Pontiac Sunfires have customer complaints of Surge/Chuggle/Slip while cruising between 45-60 mph. The driver may notice a fluctuation between 20-300 RPM on the tachometer. This condition maybe caused by variation in the torque converter clutch slip speed.

In order to test for this condition, this vehicle must have no codes, be at normal operating temperature, with TCC applied, cruising between 45-60 mph. Monitor TCC slip on the scanner. If the TCC slip fluctuates between 20-300 RPM with a duty cycle between 25-50% then command TCC full apply (99% PMW). If this eliminates the concern, re-calibrate the PCM with the appropriate calibration.

New Calibration Part Number	Description
12216203	NC1/NF7 Federal/Cal
12216193	NM Leaded Gas
12216213	K29 Unleaded Export

4T65E

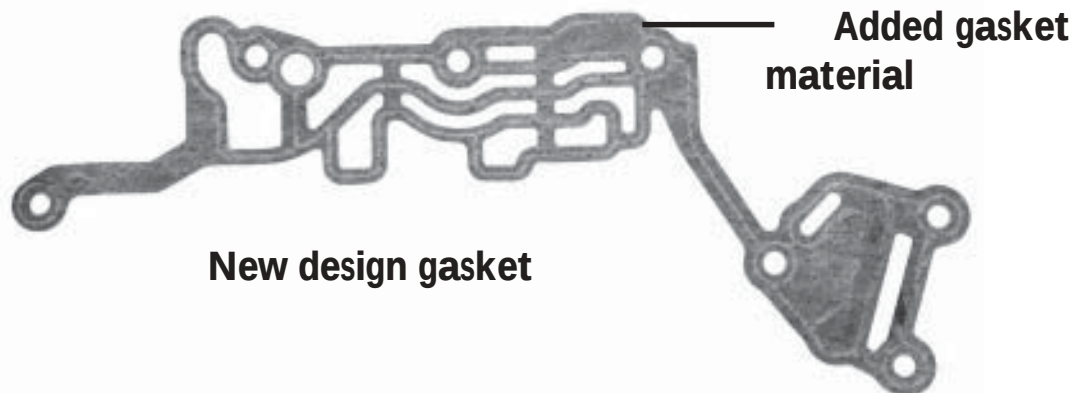
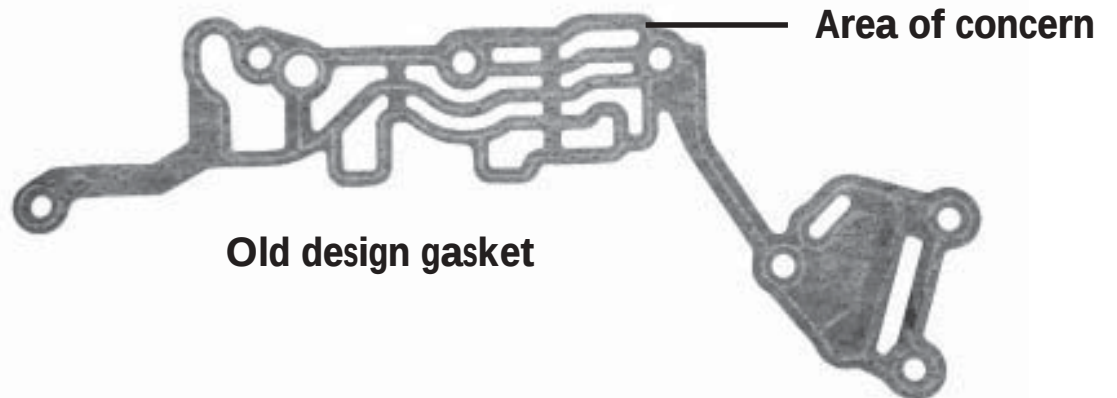
2002 Updates Fluid Leak

Concern: Leaking from vent.

Common Cause: Gasket blow out leads to leakage from the vent.

Repair: Replace with updated gasket part number 24206391

NOTE: Will retrofit to earlier model 4T65E's.



4T65E

2002 Updates (continued)

Updated Transmission Fluid Pressure (TFP) Switch

Some 2002 4T65Es will receive the updated design TFP while other's will use the previous design switch assembly.

The updated TFP was altered by eliminating 3 of the switches previously used. In addition, the wiring harness has been changed to accommodate the updated design.

A new switch known as the, Internal Mode Switch (IMS) was added. The IMS is a mechanically controlled manual valve position sensor that is mounted internally on the manual valve shift linkage.

Neither the new design TFP nor the IMS can be retrofitted to previous years.



4T65E

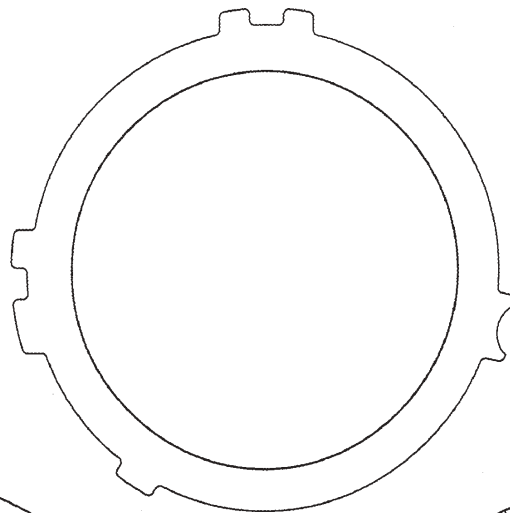
2002 Updates (continued)

Several updates occurred for the 2002 model year on 4T65E's.

- An updated 4th clutch pack
- Bonded spacer plate and gaskets
- An updated Channel plate gasket
- Altering the transmission fluid pressure (TFP) switch and adding an internal mode switch (IMS)

Updated 4th Clutch

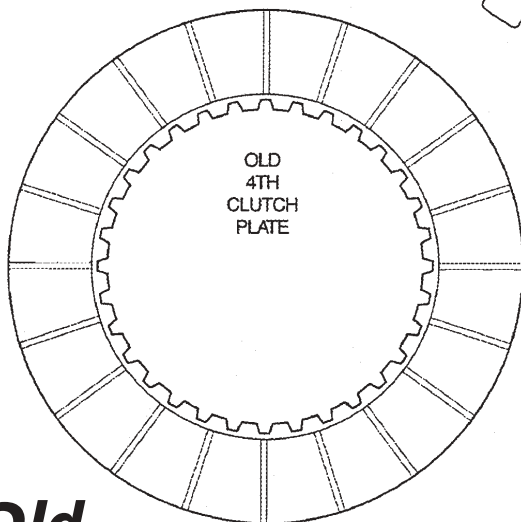
The update was implemented to eliminate a “ticking noise” at idle in park or neutral that was prevalent on 4T65E applications. The updated clutch assembly can be installed in earlier model transmissions.



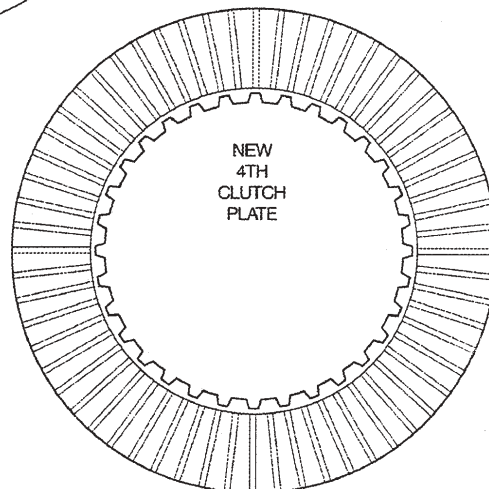
Pressure Plate
24208013

Steel plate
24208014

Clutch discs
24218248



Old



New

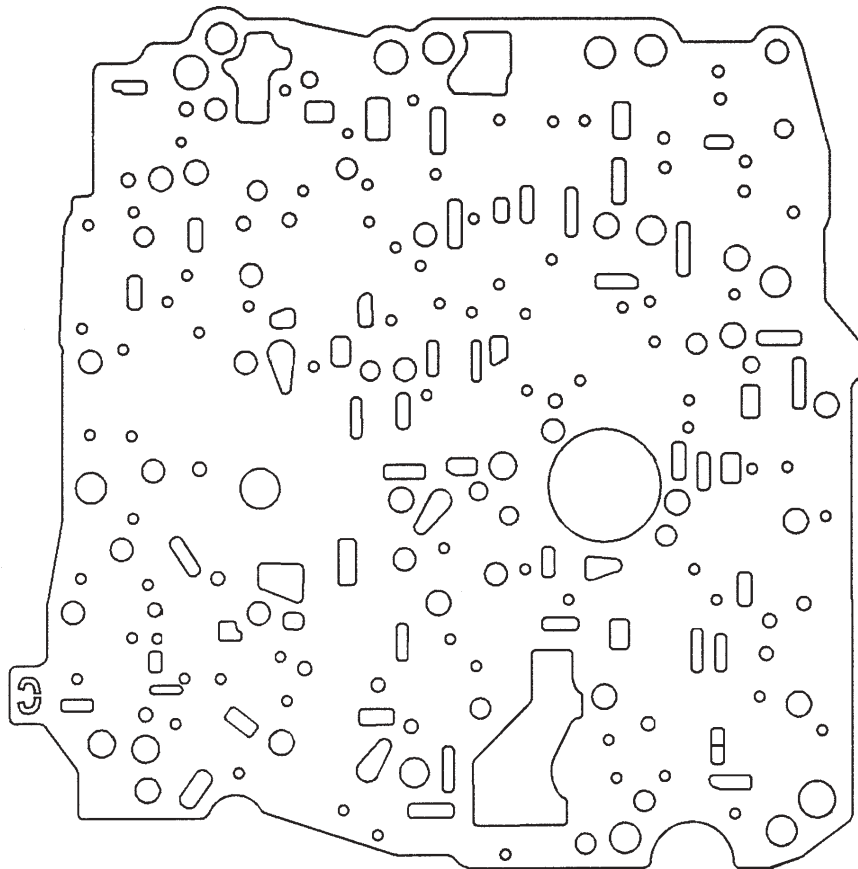
4T65E

2002 Updates (continued)

Updated Spacer Plate and Gaskets

The gasket are bonded to the “spacer plate assembly” and require that the plate and gasket be changed as an assembly.

Bonded gasket to separator plate



4T65E, 1999 and Later

Harsh Reverse Engagement Cold

Concern: This condition is most common when shifting into reverse, then to drive and then back to reverse. Generally the second shift to reverse will be the one that is harsh.

Common Cause: The main cause of this concern is a calibration error in the vehicle software. To separate the cause of this concern from a faulty Pressure Control Solenoid (PCS), note the commanded PCS amperage when the vehicle is shifted into reverse. If the commanded amperage is around .1 amps, calibration may be causing the concern.

Repair: Calibrations known as POGS (power on garage shift) adapts have been released for all applications with the exception of the W and X body vehicles. Refer to the GM calibration web site <http://calid.gm.com/vci/> for your correct calibration numbers.

On X and W body applications a quick learn of the Reverse garage shift adapt will have to be preformed. To perform the quick learn place the transmission in reverse for at least 15 seconds.

4T65E

Erratic Shifts and Multiple DTC's Wiring Harness Problems

Concern: Several different concerns may develop such as:

- P0716, P0717, Shift Solenoid, Pressure Control Solenoid, transmission Fluid Pressure, and or Transmission Fluid Temperature codes.
- The Transmission may exhibit shift related concerns, such as dropping out of the commanded gear, not shifting to the commanded gear and or hard shifts.
- Any of the above concerns may occur in conjunction with each other and may be intermittent.

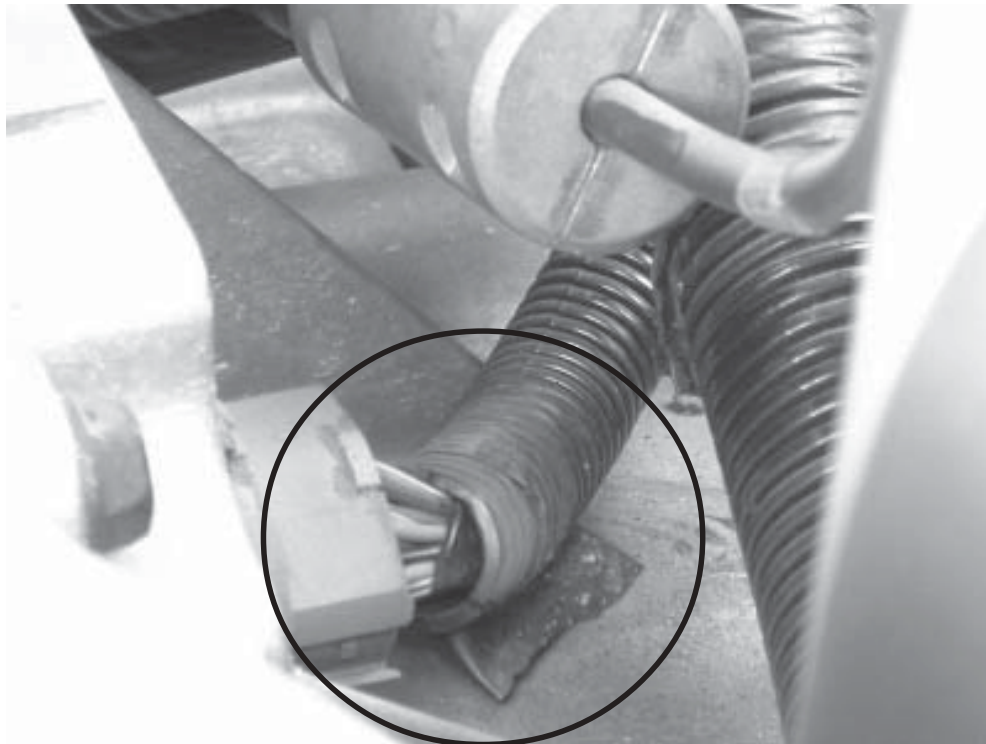
4T65E

Erratic Shifts and Multiple DTC's (continued)

Wiring Harness at Transmission side cover

Common Cause: Several vehicles, especially the 1997-01 W-body's have a problem with the transmission harness. The harness is too short, causing the harness to be under tremendous stress as engine torque moves the transmission in its cradle mounts. Many times this leads to harness damage as it rubs on the ribs of the side cover. In addition, the connector may be difficult to latch so be sure it is fully latched at the top and the bottom of the connector.

The connectors are under severe stress and the receiving pins in the connectors may be damaged leading to pin tension concerns. In addition it may prevent the weather tight seal on the connector from being properly positioned, which may allow water to penetrate the connector. This may lead to corrosion of the pins. The harness was lengthened on 2002 vehicles to address these concerns.



4T65E

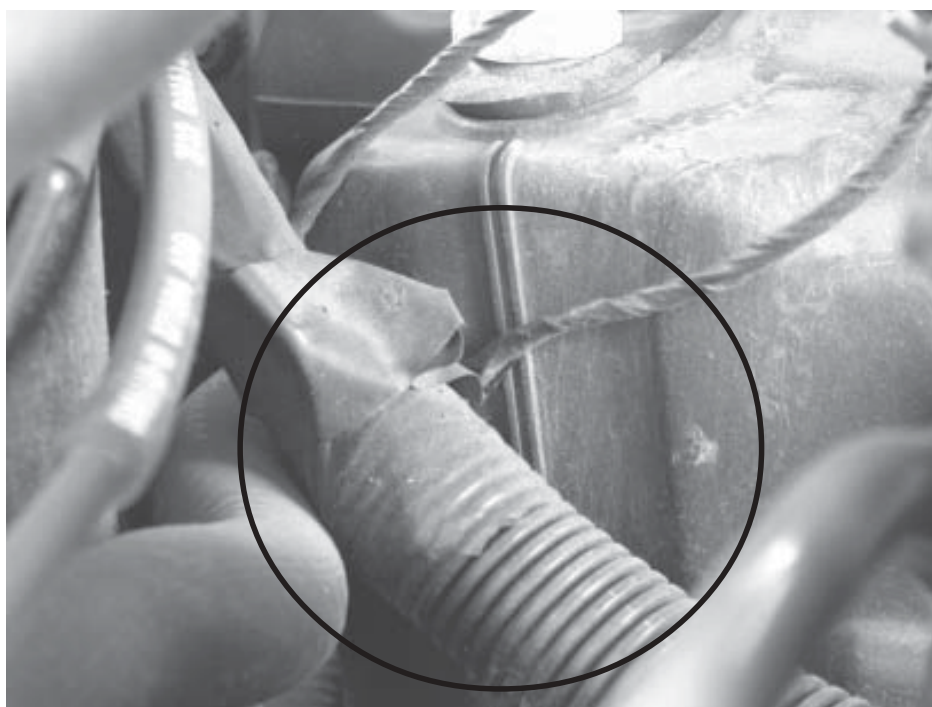
Erratic Shifts and Multiple DTC's (continued)

Wiring Harness at A/C Accumulator

Common Cause: The harness is not fully shielded with conduit in this area allowing the harness to rub on the A/C accumulator on some applications. This is the main PCM harness, so various symptoms can occur including transmission related symptoms. The symptoms or DTC's present will depend on which wires have rubbed through. Pontiac Aztec models had the harness improperly routed behind the A/C accumulator, which increases the probability of a harness problem.

Testing: A quick check for this concern includes a visual inspection for damage in the suspect area. Monitor input speed on your scanner as you wiggle the harness and the transmission connector with the engine running in park range. If input speed dramatically changes as you move the connector and/or harness inspect the harness, the connector female terminal tension and the terminal crimps for possible problems.

Repair: Address any pin tension, crimp or harness rub through concerns that may be present. Install additional conduit on the harness in the A/C accumulator area and reroute the harness to relieve the stress on the harness.



4T65E

P0741 TCC Stuck Off

Concern: 4T65E applications may exhibit a concern that causes a P0741 DTC to set. In addition a P0730 DTC may also be set.

The parameters for setting a P0741 are:

- No TP, ISS, VSS, TFP DTC's are set.
- The manual valve is in OD, D or M2 range.
- TFT is between 68°-266°F (20°-130°C).
- TP is between 4-35%.
- TCC is commanded to maximum apply.
- P0742, P1860, P1887 DTC's are not set.
- TCC slip speed is calculated to above 180 RPM for more than 7 seconds two times within the same ignition key cycle.

If P0741 is set the PCM will respond by:

- Inhibiting TCC.
- Inhibiting 4th gear if in hot mode.
- Freeze shift adapts.
- Turn on the MIL (SES) light on the "second consecutive trip" in which a failure occurred.

4T65E

P0741 TCC Stuck Off (continued)

Common Cause: Several items may cause P0741 to set.

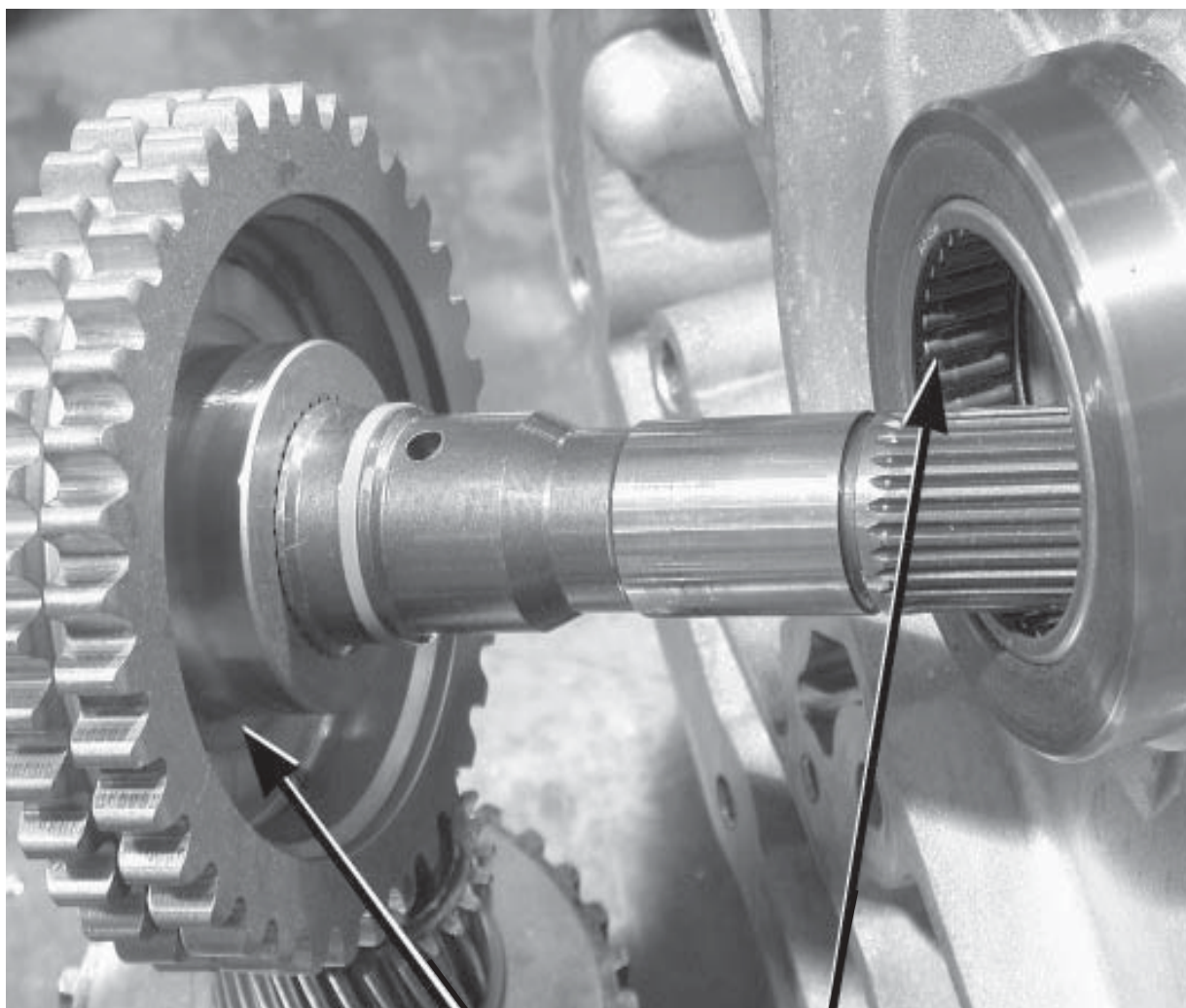
- Failure of the drive sprocket support bearing
- TCC regulator valve and valve bore side loading and wear
- TCC control valve sticking
- TCC PWM solenoid
- TCC solenoid filter plugged
- Faulty torque converter
- Check ball number 1 missing or not sealing properly
- Turbine shaft O-ring or sealing rings

4T65E

P0741 TCC Stuck Off (continued)

Failure of the drive sprocket support bearing

When the bearing first starts to fail, metal particles from the bearing can restrict the TCC solenoid and screen. As the bearing continues to fail, the TCC seal rings on the turbine shaft will be unable to seal properly on the channel plate sleeve. Ultimately the shaft loses the support in the bearing. This allows the TCC apply pressure to escape, leading to the DTC. The sleeve in the channel plate may be damaged by the turbine shaft, as it moves around in the bearing. Depending on the extent of the bearing failure the unit may have a noise associated with the DTC.



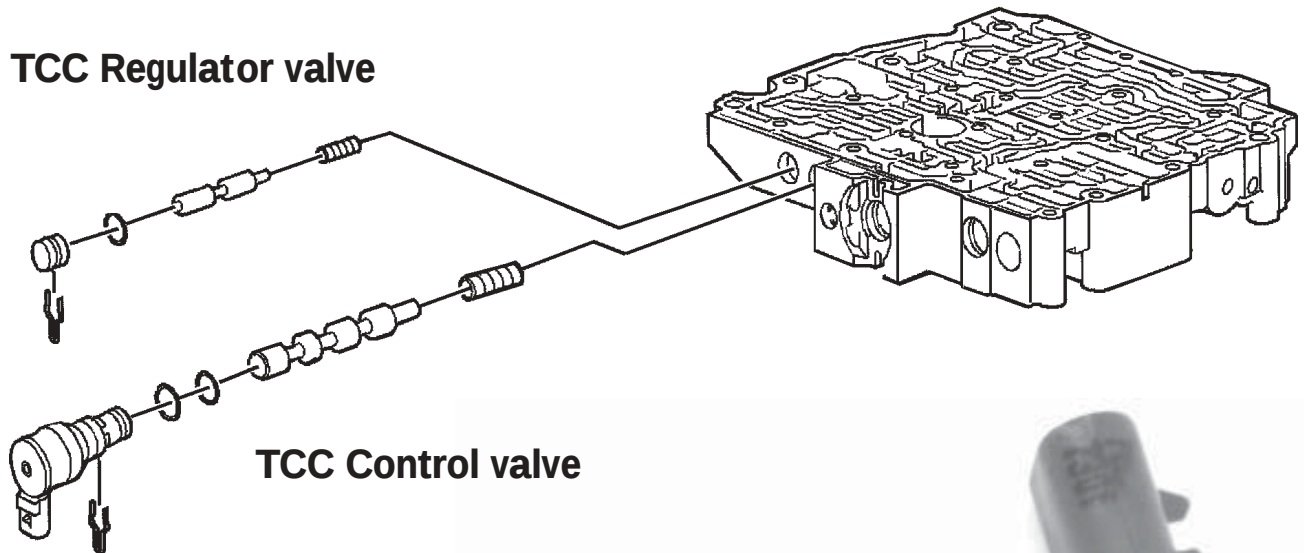
Note any wear or debris in bearing or sprocket.

4T65E

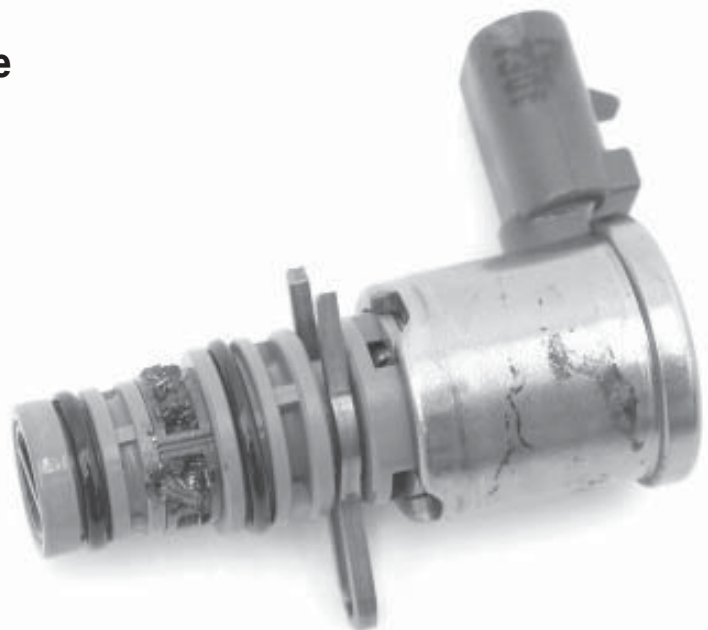
P0741 TCC Stuck Off (continued)

Side Loading/wear

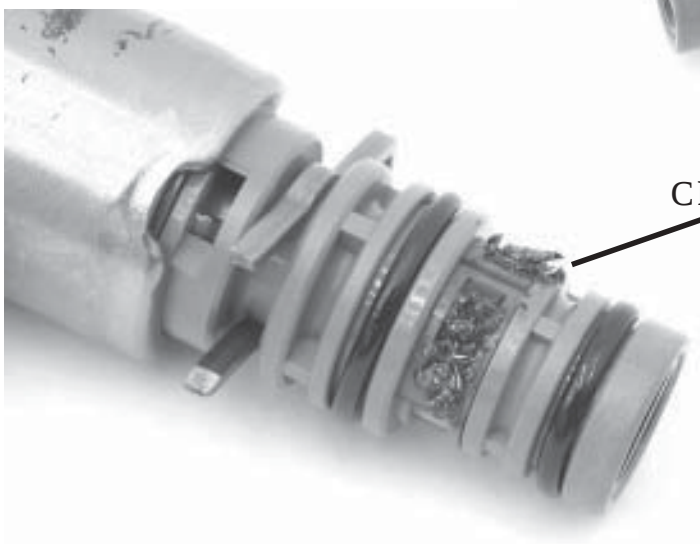
TCC Regulator valve



TCC Control valve



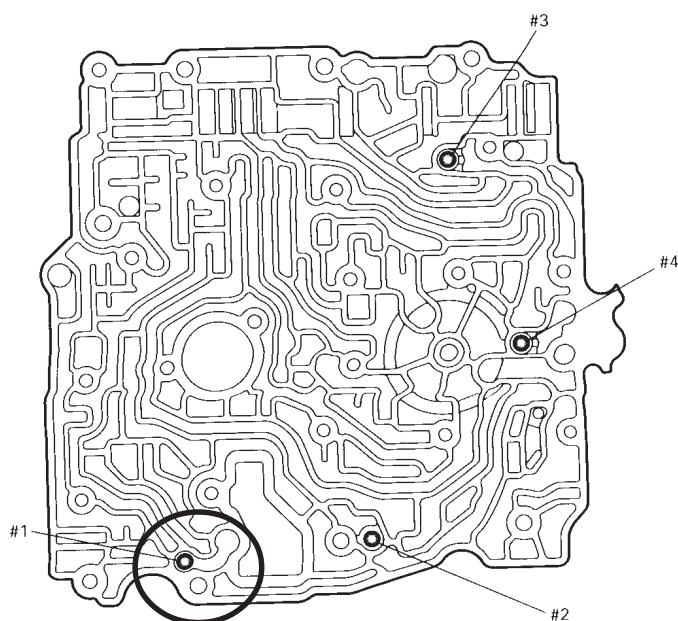
Check solenoid for clogged filter screen.



4T65E

P0741 TCC Stuck Off (continued)

Check ball number 1 missing or not sealing properly



#1 Converter Clutch Release / Apply

#2 2nd Clutch

#3 Input Clutch / PRN

#4 3rd Clutch / Lo-1st

#5 Reverse / Reverse Servo Feed

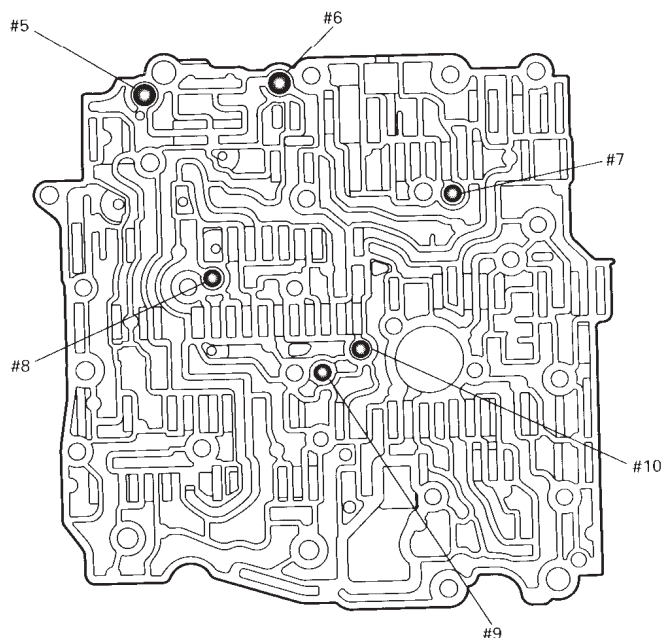
#6 D-4 / Servo Apply

#7 Lo / Lo-1st

#8 D2 / Manual 2-1 Servo Feed

#9 3rd / 3rd Clutch

#10 Line / 4th Clutch



4T65E

Will Not Move Forward, Reverse Okay

Concern: 1997 and later 4T65E transmissions may exhibit a condition where the vehicle will not move forward in any range, but it will move backward.

Common Cause: The weld attaching the sun gear to the reaction sun gear drum is breaking. Porosity in the weld causes the weld to fracture. This allows the sun gear to spin in the reaction drum as torque is applied to the gear set.

Testing: To identify if a broken sun gear is responsible for the concern, unplug the transmission electrical connector (failsafe is 3rd gear), place the transmission in OD range. If the vehicle now moves forward, the sun gear weld is broken.

Repair: Replace the reaction sun gear drum assembly.



4T80E/4T65E

No Start After Transmission Repair Replacement

Concern: This condition may occur while using transmission test boxes/tools to diagnose the unit or if the incorrect transmission was installed in the vehicle.

Common Cause: Several late model 4T65E/4T80E models utilize an internal mode switch (IMS) mounted within the transaxle. One of the functions of the IMS is to act as a neutral safety switch. When the transaxle is unplugged or when the IMS or its wiring is damaged/faulty a “NO START” condition will occur. All IMS model units utilize a feature known as “PCM controlled start” which means if the voltage sequence created by the IMS is not correct, the PCM will inhibit operation of the starter relay.

Repair: Check the Transaxle connector, make sure it is plugged in securely. If the transaxle was replaced by another unit, check the model code to be sure it is the correct model for your application. To diagnose the IMS, monitor the IMS voltage values with a meter or with a scan tool. Use the chart to isolate the cause.

4T80E/4T65E

No Start After Transmission Repair Replacement (continued)

Gear Selector Position	Range A Circuit 771	Range B Circuit 772	Range C Circuit 773	Range P Circuit 776
Park	LOW	HIGH	HIGH	LOW
Park/Reverse	LOW	LOW	HIGH	LOW
Reverse	LOW	LOW	HIGH	HIGH
Reverse/Neutra	HIGH	LOW	HIGH	HIGH
Neutral	HIGH	LOW	HIGH	LOW
Neutral/OD	HIGH	LOW	LOW	LOW
OD	HIGH	LOW	LOW	LOW
OD/D	LOW	LOW	LOW	HIGH
D	LOW	LOW	LOW	LOW
D/M2	LOW	HIGH	LOW	LOW
M2	LOW	HIGH	LOW	HIGH
M2/M1	HIGH	HIGH	LOW	HIGH
M1	HIGH	HIGH	LOW	LOW
INVALID	HIGH	HIGH	HIGH	HIGH
INVALID	LOW	HIGH	HIGH	HIGH
INVLAID	HIGH	HIGH	HIGH	LOW

LOW= Low voltage at appropriate PCM pin

HIGH= High voltage at appropriate PCM pin

Range A Pin K, Range B Pin F, Range C Pin H, Range P Pin J, Ground
Pin G at connector C115 Transmission Pass through

4L60E

P1870

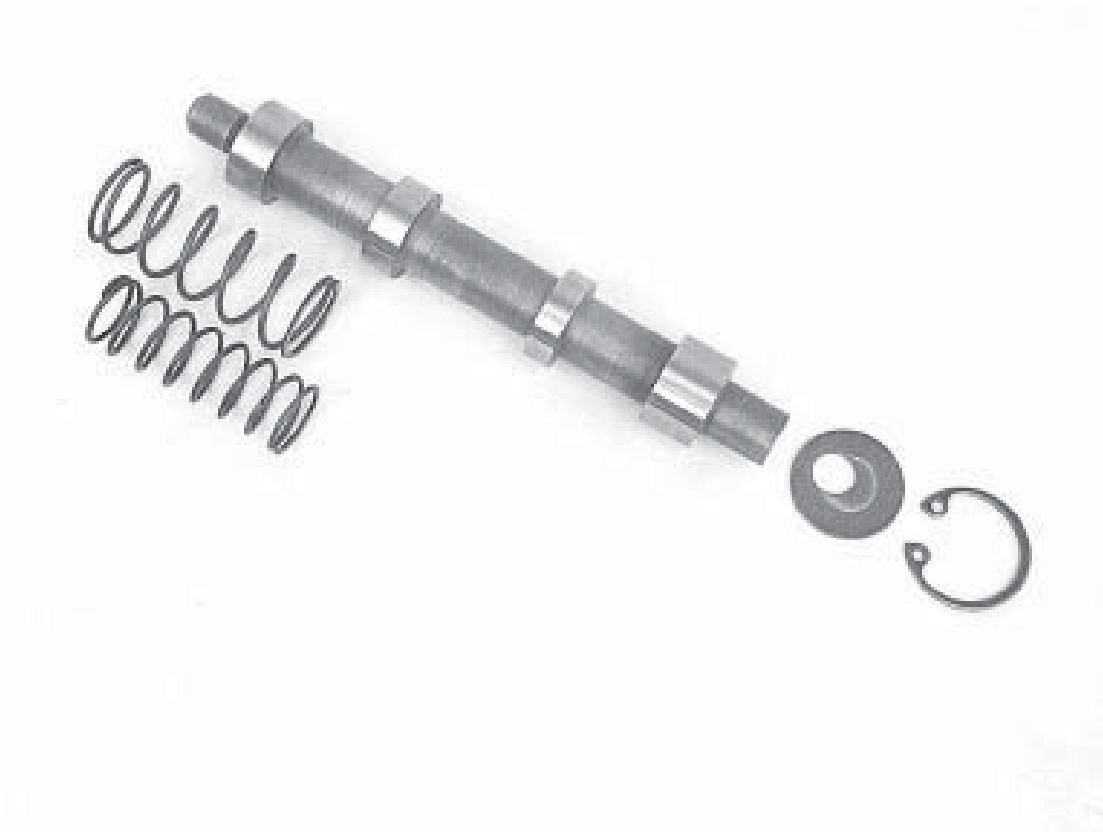
Concern: P1870 and or, intermittent no TCC

Common Cause: There are several things that were covered in the seminar in previous years that may lead to a P1870 DTC. One additional condition that may cause TCC to be inoperative is the converter clutch valve apply spring. Several springs have been found to be improperly wound. An improperly wound spring can catch in the bore, which may prevent the TCC apply valve from moving into the applied position.

Repair: The valve should move upward freely for about ½ “. When pressure is removed the valve should return to the released position. If the valve does not operate as described, the spring may not be properly wound or the valve and or bore may be damaged.

Another method is to simply remove the valve and inspect the spring. Look closely at the ends where the spring is wound correctly.

If it is not properly wound, replace the spring.



4L60E

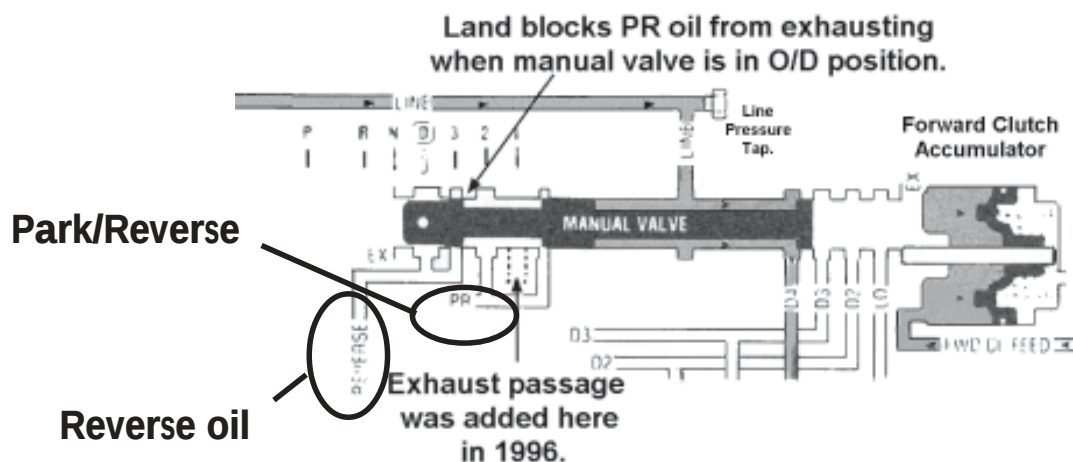
Severe Low/Reverse Clutch Failure

1993-95 4L60E's can develop cracks in the case between main line and the park/reverse (PR) circuits. With the manual valve in the OD position the PR circuit has no exhaust. The manual valve traps this leaking fluid, causing the low/reverse clutch to partially apply while driving forward. Later units may still develop cracks in the case, however in 1996 the valve body and manual valve were redesigned, adding an exhaust passage for the PR circuit while in the OD range. Because of this added exhaust passage the failure may not seem as severe on 1996-on units that develop cracks in the case. The case should always be inspected for cracks regardless of production date. The 1996 valve bodies do not retrofit due to changes such as the 3-2 control valve changing to a switch valve rather than a modulating valve. The 1996-on manual valve can be used effectively with an earlier valve body when an exhaust hole is drilled in the valve body casting.

Concern: Low/Reverse clutch failure (can fail on short test drive).

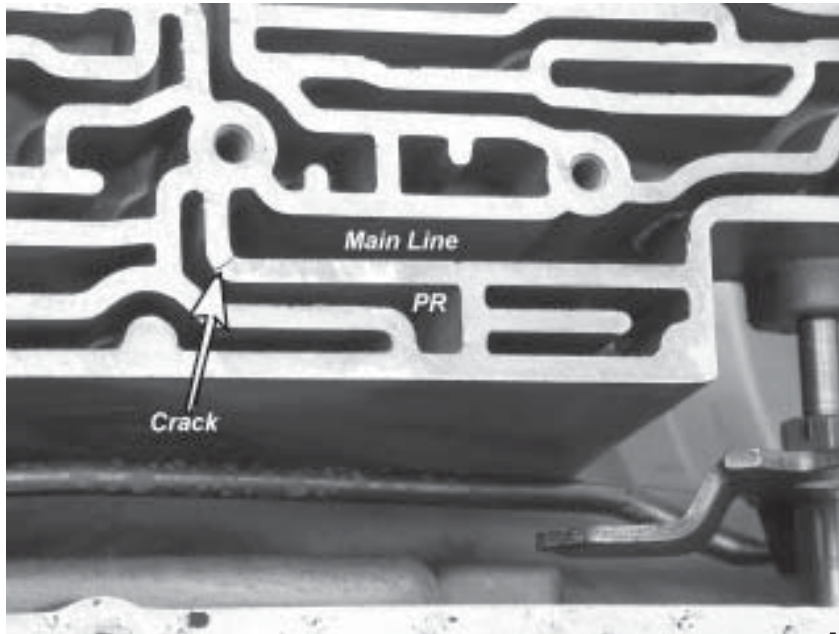
Common Cause: Crack in case passage between main line and the PR circuit.

Repair: Inspect case for cracks, replace as required. Modify early valve bodies and change the manual valve to avoid repeat failures.

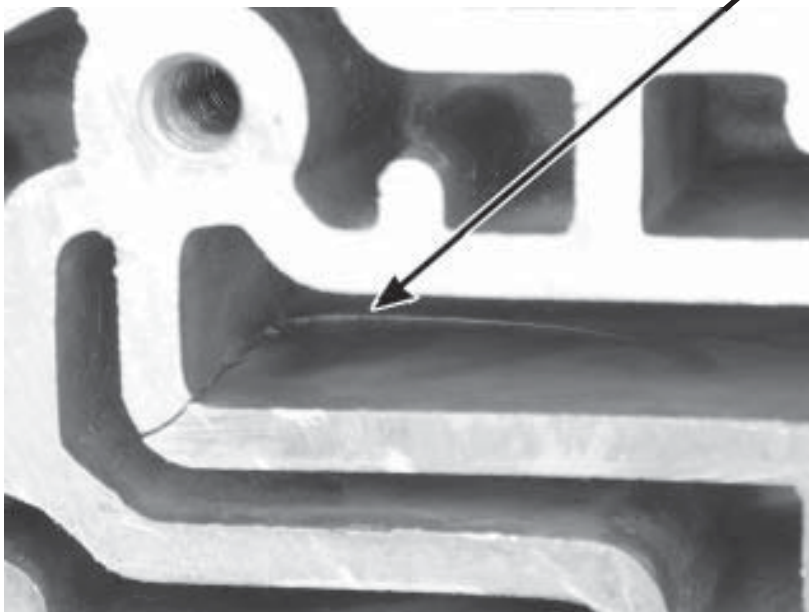


4L60E

Severe Low/Reverse Clutch Failure (continued)

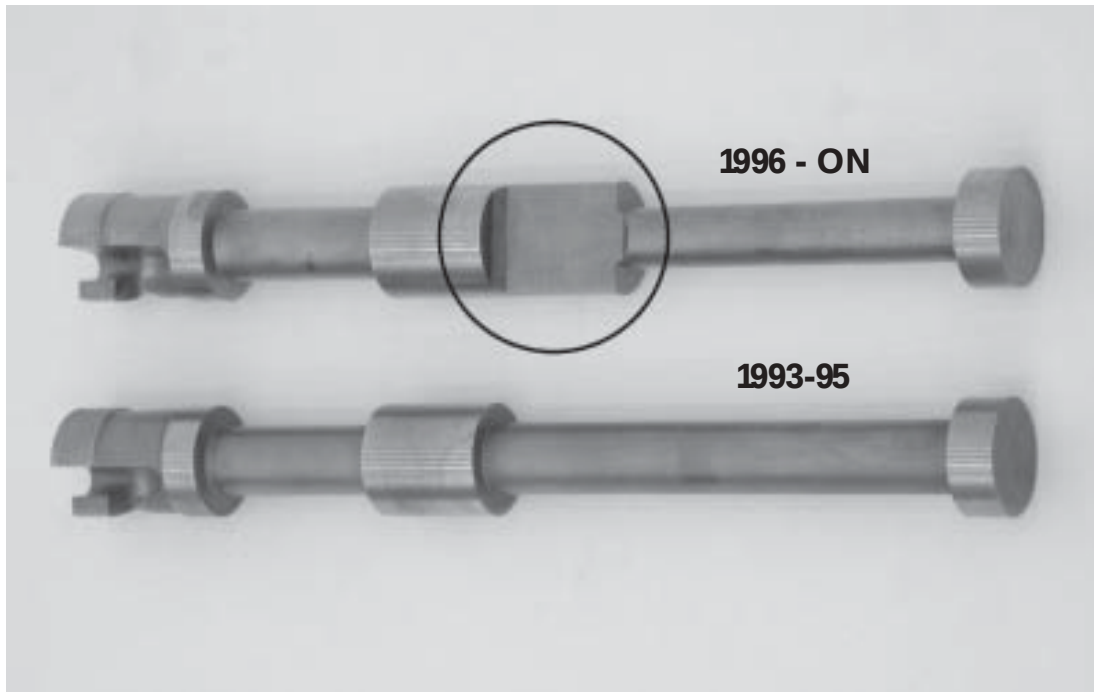


NOTE: Check closely
in bottom of channel,
some cracks may not be
this obvious.

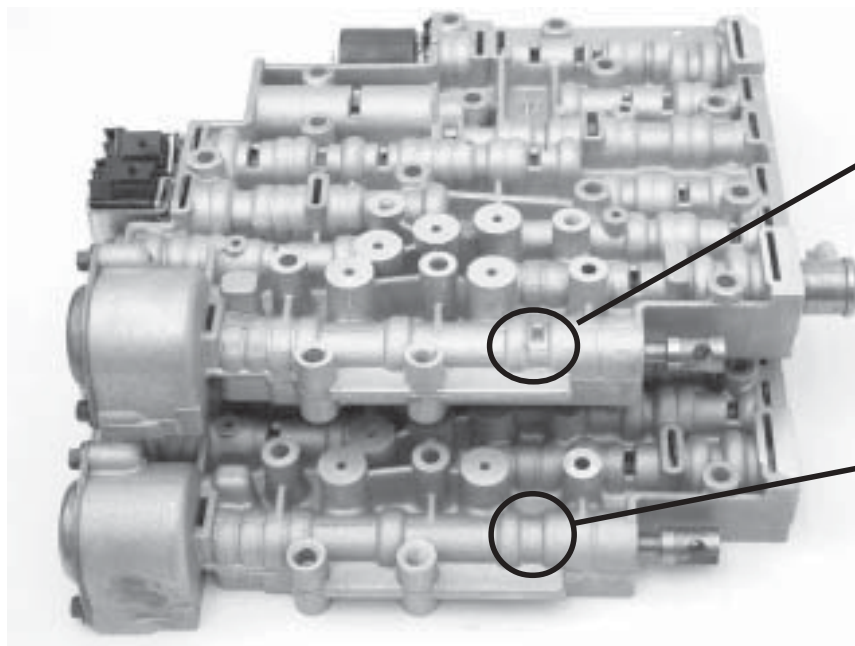


4L60E

Severe Low/Reverse Clutch Failure (continued)



The low/reverse clutch is applied in park on all 4L60Es. Additional material was added to the manual valve to prevent the Park-Reverse circuit from leaking through the added exhaust hole in the 1996-on valve body casting.



**Vent for 1996-on
valve body**

**1993-95 valve body,
when installing a
1996-on manual valve,
drill an 1/8 inch hole
through the center
of the recessed area.**

4L60E

No Cooler Flow During Lock-up

Installing a lock-up valve from a 4L60 or non-pulse width modulated 4L60E into a pulse width modulated 4L60E will cause a no cooler flow condition in lock-up.

Concern: No cooler flow in lock-up

Cause: Non-pulse width modulated lock-up valve installed in a pulse width modulated pump.

Repair: Install correct valve for application.

4L60
4L60E
NON PWM

4L60E
PWM



4L60E

Hard 1-2 Shift

Concern: Some 4L60E applications may exhibit a hard 1-2 shift condition.

Cause: This concern may be caused by any of the following conditions.

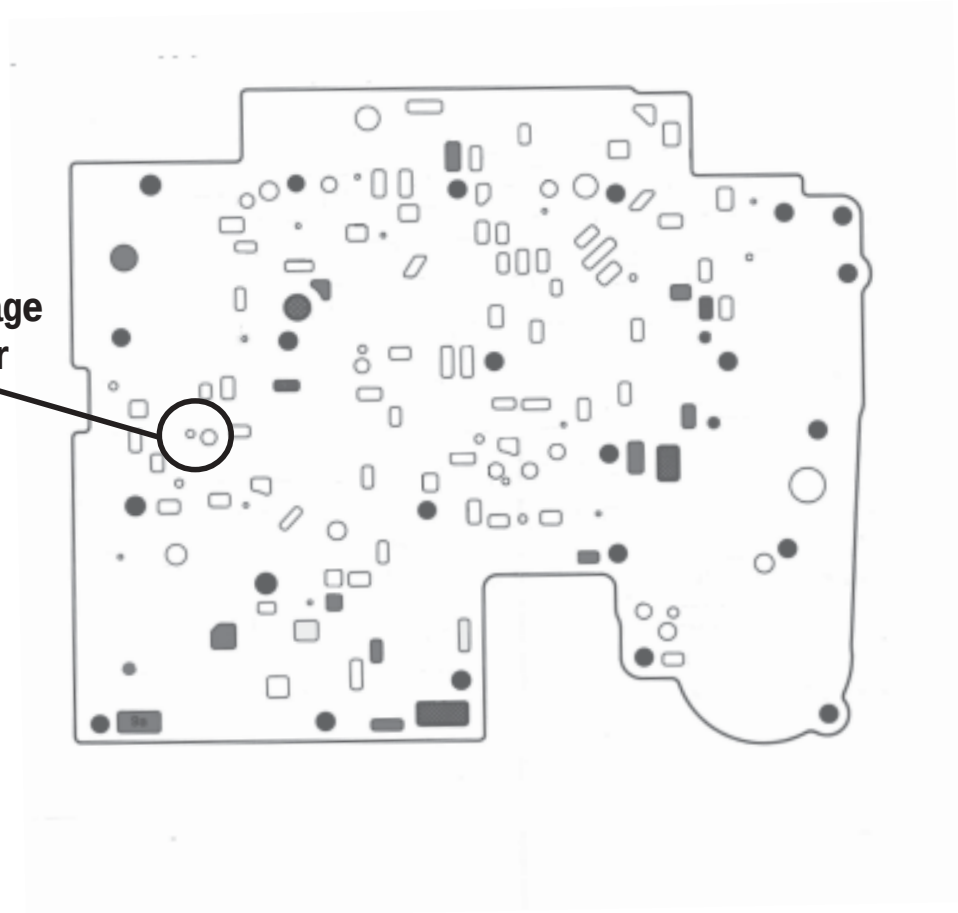
- #8 check ball may not be sealing properly on the spacer plate or it may be missing. This check ball has a tendency to severelypeen the spacer plate.
- Several DTC's may result in increased line pressure. These include slippage, ratio error and several of the solenoid DTC's.
- Broken, damaged or incorrectly installed 1-2 accumulator spring/piston.
- Sticking, damaged or incorrectly installed accumulator valve or spring.
- Drill and tap a 2-4 servo cover and note the pressure at the cover while making a 1-2 shift. If pressure is present, inspect the 4-3 sequence, 3-4 relay valves. Clean and repair the valves as required.
- Calibration was released to address this concern on some 4L60E applications. Check the GM web sight (<http://calid.gm.com/vci/>) for possible flash calibrations that may be available. On non-flash calibrations, refer to GM and ATRA bulletins on the subject.
- 4-3 sequence, 3-4 relay valve train sticking

4L60E

Hard 1-2 Shift (continued)

The most common problem is the spacer plate being damaged by the #8 check ball. Replace or repair the damaged spacer plate.

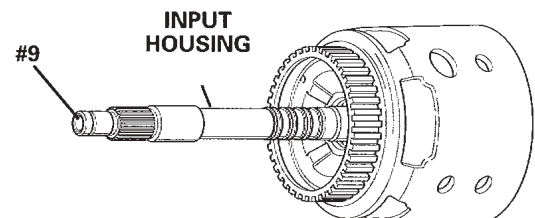
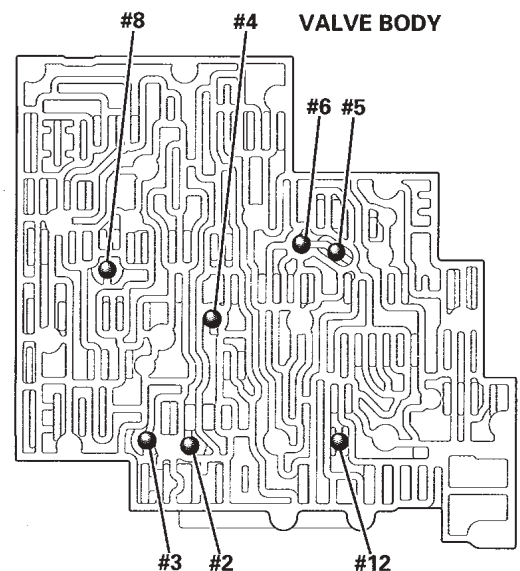
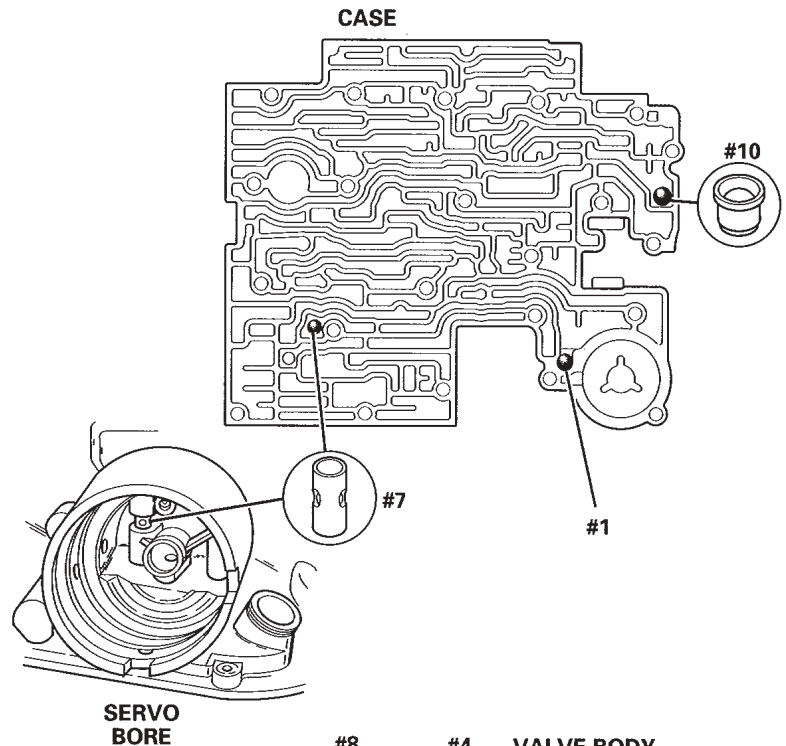
Check for damage
to the separator
plate



4L60E

Hard 1-2 Shift (continued)

- #1 3-4 Accumulator
- #2 3rd Accumulator
- #3 Reverse Input
- #4 3-4 Clutch Exhaust
- #5 Overrun Clutch Feed
- #6 Overrun Clutch Control
- #7 3rd Accumulator Exhaust
- #8 1-2 Upshift
- #9 TCC Apply
- #10 Low/Reverse Clutch Apply
- #12 Forward Clutch Accumulator



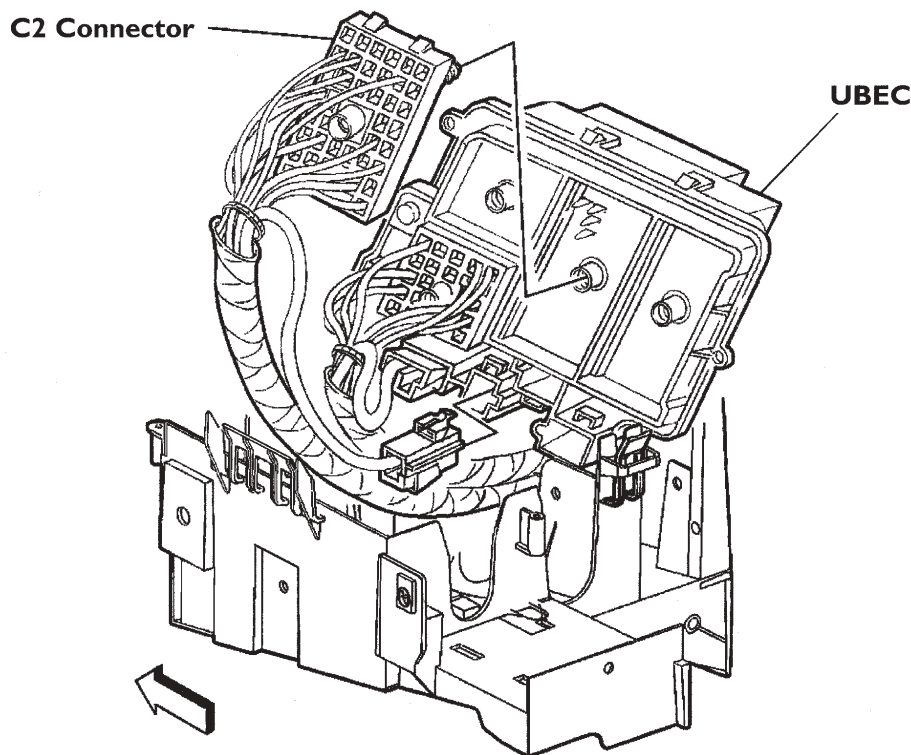
4L60E Trucks

1-2 Shift Complaint

Concern: Some Bravada, Trailblazer and Envoy 4L60E applications may exhibit a 1-2 shift complaint, (Harsh, Erratic shift patterns). In many instances this concern is “intermittent”. In addition to transmission related concerns, the vehicle may exhibit any of the following concerns; lost Radio presets and time , dash gauges erratic, other electrical components operate erratically.

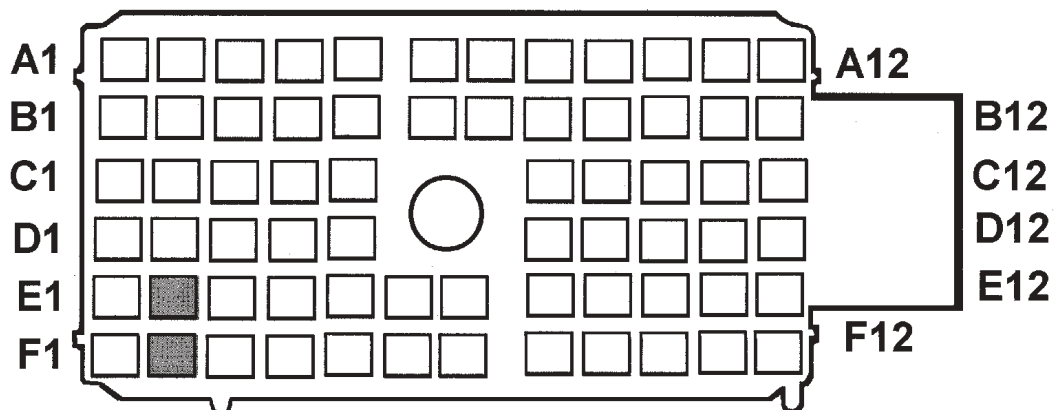
Cause: Several items can cause a hard 1-2 shift. On the above applications one additional item has been shown as a possible cause of the concern. A loose battery connection or a loose connection at the UBEC (Under Bus Electrical Connector) can lead to the concern. This concern has proven to cause drive ability and/or transmission concerns, but generally does not effect vehicle starting system operation.

Repair: Prior to attempting to repair the transmission for the concern, check for “Loss of communication” DTC’s. If a loss of communication DTC is set, inspect the battery connections for being loose or cross threaded. In addition, inspect the UBEC battery connections for possibly being loose or damaged.

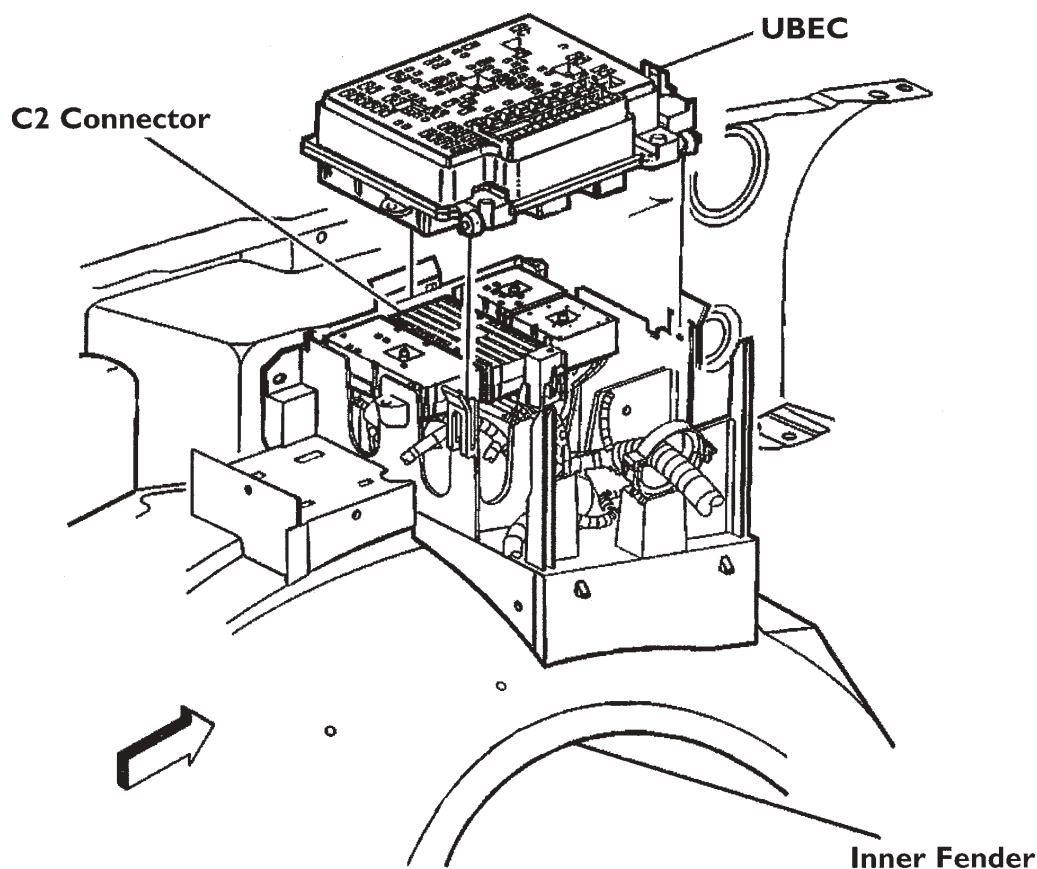


4L60E Trucks (continued)

1-2 Shift Complaint



Terminal E2: Power to UBEC
Terminal F2: Power from UBEC to Transmission



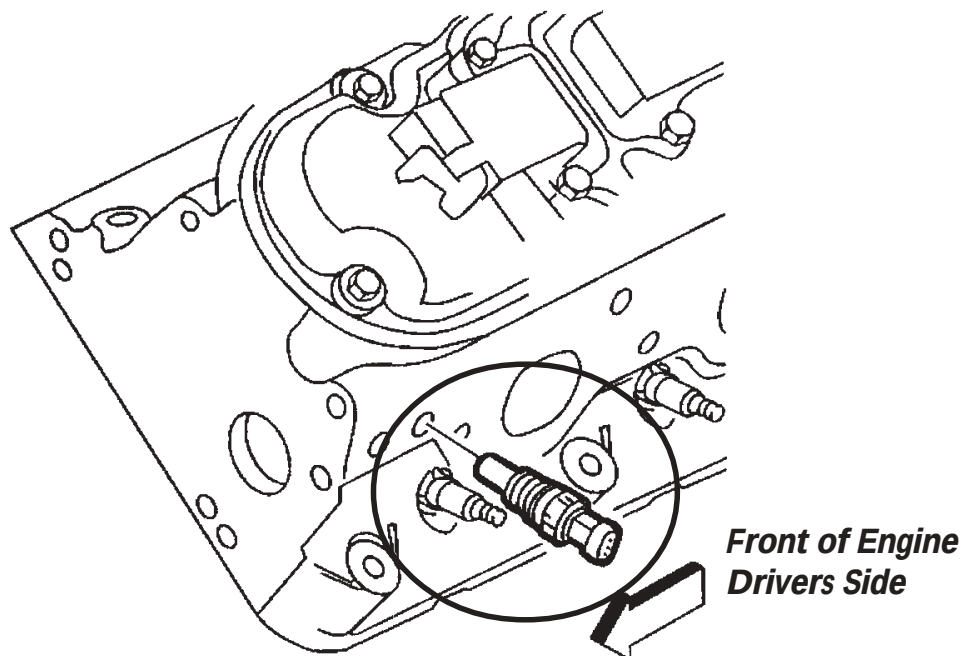
4L60E

P0118, P1115 Set Intermittently, TCC Fails to Operate Properly ***4.8, 5.3, 6.0L Engines***

Concern: Some GM full size truck's and van's may set a P0118 and or P1115 DTC (coolant temp). This concern is generally intermittent although in some cases it may be present all the time. If P0118 is displayed on the scan tool as "failed this ignition cycle" a "hard failure" is present.

Common Cause: A bad crimp at the coolant temp sensor connector is the most common cause for this concern. In most instances this is due to harness routing. The harness may be routed in such a way that it is under stress as the engine moves in its mounts with engine load changes.

Repair: Remove the terminal from the connector. If the wire has separated from the terminal, replace the terminal and reroute the harness as needed.



P1781 DTC Set

Possible P0700 Set SES/MIL Light On

Concern: Some GM pickup/truck applications equipped with the Allison Transmission (RPO code M74) may experience a condition where the SES (Service Engine Soon) light or the MIL (malfunction indicator lamp) comes on. This condition is most common on the 8.1L gas engine applications (RPO code L18).

P1781/P0700 indicates a problem with the TCM MIL request circuit. If the voltage is incorrect, the PCM will set a P1781 DTC and the MIL will be illuminated on the second consecutive failure (Type B DTC). The P1781 DTC will be stored with the “Engine DTCs” even though it is a transmission related concern.

The technician may be instructed when following the procedures in the shop manual to replace the TCM (Transmission Control Module) to correct the condition. Before replacing the TCM, check the following:

Common Cause/Repair: Several items may cause code P1781/P0700.

- Low charging system output
- Faulty battery or low battery state of charge
- Short to ground in the TCM/PCM “MIL request” circuit
- Open in TCM/PCM “MIL request” circuit
- If checking the circuit does not lead to the root cause of the concern you may want to consider reprogramming the PCM before replacing the TCM or the PCM. The concern can be caused by a programming problem with the PCM, which leads the PCM to incorrectly interpret the voltage value on circuit 2687.
- Faulty TCM/PCM

4L60E

Growl/Ring Noise with TCC Applied

Concern: Some 2000-up trucks with the 4L60E (M30 RPO) and the 4.8L V-8 (LR4 RPO) may exhibit a drive shaft ringing or growling noise when the TCC is applied at low road speeds. The noise is most prevalent when the engine rpm is between 1000-1500 rpm and the TCC is applied. This condition is most common on the standard cab, manual transfer case models but it can also occur with other vehicles.

Common Cause: The concern is caused by engine firing impulses which are transferred and magnified by the drive train.

Repair: A revised PCM calibration is available to repair this condition. The new calibration raises the TCC apply point by about 10 mph. Installing the updated calibration will lower the vehicles fuel economy so the customer should be informed of this prior to installing the new calibration. Use the chart below to identify the correct calibration for your application.

Axle Ratio RPO	Engine Size RPO	Model Year 2000 Cal #	Model Year 2001 Cal #	Model Year 2002 Cal #
(GU6) 3.42	(LR4) 4.8L	9358360	9358363	9358366
(GT4) 3.73	(LR4) 4.8L	9358361	9358364	9358367
(GT5) 4.10	(LR4) 4.8L	9358362	9358365	9358368

4L80E 1999-On

No Engine Braking In Manual Second After Rebuild

Concern: No engine braking in M2 range with the vehicle loaded.

Common Cause: The front band was updated as part of a durability package for the 1999 model year. If the wrong band and/or servo pin is used, slippage in manual second may result. If the band is updated, the servo piston and pin must also be updated.

Repair: Install the correct band, servo piston and pin for the application.

1991-1998 model years use:

- Band part number 24202631
- Servo piston and pin part number 24200418

1999-2002 model years use:

- Band part number 24210080 (2mm wider)
- Servo piston/pin part number 24223081 (.200" longer)

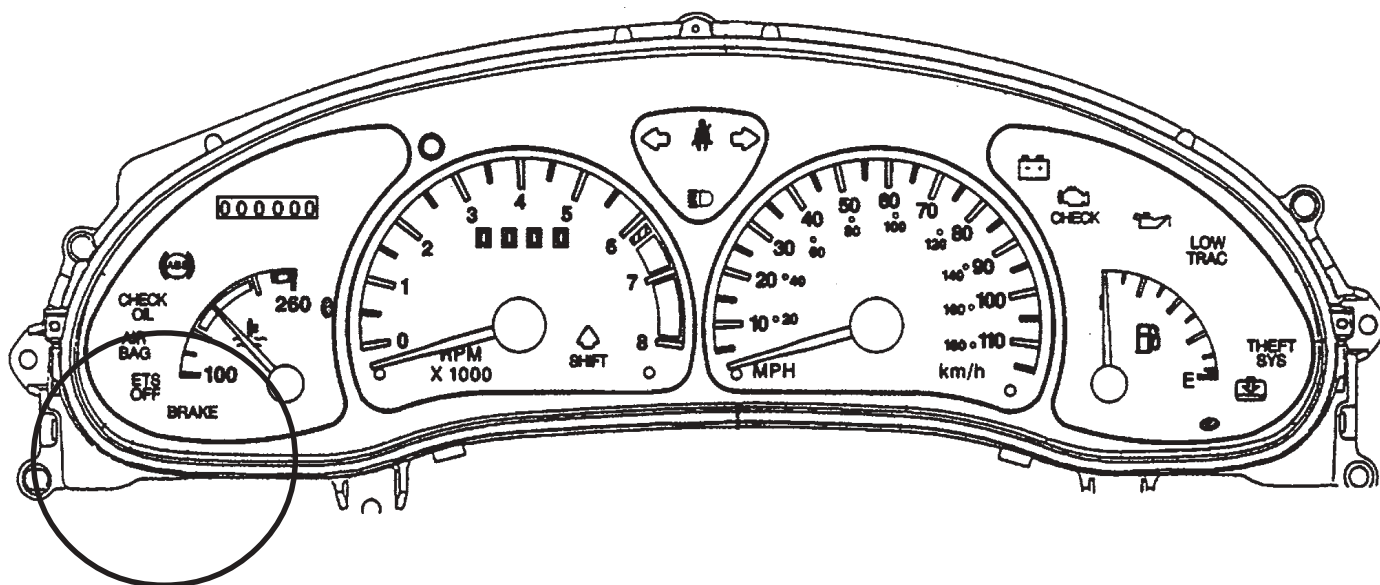
Models with ETS system

ETS OFF Indicator Light On

General Motors Vehicles with Enhanced Traction System

Concern: Enhanced Traction System (ETS) light on, no codes present

Cause: The (ETS) indicator light will be ON and the Enhanced Traction System will be disabled whenever a scan tool is connected to the diagnostic connector with the ignition switch in the RUN position.



Allison LCT 1000

Lack of Stall Speed in 4WD Range

Concern: Many technicians have commented regarding the operation of the Allison transmission on both the 6.6L Dura Max diesel and the 8.1L gas engine applications. It has been noted that the torque converter stall speed is much lower when the transmission is in reverse range and the transfer case is in 4wd range. It is common to see stall speed between 1000-1300 rpm while in reverse and 4wd range.

Common Cause: The 6.6L and 8.1L applications can supply too much torque to the front drive axle due to the transmission planetary torque multiplication available in reverse range. This excessive torque could cause the front axle to fail.

Repair: No repair should be attempted, as the vehicle is operating as designed. The 8.1L and 6.6L applications “torque manage” the engine torque output when the transmission is in reverse while in 4wd. This is accomplished by controlling the spark timing and or fuel delivery systems.

4T40E/4T45E

Ratio and Application Chart

The 4T40E/4T45E utilizes several different final drive, drive and driven sprocket combinations. Installing the wrong transmission, drive and driven sprockets or final drive can result in several different ratio error or slip DTC's . If a ratio error or maximum adapt DTC is present, and the unit has been previously repaired or replaced, final drive and drive to driven sprocket ratio could possibly be incorrect for the application. Refer to the chart to determine what final drive and sprocket's should be used for the application. The engine, transmission and final drive ratio information for your specific vehicle model is located on the RPO label. The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

Ratios

RPO Code	Description
FW6	3.05 Final drive
FY1	3.05 Final drive
F83	3.05 Final drive
FX2	3.29 Final drive
FR9	3.29 Final drive
FR3	3.29 Final drive

Transmission

RPO	Description
MN4	4T40E Transmission
MN5	4T45E Transmission

Engine

RPO	Description
L61	2.2L Engine
LN2	2.2L Engine
LD2	2.3L Engine
LD9	2.4L Engine
L81	3.0L Engine
L82	3.1L Engine
LG8	3.1L Engine
LA1	3.4L Engine

4T40E/4T45E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
J-Body (LD2)	1995	5WLR	32/38	3.29	24205524
Daewoo	1995	5WAR	32/38	3.29	24211463
Daewoo	1996	6WAR	32/38	3.29	24211463
J-Body (LD9)	1996	6WBR	32/38	3.29	24205524
J-Body (LN2)	1996	6WKR	32/38	3.05	24205525
J-Body (LD9)	1996	6FDR	32/38	3.29	24205524
Daewoo (1.5L SOHC)	1997	7WAR	32/38	3.29	24211463
Daewoo (1.5L SOHC)	1997	7CBR	32/38	3.29	24211463
Daewoo (2.0L DOHC)	1997	7ANR, 7ZZR	32/38	3.29	24211465
J-Body (LD9)	1997	7WBR	32/38	3.29	24210083
J-Body (LD9)	1997	7AAR	32/38	3.29	24210083
J-Body (LN2)	1997	7WKR	32/38	3.05	24210085
J-Body (LN2)	1997	7ACR	32/38	3.05	24210085
N-Body (L82)	1997	7WCR	35/35	3.05	24211598
N-Body (LD9)	1997	7WHR	33/37	3.05	24208699
Daewoo (2.0L)	1998	8ANR, 8ZZR	32/38	3.29	24211595

4T40E/4T45E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
Daewoo (1.5L)	1998	8YYR	32/38	3.29	24211597
Daewoo (1.5L)	1998	8WAR	32/38	3.29	24211463
J-BODY (LD9)	1998	8WBR	32/38	3.29	24213609
J-BODY (LN2)	1998	8WKR	32/38	3.05	24211599
N-Body (L82)	1998	8WCR	35/35	3.05	24211598
N-Body (LD9)	1998	8WHR	33/37	3.05	24211600
N-Body (LA1)	1999	9WXJ	35/35	3.05	24212745
N-Body (LA1) (GT Only)	1999	9MXJ	35/35	3.29	24213614
N-Body (LG8)	1999	9WCR	35/35	3.05	24211598
N-Body (L82)	1999	9WCR	35/35	3.05	24211598
N-Body (LD9)	1999	9WHR	33/37	3.05	24212744
J-Body (LN2)	1999	9WKR	32/38	3.05	24213611
J-Body (LD9)	1999	9WBR	32/38	3.29	24213609
TOYOTA (LD9)	1999	9WBR	32/38	3.29	24215872
Daewoo	1999	9XXR	32/38	3.29	24213606
Daewoo	1999	9YYR	32/38	3.29	24213607

4T40E/4T45E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
Daewoo (2.0L)	1999	9ZZR	32/38	3.29	24213608
J-Body (LD9)	2000	0WBR	32/38	3.29	24215872
J-Body (LN2)	2000	0WKR	32/38	3.05	24215873
N-Body (LG8)	2000	0WCR	35/35	3.05	24213613
N-Body (LD9)	2000	0WHR, 0WHR	33/37	3.05	24215875
N-Body (LA1)	2000	0WXJ	35/35	3.05	24215876
N-Body (LA1) (GT Only)	2000	0MXJ	35/35	3.29	24215877
TOYOTA (LD9)	2000	0WBR	32/38	3.29	24215872
SATURN (L61)	2000	0PCR	32/38	3.29	24215280
Z Body Saturn (L81)	2000	0FDJ	33/37	3.29	24215281
Daewoo 1.5/1.6L	2000	0XXR	32/38	3.29	24216342
Daewoo 1.5/1.6L	2000	0YYR	32/38	3.29	24216343
Daewoo 2.0L	2000	0ZZR	32/38	3.29	24216344
J-Body (LD9)	2001	1WBR	32/38	3.29	24218104
J-Body (LN2)	2001	1WKR	32/38	3.05	24218102
N-Body (L82)	2001	1WCR	35/35	3.05	24218103

4T40E/4T45E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
N-Body (LD9)	2001	1WHR	33/37	3.05	24218104
N-Body (LA1)	2001	1WXJ	35/35	3.05	24218109
N-Body (LG8)	2001	1WCR	35/35	3.05	24218103
N-Body (LA1) (GT Only)	2001	1MXJ	35/35	3.29	24218111
TOYOTA (LD9)	2001	1WBR	32/38	3.29	24218101
SATURN (L61)	2001	1PCR	32/38	3.29	24218105
SATURN (L81)	2001	1FDJ	33/37	3.29	24218110
Daewoo	2001	1YYR, 1XXR, 1ZZR	32/38	3.29	24210489 24210409 24212163
J-Body (LN2)	2002	2WKR	32/38	3.05	24218115
J-Body (L61)	2002	2PCR	32/38	3.29	24218118
N-Body (LG8)	2002	2WCR	35/35	3.05	24218116
N-Body (L61)	2002	2PCR	32/38	3.29	24218118
N-Body (L82)	2002	2WCR	35/35	3.05	24218116
N-Body (LA1)	2002	2WXJ	35/35	3.05	24218121
N-Body (LA1) (GT Only)	2002	2MXJ	35/35	3.29	24218123
TOYOTA (LD9)	2002	2WBR	32/38	3.29	24218114

4T40E/4T45E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
J BODY Saturn (L81)	2002	2FDJ	33/37	3.29	24218122
J BODY Saturn (L61)	2002	2PCR	32/38	3.29	24218118
Daewoo	2002	2XXR, 2ZZR	32/38	3.29	

4T65E

Ratio and Application Chart

The 4T65E utilizes several different final drive and drive to driven sprocket combinations. Installing the wrong transmission, drive/driven sprockets or final drive can result in several different ratio error or slip DTC's. If a ratio error or maximum adapt DTC is present, and the unit has been previously repaired or replaced, final drive ratio and/or drive and driven sprocket ratio could possibly be incorrect for your application. Refer to the chart to determine what final drive and sprockets should be used for the application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the RPO. The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

Ratios	
RPO Code	Description
FQ3	2.86 Final drive
FR2	2.93 Final drive
F83	3.05 Final drive
FR9	3.29 Final drive
FV4	3.71 Final drive

Engine	
RPO	Description
LB8	2.5L Engine
L46	3.0L Engine
LG8	3.1L Engine
LA1	3.4L Engine
LQ1	3.4l DOHC Engine
LX5	3.5L DOHC Engine
L36	3.8L Engine
L67	3.8L Engine Super charged

Transmission	
RPO	Description
MN3	4T65E Transmission
MN7	4T65E HD Transmission
M76	4T65E AWD Transmission
M15	4T65E Advanced Electronic

4T65E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
C-Body (L36) (MN3)	1997	7BDB, 7FHB	35/35	3.05	24210250
G-Body (L36) (MN3)	1997	7BDB, 7FHB	35/35	3.05	24210250
C-Body (L67) (MN7)	1997	7BMB, 7FBB	37/33	3.29	24210249
G-Body (L67) (MN7)	1997	7BMB, 7FBB	37/33	3.29	24210249
W-Body Buick/Pontiac (L67) (MN7)	1997	7HKB, 7XAB	37/33	3.29	24210251
W-Body Chev (LQ1) (M15)	1997	7YSB	33/37	3.05	24207980
H-Body Olds/Pontiac (L36) (MN7)	1997	7MAB, 7YWB	37/33	3.29	24210252
C-Body (L36)	1998	8FFB	35/35	3.05	24210801
C-Body (L67)	1998	8FCB	37/33	3.29	24210802
G-Body (L67)	1998	8FCB	37/33	3.29	24210802
W-Body Olds (LX5) (MN3)	1998	8YCB	35/35	3.29	24211353
H-Body (L67) (MN7)	1998	8FDB	37/33	3.29	24211172
H-Body (L36) (M15)	1998	8TPB	35/35	3.05	24211173
H-Body (L36) (MN3)	1998	8YFB	35/35	2.86	24211350
W-Body (L67) (MN7)	1998	8XAB	37/33	3.29	24211351
W-Body (L36) (M15)	1998	8THB	35/35	3.29	24211352

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Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
W-Body (L36) (M15)	1998	8TNB	35/35	3.05	24210743
W-Body- Police Package (L36) (M15)	1998	8KAB	35/35	3.29	24211354
C-Body (L36) (MN3)	1999	9FFB	35/35	3.05	24213640
C-Body (L67) (MN7)	1999	9FCB	37/33	3.29	24213641
H-Body (L36) (MN3)	1999	9YFB	35/35	2.86	24213644
H-Body (L67) (MN7)	1999	9FDB	37/33	3.29	24213645
H-Body (L36) (M15)	1999	9TNB	35/35	3.05	24213643
W-Body (LX5) (MN3)	1999	9YCB	35/35	3.29	24213651
W-Body (L36) (MN3)	1999	9APB	35/35	3.05	24213653
W-Body (L67) (MN7)	1999	9XAB	37/33	3.29	24213650
W-Body (L36) (M15)	1999	9CRB	35/35	3.05	24213652
W-Body (L36) (M15)	1999	9THB	35/35	3.29	24213648
W-Body (L36) (M15)	1999	9BCB	35/35	3.29	24213646
W-Body (L46) (MD7)	1999	9FMB	35/35	3.29	24213647
W-Body (LB8) (MD7)	1999	9FAB	33/37	3.29	
W-Body- Police Package (L36) (M15)	1999	9KAB	35/35	3.29	24213649

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Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
U-Body (LA1) (M15)	1999	9BCB	35/35	3.29	24213646
G-Body (L67)	1999	9CMB	37/33	3.29	24213642
C-Body (L36) (MN3)	2000	0FKB, 0FFB	35/35	3.05	24216459
C-Body (L67) (MN7)	2000	0FDB, 0FCB	37/33	3.29	24216465
H-Body (L36) (MN3)	2000	0PPB, 0PAB	35/35	2.86	24216462
H-Body (L36) (MN3) (Y56 On some models)	2000	0PCB, 0PBB	35/35	3.05	24216463
H-Body (L67) (MN7)	2000	0CHB, 0FHB	37/33	3.29	24216466
W-Body (LX5) (MN3)	2000	0YHB, 0YCB	35/35	3.29	24216460
W-Body (L36) (MN3)	2000	0ARB, 0APB	35/35	3.05	24216464
W-Body (L67) (MN7)	2000	0XBB, 0XAB	37/33	3.29	24216467
W-Body (LA1) (M15)	2000	0RLB, 0RDB	35/35	2.86	24216468
W-Body (L36) (M15)	2000	0BRB, 0BCB	35/35	3.29	24216469
W-Body (LG8, M15)	2000	0RWB, 0RNB	35/35	3.05	24216470
W-Body (L36) (M15)	2000	0LPB, 0LBB	35/35	3.05	24216471
W-Body (L36) (M15)	2000	0LMB, 0LDB	35/35	3.29	24216472
W-Body- Police/TAXI Package (L36) (M15)	2000	0LNB, 0LCB	35/35	3.29	24216473

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Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
U-Body (LA1) (M15)	2000	0BRB	35/35	3.29	24216469
C-Body (L36) (MN3)	2001	1FFB	35/35	3.05	24217188
C-Body (L67) (MN7)	2001	1FCB	37/33	3.29	24217195
H-Body (L36) (MN3)	2001	1PAB	35/35	2.86	24217192
H-Body (L36) (MN3) (Y56 On some models)	2001	1PBB	35/35	3.05	24217193
H-Body (L67) (MN7)	2001	1CHB	37/33	3.29	24217196
W-Body (LX5) (MN3)	2001	1YCB	35/35	3.29	24217190
W-Body (LX5) (MN3)	2001	1YMB	35/35	3.05	24217191
W-Body (L36) (MN3)	2001	1APB	35/35	3.05	24217194
W-Body (L67) (MN7)	2001	1XAB	37/33	3.29	24217197
W-Body (LA1) (M15)	2001	1RDB	35/35	2.86	24217198
W-Body (L36) (M15)	2001	1BCB	35/35	3.29	24217199
W-Body (LG8, M15)	2001	1RNB	35/35	3.05	24217200
W-Body (L36) (M15)	2001	1LDB	35/35	3.29	24217201
W-Body (LG8, M15)	2001	1LBB	35/35	3.05	24217223
W-Body- Police/TAXI Package (L36) (M15)	2001	1LCB	35/35	3.29	24217202

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Ratio and Application Chart (continued)

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
B-Body (LA1) (M76)	2001	1CXB	35/35	3.29	24217205
B-Body (LA1) (M15)	2001	1BCB	35/35	3.29	24217199
U-Body (LA1) (M15)	2001	1BCB	35/35	3.29	24217199
G-Body (LX5) (MN3)	2001	1DGB	35/35	3.29	24217189
G-Body (LX5) (MN3)	2001	1DCB	35/35	3.29	24217183
C-Body (L36) (MN3)	2002	2FFB	35/35	3.05	24217207
C-Body (L67) (MN7)	2002	2FCB	37/33	3.29	24217214
H-Body (L36) (MN3)	2002	2PAB	35/35	2.86	24217209
H-Body (L36) (MN3) (Y56 On some models)	2002	2PBB	35/35	3.05	24217210
H-Body (L67) (MN7)	2002	2CHB	37/33	3.29	24217215
W-Body (LX5) (MN3)	2002	2YCB	35/35	3.29	24217211
W-Body (LX5) (MN3)	2002	2YMB	35/35	3.05	24217212
W-Body (L67) (MN7)	2002	2XAB	37/33	3.29	24217216
W-Body (LA1) (M15)	2002	2RDB	35/35	2.86	24217219
W-Body (L36) (M15)	2002	2BCB	35/35	3.29	24217218
W-Body (L36) (M15)	2002	2LBB	35/35	3.29	24217223

4T65E***Ratio and Application Chart (continued)***

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive	SRTA Part #
W-Body (LG8, M15)	2002	2RNB	35/35	3.05	24217220
W-Body- Police/TAXI Package (L36) (M15)	2002	2LCB	35/35	3.29	24217221
B-Body (LA1) (M76)	2002	2CXB	35/35	3.29	24217224
B-Body (LA1) (M15)	2002	2BCB	35/35	3.29	24217218
U-Body (LA1) (M15)	2002	2BCB	35/35	3.29	24217218
G-Body (LX5) (MN3)	2002	2DCB	35/35	3.29	24217208

4T80E

Ratio and Application Chart

The 4T80E utilizes several different final drive's. Installing the wrong transmission or final drive can result in several different ratio error or slip DTC's. Refer to the chart to determine what final drive and converter should be used for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission and/or final drive fits in which vehicle body style and application.

“NOTE” All 4T80E applications use the same drive/driven sprocket tooth counts.

Ratios	
RPO Code	Description
FP3	2.73 Final drive
F79	2.97 Final drive
F17	2.84 Final drive
FW2	3.06 Final drive
FV3	3.11 Final drive
F13	3.48 Final drive
FR9	3.29 Final drive
FV4	3.71 Final drive

Engine	
RPO	Description
LD8	4.6L Northstar
L37	4.6L Northstar
L47	4.0L Northstar
L67	3.8L Supercharged

Transmission	
RPO	Description
MH1	4T80E Transmission

To determine the final drive ratio, add the ring gear tooth count to the sun gear then divide that total by the sun gear.

4T80E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Converter	Final Drive	SRTA Part #
V-Body 4.6L	1992	2AJN	TCC	3.71	08684918
E-Body-ETC-4.6L	1993	3AAN	VCC	3.11	08684919
E/K/V Body-STS-4.6L	1993	3AJN, 3ARN	TCC	3.71	08684920
E/K/K Special-4.6L	1994	4AAN	VCC	3.11	08684956
K/V-Body- STS-4.6L	1994	4BCN, 4AJN	TCC	3.71	24201795
E/K Export-4.6L (L37)	1995	5BCN	TCC	3.71	24201796
E/K/K Special-4.6L (LD8)	1995	5AAN	VCC	3.11	24211478
E/K/K Special-4.6L (L37)	1995	5MKN	VCC	3.71	24211479
G-Body-4.0L (L47)	1995	5BMN, 5AKN, 5MDN	VCC	3.48	24204808
G-Body-4.0L (L47)	1995	5BBN, 5ZYN, 5MSN	VCC	3.71	24204809
E/K/K Special-4.6L (LD8)	1996	6AAN	VCC	3.11	24211487
E/K/K Special-Export 4.6L(L37)	1996	6AJN	TCC	3.71	24204805
E/K-Body 4.6L (L37)	1996	6MLN	VCC	3.71	24211488
G-Body-4.0L (L47)	1996	6MDN	VCC	3.48	24204808
G-Body-4.0L (L47)	1996	6MSN	VCC	3.71	24204809
E/K/K Special-4.6L (LD8)	1997	7AAN	VCC	3.11	24205299

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Ratio and Application Chart (continued)

Application	Year	Model Codes	Converter	Final Drive	SRTA Part #
E/K Export-4.6L (L37)	1997	7AJN	TCC	3.71	24205300
E/K Body 4.6L (L37)	1997	7MLN	VCC	3.71	24205301
G-Body-4.0L (L47)	1997	7MDN	VCC	3.48	24205302
G-Body-4.0L (L47)	1997	7MSN	VCC	3.71	24205303
E/K/K Special-4.6L (LD8)	1998	8BBN 8AAN	VCC	3.11	24213654
E/K Export-4.6L (L37)	1997	7AJN	TCC	3.71	24205300
E/K Body 4.6L (L37)	1997	7MLN	VCC	3.71	24205301
G-Body-4.0L (L47)	1997	7MDN	VCC	3.48	24205302
G-Body-4.0L (L47)	1997	7MSN	VCC	3.71	24205303
E/K/K Special-4.6L (LD8)	1998	8BBN 8AAN	VCC	3.11	24213654
E/K Export-4.6L (L37)	1998	8CMN 8AJN	TCC	3.71	24213655
E/K Body 4.6L (L37)	1998	8CTN 8MLN	VCC	3.71	24213656
G-Body-4.0L (L47)	1998	8DCN, 8MDN	VCC	3.48	24213657
G-Body-4.0L (L47)	1998	8DFN 8MSN	VCC	3.71	24213658
E-Body-S5S- 4.6L (LD8)	1998	8BSN 8ABN	VCC	3.11	24213659
E-Body-S5S- 4.6L (L37) Export	1998	8CRN 8ACN	TCC	3.71	24213660

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Ratio and Application Chart (continued)

Application	Year	Model Codes	Converter	Final Drive	SRTA Part #
E-Body-S5S- 4.6L (L37)	1998	8CLN 8ADN	VCC	3.71	24213661
E/K/K Special-4.6L (LD8)	1999	9MCN	VCC	3.11	24213686
E/K Body 4.6L (L37)	1999	9MHN	VCC	3.71	24213688
G-Body-4.0L (L47)	1999	9MDN	VCC	3.48	24213689
G-Body-4.0L (L47)	1999	9MSN	VCC	3.71	24213690
E-Body-S5S- 4.6L (LD8)	1999	9AAN	VCC	3.11	24213691
E/K-Body-S5S- 4.6L (L37) Export	1999	9AJN	TCC	3.71	24213687
E/K-Body-S5S- 4.6L (L37)	1999	9MLN	VCC	3.71	24213692
E-Body- 4.6L (LD8)	2000	0MCN	VCC	3.11	24216026
E-Body- 4.6L (L37)	2000	0MHN	VCC	3.71	24216027
E-Body- 4.6L (L37)	2001	1VHN 1MHN	VCC	3.71	24222036
E-Body- 4.6L (LD8)	2001	1VCN 1MCN	VCC	3.11	24222035
G-Body-4.0L (L47)	2001	1VSN 1MPN 1MSN	VCC	3.71	24222040
K/K Special S5S (LD8)	2001	1VAN 1AAN	VCC	3.11	24222037
K-Body-S5S- 4.6L (L37) Export	2001	1VJN 1AJN	TCC	3.71	24222038
K/K Special S5S (L37)	2001	1VLN 1MLN	VCC	3.71	24222039
E-Body- 4.6L (LD8)	2002	2VCN	VCC	3.11	24222396

4T80E

Ratio and Application Chart (continued)

Application	Year	Model Codes	Converter	Final Drive	SRTA Part #
E-Body- 4.6L (L37)	2002	2VHN	VCC	3.71	24222398
G-Body-4.0L (L47)	2002	2VSN	VCC	3.71	24222401
K/K Special S5S (LD8)	2002	2VAN	VCC	3.11	24222397
K-Body-S5S- 4.6L (L37) Export	2002	1VJN	TCC	3.71	24222399
K/K Special S5S (L37)	2002	2VLN	VCC	3.71	24222400
E-Body- 4.6L (L37)	2001	1VHN 1MHN	VCC	3.71	24222036
E-Body- 4.6L (LD8)	2001	1VCN 1MCN	VCC	3.11	24222035
G-Body-4.0L (L47)	2001	1VSN 1MPN 1MSN	VCC	3.71	24222040
K/K Special S5S (LD8)	2001	1VAN 1AAN	VCC	3.11	24222037
K-Body-S5S- 4.6L (L37) Export	2001	1VJN 1AJN	TCC	3.71	24222038
K/K Special S5S (L37)	2001	1VLN 1MLN	VCC	3.71	24222039
E-Body- 4.6L (LD8)	2002	2VCN	VCC	3.11	24222396
E-Body- 4.6L (L37)	2002	2VHN	VCC	3.71	24222398
G-Body-4.0L (L47)	2002	2VSN	VCC	3.71	24222401
K/K Special S5S (LD8)	2002	2VAN	VCC	3.11	24222397
K-Body-S5S- 4.6L (L37) Export	2002	1VJN	TCC	3.71	24222399
K/K Special S5S (L37)	2002	2VLN	VCC	3.71	24222400

Automatic Transfer Case

Chatter/Slippage

Concern: Some GM compact trucks, vans, full size trucks and sport utility vehicles equipped with the NV 136, NV 236 or the NV 246 “auto transfer case”, may have a complaint of a chatter concern when turning if the transfer case is in the “Auto” range. (Note: The NV 136 is in the auto range all the time) The chatter concern tends to get worse as the transfer case fluid temperature increases. This is especially noticeable after the vehicle has been left sitting for a few minutes at full temperature.

In addition, some customers may have an additional or different symptom, such as front wheel slippage when the transfer case is in auto or 4wd range.

Cause's: Several items can cause the above concerns such as:

- The wrong fluid was used in the transfer case. All auto transfer case applications require “AUTO TRAC II FLUID ONLY”. Do not use regular ATF!
- Clutch pack clearance is incorrect or damaged clutches
- Front axle drag, causing damage to the transfer case clutches when the unit is operated at very cold temperatures in 2wd range.
- Misassembled or internal damage
- Drive motor binding/damaged
- Shift fork binding/damaged

Repair: Depending on the extent of the concern, the unit may be repaired by draining the fluid and then refilling it with “Auto Trac II fluid”(Part # 12378508 Canada Part # 10953626). Drive the vehicle in a figure 8 pattern several times with the unit in auto mode. Operate the vehicle until the transfer case reaches full operating temperature. Drain and refill the unit with Auto Trac II fluid. In addition you may want to consider upgrading the fluid being used in the front axle to Castrol Synthetic fluid (Part # 12378261 or in Canada Part# 10953455) (75w-90) or equivalent.

Automatic Transfer Case Chatter/Slippage (continued)

If this procedure does not correct the concern, or if the vehicle has been operating with the concern for several thousand miles proceed as follows:

- Refill the front axle with Castrol Synthetic fluid (Part # 12378261 or in Canada Part# 10953455) (75w-90) or equivalent.
- Replace the clutches per the Factory procedures.

Clutch friction plates NV 246, NV 236 Part #12473054

Clutch friction plates NV 136 (RPO NP4) Part #12473054

Clutch friction plates NV 136 (RPO NP4) Part # 12547608

Clutch steel plates NV 246, NV 236 Part # 12547608

Shim Kit Part # 12474121

Apply plate Part # 12474070

Special Notes for Repair:

- Be sure to lock the motor in place using a motor positioning tool or damage to the motor/encoder may occur. Do not rotate the motor unless it is attached to the transfer case.

Ford

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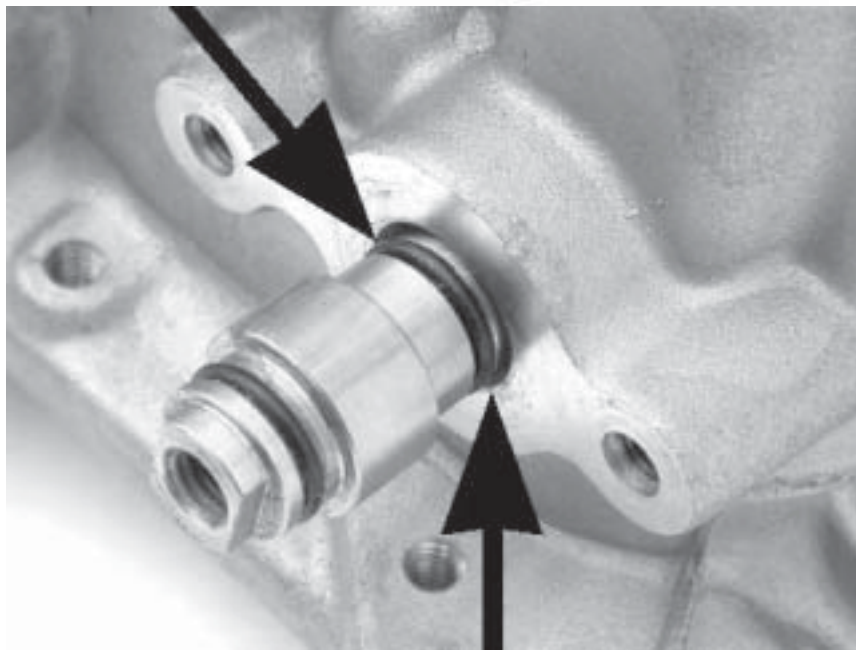
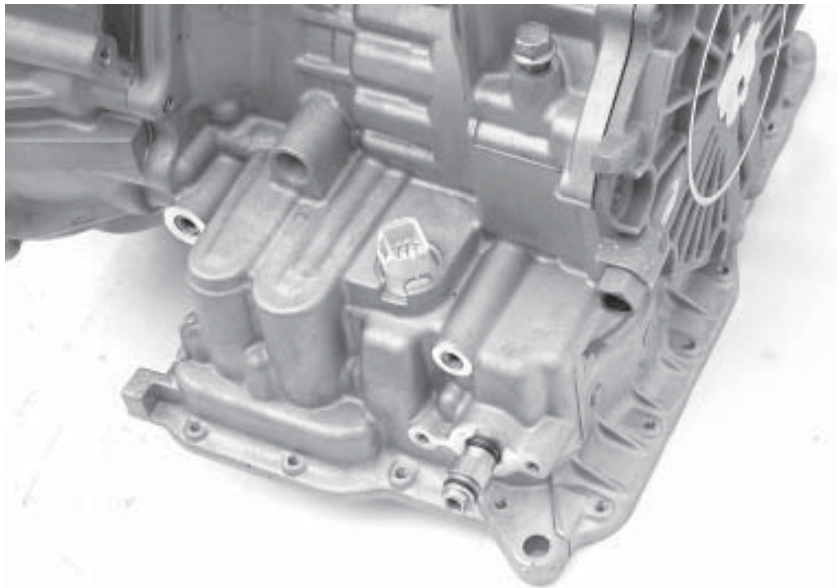
Notes:

4F27E

Transmission Manual Shaft Leak

Common Cause: Manual shaft O-ring leaking, causing fluid to leak into the TRS. During early production a number of transaxles were assembled with a manual shaft O-ring that's diameter was too large. During installation these O-rings were cut or pinched causing them to leak.

Repair: Install new, smaller diameter O-ring-part # **XS4Z-7B498-AB**.



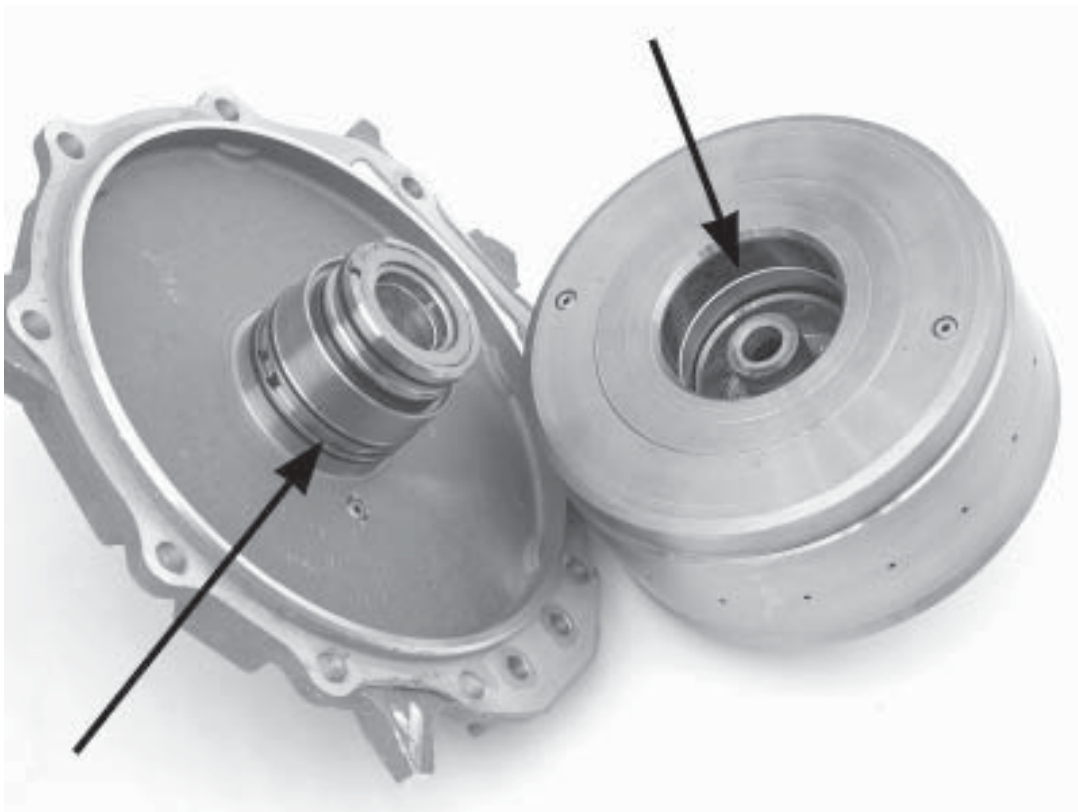
4F27E

Delay or No Reverse

Concern: Delayed or no reverse all other gears normal.

Common Cause: High pressure due to pressure regulator valve wear causing reverse clutch drum to side load on the rear support.

Repair: Replace drum, support assembly and valve body.



AX4S/AX4N

Redesigned Park System

2000 Taurus with Build Dates After 8/1999

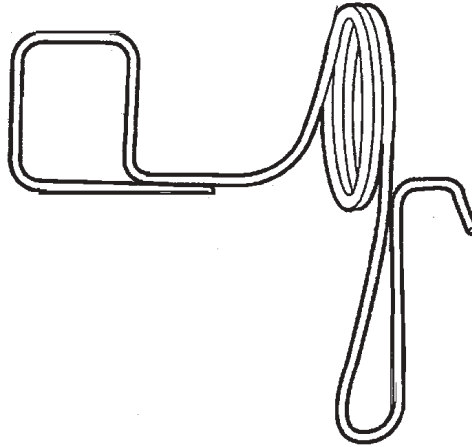
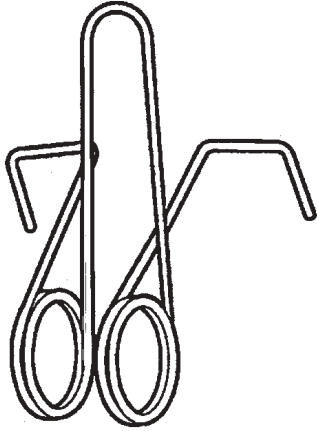
Parking System

1999 Taurus, Sable and Windstar vehicles with AX4S transaxles built August 1999 and beyond and all 2000 Taurus, Sable and Windstar vehicles with AX4S or AX4N transaxles and 2000 Continentals built 10/1999 or later have a redesigned park system.

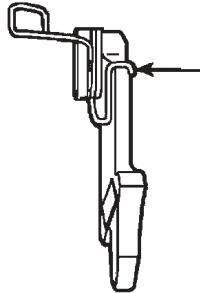
Part #	Description	Application
YF1Z-7A441-AA	Parking pawl	
YF1Z-7D070-A	Park spring	
YF1Z-7D071-A	Park shaft	
W706012-S300	Bolt	
YF1Z-7G101-A	Plate	
1F2Z-7D232-A	Rod	AX4S (only)
1F1Z-7D232-A	Rod	AX4N (only)
YF1Z-7A256-AA	Rod	
YF1Z-7A115-A	Lever	Model Dependent
YF1Z-7E332-AA	Spring	
YF1Z-7C493-A	Shaft	
1F1Z-7005-AA	Case	Model Dependent
1F1Z-7005-BA	Case	Model Dependent
-7G188-	Cover	Model Dependent
YF1Z-7G303-A	Gasket	
YF2Z-7A130-AA	Support	AX4S (only)
YF1Z-7A194-AA	Pan	AX4N (only)
YF1Z-7G084-A	Tube	AX4N (only)
N803202S		

AX4S/AX4N

Redesigned Park System (continued) *2000 Taurus with Build Date After 8/1999*



YF1Z-7D070-A



YF1Z-7A441-AA



Old

New

AX4S/AX4N

Redesigned Park System (continued)

2000 Taurus with Build Date After 8/1999

AX4N



Old

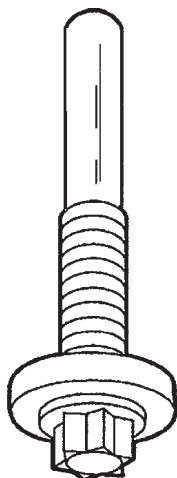
AX4S



Both AX4S
and AX4N

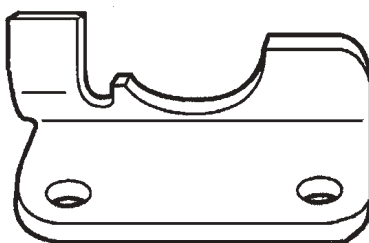
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New

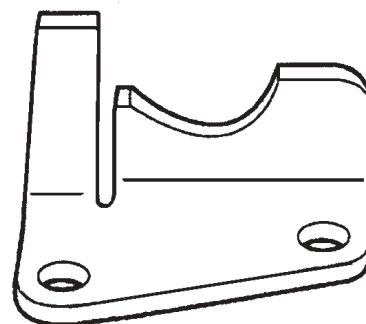


W706012-S300
(AX4S only)

New



Old

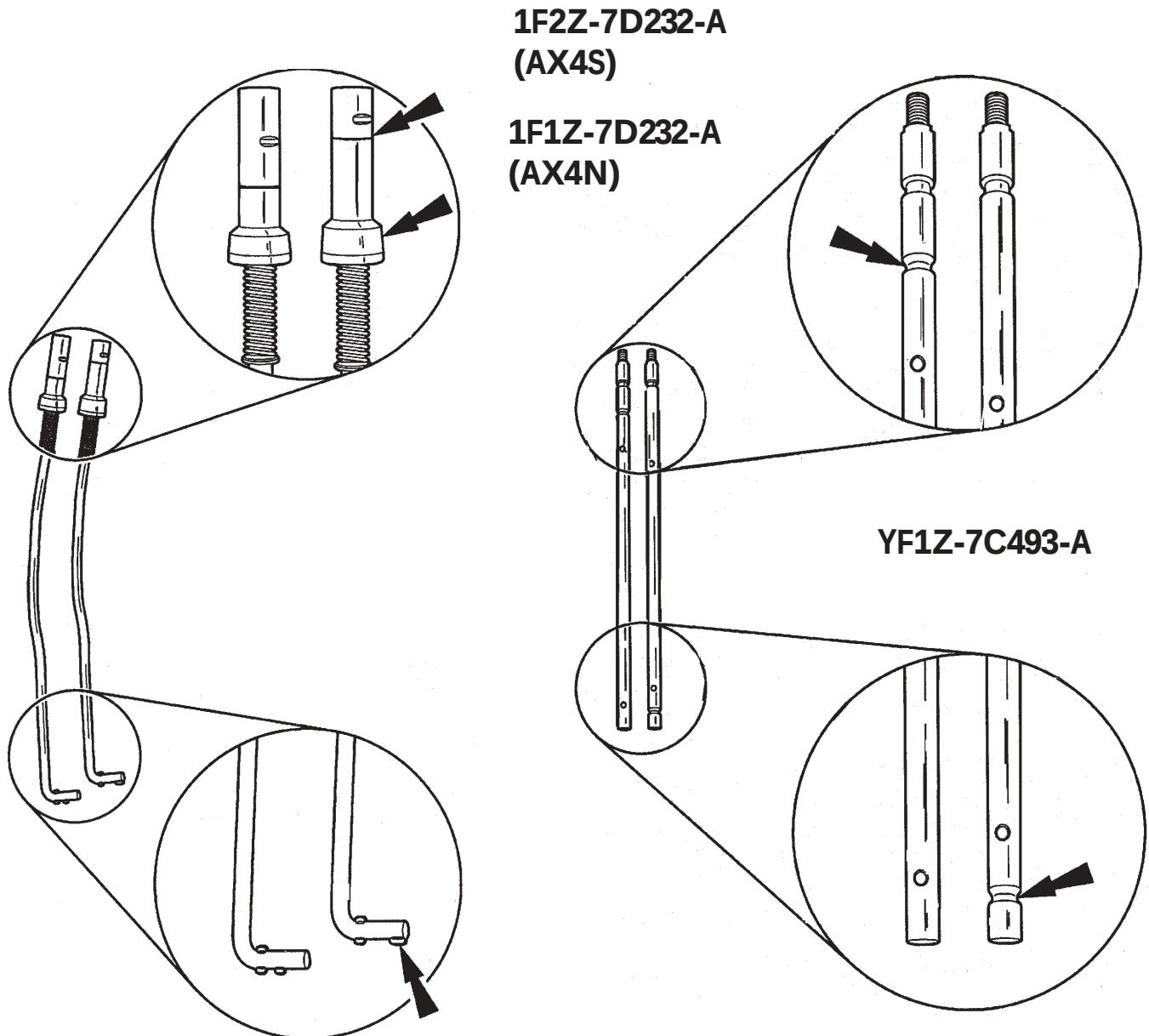


YF1Z-7G101-A

New

AX4S/AX4N

Redesigned Park System (continued) *2000 Taurus with Build Date After 8/1999*



AX4S/AX4N

Redesigned Park System (continued) *2000 Taurus with Build Date After 8/1999*

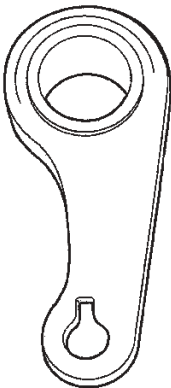


Old

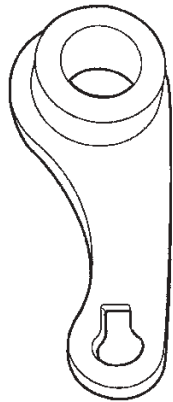


YF1Z-7E332-AA

New

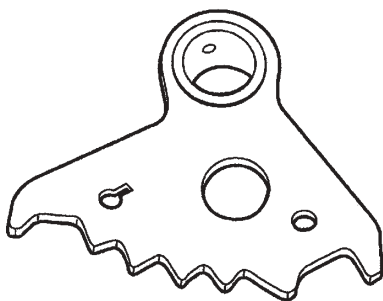


Old

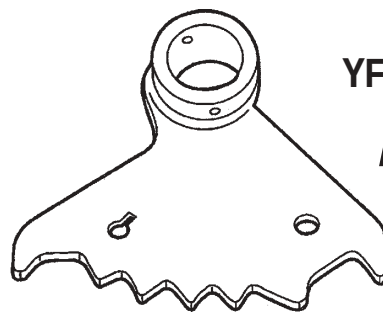


YF1Z-7A256-AA

New



Old

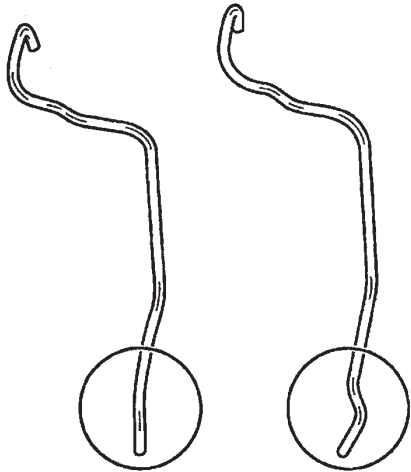


YF1Z-7A115-A

New

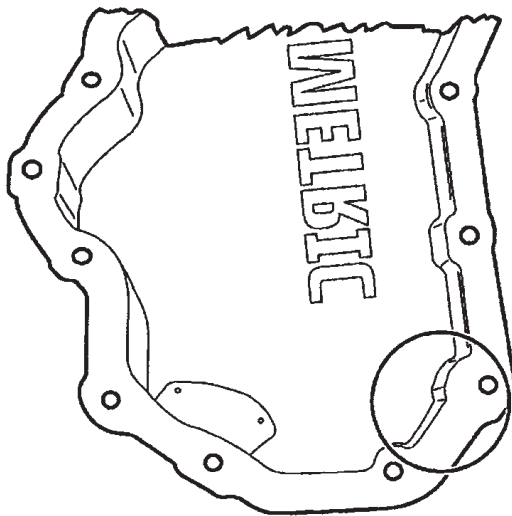
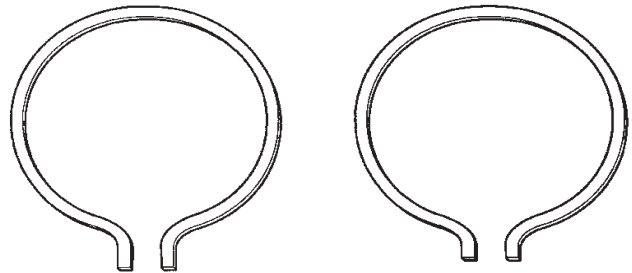
AX4S/AX4N

Redesigned Park System (continued) 2000 Taurus with Build Date After 8/1999

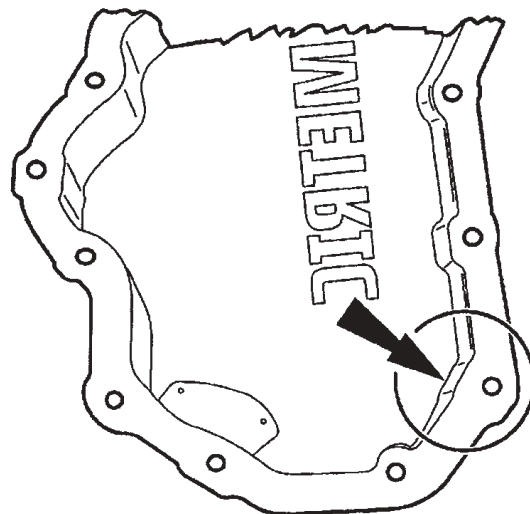


Lube Tube (AX4N only)
YF1Z-7G084-A

N803202S



Old



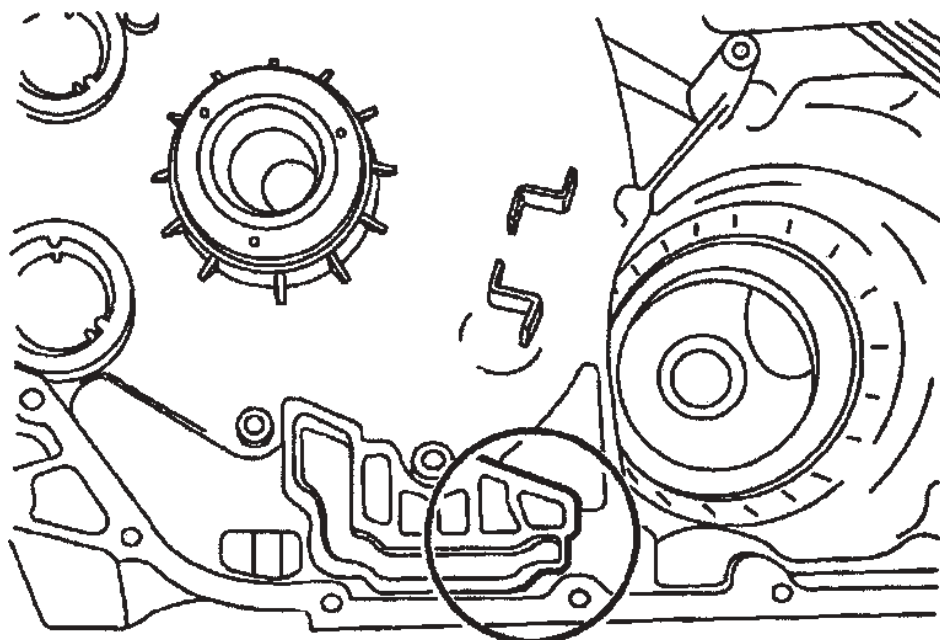
YF1Z-7A194-AA
(AX4N)

New

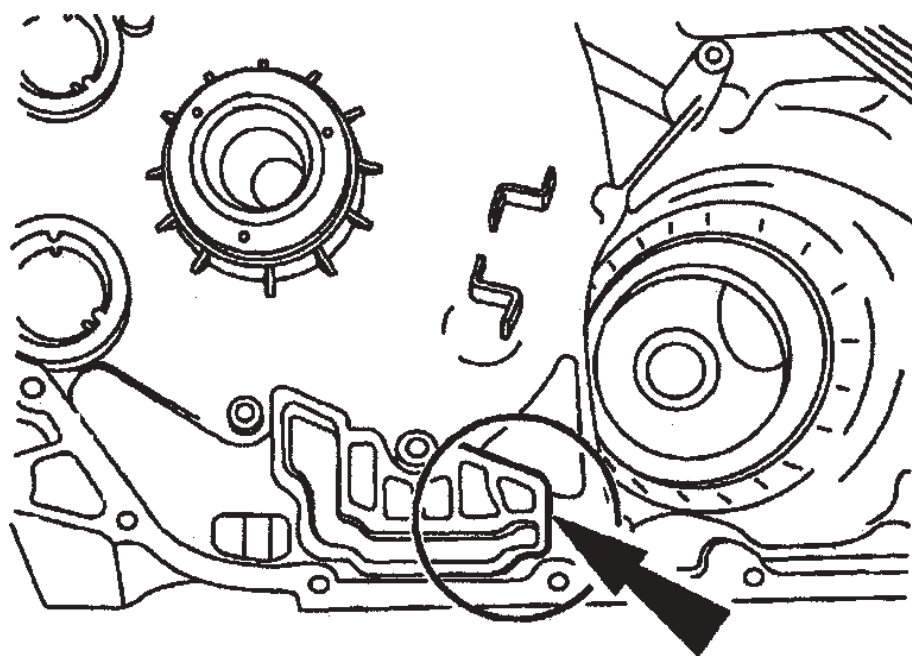
AX4S/AX4N

Redesigned Park System (continued) *2000 Taurus with Build Date After 8/1999*

Case Assembly



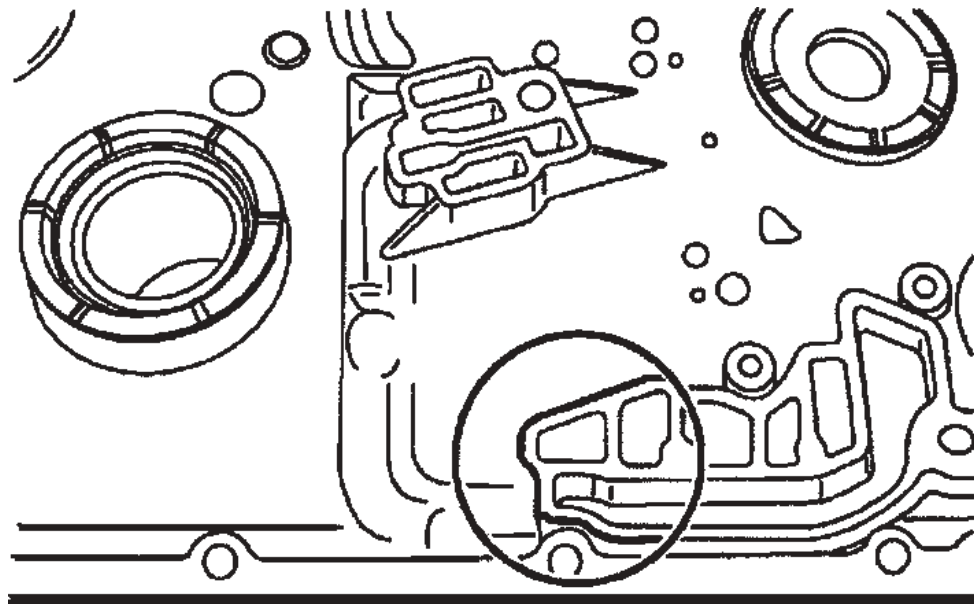
-7005-
(Model Dependant)



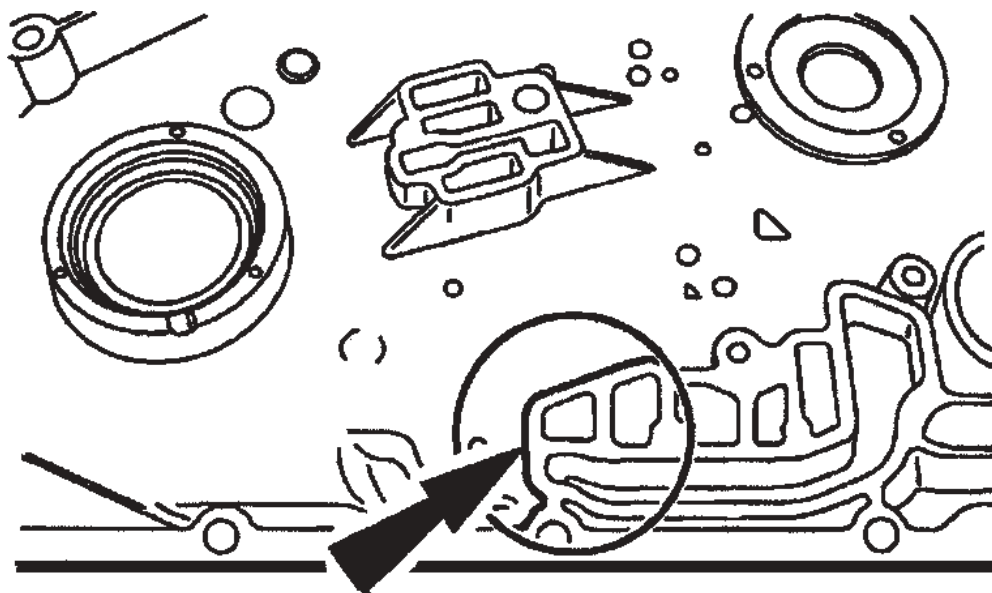
AX4S/AX4N

Redesigned Park System (continued) *2000 Taurus with Build Date After 8/1999*

Channel Casting

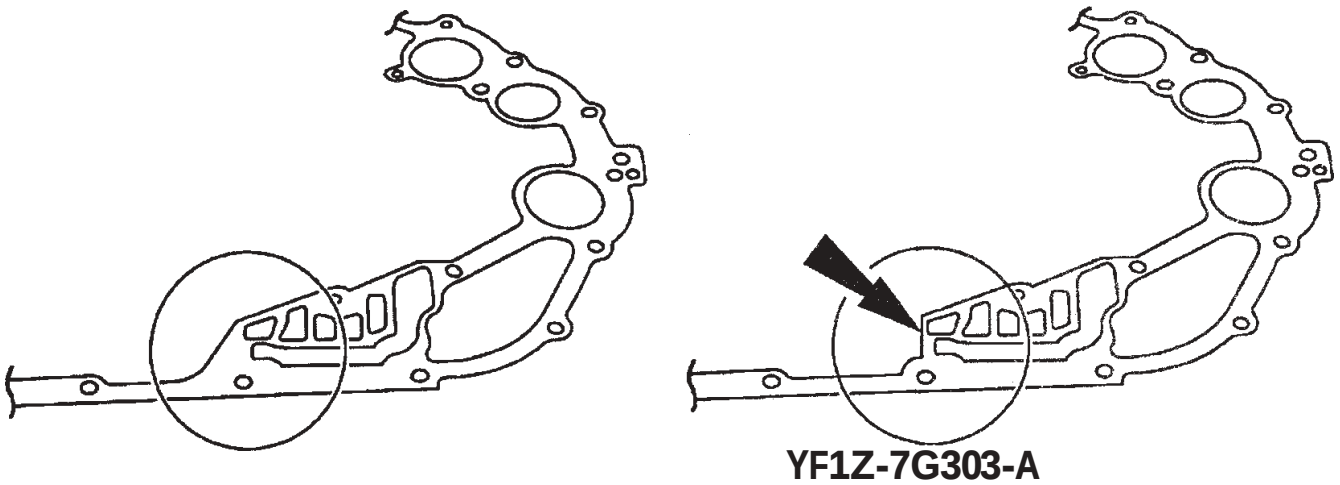


7G188
(Model Dependant)

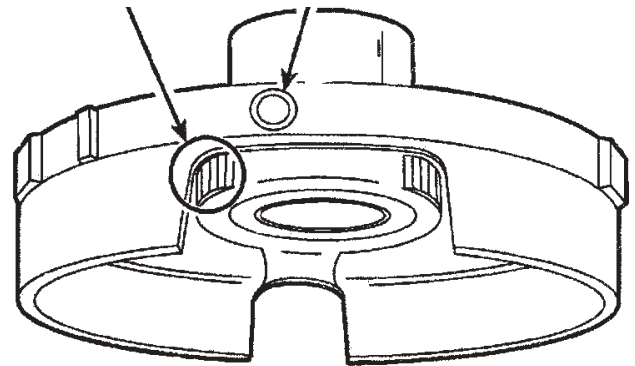
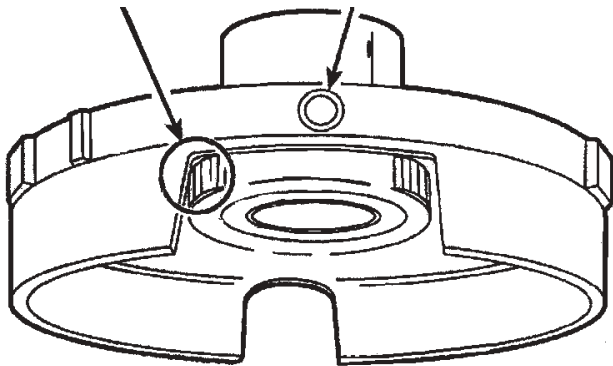


AX4S/AX4N

Redesigned Park System (continued) *2000 Taurus with Build Date After 8/1999*



Note: Match channel plate and gasket to avoid reverse clutch oil lose.

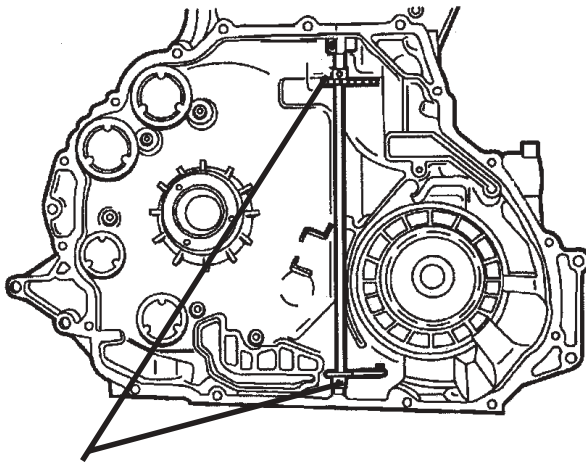


**YF2Z-7A130-AA
(AX4S)**

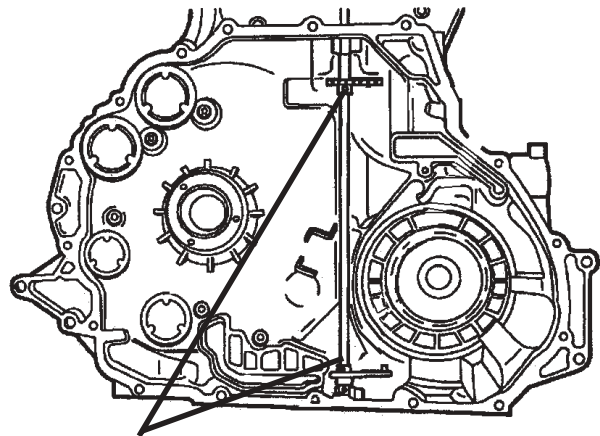
AX4S/AX4N

Redesigned Park System (continued) *2000 Taurus with Build Date After 8/1999*

Old

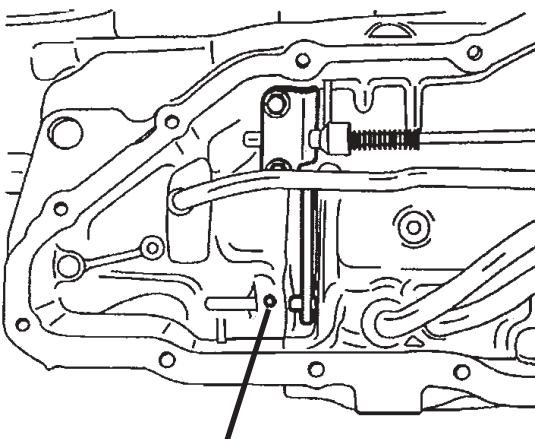


New



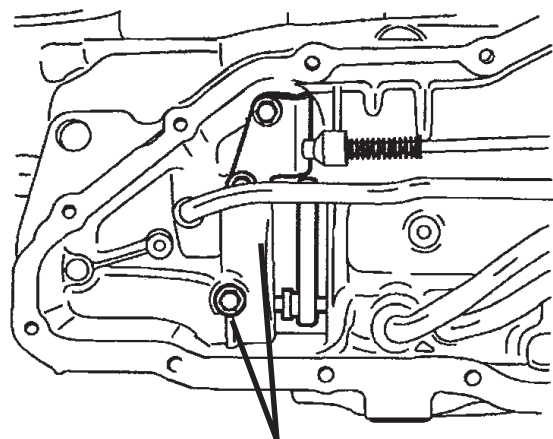
The positions of the roll pins changed

Redesigned plate uses an additional bolt.



Roll pin.

Old



Bolt and Plate assembly.

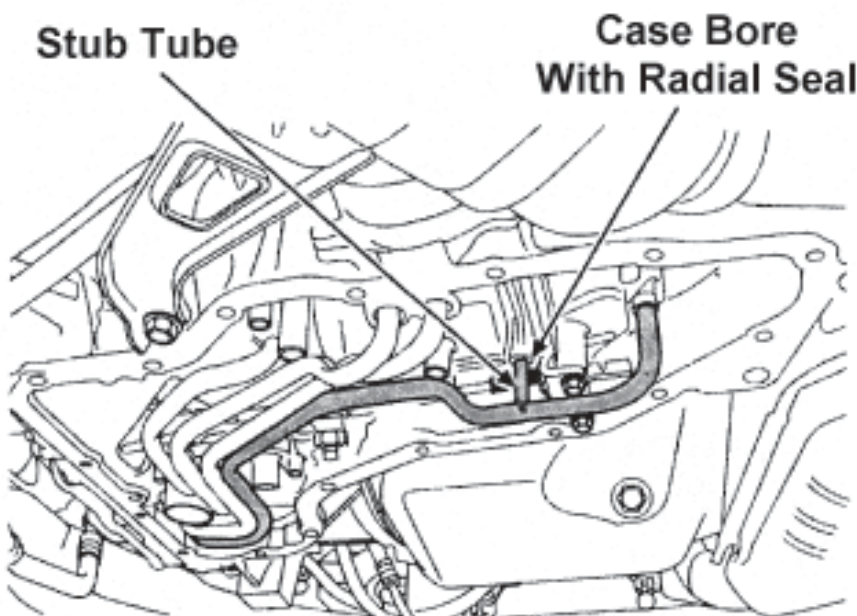
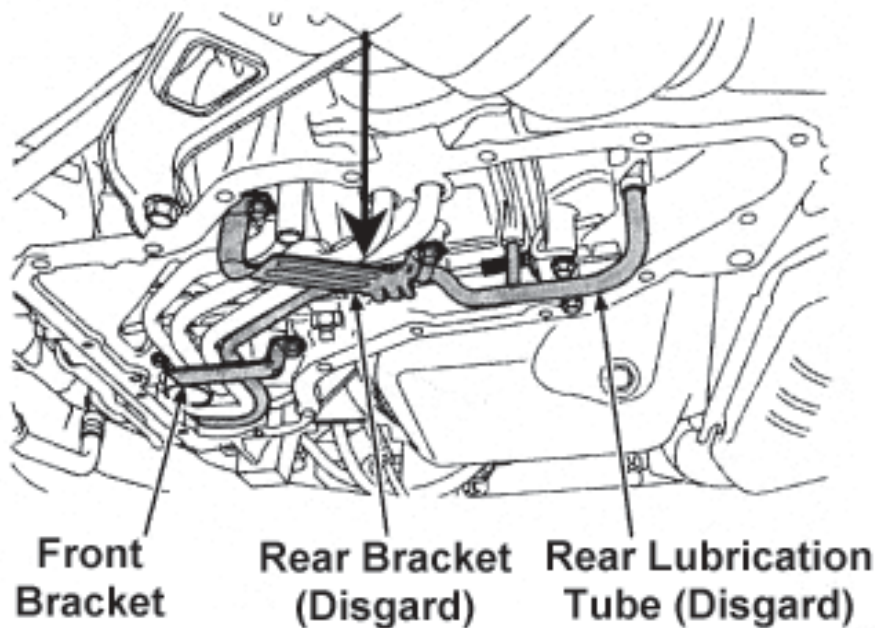
New

AX4S

Rear Lube Tube Cracking

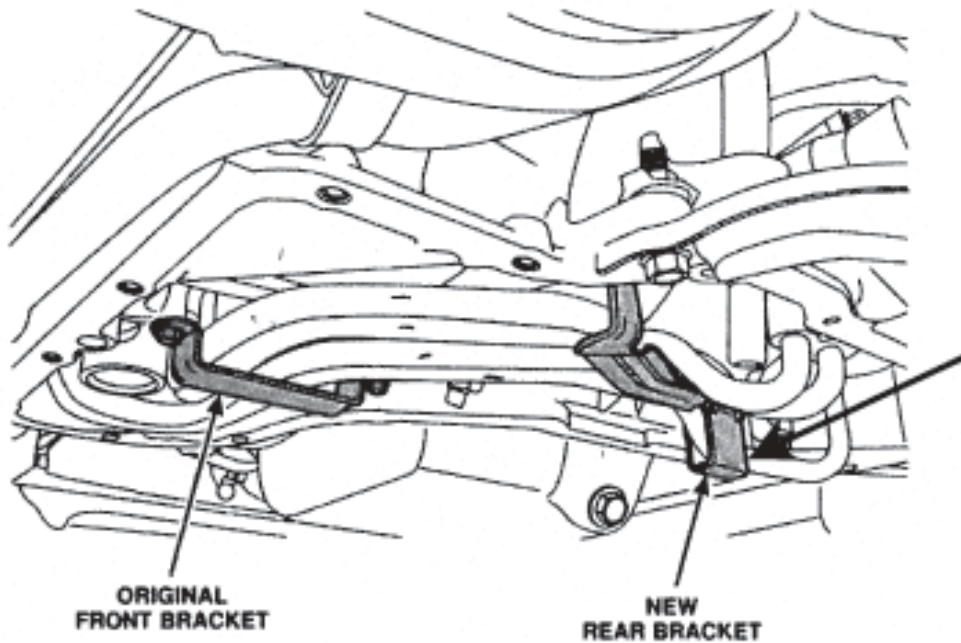
Cause: A loose fit of the tube to the case assembly allowed the tube to vibrate and move, causing it to crack at the stub area.

Repair: Replace with redesigned tube and rear bracket. FORD part number 1F1Z-7G353-AA



AX4S

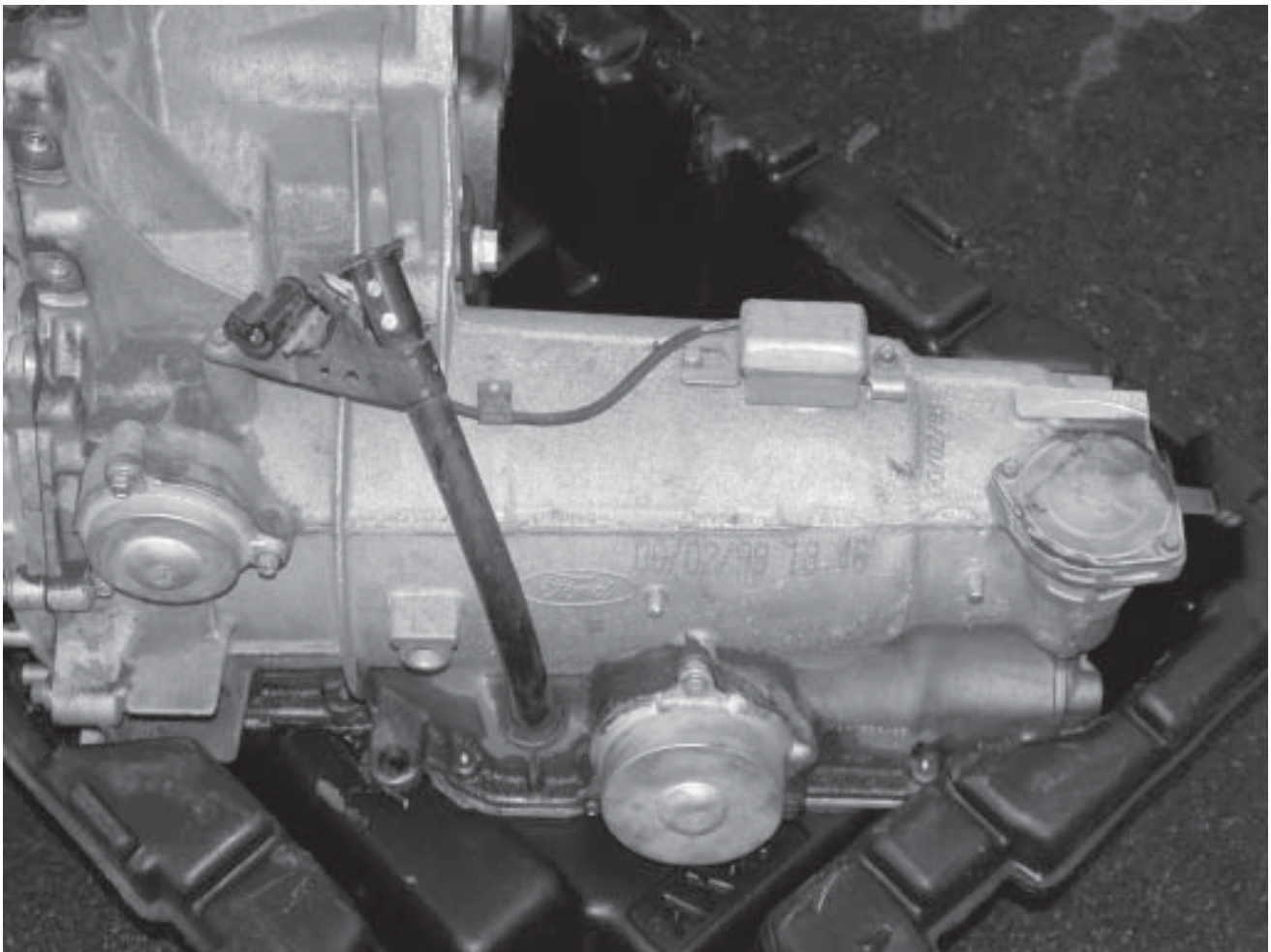
Rear Lube Tube Cracking



AX4S/AX4N

Service Case to Replace Past Models

The case on 2000 and later units with the park upgrade will service past models as complete assemblies.



AX4S/AX4N

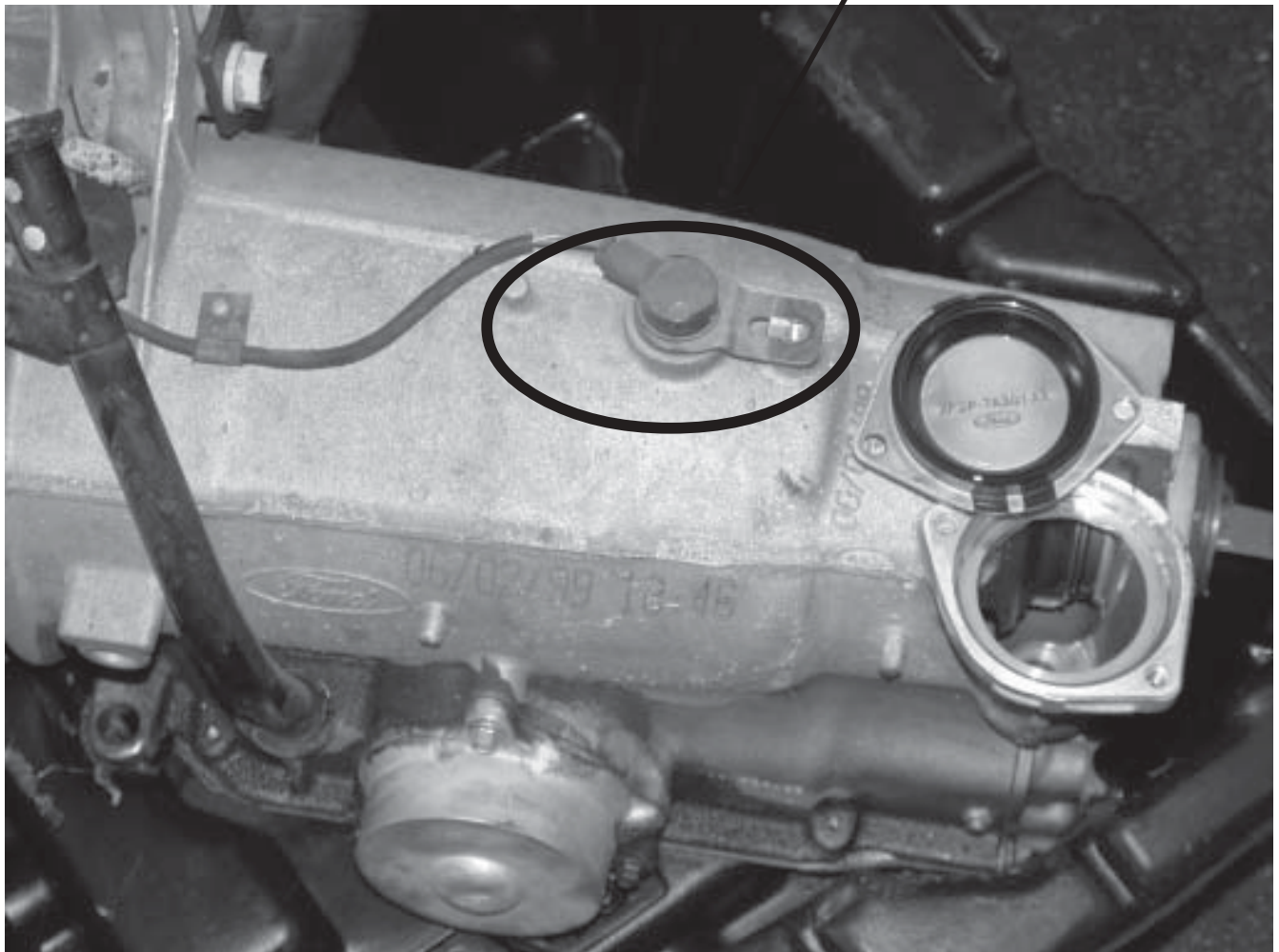
Service Case to Replace Past Models (continued)

AX4S 1991-1999 also needs plug for speed sensor



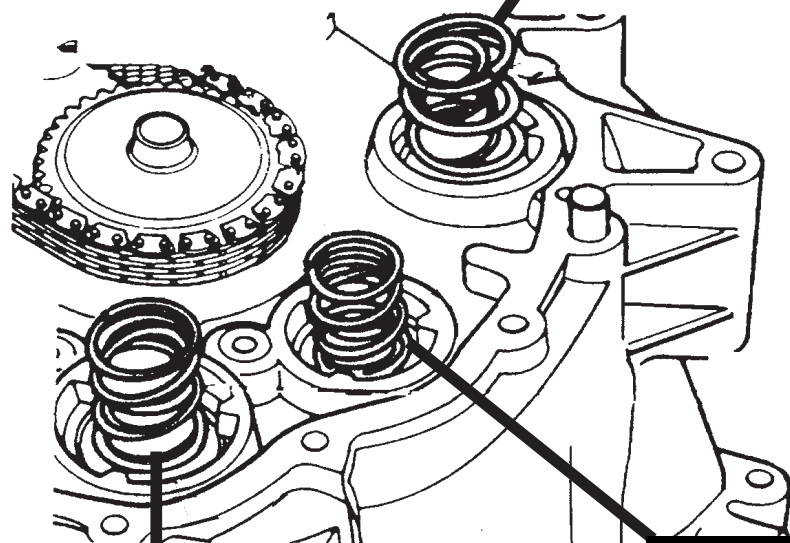
XF2Z-7H398-AB

Replacement
plug goes here



AX4S

Accumulator Spring Changes


AX4S ACCUMULATOR SPRINGS

VEHICLE	N-D ACCUMULATOR	COLOR
ALL MODELS	E6DZ-7G300-A	BLUE
98-02	F8DZ-7G300-BA	GREEN

AX4S ACCUMULATOR SPRINGS

VEHICLE	3-4 ACCUMULATOR	COLOR
91-95	E9DZ-7G266-A	WHITE
95-97	F5DZ-7G266-A	YELLOW
98-02	F8DZ-7G266-AA	YELLOW

AX4S ACCUMULATOR SPRINGS

VEHICLE	1-2 ACCUMULATOR	COLOR
91-95	E6DZ-7G267-A	BROWN
95-02	F58Z-7G326-A	PLAIN

AX4N

Accumulator Spring Changes

AX4N ACCUMULATOR SPRINGS

VEHICLE	1-2 ACCUMULATOR	COLOR
95-02	F5DZ-7G267-A	ORANGE
95-96 SHO ONLY	F6DZ-7G267-A	PURPLE
97-01 SHO ONLY	F7DZ-7D397-AA	PLAIN

AX4N ACCUMULATOR SPRINGS

VEHICLE	2-3 ACCUMULATOR	COLOR
95-02	F5DZ-7F285-A	LT BLUE

AX4N ACCUMULATOR SPRINGS

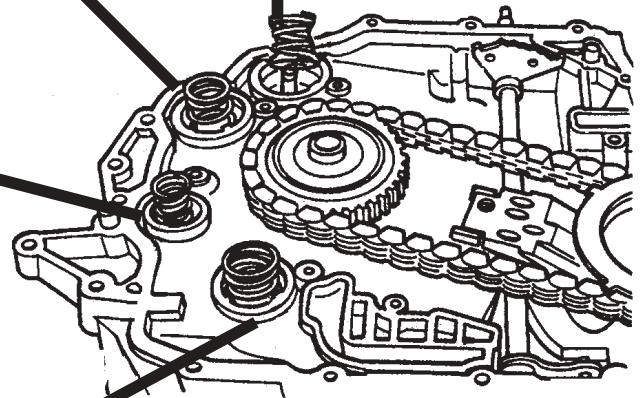
VEHICLE	3-4 ACCUMULATOR	COLOR
95-02	F5DZ-7G266-A	BLUE

AX4N ACCUMULATOR SPRINGS

VEHICLE	R ACCUMULATOR	COLOR
95-97	F5DZ-7E485-A	GREEN
98-02	F8OZ-7E485-BA	YELLOW (INNER)

AX4N ACCUMULATOR SPRINGS

VEHICLE	N-D ACCUMULATOR	COLOR
ALL EXCEPT 94 TAURUS	F5OZ-7G300-A	GREEN (OUTER)
94 TAURUS/SABLE	F4DZ-7G300-A	PLAIN (OUTER)
ALL EXCEPT 94 TAURUS	F5OZ-7G301-A	BROWN



AX4S/AX4N

Accumulator Spring Changes (continued)

AX4S ACCUMULATOR SPRING IDENTIFICATION				
PART NUMBER	COLOR	O.D. DIAMETER	LENGTH	WIRE DIAMETER
1-2 ACCUMULATOR				
E8DZ-7G358-A	PINK (Middle)	1.200"	1.460"	0.099"
E8DZ-7G326-A	PURPLE (Inner)	0.905"	1.620"	0.075"
E8DZ-7G267-A	BROWN (OUTER)	1.575"	1.435"	0.125"
F58Z-7G326-A	PLAIN	1.208"	1.480"	0.105"
3-4 ACCUMULATOR				
E9DZ-7G266-A	WHITE (Outer)	1.175"	1.760"	0.099"
E6DZ-7F288-A	GREEN/WHITE (Inner)	0.875"	1.450"	0.080"
F8DZ-7G266-AA	YELLOW	1.185"	1.770"	0.098"
N-D ACCUMULATOR				
E6DZ-7G301-A	BLUE (Outer)	1.485"	1.790"	0.135"
E6DZ-7D300-A	ORANGE (Inner)	1.020"	1.725"	0.099"
F8DZ-7G300-BA	GREEN	1.475"	1.218"	0.101"

AX4N ACCUMULATOR SPRING IDENTIFICATION				
PART NUMBER	COLOR	OUTSIDE DIAMETER	LENGTH	WIRE DIAMETER
1-2 ACCUMULATOR				
F5DZ-7G267-A	PLAIN	1.324"	1.540"	.112"
F6DZ-7G267-A	PURPLE (SHO ONLY)	1.510"	1.390"	.120"
2-3 ACCUMULATOR				
F5DZ-7F285-A	ORANGE/BLUE	1.300"	1.225"	.110"
3-4 ACCUMULATOR				
F5DZ-7G266-A	BLUE	1.312"	1.482"	.112"
REV. ACCUMULATOR				
F5DZ-7E485-A	GREEN	0.965"	1.405"	0.091"
F8OZ-7E485-BA	YELLOW	0.960"	1.405"	0.091"
N-D ACCUMULATOR				
F5OZ-7G300-A ALL EXCEPT 94 TAURUS/SABLE	GREEN (OUTER)	1.475"	1.218"	0.101"
F4DZ-7G300-A 94 TAURUS/SABLE	PLAIN (OUTER)	1.369"	1.218"	0.091"
F5OZ-7G301-A ALL EXCEPT 94 TAURUS/SABLE	BROWN (INNER)	1.172"	1.218"	0.083"

AX4S

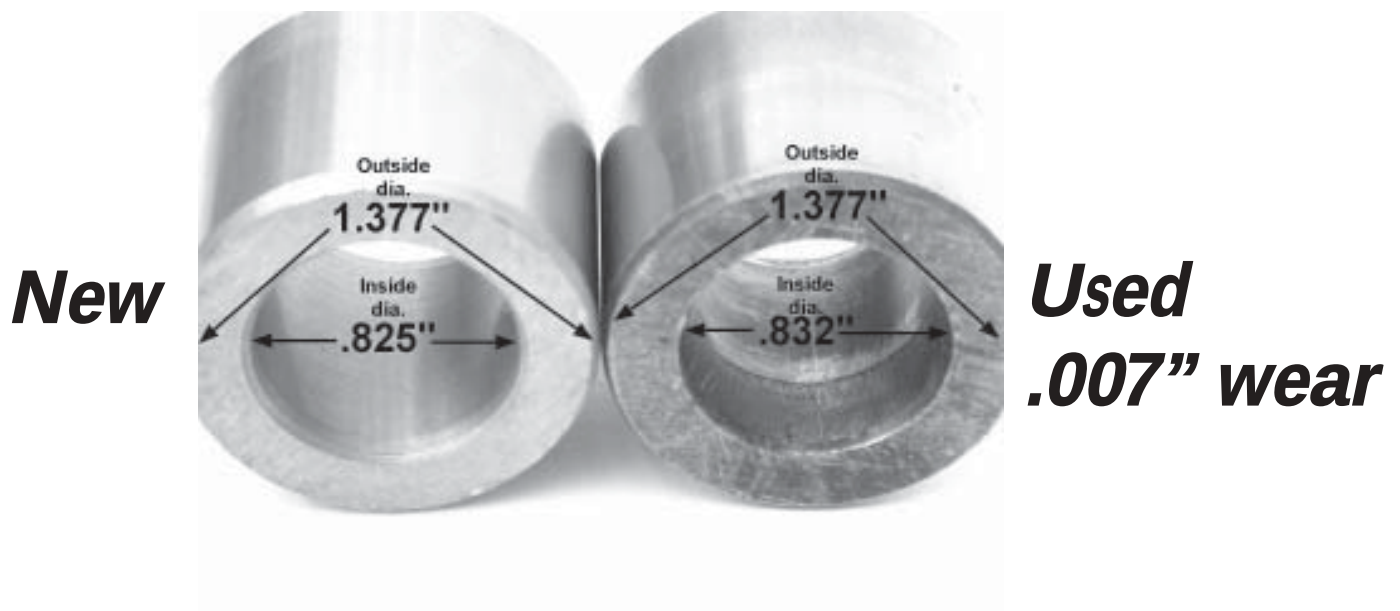
3.8L Torque Converter Pilot Bushing Wear

Concern: When a replacement transmission or engine is necessary make sure to visually check the torque converter pilot bushing in the crankshaft for excessive wear.

Note: All 3.8L require this bushing.

Cause: Pilot bushing in the crankshaft worn, allowing the torque converter to run off center.

Repair: Replace the bushing and check the run out.



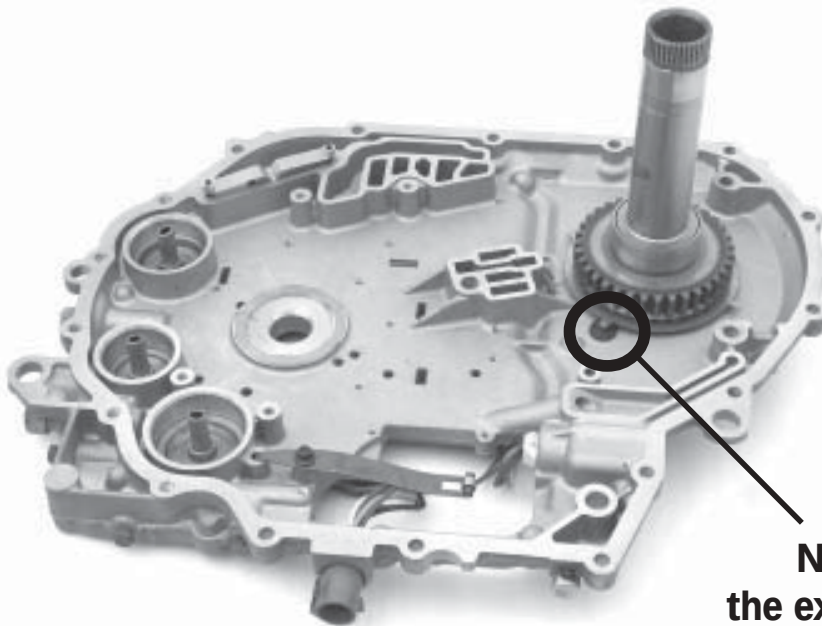
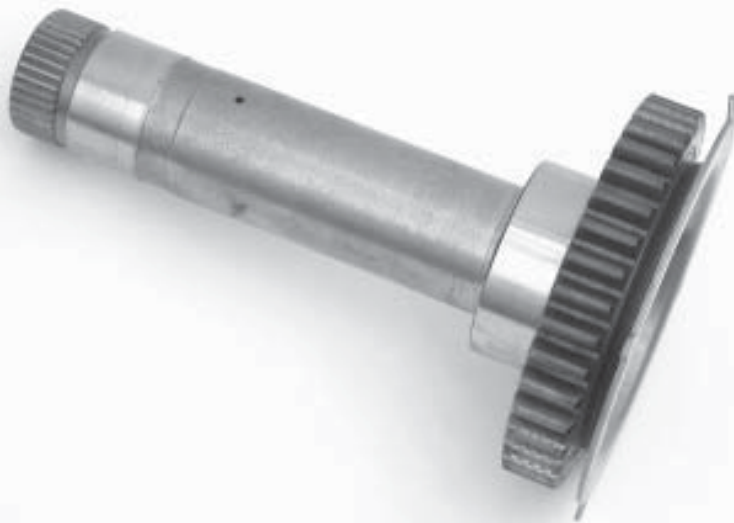
AX4S/AX4N

TSS Exciter Wheel Bent

Concern: Damage to the exciter ring on the driven sprocket, (primarily on 1996-1997 model years).

Common Cause: The exciter ring may cause the PCM to control line pressure higher than normal.

Repair: Straighten or replace sprocket.



NOTE: Measurement from the exciter ring to the tip of the sensor is .050"-.055".

4R44E/5R55E

New Direct Drum

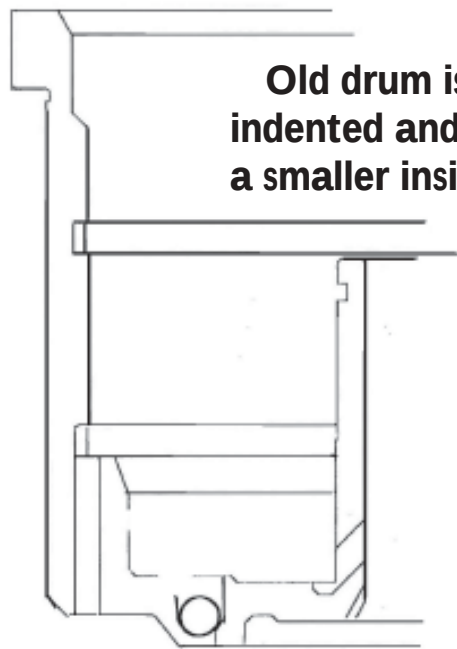
As of 1999 a new direct drum was available for the 4R44E/5R55E. This drum will interchange as an assembly. **Do not MIX old parts and NEW parts! (Piston, Retainer, Etc.)**

Old Drum

97GT-7D044-A1E/A2E/A2F

Match with Case numbers

97GT-7D014-GA/HA/KA/LA



Old drum is not
indented and requires
a smaller inside diameter bearing

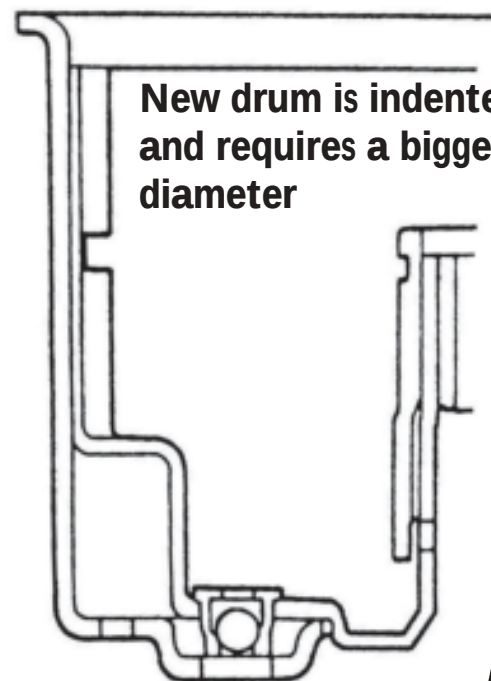
Old

New Drum

XL2P-7D044-AA/CB/DB

Match with Case numbers

XW4P-7F374-CA/DA/EA/FA



New drum is indented
and requires a bigger inside
diameter

New

4R44E/55E and 5R44E/55E

TCC Concerns

How to Test the system

The easiest way to test the TCC circuit is to know what's happening when the computer is ready to apply the TCC. Once all parameters are met, and the computer is ready to apply the TCC, the TCC solenoid is energized by the computer. Hydraulically, the line pressure is supplied to the coast clutch regulator valve. The coast clutch regulator valve charges the TCC solenoid and now the TCC solenoid pulses the TCC regulator valve to apply the torque converter clutch. To determine whether or not the converter, solenoid or both are causing the problem simply energize the TCC in the stall on the lift, or stationary. This test is simply checking the integrity of the converter and the circuit.

If the engine Stalls: The converter is capable of locking-up and the valves definitely moved and the problem may be in the regulation of the valves and the performance of the PWM circuit.

If the engine doesn't Stall: The first thing to check is the solenoid if the solenoid is working then the TCC charge has a leak in the system. This leak can be in a number of different areas.

Using your scan tool, locate the parameter that says TCC% and TCCAMACT or TCC RPM on your data screen. These parameters will give you a quick look at the system. TCC% is the amount of duty cycle the computer is commanding the TCC solenoid to pulse, usually this parameter runs between 90% and 100% on your scanner. TCCAMACT is the amount of slip RPM the computer is detecting.

GOOD Reading:

TCC %	Varying between 90% and 100%
TCCAMACT	Varying between 0-10 RPM

BAD Reading:

TCC %	Varying between 90% and 100%
TCCAMCAT	Varying higher then 10 RPM and as high as 200 RPM

4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Torque converter concerns on 4R44E/4R55E/5R55E have been a constant concern. In recent years there have been a number of concerns related to torque converter apply as well as No cooler flow, Harsh TCC and Soft TCC engagement, No Lock-up or loss of TCC when hot. Diagnosing torque converter problems can be troublesome. The following pages have tips you can use to determine the fix.

Here are the common codes you will get:

Codes	Discriptions
628:	Torque Converter Clutch Slip or Error
P0740:	Torque Converter Clutch System Problem
P0741:	Torque Converter Clutch System Performance or Stuck Off
P0742:	Torque Converter Clutch System Stuck Off
P0743:	Torque Converter Clutch System Electrical
P1740:	Torque Converter Clutch Malfunction
P1741:	Torque Converter Clutch Control Error
P1742:	Torque Converter Clutch Solenoid Failed On, MIL Lamp On
P1743:	Torque Converter Clutch Solenoid Failed On, TCIL Lamp ON
P1744:	Torque Converter Clutch Mechanical Noise or Stuck in Off Position

4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Damaged TCC Solenoid

Concern: A no TCC apply on 1995 through 1998 with a flashing overdrive light, DTC 628, P0741, P1740 or P1744.

Common Cause: TCC solenoid (there were certain TCC solenoids that were poorly designed and the result was the tip blowing out and the brackets were cracking).

Repair: Replace solenoid.

Note: *Make sure not to reuse lot numbers between 769 and 771, these solenoids are defective.*

**Check the
crimped area for
cracks.**



Lot number location



4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Torque Converter Clutch Failure

Slip codes are very common. Make sure to diagnose converter codes correctly before replacing converter.

Concern: No converter clutch apply.

Common Cause: Torque converter lining burnt or flaked off.

Repair: Replace converter.



4R44E/55E and 5R44E/55E

TCC Concerns (continued)

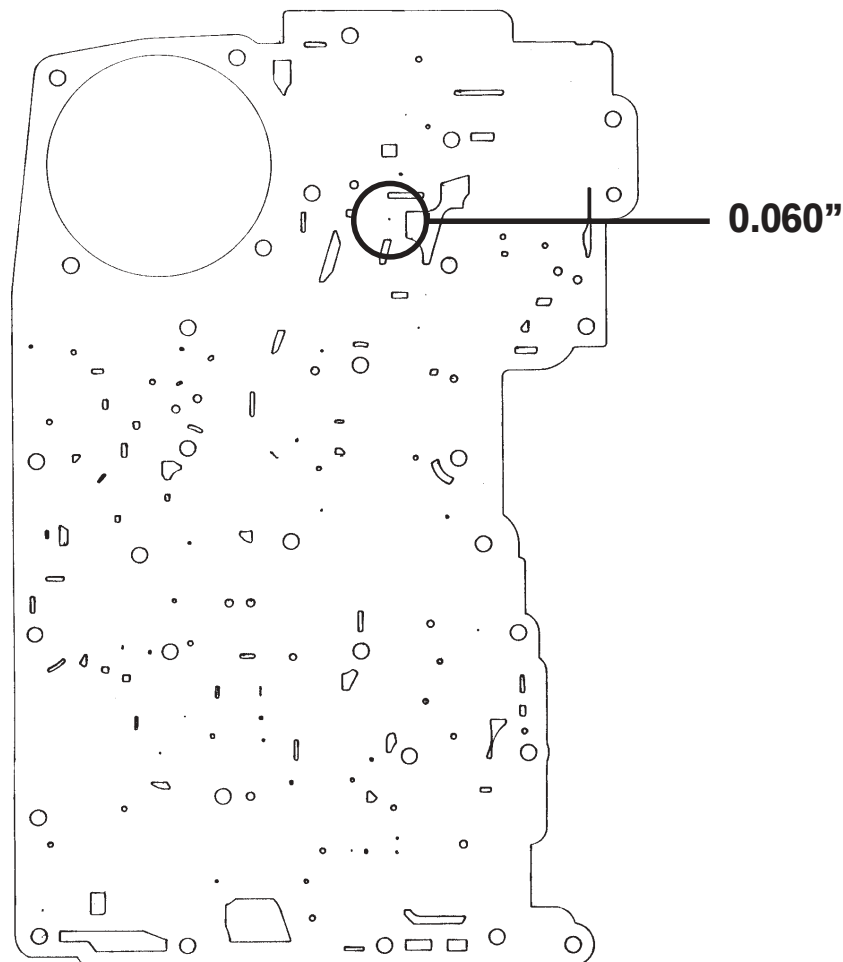
Separator Plate Feed Hole Modification

Modify the Separator plate to increase cooler flow. Cooler flow should be a minimum of 1 quart in 20 seconds. Make sure line pressure is within specification, high line pressures can cause low cooler flow.

Concern: TCC slip, or insufficient cooler flow.

Common Cause: The separator plate may have the wrong size feed holes. The converter feed holes are normally between 0.032" and 0.048".

Repair: Drill the converter feed hole in the separator plate to 0.060" for increased cooler flow.



4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Butt-cut Seal Damaged

Concern: Slip or no TCC apply.

Common Cause: Seal broken or stator shaft worn or cracked.

Repair: Replace seal and check stator support for shaft wear or cracking around the seal area. If crack is evident replace stator.

Check seal for damage.



4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Inner Pump Gear Seal Damaged

Concern: TCC slip

Common Cause: Installing A4LD pump gears that don't have an O-ring, or correct pump gear inner O-ring damaged or missing. This will allow converter charge oil to leak into the converter bushing lube or drain back passage creating low converter charge.

Repair: Install correct pump gears and O-ring. Inspect converter hub and lubricate prior to installation.

NOTE: Must have gear with o-ring.

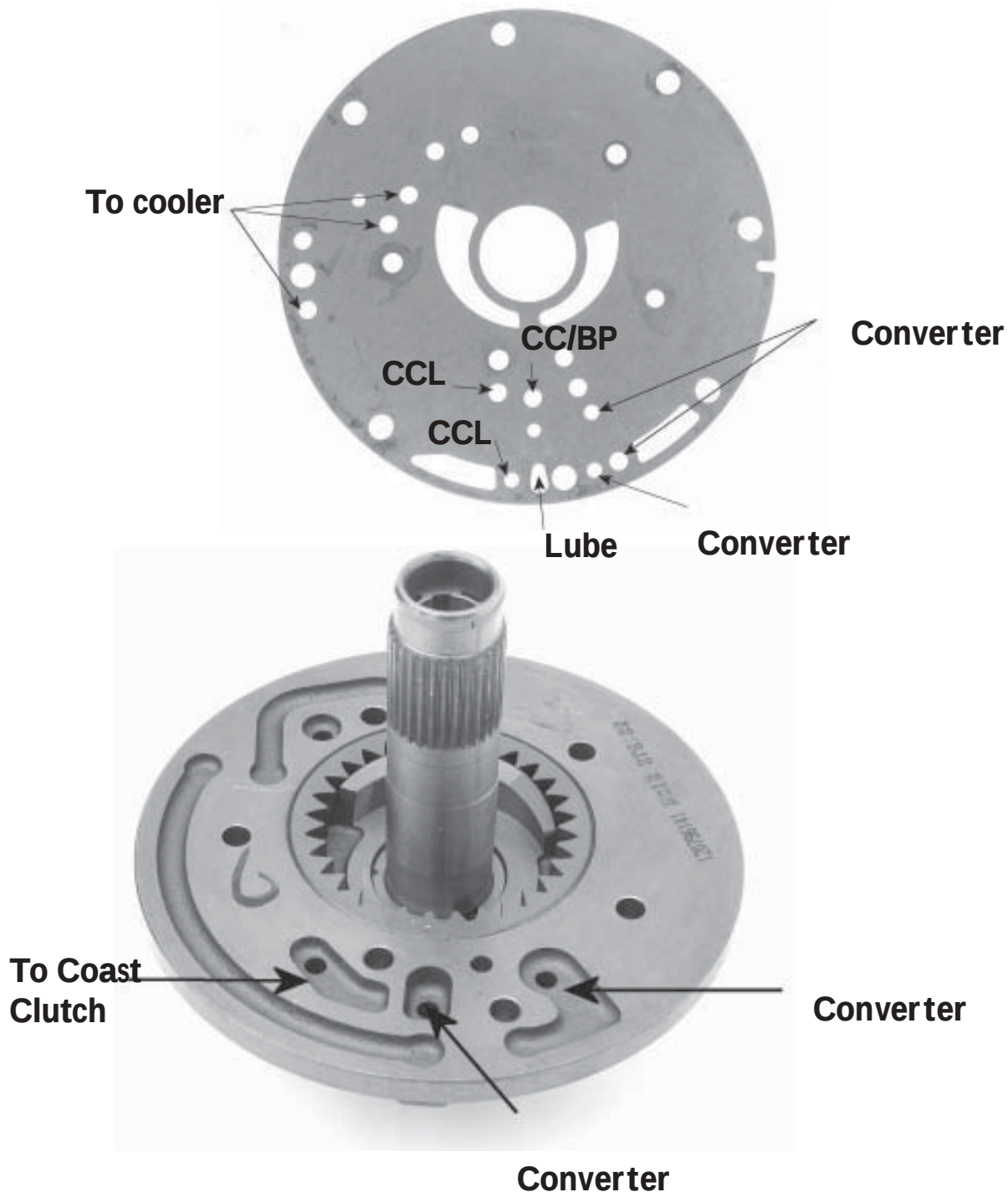


4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Pump and Spacer Plate Damage

Always inspect Pump assembly for damage, note any wear marks or warping and replace if necessary.



4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Valve Body Damage

The valve body can cause many different TCC related problems. There are a number of valves involved:

- Torque Converter Regulator Valve
- Torque Converter Modulator Valve
- Coast Clutch Shift Valve
- Thermostatic Bypass Valve
- Converter Relief Valve

Anyone of these valves can cause a TCC failure.

Concern: Slip or No TCC apply.

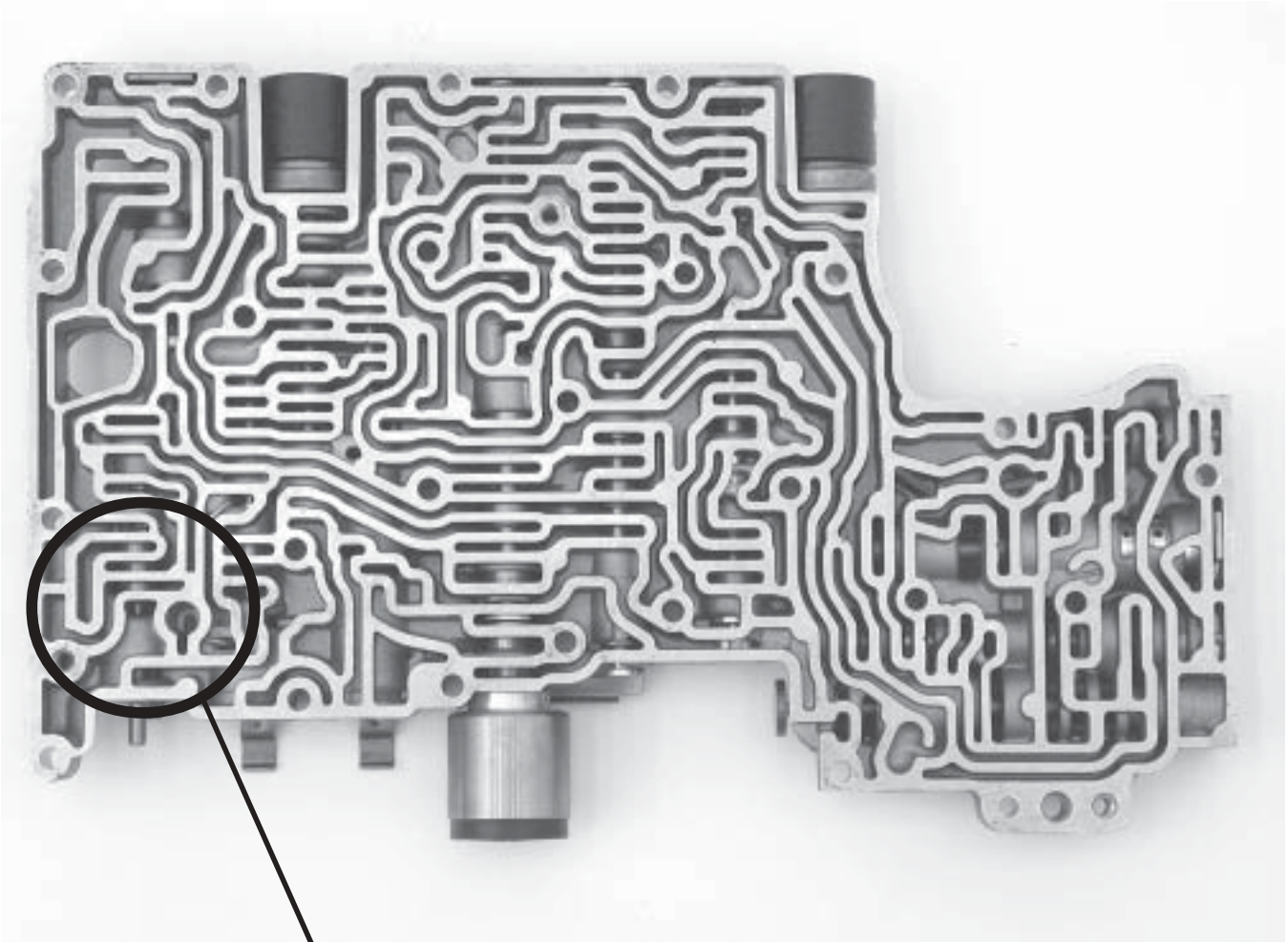
Common Cause: Wear in the Valve Body.

Repair: Repair or Replace Valve Body.

4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Valve Body Damage

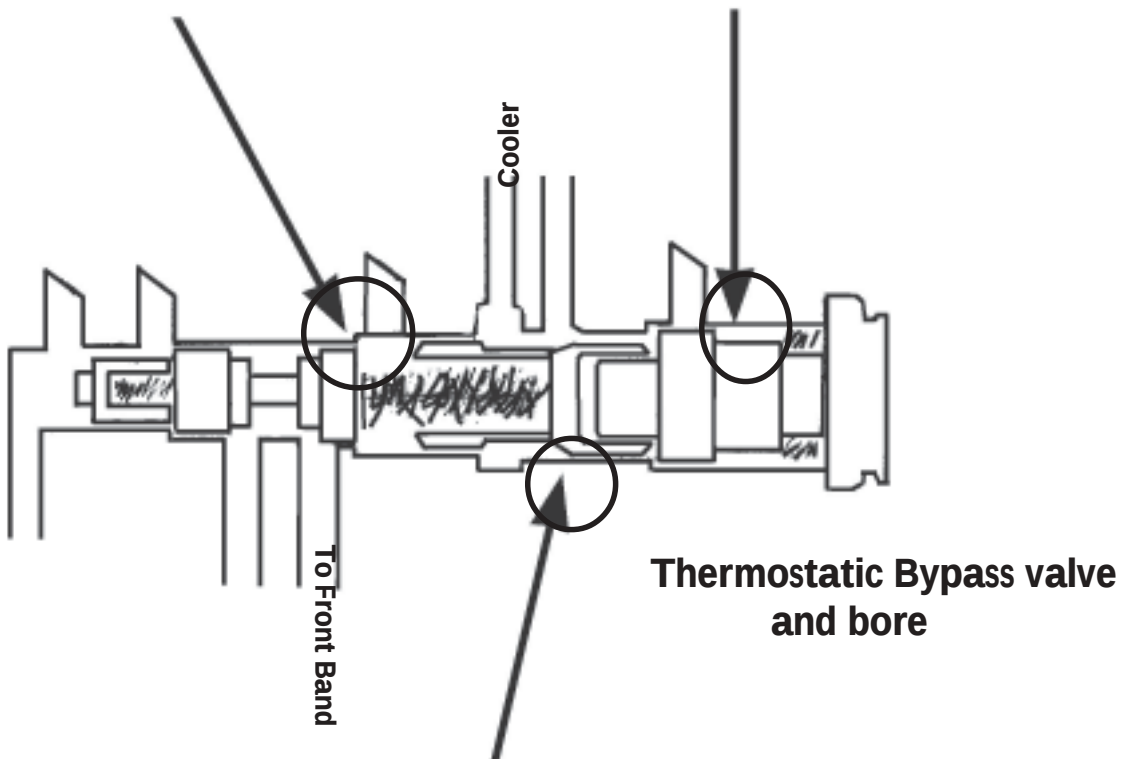
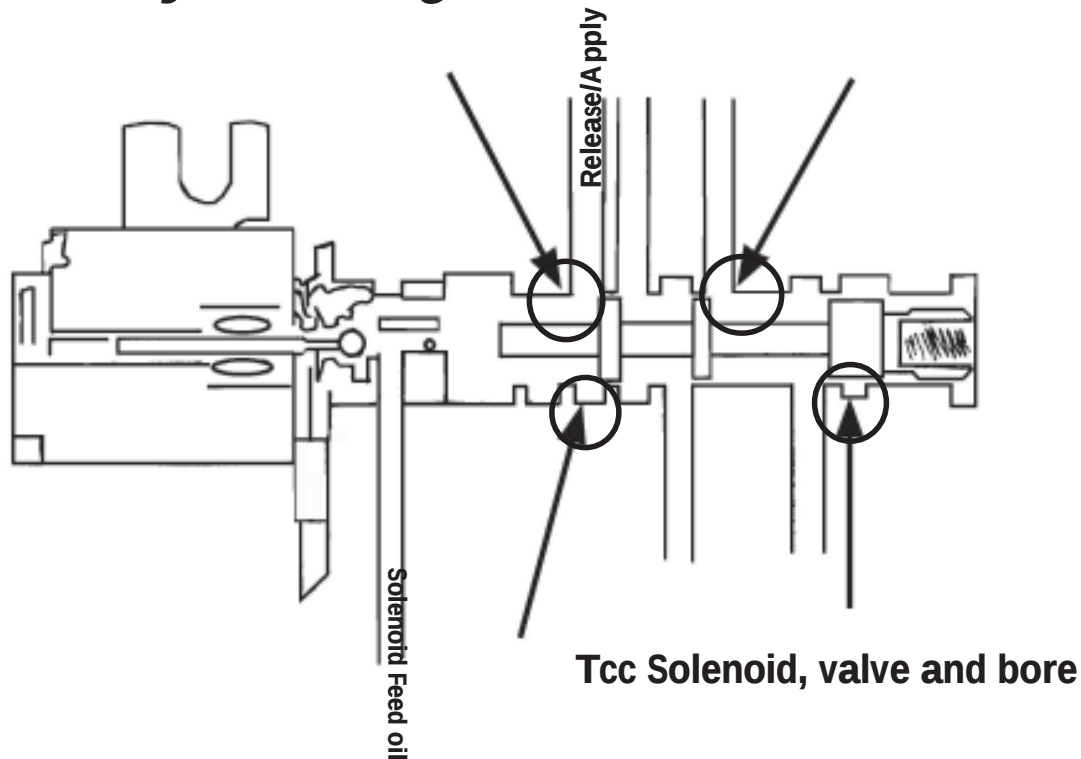


Always check valve body surface for warping

4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Valve Body Damage

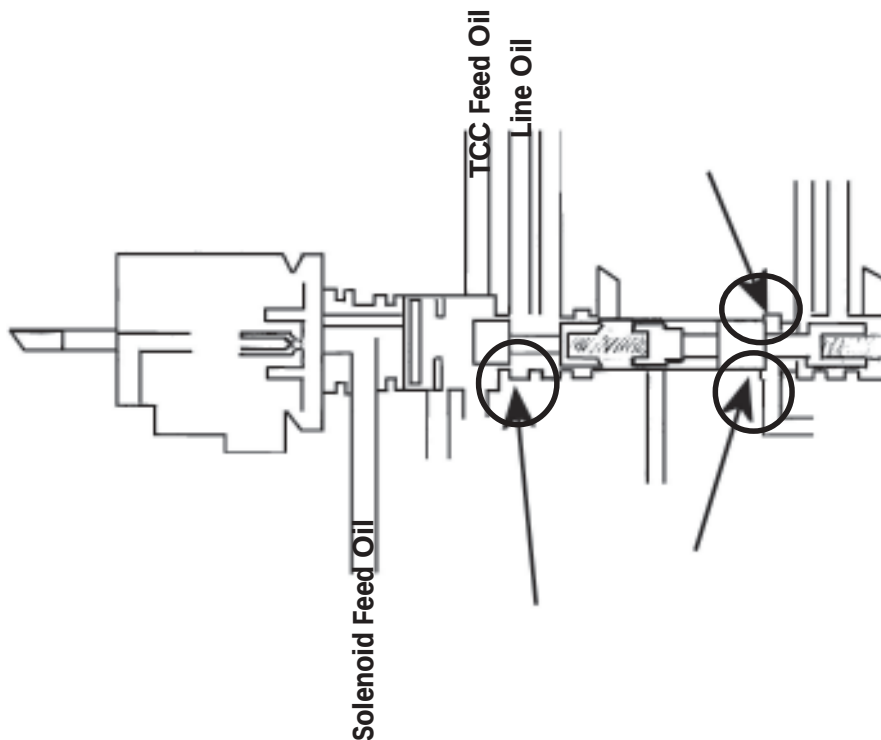


4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Valve Body Damage

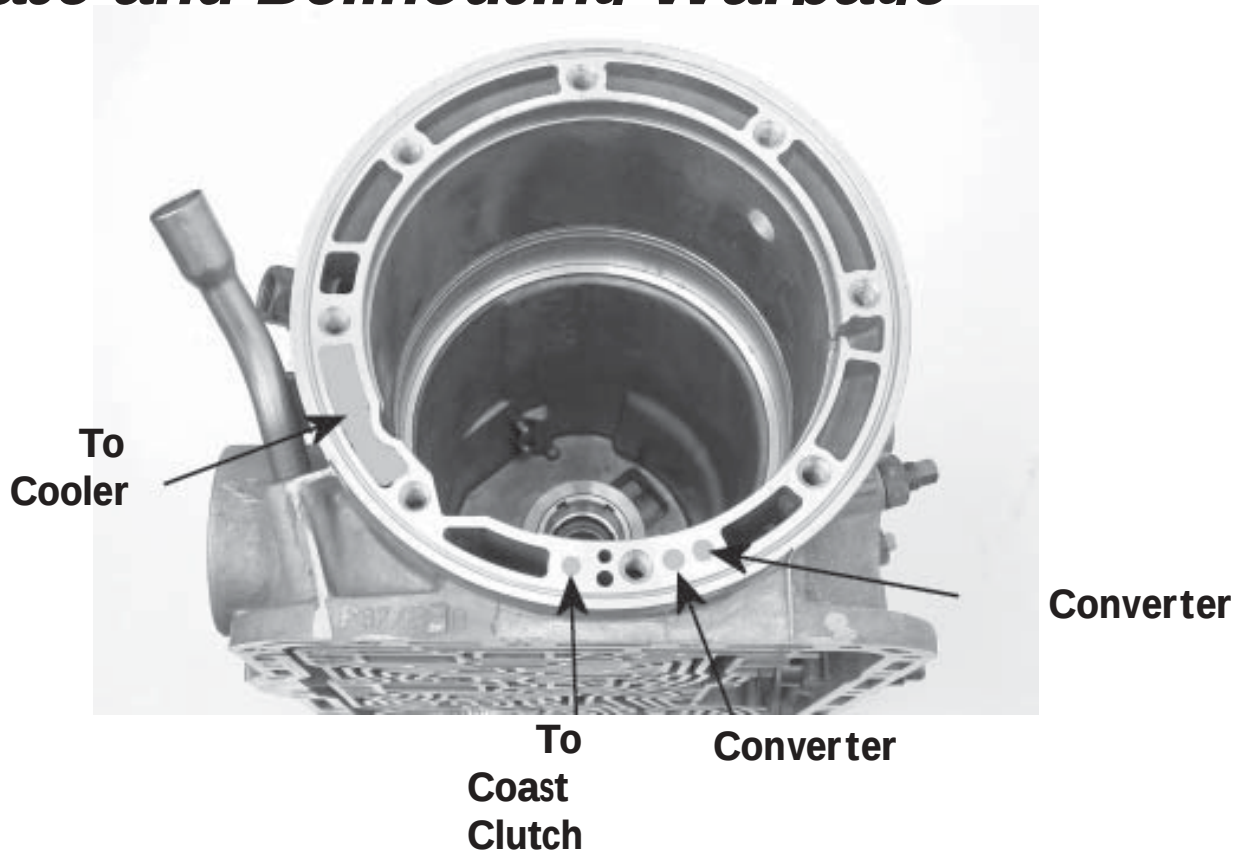
Coast Clutch Regulator Valve and Bore



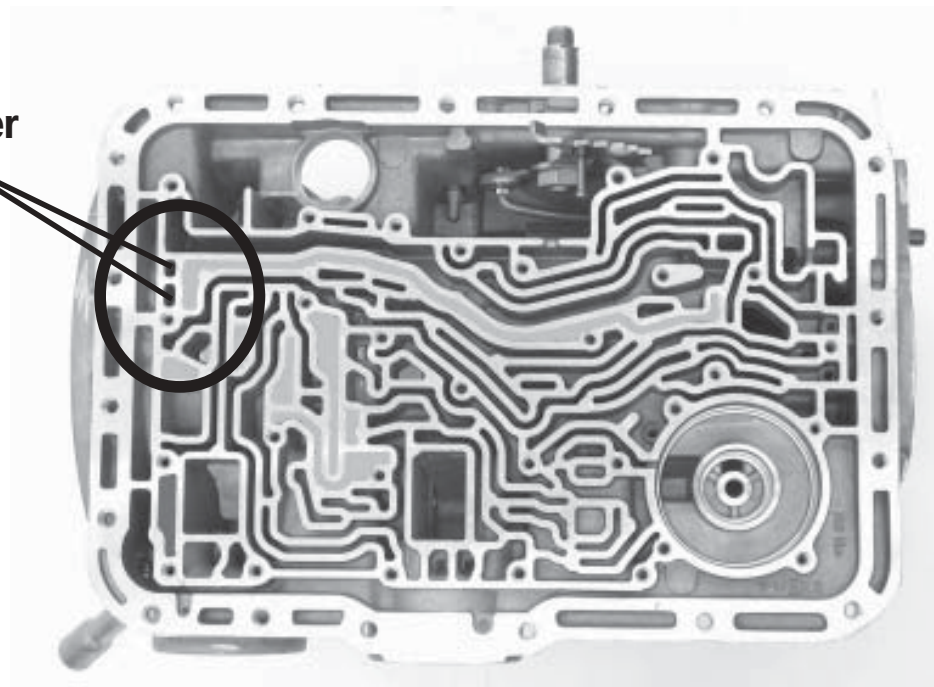
4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Case and Bellhousing Warpage



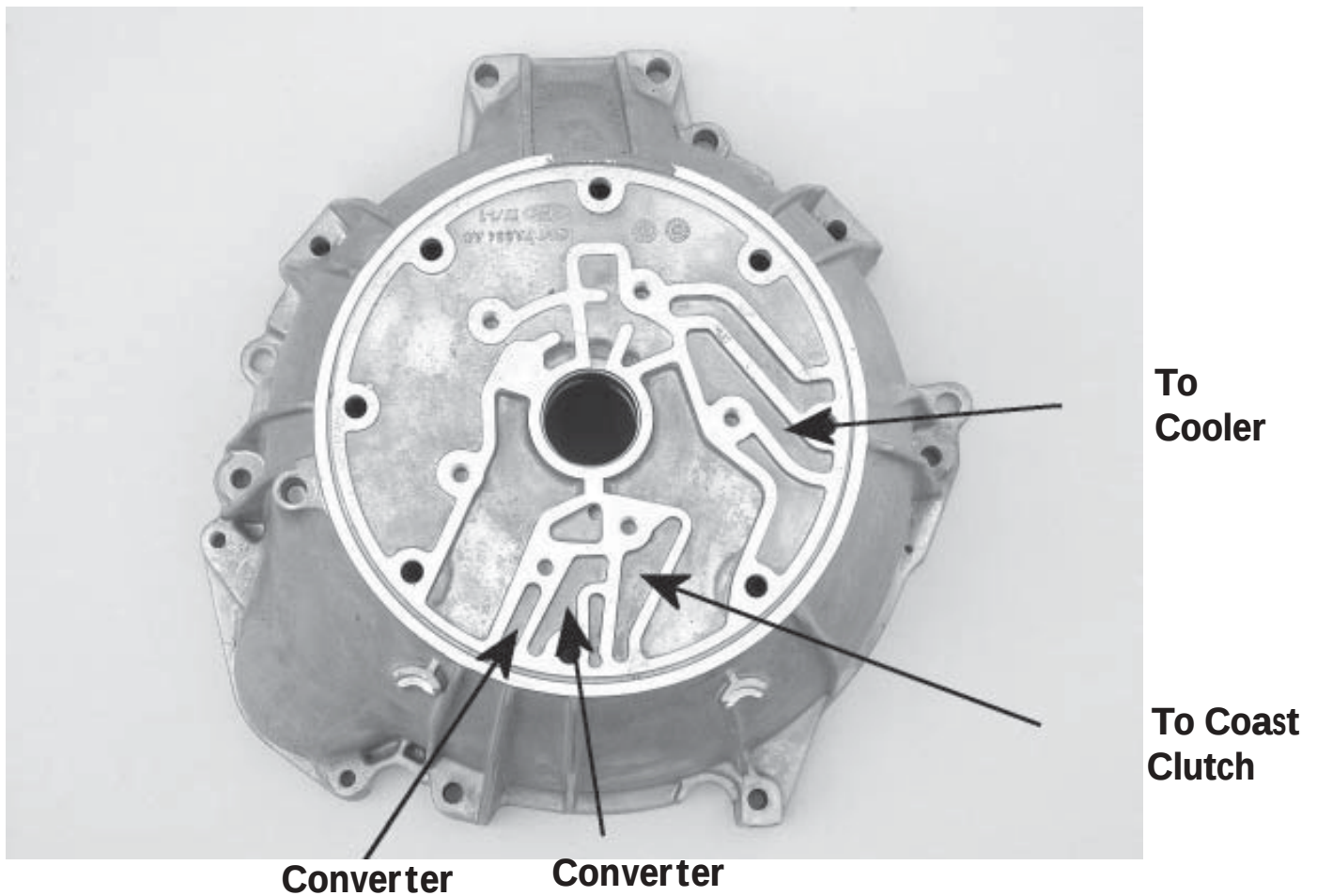
To Converter



4R44E/55E and 5R44E/55E

TCC Concerns (continued)

Case and Bellhousing Warpage



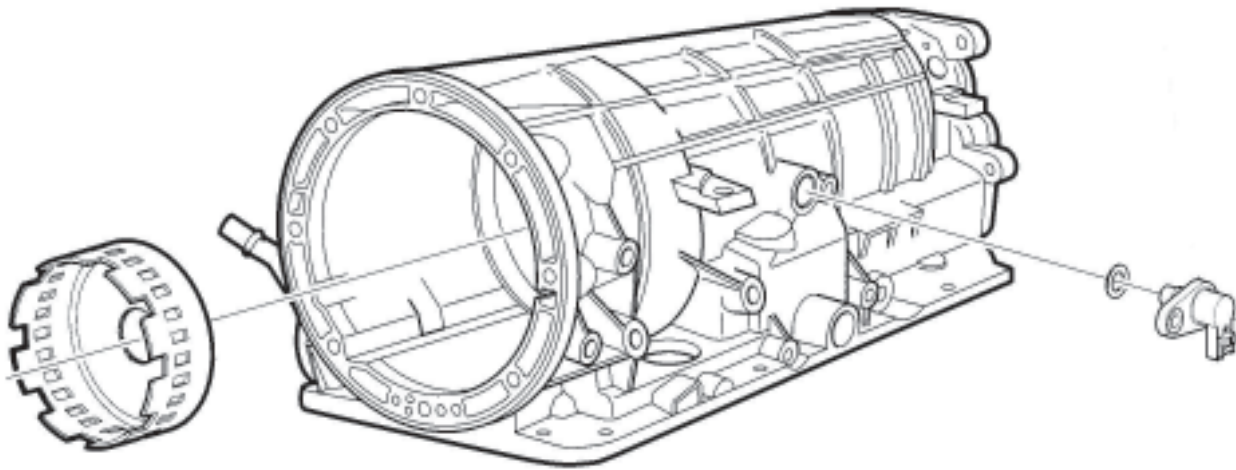
5R44E/ 5R55E

New Upgrades for 2001-On

The 5R44E is a new transmission that will replace the 4R44E. Some of the parts upgrades consist of:

- New Intermediate Shaft Speed (ISS) sensor for 5R44E/5R55E
- New Case, to accept the ISS Sensor
- New input shell trigger point for the ISS Sensor.

Note: New Input Shell may be use to service 97-On



5R44E/ 5R55E

Shift and Stall Speed chart for 2001

Shifts @ Vehicle Speed (MPH)*
5R44E / 5R55E (2001 Only)

Position	OD Position, Shift	Vehicle Speed
Closed	5-4	34 to 50 mph
	4-3	-
	3-2	-
	2-1	10 to 13 mph
Minium TP Voltage = 1.25V	1-2	10 to 22 mph
	2-3	13 to 24 mph
	3-4	18 to 28 mph
	4-5	28 to 60 mph
	5-4	25 to 36 mph
	4-3	10 to 20 mph
	3-2	-
	2-1	9 to 12 mph
Wide Open	1-2	37 to 46 mph
	2-3	55 to 69 mph
	3-4	69 to 82 mph
	4-5	95 to 116 mph
	5-4	85 to 114 mph
	4-3	64 to 78 mph
	3-2	45 to 61 mph
	2-1	30 to 37 mph
* Range covers all OEM axle ratios and tire sizes. Always drive vehicle safely according to traffic conditions and obey all traffic laws.		

Stall Speed Specifications 5R44E / 5R55E (2001 Only)

Trans.	Vehicle	Engine	RPM Range
5R44E	Ranger	2.3L	2621-3050
	Ranger	3.0L	2833-3384
5R55E	Ranger	4.0L SOHC	2557-3032
	Explorer Sport	4.0L SOHC	2557-3036
	Explorer Sport Trac	4.0L SOHC	2557-3036

5R44E/ 5R55E***Pressure Specification for 2001***

Trans.	Application	Range	Idle@ 1000 rpm Pressures, psi		WOT Stall Pressures, psi	
			EPC	Line	EPC	Line
5R44E	2.3L Ranger 4x2	R	40-50	145-190	112-134	282-350
		N	20-40	75-120		
		OD, 2, 1	20-40	75-120	112-134	228-263
	3.0L Ranger	R	45-55	150-195	112-134	282-350
		N	20-40	75-120		
		OD, 2, 1	20-40	75-120	112-134	228-263
5R55E	4.0L SOHC Ranger	R	65-75	215-235	112-134	282-350
	4.0L SOHC Explorer Sport	N	20-40	75-120		
	4.0L SOHC Explorer Sport Trac	OD, 2, 1	35-50	110-145	112-134	228-263

5R44E/55E, 5R55N/55W

Shift Concerns With Adaptive Shift Strategy

Adaptive shift strategy, although fairly new to Ford, has been around for quite sometime now. The new 2001 5R44E/55E and 5R55N/55W are equipped with the adaptive strategy and it is important to understand the conditions needed for proper shift timing. The Adaptive Strategy is also used for adjusting the pressure control system. When power is lost to the Powertrain Control Module (PCM) the transmission shifts are affected, and may cause damage if precautions are not taken.

The reasons for shift adaptive electronic pressure control strategy:

- Better control over shift events.
- Maintain high mileage durability.
- Reduce unit variation from vehicle to vehicle.
- Provide consistent shift feel over the life of the vehicle.

Reasons for loss of power to the PCM:

- Vehicle battery disconnected or battery drain.
- An updated calibration installed to the Powertrain Control Module.
- Keep Alive Power lost to the Powertrain Control Module while the battery is still connected. (Bad Relay, Fuse, Wiring, PCM)

5R44E/55E, 5R55N/55W

Shift Concerns With Adaptive Shift Strategy (continued)

The inputs that directly affect the transmissions capability to shift correctly and maintain smooth shifting sequences are:

Inputs:

- Mass air flow sensor (MAF)
- Engine speed (RPM)
- Turbine speed (TSS)
- Intermediate speed (ISS)
- Vehicle speed/output speed (VSS/OSS)

Conditions needed to adapt:

- Calibrated minimum throttle level and minimum change in throttle.
- Calibrated operating temperature.
- Upshifts.
- Closed throttle, manual downshifts.
- Engagements.

Normal conditions for Adaptive Shift Control:

- New vehicle/transmission with abrupt shift feel or slip.
- Shifts only adapt at operating temperature.
- May take several shifts under same operating conditions to adapt.
- Information gets stored in Keep Alive Memory (KAM) power.
- Power loss to KAM, transmission shifts in its pre-adapted level.
- Adaptive process will, over time, fully update KAM.
- Depending on driving style, it may take longer to complete the adaptive strategy.

All Ford Vehicles

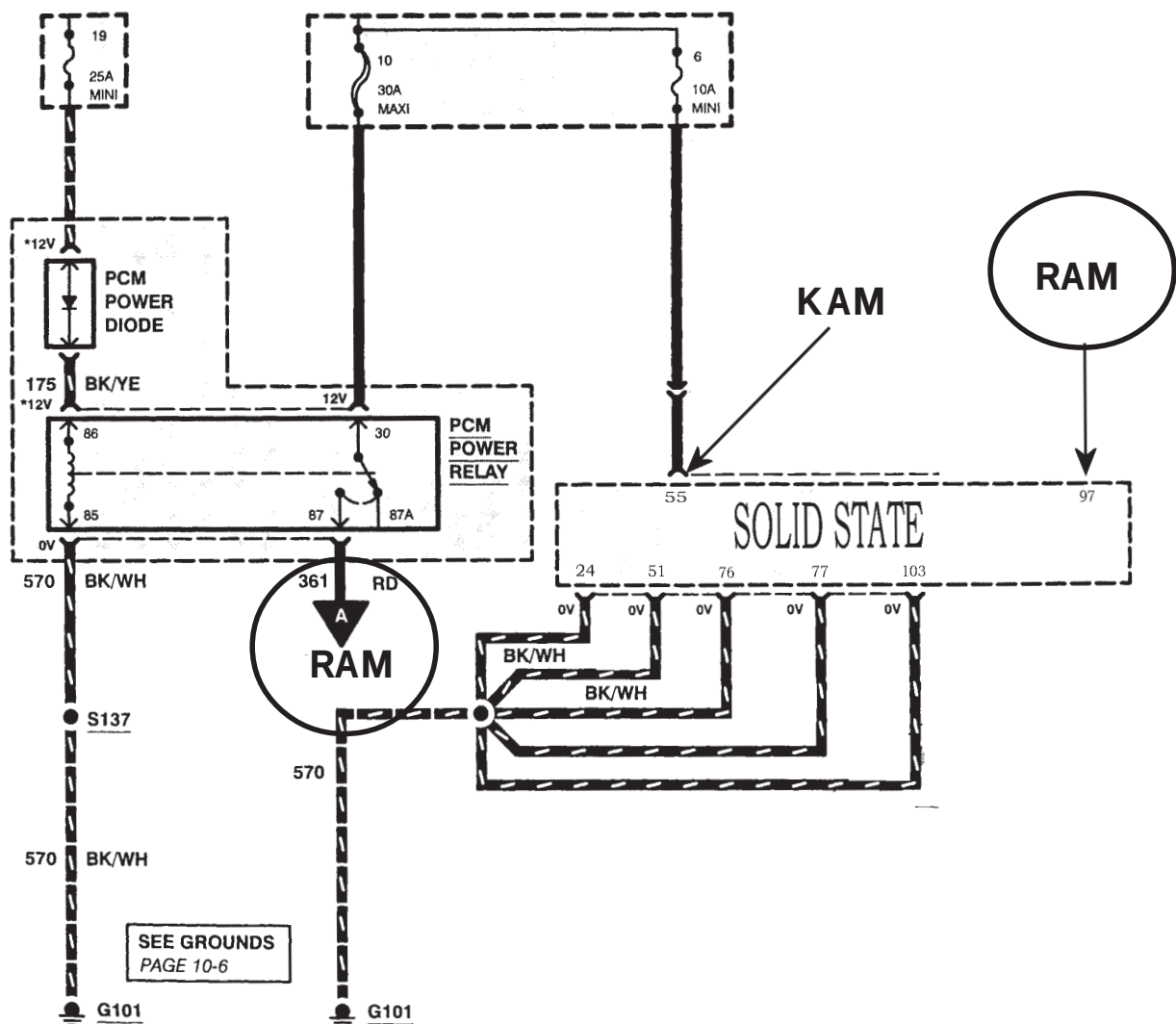
P0603 (KAM Test Code)

P0605 (RAM Test Code)

Any Ford with codes P0603 or P0605 may have an aftermarket chip installed on at or near the PCM.

- P0603 indicates **KEEP ALIVE MEMORY** at the PCM is or has been interrupted.
- P0605 indicates **RANDOM ACCESS MEMORY** at the PCM is or has been interrupted.

Check wiring for aftermarket installation or ask customer if they have had any performance modifications done to the vehicle.

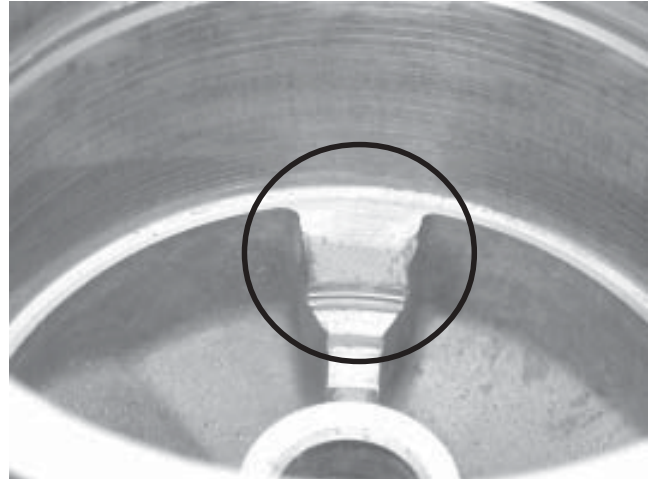
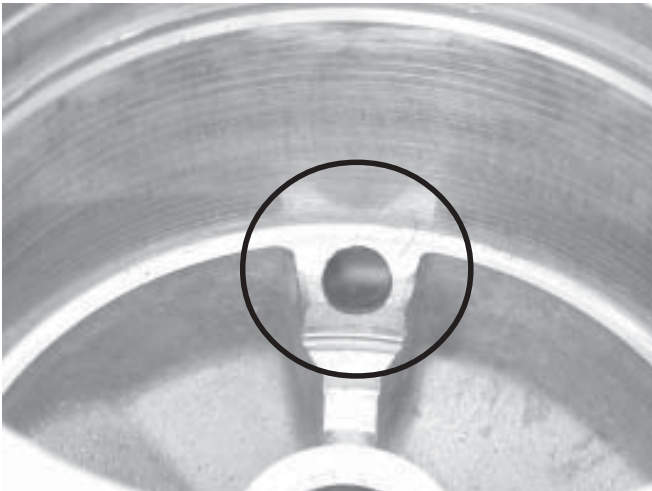


4R70W

Case Changes and Updates (Truck only)

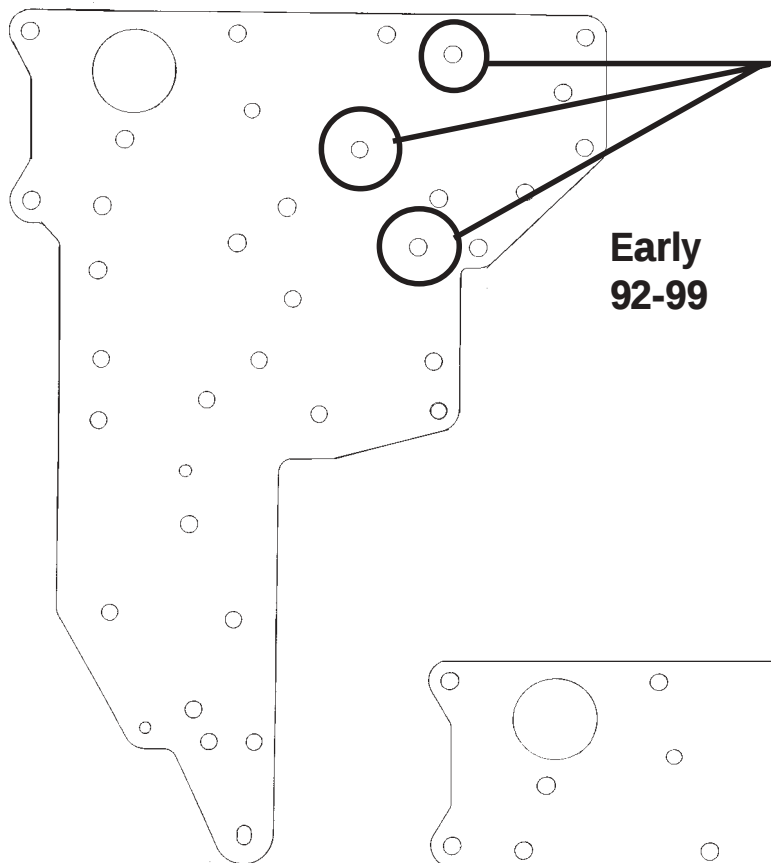
In 2001, 4R70W cases changed for the truck lines only. These changes include:

- Overdrive Servo bleed hole **“DELETED”**
- Unique Valve body for trucks only
- New case **WILL NOT** service earlier models, due to calibration changes.



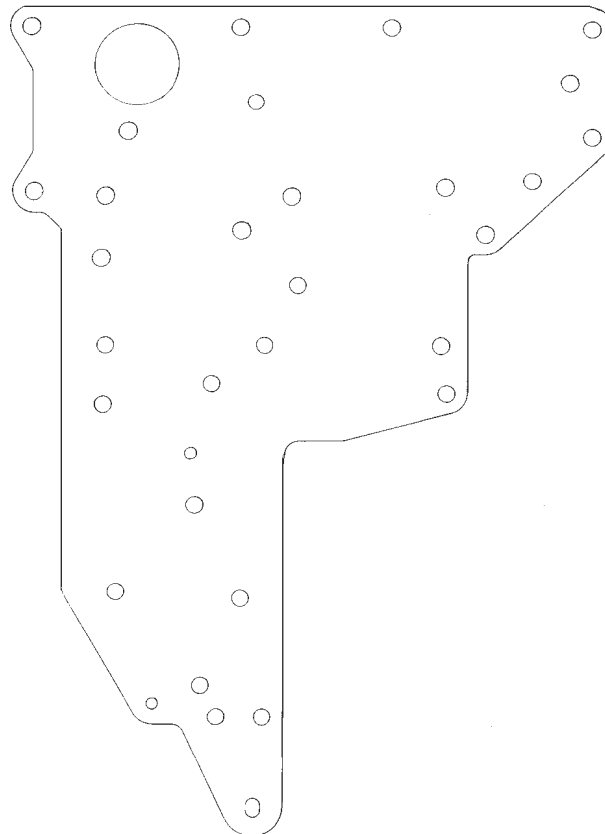
4R70W

Valve Body Lower Separator Plate/Gasket Changes



These holes were
eliminated in 1999
and on transmissions

Early
92-99



Late
99-2002

4R70W

Valve Body Separator Plate Changes (continued)

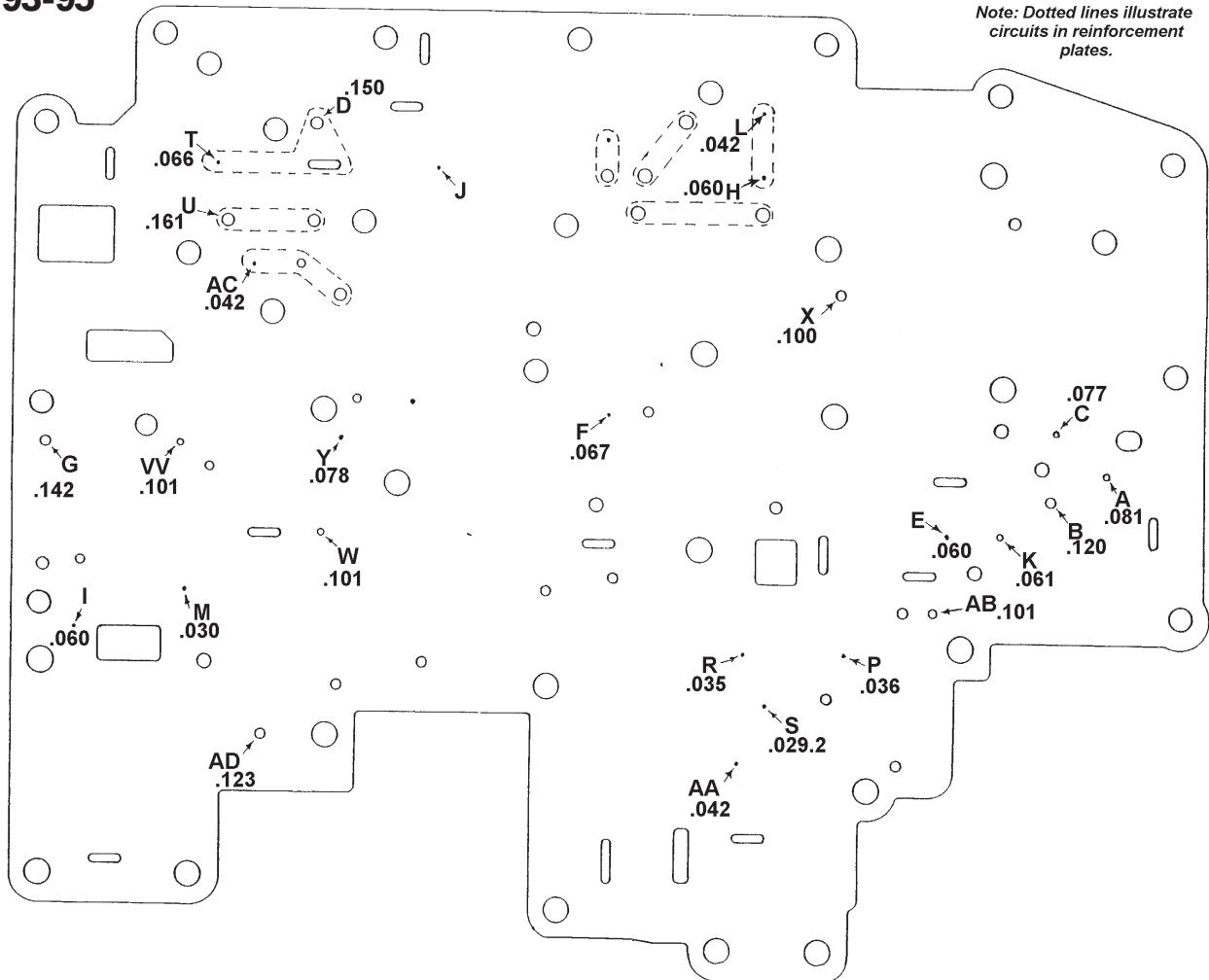
These are the orifice names you will see on the separator plate.

A=	Forward Clutch Feed
AA=	TCC Feed
AB=	Rear Lube
AC=	Converter Clutch Apply
AD=	By-Pass Clutch control plunger
B=	2-3 Shift valve
C=	2-3 Accumulator
D=	O/D Servo regulator
F=	Low-Reverse Servo Release
G=	Intermediate Clutch Feed
H=	3-4 Shift valve to O/D regulator valve
I=	Reverse Clutch
K=	Direct Clutch
L=	O/D Servo Regulator Valve side
M=	Main Regulator valve
P=	SS1 Feed
R=	SS2 Feed
S=	Solenoid Main Feed
T=	Intermediate Clutch from the 1-2 shift valve
U=	B8 Intermediate Apply
VV=	Converter Drain/Lube
W=	Converter charge
Y=	By-Pass Clutch control

Valve Body Separator Plate Changes (continued)

93-95

Note: Dotted lines illustrate circuits in reinforcement plates.

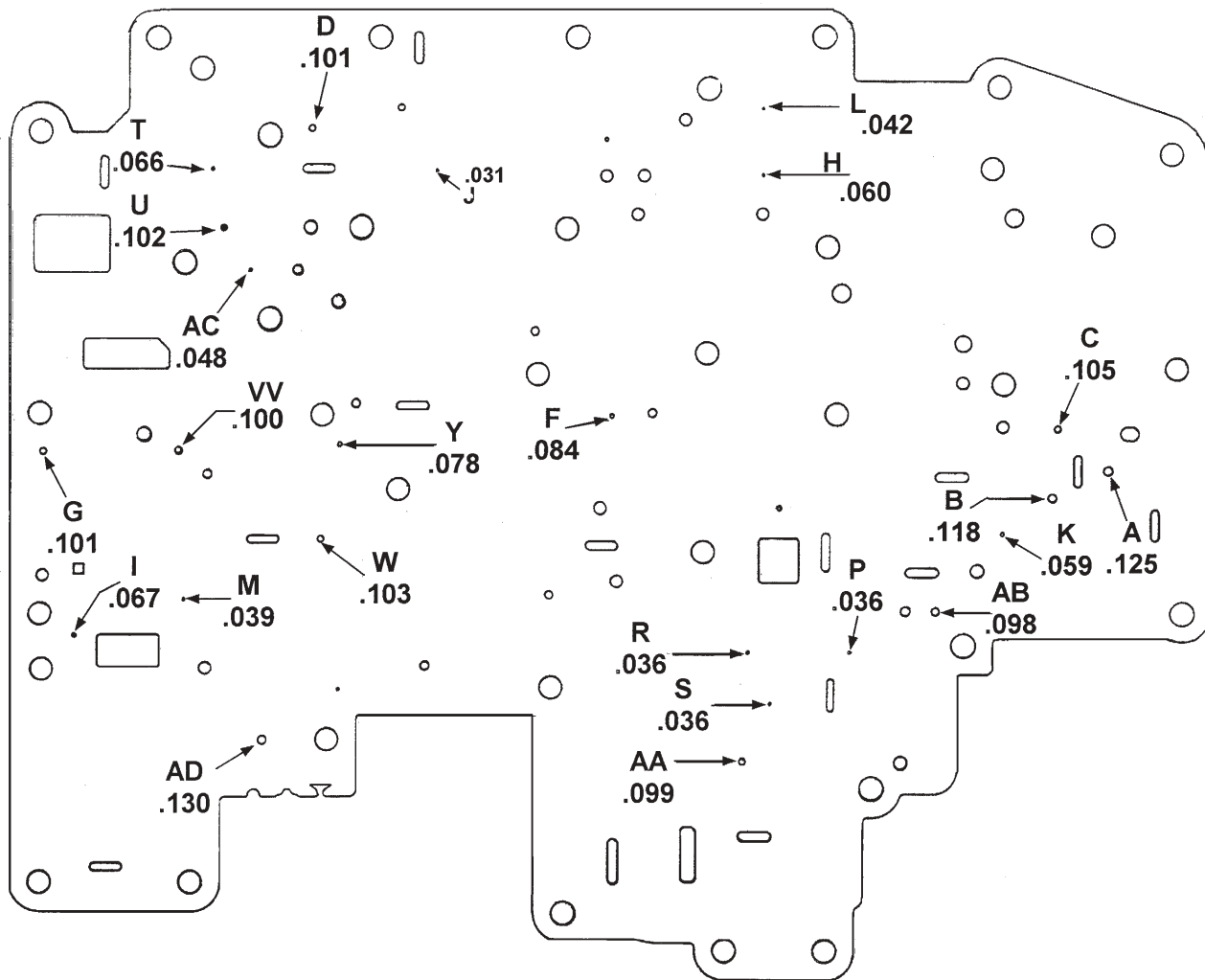


4R70W/AODE

Valve Body Separator Plate Changes (continued)

96-98

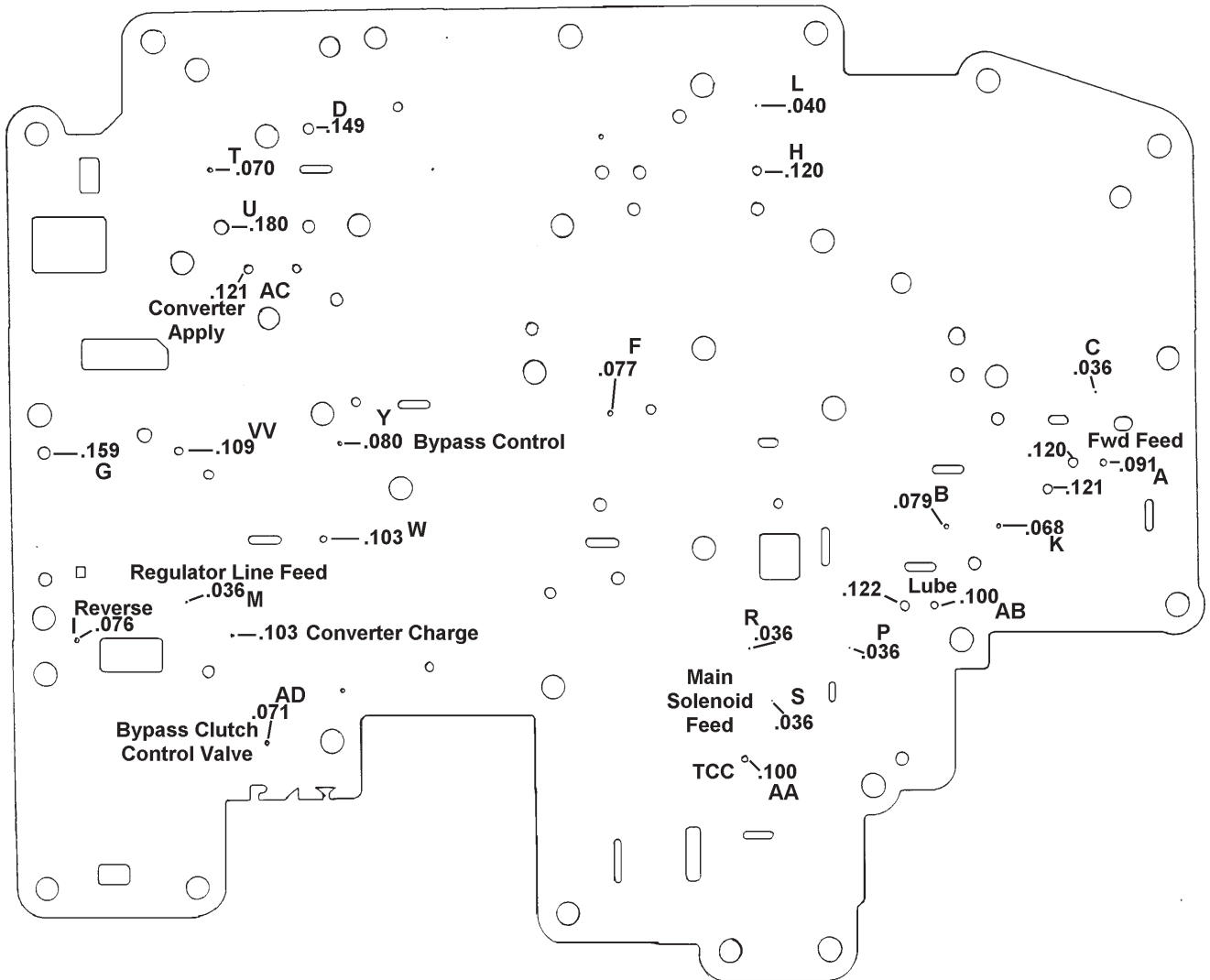
96-98 AODE



4R70W/AODE

Valve Body Separator Plate Changes (continued)

99-on



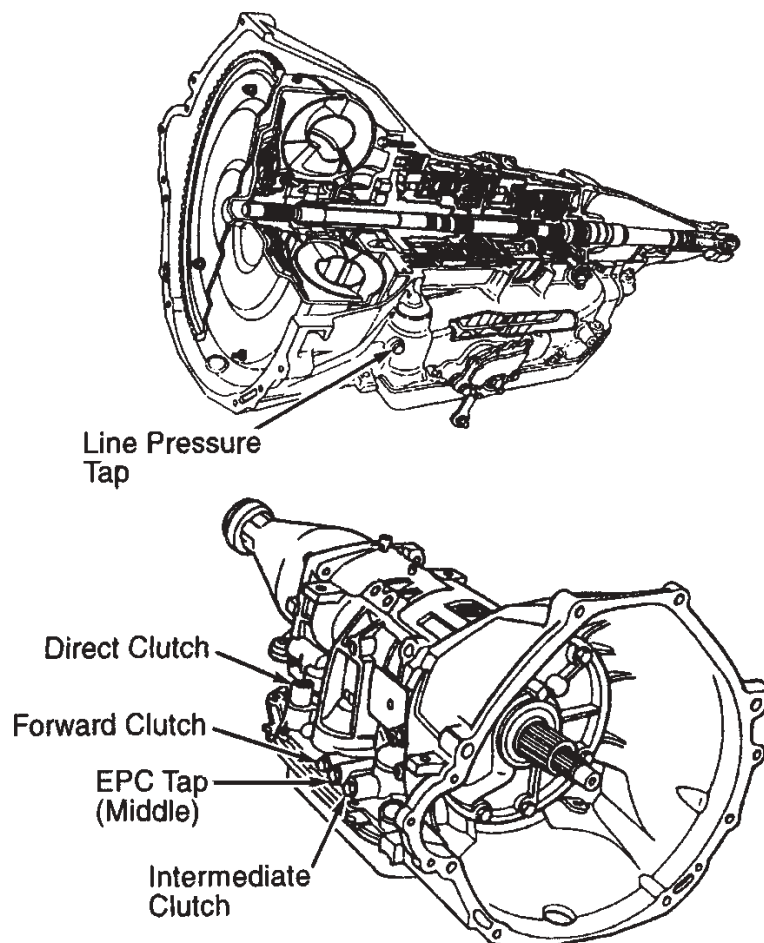
AODE/4R70W

Neutrals While Taking Off From a Stop

Concern: Typically described as during heavy acceleration from a stop the transmission neutralizes, but additional symptoms may be present. In 1st, 2nd or 3rd gear in the O/D position during heavy acceleration the transmission neutralizing may also accompany this concern.

Common Cause: The 3/4 shift valve strokes cutting off the forward clutch. Restricted solenoids being the most common concern are the focus of our attention, but keep in mind that it is the flooding of the solenoids that causes the neutralization so anything that can cause a solenoid to flood is also of concern.

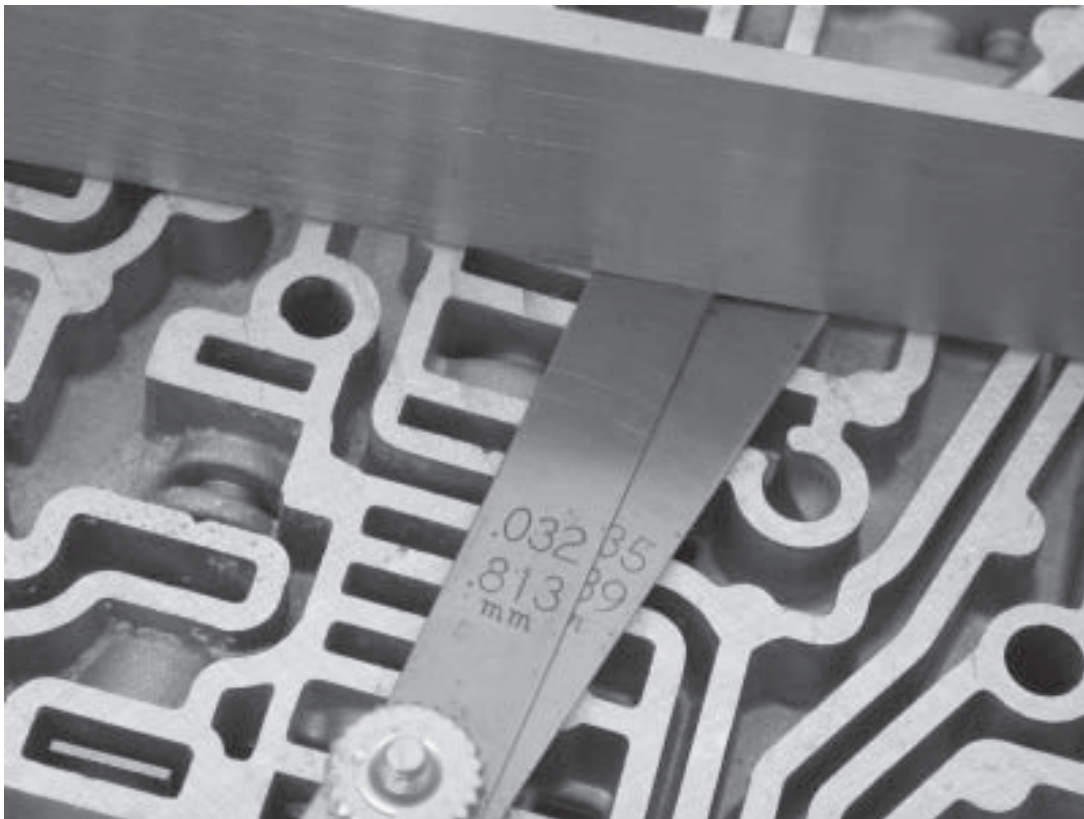
Testing & Repair: Install a gauge on the forward clutch pressure tap. When the neutralization occurs, if the gauge reads at or near 0psi, replace the shift solenoids and inspect the solenoid pressure regulator valve and bore for wear.



AODE/4R70W

Neutrals Taking Off From a Stop (continued)

Valve Body Warping

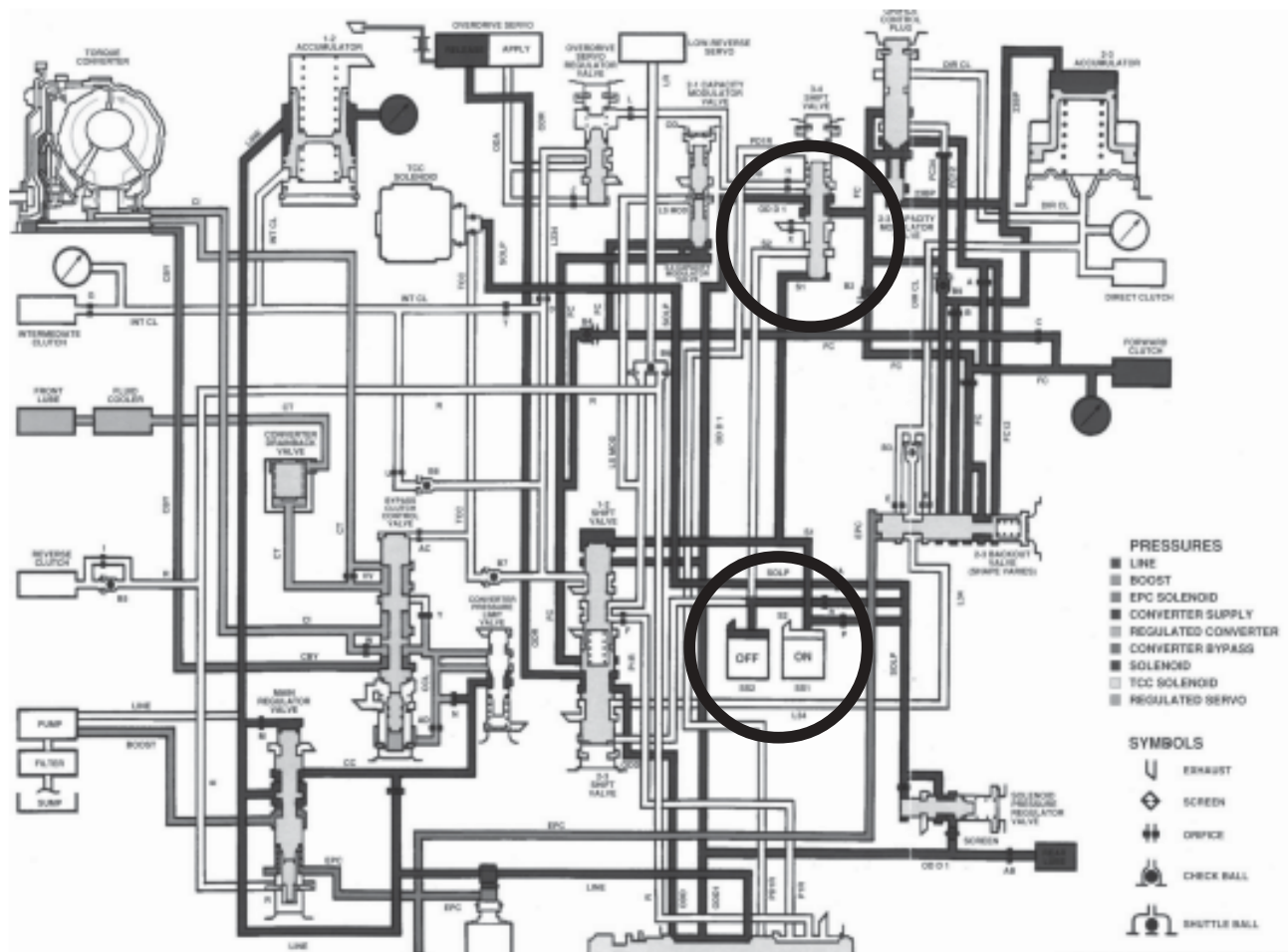


AODE/4R70W

Neutrals Taking Off From a Stop (continued)

Electrical Components

There is no direct command for a neutral condition with the manual valve in the drive position. However incorrect inputs to the processor may cause high pressure concerns that will in turn flood the shift solenoids circuit causing a neutral condition.

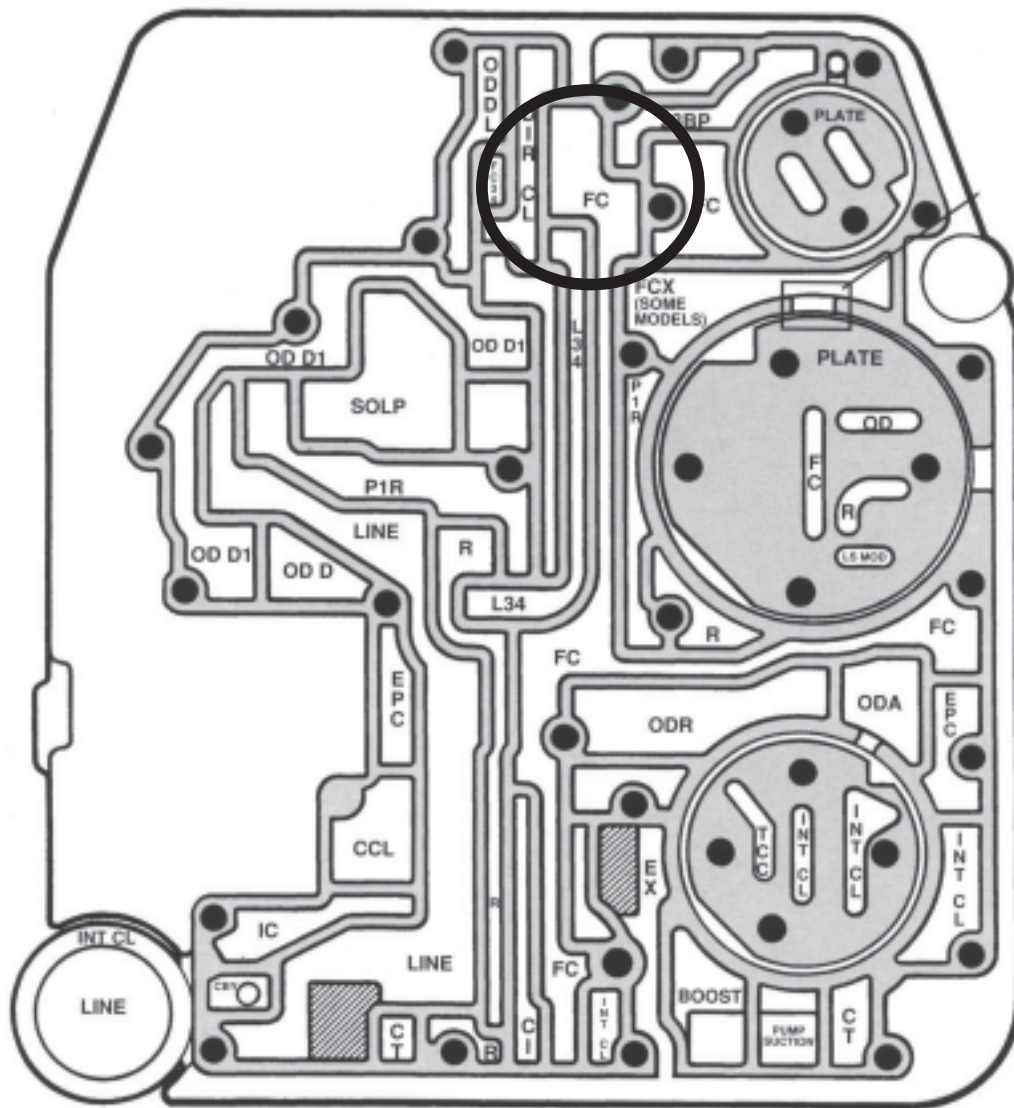


AODE/4R70W

Neutrals Taking Off From a Stop (continued)

Case Warping

Note: FC = Forward Clutch

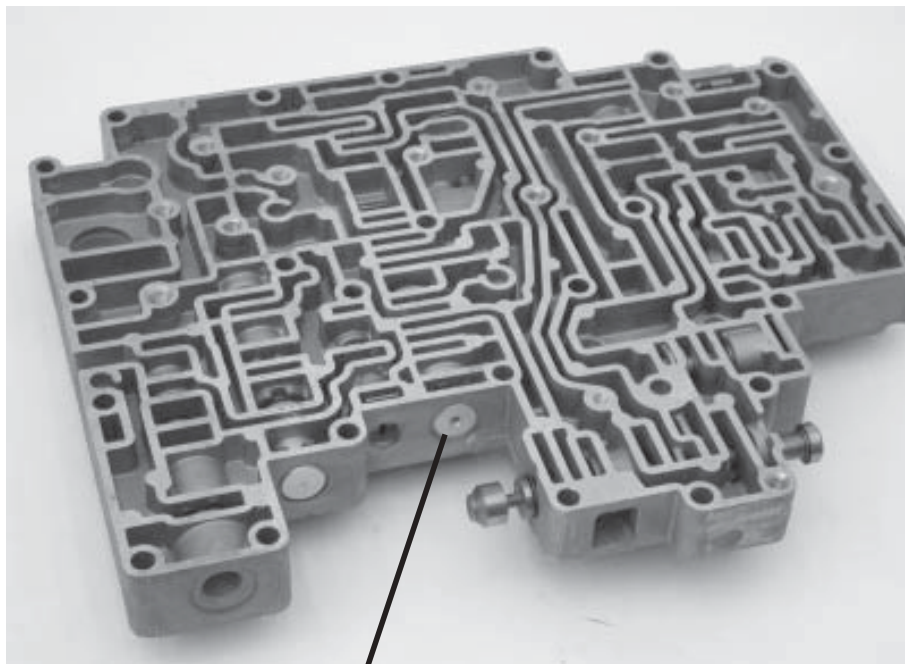


AODE/4R70W

Neutrals during the 3/4 shift

Concern: During a 3/4 shift or just accelerating in 4th the transmission neutralizes. No codes present and the correct commands are being sent to the transmission.

Common Cause: 2/3 shift valve end plug leaking. This leak causes the direct clutch to be cut off due to the amount of solenoid oil pressure required to keep both the 3/4 shift valve and the 2/3 shift valve in the stroked position. Because the 2/3 shift valve has only one area for solenoid pressure to pin the valve verses two for the 3/4 shift valve it is more likely to be susceptible to the leak.



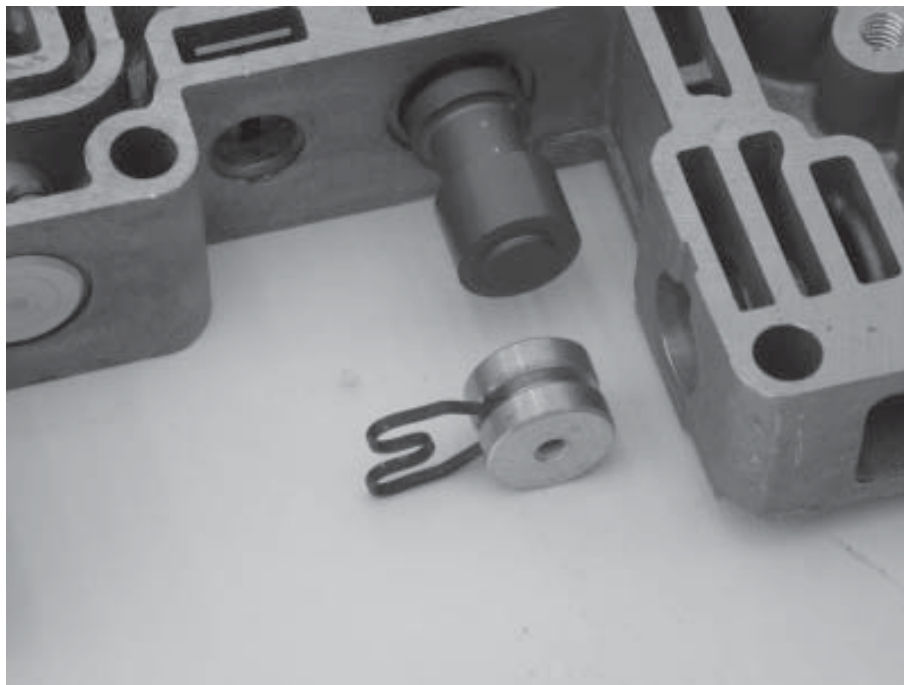
2-3 shift valve end plug

4R70W

Neutrals on the 3-4 Shift (continued)

Testing & Repair: Install a pressure gauge on the direct clutch tap. When the transmission neutralizes if the gauge shows little or no pressure, then remove the 2/3 shift valve end plug and run a tubing cutter around the outside diameter to seal the leak.

NOTE: While performing this repair also check the 2/3 shift and solenoid pressure regulator valves and bores for wear.



E4OD/4R100

Separator Plate and Valve Body Matching

Between 1989 and 2002 there have been a number of different changes in separator plates, gaskets and valve bodies. The chart indicates the relationship between separator plates and valve bodies.

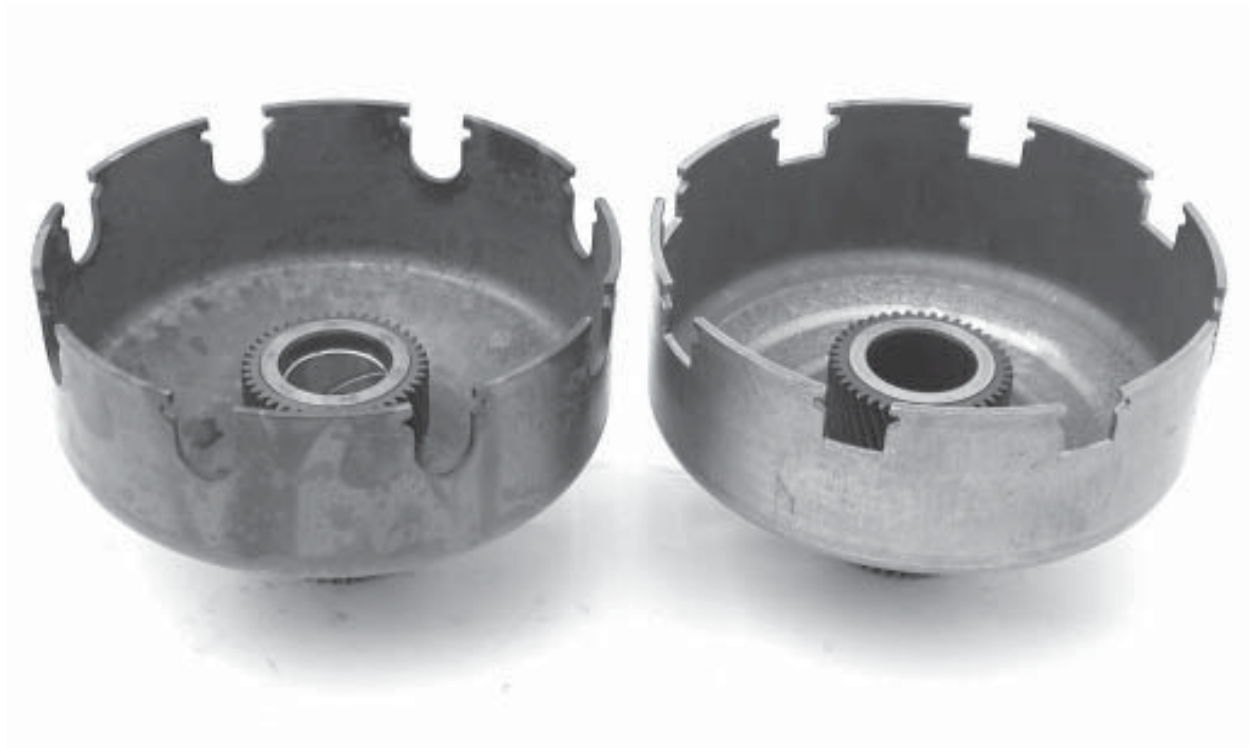
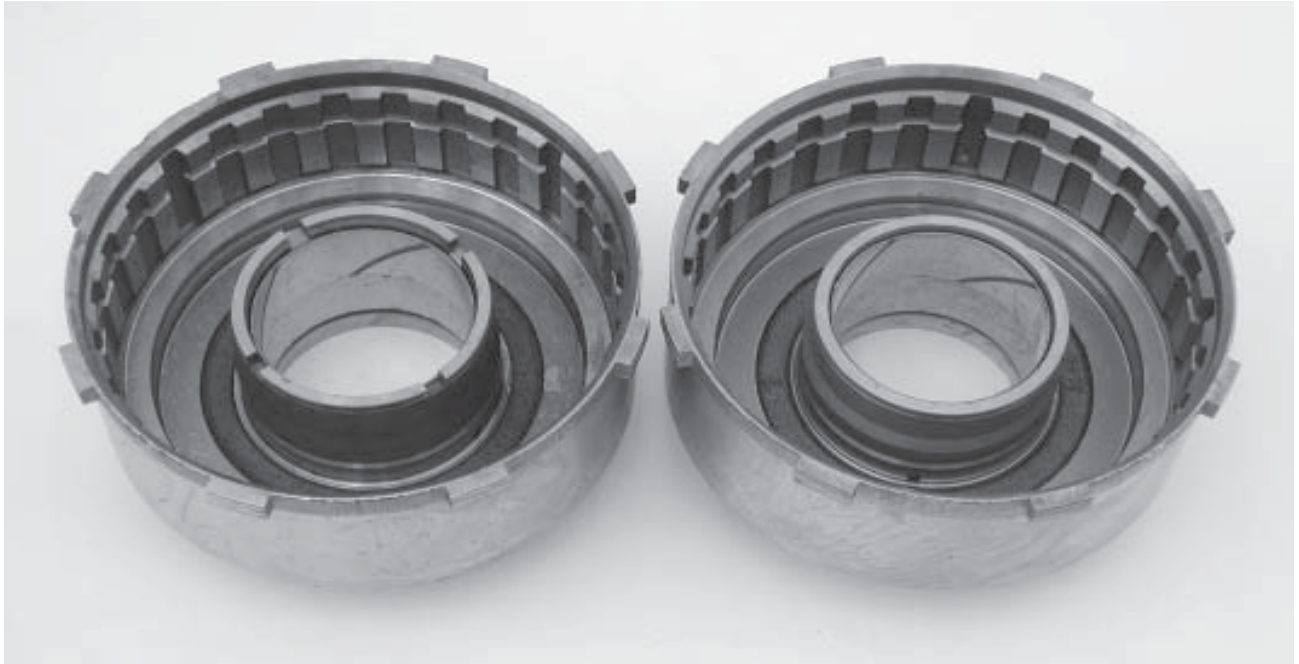
YEAR	ENGINE	V/B	SEP PLATE
1989	7.3/7.5/5.8	E9TZ-A E9TZ-B	E9TZ-A
1990-95	4.9/5.0/5.8/7.3/7.5	F0TZ-J F3TZ-G	F4TZ-A
1990-95	4.9/5.0/5.8/7.3/7.5	F5TZ-A F3TZ-G	F5TZ-A
1990-95	4.9/5.0/5.8/7.3/7.5	F6TZ-D F6TZ-A*	F6TZ-B*
1990-95	4.9/5.0/5.8/7.3/7.5	F6TZ-B F6TZ-A*	F5TZ-B*
1996	4.9/5.0/5.8/7.3/7.5	F6TZ-D F6TZ-A	F6TZ-B
		F6TZ-C	F7TZ-AA
1997	6.8	F6TZ-C	F7UZ-AA
		F6TC-C	F8UZ-CA
		F6TC-C	F81Z-EA
	4.2/4.6/5.4/7.3	F6TZ-C	F7TZ-AA
1998	6.8/7.3 4R100	F81Z-AA NON-PTO	F8UZ-AA
E4OD	6.8	F81Z-AA	F8UZ-BA
1998-2000	4.2/4.6/5.4	F6TZ-C	F7TZ-AA
2000-2001	H/J/L/M/K	F81Z-BA PTO	F81Z-BA
1999-2001	A/B/C/D/E/F	F81Z-AA NON-PTO	F81Z-DA

***Replacement valve body as an assembly only**

4R100

#8 Thrust Washer Removed

The new designed Direct Drum does not use the #8 thrust washer. There is no longer a loading of the forward clutch drum on the direct clutch drum. The Sun Shell was also replaced to accommodate this change. It now the supporting element for the Direct Drum.



4R100

Squawking Noise in Reverse, While Backing up a Hill

Concern: 1999 F250 Heavy Duty and Super Duty F-series trucks with 5.4L or 6.8L gas engines.

Common Cause: This condition is often due to low line rise. The computer command for line rise isn't adequate for the conditions.

Repair: Ford has issued an update computer calibration. Use the transmission tag number and calibration number to determine whether the truck requires this update.

Notice the drum flared at the top.



Ford Computer Calibration Update

Application	Transmission ID Tag	Calibration Number
5.4L 49 State	MER	9 VZA-AF
5.4L CA	NUY	9 VZA-BJ
6.8L 49 State	YHH	9 WAA-AA
	AEO	9 WAA-AC
	BIH	9 WAA-AF
	DOZ	9 WAA-AH
	MCM	9 WAA-AI
	EAP	9 WAA-BC
6.8L CA	FOT	9 WAA-BD
	JUR	9 WAA-BL
	JTY	9 WAA-BV
	MFG	9 WAA-BY
	NRR	9 WAA-BZ

4R100

Squawking Noise in Reverse, While Backing up a Hill (continued)

The Low/Reverse clutch assembly can be replaced with E4OD parts. These parts include:

- Low one-way roller clutch.
- Reverse hub assembly.
- Inner race assembly.
- Low/Reverse clutch return spring.
- Reverse ring gear and hub.
- Reverse Planetary assembly.
- Clutches and steel plates



4R100

Solenoid Pack Update

In January 1998 diesel applications were changed to Pulse Width Modulated (PWM) Torque Converter Clutches from On/Off operation. The remaining Gas applications with 4R100 became modulated in the 1999 new model introduction.

A filter was added to the Solenoid bodies with PWM. These filters were installed to help keep the TCC solenoid from being contaminated.

Identifying Solenoid Bodies:

First Design

- The first design PWM solenoid body has a NATURAL top cover.

Note: This solenoid body does not have a TCC screen!

Second Design

- The second design PWM solenoid body has a GREEN top cover and a screen for the PWM circuit. However, this solenoid body caused a 2-3 and 3-4 shift flare with marginal fluid capacity at the PWM solenoid. The PWM solenoid and PCM calibration had to be updated.

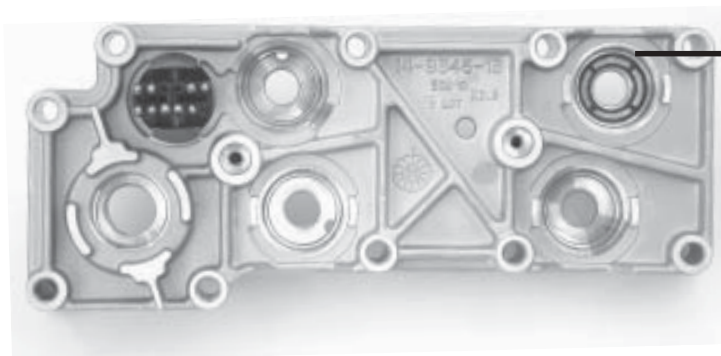
Note: This change resulted in the third design replacement solenoid body! (Do not use the second design solenoid body)

Third Design

- The third design replacement solenoid body has an Orange top cover.

Note: This solenoid body has a screen!

This screen is not serviceable. When replacements are necessary it will be necessary to replace the solenoid body assembly.



PWM screen

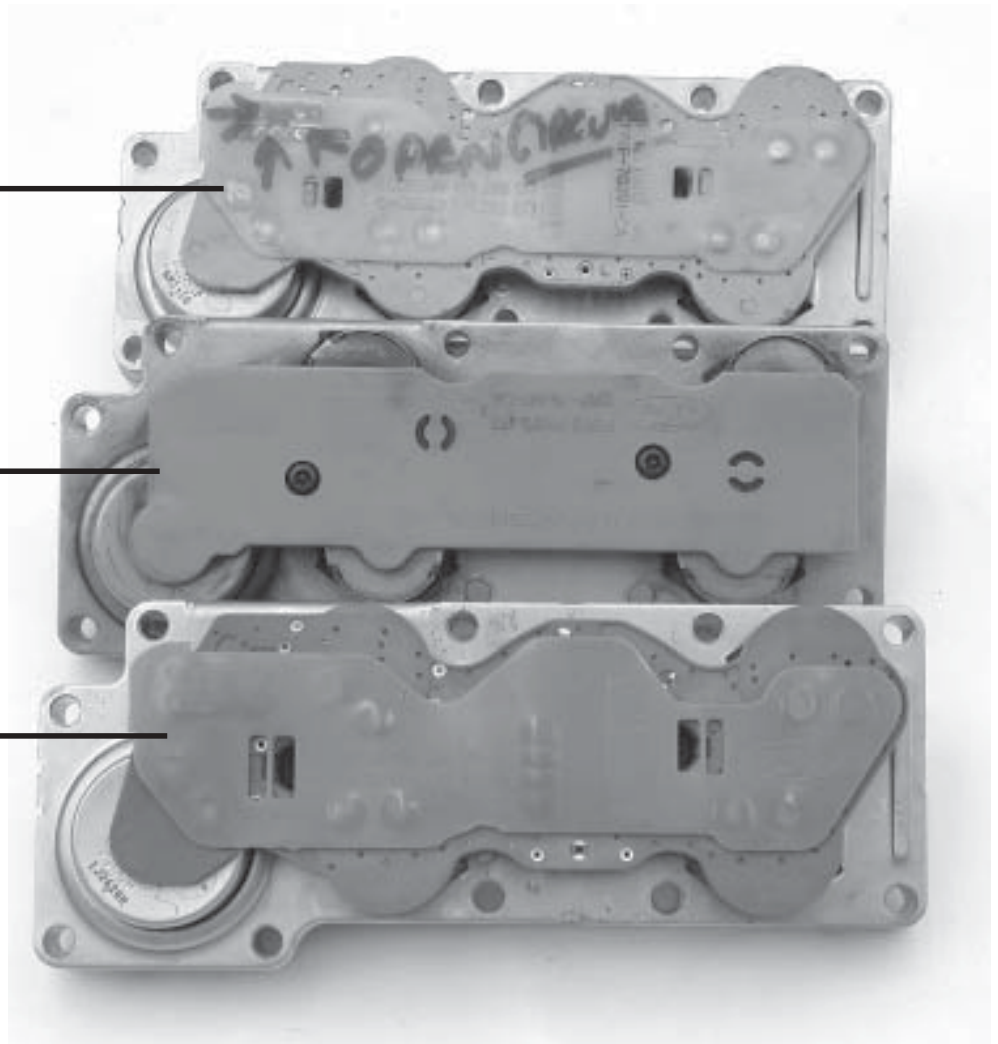
4R100

Solenoid Pack Update (continued)

Early PWM
Natural
cover

Replacement
PWM Green
cover

New PWM
Orange
cover
Part number
F81Z-7G391-CB



4R100

Rattle Noise from Converter Area

1998-2000 Econoline

1999-2000 Superduty F-Series

7.3L engine and 4R100 transmission

PWM (Only)

Concern: Rattle noise coming from the converter area when the converter is **not** engaged.

Common Cause: The impact between the outer lugs at the converter piston and the cover. To confirm this problem you can command the torque converter on from the computer or test it at the transmission.

1. Ground PIN #54 at the computer to fully apply the converter clutch.
2. Cycle the converter ON and OFF a few times by applying and removing the ground from pin #54.
3. If the noise goes away when the converter is applied, replace the torque converter.

Old Converter



4R100

Rattle Noise from Converter Area (continued)

Repair: Replace Torque Converter with Part# XL3Z-7902-DARM

New Converter



NOTE: Replacement converter comes with a two piece apply piston

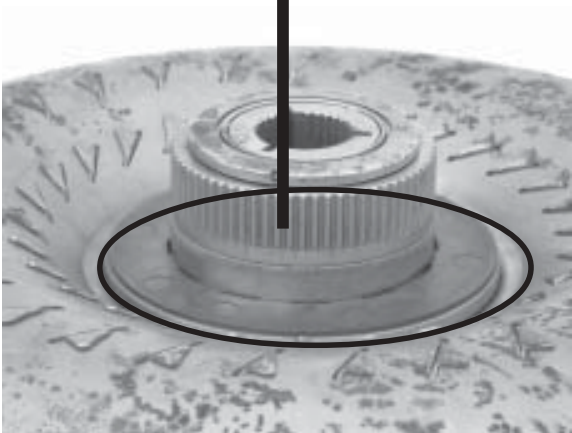
4R100

Rattle Noise from Converter Area (continued)

Old



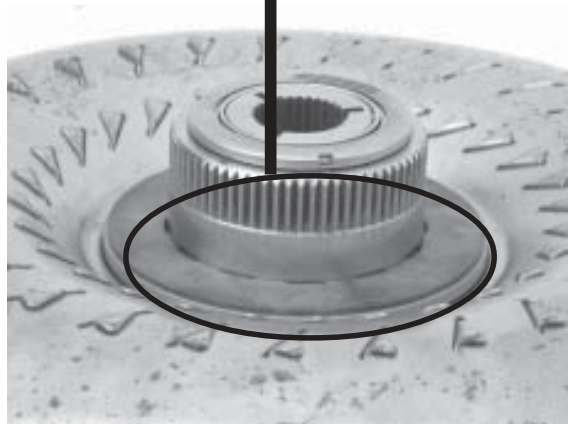
**With sealing ring
on turbine hub**



New



**Without sealing
ring on turbine hub**



4R100

Rattle Noise from Converter Area (continued)

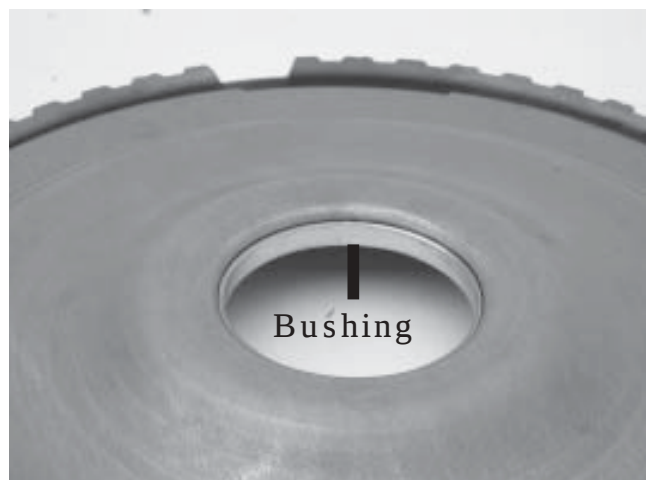


New converter has a two piece apply piston.

Old



New



4R100

Shift Solenoid Failures

Solenoid Operation and Failure Charts

Shift solenoid operation is the first step in diagnosing shift timing concerns. The following shift solenoid operation and failure charts will help to quickly diagnose common problems such as wrong gear starts, skipping gears and irregular shift patterns.

Operation of the Power Take Off PTO will be affected by shift solenoid B (SSB) failure. If the vehicle is equipped with a PTO it must be turned off during diagnosis. On-Board Diagnostic is not accessible when the PTO unit is in operation. SSB must be on and working correctly for the PTO to operate properly.

SOLENOID OPERATION CHART					
TRANSMISSION RANGE SELECTOR LEVER POSITION	PCM COMMAND GEAR	SSA	SSB	TCC	CCS
P / R / N	1	ON	OFF	OFF	OFF
D	1	ON	OFF	*	*
D	2	ON	ON	*	*
D	3	OFF	ON	*	*
D	4	OFF	OFF	*	OFF
D	FIRST THROUGH THIRD GEAR ONLY, SSA, SSB, TCC, SAME AS OVERDRIVE, CCS ALWAYS ON				
CANCEL					
MANUAL 2	2	*	*	*	ON
MANUAL 1	2	OFF	OFF	OFF	ON
MANUAL 1	1	ON	OFF	OFF	ON
* PCM Controlled					

4R100

Shift Solenoid Failures (continued)

Solenoid Operation and Failure Charts

SSA ALWAYS OFF				SSA ALWAYS ON			
PCM GEAR COMMANDE	GEAR LEVER POSITION			PCM GEAR COMMANDE	GEAR LEVER POSITION		
	D	2	1		D	2	1
	ACTUAL GEAR OBTAINED				ACTUAL GEAR OBTAINED		
1	4	2	1	1	1	2	1
2	3	2	2	2	2	2	1
3	3	2	2	3	2	2	1
4	4	2	2	4	1	2	1

SSB ALWAYS OFF				SSB ALWAYS ON			
PCM GEAR COMMANDE	GEAR LEVER POSITION			PCM GEAR COMMANDE	GEAR LEVER POSITION		
	D	2	1		D	2	1
	ACTUAL GEAR OBTAINED				ACTUAL GEAR OBTAINED		
1	1	2	1	1	2	2	1
2	1	2	1	2	2	2	1
3	4	2	2	3	3	2	2
4	4	2	2	4	3	2	2

Saturn

Contents

MP6 / MP7

MIL light on Code P0741	149	Multiple Codes after	156
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Bump or Ratchet in 1 st Gear	152	Whine Noise in 2 nd Only	157
Erratic Transmission Behavior	153	Harsh or Erratic Shifts	158
Pressure Test	154		

Notes:

MP6/MP7

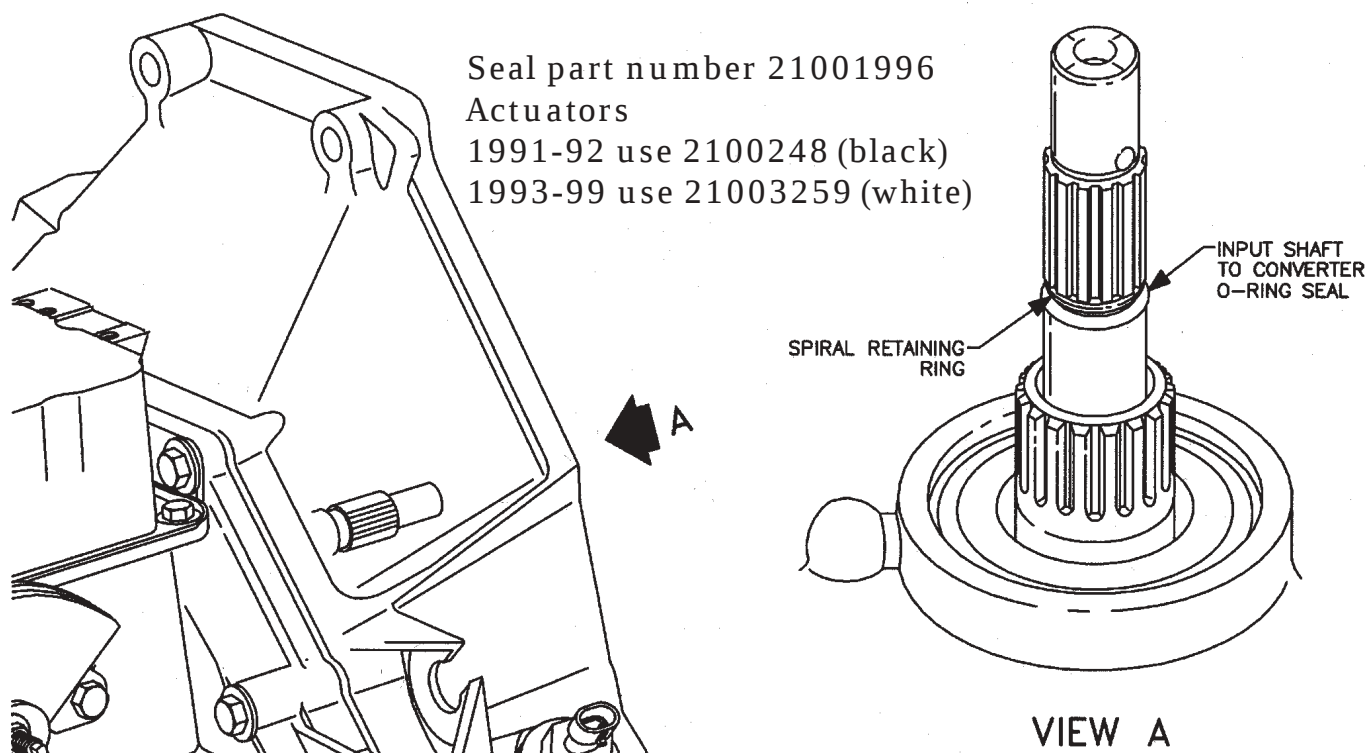
MIL light on and Code P0741 TCC malfunction

These are the components that can cause code to appear in the PCM, they are:

- Input shaft converter O-Ring
- Input shaft to stator shaft seal leaking
- Missing check ball pressed into input shaft
- Damaged torque converter
- PCM damaged
- TCC actuator

The most common causes are both the TCC actuator and or the input shaft converter O-Ring.

When diagnosing DTC P0741, perform the actuator quick test and verify the TCC actuator is working properly. If the actuator is working properly it may be necessary to remove the transmission and check the input shaft O-Ring.



MP6/MP7

Actuator quick test

1. Remove the #15, 10A body fuse, located in the instrument panel junction block.
2. Using a flat spade connectors with a wire as your lead, jump the fuel pump probe hole to the B+ terminal of the body fuse.
3. Ground diagnostic enable by Jumping DLC terminal A to B.
4. Move gear selector through the various positions (Key On, engine Off) to check desired actuator.

<u>Actuators</u>	<u>Select</u>
2 nd Actuator	2
3 rd Actuator	3
4 th Actuator	4
TCC Actuator	R
Line Actuator	N

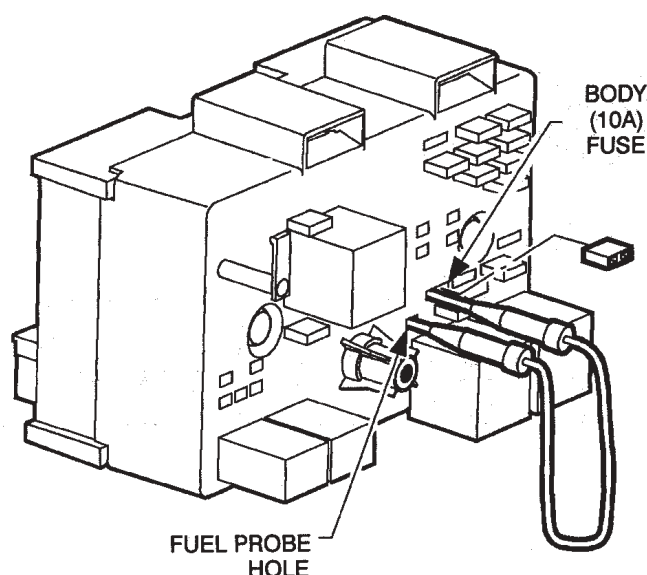


MP6/MP7

Actuator quick test (continued)

When a gear is selected , the PCM will pulse the actuators at a set duty cycle for approximately six seconds. Listen and compare the noise between the different actuators. If one or more are distinctively different, replace them. All the actuators should sound the same.

NOTE: Prior to any replacement of electrical components, check the connections and check for proper battery voltage.



MP6/MP7

Bump or Ratchet in 1st Gear at Slow Speeds

Concern: During slow driving maneuvers in parking lots a bump or ratcheting noise may be apparent.

Common cause: The Calibration is incorrect for vehicle.

Repair: Re-Calibrate PCM using the chart below.

CALIBRATIONS			
END MODEL	Type	DESCRIPTION	SERVICE PCM PART #
1996 SOHC (L24)/AUTOMATIC TRANSAXLE MP6			
21008695	Flash	B/A California First Gear Bump Calibration	21023775
21008694	Flash	B/A Federal First Gear Bump Calibration	21023775
21008699	Flash	B/A Canada/Taiwan First Gear Bump Calibration	21023775
1996 DOHC (LL0)/AUTOMATIC TRANSAXLE MP7			
21008692	Flash	P/A Federal and California First Gear Bump Calibration	21023776
21008698	Flash	P/A Canada/Taiwan First Gear Bump Calibration	21023776
1997 SOHC (L24)/AUTOMATIC TRANSAXLE MP6			
21008695	Flash	B/A California First Gear Bump Calibration	21023775
21008694	Flash	B/A Federal First Gear Bump Calibration	21023775
21008699	Flash	B/A Canada/Taiwan First Gear Bump Calibration	21023775
1997 DOHC (LL0)/AUTOMATIC TRANSAXLE MP7			
21008693	Flash	P/A California First Gear Bump Calibration	21023776
21008692	Flash	P/A Federal First Gear Bump Calibration	21023776
21008698	Flash	P/A Canada/Taiwan First Gear Bump Calibration	21023776
21008700	Flash	P/A Japan First Gear Bump Calibration	21023807

MP6/MP7

Erratic Transmission Behavior

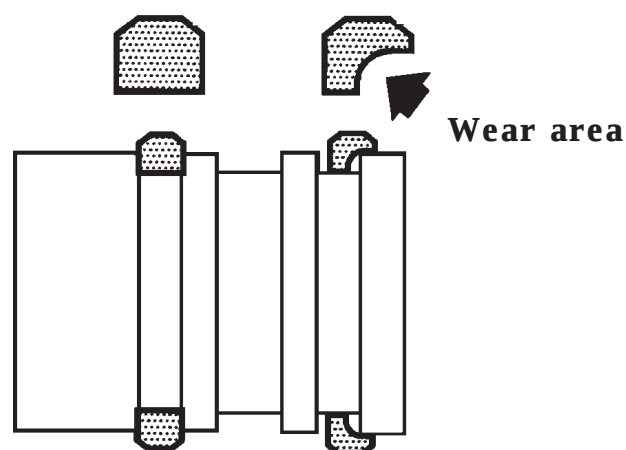
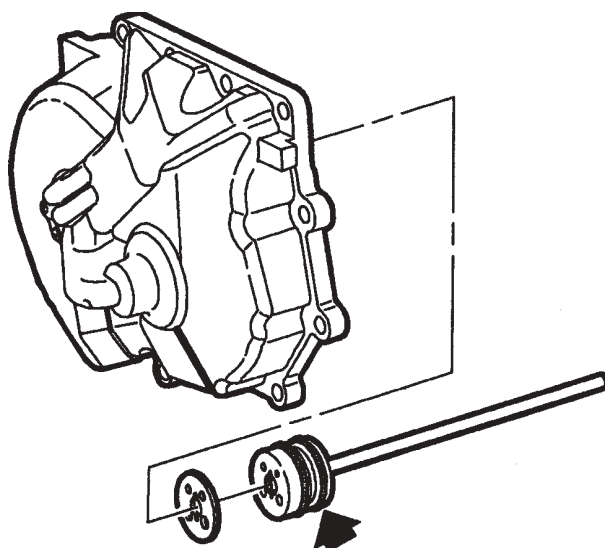
2000 S-series Saturns with MP6 transaxles built before and including VIN YZ315846, having erratic transmission conditions such as:

- Delayed and or Harsh Engagement into D or R
- Erratic Shifting 1st to 2nd
- Bind-Up in Reverse
- No 2nd or 3rd
- DTC's P7031, P7032, P7033, P7034

These conditions may be caused by an improperly machined surface on the input shaft tube hub where the seal rides. Having a poor surface may cause the seal to wear and cross leak between the 1st, 2nd and Reverse clutches.

Input shaft tube hub 21002498

Hub seal 21002684



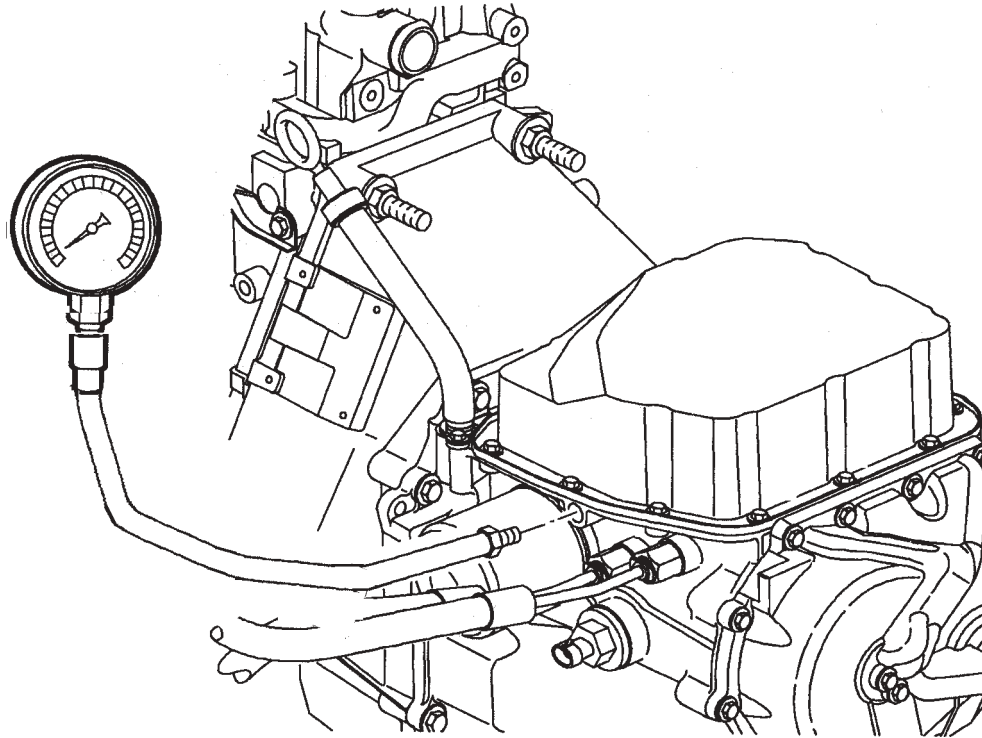
MP6/MP7

Pressure Test

1. Run the engine up to operating temperature (approximately 158° F).
2. Remove transaxle temperature sensor and install a pressure gauge.
3. Connect a scan tool to the diagnostic connector.
4. With the Key On engine Off, select “Special Test” on the menu selection.
5. Select line pressure.
6. Transaxle in park.
7. Start engine and select run on the scanner, the test should set engine speed at 1500 RPM and command line pressure up in steps from 57-220 psi. in 15 psi intervals.
8. As the test is in progress make sure the pressures move in the intervals commanded by the PCM.
9. Oil pressure minimum and maximums should be check using the following procedure:
 - With gauge connected and transmission at operating temperature.
 - Engine idling in park, line pressure should be 58-72 psi.
 - Remove line pressure fuse (7.5 Amp TRS LP) Underhood Junction Block.
 - With engine idling in park, pressure should be 175-245 psi.

MP6/MP7

Pressure Test (continued)



COMMAND LINE PRESSURE		GAUGE READINGS SHOULD BE IN THIS RANGE	
kPa	psi	kPa	psi
396	57	400 – 500	58 – 72
498	72	425 – 550	61 – 80
600	87	500 – 675	72 – 98
702	102	600 – 800	87 – 116
804	117	700 – 925	101 – 134
906	131	800 – 1050	116 – 152
1008	146	900 – 1175	130 – 170
1110	161	1000 – 1300	145 – 188
1212	175	1100 – 1400	159 – 203
1314	191	1200 – 1500	174 – 218
1416	205	1300 – 1650	188 – 240
1518	220	1500 – 1850	218 – 268

MP6/MP7

Multiple Codes after Transaxle Replacement

The following codes may set after transaxle replacement:

- 1991-1995 Codes 16, 18, 21, 23, and or 24.
- 1996-1999 Codes P0730, P0731, P0732, P0733, and/or P0734.

All of these codes are ratio error codes, two possible causes may contribute to these codes:

1. An incorrect transmission with the wrong gear components installed. The PCM will not match the actual gear ratios and will set a code.
2. Incorrect calibration installed due to the wrong VIN in the PCM.

Use the following chart to identify the proper tooth count.

	1st Drive	1st Driven	2nd Drive	2nd Driven	3rd Drive	3rd Driven	4th Drive	4th Driven	Rev. Idler	Output Shaft	Ring Gear
91-93 MP6 1st Design*	21	47	30	38	37	30	42	25	28	15	62
93-94 MP6 2nd Design**	19	48	30	38	37	30	42	25	28	15	62
91-94 MP7	19	48	27	42	33	34	40	28	28	15	62
95-99 MP6	19	48	30	38	37	30	42	25	28	16	65
95-99 MP6	19	48	27	42	33	34	40	28	28	16	65
* Vehicles built prior to and including 1993 VIN PZ156139											
** Vehicles built after and including 1993 VIN PZ156140											

MP6

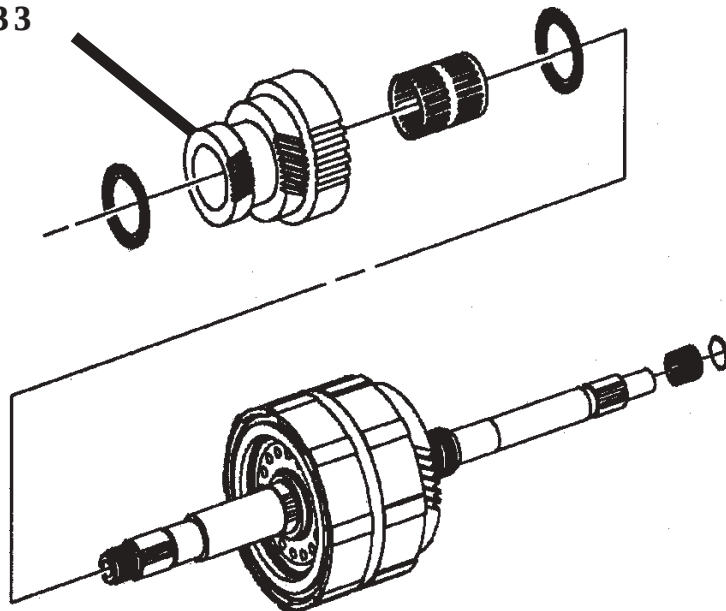
Whine Noise in 2nd Gear Only

Vehicles built after 1998 VIN **WZ312775** through 1999 VIN **XZ114349** may exhibit this problem. Check the VIN and verify that your vehicle falls into this category.

Common Cause: Improperly designed gear surface on the 2nd/Reverse gear.

Repair: Replace the 2nd/Reverse gear with updated part number .

**Part Number
21003233**



MP6/MP7

Harsh or Erratic Shifts, No Gear, Multiple Codes

Common Cause: These symptoms can be caused by iron sediment that migrates through the valve body assembly causing the actuators to seize or be sluggish. This was a manufacturing problem and the sediment was not cleaned out properly.

Areas of contamination are:

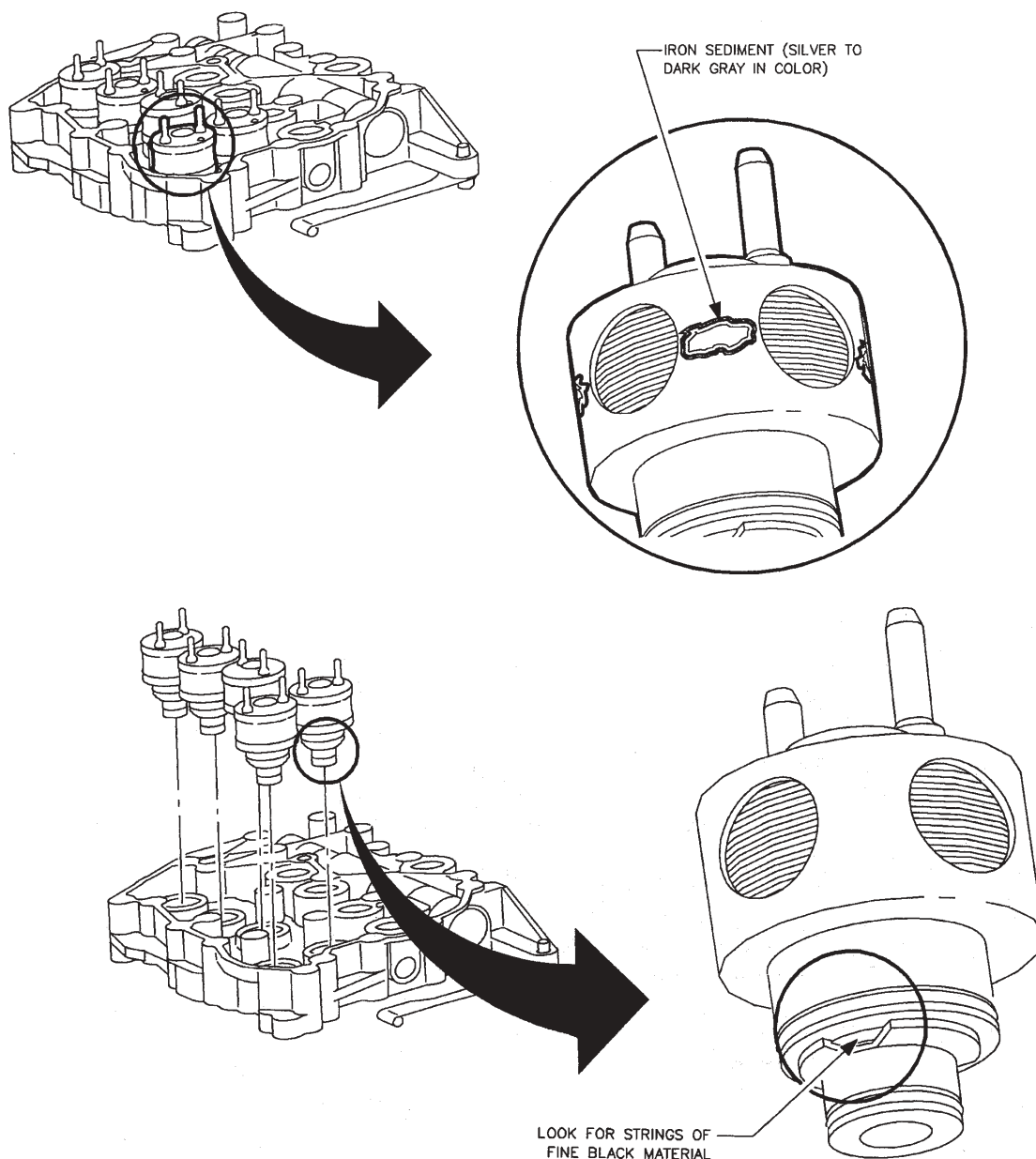
- Actuator valve assembly
- Valve body assembly
- Clutch housings and case
- Clutch drums and lube holes
- Pump gear hub and drain hole

MP6/MP7

Harsh or Erratic Shifts, No Gear, Multiple Codes (continued)

Actuator valve armature assembly

The actuator valve assembly can become contaminated causing the valve to stick.

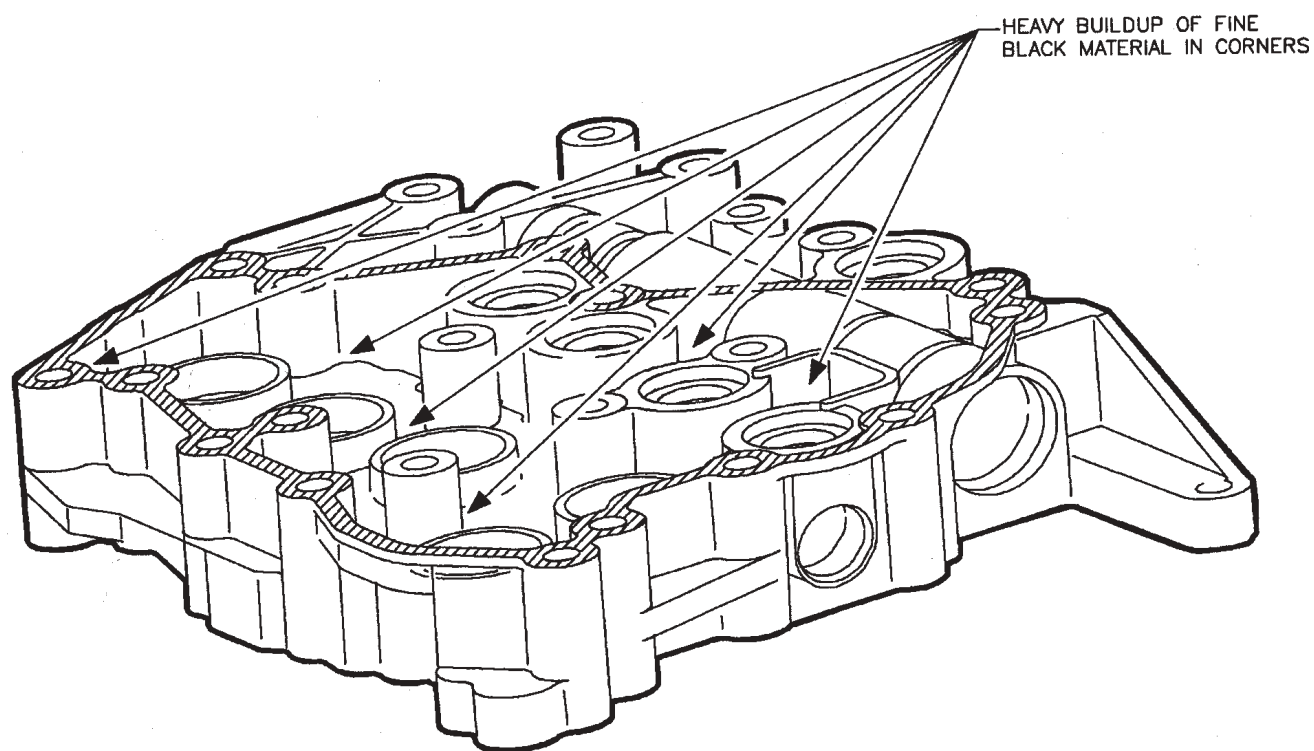


MP6/MP7

Harsh or Erratic Shifts, No Gear, Multiple Codes (continued)

Valve Body Assembly

The valve body is the most common area of fault. The problem can be identified easily.

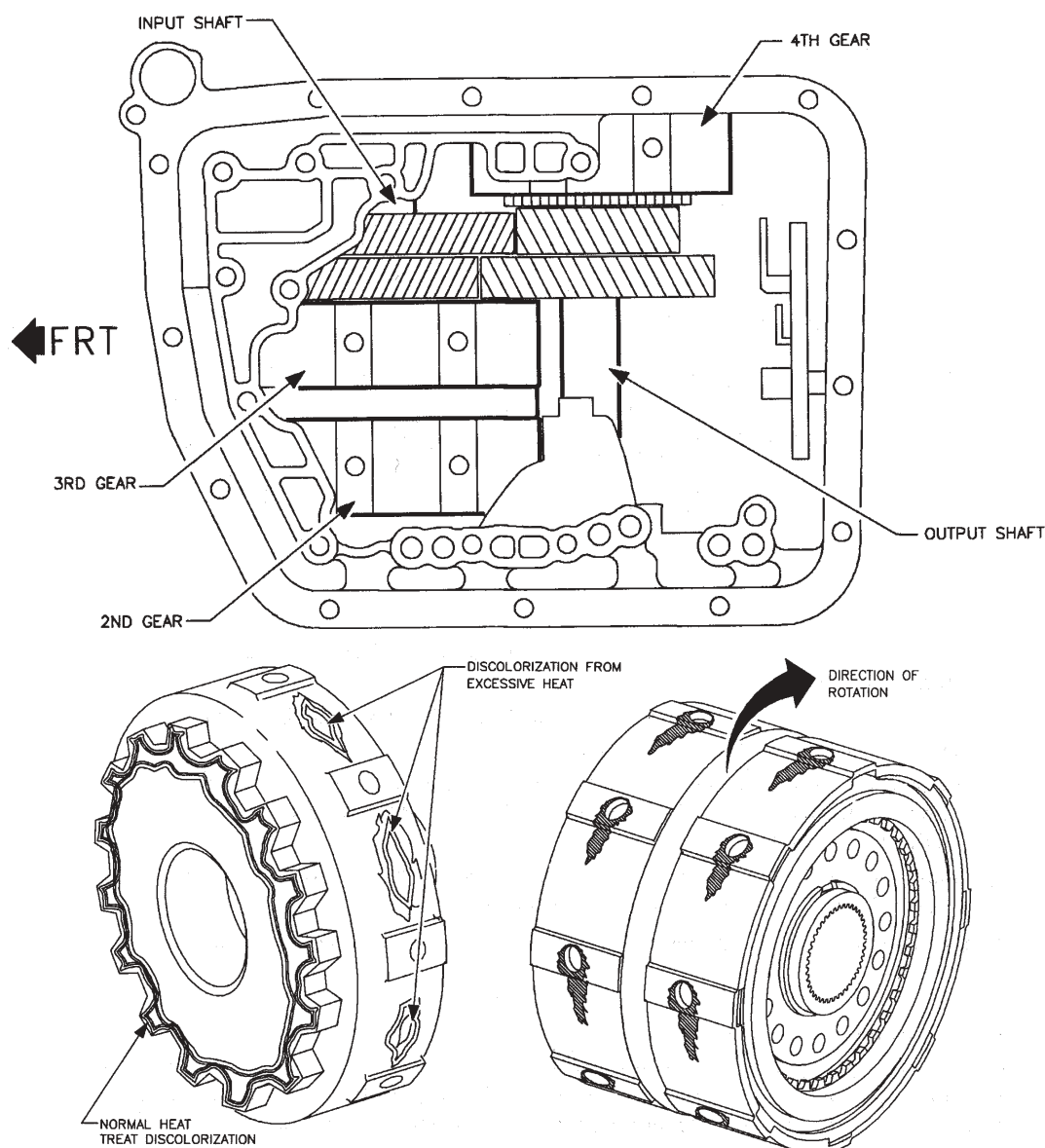


MP6/MP7

Harsh or Erratic Shifts, No Gear, Multiple Codes (continued)

Clutch housings and case, Clutch drums and lube holes:

Locate the areas of contamination in the case and clean as necessary.

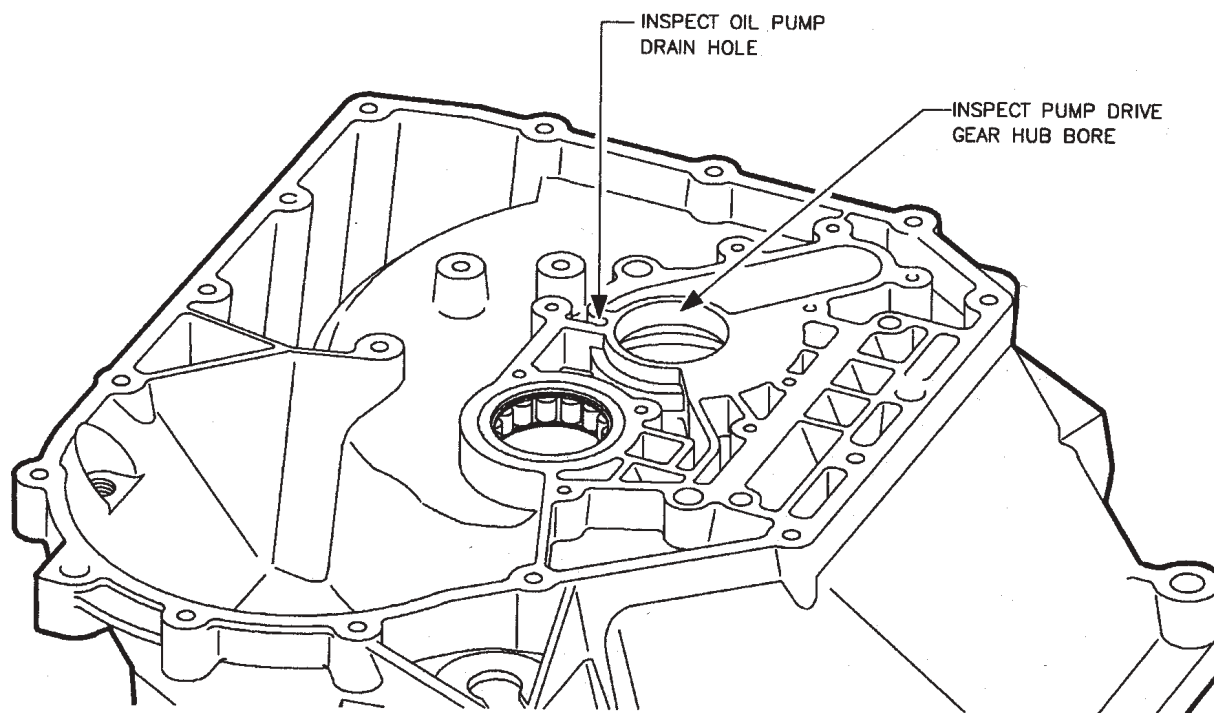


MP6/MP7

Harsh or Erratic Shifts, No Gear, Multiple Codes (continued)

Pump gear hub and drain hole

Check pump drive and gear assembly for pitting or scoring.



Chrysler

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Notes:

46/47RE 1998-Up Diesel

Lock-up and or 4th Gear Hunt, No Codes

In 1998, Dodge began using an Accelerator Pedal Position Sensor APPS instead of a Throttle Position Sensor TPS in the 5.9L Diesel Pick-ups. There are three major differences between the APPS and TPS.

1. Cost
2. The addition of two idle switches and
3. The APPS signal enters the Engine Control Module ECM then exits as the TPS signal to the Powertrain Control Module PCM.

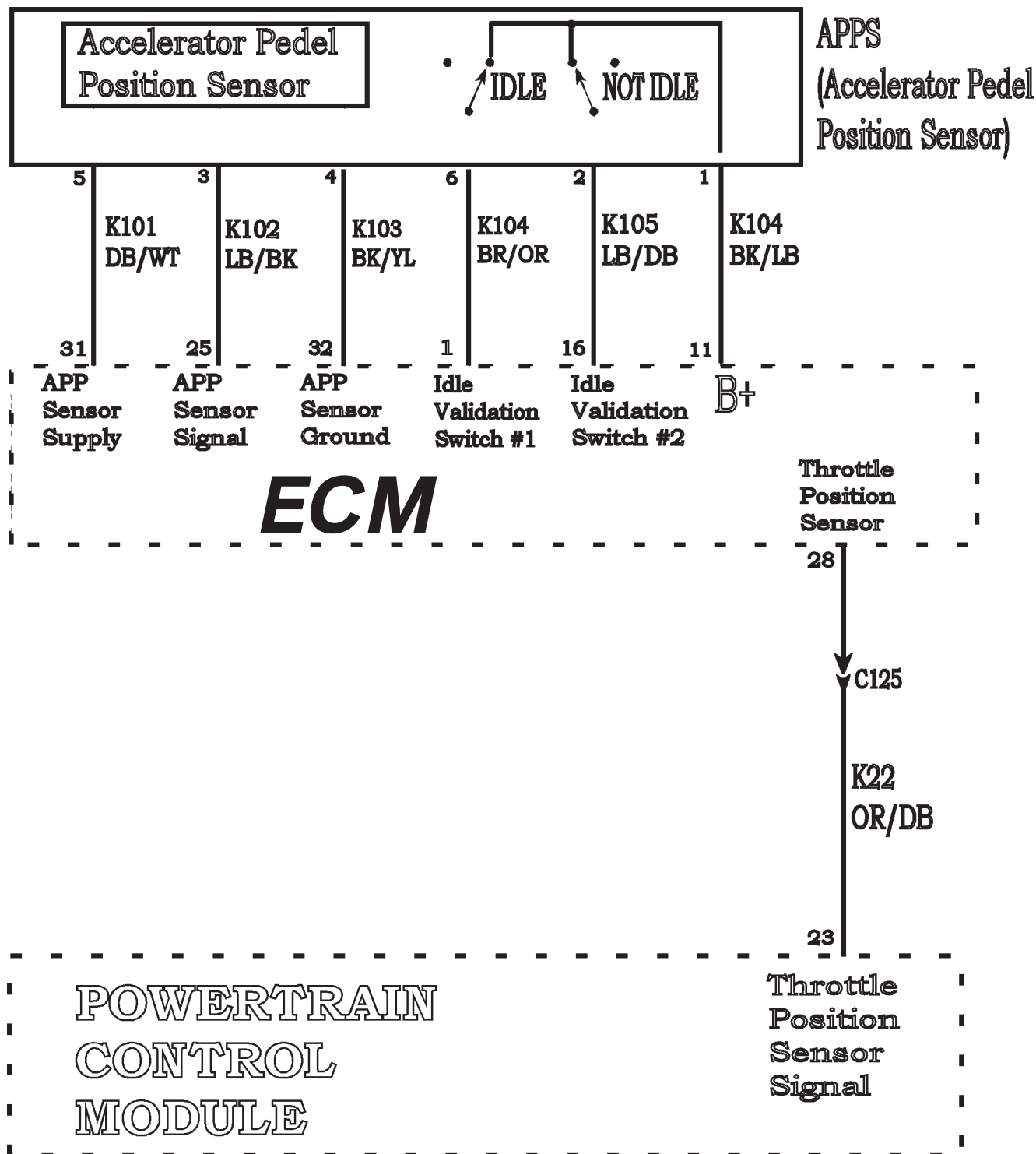
Concern: Lock-up and or 4th gear hunting with no codes present. Scan data shows hunt is commanded with no other parameters varying.

Cause: The most frequent failures occur either inside the ECM or in the wiring between the ECM and the PCM. The APPS input circuit H102 enters the ECM as a good signal, but the TPS output circuit K22 to the PCM is erratic. Transmission operation is affected because it is the primary job of the PCM to control its operation.

Repair: Jumper an additional wire into circuit H102. Cut the wire at circuit K22 at the PCM connector C1 terminal 23. Connect the jumper wire from circuit H102 to terminal 23 on PCM connector C1 and retest.

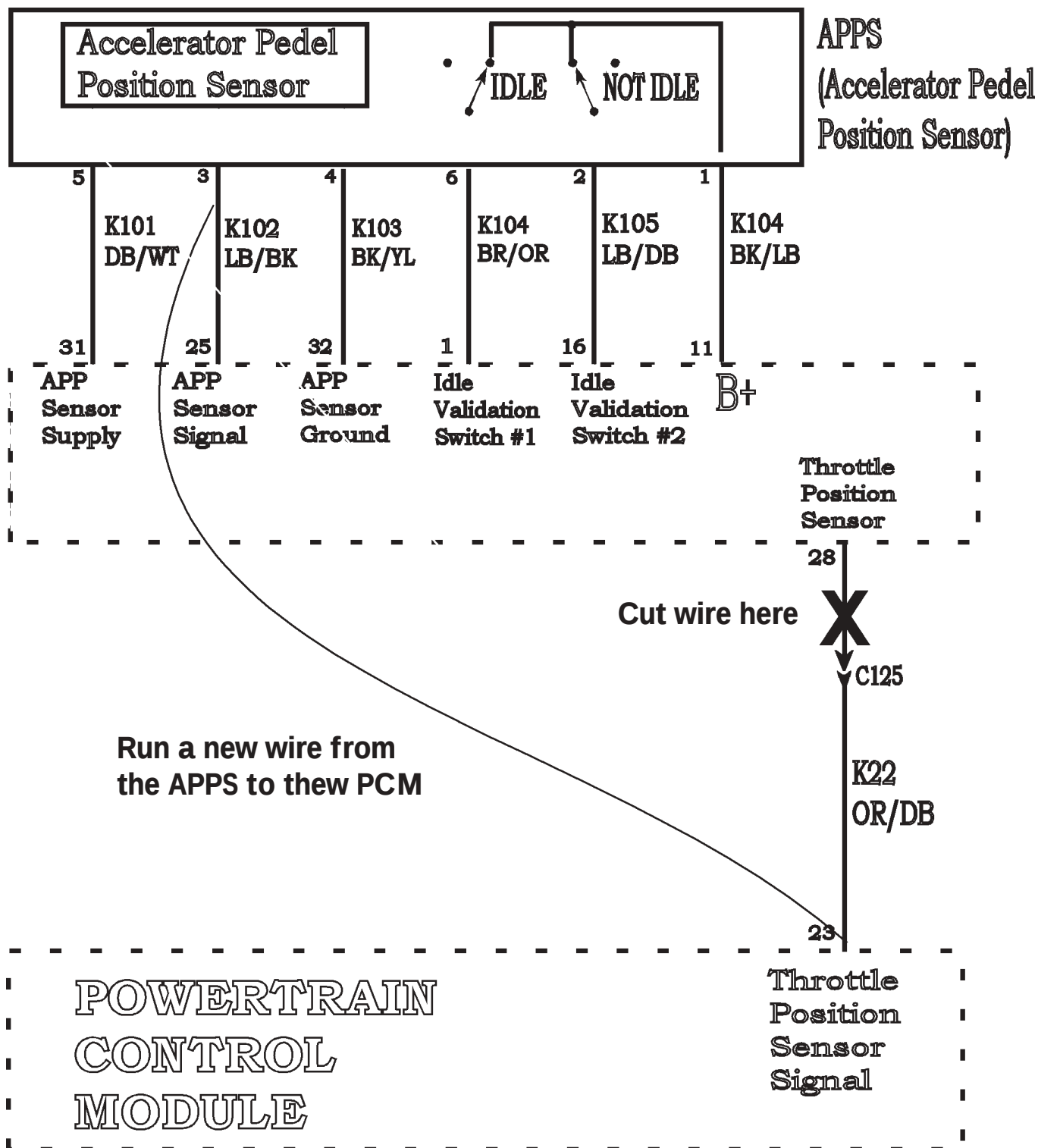
46/47RE 1998-Up Diesel

Lock-up and or 4th Gear Hunt No Codes (continued)



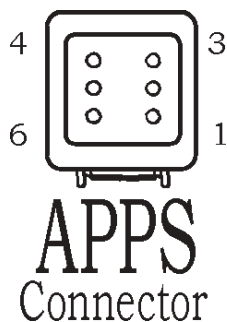
46/47RE 1998-Up Diesel

Lock-up and or 4th Gear Hunt No Codes (continued)



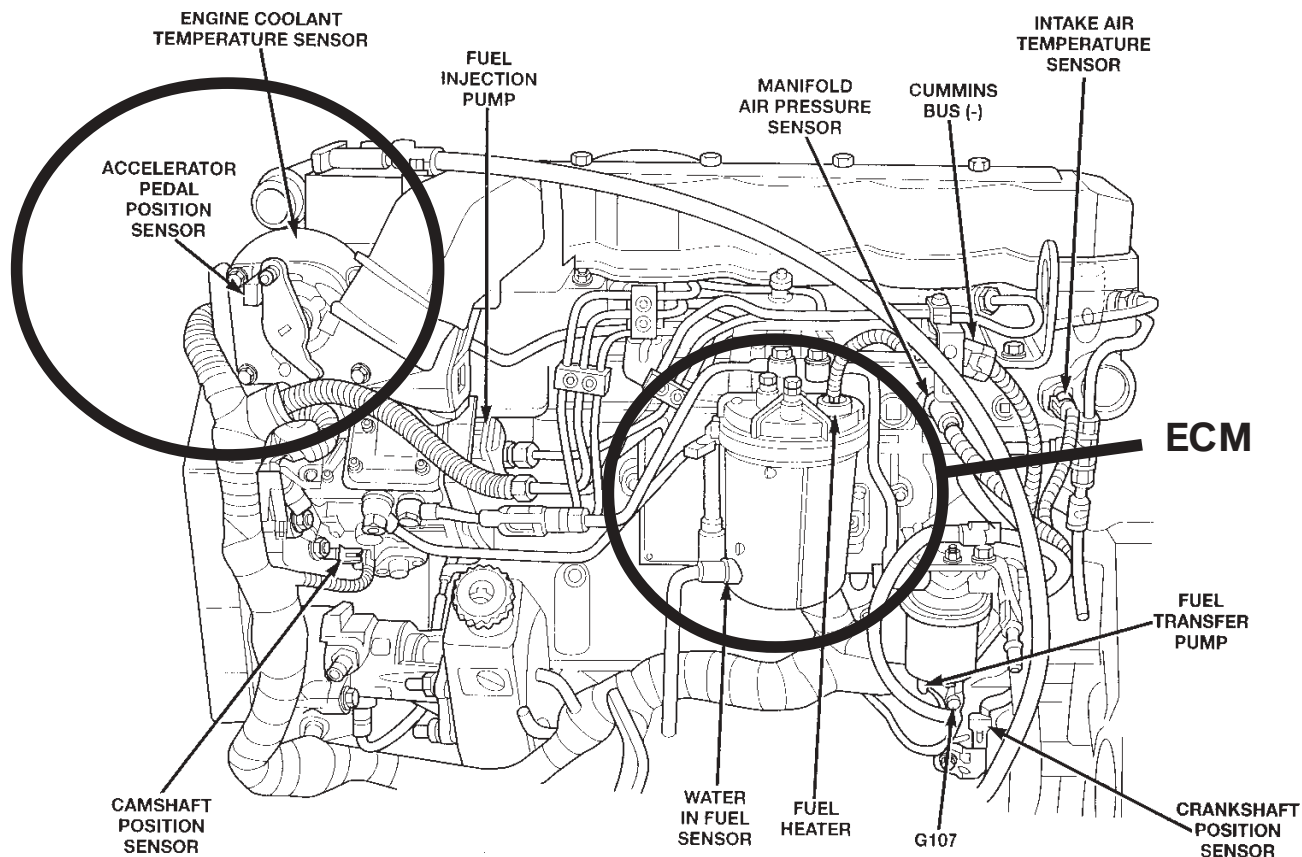
46/47RE 1998-Up Diesel

Lock-up and or 4th Gear Hunt No Codes (continued)



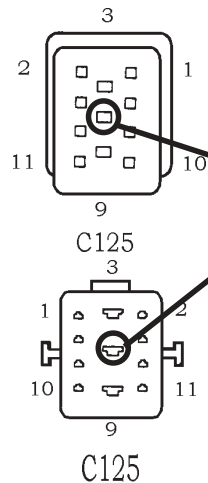
- 1 B+
- 2 Idle Switch No. 2
- 3 Accelerator Pedal Position Sensor Signal
- 4 Accelerator Pedal Position Sensor Ground
- 5 Accelerator Pedal Position Sensor Supply
- 6 Idle Switch No. 1

The ECM is located behind the water separator.



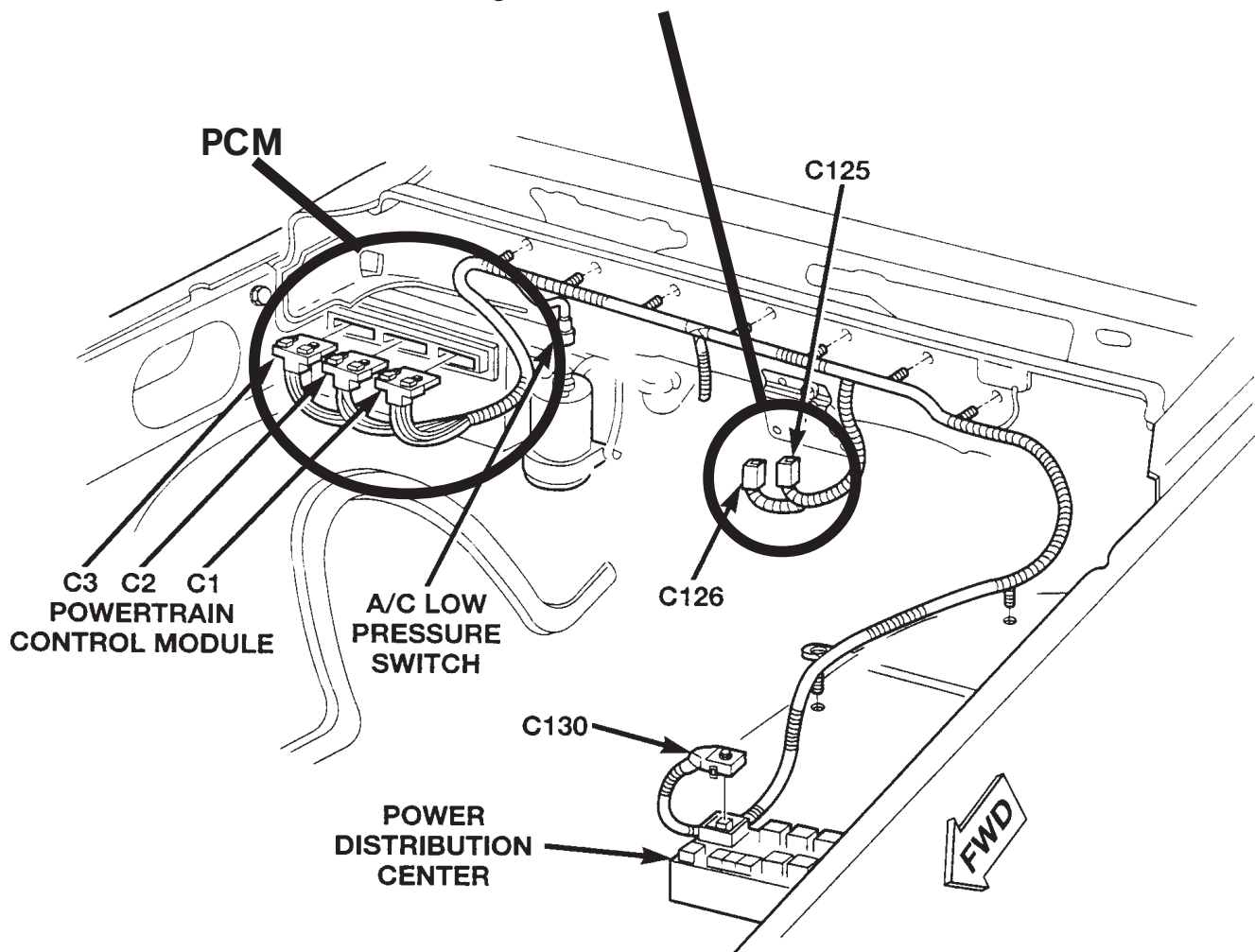
46/47RE 1998-Up Diesel

Lock-up and or 4th Gear Hunt No Codes (continued)



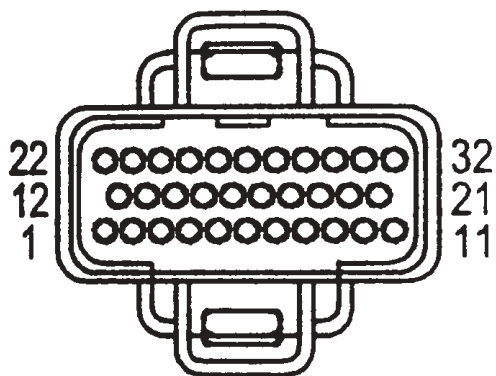
Pin 6 TPS signal to PCM from ECM

Make sure connection is good and no corrosion is evident.

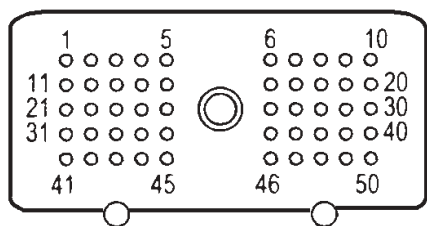


46/47RE 1998-Up Diesel

Lock-up and or 4th Gear Hunt No Codes (continued)



Pin 23-Throttle Position Sensor



**Engine Control
Module**

- | | |
|-----------|---|
| 1 | Idle Valve Switch No. 1 |
| 11 | B+ |
| 16 | Idle Valve Switch No. 2 |
| 25 | Accelerator Pedal Position Sensor Signal |
| 32 | Accelerator Pedal Position Sensor Ground |
| 31 | Accelerator Pedal Position Sensor Supply |

45RFE

Proper Oil Level Check Sequence

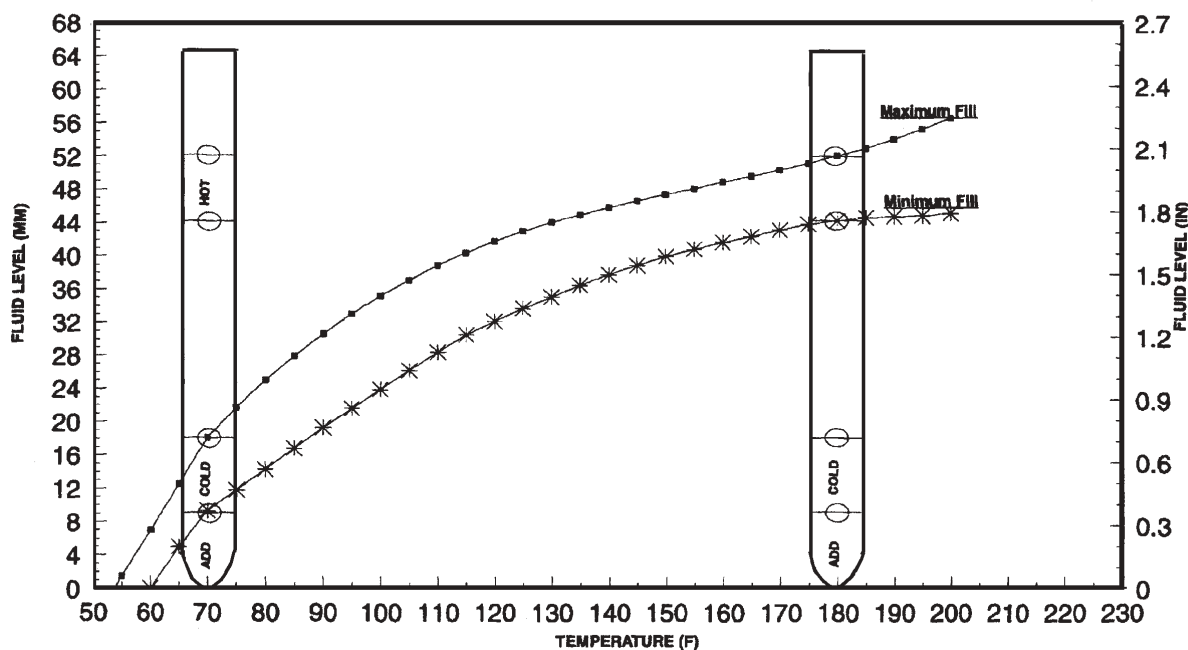
Accurate fluid level is difficult to determine. Initially add only five quarts of fluid during the refill procedure. This amount will allow the engine to be started and the transmission to be operated in neutral until the transmission temperature has reached at least 70°F. Once the fluid temperature is known, the final amount of fluid can be added without overfilling the transmission. During this procedure, pressure switch and/or loss of prime DTC's may be set.

There are a few things you need to do before checking the fluid level on a 45RFE.

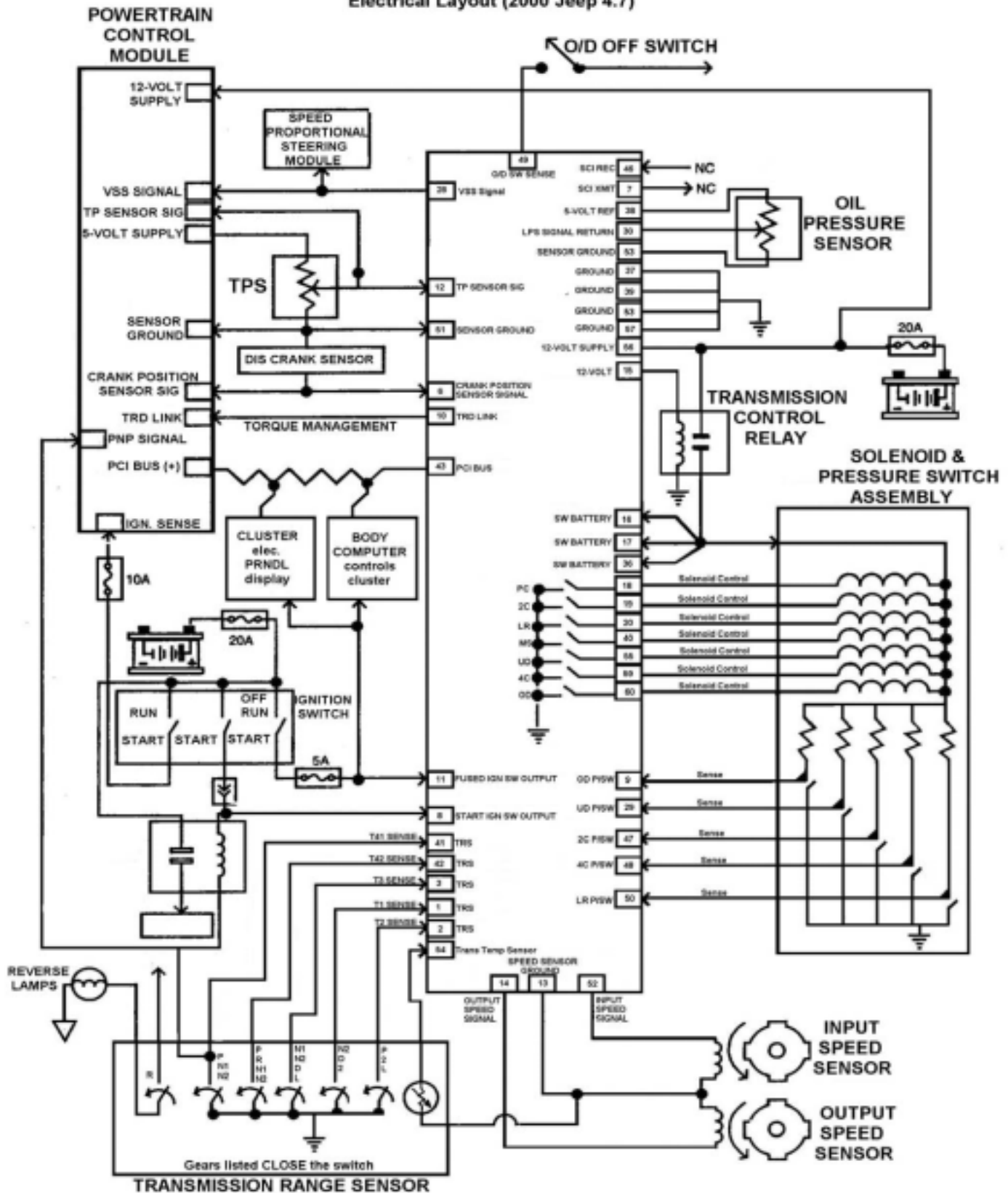
1. Warm to fluid to at least between 70°-180°F by operating the vehicle.
2. Measure the transmission fluid temperature using scanner.
3. Move the gear selector through drive and reverse. Place the gear selector in the Park position.
4. Check the fluid level against the chart below.

If the fluid temperature is below 50°F, it will not register on the dipstick.

45RFE - TEMPERATURE VS FLUID LEVEL

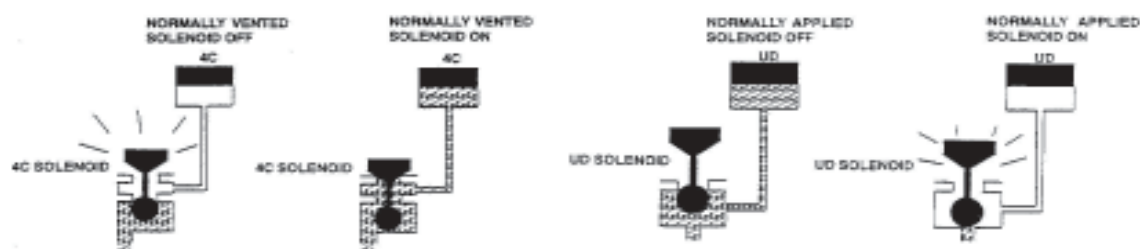


Electrical Layout (2000 Jeep 4.7)



45RFE

Solenoid Application Chart



Solenoid Application Chart

SOLENOIDS							
Manual Valve Lever Position	Gear	NA UD	NV OD	NV 4 th Clutch	NV 2 nd Clutch	NV L/R	NA MS
R	R						^^
P/N	P/N					(X)	
OD	D1					(X)	X
OD	D2				X		X
OD	D2'			X			X
OD	[D3]		X				X
OD	*D3*						
OD	[D4]	X	X	X			X
OD	*D4*	X		X			
OD L/I	3 rd						
M2 L/I	2 nd						

^^ = On only if shift to Reverse is above 8 MPH.

() = On only at speeds less than 8 MPH.

{ } = On only from Neutral or coast down or in manual 1. Off with output RPM above

100. Off with kickdown to 1st. Off during extreme cold shift schedule.

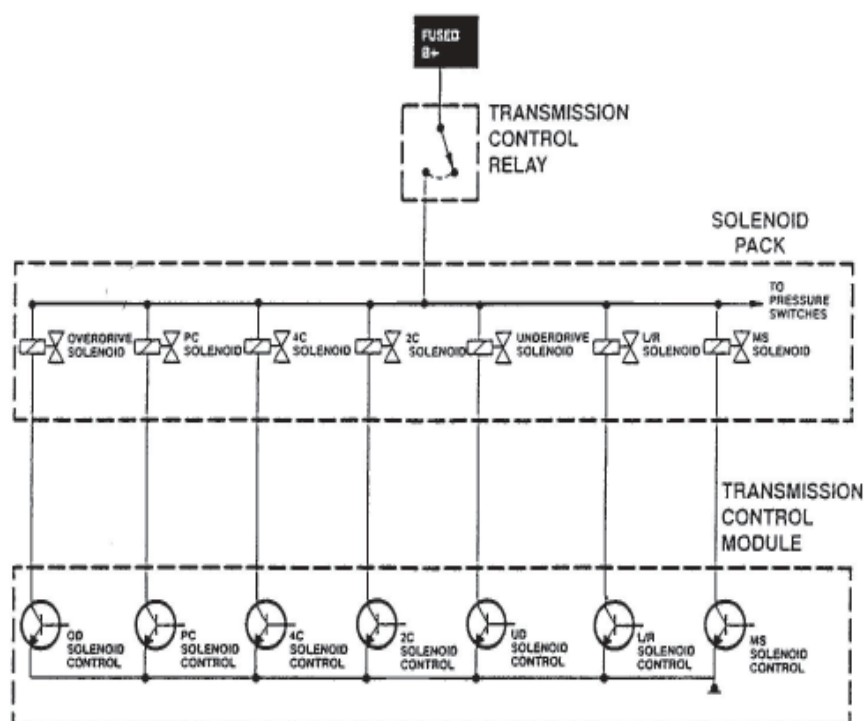
[] = Without ESL

** = With ESL, D2' = 2 Prime.

45RFE

Solenoid Application Chart (continued)

These solenoids get their power supply from the transmission relay. The computer regulates the solenoids by pulsing the ground side of the solenoid. In doing this the computer can regulate how much oil will feed through each circuit.



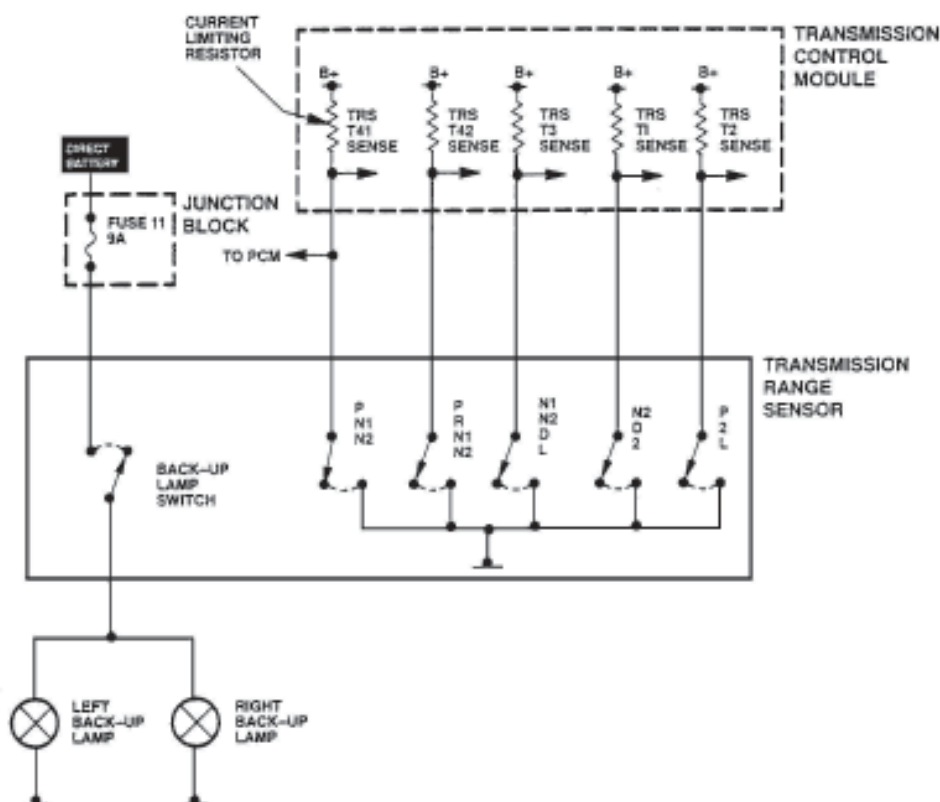
LR/TCC, OD, UD, 2nd, 4th, MS
Line pressure solenoid

1.9 Ohms
4.3 Ohms

45RFE

Transmission Range Sensor (TRS)

The TRS is a series of open switches. Each switch must function in the order listed in the chart for the computer to know what range and is present when the switches are selected. Battery voltage is supplied by the computer to the switches, when the switches close, the circuit goes to ground. The switches must close in the correct sequence or the PCM will see a fault and set codes pertaining to the TRS.

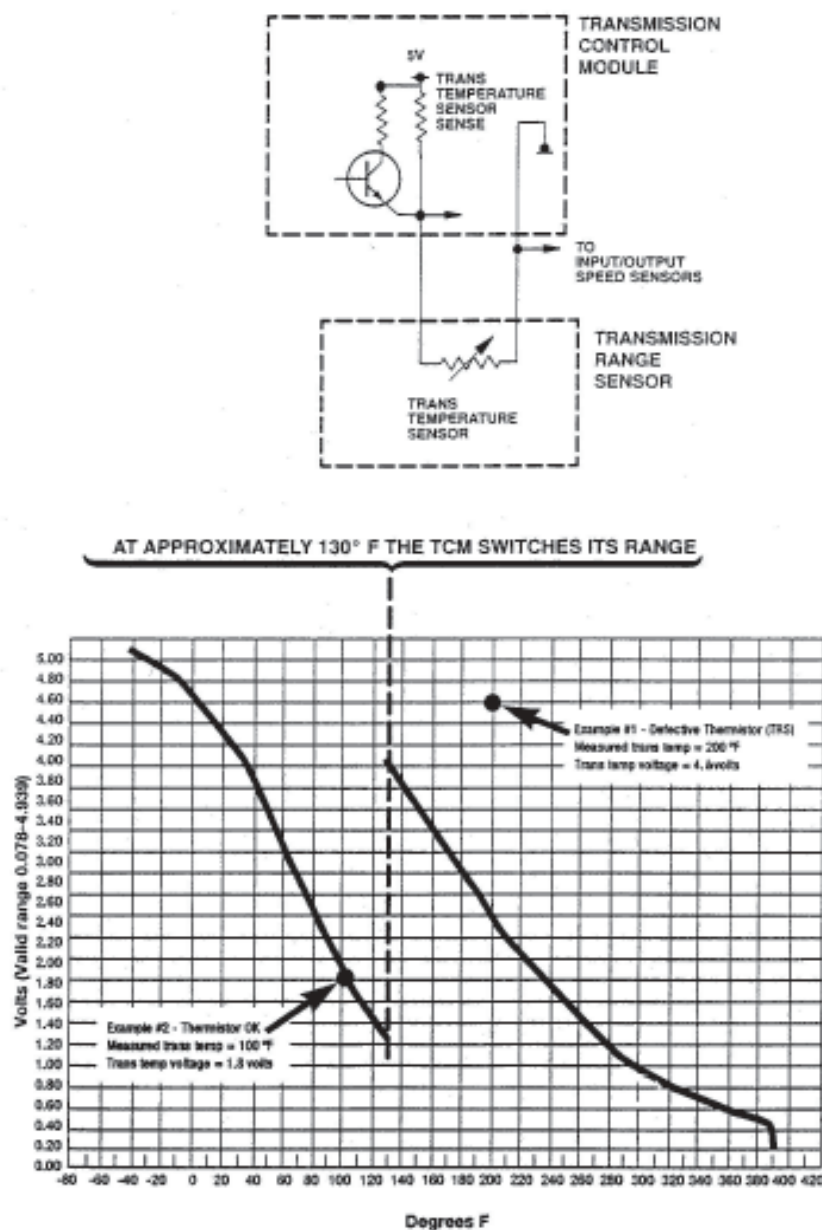


	T1 (C4)	T2 (C5)	T3 (C3)	T81 (C1)	T42 (C2)
Park	OP	CL	OP	CL	CL
Tmp 1	OP	CL	OP	OP	CL
Rev	OP	OP	OP	OP	CL
Tmp 2	OP	OP	CL	OP	CL
N1	OP	OP	CL	CL	CL
N2	CL	OP	CL	CL	CL
Tmp 3	CL	OP	CL	OP	CL
D	CL	OP	CL	OP	OP
Tmp 4	CL	OP	OP	OP	OP
2	CL	CL	OP	OP	OP
Tmp 5	OP	CL	OP	OP	OP
L	OP	CL	CL	OP	OP

45RFE

Transmission Oil Temperature (TOT) Sensor

TOT resistance varies with transmission oil temperature. The computer supplies a 5.0V reference. As temperature increases, TOT resistance decreases and visa versa. When transmission temperature reaches about 130°F there is an internal switch in the TCM that changes the voltage scale as shown in the chart below.

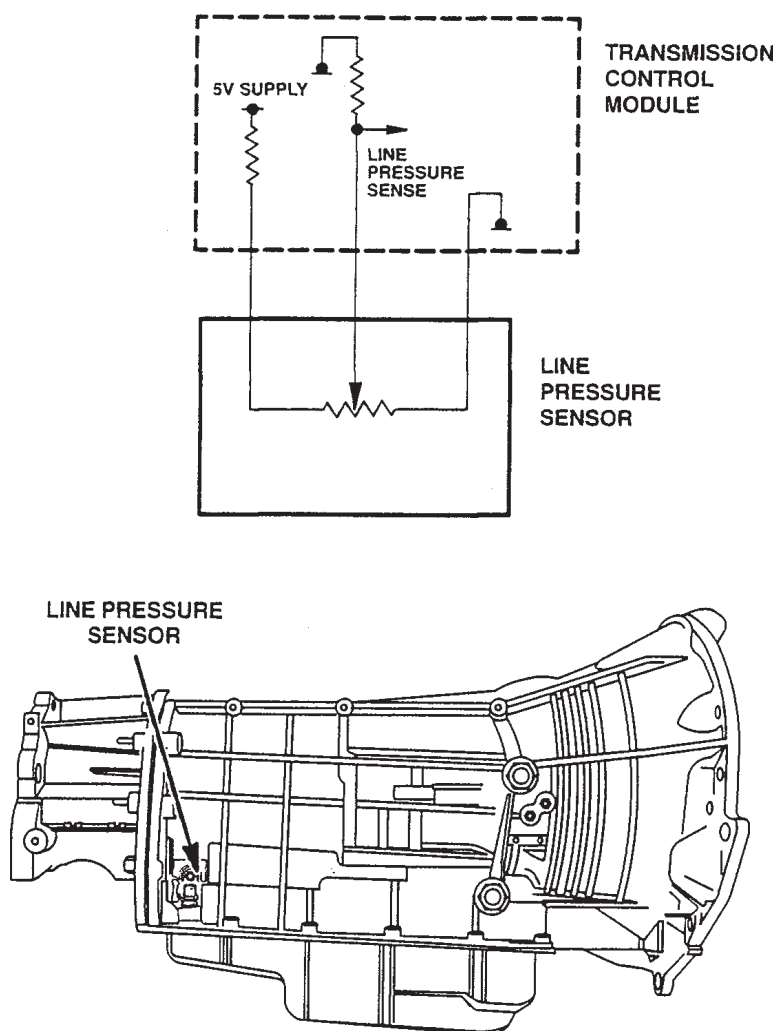


45RFE

Line Pressure Sensor (LPS)

Line pressure is controlled by the TCM it receives it's signal from the line pressure sensor (LPS). The LPS is a variable pressure sensor that gives a direct input to the TCM. A plunger inside of the solenoid sets the varying voltage. This sensor works under the same principle as the TPS but instead of having a mechanical sweep, the TCM calculates the desired line pressure based on the inputs from the transmission and engine. The TCM calculates torque input to the transmission and uses it as the primary input to the desired line pressure calculation. This is called "Torque Based Line Pressure".

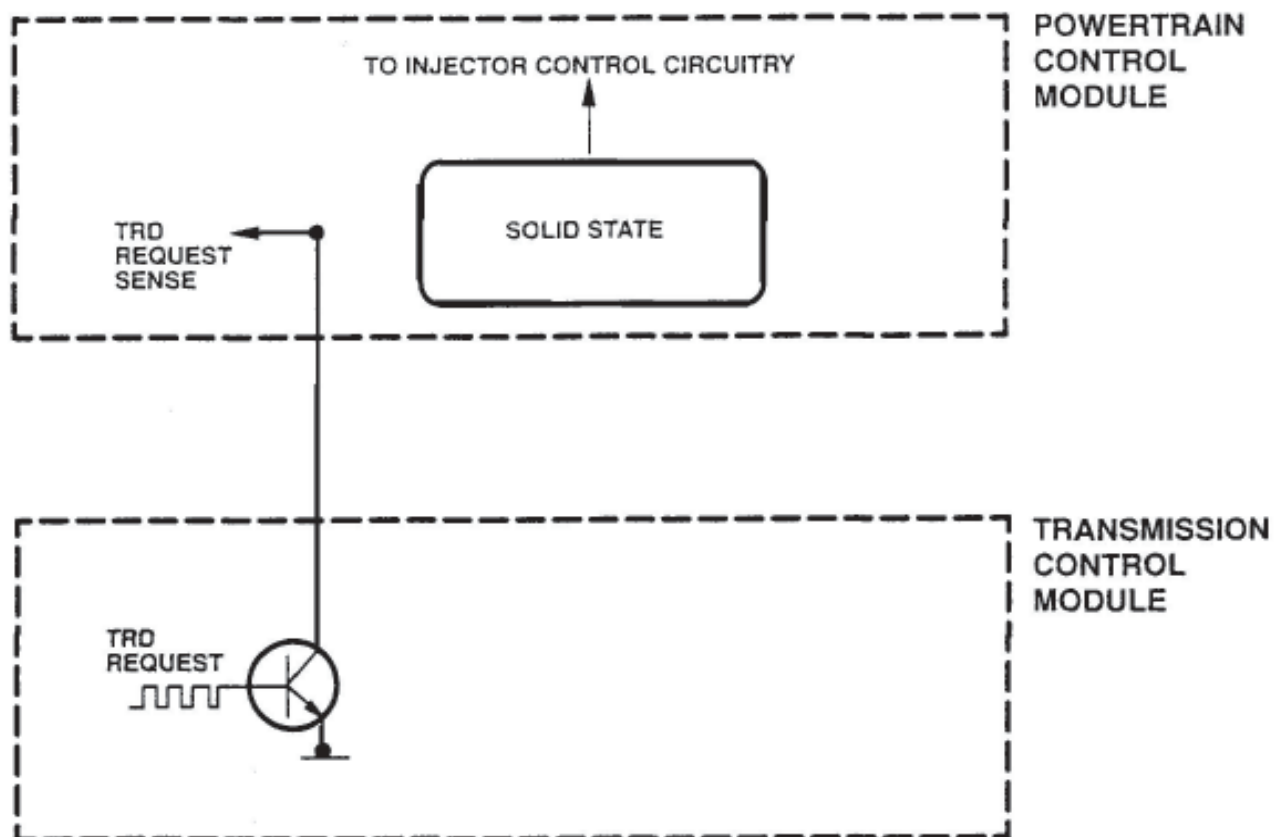
Neutral to ensure consistent shift quality.



45RFE

Torque Reduction (TRD)

During high torque shifts the TCM sends a message to the PCM requesting that the PCM reduce engine power until the shift is complete. The PCM reduces engine torque by shutting off a certain number of fuel injectors and retarding ignition timing slightly. This message is sent from the TCM to the PCM across the TRD sense circuit. The PCM acknowledges the TCM's request by sending a confirmation message across the Data Bus. The TRD link communication is also tested periodically for operation whenever the engine is running and the vehicle is not moving and at zero degrees throttle. If torque reduction is requested from the TCM and there is no confirmation back from the PCM it will set a code that does NOT illuminate the MIL or result in limp-in. What you will see is the transmission upshift at lower RPMs when the throttle is at or near Wide Open Throttle and a complaint of short shifting or lack of power. This will also inhibit high speed 2-1, 3-2, 4-3 and 4-2 kickdowns at heavy throttle.



45RFE

Harsh 1-2, 2-3 & 4-3

Vehicles equipped with a 45RFE transmission may experience the following shift quality issues:

- A harsh 2-3 upshift causing a powertrain clunk or shudder when accelerating.
- A harsh 1-2 upshift during light or wide open throttle accelerations.
- A harsh 4-3 kickdown shift during low speed, light throttle conditions.

TCM and Reprogramming

The revision to the TCM software addresses the above shift quality conditions for all vehicles, and adds a final gear ratio to the Grand Cherokee transmission only.

Only the 1999 and 2000 Grand Cherokee vehicles, with a Federal Emissions System (NAA) and PCM software that is earlier than calibration level 99- Cal-19A (for 1999 M.Y.) or 00-Cal-16A (for 2000 M.Y.), require PCM reprogramming. Verify the current calibration level of the PCM.

45RFE

Quick Learn Procedure

Clutch volume index (CVI) represents the volume of fluid needed to stroke the clutch return spring. The programming of the TCM allows it to constantly monitor the time it takes to fill the clutch. If the TCM detects a longer or shorter than normal shift it will try to make the necessary adjustments to the solenoids through modulating the duty cycle. By doing this the TCM can keep the shift quality consistent over the life of the vehicle.

L/R Clutch volume is updated when doing a 2-1 or 3-1 manual downshift to lower gear with the throttle angle below 5°. Transmission temperature must be above 110°F. the Clutch volume should be between **82-134**

2C Clutch volume is updated when doing a 3-2 kickdown shift with the throttle angle between 24° and 54°. Transmission temperature must be above 110°F. the Clutch volume should be between **25-64**

OD Clutch volume is updated when doing a 2-3 upshift with the throttle angle below 5° and 54°. Transmission temperature must be above 110°F. the Clutch volume should be between **25-64**

4C Clutch volume is updated when doing a 3-4 upshift with the throttle angle between 5° and 54°. Transmission temperature must be above 110°F. the Clutch volume should be between **30-64**

UD Clutch volume is updated when doing a 4-3 kickdown shift with the throttle angle between 20° and 54°. Transmission temperature must be above 110°F. the Clutch volume should be between **44-92**

45RFE

Quick Learn Procedure (continued)

Concern: The transmission doesn't shift smoothly. This condition may occur even after a Quick Learn procedure has been completed. The 45RFE transmission adapts to its mechanical tolerances by learning the clutch volume indexes (CVI's) as well as the duty cycle and other parameters that control shift quality. Performing a Quick Learn will simply reset all transmission adaptive values to factory preset values and it will exercise the transmission clutches to learn an approximate value for the clutch CVI's.

Quick Learn should not be used as a remedy for shift quality complaints. Quick Learn resets more than 70 learn parameters to their preset values and will require them to be relearned.

Quick Learn should only be used when a transmission has been replaced or overhauled, or when the Transmission Control Module has been replaced or flashed. Once Quick Learn is performed, an initial drive evaluation should be performed to determine if the transmission is shifting smoothly.

The first step is to verify that the shifter linkage is adjusted properly and that the CHECK PRNDL fault (code 28) is not present.

A misadjusted shifter will not set code 28. A misadjusted shifter cable will however cause poor 2-3 shift quality.

It is critical that the PRNDL code be OD when the shifter is in the OD position gate. Use a scan tool to confirm that the correct code is present. If the shifter has a temporary code (T3 or T4) in the OD shifter position, then this is the most likely cause for consistent poor 2-3 shift quality. If the linkage is out of adjustment, then adjust the shifter cable.

Perform the portion of the following 45RFE Quick Learn Procedure that will learn the specific shift characteristic for the shift problem in question.

45RFE

Quick Learn Procedure (continued)

Procedure to Learn a Smooth 1st Neutral to Drive Shift

Perform this procedure only if the complaint is for a delayed or harsh shift the first time the transmission is put into gear after the vehicle is allowed to set with the engine not running for at least 10 minutes. Use the following steps to have the TCM learn the 1st N-1 UD CVI.

NOTE: **The transmission oil temperature must be between 80°-110° F (27°-43°C).**

- Start the engine only when the engine and ignition have been off for at least ten (10) minutes.
- With the vehicle at a stop and the service brake applied, record the UD CVI while performing a Neutral to Drive shift. During the shift, the UD CVI will temporarily show a different value which is the 1st N-1 UD CVI. The 1st N-1 UD CVI account for air entrapment in the UD clutch that may occur after the engine has been off for a period of time.
- Repeat until the recorded 1st N-1 UD CVI value stabilizes.

It is important that this procedure be performed when the transmission temperature is between 80°-110° F (27°-43°C). If this procedure takes too long to complete fully for the allowed transmission oil temperature, the vehicle may be returned to the customer with an explanation that the shift will improve daily during normal vehicle usage. The TCM also learns at higher oil temperatures, but these values (line pressure correction values) are not available for viewing on a scan tool.

45RFE

Quick Learn Procedure (continued)

Procedure to Learn a Smooth Neutral to Drive Garage Shift

Perform this procedure if the complaint is for a delayed or harsh shift when the transmission is put into gear after the vehicle has had its first shift. Use the following steps to have the TCM learn the N-1 UD CVI.

NOTE: **The transmission oil temperature must be between 80°-110° F (27°-43°C).**

- Start the vehicle engine and shift to drive.
- Move the vehicle forward to a speed of at least 10 MPH and come to a stop.
- Perform repeated N-1 shifts at a stop while pausing in Neutral for at least 2-3 seconds and monitor UD CVI volume until the value stabilizes. The value will change during the N-D shift. This is normal since the UD value is different for the N-1 shift than the normal value shown which is used for 4-3 coastdown and kickdowns. Perform repeated shifts in this temperature range until the UD CVI value stabilizes and the N-1 shifts become smooth.

Procedure to Learn 1st 2-3 Shift After a Restart or Shift to Reverse

Use the following procedure to have the TCM learn the 1st 2-3 shift OD CVI.

NOTE: **The transmission oil temperature must be above 80°F (27°C).**

- With the vehicle engine running, select reverse gear for over 2 seconds.
- Shift the transmission to Drive and accelerate the vehicle from a stop at a steady 15 degree throttle opening and perform a 2-3 shift while noting the OD CVI. During the shift, a different value will appear on the screen, which is the 1st 2-3 OD CVI.
- Repeat until the 1st 2-3 upshift becomes smooth and the 1st 2-3 OD CVI stabilizes.

45RFE

Quick Learn Procedure (continued)

Procedure to Learn a Smooth 2-3 Shift and 3-4 Upshift

Use the following procedure to have the TCM learn the OD and 4C CVI's.

NOTE: The transmission oil temperature must be above 110°F (43°C).

- Accelerate the vehicle from a stop at a steady 15 degree throttle opening and perform multiple 1-2, 2-3, and 3-4 upshifts. The 2nd 2-3 shift following a restart or shift to reverse will be shown during the shift as a value between the 1st 2-3 OD CVI and the normal OD CVI. Updates to the normal OD CVI will occur after the 2nd shift into 3rd gear, following a restart or shift to reverse.
- Repeat until the 2-3 and 3-4 shifts become smooth and the OD and 4C CVI become stable.

Procedure to Learn a Smooth 4-3 Coastdown & Part Throttle 4-3 Kickdown

Use the following procedure to have the TCM learn the UD shift volume.

NOTE: The transmission oil temperature must be above 110°F (43°C).

- At a vehicle speed between 40 - 60 MPH, perform repeated 4-3 kickdown shifts.
- Repeat until the UD volume becomes somewhat stable and the shift becomes smooth.

Procedure to learn 1st 2-3 shift after a restart or shift to reverse

Use the following procedure to have the TCM learn the 2C shift volume.

NOTE: The transmission oil temperature must be above 110°F (43°C).

- With a vehicle speed below 30 MPH and the transmission in 3rd gear, perform multiple 3-2 kickdowns.
- Repeat until the 3-2 kickdowns become smooth and the 2C CVI becomes stable.

45RFE

Quick Learn Procedure (continued)

Procedure to Learn a Smooth Manual 2-1 Pulldown Shift as well as a Neutral to Reverse Shift

Use the following procedure to have the TCM learn the LR volume.

NOTE: The transmission oil temperature must be above 110°F (43°C).

- With the vehicle speed around 25-30 MPH in Manual 2nd, perform manual pulldowns to Low or 1st gear at closed throttle.
- Repeat until the LR CVI become stable and the manual 2-1 becomes smooth

Procedure to Learn a Smooth Neutral to Reverse Shift

Perform the following shifts.

NOTE: The transmission oil temperature must be above 110°F (43°C).

- With the vehicle at a stop, perform Neutral to Reverse shifts until the shift is smooth. An unlearned Neutral to Reverse shift may be harsh or exhibit a double bump.

If any of the shifts are still not smooth after the clutch volume stabilizes, an internal transmission problem may be present.

45RFE

Shift Quality Concerns after TCM Replacement

Whenever a Transmission Control Module (TCM) is replaced due to failure, the software of the replacement controller must be verified for the latest revision level. Use the flash procedure to update replaced controllers as necessary.

Several improvements in shift quality have recently been made to address the following concerns:

- Harsh (light throttle) 1 - 2 shift between 10 and 15 miles per hour.
- Low speed (10 - 12 mph) light throttle tip in bump.
- Drone at approximately 40 - 45 mph in 4th gear with EMCC engaged.
- Slow (1 1/2 to 2 seconds) park/neutral to drive engagement.
This condition may occur after the first key “ON” or once after subsequent key “ONs” with a soak time of several minutes or more. This will not address long engagements due to pump loss of prime.
- Neutral coastdown bump at approximately 8 miles per hour.
This may occur if a customer coasts to a stop with the transmission in neutral.
- Neutral to drive engagement harshness with the vehicle rolling between 5 and 10 miles per hour. This may occur if a customer is coasting in neutral within the specified speed range and shifts the transmission into drive.

42, 46RE

Intermittent Harsh Engagement Into Reverse

This applies to 1999 and 2000 model year vehicles equipped with either a 42RE automatic transmission built before September 1, 1999 or 2000 model year vehicles equipped with a 46RE automatic transmission built before December 1, 1999.

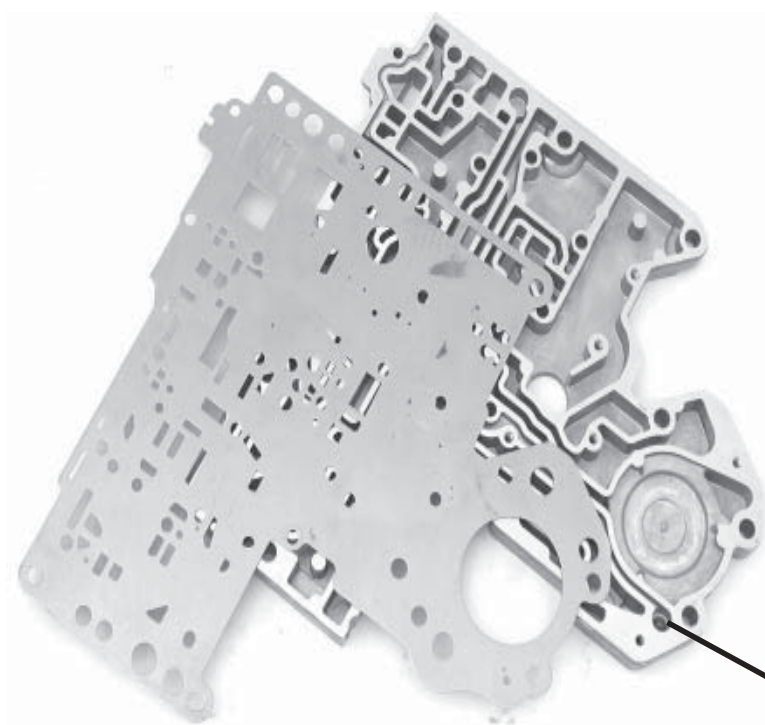
Concern: Harsh engagement into Reverse. This condition may be intermittent, and may occur more frequently as the transmission fluid warms to normal operating temperatures.

Common Cause: Check ball not seating properly

Repair: For both the 1999 and 2000 M.Y. 42RE and 46RE Transmission:

- Replace the original steel rear servo check ball with the plastic check ball.
- Install the new transmission valve body upper housing separator plate.
- Reassemble the transmission.

Qty.	Part No.	Description
1	52118261	Rear Servo Check Ball (plastic for 42RE and 46RE)
1	52118272	Plate, Valve Body Separator (42RE trans.)
1	04617196AB	Plate, Valve Body Separator (46RE trans.)



Rear Servo Check Ball

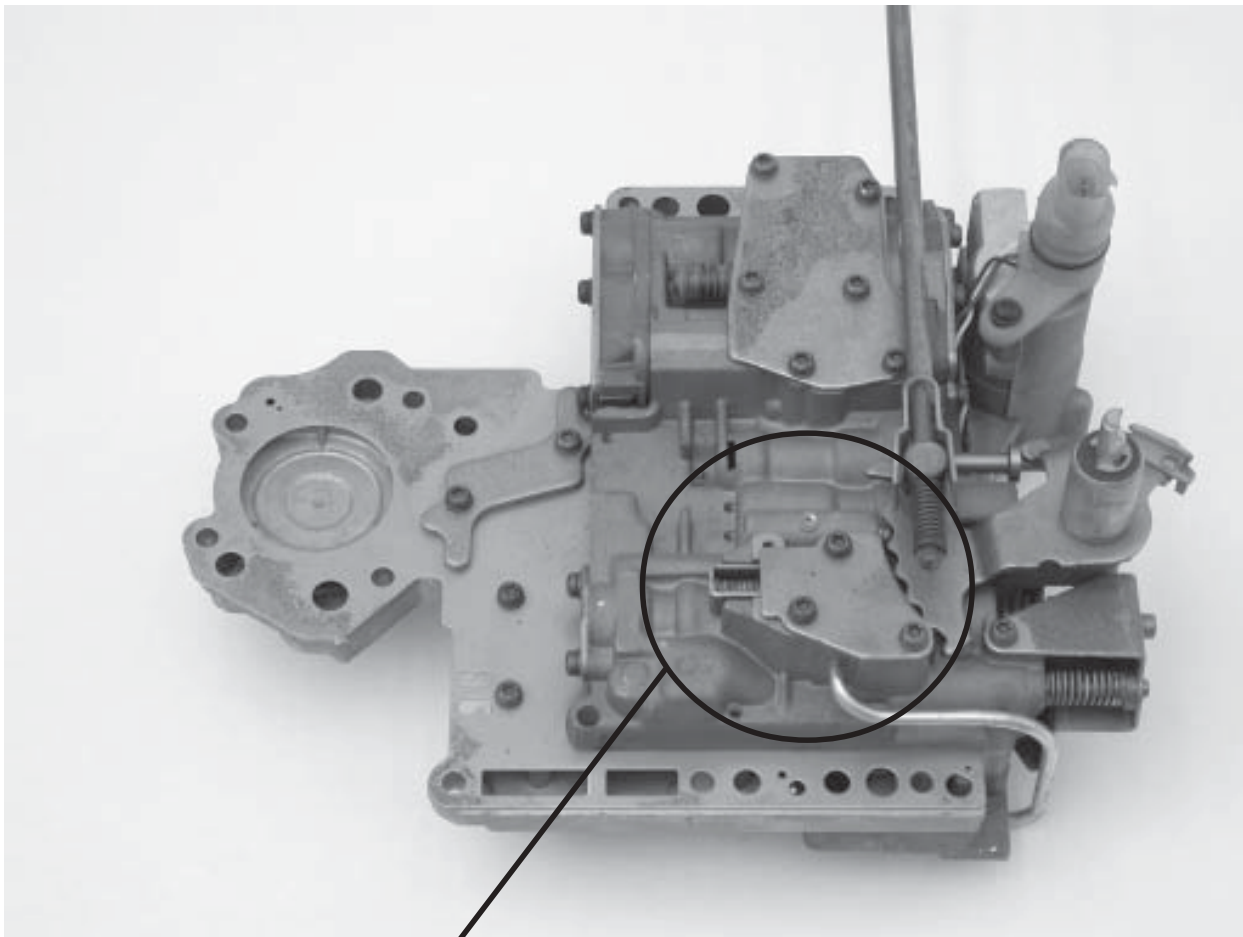
All RWD 4SP RH/RE Series with Pressure Boost Valve

P0740, P1740 TCC Performance

In fourth gear or when lock-up is applied the pressure boost valves function is to provide approximately 5psi of line rise.

Concern: Code present with no apparent driveability concern. More common with diesel motors.

Common Cause: Intermittent momentary TCC slip, caused by insufficient line pressure boost.

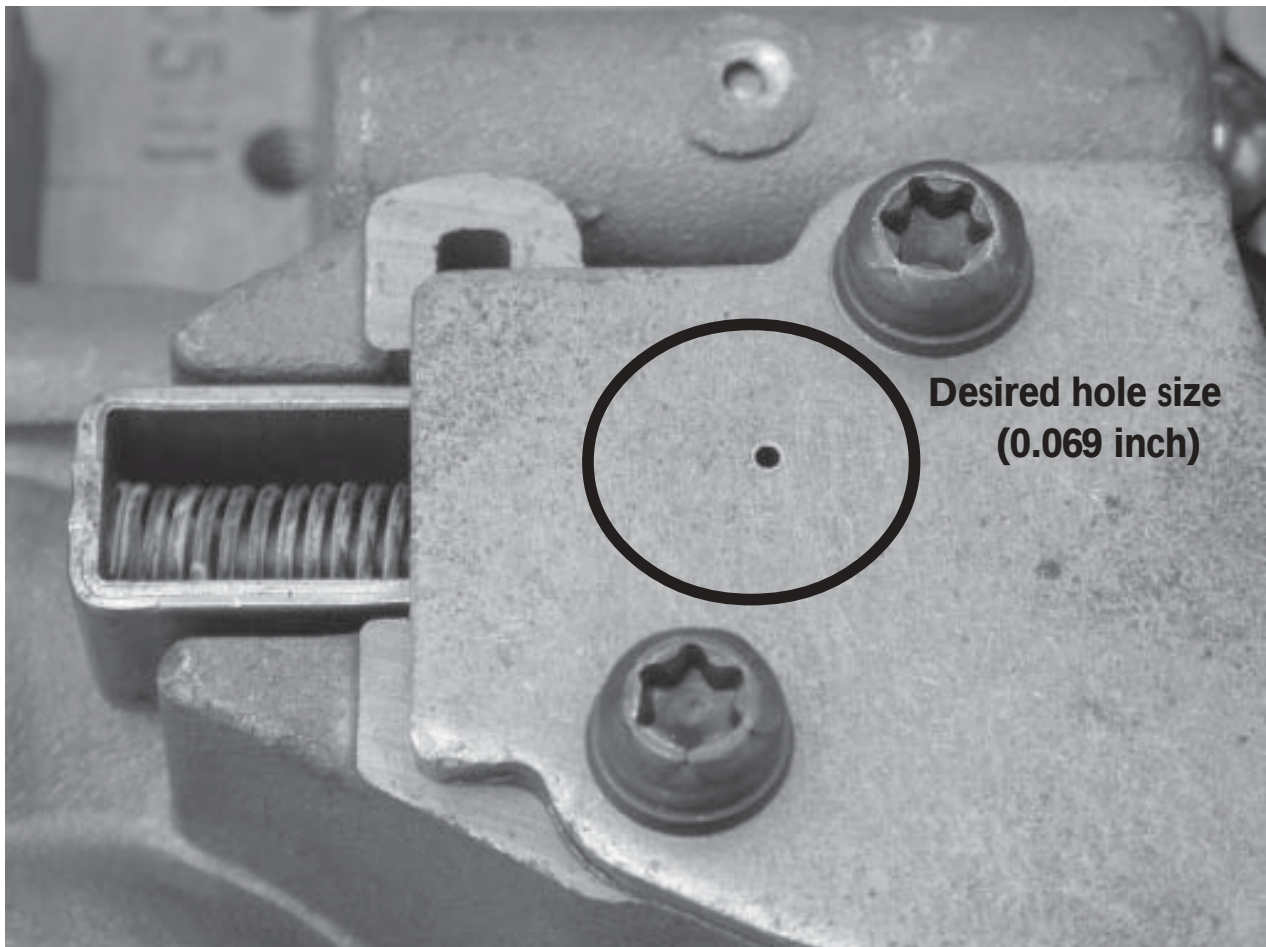


Boost Valve Location

All RWD 4SP RH/RE Series with Pressure Boost Valve

P0740, P1740 TCC Performance

Repair: Enlarge pressure boost valve exhaust hole from 0.048" to 0.069".



42RE, 44RE, 46RE, and 47RE

Vehicle Bucking During Wide-Open Throttle Acceleration

Concern: Some vehicles may experience bucking during wide-open throttle (WOT) acceleration. The bucking occurs at approximately 5300 RPM.

Common Cause: This condition may be caused by reaching the high RPM fuel shut off rev limit before the transmission can shift into the next higher gear and is most likely to occur with high electrical loads (high beams on, heated seats, radio, blower motor on MAX, etc.). During high current demands, the generator may emit electrical noise that can affect the transmission governor pressure sensor output. If this occurs, the transmission may not shift properly to the next higher gear under (WOT) acceleration conditions and therefore reach the fuel shut off rev limiter. This may be seen most often between the 2-3 shift but can also be experienced between the 1-2 shift.

Testing: Attempt to duplicate the condition by switching on all accessory loads and driving the vehicle with WOT accelerations through a shift sequence to see if the engine will reach the fuel shut off rev limiter before the 2-3 or 1-2 shift is made.

If the bucking condition is experienced at approximately 5300 RPM before making the appropriate upshifts, switch off all electrical loads and repeat the procedure. Repeat the procedure with the electrical loads on and off a second time. If the bucking occurs with the electrical loads on and does not occur with the loads off.

Repair: Replace the governor pressure sensor.

Part Number	Description
P/N 56041403AA	Sensor, Governor Pressure

41TE

Underdrive Accumulator Springs

Mitsubishi Eclipse and Dodge Stratus vehicles equipped with a 41TE transaxle have underdrive accumulator springs that are different from other applications. These vehicles have an inner and an outer spring unlike other applications that only used the outer spring. The outer spring is color coded. Typically this coding is unrecognizable after cleaning or high mileage. Use the information below to identify the springs.

Outer spring Eclipse & Stratus:

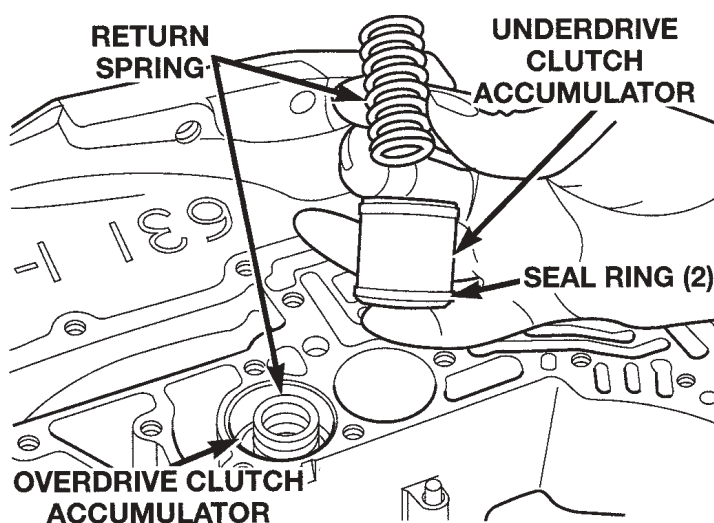
- (color) green
- (height) 2.110"
- (wire diameter) .112"

Outer spring most models:

- (color) none
- (height) 1.930"
- (wire diameter) .151"

Inner spring

- (color) none or yellow stripe
- (height) 1.693"
- (wire diameter) .116"



Mitsubishi

Contents

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Notes:

F4A41/42/51

Transmission Identification

Transmission identification has been difficult because of multiple gear ratios and early production units not using a one-way clutch. The illustration below shows a sample of an ID code. The chart on page 2 shows the break down of the ID code.



Transmission Identification

F 4 A 4 2 K 2 M 6 B

Drive Axle _____

F...Front Wheel Drive

Forward Speeds _____

4...Four Speeds

Transmission Type _____

A...Automatic

Capacity _____

41...Light Duty

42...Medium Duty

51...Heavy Duty

Factory Location _____

K...Kyoto Works

(This space may be blank.)

Version _____

1...1st

2...2nd

Final Drive Ratio's _____

	<i>F4A41-42</i>	<i>F4A51</i>
<i>B</i>	<i>N/A</i>	<i>3.274</i>
<i>D</i>	<i>N/A</i>	<i>3.497</i>
<i>E</i>	<i>3.770</i>	<i>3.735</i>
<i>F</i>	<i>3.769</i>	<i>N/A</i>
<i>M</i>	<i>4.042</i>	<i>4.018</i>
<i>U</i>	<i>4.407</i>	<i>4.324</i>
<i>W</i>	<i>4.626</i>	<i>N/A</i>

The final drive ratios include the ratio of the transfer gears.

1.186 for the F4A41-42

1.119 for the F4A51

Speedo Gear Ratio _____

4 27/36

5 28/36

6 29/36

7 30/36

8 31/36

9 32/36

One-Way Clutch _____

A...No One-Way Clutch

B...One-Way Clutch

Manufacturer's Use Only _____

(This space may be blank.)

F4A41/42/51

Clutch and Band Application Chart

Vehicles without sport mode

Selector Lever Position	Gear Obtained	Operating Element					
		Underdrive Clutch (UD)	Reverse Clutch (REV)	Overdrive Clutch (OD)	Low-Reverse Brake (LR)	Second Brake (2nd)	One-Way Clutch (OWC)
P	Parking	-	-	-	X	-	-
R	Reverse	-	X	-	X	-	-
N	Neutral	-	-	-	X	-	-
D	1st	X	-	-	X*	-	X
D	2nd	X	-	-	-	X	-
D	3rd	X	-	X	-	-	-
D	4th	-	-	X	-	X	-
3	1st	X	-	-	X*	-	X
3	2nd	X	-	-	-	X	-
3	3rd	X	-	X	-	-	-
2	1st	X	-	-	X*	-	X
2	2nd	X	-	-	-	X	-
I	1st	X	-	-	X	-	X

*** (Units with one-way clutch) LR is only applied at or below 6.2 mph.**

Vehicles with sport mode

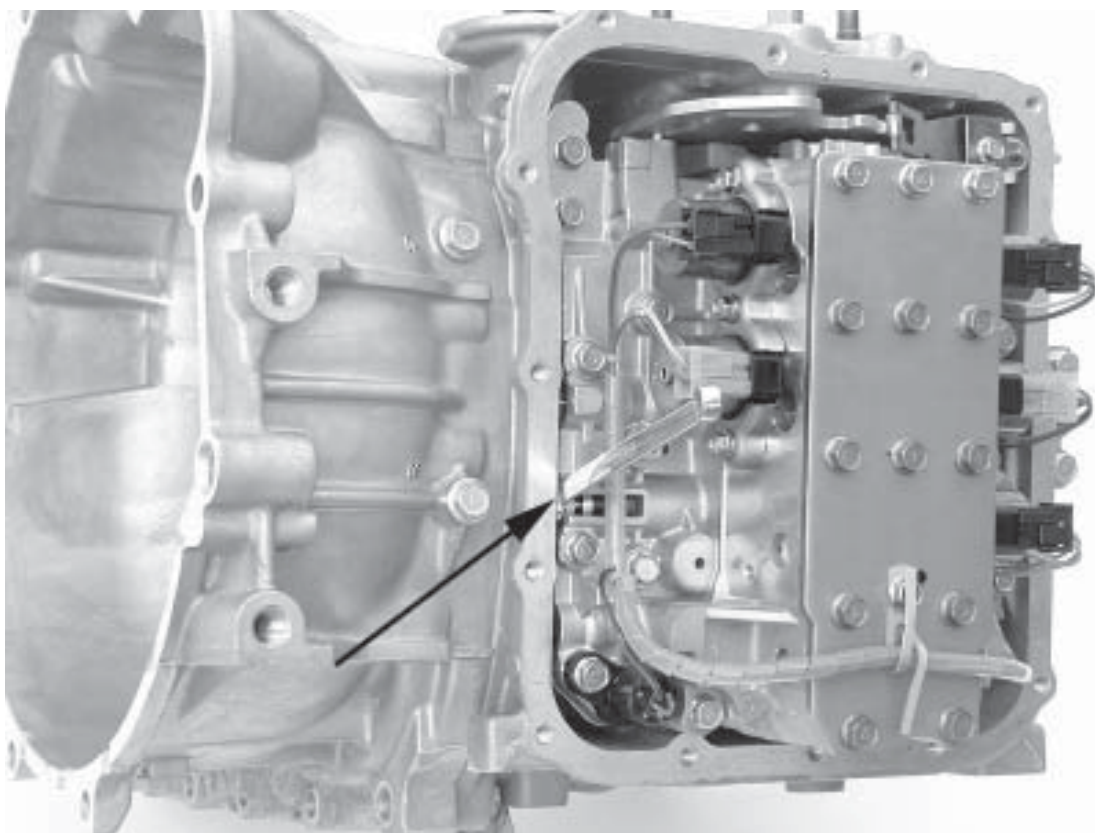
Selector Lever Position	Gear Obtained	Operating Element					
		Underdrive Clutch (UD)	Reverse Clutch (REV)	Overdrive Clutch (OD)	Low-Rev Brake (LR)	Second Brake (2nd)	One-Way Clutch (OWC)
P	Park	-	-	-	X	-	-
R	Reverse	-	X	-	X	-	-
N	Neutral	-	-	-	X	-	-
D	1st	X	-	-	X*	-	X
D	2nd	X	-	-	-	X	-
D	3rd	X	-	X	-	-	-
D	4th	-	-	X	-	X	-
Sport Mode 1	1st	X	-	-	X*	-	X
Sport Mode 2	2nd	X	-	-	-	X	-
Sport Mode 3	3rd	X	-	X	-	-	-
Sport Mode 4	4th	-	-	X	-	X	-

*** LR is only applied at or below 6.2 mph.**

F4A41/42/51

Line Pressure Adjustment

Line pressure can be adjusted by turning the bolt on the end plug of the pressure regulator valve using an 8mm wrench, . Each full turn will change line pressure approximately 5 psi.



- **Counter-clockwise raises pressure**
- **Clockwise lowers pressure**

F4A41/42/51

Pressure Specifications 2.4, 3.0 and 3.5L Motors

MEASUREMENT CONDITION			STANDARD HYDRAULIC PRESSURE kPa (psi)					
SELECTOR LEVER POSITION	SHIFT POSITION	ENGINE SPEED (r/min)	UNDER-DRIVE CLUTCH PRESSURE [UD]	REVERSE CLUTCH PRESSURE [RV]	OVERDRIVE CLUTCH PRESSURE [OD]	LOW-REVERSE BRAKE PRESSURE [LR]	SECOND BRAKE PRESSURE [2ND]	TORQUE CONVERTER PRESSURE [DR] *
P	-	2,500	-	-	-	220 - 360 (32 - 52)	-	250 - 390 (37 - 57) *
R	Re-verse	2,500	-	1,270 - 1,770 (185 - 256)	-	1,270 - 1,770 (185 - 256)	-	500 - 700 (73 - 101) *
N	-	2,500	-	-	-	220 - 360 (32 - 52)	-	250 - 390 (37 - 57) *
L <Vehicles without sport mode> or Sport mode <Vehicles with sport mode>	1st gear	2,500	1,010 - 1,050 (147 - 152)	-	-	1,010 - 1,050 (147 - 152)	-	500 - 700 (73 - 101) *
2 <Vehicles without sport mode> or Sport mode <Vehicles with sport mode>	2nd gear	2,500	1,010 - 1,050 (147 - 152)	-	-	-	1,010 - 1,050 (147 - 152)	500 - 700 (73 - 101) *
3 <Vehicles without sport mode> or Sport mode <Vehicles with sport mode>	3rd gear	2,500	784 - 882 (113 - 128)	-	784 - 882 (113 - 128)	-	-	-
D <Vehicles without sport mode> or Sport mode <Vehicles with sport mode>	4th gear	2,500	-	-	784 - 882 (113 - 128)	-	784 - 882 (113 - 128)	-

* Torque converter DA (release) pressures measured at 1500 RPM.

* Torque converter DA (apply) pressure can vary between 0-50 psi. When OFF depending on throttle opening and gear changes. With the torque converter fully applied pressures should be approximately 100 psi.

F4A41/42/51

Pressure Specifications 1.5 and 1.8L Motors (continued)

Measurement condition			Standard hydraulic pressure kPa					
Selector lever position	Shift position	Engine speed (r/min)	Underdrive clutch pressure [UD]	Reverse clutch pressure [RV]	Overdrive clutch pressure [OD]	Low and reverse brake pressure [LR]	Second brake pressure [2ND]	Torque converter pressure [DR] *
P	–	2,500	–	–	–	310 – 390 (46 – 57)	–	250 – 390 (37 – 57) *
R	Reverse	2,500	–	1,270 – 1,770 (185 – 256)	–	1,270 – 1,770 (185 – 256)	–	500 – 700 (73 – 101) *
N	–	2,500	–	–	–	310 – 390 (46 – 57)	–	250 – 390 (37 – 57) *
D	1st gear	2,500	1,010 – 1,050 (147 – 152)	–	–	1,010 – 1,050 (147 – 152)	–	500 – 700 (73 – 101)
	2nd gear	2,500	1,010 – 1,050 (147 – 152)	–	–	–	1,010 – 1,050 (147 – 152)	500 – 700 (73 – 101) *
	3rd gear	2,500	590 – 690 (85 – 100)	–	590 – 690 (85 – 100)	–	–	450 – 650 (65 – 94) *
	4th gear	2,500	–	–	590 – 690 (85 – 100)	–	590 – 690 (85 – 100)	450 – 650 (65 – 94) *

* Torque converter DR pressure (release) is measured at 1500 RPM.

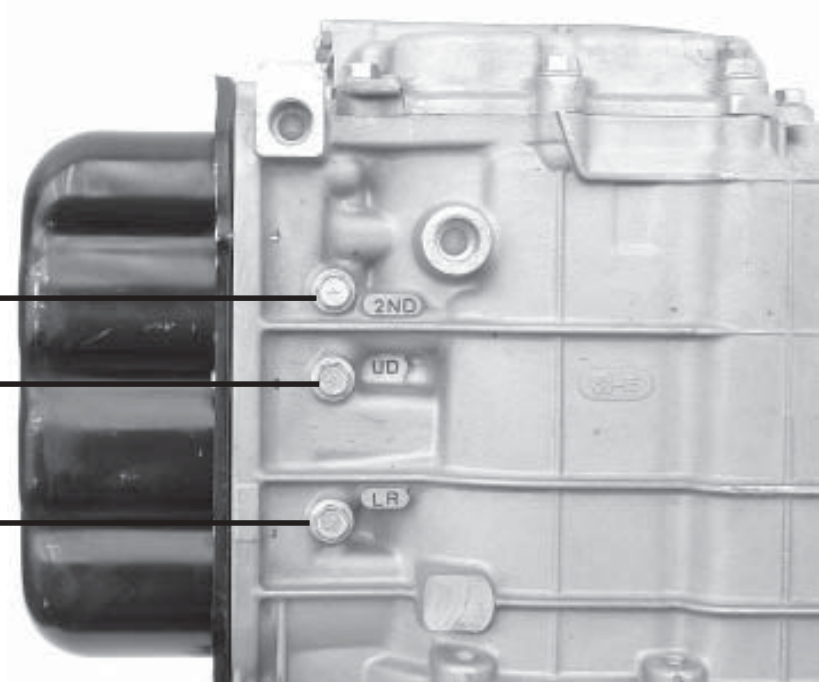
F4A41/42/51

Pressure Port Identification

(2nd) Second brake
pressure

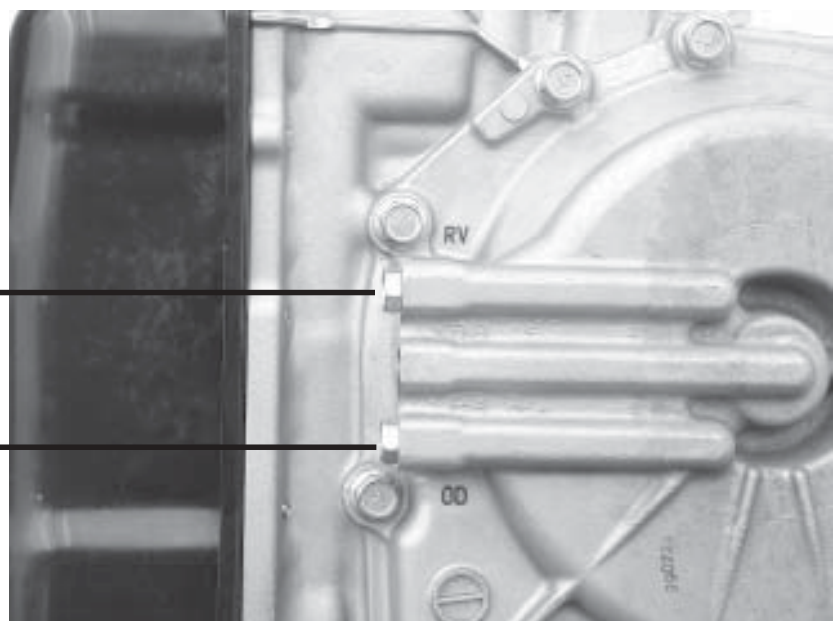
(UD) Underdrive clutch
pressure

(LR) Low/Reverse brake
pressure



(RV) Reverse clutch
pressure

(OD) Overdrive clutch
pressure

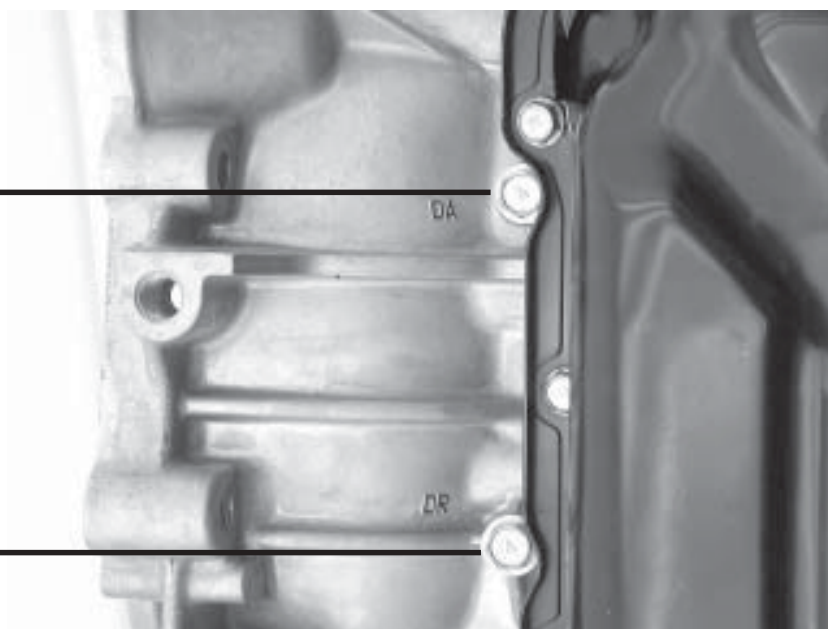


F4A41/42/51

Pressure Port Identification (continued)

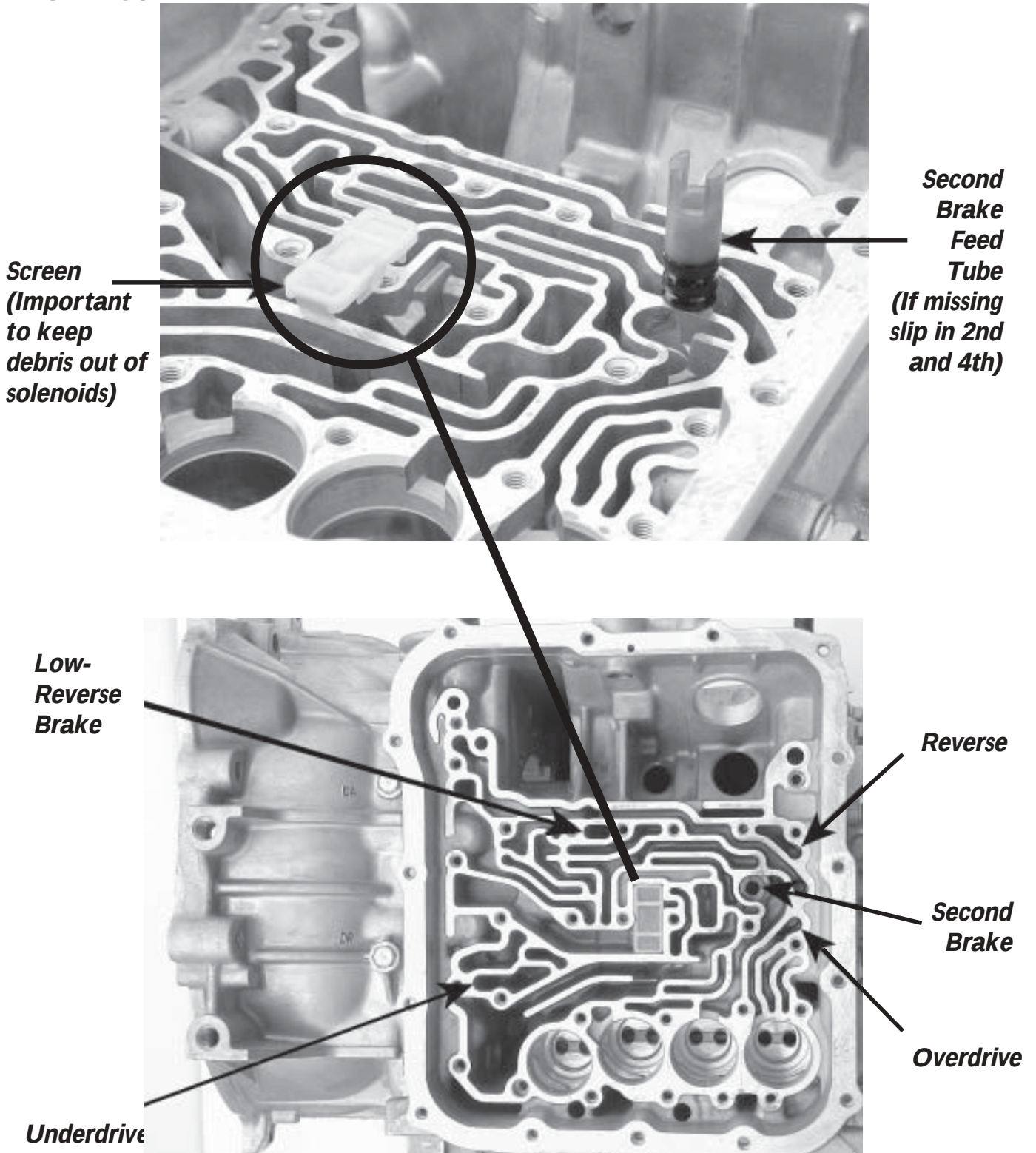
(DA) Torque converter
apply pressure

(DR) Torque converter
release pressure



F4A41/42/51

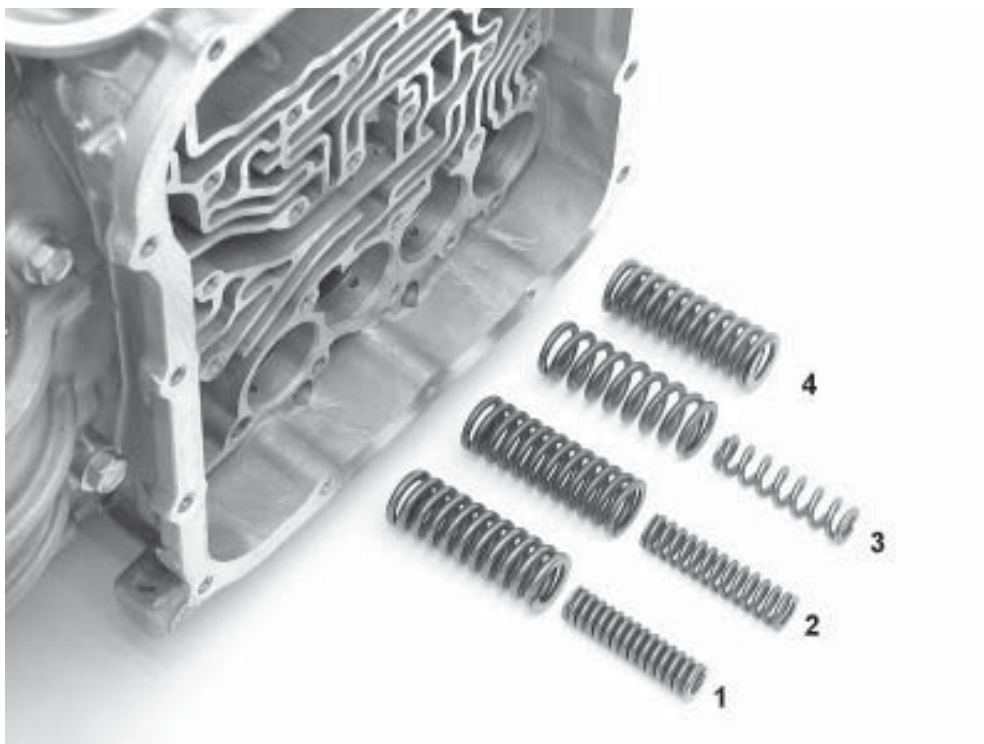
Second Brake Feed Tube and Air Test Points



F4A41/42/51

Accumulator Spring Location's

Most books identify the accumulator springs with ink marks on the springs. Over time or when run through a cleaning machine these identification marks may become unidentifiable.



	Total Length	Wire Diameter	Number of Coils
1. Low/Reverse Brake			
Outer Spring	64.6mm	4.0mm	12
Inner Spring	53.1mm	2.9mm	16
2. Underdrive			
Outer Spring	66.3mm	3.5mm	13
Inner Spring	57.4mm	2.6mm	15
3. Second Brake			
Outer Spring	65.3mm	3.5mm	10
Inner Spring	53.9mm	2.9mm	9
4. Overdrive Clutch	64.6mm	4.0mm	12

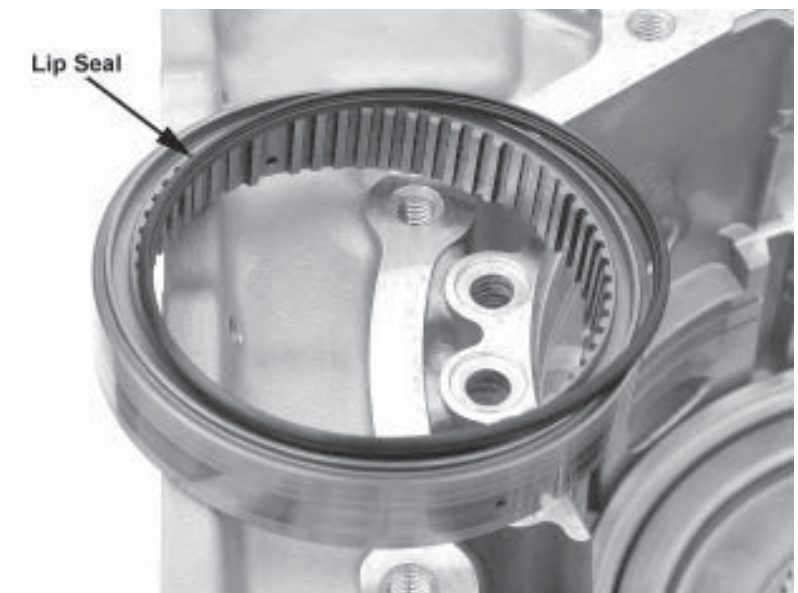
F4A41/42/51

One-Way Clutch and Inner Race Assembly

Mitsubishi doesn't show the one-way clutch disassembled in their manuals. Refer to the picture below if the one-way clutch was disassembled for inspection or cleaning and the rotation was not noted.

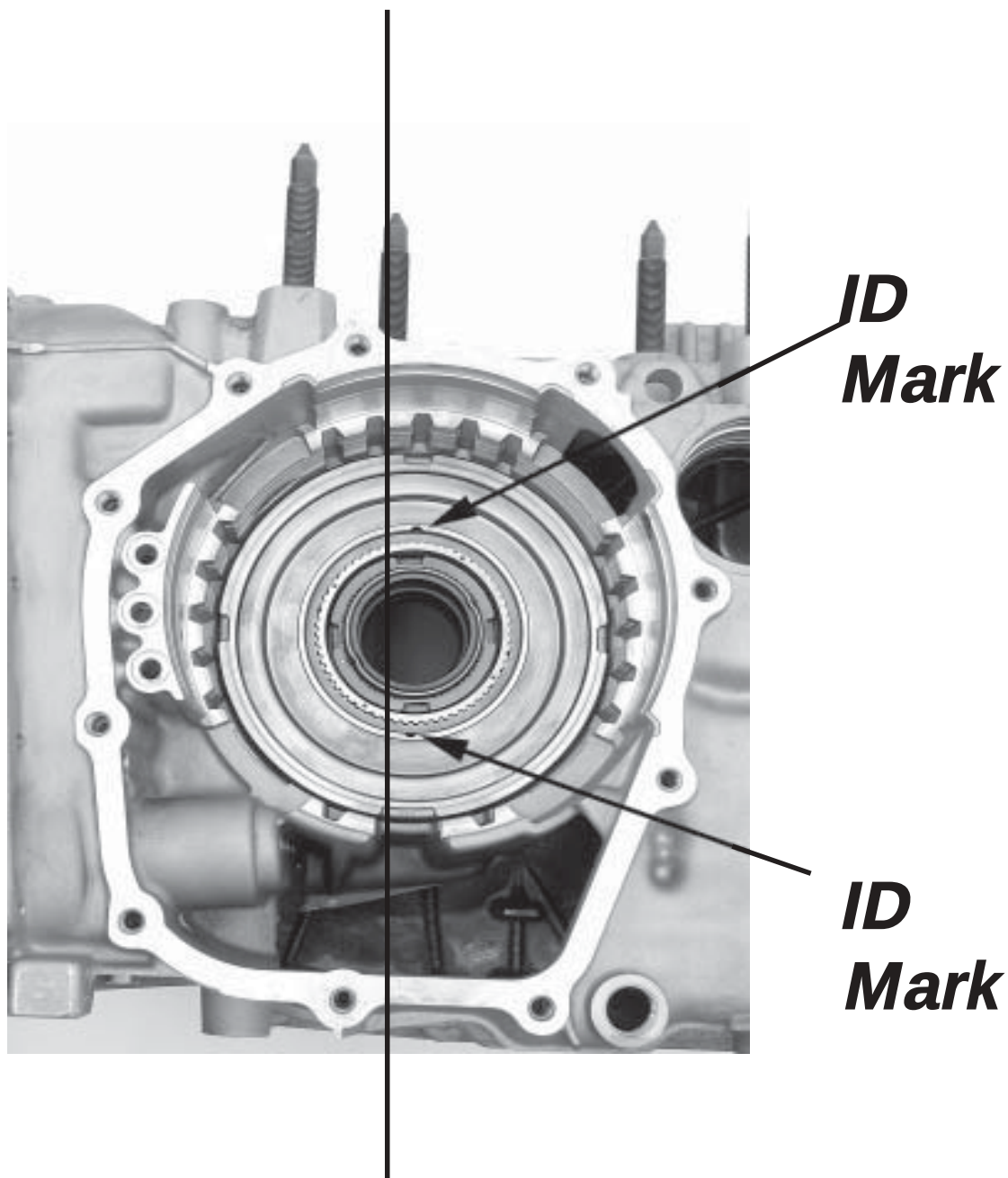


Without the lip seal installed in the inner race for the one-way clutch, lube oil can leak out before even getting to the clutch, causing premature failure.



F4A41/42/51

Inner Race (continued)



When installing the inner race, line up identification marks of the inner race, vertically with case. If the race is not indexed properly, lube will be insufficient.

F4A41/42/51

Alternative Pump Alignment Procedure



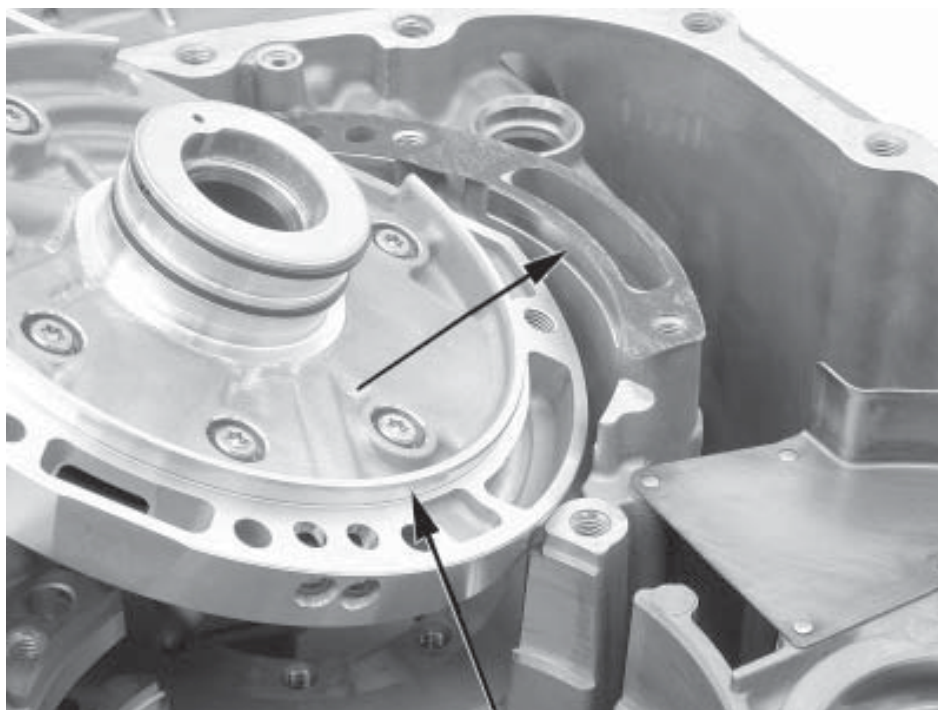
The pump is aligned with a special fixture at the assembly plant. There are no alignment tools available at this time. This method of pump alignment or body to cover is one option when the pump has been disassembled.

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Alternative Pump Alignment Procedure (continued)

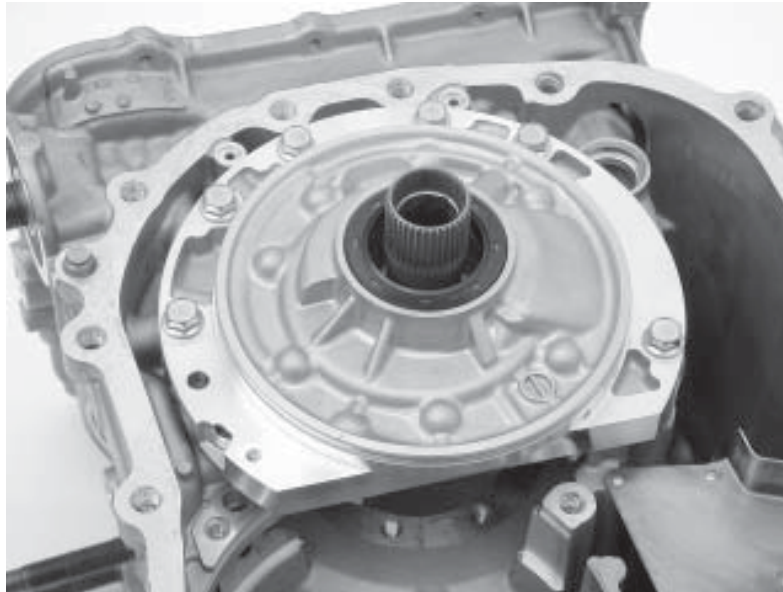


The pump body to converter housing and stator support to main case is practically an interference fit.

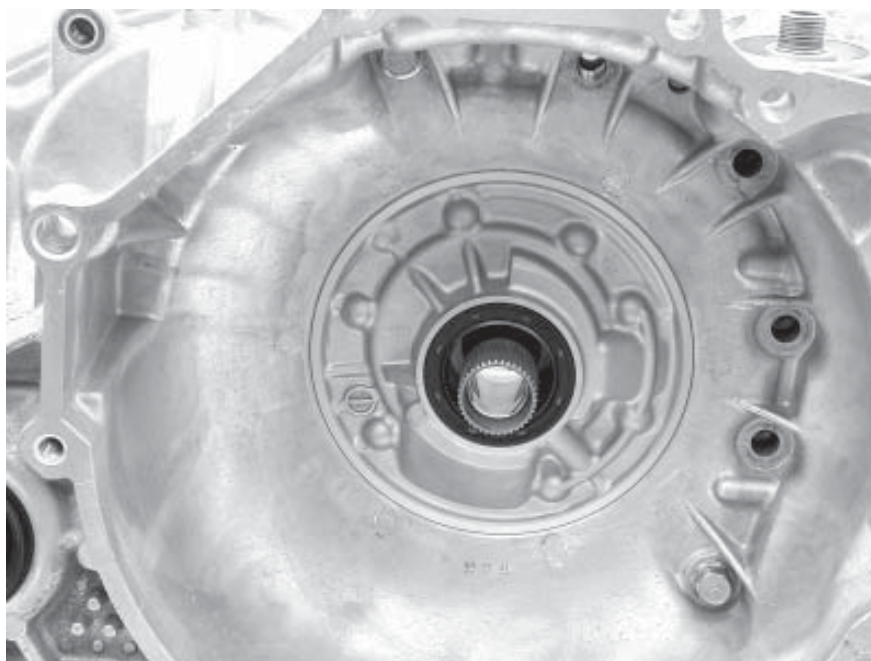


F4A41/42/51

Alternative Pump Alignment Procedure (continued)



- Assemble the pump body and the stator (leave bolts loose).
- Secure the pump to the main case.
- Bolt the converter housing to the main case.



F4A41/42/51

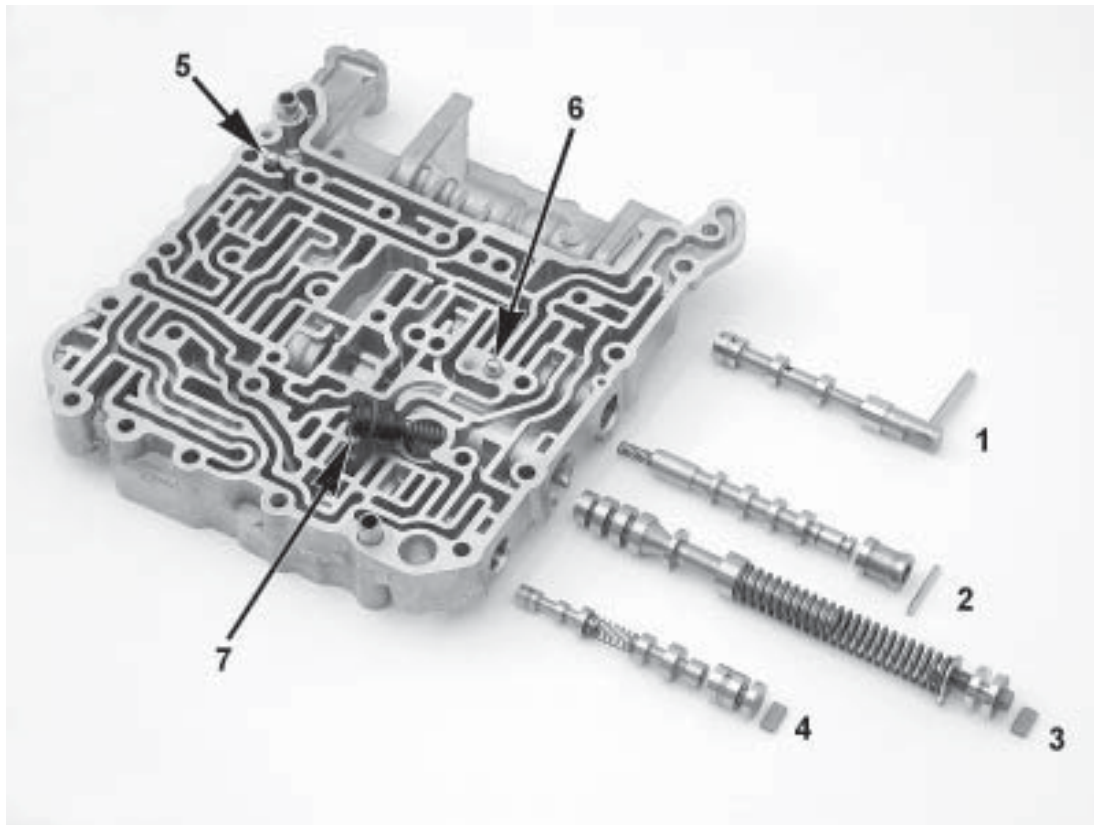
Alternative Pump Alignment Procedure (continued)



- Tighten the bolts securing the pump body to the stator support through the center of the case to 90-110 inch pounds.
- Disassemble the case halves.
- Remove the pump from the main case.
- Torque stator to pump body bolts.

F4A41/42/51

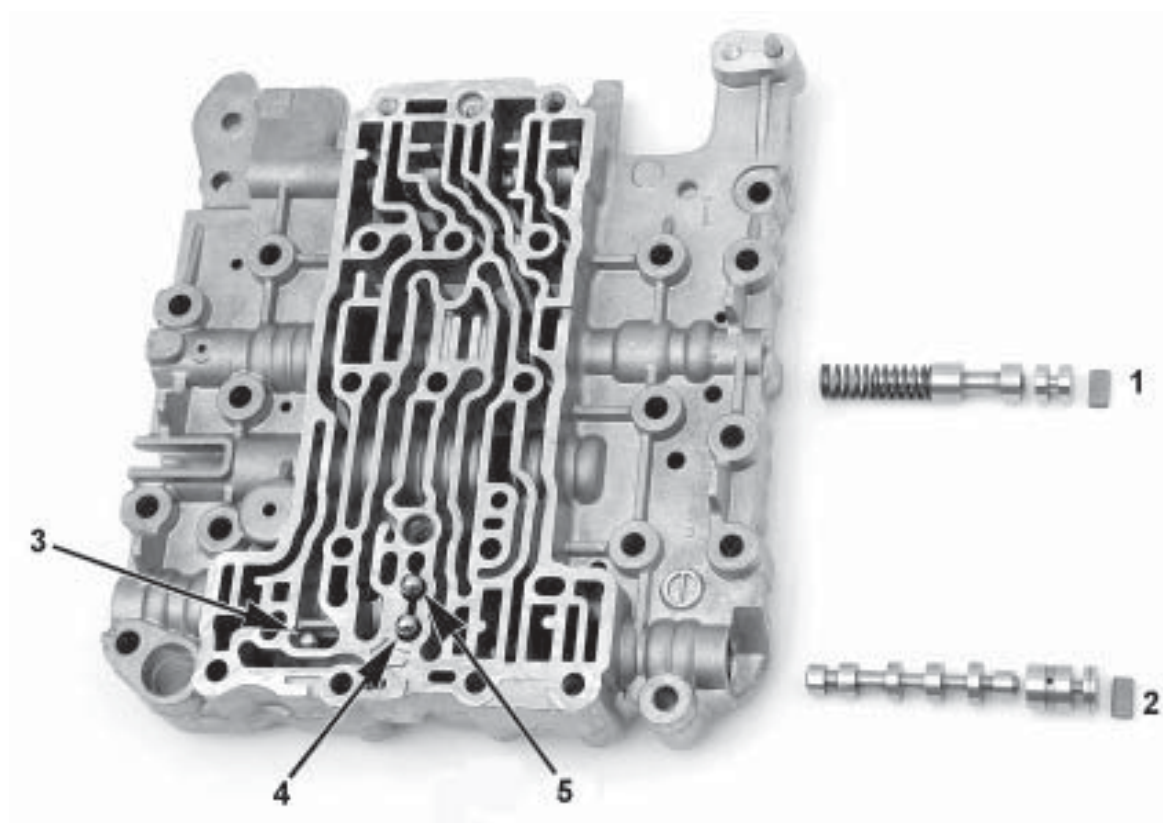
Valve Body



- 1 Manual Valve: Check the small roll pin & cup plug in the end of valve (A missing plug will exhaust line pressure)
- 2 Torque converter clutch control valve: The I.D. groove on the sleeve faces the retainer pin
- 3 Pressure regulator valve: Adjustable
- 4 Fail-safe valve A: 4th gear only
- 5 Checkball & small spring: Reverse clutch orifice ball (Harsh apply into Reverse if missing).
- 6 Checkball & large spring: Line pressure relief
- 7 Accumulator: Low reverse brake (used in reverse only)

F4A41/42/51

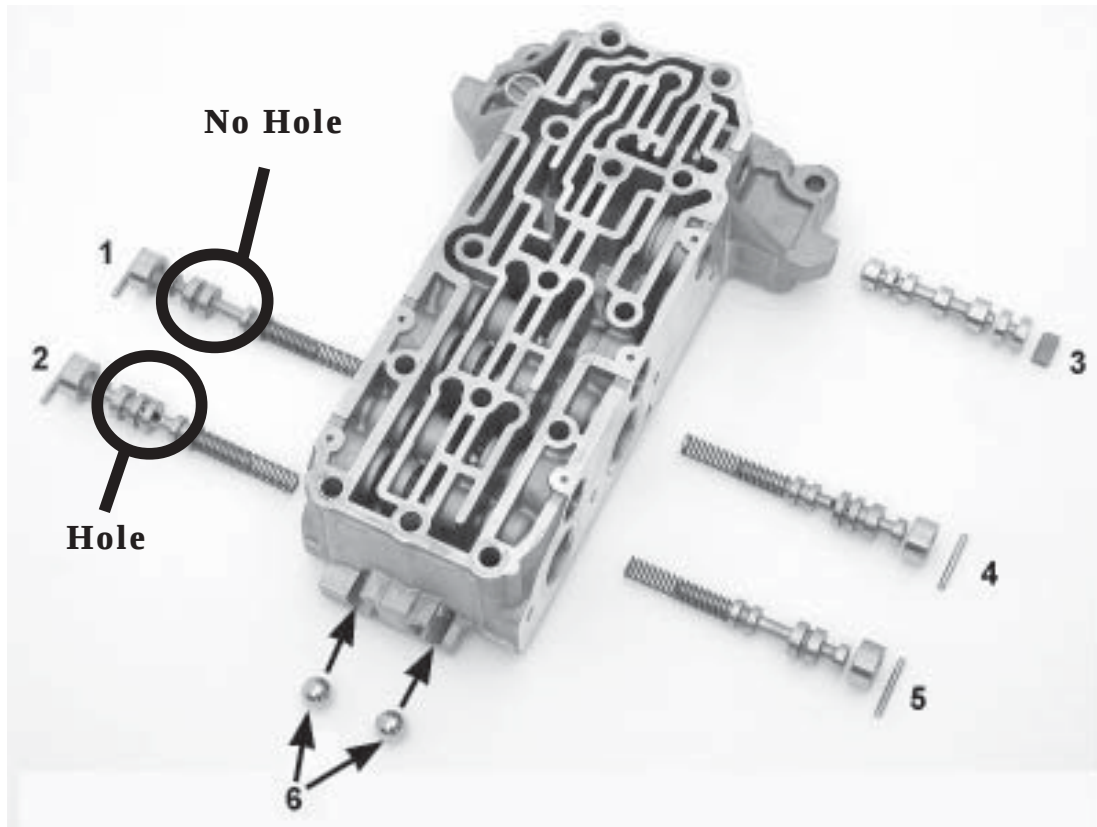
Valve Body (continued)



- 1 Torque converter pressure control valve: **Caution:** Can be installed backward
- 2 Fail-safe valve B: 3rd gear only
- 3 Checkball: Low and reverse clutch shuttle ball
- 4 Checkball & small spring: Blocks line oil to underdrive clutch
- 5 Checkball & small spring: Block line oil to overdrive clutch

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Valve Body (continued)

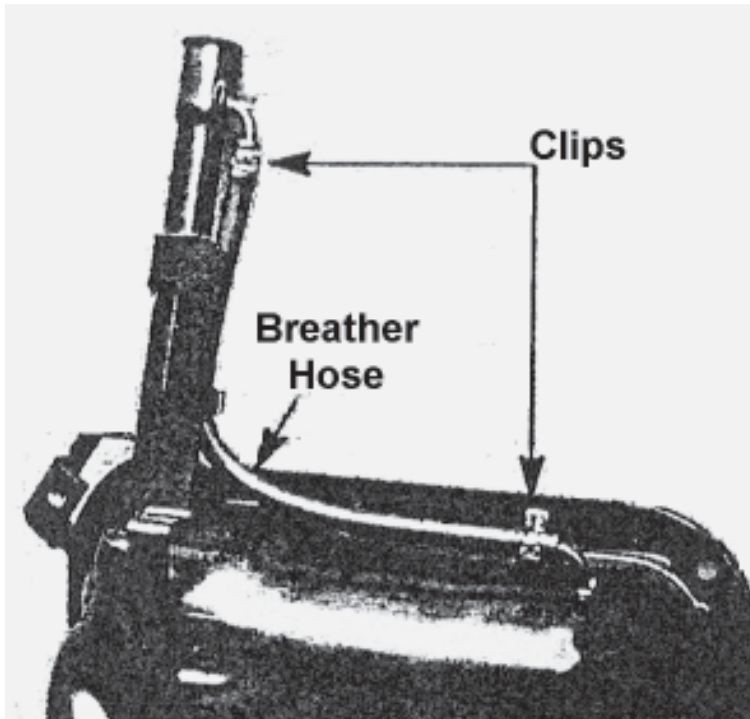


- 1* Second brake control valve: 5 Lands, No Hole in valve
- 2* Underdrive control valve: 6 Lands, Hole through valve
- 3 Switch valve
- 4* Low/Reverse control valve: 6 Lands, Hole through valve
- 5* Overdrive control valve: 5 Lands, No Hole in valve
- 6 Large checkballs: Seals exhaust passage for solenoids, clutches, manual valve, etc.

*** Caution: All four clutch control valves can fit in each others bores.**

F4A41/42/51

Leak from Dip Stick



Concern: Fluid seeping from the dipstick.

Common Cause: Imbalance of internal pressure.

Repair: Use the revised pan which as a longer dipstick tube and additional breather hose was added to balance internal pressure.

Part number MR567457 includes:

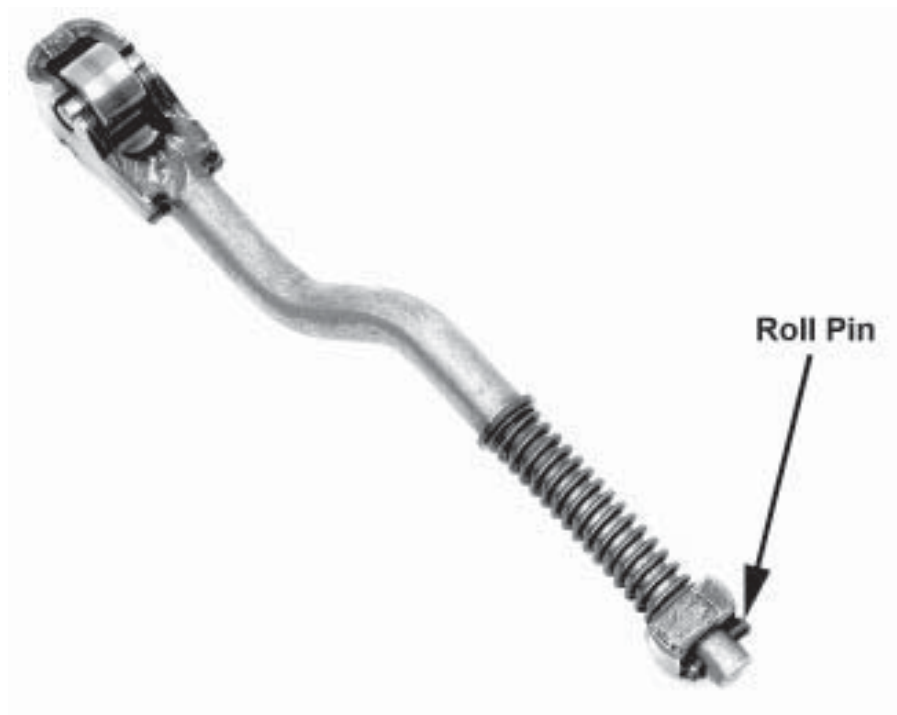
- Pan
- Dipstick
- Breather Hose
- 2 Hose Clips

F4A41/42/51

No Park, Stuck in Park, or Ratcheting noise in Reverse

Common Cause: Roll pin breaking on the end of the park pawl rod.

Repair: Replace park pawl rod, or find a suitable pin to repair.



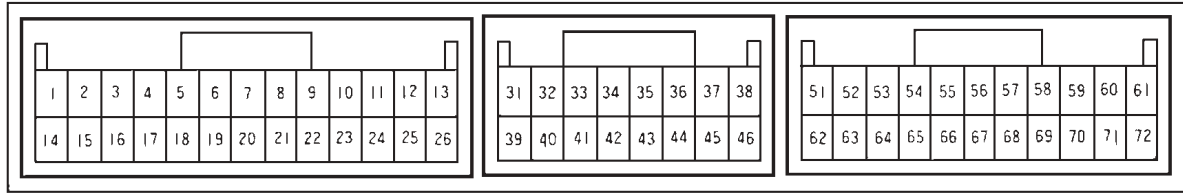
Roll pin fatigue is evident on even low mileage units.

F4A41/42/51

Computer Application Chart

TCM (72PIN)		
Year	Vehicle	Engine
1997	Diamante	3.5L
1998	Diamante	3.5L
1997	Mirage	1.5L & 1.8L
1998	Mirage	1.5L & 1.8L
1999	Mirage	1.5L & 1.8L
2000	Mirage	1.5L & 1.8L
PCM (130 PIN)		
Year	Vehicle	Engine
1999	Diamante	3.5L
2000	Diamante	3.5L
2001	Diamante	3.5L
2001	Mirage	1.5L & 1.8L
1999	Galant	2.4L & 3.0L
2000	Galant	2.4L & 3.0L
2001	Galant	2.4L & 3.0L
2000	Eclipse	2.4L & 3.0L
2001	Eclipse	2.4L & 3.0L

F4A41/42/51 TCM



Terminal No. Check item

- 1 Underdrive solenoid
- 2 Solenoid power supply
- 3 Solenoid power supply
- 8 Auto-cruise signal
- 10 A/C Compressor load signal
- 11 Power supply
- 12 Ground
- 13 Ground
- 14 Overdrive solenoid
- 15 Torque converter solenoid
- 16 Second solenoid
- 23 Diagnosis control
- 24 Power supply
- 25 Ground
- 26 Ground
- 31 Input speed sensor
- 32 Output speed sensor
- 33 Crankshaft position sensor
- 36 Closed throttle position switch
- 38 Power supply (Backup)
- 43 Sensor ground (ISS, OSS, TFT)
- 44 ATF temperature sensor
- 45 Throttle position sensor (Return)
- 53 Communication with ECM
- 54 Communication with ECM
- 55 Park/neutral position switch: P
- 56 Park/neutral position switch: N
- 57 Park/neutral position switch: 3
- 58 Park/neutral position switch: L
- 59 Brake light switch
- 62 Low and reverse solenoid
- 63 Diagnosis output
- 66 Park/neutral position switch: R
- 67 Park/neutral position switch: D
- 68 Park/neutral position switch: 2
- 69 Vehicle speed sensor
- 71 A/T control relay
- 72 Ground

NOTE: Not all computers will use all terminals listed.

F4A41/42/51 PCM

1	2	3	4		5	6	7	8	41	42	43		44	45	46	71	72	73	74		75	76	77	101	102	103	104		105	106	107																				
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		47	48	49	50	51	52	53	54	55	56	57	78	79	80	81	82	83	84	85	86	87	88	89	108	109	110	111	112	113	114	115	116	117	118	119	120
24	25	26	27	28	29	30	31	32	33	34	35		58	59	60	61	62	63	64	65	66		90	91	92	93	94	95	96	97	98		121	122	123	124	125	126	127	128	129	130									

Terminal No. Check Item

- 41 Power supply
- 45 Crankshaft position sensor
- 46 Throttle and accelerator position sensor supplied voltage
- 47 Power supply
- 50 A/T Control relay
- 57 Sensor ground (TPS, ISS, OSS, TFT)
- 66 Power supply (Backup)
- 75 Auto-cruise signal
- 76 Ground
- 77 Solenoid power supply
- 78 Throttle position sensor (Return)
- 79 Closed throttle position switch or Idle switch (Vehicles with Traction Control)
- 80 Vehicle speed sensor
- 81 Diagnosis control
- 83 A/C Compressor load signal
- 84 Diagnosis control
- 85 Diagnosis output
- 88 Ground
- 89 Solenoid power supply
- 97 Ground
- 101 Park/neutral position switch: P
- 102 Park/neutral position switch: D
- 103 Input speed sensor
- 104 Output speed sensor
- 105 Shift indicator light 1st
- 106 Second solenoid
- 107 Torque converter solenoid
- 108 Park/neutral position switch: R
- 109 Park/neutral position switch: 3
- 110 Park/neutral position switch: L or Shift switch DOWN (Sport mode)
- 117 Shift indicator light 3rd
- 118 Shift indicator light 2nd
- 120 Underdrive solenoid
- 121 Park/neutral position switch: N
- 122 Park/neutral position switch: 2 or Shift switch UP (Sport mode)
- 123 Brake light switch
- 124 ATF temperature sensor
- 128 Shift indicator light 4th
- 129 Low and reverse solenoid
- 130 Overdrive solenoid

NOTE: Not all computers will use all terminals listed

F4A41/42/51

Power and Ground					
Terminal Number		Item Being Checked	Conditions	Specifications	
PCM	TCM				
41	11	Power Supply	Ignition Switch: OFF	0V	
47	24		Ignition Switch: ON	Battery Voltage	
66	38	Back-up Power Supply	Always	Battery Voltage	
77	2	Solenoid Power Supply	Ignition Switch: OFF	0V	
89	3		Ignition Switch: ON	Battery Voltage	
46	-	Throttle Position Sensor Supplied Voltage	Ignition Switch: ON	4.8-5.2V	
57	43	Sensor Ground	Always	0V	
76	12	Ground	Always	0V	
88	13				
97	25				
	26				
	72				

Throttle Position					
Terminal Number		Item Being Checked	Conditions	Specifications	
PCM	TCM				
78	45	Throttle Position Sensor	Ignition Switch: ON (check for smooth voltage increase as throttle is moved from idle position to wide open throttle)	Idle	0.6 - 0.8V
				Wide Open Throttle	4.8 - 5.2V
79	36	Closed Throttle Position Switch or Idle Switch (Models with Traction Control)	Engine: Idling	0V	
			Engine: Other Than Idling	5V	

Diagnostics					
Terminal Number		Item Being Checked	Conditions	Specifications	
PCM	TCM				
85	63	Diagnosis Output	Normal (No diagnosis code output)	0 - 5V Flashing	
81 84	23	Diagnosis Control	-	-	
-	53 54	Communication with ECM	Engine: Idling Selector Lever Position: D	Other than 0V	

F4A41/42/51

Shifter Position				
Terminal Number		Item Being Checked	Conditions	Specifications
PCM	TCM			
101	55	Park/Neutral position switch: P	Ignition switch: ON Selector lever position: P	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
108	66	Park/Neutral position switch: R	Ignition switch: ON Selector lever position: R	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
121	56	Park/Neutral position switch: N	Ignition switch: ON Selector lever position: N	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
102	67	Park/Neutral position switch: D	Ignition switch: ON Selector lever position: D	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
109	57	Park/Neutral position switch: 3 <vehicles without sport mode>	Ignition switch: ON Selector lever position: 3	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
122	68	Park/Neutral position switch: 2 <vehicles without sport mode>	Ignition switch: ON Selector lever position: 2	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
		Select switch (Up) <vehicles with sport mode>	Ignition switch: ON Selector lever position: Upshift and hold the selector lever	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
110	58	Park/Neutral position switch: L <vehicles without sport mode>	Ignition switch: ON Selector lever position: L	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V
		Select switch (Down) <vehicles with sport mode>	Ignition switch: ON Selector lever position: Down shift and hold the selector lever	Battery voltage
			Ignition switch: ON Selector lever position: Other than above	0V

F4A41/42/51

Transaxle Control Solenoids				
Terminal Number		Item Being Checked	Conditions	Specifications
PCM	TCM			
129	62	Low-reverse solenoid	Engine: Idling Selector lever position: P	Battery voltage
			Engine: Idling Selector lever position: 2 (2nd gear) <Vehicles without sport mode> Sport mode (2nd gear) <Vehicles with sport mode>	7 - 9V
130	14	Overdrive solenoid	Engine: Idling Selector lever position: 3 (3rd gear) <Vehicles without sport mode> Sport mode (3rd gear) <Vehicles with sport mode>	Battery voltage
			Engine: Idling Selector lever position: P	7 - 9V
120	1	Underdrive solenoid	Engine: Idling Selector lever position: L (1st gear) <Vehicles without sport mode> Sport mode (1st gear) <Vehicles with sport mode>	Battery voltage
			Engine: Idling Selector lever position: P	7 - 9V
106	16	Second solenoid	Engine: Idling Selector lever position: 2 (2nd gear) <Vehicles without sport mode> Sport mode (2nd gear) <Vehicles with sport mode>	Battery voltage
			Engine: Idling Selector lever position: P	7 - 9V
107	15	Torque converter clutch solenoid	Engine: Idling Selector lever position: L (1st gear) <Vehicles without sport mode> Sport mode (1st gear) <Vehicles with sport mode>	Battery voltage

Temperature Sensor				
Terminal Number		Item Being Checked	Conditions	Specifications
PCM	TCM			
124	44	A/T fluid temperature sensor	A/T fluid temperature: 20°C (68°F)	3.8 - 4.0 V
			A/T fluid temperature: 40°C (104°F)	3.2 - 3.4 V
			A/T fluid temperature: 80°C (176°F)	1.7 - 1.9 V

F4A41/42/51

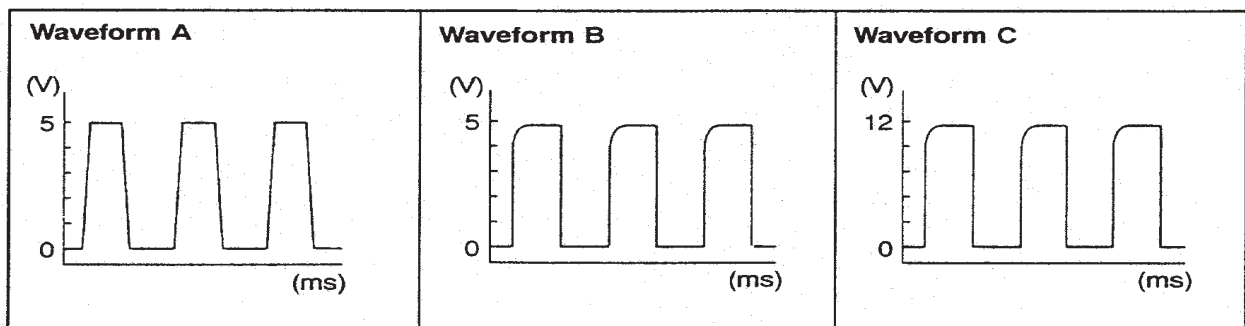
Miscellaneous				
Terminal Number		Item Being Checked	Conditions	Specifications
PCM	TCM			
123	59	Brake light switch	Ignition switch: ON Brake pedal: Depressed	Battery voltage
			Ignition switch: ON Brake pedal: Released	0V
75	8	Auto-cruise ECU	No OD-OFF request	Battery voltage
			OD-OFF request	0V
83	10	A/C compressor load signal (Dual pressure switch)	A/C switch: OFF	0V
			A/C switch: ON	Battery voltage
50	71	A/T control relay	Ignition switch: OFF	0V
			Ignition switch: ON	Battery voltage

Shift Indicator Lights (Vehicles with Sport Mode)				
Terminal Number		Item Being Checked	Conditions	Specifications
PCM	TCM			
128	-	Shift indicator light: 4th	Engine: Idling Gear range: 4th	Battery voltage
			Engine: Idling Gear range: other than 4th	0 - .9V
117	-	Shift indicator light: 3rd	Engine: Idling Gear range: 3rd	Battery voltage
			Engine: Idling Gear range: other than 3rd	0 - .9V
118	-	Shift indicator light: 2nd	Engine: Idling Gear range: 2nd	Battery voltage
			Engine: Idling Gear range: other than 2nd	0 - .9V
105	-	Shift indicator light: 1st	Engine: Idling Gear range: 1st	Battery voltage
			Engine: Idling Gear range: other than 1st	0 - .9V

F4A41/42/51

Speed Sensors				
Terminal Number		Item Being Checked	Conditions	Specifications
PCM	TCM			
45	33	Crankshaft position sensor	Engine: idling	Waveform A
103	-	Input shaft speed sensor	Measure between terminals 57 and 103 with an oscilloscope. Engine: 2000 RPM Selector lever position: 3 (3rd gear) <Vehicle without sport mode> sport mode (3rd gear) <Vehicle with sport mode>	Waveform B
104	-	Output shaft speed sensor	Measure between terminals 57 and 104 with an oscilloscope. Engine: 2000 RPM Selector lever position: 3 (3rd gear) <Vehicle without sport mode> sport mode (3rd gear) <Vehicle with sport mode>	Waveform B
-	31	Input shaft speed sensor	Measure between terminals 31 and 43 with an oscilloscope. Engine: 2000 RPM Selector lever position: 3 (3rd gear)	Waveform B
-	32	Output shaft speed sensor	Measure between terminals 32 and 43 with an oscilloscope. Engine: 2000 RPM Selector lever position: 3 (3rd gear)	Waveform B
80	69	Vehicle speed sensor	Engine: 2000 RPM Selector lever position: 3 (3rd gear)	Waveform B or C

Waveform sample



Volkswagon

Contents

096 / 01M

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No Reverse	237	68 Pin Chart	247
K3 Clutch Drum	238		

Notes:

096/01M

Differential Fill

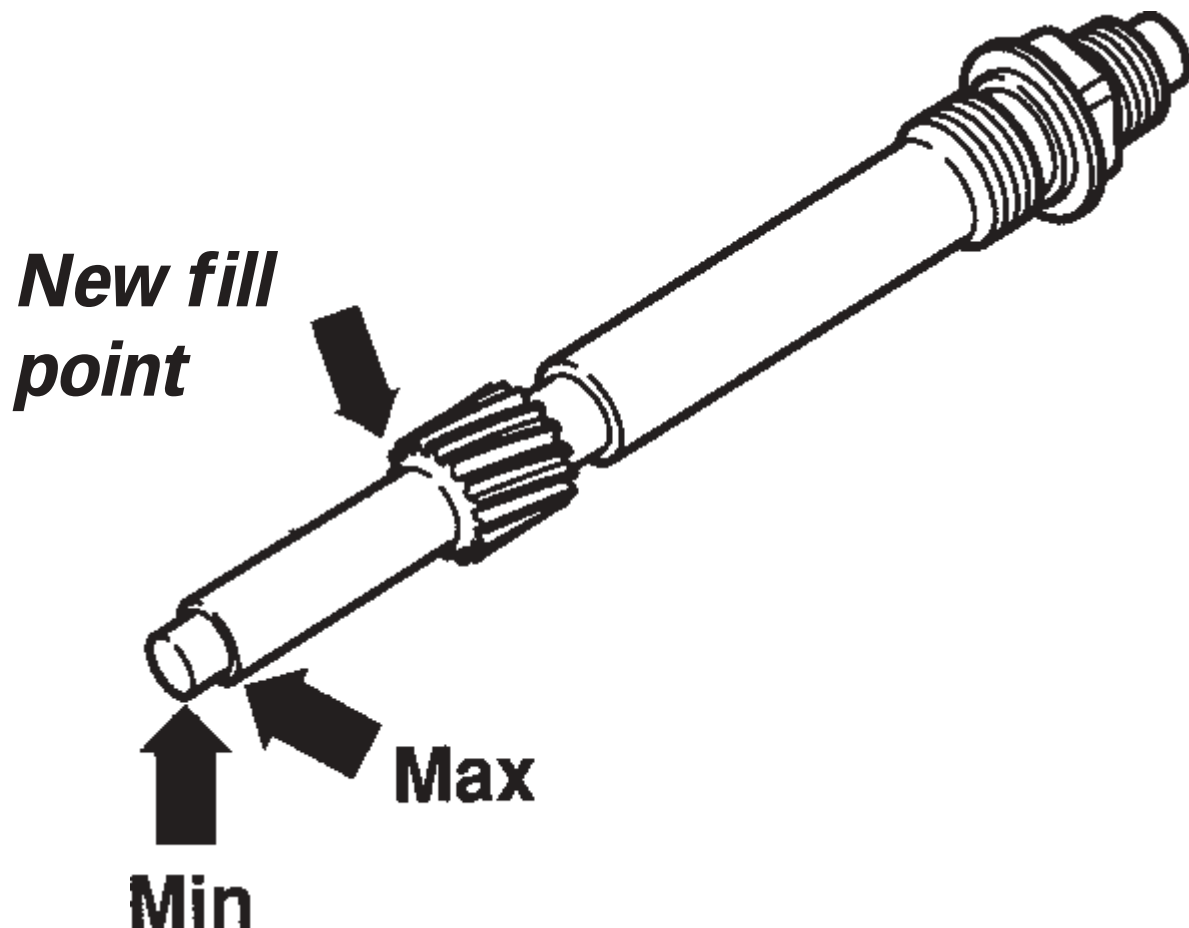
To avoid repeat differential failures technicians are raising the fluid level from the Max level, to the bottom of the speedometer gear as indicated below. Both transaxles original refill capacity is 0.75L with the difference between the Min and Max being 0.1L. Use VW synthetic ATF in the 01M differential and VW synthetic gear oil in the 096 differential.

VW synthetic ATF:

- 0.5L part # G 052 162 A1
- 1.0L part # G 052 162 A2

VW synthetic Gear Oil (SAE 75 W90):

- 0.5L part # G 052 145 A1
- 1.0L part # G 052 145 A2

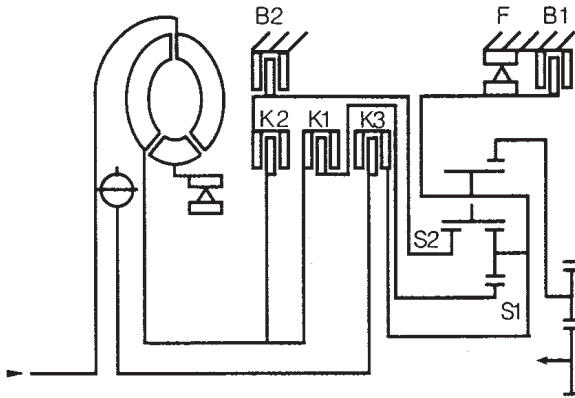


Clutch Apply Charts

Phase 0 Transmission

R ←-----→ 1H ↔ 2H ↔ 3H ↔ 3M ↔ 3LT2 ↔ 4

**Has
ECOL
Sport
Switch**

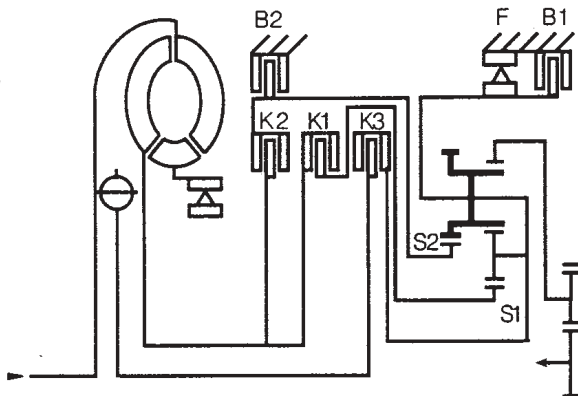


	Clutches/Brakes						Gear Ratios
	B1	B2	K1	K2	K3	F	
R1	●			●			2.11
1H			●			●	2.71
2H		●	●				1.55
3H			●	●			1.00
3M			●	●	●		
3LT2				●	●		
4M		●			●		0.68

Phase 1 Transmission

R ←-----→ 1H ↔ 2H ↔ 3H ↔ 4M

**Deleted
ECOL
Sport
Switch**

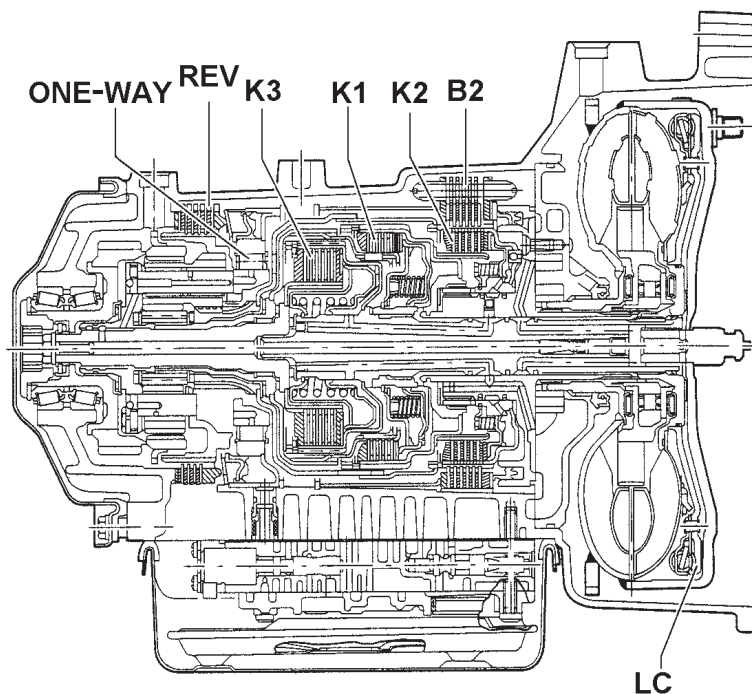


	Clutches/Brakes						Gear Ratios
	B1	B2	K1	K2	K3	F	
R	●			●			2.88
1			●			●	2.71
2		●	●				1.44
3			●	●			1.00
4		●			●		0.74

Clutch Apply Charts

096 Phase 2 Transmission

Gear	B1	B2	K1	K2	K3	F	LC	GEAR RATIO
Man Low	●		●					
Reverse	●			●				2.88
Dr. 1H			●			●		2.71
Dr. 1M			●			●	●	
Dr. 2H		●	●					1.44
Dr. 2M		●	●				●	
Dr. 3H			●		●			1.00
Dr. 3M			●		●		●	
Dr. 4H		●			●			0.74
Dr. 4M					●		●	



Conventional L/U converter
Clutch. Added the transmis-
sion speed sensor.

01M Transmission

Gear	B 1	B 2	K 1	K 2	K 3	F	L C	GEAR RATIOS
R	X			X				2.88
1H			X			X		2.71
1M			X			X	X	
2H		X	X					1.44
2M		X	X				X	
3H			X	X				1.00
3M			X	X			X	
4H		X			X			0.74
4M		X			X		X	

X = clutches, brakes or free
wheel engaged

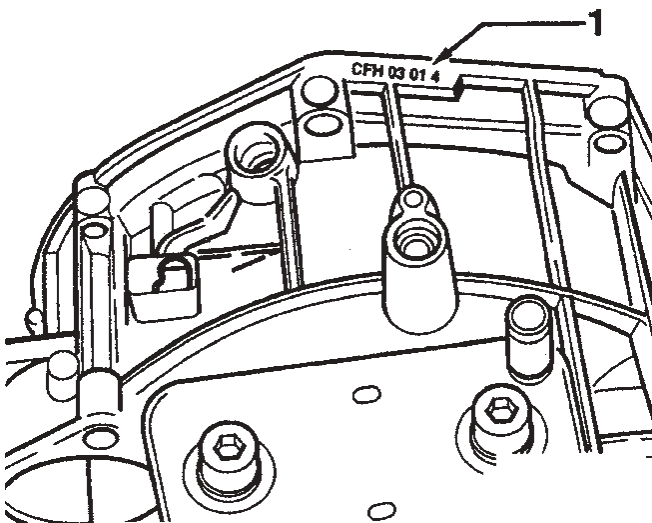
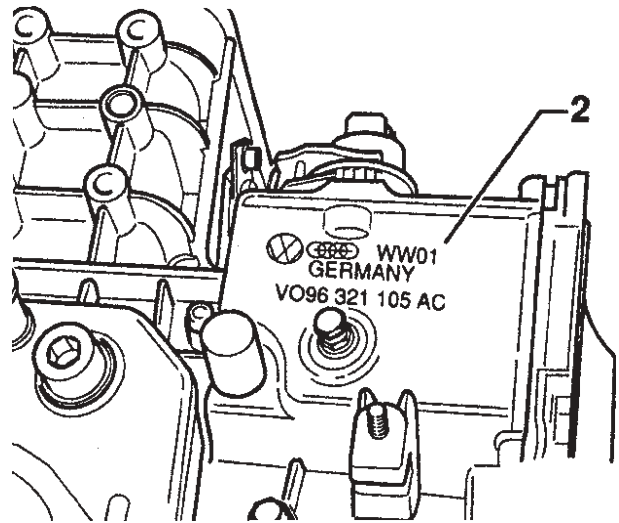
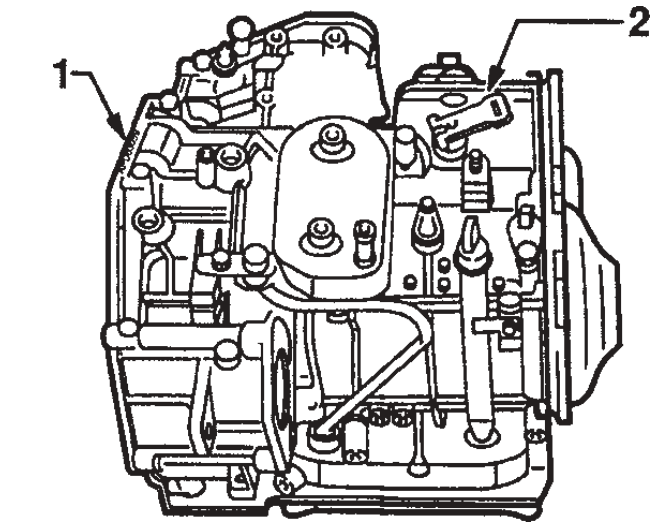
H = hydraulic

M = mechanical

VW 096

Transaxle Identification

The 096 transaxle has three different phases 0, 1, and 3 all of which use different apply charts. Phase 0 vehicles have an ECO/SPORT switch. Phase 1 vehicles eliminated the ECO/SPORT function. Phase 2 and 01M vehicles use a conventional converter clutch and a transmission speed sensor was added. The identification code can be used to obtain production dates and to match the transaxle to the vehicle.

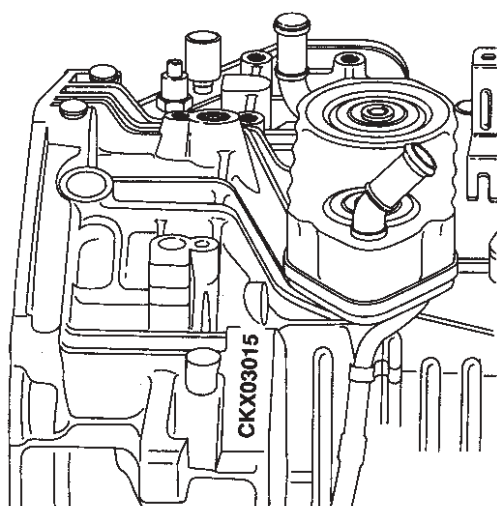
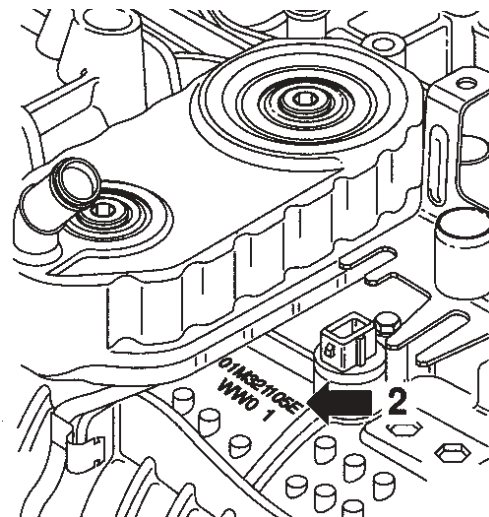
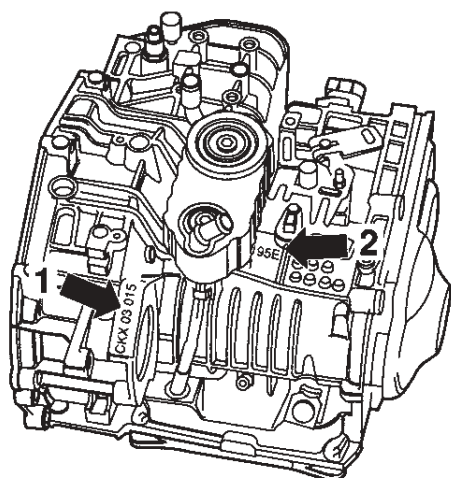


Example:	CFH	03	01	4
Transmission code letters	Day of manufacture (1994 shown)	Month	Year	

NOTE: The code letters of the transmission also appears on the vehicle data plate.

VW 01M

Transaxle Identification (continued)



Example:	CKX	03	01	5
	Code	Day	Month	Year (1995)
	letters			of
				manufacture

NOTE: The code letters of the transmission also appears on the vehicle data plate.

096 Phase 2 and 01M

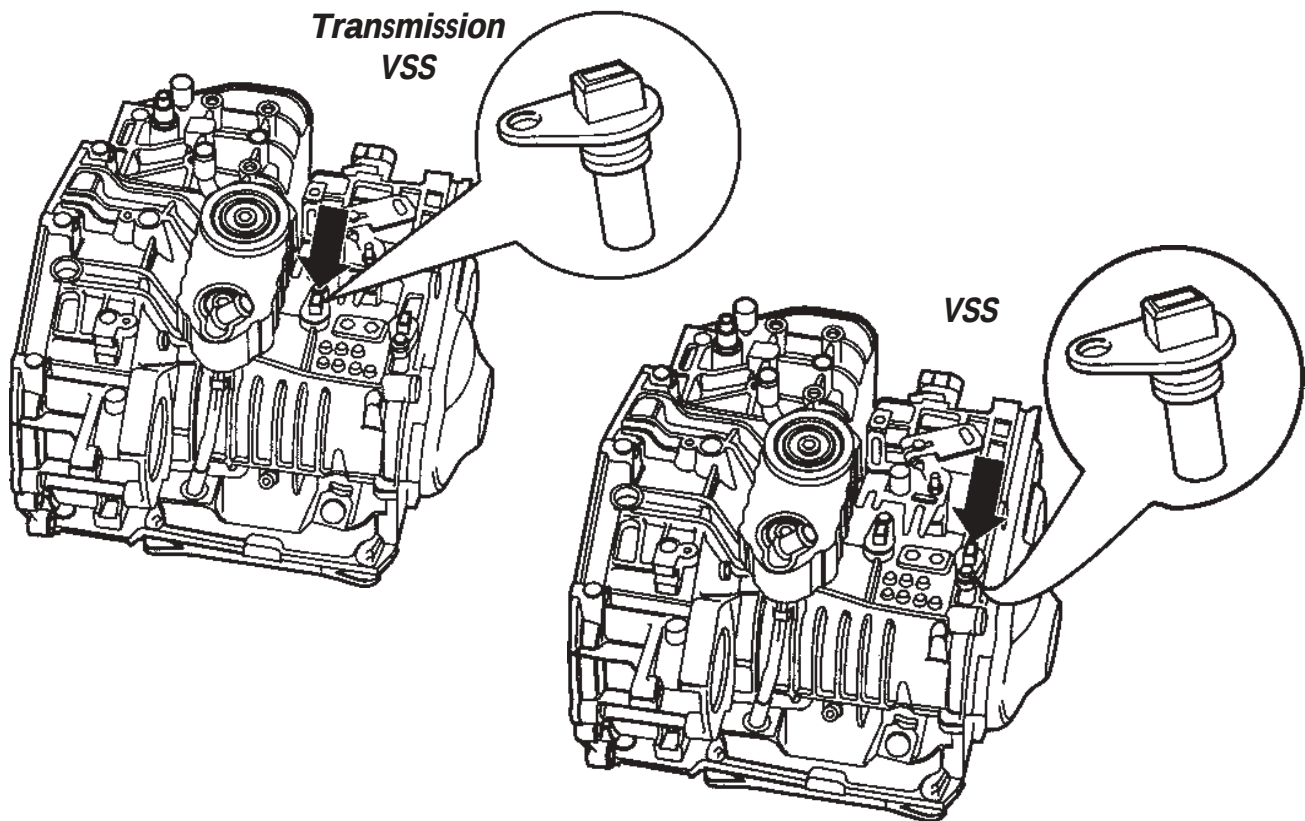
Shift Hunting

The Transmission Vehicle Speed Sensor (Transmission VSS) and Vehicle speed sensor (VSS) connectors can be swapped. This error may not set a code, but it will cause driveability complaints.

Concern: Vehicle shifts 1-2-1-2 or 3-4-3-4 depending on speed.

Common Cause: Transmission VSS and VSS connectors reversed.

Repair: Connector with red and green wires is for the Transmission VSS. Connector with yellow and white wires is for the VSS.



096/01M

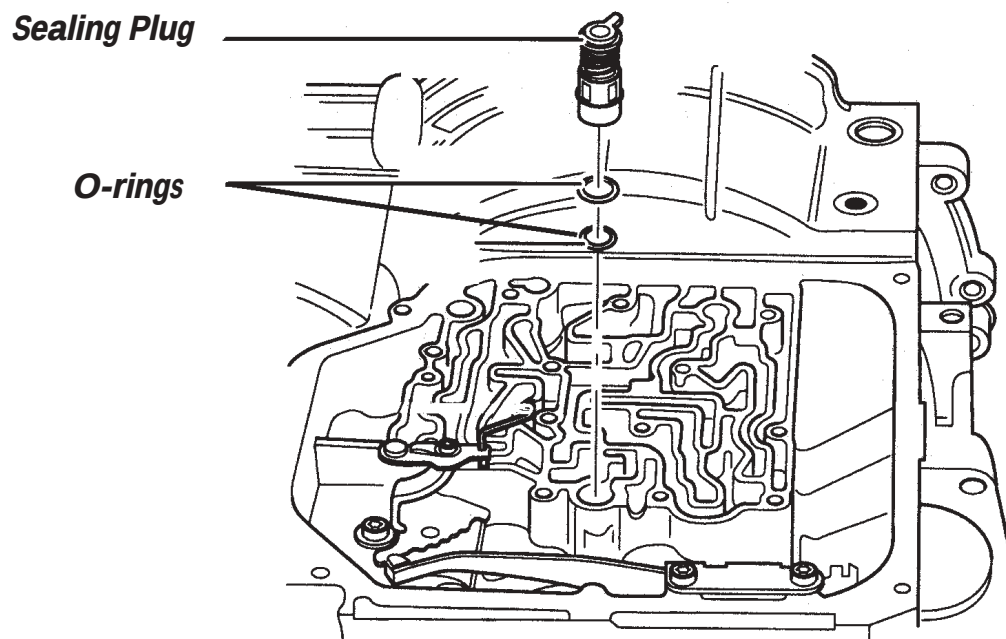
No Reverse

In the transaxle case there is a sealing plug and two o-rings that seal the reverse passage between the valve body and the B1 piston housing.

Concern: No reverse after overhaul or valve body removal.

Common Cause: Only one o-ring installed under sealing plug.

Repair: Install two o-rings under sealing plug.

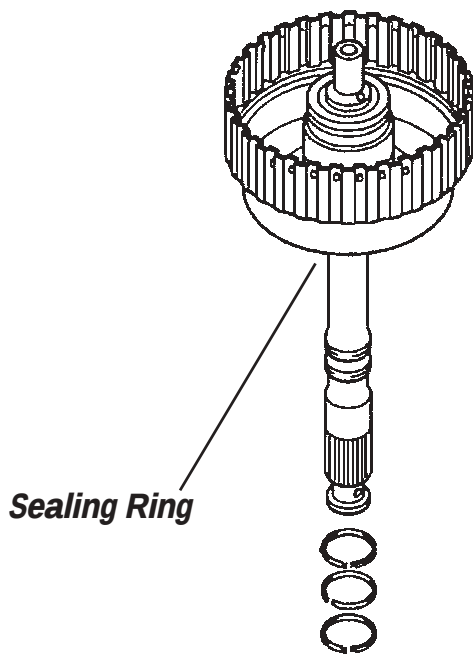


Note: Make sure sealing plug is properly indexed in case.

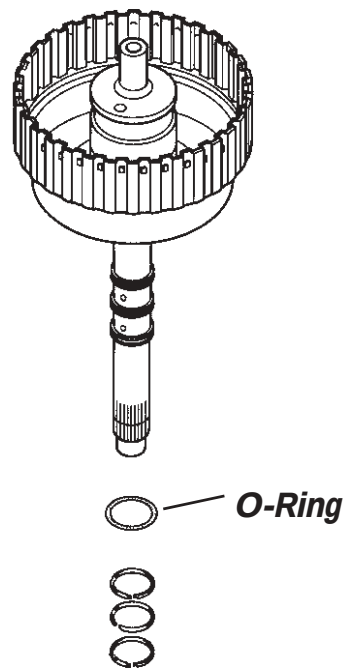
096/01M

K3 Clutch Drum

The 096 phase 0 and 1 transaxle built prior to 1994 use a K3 clutch drum and shaft assembly with three sealing rings on the shaft, one of the sealing rings is difficult to remove and install. When damage to the sealing ring, drum or sealing ring surface in the turbine shaft is present it is recommended that this assembly be changed. The 096 phase 2 and 01M transaxles relocated the third sealing ring to an accessible position.



096 Phase 0 and 1



096 Phase 2 and 01M

38 Pin TCU

DTC Definitions — 096

DTC	Description
00000.....	No Communication
00258.....	Solenoid Valve No. 1
00260.....	Solenoid Valve No. 2
00262.....	Solenoid Valve No. 3
00263.....	Hydraulic Electrical Or Mechanical Transmission Fault
00264.....	Solenoid Valve No. 4
00266.....	Solenoid Valve No. 5
00268.....	Solenoid Valve No. 6
00270.....	Solenoid Valve No. 7
00281.....	Vehicle Speed Sensor
00293.....	Transmission Range (TR) Switch
00296/00660	Kickdown Switch
00299.....	TR Program Switch
00300.....	Transmission Temperature Sensor
00518.....	TPS Out Of Range
00526.....	Brake Light Switch
00529.....	RPM Information Missing
00532.....	Supply Battery Voltage Low
00545/00638	Engine/Transmission Electrical Connection
00596.....	Shorted Wiring
00641.....	Trans. Temp. Too Hot
00652.....	Gear Ratio
01236.....	Shift Lock Solenoid
65535.....	Control Module Malfunctioning

68 Pin TCU

DTC Definitions (1997 Passat, 1997-98 Cabrio, Golf, GTI &

DTC	Jetta)	Description
00258.....	Open Or Short to Ground Or Faulty Solenoid No. 1	
00260.....	Open Or Short to Ground Or Faulty Solenoid No. 2	
00262.....	Open Or Short to Ground Or Faulty Solenoid No. 3	
00264.....	Open Or Short to Ground Or Faulty Solenoid No. 4	
00266.....	Open Or Short to Ground Or Faulty Solenoid No. 5	
00268.....	Open Or Short to Ground Or Faulty Solenoid No. 6	
00270.....	Open Or Short to Ground Or Faulty Solenoid No. 7	
00281.....	Open In Wiring, Faulty Vehicle Speed Sensor (VSS)	
		Or Impulse Wheel Loose
00293.....	Open In Wiring Or Faulty Transmission Range (TR) Switch	
00297.....	Open In Wiring Or Faulty Transmission VSS	
00300.....	Open In Wiring Or Faulty Transmission Temperature Sensor	
00518.	Open Or Short In Wiring Or Faulty Throttle Position Sensor ^{1,2}	
00529.....	Open In Wiring, Engine Speed Information Missing	
00532.....	Battery Faulty Or Poor Voltage Supply To Solenoid Valves	
00545.....	Open Or Short To Ground (No Communication Between	
		ECM & TCM)
00596.....	Short In Wiring Between Solenoid Valves	
00638.....	Open Or Short To Ground (No Communication Between	
		ECM & TCM)
00641.....	ATF Temperature Too High Or Faulty ATF Temperature	
		Sensor
00652.....	Gear Ratio Error/Hydraulic Malfunction (Clutch Or Valve	
		Body Faulty)
00660....	Open Wiring Or Incorrect Signal From TP Sensor (Faulty TP	
		Sensor)
65535.....	Faulty TCM	

1 - On 6-cylinder or diesel engine models, TP signal is sent through ECM to TCM

2 - On vehicles with CAN-Bus system, TCM checks signal from TP sensor only, not TP sensor operation. On Vehicles without CAN-Bus system, wire to TCM from TP sensor for signal is also checked. If DTC is retrieved from TCM or TP sensor, retrieve ECM DTC and repair first.

68 Pin TCM

DTC Definitions (1998 New Beetle)

DTC	Description
00258	Open Or Short to Ground Or Faulty Solenoid No. 1
00260	Open Or Short to Ground Or Faulty Solenoid No. 2
00262	Open Or Short to Ground Or Faulty Solenoid No. 3
00264	Open Or Short to Ground Or Faulty Solenoid No. 4
00266	Open Or Short to Ground Or Faulty Solenoid No. 5
00268	Open Or Short to Ground Or Faulty Solenoid No. 6
00270	Open Or Short to Ground Or Faulty Solenoid No. 7
00281	Open In Wiring, Faulty Vehicle Speed Sensor (VSS) Or Impulse Wheel Loose
00293	Open In Wiring Or Faulty Transmission Range (TR) Switch
00297	Open In Wiring Or Faulty Transmission VSS
00300	Open In Wiring Or Faulty Transmission Temperature Sensor
00518	Open Or Short In Wiring Or Faulty Throttle Position Sensor ¹
00529	Open In Wiring, VSS, Trans VSS, Engine Speed or TP Sensor Information Missing
00532	Battery Faulty Or Poor Voltage Supply To Solenoid Valves
00545	Open Or Short To Ground (No Ignition Timing Point Reference Signal Transferred From ECM To TCM)
00638	Open Or Short To Ground (No TP Signal Transferred From ECM To TCM)
00641	ATF Temperature Too High Or Faulty ATF Temperature Sensor
00652	Gear Ratio Error/Hydraulic Malfunction (Clutch Or Valve Body Faulty)
00660	Open Wiring Or Incorrect Signal From TP Sensor (Faulty TP Sensor)
01192	Torque Converter Clutch Slipping (Faulty Valve Body)
01236	Open Or Short In Wiring Or Faulty Shift Lock Solenoid
01312	Failure In Communication Network Between ECM & TCM (Open Wiring Or Connectors)
01314	Failure In Communication From ECM Or Faulty ECM
01316	Failure In Communication From ABS Control Module Or Faulty ABS Control Module
65535	Faulty TCM

¹ - On vehicles with CAN-Bus system, TCM checks signal from TP sensor only, not TP sensor operation. On Vehicles without CAN-Bus system, wire to TCM from TP sensor for signal is also checked. If DTC is retrieved from TCM or TP sensor, retrieve ECM DTC and repair first.

Passat with Tiptronic

DTC Definitions 68 Pin TCM

DTC	Description
00000	No Communication With TCM
00258	Solenoid Valve No. 1
00260	Solenoid Valve No. 2
00262	Solenoid Valve No. 3
00264	Solenoid Valve No. 4
00266	Solenoid Valve No. 5
00268	Solenoid Valve No. 6
00270	Solenoid Valve No. 7
00293	Transmission Range (TR) Switch
00296	Kickdown Switch
00297	Output Speed Sensor
00300	Transmission Temperature Sensor
00518	TPS Out Of Range
00526	Brake Light Switch
00529	RPM Information Missing
00532	Supply Battery Voltage Low
00543	RPM Information Maximum Exceeded
00545	Engine/Transmission Electrical Connection
00549	Consumption Signal
00638	Engine/Transmission Electrical Connection (Terminal No. 2 Or No. 30)
00652	Incorrect Gear Ratio
01192	Torque Converter Clutch RPM Deviation
01236	Shift Lock Solenoid
17101	Turbine Input Speed Sensor
18141	Tiptronic Switch, Down
18147	Tiptronic Switch, Up
18152	Tiptronic Switch, Recognition
18192	High / Downshift Wire
18193	High / Downshift Wire
65535	TCM Faulty

38 Pin TCU

Switch to voltage measuring range 20 V					
Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
1	19 + 1	Supply voltage from Transmission Control Module (TCM)	* Ignition switched ON	approx. Battery Positive Voltage (B+)	- Check wiring from pin 1 to Ground (GND) - Check wiring from pin 19 to terminal 15 central electrics
2	10 + 29	Throttle Position (TP) Sensor (4)	* Ignition switched ON - Disconnect connector from Throttle Position (TP) Sensor	4.6 to 5 V	- Check wiring on basis of wiring diagram - Replace Transmission Control Module
	9 + 29		* Ignition switched ON		
			Idle - min.	0.156 V	
			Idle - Max.	0.8V	
3	19 + 20	Shift Lock Solenoid	* Ignition switched ON	approx. Battery Positive Voltage (B+)	- Perform test step 4
			* With brake operated	0 V	
4	26 + 1	Brake Light Switch	* Ignition switched ON	0 V	- Check of wiring - Brake Light Switch
			- Brake pedal depressed	approx. Battery Positive Voltage (B+)	

(4) Not checked on vehicles with 6-cylinder engine.
Signal from TP Sensor is directed to TCM via ECM

38 Pin TCU

Switch to voltage measuring range 20 V					
Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
5	34+1	Multi-function Transmission Range (TR) Switch -F125-	* Ignition switched ON	4.50 to 5 V	- Check wiring on basis of wiring diagram - Replace Multi-function TR Switch
			- Selector lever position R, N, D, 3 and 2		
			Selector lever position P and 1	0 to 0.8 V	
	15 + 1		Selector lever position P, R, 2 and 1	4.5 to 5 V	
			Selector lever position N, D and 3	0 to 0.8 V	
	35 + 1		Selector lever position P, R, N and D	4.5 to 5 V	
			Selector lever position 3, 2 and 1	0 to 0.8 V	
	16 + 1		Selector lever position P, R and N	approx. Battery Positive Voltage (B+)	
			Selector lever position D, 3, 2 and 1	0 to 0.8 V	
Switch to Ohms measuring range 200 Ohms					
6	22 + 18	Solenoid Valve 1 -N88-	Ignition OFF	55 to 65 ohms	- Check wiring on basis of wiring diagram
	22 + 1		Transmission Control Module (TCM) disconnected	infinite ohms (1)	
7	23 + 18	Solenoid Valve 2 -N89-	Ignition OFF	055 to 65 ohms	- Check wiring on basis of wiring diagram
	23 + 1		TCM disconnected	infinite ohms (1)	
8	3 + 18	Solenoid Valve 3 -N90-	Ignition OFF	55 to 65 ohms	- Check wiring on basis of wiring diagram
	3 + 1		TCM disconnected	infinite ohms (1)	
9	2 + 18	Solenoid Valve 4 -N91-	Ignition OFF	55 to 65 ohms	- Check wiring on basis of wiring diagram
	2 + 1		TCM disconnected	infinite ohms (1)	

(1) Switch multimeter to largest Ohms range

38 Pin TCU

Switch to Ohms measuring range 200 Ohms					
Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
10	24 + 18	Solenoid valve 5	* Ignition switched OFF	55 to 65 ohms	- Check wiring on basis of wiring diagram
	24 + 1	Solenoid valve 5	* Transmission Control Module (TCM) disconnected	infinite ohms (1)	
11	25 + 18	Solenoid valve 6	* Ignition switched OFF	4.5 to 6.5 ohms	- Check wiring on basis of wiring diagram
	25 + 1	Solenoid valve 6	* TCM disconnected	infinite ohms (1)	
12	21 + 8	Solenoid valve 7	* Ignition switched OFF	55 to 65 ohms	- Check wiring on basis of wiring diagram
	21 + 1	Solenoid valve 7	* TCM disconnected	infinite ohms (1)	
13	19 + 20	Shiftlock Solenoid	* Ignition switched OFF * TCM disconnected	14 to 25 ohms	- Check wiring on basis of wiring diagram - Replace Shiftlock Solenoid
14	1 + 17	Kickdown Switch	* Ignition switched OFF * Transmission Control Module (TCM) disconnected * Accelerator Pedal NOT depressed	infinite ohms (1)	- Check wiring on basis of wiring diagram - Adjust Accelerator Pedal cable, or replace
			- depress Accelerator Pedal as far as kick-down	less than 1.5 ohms	

(1) Switch multimeter to largest Ohms range

38 Pin TCU

Switch to Ohms measuring range 20,000 Ohms					
Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
15	32 + 33	Vehicle Speed Sensor (VSS) -g68-	* Ignition OFF * Transmission Control Module (TCM) disconnected	55 to 65 ohms 0.8K ohms 0.9 K ohms	- Check wiring on basis of wiring diagram - Replace Vehicle Speed Sensor (VSS)
Switch to Ohms measuring range 2,000,000 Ohms					
16	30 + 18	Transmission Fluid Temperature Sensor (ATF)	* Ignition OFF		- Check wiring on basis of wiring diagram
			* Transmission Control Module (TCM) disconnected		
			Transmission Fluid Temperature approx. 20°C (68°F)	0.247 M ohms	
			- Switch to resistance measuring range 200,000 ohms		
			approx. 60°C (140°F) approx. 120°C (248°F)	48.8 K ohms 7.4 K ohms	- Check wiring on basis of wiring diagram

(1) Switch multimeter to largest Ohms range

68 Pin TCU

Switch to voltage measuring range 20 V					
Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
1	23 + 1	B+ Supply voltage from Transmission Control Module (TCM)	* Ignition switched ON	approx. Battery Positive Voltage (B+)	- Check wiring per wiring diagram - Check wiring from contact 1 to Ground - Check wiring from contact 19 to terminal 15 central electric (ign. fused)
2	29 + 15	Shift Lock Solenoid	* Ignition switched ON - Brake pedal not depressed	approx. Battery Positive Voltage (B+)	- Check wiring per wiring diagram
			- Brake pedal depressed	0.2 V	- Replace shift lock solenoid
3	15 + 1	Brake Light Switch	* Ignition switched ON	0 V	- Check wiring per wiring diagram - Replace brake light switch
			- Brake pedal depressed	approx. Battery Positive Voltage (B+)	

68 Pin TCU

Switch to Ohms measuring range 20,000 Ohms					
Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
4	5 + 28	Throttle Position (TP) Sensor - (3)	* Ignition switched OFF Accelerator Pedal Position:		- Check wiring on basis of wiring diagram - The resistance measurement will constantly change when operating Accelerator Pedal from idling to Wide OPEN Throttle - Adjusting Throttle Position (TP) Sensor, replace if necessary
			Idling Mln. Idling Max.	0.7k ohms 1.8k ohms	Return system to basic seting
			Wide Open Throttle min. Wide Open Throttle max.	2.1k ohms 3.9k ohms	
	5 + 50	Throttle Position (TP) Sensor - (3)	Idling Mln. Idling Max.	2.1k ohms 3.9 k ohms	
			Wide Open Throttle min. Wide Open Throttle max.	0.7k ohms 1.8 k ohms	
			Switch to voltage measuring range 200 V		
5	63 + 1	Multi-function Transmission Range (TP) Sensor	- Selector lever positon R, N, D, 3 and 2	infinite ohms (2)	- Check wiring on basis of wiring diagram Check connector on Multi-function TR Switch for contact corrosion, replace if necessary - Replace Multi-function TR switch
	Selector lever position P and 1		0 to 0.8 V		
	40 + 1		Selector lever position P, R, 2 and 1	infinite ohms (2)	
	Selector lever position N, D and 3		0 to 0.8 V		
	62 + 1		Selector lever positionP, R, N and D	infinite ohms (2)	
	Selector lever position 3, 2 and 1		0 to 0.8 V		
	18 + 1	Switch to voltage measuring range 20 V			
		Selector lever positionP, R and N	approx .battery voltage		
		Selector lever position D, 3, 2 and 1	0V		

(3) Engine with Mono Motronic - Coolant temperature min. 80° C (176°F)

Not checked on vehicles with 6-cylinder engine; signal from Throttle Position (TP) Sensor -G69_ is directed via Engine control Module (ECM) to Transmission control Module (TCM) and can only be checked with VAG 1551.

(2) Switch multimeter to largest Ohms range.

68 Pin TCU

Switch to Ohms measuring range 200 Ohms					
Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
6	55 + 67	Solenoid valve 1 -N88-	* Ignition switched OFF	55 to 65 ohms	- Check routing of wiring per wiring diagram
	55 + 1			Infinite ohms (1)	
7	54 + 67	Solenoid valve 2 -N89-	* Ignition switched OFF	55 to 65 ohms	- Check routing of wiring per wiring diagram
	54 + 1			Infinite ohms (1)	
8	9 + 67	Solenoid valve 3 -N90-	* Ignition switched OFF	55 to 65 ohms	- Check routing of wiring per wiring diagram
	9 + 1			Infinite ohms (1)	
9	47 + 67	Solenoid valve 4 -N91-	* Ignition switched OFF	4.5 to 6.5 ohms	- Check routing of wiring per wiring diagram
	47 + 1			Infinite ohms (1)	
10	56 + 67	Solenoid valve 5 -N92-	* Ignition switched OFF	55 to 65 ohms	- Check routing of wiring per wiring diagram
	56 + 1			Infinite ohms (1)	
11	58 + 22	Solenoid valve 6 -N93-	* Ignition switched OFF	4.5 to 6.5 ohms	- Check routing of wiring per wiring diagram
	58 + 1			Infinite ohms (1)	
	22 + 1				
12	10 + 67	Solenoid valve 7-N94-	* Ignition switched OFF	55 to 65 ohms	- Check routing of wiring per wiring diagram
	10 + 1			Infinite ohms (1)	
13	23 + 29	Shift lock solenoid	* Ignition switched OFF	14 to 25 ohms	- Check routing of wiring per wiring diagram - Replace shift lock solenoid

(1) Switch multimeter to largest Ohms range

68 Pin TCU

Switch to Ohms measuring range 200,000 Ohms

Test Step	TCU Pins	Test of	* Test Conditions - Additional Operations	Specified Value	Repairing Malfunction (Notes)
14	1 + 16	Kickdown switch	* Ignition switched Off * Accelerator Pedal not depressed *Depress Accelerator Pedal as far as kickdown	Infinite ohms (1) less than 1.5 ohms	-Check routing of wiring per wiring diagram - Adjust accelerator cable or replace
15	6 + 67	Transmission Fluid Temperature Sensor	* Ignition switched OFF * ATF temperature approx. 20° C - Switch digital multimeter to 200 K Ohms approx. 60° C approx. 120° C	0.247 M ohms 48.8 K ohms 7.4 K ohms	
16	20 + 65	Vehicle Speed Sensor (VSS)	Ignition switched OFF min. max	 0.8 K ohms 0.9 K ohms	-Check routing of wiring per wiring diagram - Replace vehicle speed sensor (VSS)
17	21 + 66	Vehicle Speed Sensor (VSS)	Ignition switched OFF min. max	 0.8 K ohms 0.9 K ohms	-Check routing of wiring per wiring diagram - Replace vehicle speed sensor (VSS)

(1) Switch multimeter to largest ohms Range.

Reference

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Conversion Tables

Area		
Multiply	By	To Obtain
In ²	645.2	mm ²
In ²	6.452	cm ²
In ²	0.0069	Ft ²
Ft ²	0.0929	m ²
Ft ²	144.0	In ²
m ²	10.764	Ft ²
cm ²	0.155	In ²
mm ²	0.00155	In ²
area of a circle = ϕr^2 area of a cylinder = $\phi r^2 h$		
$\phi = 3.14$ r = Radius h = Height		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

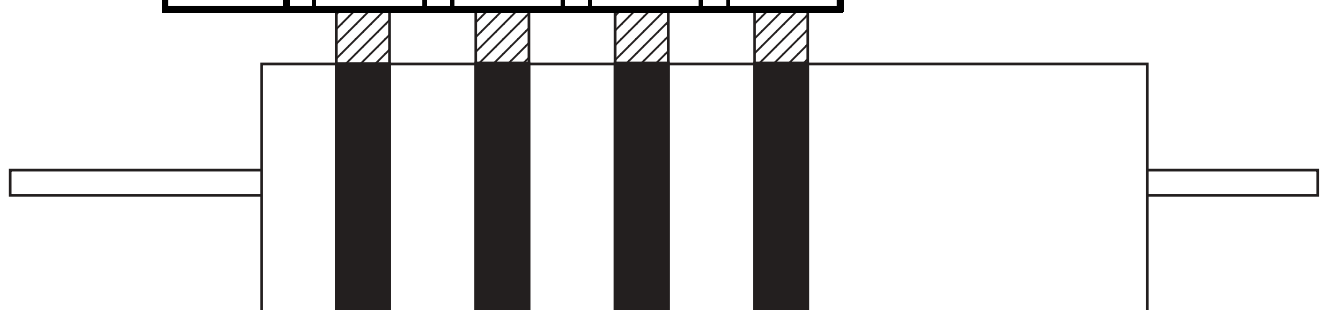
* The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	0	—
Brown	1	1	1	—
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Brown	—	—	—	1%
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%



So if the bands are:

Blue Green Yellow Silver
6 5 0,000 ±10%

Red Violet Brown Gold
2 7 0 ±5%

White Orange Violet Plain
9 3 0,000,000 ±20%

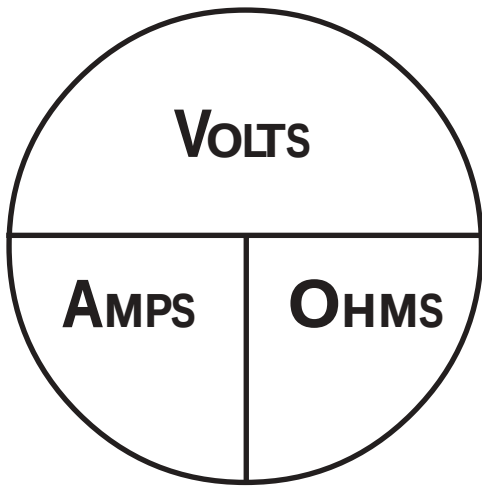
The resistor value is:

= 650 kΩ, ±10%

= 270 Ω, ±5%

= 930 MΩ, ±20%

Ohm's Law



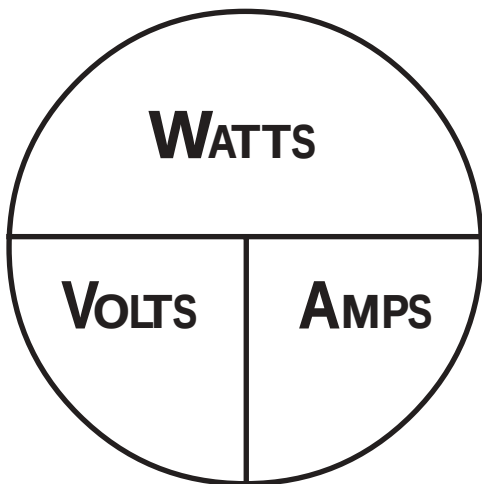
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

Multiple Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

Schematic Symbols

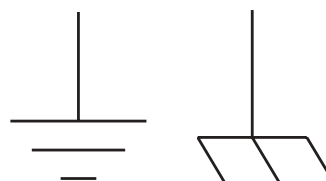


Battery

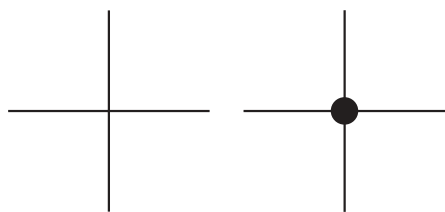
+V



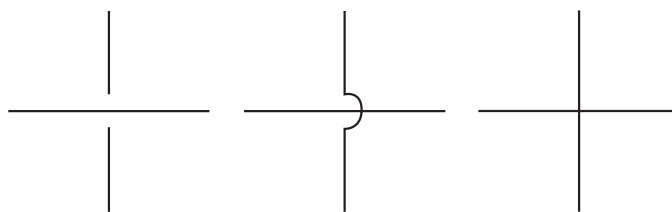
Power



Ground



Connected Wires



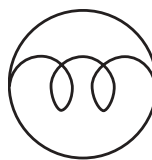
Unconnected Wires



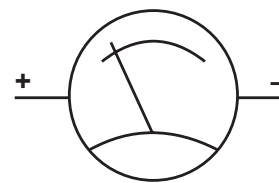
Fuse



Circuit Breaker



Bulb

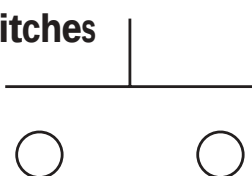


Meter

Pushbutton Switches



NC Switch

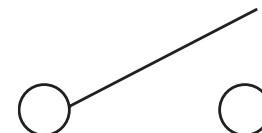


NO Switch

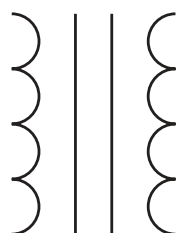
On/Off Switches



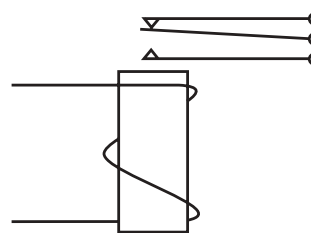
NC Switch



NO Switch

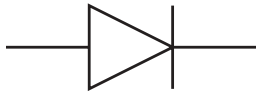
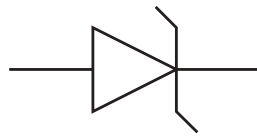
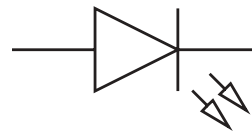
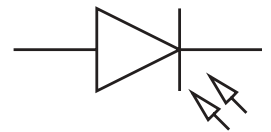
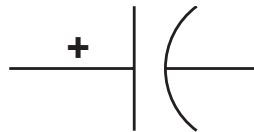
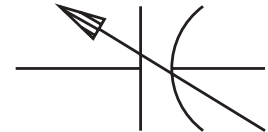
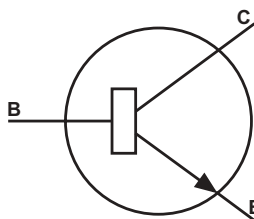
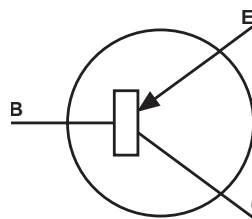
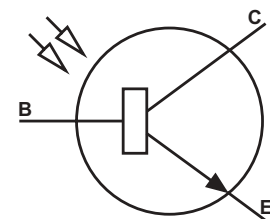
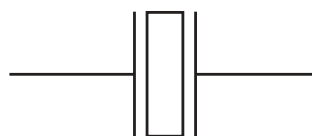


Transformer (Coil)



Relay

Schematic Symbols (continued)

**Fixed Resistor****Variable Resistor****Potentiometer****Diode****Zener Diode****LED****Photodiode****Fixed Capacitor****Fixed Capacitor (Polarized)****Variable Capacitor****NPN Transistor****PNP Transistor****Phototransistor****Crystal**

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates

that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition systems.

Glossary of Electrical Terms (cont)

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical

circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific direction, or the LED won’t light.

Glossary of Electrical Terms (cont)

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm's Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). Ohms x Amps = Volts; Volts , Ohms = Amps; Volts ÷ Amps = Ohms.

Open Circuit — An incomplete electrical path that won't provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won't operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component's operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won't prevent the other legs from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the voltage signal, based on its position

along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device controlling the circuit.

Glossary of Electrical Terms (cont)

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely be dealing with open and close to control hydraulic flow, to allow the transmission to shift gears, control lockup, and control line pressure.

Thermistor — A semiconductor that varies resistance based on temperature. There are two types of thermistor: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). The NTC thermistor is more common — as the temperature goes up, its resistance goes down.

Transistor — A semiconductor that operates as an electronic "relay." Transistors allow a low current circuit to control power or ground to a high current circuit.

Variable Resistor — A one- or two-wire sensor that modifies a voltage signal based on stress or temperature. Thermistors are the most common type of variable resistor in today's cars and trucks.

Voltage — The pressure in an electrical system, that pushes current through the circuit. One volt of pressure is necessary to push one amp of current through one ohm of resistance. Sometimes called the circuit's potential.

Voltmeter — Electrical test device that measures the voltage potential in a circuit. Displays its reading in volts.

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kV	Kilovolt
AC	Alternating current	kW	Kilowatt
B, b	Base electrode, units with single base	kWH	Kilowatt hour
°C	Degrees Celsius or centigrade	lb	Pound
C	Capacitance, capacitor	M	Mega; x1,000,000
C, c	Collector electrode	m	Milli; one-one thousandth; 1 / 1000;
cm	Centimeter	0.001	
cu	Cubic	mf, mfd	Microfarad
db	Decibels	MHz	Megahertz
DC	Direct current	mm	Millimeter
dm	Decimeter	NC	Normally closed
DPDT	Double-pole, double-throw switch	Nm	Newton-meter
DPST	Double-pole, single-throw switch	NO	Normally open
E, e	Emitter electrode	R	Resistance; resistor
E, e	Voltage	SPDT	Single-pole, double-throw switch
mf	Microfarad	SPST	Single-pole, single-throw switch
°F	Degrees Fahrenheit	t	Time
F, f	Frequency	T	Temperature
flu	Fluid	V, v	Volt; voltmeter
FM	Frequency modulation	V _{BB}	Base supply voltage (DC)
g	Gram	V _{BC}	Base-to-collector voltage (DC)
gnd, grd	Ground	V _{BE}	Base-to-emitter voltage (DC)
Hg	Mercury	V _{CB}	Collector-to-base voltage (DC)
Hz	Hertz	V _{CC}	Collector supply voltage (DC)
I	Current	V _{CE}	Collector-to-emitter voltage (DC)
I _B	Base current (DC)	V _{EB}	Emitter-to-base voltage (DC)
I _C	Collector current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _E	Emitter current (DC)	v _{ee}	Emitter supply voltage (DC)
k	x1000	v _F	Forward voltage (DC)
kg	Kilograms	W	Watt; work
kHz	Kilohertz	w	Watt
		wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	¹ / ₁₂₈	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	¹⁵ / ₁₂₈	2.9769		
0.0156	¹ / ₁₆	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	¹ / ₈	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	¹⁷ / ₁₂₈	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	³ / ₁₂₈	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	⁹ / ₆₄	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	³ / ₁₆ -24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	¹ / ₃₂	0.7925			0.1484	¹⁹ / ₁₂₈	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	⁵ / ₃₂	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	³ / ₁₆ -32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	⁵ / ₁₂₈	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	²¹ / ₁₂₈	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	³ / ₆₄	1.1913		0-80 NF	0.1719	¹¹ / ₆₄	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	⁷ / ₁₂₈	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	²³ / ₁₂₈	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1653		4.2000		5.5mm - 0.80
0.0625	¹ / ₁₆	1.5875			0.1820		4.6228	14	12-28 NF
0.0635		1.6129	52		0.1850		4.6990	13	12-32 NEF
0.0670		1.7018	51		0.1875	³ / ₁₆	4.7625		
0.0700	⁹ / ₁₂₈	1.7780	50	2-56 NC 2-64 NF	0.1890		4.8006	12	
					0.1910		4.8514	11	
0.0730		1.8542	49		0.1935		4.9149	10	14-20 NS
0.0760		1.9304	48		0.1953	²⁵ / ₁₂₈	4.9606		
0.0781	⁵ / ₆₄	1.9837			0.1960		4.9784	9	
0.0785		1.9939	47	3-48 NC	0.1990		5.0546	8	
0.0810		2.0574	46		0.2010		5.1054	7	¹ / ₄ -20 NC
0.0820		2.0828	45	3-56 NF					14-24 NS
0.0860	¹¹ / ₁₂₈	2.1844	44	4-36 NS	0.2031	¹³ / ₆₄	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	³ / ₃₂	2.3825		¹ / ₈ -32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	¹ / ₄ -24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	²⁷ / ₁₂₈	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	¹ / ₄ -28 NF
0.1015		2.5781	38	¹ / ₈ -40NF 5-40NC	0.2188	⁷ / ₃₂	5.5575		¹ / ₄ -32 NEF
					0.2210		5.6134	2	
0.1016	¹³ / ₁₂₈	2.5806			0.2266	²⁹ / ₁₂₈	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	¹ / ₄ -40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	⁷ / ₆₄	2.7788			0.2344	¹⁵ / ₆₄	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	²⁹ / ₆₄	11.5087		¹ / ₂ -20 NF ¹ / ₂ -24 NS
0.2422	³¹ / ₁₂₈	6.1519			0.4609	⁵⁹ / ₁₂₈	11.7069		
0.2460		6.2484	D		0.4688	¹⁵ / ₃₂	11.9075		
0.2500	¹ / ₄	6.3500	E		0.4766	⁶¹ / ₁₂₈	12.1056		
0.2570		6.5278	F	⁵ / ₁₆ -18 NC	0.4800		12.1920		14mm - 2.00
0.2578	³³ / ₁₂₈	6.5481			0.4844	³¹ / ₆₄	12.3038		⁹ / ₁₆ -12 NC
0.2610		6.6294	G		0.4922	⁶³ / ₁₂₈	12.5019		
0.2656	¹⁷ / ₆₄	6.7462			0.5000	¹ / ₂	12.7000		14mm - 1.50
0.2660		6.7564	H		0.5039		12.8000		14mm - 1.25
0.2720		6.9088	I	8mm - 1.25 ⁵ / ₁₆ -24 NF	0.5156	³³ / ₆₄	13.0962		⁹ / ₁₆ -18 NF
0.2734	³⁵ / ₁₂₈	6.9444			0.5312	¹⁷ / ₃₂	13.0962		⁵ / ₈ -11 NC
0.2770		7.0358	J		0.5469	³⁵ / ₆₄	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	⁹ / ₁₆	14.2875		
0.2813	⁹ / ₃₂	7.1450		⁵ / ₁₆ -32 NEF	0.5781	³⁷ / ₆₄	14.6837		⁵ / ₈ -18NF ³/₈-18NPT
0.2891	³⁷ / ₁₂₈	7.3431			0.5787		14.7000		16mm - 1.50
0.2900		7.3660	L		0.5938	¹⁹ / ₃₂	15.0825		¹¹ / ₁₆ -11 NS
0.2950		7.4930	M		0.6094	³⁹ / ₆₄	15.4788		
0.2969	¹⁹ / ₆₄	7.5413			0.6220		15.8000		18mm - 2.50
0.3020		7.6708	N		0.6250	⁵ / ₈	15.8750		¹¹ / ₁₆ -16 NS
0.3047	³⁹ / ₁₂₈	7.7394			0.6406	⁴¹ / ₆₄	16.2712		
0.3110		7.8994		9mm - 1.25 ³ / ₈ -16 NC	0.6562	²¹ / ₃₂	16.6675		³ / ₄ -10 NC
0.3125	⁵ / ₁₆	7.9375			0.6614		16.8000		18mm - 1.50
0.3160		8.0264	O		0.6719	⁴³ / ₆₄	17.0663		
0.3190		8.1026		9mm - 1.00	0.6875	¹¹ / ₁₆	17.4625		³ / ₄ -16NF
0.3203	⁴¹ / ₁₂₈	8.1356			0.7008		17.8000		20mm - 2.50
0.3230		8.2042	P		0.7031	⁴⁵ / ₆₄			¹/₂-14 NPT
0.3270		8.3058		9mm - 0.75	0.7187	²³ / ₃₂			
0.3281	²¹ / ₆₄	8.3337			0.7344	⁴⁷ / ₆₄			
0.3320		8.4328	Q	³ / ₈ -24 NF	0.7500	³ / ₄			
0.3359	⁴³ / ₁₂₈	8.5319			0.7656	⁴⁹ / ₆₄			⁷ / ₈ -9 NC
0.3390		8.6106	R	¹/₈-27 NPT	0.7812	²⁵ / ₃₂			
0.3430		8.7122		10mm - 1.50	0.7969	⁵¹ / ₆₄			
0.3438	¹¹ / ₃₂	8.7325			0.8125	¹³ / ₁₆			⁷ / ₈ -14 NF
0.3480		8.8392	S		0.8228		20.9000		22mm - 1.50
0.3500		8.8900		10mm - 1.25	0.8281	⁵³ / ₆₄			⁷ / ₈ -18 NS
0.3516	⁴⁵ / ₁₂₈	8.9306			0.8425		21.4000		24mm - 3.00
0.3580		9.0932	T	10mm - 1.0	0.8437	²⁷ / ₃₂			
0.3594	²³ / ₆₄	9.1288			0.8594	⁵⁵ / ₆₄			
0.3672	⁴⁷ / ₁₂₈	9.3269			0.8750	⁷ / ₈			1-8 NC
0.3680		9.3472	U	⁷ / ₁₆ -14 NC	0.8779		22.3000		24mm - 2.00
0.3750	³ / ₈	9.5250			0.8906	⁵⁷ / ₆₄			
0.3770		9.5758	V		0.9062	²⁹ / ₃₂			
0.3820		9.7028		11mm - 1.50	0.9219	⁵⁹ / ₆₄			1-12 NF
0.3828	⁴⁹ / ₁₂₈	9.7231			0.9375	¹⁵ / ₁₆			³/₄-14 NPT
0.3860		9.8044	W		0.9531	⁶¹ / ₆₄			1-14 NS
0.3906	²⁵ / ₆₄	9.9212		⁷ / ₁₆ -20 NF	0.9687	³¹ / ₃₂			
0.3970		10.0838	X		0.9844	⁶³ / ₆₄			
0.3984	⁵¹ / ₁₂₈	10.1194			1.0000	1			
0.4040		10.2616	Y						
0.4063	¹³ / ₃₂	10.3200							
0.4130		10.4902	Z	12mm - 1.75					
0.4141	⁵³ / ₁₂₈	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	²⁷ / ₆₄	10.7163		¹ / ₂ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	⁵⁵ / ₁₂₈	10.9144							
0.4375	⁷ / ₁₆	11.1125		¹/₄-18NPT					
0.4453	⁵⁷ / ₁₂₈	11.3106							

2003

TECHNICAL SEMINAR



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Dennis Madden
Chief Executive Officer



Lance Wiggins
Technical Director

Creating a Great Seminar...

For most of you, a technical seminar is maybe half-a-dozen or so hours of intense technical information... and then, as quickly as it begins, it's over. But a lot of effort goes in ahead of time, researching, developing and designing a seminar, long before it's ready to play your town. Long days... late hours... frayed nerves... all part of the process to put a clean, carefully-choreographed presentation in front of a discriminating audience.

The folks involved in developing this year's seminar are the leaders in the transmission repair industry. With over 200 years of combined technical experience, they've poured their heart and soul into every page and slide in this program. Whether their contribution involved technical expertise or organizational skills, the culmination of their efforts was an extraordinary educational experience that we're proud to call the ATRA 2003 Technical Seminar.

We hope your experience is as rewarding as it was for us to develop it.

A handwritten signature in cursive script, reading "Lance Wiggins".



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It's difficult enough getting the seminar book researched, written, pictured, edited, and printed let alone getting it out to the seminar attendees. This is where the ATRA Staff comes in.

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Without the ATRA team, it would be very hard to accomplish the task at hand. Please enjoy the seminar.

Lance Wiggins
ATRA, Technical Director

General Motors Contents

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Service 4wd Light On, Possible DTC B2725 set

A complaint of the “Service 4WD” light is on in the instrument cluster or the transfer case “shifts by itself”.

Once the DTC is set, the transfer case will not shift into 4WD. This condition may effect 1999-2003 Full size GM trucks and sport utility vehicles such as Silverado, Tahoe, Escalade, Yukon, Yukon XL, Avalanche and Suburban applications with the NV 246 transfer case (RPO NP8) and/or the 2002/2003 Trail Blazer/Envoy with the NV236 transfer case. In addition complaints of incorrect reading in the transfer case switch assembly is illuminated.

NOTE: Your scan tool must be capable of communicating with the vehicle body computer/TCCM (Transfer Case Control Module) in order for you to read the codes, as these are not PCM related DTC’s.

DTC B2725 will set if:

The TCCM detects low voltage (Less than 1 volt) on the transfer case range switch circuit for longer than 5 minutes.

If B2725 is set the TCCM will:

- Ä Inhibit 4WD
- Ä Illuminate the 4WD light



Service 4wd Light On, Possible DTC B2725 set

Possible causes for this code can be:

- Ä A faulty transfer case control switch (which is mounted in the dash)
- Ä A short to ground in the wiring between the control switch assembly mounted in the dash and the TCCM
- Ä A faulty TCCM
- Ä TCCM Reprogm updat for 2003

NOTE: When following the service manual diagnostic procedure, you may be lead to replace components that are not faulty. The switch resistance values listed in the service manual maybe incorrect.

The correct control switch resistance values are as follows:



**Measure Resistance
between Pin 1 and Pin 2**

No buttons pushed:	8.63-9.54 ohms
Auto 4wd:	61.7-68.1 ohms
4 HI:	656-670 ohms
2 HI:	1.5-1.53 K ohms
4 LOW:	2.32-2.37 K ohms
Neutral:	1.015-1.035 K ohms



All GM

B1001, B1271, B1780

1996 and later controller replacement and reprogramming is becoming an increasingly common service procedure for most shops. Several DTCs may be set when programming or replacing a controller including B1001, B1271 and B1780.

All GM vehicles utilize either a Class 2 or CAN data bus. Serial Data communications constantly occur between the different controllers on your GM vehicle. The modules that are common to most applications are:

- Ä PCM (Powertrain control module)
- Ä BCM (Body control module)
- Ä DIM (Dash integration module)
- Ä IPC (Instrument panel cluster)
- Ä HVAC (Heating, ventilation, A/C module)
- Ä SDM (Sensing and deployment module) Airbag

If a B1001 (SDM configuration error) sets, deployment of the air bags will be inhibited. If a B1271 or a B1780 (Radio theft lock) DTCs are set the radio will no longer work. These DTC's will turn on the AIRBAG lamp. In addition, the radio will display "LOCKED" after your repair.

The most common cause of this problem happens when attempting to interchange a module from another vehicle. This can result in not only the DTCs described above setting, but also a possible no start condition. Another cause is the wrong VIN loaded into the NEW PCM or BCM. Both the PCM and the BCM require programming before they will function.

REPAIR: Several steps should be taken if these DTCs are set including:

1. Make sure the correct part number controllers were used for your application.
2. Make sure the correct VIN was loaded into the replacement controller
3. After the controller was installed, turn the key off for at least 30 seconds
4. Turn the ignition ON and check for the DTCs. If DTCs B1001 and/or B1271 and/or B1271 are set as "HISTORY" codes do not replace the SDM or the RADIO. Simply Clear all the stored DTCs.
5. Cycle the key off, then on and monitor the Airbag lamp in the dash. It should flash 7-9 times and then go off.

NOTE: Clearing the DTCs as described above is a common part of the replacement and reprogramming procedure on all GM applications.

4T40E/45E N-Car

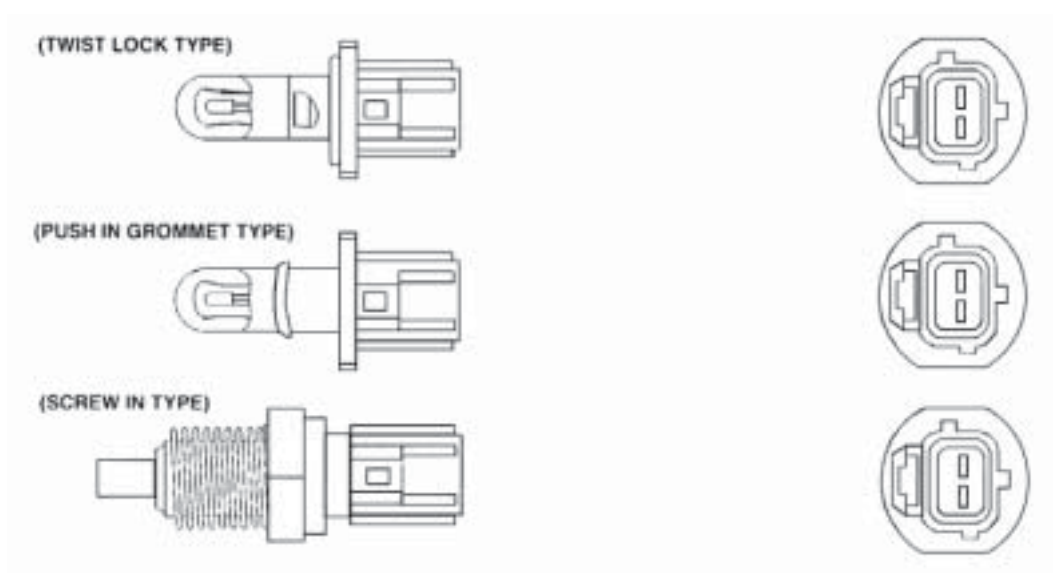
Hard Shifts/ No DTC'S

4T40E/45E applications may exhibit a hard shift concern that may/may not be intermittent. In some instances an IAT (intake air temperature sensor) DTC may be set. The PCS commanded/actual amperages will indicate low amperage flow through the PCS and its circuits. In addition the technician may indicate that he/she had problems controlling the PCS amperage when using the PCS override feature on their scan tool.

Several of the 4T40E/45E applications utilize the IAT sensor as part of the engine torque calculations. Torque modeling is used by the PCM to determine the line pressure calculation.

The most common causes of this concern are:

- Ä Broken wiring, generally the wire is damaged at the sensor connector
- Ä Terminal pin tension, terminal crimp damaged
- Ä A faulty IAT sensor



4T40E

Saturn Application

Possible P0731 DTC set

Saturn applications use individual DTCs to identify which gear the transaxle was in at the time a ratio error occurred. P0731 sets if a ratio error occurs in 1st gear while P0732 will set if a ratio error is present in 2nd, P0733 in 3rd and P0734 will set in 4th.

If a P0731 is set along with any or all of the following DTCs, address the other DTCs first. Other DTCs which may effect diagnosis include:

- Ä P0716 (Turbine speed electrical interference/noise)
- Ä P0717 (No turbine signal)
- Ä P0745 (Low line pressure)
- Ä P0722 (No VSS signal).

If only a P0731 is set, review the stored data relating to the DTC and note which shifter position the transaxle was in and the VSS values. If the DTC was set in park and the VSS data indicates a VSS reading (usually around 15-35mph) the cause of the problem is typically a poor ITCM (Internal Transmission Control Module) ground (G115 on the back of the engine).

4T40/45E N-Car

VSS Intermittent or Possible DTC P0502

Erratic speedometer operation, No/Erratic/Intermittent transmission shifts, intermittent cruise control operation. Possible DTC P0502 may be set. This problem is most common on the N-body (Grand AM, Alero) applications with the 2.2L L61 engine and J41 brakes.

A common cause for this is the VSS harness being too long in the area of the right hand (passenger side) axle shaft area. The extra harness length allows the harness (circuit 400 and 401) to contact the axle shaft leading to harness chaffing and the intermittent complaint.

Reposition the conduit for the wiring leg to allow clearance at the top of the engine rather than at the axle area. Secure the harness in the mounting clip.



**VSS harness
the right hand
(passenger side)
axle shaft area.**

4T40E/4T45E

Driveability Concerns N-Car 2.2L/ 3.4L

Pontiac Grand AM/Oldsmobile Alero applications with the 2.2L or 3.4L engine and the 4T40E or 4T45E transmission may experience any of the following concerns in any combination:

- Ä No start
- Ä Drivability conditions (engine miss, etc.)
- Ä MIL on
- Ä Possible DTCs
- Ä Cooling Fan inoperative
- Ä ABS inoperative
- Ä Any of the above concerns can be intermittent in nature

A common cause for these concerns are Ground G-103 being loose or corroded. Remove the ground from the bell housing. Clean and reinstall the ground. You may want to install a star washer to assure proper ground continuity. The ground strap is located on the right upper bell housing bolt on the drivers side.



**Located on
the upper right
hand side of the
bell housing.**

4T40E/45E

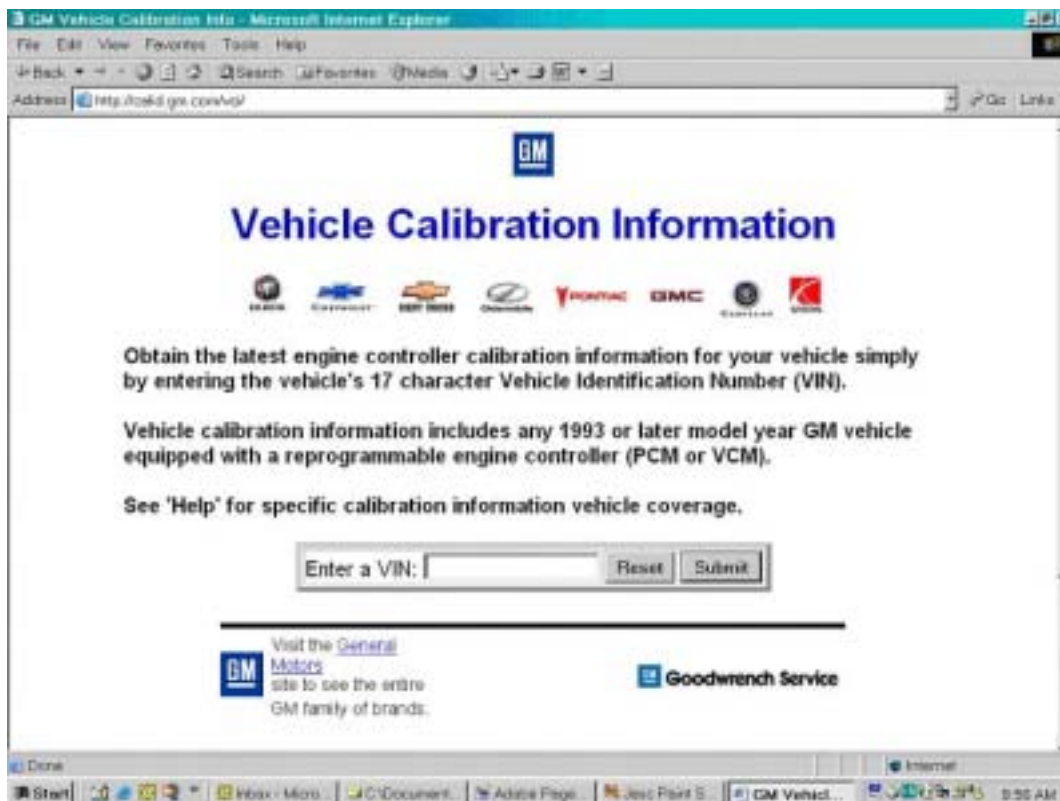
P0741 Set N-Car 3.1L (RPO LG8)

1995-2002 Chevrolet Malibu “N” body, may have the SES light is on and P0741 (TCC stuck off) DTC set in memory. On 1995-2001 applications this condition may not have occurred until the PCM was recalibrated for some other concern.

The calibration loaded in the 2002 Malibu and any calibration updates that were done on early model Malibu applications during the 2002 model year may have a software problem. The 2002 calibration tables allowed the P0741 to falsely set.

An updated 2003 calibration is now available to repair this concern. Visit the GM web site to see if your vehicle requires recalibration.

<http://calid.gm.com/vci/>



4T40E/45E

P1815 Set N-Car

Code P1815 may also be set in conjunction with other PSA DTCs such as a P1810. In many instances the PSA has already been replaced for this condition. If the P1815 is set in conjunction with other PSA DTCs the problem is probably caused by metal contamination. This can be from the manufacture or possibly from the transmission itself. If the P1815 is set with no other DTCs it may be a false code.

P1815 will set if:

- Ä D2, D4 or reverse range is indicated at start up
- Ä The condition lasts for longer than 25 seconds

P1810 will set if:

- Ä The PCM detects an invalid gear range
- Ä The condition lasts for longer than 60 seconds

If the problem is related to contamination replace the PSA. Updated procedures are now being followed by the vendor to prevent contamination. If the P1815 is set but there are no other codes, update the PCM with the calibration designed to prevent a false P1815 from setting. Visit the GM web site to obtain the correct calibration for your application. [**http://calid.gm.com/vci/**](http://calid.gm.com/vci/)

4T60E

Ratio and Application Chart

The 4T60E utilizes several different final drive, drive/driven sprocket, speed sensor and torque converter combinations. Installing the wrong transmission, drive/driven sprockets, final drive, speed sensor or torque converter can result in ratio error or slip DTC's . If a ratio error or a TCC slip DTC is present, and the unit has been previously repaired or replaced, the converter, final drive ratio, speed sensor and/or drive to driven sprocket ratio could possibly be incorrect for your application. Refer to our chart to determine what transmission should be used for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application

RPO Codes for the 4T60E Applications			
RPO	Definition	RPO	Definition
L82	3.1L Engine	L26	4.9L Engine
L67	3800 Engine	L27	3800 Engine
LQ1	3.4L DOHC Engine	LHO	3.1L Engine
L40	2.31 DOHC Engine	LD2	2.3L Engine
L36	3800 Engine	L67	3800 Super Charged
L27	3800 Engine		
LN2	2.2L Engine	LD9	2.4L Engine
FX8	3.61 Ratio	LA1	3.4L Engine
F17	2.84 Ratio	F68	3.45L Ratio
M13	4T60E	FVO	3.67 Ratio
FW2	3.06 Ratio	MXO	4 Speed
F13	3.48 Ratio	FRQ	3.29 Ratio
F79	2.97 Ratio	F16	2.53 Ratio
F83	3.05 Ratio	FW9	3.43 Ratio
FR9	3.29 Ratio	F16	2.53 Ratio

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
Cad E/K Body 4.9 L28	1991	1A2W 1AM 1A2	37/33	3.33	30	8686931
Cad C/K Body 4.9L L26	1991	1A4W 1AP 1A4	37/33	3.33	30	8686932
Cad E/K Touring 4.9L L26	1991	1A7W 1AY 1A7	37/33	3.33	30	8686933
BUICK E BODY 3800	1991	1YPW 1YP	35/35			8651955
C-BODY	1991/1992	2B1W 1BT 2BT 2B1	37/33	3.33	31	8686916
C/H BODY TOUR	1992	2C1W 2CL 2C1	35/35	2.84	30	8686918
C/H BODY TOUR	1992	2C2W 2CS 2C2	35/35	3.06	30	8686919
C/H BODY	1992	2C3W 2CT 2C3	35/35	3.06	31	8686920
W BODY 3.4L	1991/1992	1CW 2C4W 2CW 2C4	33/37	3.06	30	8686921
C BODY 3800 TOUR	1992	2C5W 2CX 2C5	37/33	3.33	31	8686922
H BODY SSE,SSEI TOUR	1992	2C6W 2CZ 2C6	37/33	3.33	31	8686923
H BODY SSE	1992	2P1W 2PH 2P1	37/33	3.33	31	8686924

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Drive-n Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
C/H/W BODY 3800	1992	2W1W 2WA 2W1	35/35	3.06	31	8686925
C/H BODY 3800	1992	2YLW 2YL 2Y1	35/35	2.84	31	8682926
C/H BODY 3800	1991/1992	2Y2W 2YM 2Y2 1YM	35/35	2.84	30	8686927
C/H BODY 3800	1991/1992	1YZ 2YZ 2Y4 2Y4W	35/35	3.06	30	8686929
H BODY SSE	1992	2B2W 2BY 2B2	35/35	3.06	31	8686917
CAD E/K TOUR L26	1992	2A7W 2AY	37/33	3.33	31	8686913
CAD C BODY TOUR L26	1992-1993	2AB 2A1 3ABW 3AB	37/33	3.06	30	8651986
CAD E/K L26	1992/1993	2AM 2A2 3AMW 3AM	37/33	3.33	31	8651987
CAD C BODY TOUR L26	1992/1993	2AN 2A3 3AN 3ANW	37/33	3.33	30	8651988
CAD E/K BODY EXPORT L26	1992/1993	2AP 2A4 3AP 3APW	37/33	3.33	31	8651989
CAD C BODY L26	1991-1993	1AH 1AV 2AV 2A5 3AV 3AVW	37/33	3.06	30	8651990

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Drive-n Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
CAD C BODY TOUR EXPORT L26	1992/1993	2AW 2A6 3AW 3AWW	37/33	3.33	30	8651991
CAD C BODY LIMO L26	1991-1993	1AZ 2AZ 2A8 3AZ 3AZW	37/33	3.06	32	8651992
C BODY 3800 L67	1993	3BTW 3BT	37/33	3.33	31	8651993
H BODY 3800 L27	1993	3BY 3BYW	35/35	3.06	31	8651994
C/H BODY TOUR 3800 L27	1993	3CL 3CLW	35/35	2.84	30	8651995
C/H BODY TOUR EXPORT 3800 L27	1993	3CS 3CSW	35/35	3.33	30	8651996
H BODY SSE 3800 L27	1993	3CT 3CTW	35/35	3.06	31	8651997
C BODY TOUR 3800 L67	1993	3CX 3CXW	37/33	3.06	31	8651998
H BODY SSE SSEI TOUR 3800 L67	1993	3CZ 3CZW	37/33	3.33	31	8651999

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
H BODY SSE TOUR 3800 L67	1993	3PH 3PHW	37/33	3.33	31	8686900
C/H/W BODY 3800 L27	1993	3WA 3WAW	35/35	3.06	31	8686901
C/H BODY 3800 L27	1993	3YM 3YMW	35/35	2.84	30	8686902
C/H BODY EXPORT 3800 L27	1993	3YZ 3YZW	35/35	3.06	30	8686903
W BODY 3.4 L LQ1	1993	3CW 3CWW	33/37	3.06	30	8686904
W BODY 3.1 L LHO	1993	3CM 3CMW	35/35	3.33	30	8686905
H BODY 3800 L27	1993	3YL 3YLW	35/35	2.84	31	8686906
E BODY 3800 L27	1993	3YR 3YRW	35/35	3.06	30	8686907
W BODY 3.1 L L82	1993	3BH 3BHW	35/35	3.33	30	8686934
N BODY 2.3 L L40	1994	4CLW 4CL	33/37	3.06	29	24200806
N BODY 2.3 L LD2	1994	4PH 4PHW	33/37	3.33	29	24200805
L/N BODY 3.1 L L82	1994	4WS 4WSW	37/33	3.33	29	24200804
W BODY 3.1 L LHO	1994	4CM 4CMW	35/35	3.33	30	24200592

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
H BODY 3800 L27	1994	4PF 4PFW	35/35	3.06	31	8686940
C/H BODY 3800 L27	1994	4WA 4WAW	35/35	3.06	31	8686941
CAD K BODY 4.9L L26	1994/1995	4AT 5AT 5ATW	37/33	3.06	31	24201790
N BODY 2.3L LD2	1995	5PC 5PCW	33/37	3.29	29	24201792
A BODY EXPORT 3.1L L82	1994/1995	4AJ 5AJ 5AJW	37/33	3.33	29	24201788
A BODY 3.1L L82	1994/1995	4PA 5PA 5PAW	37/33	3.33	29	24201789
L/N BODY 3.1L L82	1995	5WF 5WFW	37/33	3.29	29	24201791
W BODY 3.4L LQ1	1994/1995	4PB 5PB 5PBW	33/37	3.06	30	24200941
W BODY 3800 L27	1994/1995	4BL 5BL 5BLW	35/35	3.06	31	24200589
G BODY 3800 L36	1995	5CA 5CAW	35/35	3.05	31	24202030
G BODY 3800 L67	1995	5BF 5BFW	37/33	3.29	31	24200590
U VAN 3800 L27	1994/1995	4KU 5KU 5KUW	35/35	3.06	31	24201793
U VAN EXPORT 3800 L27	1994/1995	4PM 5PM 5PMW	35/35	3.06	30	24201794

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
C/H BODY 3800 L36	1995	5AC 5ACW	35/35	3.06	30	24202033
C/H BODY 3800 L36	1995	5AS 5ASW	35/35	2.84	30	24202028
H BODY 3800 L27	1994/1995	4YZ 5YZ 5YZW	35/35	3.06	30	24202029
H BODY 3800 L36	1995	5BX 5BXW	35/35	3.06	31	24202031
H BODY 3800 L36	1995	5BK 5BKW	35/35	3.06	31	24202032
H BODY 3800 L27	1994/1995	4YM 5YM 5YMW	35/35	2.84	30	24202027
C/H BODY 3800 L67	1994/1995	4YC 5YD 5YDW	37/33	3.33	31	24202034
H BODY SSEI 3800 L67	1994/1995	4KH 5YN 5YNW	37/33	3.33	31	24202035
A BODY 3.1L L82	1996	6PA 6PAW	37/33	3.33	30	24204175
L BODY 3.1L L82	1996	6WF 6WFW	37/33	3.29	30	24204177
W BODY 3.4L LQ1	1996	6PB 6PBW	33/37	3.06	30	24204179
U VAN 3.4L LA1	1996	6PK 6PKW	35/35	3.29	30	24204186
G BODY 3800 L36	1996	6CA 6CAW	35/35	3.05	30	24204183

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
C/H BODY 3800 L36	1996	6AC 6ACW	35/35	3.06	30	24204174
C/H BODY 3800 L36	1996	6AS 6ASW	35/35	2.84	30	24204181
H BODY 3800 L36	1996	6BX 6BXW	35/35	3.06	30	24204173
C/H BODY 3800 L67	1996	6YL 6YLW	37/33	3.29	30	24204191
H BODY 3800 L67	1996	6YR 6YRW	37/33	3.29	30	24204192
G BODY 3800 L67	1996	6CT 6CTW	37/33	3.29	30	24204193
N BODY 2.4L LD9	1996/1997	6CU 7CU 7CUW	33/37	3.05	30	24206839
W BODY 3.1L L82	1994-1997	4AF 5AF 6AF 7AF 7AFW	35/35	3.33	30	24206840
W BODY 3.1L L82	1997	7AF 7AHW	35/35	3.29	30	24206841
N BODY 3.1L L82	1996/1997	6BS 7BS 7BSW	37/33	3.29	30	24206842
U VAN 3.4L LA1	1997	7YA 7YAW	35/35	3.29	30	24206844
H BODY 3800 L36	1997	7AC 7ACW	35/35	3.06	30	24206845

4T60E

Ratio and Application Chart

Application	Year	Model Codes	Drive/Driven Sprockets	Final Drive SRTA Part #	Speed Sensor Teeth	SRTA Part #
H BODY 3800 L36	1997	7AS 7ASW	35/35	2.84	30	24206846
W CAR 3800 L36	1997	7AW 7AWW	35/35	3.29	30	24206847
H BODY SSE 3800 L36	1997	7BX 7BXW	35/35	3.06	30	24206848
W BODY 3800 L36	1996/1997	6HB 6AV 7HB 7HBW	35/35	3.05	30	24206849
W BODY 3.1L L82	1998	8AH 8AHW	37/33	3.29	30	24211255
N BODY 2.4L LD9	1998	8CU 8CUW	33/37	3.05	30	24211256
U VAN 3.4L LA1	1998	8DK 8YA 8DKW	35/35	3.29	30	24214260
W BODY 3.1L L82	1999	9AH 9AHW	35/35	3.29	30	24213669

4T65E Update

2002-2003 Changes

Many changes have occurred in the 4T65E pump assembly to reduce costs. These changes were implemented on June 24th 2002 on some models. These changes include:

Ä A new three-piece pump design. The new design eliminates all the selective rotors and slides available for the previous design pump. All of the rotors use a tapered, random pumping chamber design (staggered spaces in the rotor).

Ä The valve body sleeve that supported the rotor in the previous design pump has been moved to the pump body on the three-piece pump. In addition, some of the valve bodies are designed for a fully contented PSA while others are designed for de-contented PSAs.

Ä A new internal wiring harness with revised wire lengths for the PWM and PCS as well as a new connector design for the new pressure control solenoid and PSA on 2003 models.

**New Sleeve to
support the rotor**



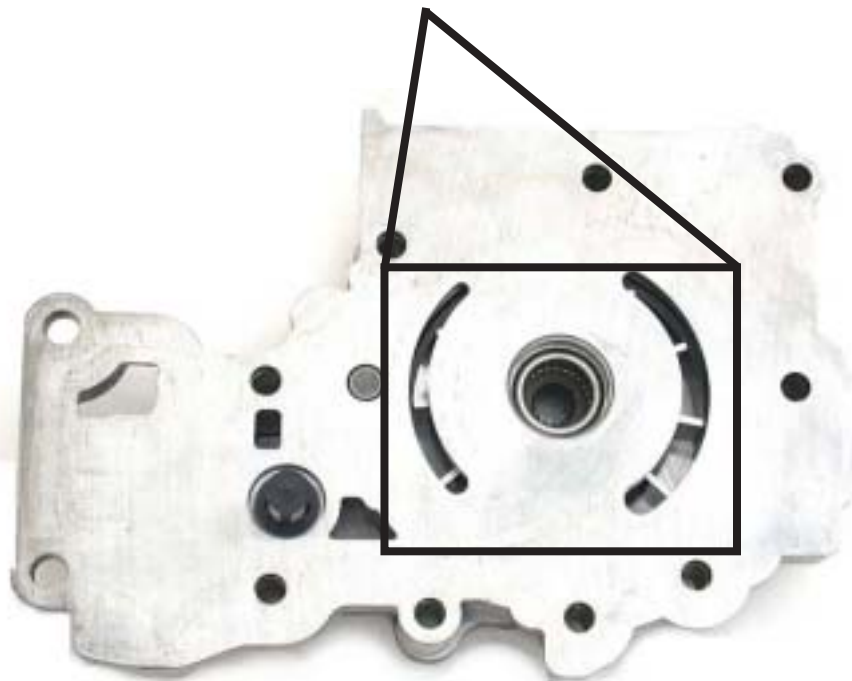
4T65E Update

2002-2003 Pump Changes (Continued)

GM recommends the new pump **not be installed** on earlier design applications, however, if you can successfully remove the sleeve, the pump would then be able to back service previous design units. Since this is a very confusing mid-year change we recommend that you refer to the following to identify which design pump should be in your transmission:

Ä 2002-1st design two-piece pump (Part # 24221299)
For all 2002 models including model code 2RDB with update level LESS than “7” but not 2BCB or 2RNB models with update levels GREATER than “3” use the 24221299 pump assembly.

Earlier Design



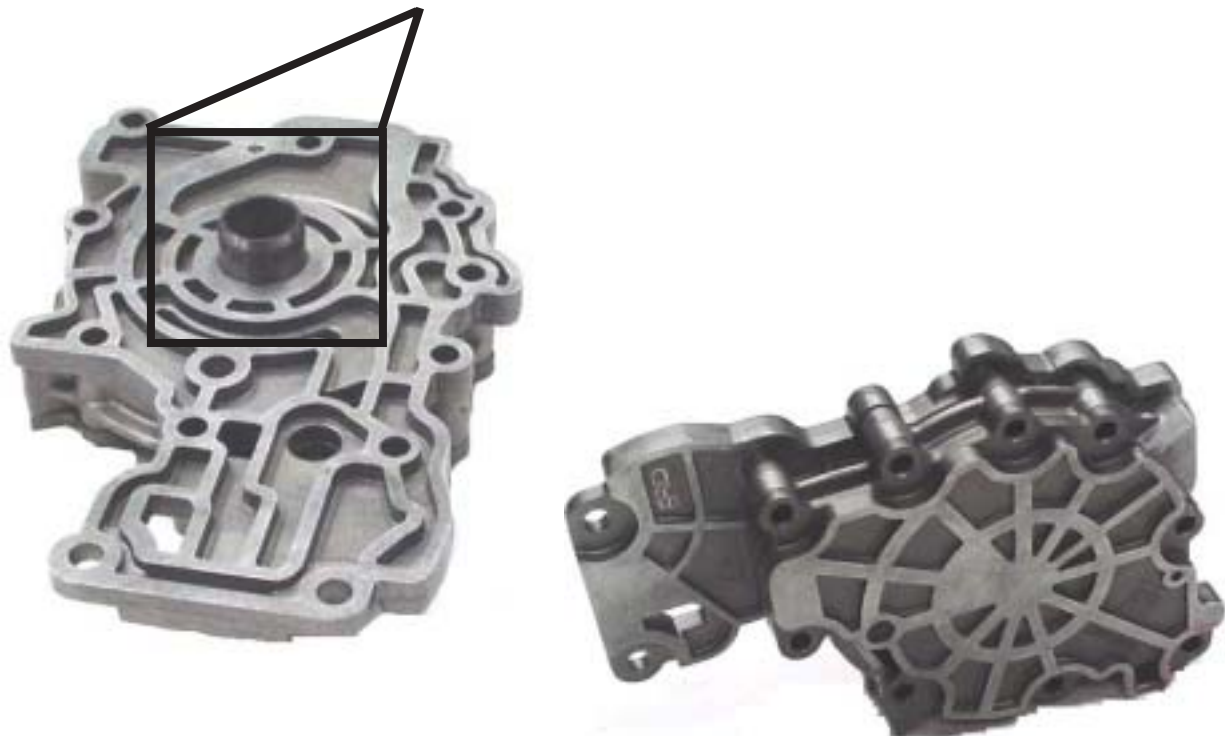
4T65E Update

2002-2003 Pump Changes

2002 2nd design three-piece pump (Part # 24225894) For all 2BCB and 2RNB models with an update level of “4” and 2RDB models with an update level of “7” use the 24225894 pump assembly.

2003-1st design 2 piece pump (Part # 24221299) For all 2003 models with an update level LESS than three and for model 3BCB model with update level “4” use the 24221299 pump assembly.

Late Design



4T65E Update

2002-2003 Pump Changes

2003-2nd design 3 piece pump (Part # 24225894) For all 2003 models with an update level GREATER than “3” use the 24225894 pump assembly. (except the 3BCB model with an update level of “4”)

As of July 15 2002 (Julian date 196) all models use the updated 2nd design pump and valve body assembly

If a model is not listed above it uses the 1st design 2 piece pump assembly.

As mentioned the valve body was also changed when the pump was changed. Part numbers are as follows:

2002-1st design valve body with support (Part # 24218255) For all 2002 models including 2RDB with update level LESS than “7” but not a 2BCB or 2RNB models with update levels GREATER than “3” use the 24218255 valve body assembly.

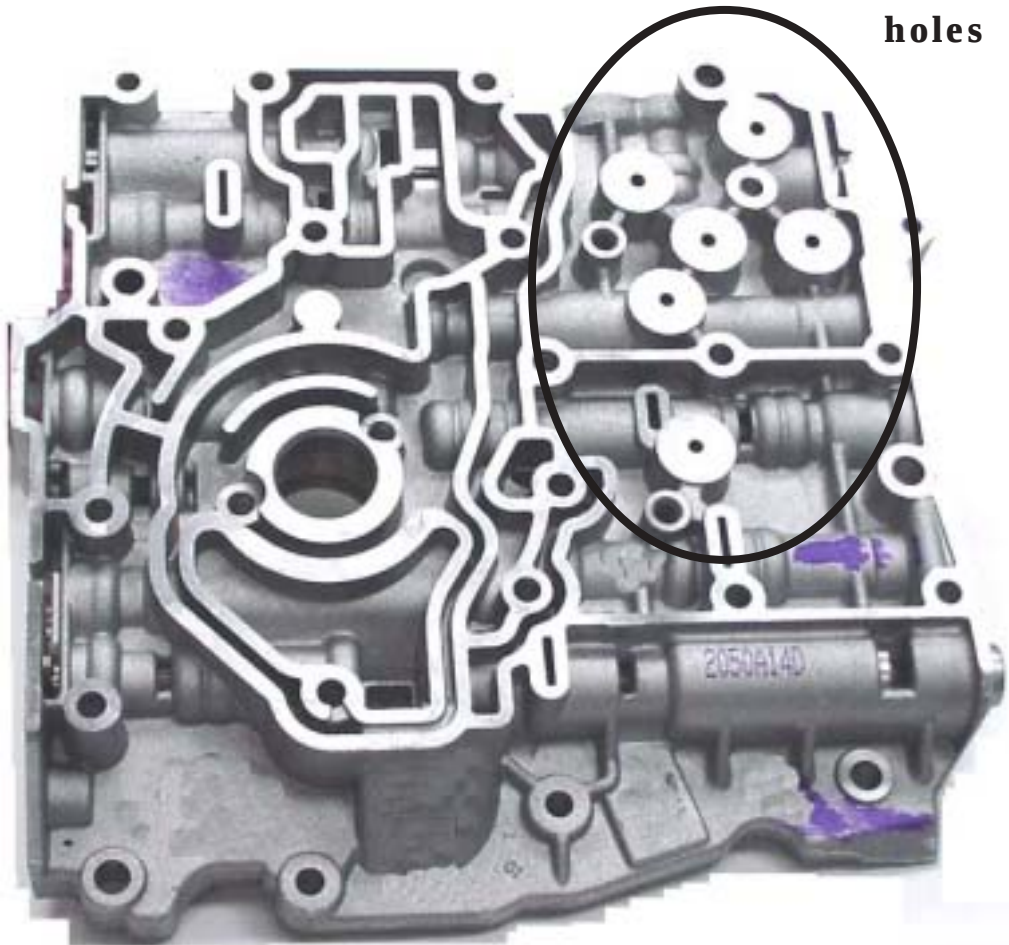


4T65E Update

2002-2003 Valve Body Changes

2002 2nd design valve body without the support (Part # 24225924) For all 2BCB and 2RNB models with an update level of “4” and 2RDB models with an update level of “7” use the 24225924 pump assembly.

**Valve Body
without support
and Six pressure
holes**

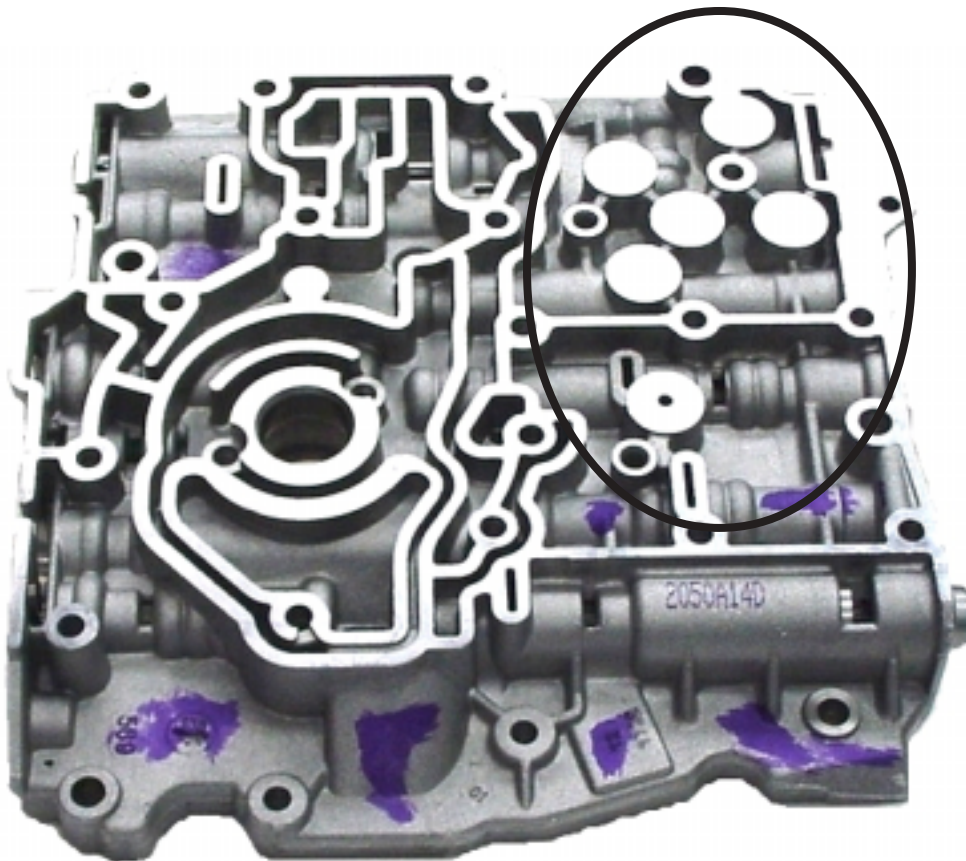


4T65E Update

2002-2003 Valve Body Changes

2003-1st design valve body with support (Part 24225443) For all 2003 models with an update level LESS than “3” and for model 3BCB model with update level “4” use the 24225443 valve body assembly.

**Valve Body
without support
and one pressure
holes**



4T65E Update

2002-2003 Valve Body Changes

2003-2nd design valve body without support (Part # 24225926) For all 2003 models with an update level GREATER than “3” use the 24225926 valve body assembly. (except the 3BCB model with an update level of “4”)

Remember, the valve body update not only includes changes to the sleeve area but also changes to the PSA area to accommodate or not to accommodate the de-contented PSA assembly so always refer to the above information before ordering parts.

The 24225926 part number is for a “new valve body”. At a future date the part number will likely be changed as a remain valve body becomes available. Check with your parts person to be sure your ordering the correct part number in the future.



4T65E Update

2002-2003 Changes

An IMS (Internal Mode Switch) was added to all 4T65Es. A new design replaced the previous design that used a nut to hold the design together. The update was done as a cost savings.

The new design will back service the 99 and later model 4T65Es that utilized an IMS. As with the previous design, make sure the IMS is properly positioned on the rooster comb before installing the transmission in the vehicle!! The IMS part number is 24213847



**Fastening Nut
was removed on
the new switch**

4T65E Update

2002-2003 Changes

A new PSA was added to all models for 2003. This Change meant the valve body machining, and the wiring harness/connector also changed to accommodate the new design PSA. The update was done because of contamination issues with the PSA. The vehicle software was also updated eliminating the PSA DTC P1810.

The new design PSA and wiring harness will not back service the previous applications as the valve body machining has drastically changed. The part number for the previous design PSA is 24203699, the part number for the de-contented PSA is 24216426



**Early style PSA
with Six switches**



**Late style PSA
with one switch**



4T65E Update

2002-2003 Changes

A new design PCS was introduced for the 2003 applications. The vendor was changed from Delphi to Bosch. To accommodate the new design solenoid, the torque signal regulator valve spring tension was significantly increased. This new design will become common on all applications in the years to come.

GM does not recommend interchanging the two solenoids. If the old design is installed in a unit designed for the updated solenoid a slipping concern may occur. If the updated design is installed in an early model unit hard shift concerns may occur. The Delphi PCS part number is 10478146, the part number for the Bosch PCS is 24225825

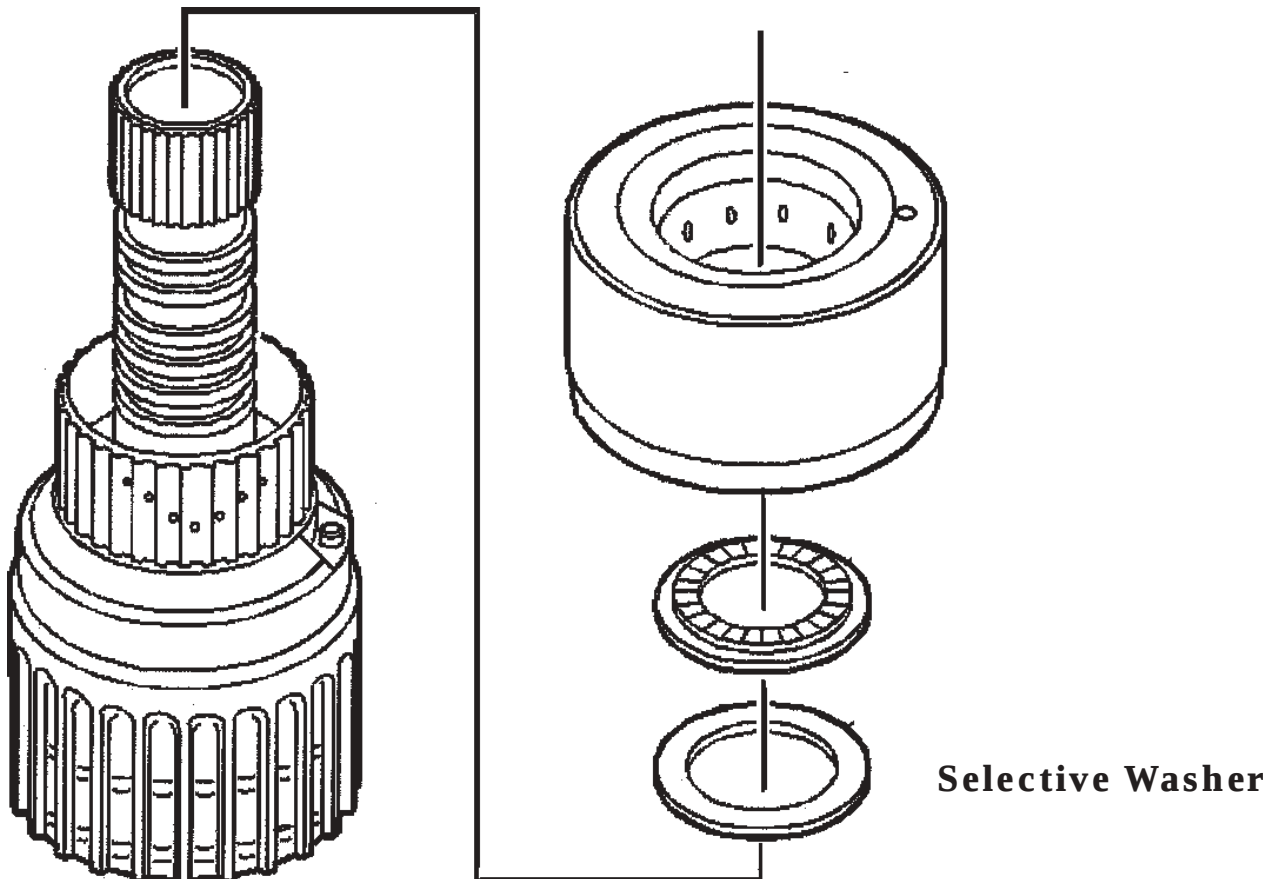


4T65E Update

2002-2003 Changes

A running change is planned for the input housings on all 4T65E models. The new housing will accommodate a new design input housing washer (End play washer) which is wider, to fully support the sprocket support thrust bearing. The Housing machining diameter where the washer sets is now smaller (54.5mm).

The new design washer is available in 10 selective thickness. The updated washer must be used with the updated input housing due to the machining changes. The input housing is interchangeable with earlier years.



4T65E Update

2002-2003 Changes

The input and 3rd one way clutches were updated as of July 17th 2002 on some models. Full implementation is scheduled for February 2003. The new one way clutches are a “PAWL” design (commonly referred to as a diode) rather than the sprag design that has been used since the 4T65E was introduced in 1997. In addition, the new pawl design assembly requires new design input clutches. The new clutch plates utilize a wave design spline and are thicker than the previous design components. This update was done because of durability problems with the previous design components.

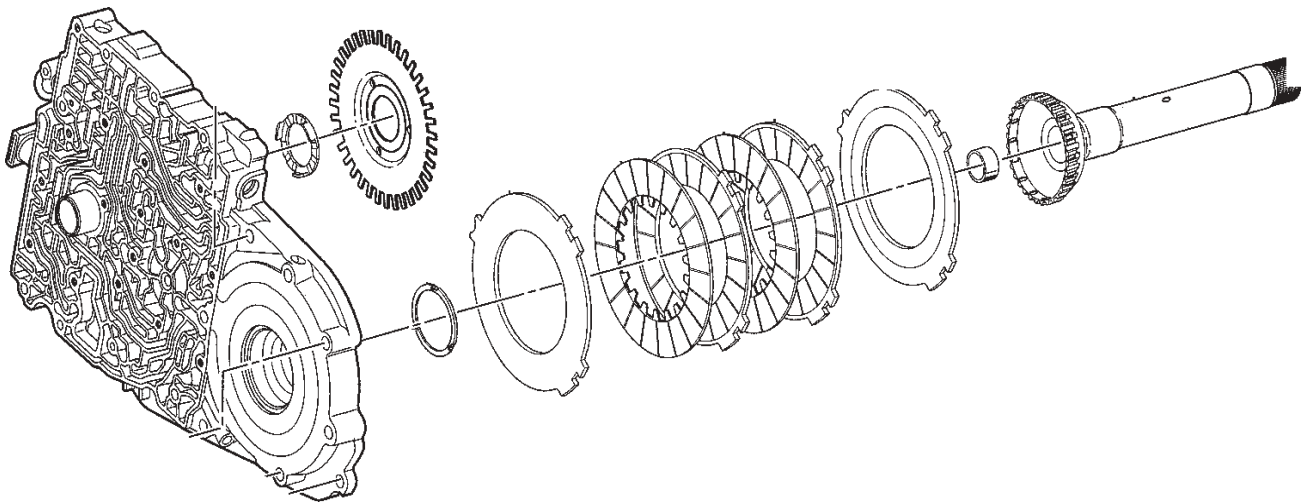
The pawl design one way clutches are not currently serviced other than as an assembly. In other words, the pawl components are not available as individual pieces. The clutches must be changed if the pawl design one ways are installed in a previous design application. The pawl one way clutch part numbers are 24216516 for the input and 24216517 for the 3rd. The new input clutch part number is 24216502.

4T65E Update

2002-2003 Changes

A mid year change for the 4th clutch is planned. The 4th clutch apply plate has an additional mounting tab added to it for easier installation. In order to accommodate this change the channel plate was also updated.

The previous design channel plate cannot be used to service the updated design with the new apply plate. The Updated design channel plate will back service previous applications. The updated disc/plate designs will not back service unless the channel plate is also changed. GM is planning on releasing the parts as a service package which will include the channel plate, apply plate and friction plates.



4T65E Update

2002-2003 Changes

Mid year change included a 2ND lock ramp was added to the pass through connector. This design prevents the connector from side loading.

This change has no effect on service as the harness was only updated for the new 2003 harness applications.

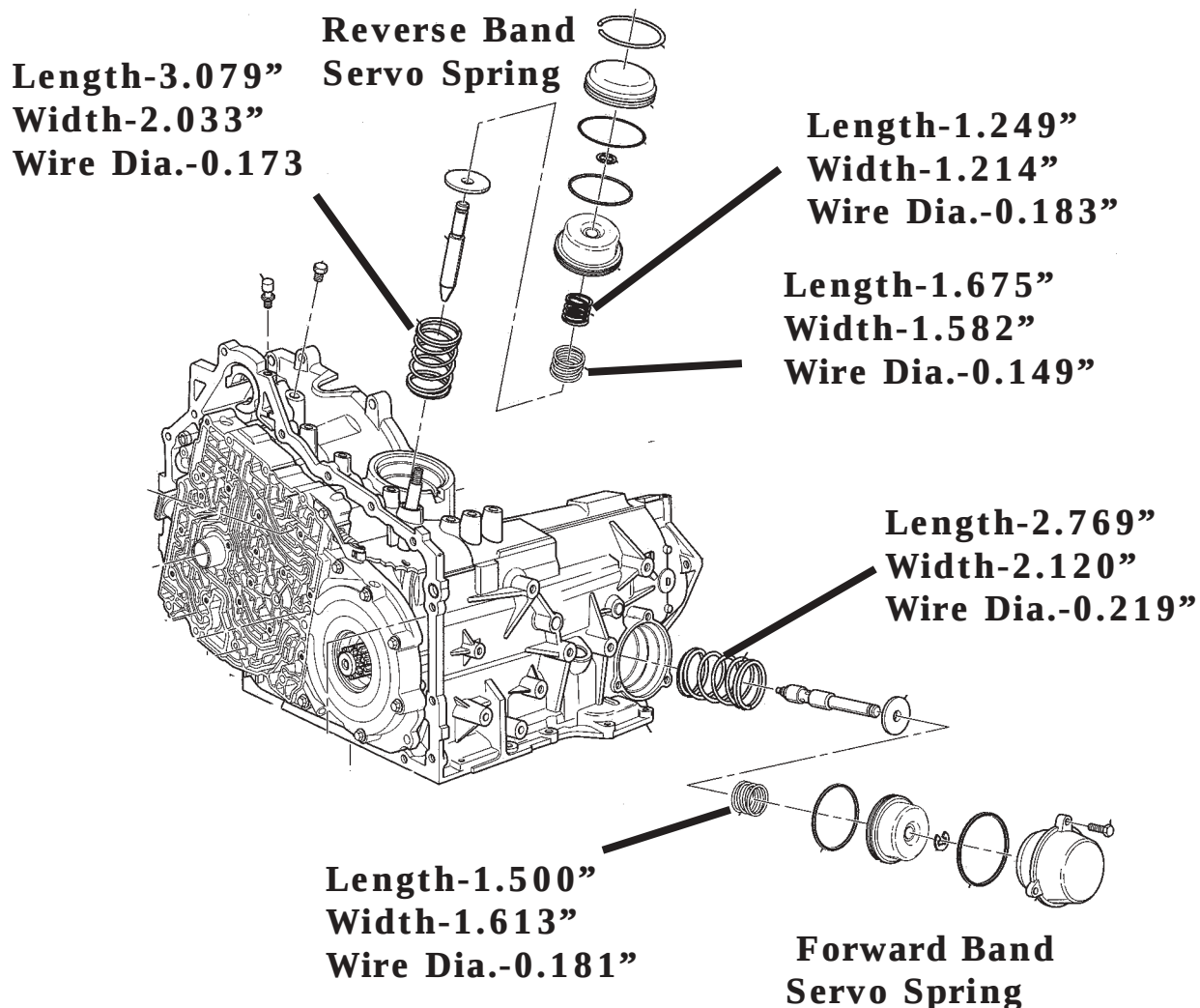


**Make sure your new
harness has the new clip**

4T65E

Harsh or Soft Forward or Reverse Engagment

When rebuilding a 4T65E make sure you have the correct servo springs assembled in their correct locations. Because the 4T65E uses a Forward and Reverse servo for engagement if the springs were switched accidently you may experiance a harsh or soft forward or reverse engagement.



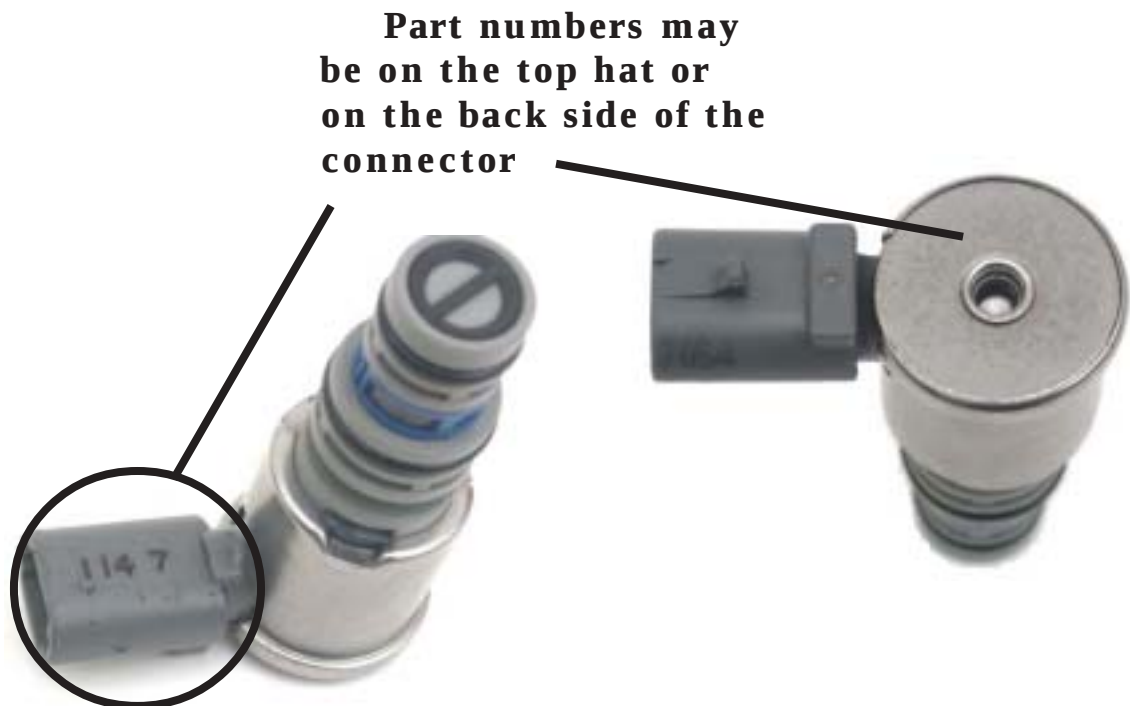
4T80E

TCC Concern

Lock-up on the 2-3 Shift, Erratic TCC Operation

When encountering a TCC concern with a 4T80E transaxle, make sure you have the correct TCC PWM solenoid installed. To verify the correct solenoid check the Julian date. This date may be located in a number of different places including, top cover, connector top / bottom, or body assembly. To ensure you have the correct solenoid make sure the Julian dates are NOT within 1137-1171. If you have a solenoid between these numbers you will need to replace the solenoid assembly. Part # 24212690

A ***Do Not Use Solenoids With The Numbers Between 1137 and 1171***



4T80E

Hard Shifts Possible DTCs Set Northstar Application

Oldsmobile and Cadillac vehicles exhibiting any or all of the following conditions:

- Ä Surge especially when TCC is applied
- Ä Engine backfire
- Ä Hard shifts
- Ä SES lamp or message displayed on DIC
- Ä Any combination of the following DTCs may be set, P0335, P0385, P1372, P0341, P1599

The Northstar engine applications utilize two crank sensors and one cam sensor. The crank sensors are different part numbers and are also different colors (Grey and Black plastic) If one of the crank sensors fail or if a loss of signal occurs the PCM will raise line pressure resulting in harsh shift concerns. If the Cam sensor fails, DTCs may set and drivability concerns may be present, but shift feel will remain normal.

Inspect the sensor connector pin tension and the terminal crimp. If pin tension is good replace the suspect sensor.

NOTE: If a crank sensor is replaced the “RELEARN PROCEDURE” for the crank sensor must be performed using a scan tool. Failure to relearn the crank sensor value will result in a DTC being set and possible drivability concerns

Crank Sensor



Crank Sensor



4T80E

MAF DTC, Poor Drivability, Surge with TCC ON Under load, Lack of Power

Oldsmobile/Cadillac G, K and K special applications with the Northstar engine and the 4T80E transmission may exhibit any or all of the following conditions:

- Ä Surge with TCC ON. This is most common at low speeds when you are crowding the accelerator on a slight incline. The surge is most commonly felt during throttle “Tip In” acceleration and generally goes away as the throttle is held steady.
- Ä Possible Lean fuel trim DTCs, MAF DTCs, Misfire DTC’s and/or Pre cat DTC’s may be set.
- Ä A possible lack of power may also be present

Cause: Two common causes for this condition exist, they are:

1. The MAF sensor is dirty or skewed
2. The air cleaner air box may be filled with water or other contaminants.



4T80E

MAF DTC, Poor Drivability, Surge with TCC ON Under load , Lack of Power (Continued)

Skewed MAF sensors are quite common with these applications. Generally, fuel trim values will be around +20% when the surge is present. If this occurs, clean or replace the MAF sensor and clear any DTCs that may be set.

If the concern is on a 95-97 application, check the air cleaner air box for water and other contaminants. If water is present enlarge the air box water drain hole to at least ½”.

**Look for contamination
in the inlet air hole**



4L30E/5L40E

P0601/P0602

1999-2002 4L30E/5L40E applications may set DTCs P0601 and/or P0602. These codes indicate a failure in communication with the TCM/ECM. In most instances the transmission will have clutch damage. If these DTCs are set due to their default values.

The DTCs will react as follows:

P0601 will set if:

Ä The TCM check sum is incorrect (internal software check)

If a P0601 is set:

Ä The TCM will flash the sport mode lamp and it will send an MIL request message to the ECM on the second consecutive trip in which a failure occurs.

Ä The ECM records the freeze frame and failure record information and turns on the MIL lamp.

Ä The TCM defaults the transmission by, raising line pressure to maximum, commanding 4th gear (4L30E), or 5th gear (5L40E) while inhibiting TCC and freezing adapts. NOTE: Even though the units default to high gear, if manual ranges are selected the unit will start in lower gears. If the customer does not manually override the default high gear start, damage to the transmission clutches may occur

4L30E/5L40E

P0601/P0602 (Continued)

P0602 will set if:

• The PCM was not correctly programmed or has not had a calibration loaded

If a P0602 is set, the ECM will turn on the MIL and record a freeze frame regarding the failure on the 1st drive cycle the failure is present. Possible EMI (Electromagnetic Interference) during power up or a faulty TCM (if a P0601 is also present). If a P0602 is present the ECM may not be properly calibrated.

Repair the EMI condition or replace the TCM if a P0602 was set. When diagnosing a P0601 and/or a P0602 set in the TCM do not attempt to reprogram the TCM.

If a new TCM is required simply install it and clear the ECM DTCs that are set. If the P0602 resets update the ECM software with the latest calibration designed to address P0602 concerns.



4L60E

Slips When Cold

The Chevrolet Trailblazer, GMC Envoy and Oldsmobile Bravada utilize a new style cooling fan. The new electronic viscous clutch fan is computer controlled. A design characteristic of the viscous coupling may lead the customer to misinterpret the fan operation as a possible transmission slippage condition. Some cold start fan noise is normal, but it's possible that the unit may exhibit excessive noise if the vehicle has been left sitting overnight or for extended periods of time.

It is common for the viscous coupling to leak fluid from its internal reservoir into the coupling, leading to tremendous amounts of noise on a cold start, or as the vehicle is accelerated.

An updated electronic clutch fan has been released to address this concern. The new part was introduced as a running change on the 2003 model year applications.

**The new part
number is
15192192.**



4L60E

Shift Complaints

2002 Trailblazer/Envoy/Bravada

Several shift quality concerns have arisen with this application including:

- Ä Hard/soft garage shifts
- Ä Delayed downshifts
- Ä Harsh 1-2 shifts

Several calibrations have been released to address these concerns. The latest update is calibration number 12579253. Make sure to visit the GM calibration web site at: **<http://calid.gm.com/vci/>**

4L60E

Intermittent neutral or flare, bump when accelerating from a stop

1999 and later 4L60E applications (Silverado, Tahoe, Yukon, Suburban, Sierra) may exhibit a neutral condition while in D4 range and the vehicle is accelerated from a stop. In addition, a complaint that the transmission neutrals, then bangs into gear (harsh engagement) when accelerated from a stop.

Generally the problem is not related to the internal transmission components (Sprag, roller, forward clutch). The most common cause of this concern is the transmission shift cable or the shift cable adjustment.

First try making an adjustment, if you determine the cable is stretched replace the transmission shift cable and adjust.



4L60E

Surge/Shudder/Miss

1995-2002 Trucks with 4.3L (RPO L35 or LU3) engine may experience a rough running, or surge/shudder/miss problem. This condition may be associated with a DTC P0300. Many times this condition has been confused with a transmission related concern.

The problem is often caused by moisture leaking from the A/C line onto the distributor. On several of the applications, the A/C line is routed directly over the distributor. This moisture leads to corrosion, and crossfire within the cap.

Inspect for the following:

Ä White corrosion/residue on the cap wall, or on higher mileage units brown residue



Locate the AC hose above the Distributor and install a foam conduit over the hose which will allow the water to drain off the sides.

4L60E

Surge/Shudder/Miss (Continued)

- Ä Rotor: Inspect for black streaks on the plastic surface of the rotor or green spots on the copper surface of the rotor terminal.
- Ä Distributor housing/base: Inspect for excessive levels of rust on the shaft or surface contamination on the cam sensor hold down screws.

If you find evidence of corrosion replace the cap/rotor and the distributor if deemed necessary. Take 8" of foam pipe insulation (you can buy it a hardware store) and wrap the a/c pipe above the distributor with the pipe insulation.

Note: The distributor is referred to as an HVS "high voltage switch" by General Motors.

4L60E

1-2 Shift Shudder Hot

2000-2002 C/K Trucks with a concern of a shift shudder during the 1-2 shift is mostly common under light throttle conditions, after the vehicle has reached full operating temperature and ambient temperature is high.

The problem is usually caused by a frequency signal riding on the generator output . The signal is causing interference problems with the PCM circuitry.

Install a sense lead for the Alternator as follows:

Parts:

Connector replacement pack 15306009

1 ring connector pack 02984172 (sold as packs of 10)

RTV sealer



Procedure:

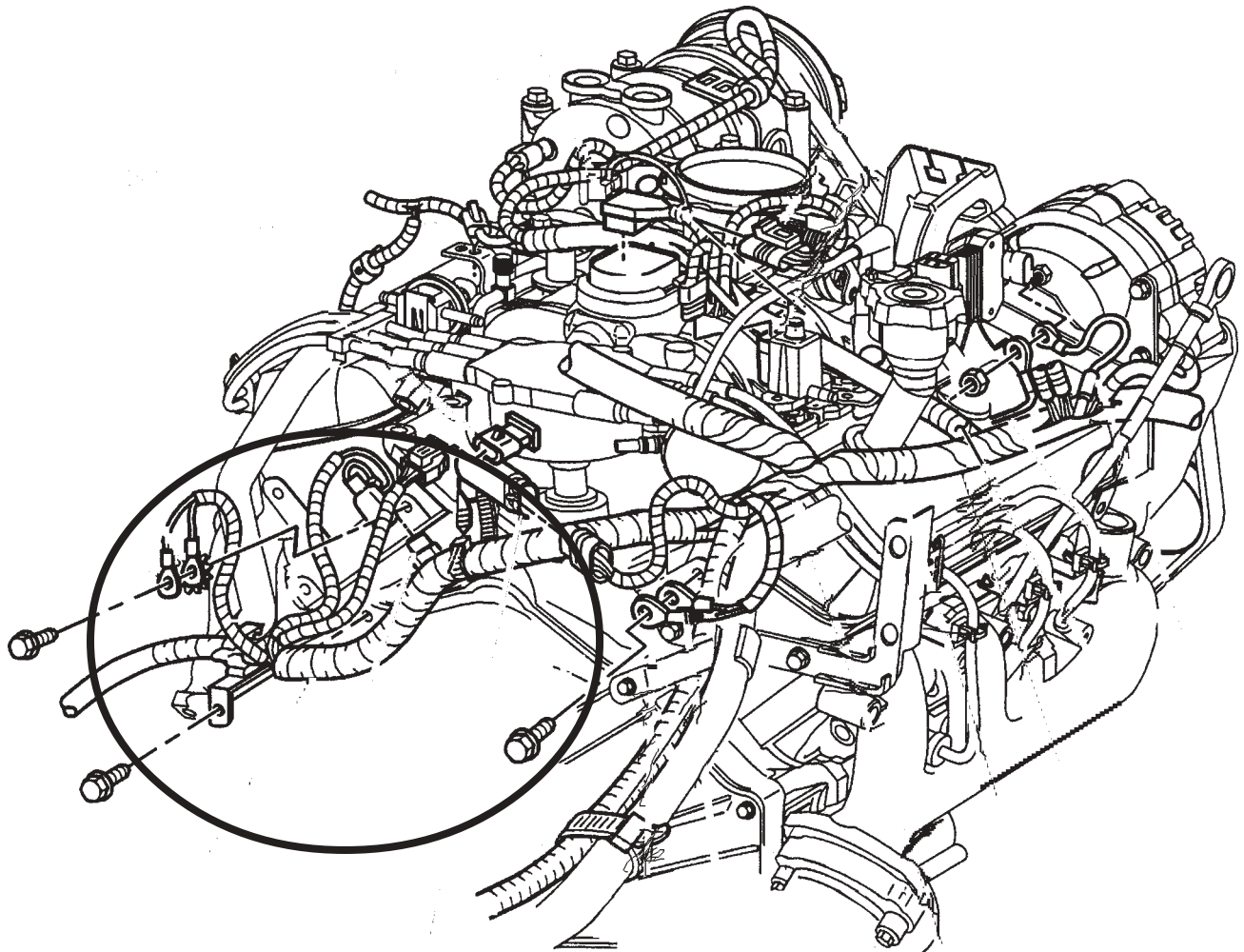
1. Disconnect the negative battery cable
2. Remove the two-wire, four-cavity connector from the alternator
3. Remove the brown wire (cavity B) and the gray wire (cavity C)
4. Remove the wires from the connector pack and discard wires "B" and "C"
5. Install the brown wire from the vehicle harness into cavity B of the service connector. Install the gray wire from the vehicle harness into cavity C of the service connector.
6. Install the TPA (Terminal Position Assurance Clip) into the service connector and install the service connector into the alternator.
7. Hook the wire in cavity "D" of the service connector to the battery terminal on the alternator using the ring connector.
8. Trim the wire in cavity "A" of the service connector flush
9. Seal the connector with RTV and connect the negative battery cable.

4L60E

Multiple DTC'S

Some 1995-2000 M/L (Astro, Safari) vans may experience DTCs setting related to the transmission or possibly engine related systems. The most common DTC is P0758 (3-2 solenoid) but others may set as well.

The wiring harness runs along the bell housing area and over the engine. In many instances the harness contacts the A/C accumulator which leads to a rub-through condition. Depending on which wires have insulation damage, a DTC will likely set for that circuit.



4L60E ATC DTC C0379

Service 4WD Light On K Trucks

Some K-trucks with the automatic transfer case may experience the following conditions:

- Service 4WD light is on
- DTC C0379 is set
- The front actuator no longer functions

The wiring harness for the front axle circuit may be chaffed near the A/C compressor.



Secure the harness so it can no longer contact the A/C compressor.

4L60E

Delayed Downshift

2002 Trailblazer, Envoy, Bravada, T truck 4.2L (LL8) applications may experience “any or all” of the following conditions:

- Delayed downshifts, erratic downshifts
- Excessive cooling fan noise
- SES light ON
- Any or all the following DTC's, P0014 (Cam Phaser Performance) P1683 Low power counter failure) P0116 (High side coolant rationality)

This concern is caused by calibration problems. An updated calibration has been released to address the concerns. View the GM web site <http://calid.gm.com/vci/> to locate the correct calibration number for your application.



4L60E/4L65E

Updated PCS

A new pressure control solenoid was used for all 2003 model units. The vendor for the solenoid is now Borg Warner and will be available in two versions. The 1st design utilizes only one flat on the aluminum body of the solenoid while the 2nd design has two flats on the solenoid body. The 2nd design will replace the 1st design and is scheduled for use in other transmission applications starting in the 2004 model year. In addition to the solenoid change, the harness was also changed to accommodate the updated solenoid.

The 1st design solenoid went into production at SOP (Start of Production) 2003 while the 2nd design was introduced in December 2002 as a running change for the 2003 model year. The part number for the 1st design solenoid is 24219308 while the 2nd design part number is 24224905. The harness was updated to prevent someone from interchanging the Borg Warner solenoid with the previous Delphi solenoid. The updated harness part number is 24222891.

**Make sure the
correct solenoid is
used for the cor-
rect vehicle**



4L60E/4L65E, 4L80E/4L85E, LCT 1000 DTC U1241 SET

Most OBDII equipped vehicles have DTCs related to data line problems. Some technicians may notice a DTC U1241 set in history on vehicles equipped with a BCM. U1241 may be stored in several of the various modules. In addition, the technician may have noted that the DTC may have not been present until after DTCs were requested or displayed .

U1241 DTC is caused by a loss serial data. The loss of data is caused by your scan tool interface with some of the modules on the vehicle. When your scan tool requests DTCs from some of the modules it becomes the master module which results in other modules setting the U1241 in memory.

This is a normal condition, no repairs should be attempted if the condition for setting the DTC is as described above.



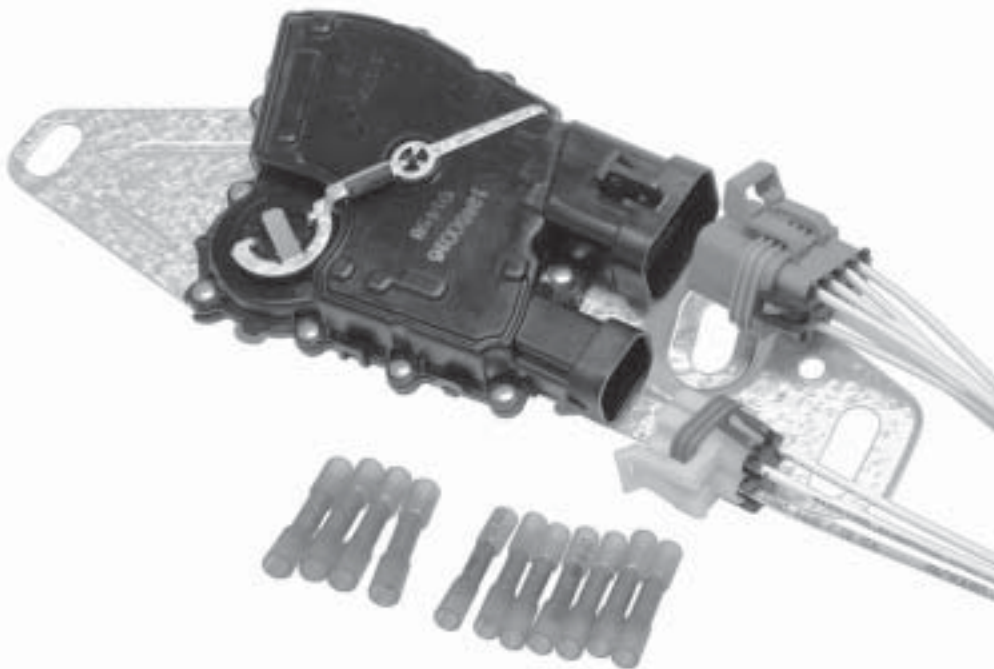
4L80E/4L85E

P0706 Set

Vehicles with a 4L80E/85E transmission may set a code P0706 (Transmission Range Switch Performance) and may exhibit a no start condition.

In many instances the P0706 is not caused by a faulty switch. On 1999 and later applications check for a possible recalibration for this condition prior to replacing the switch.

Before part repairs are done check the web site <http://calid.gm.com/vci/> for updated calibration to repair the false P0706.



NOTE: Always check the connections for melting and wire damage

4L80E

TCC surge or chuggle when road speed is between 40-50 mph

On 1994 and later Diesel 4L80E applications, customers may complain of a surge or chuggle condition which occurs only when the TCC is applied and the vehicle is between 40 and 50 mph. If the TCC is disabled, the surge/chuggle is typically eliminated. You will also find that disconnecting the EGR on 6.5L Diesel applications (RPO L56) may also eliminate the concern.

The typical cause of this concern is retarded pump timing. Checking the pump timing requires a scan tool.

To determine if the timing is correct, note the data parameter known as “TDC offset” using a scan tool. The value should be minus -.75 or less. A minus number on the scan tool indicates the timing is advanced while a plus (+) value indicates the timing is retarded. For proper operation, fuel economy and power, the timing TDC offset should read -1.25 to -1.50. If the timing is not correct a TDC relearn procedure should be performed after the timing has been set. . (Note: to perform a TDC relearn on a 1994-95 application you must use a scan tool. It should be noted that not all scan tools are capable of performing a TDC relearn procedure)

4L80E

TCC surge or chuggle when road speed is between 40-50 mph (Continued)

If the Timing is incorrect:

Shut the engine off and loosen the pump bolts slightly. Using the proper adjustment tool move the pump slightly (.040" of movement = 1 degree of timing change). Move the pump toward the drivers side of the vehicle to advance the timing and toward the passenger side of the vehicle to retard the timing. Once the pump is moved slightly, tighten the pump bolts and perform the TDC offset learn procedure using a scan tool.

To perform the TDC offset procedure on a 1994-95 application

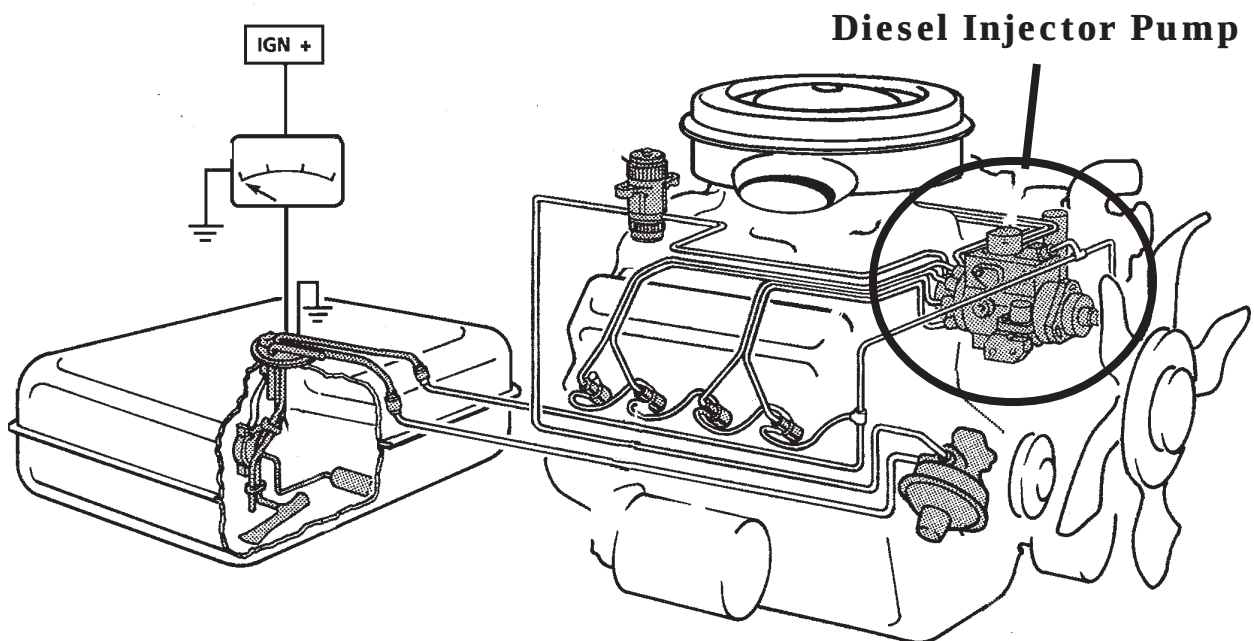
Start the engine, Press the button on the scan tool to engage the TDC offset procedure and note the value when the scan tool locks in the TDC offset value. It should read between -1.25 and -1.50. If so, no further adjustments are needed. Once the relearn is complete, check the TDC offset value displayed on the scan tool again. If the offset value is not correct, shut off the engine, loosen the pump bolts and rotate it in the desired direction. Tighten the bolts and repeat the above TDC offset learn procedure.

4L80E

TCC surge or chuggle when road speed is between 40-50 mph *(Continued)*

To perform the TDC offset procedure on the 1996 and Later applications:

1. Turn on the ignition key and clear all DTC's
2. Depress the throttle to the WOT position and hold it there for at least 4-5 seconds
3. Key off and then close the throttle
4. Wait 30 seconds minimum
5. Key on and start the engine
6. The TDC offset will be automatically learned when the coolant temperature reaches 170-172 degrees Fahrenheit.
7. If the vehicle is already above the minimum 170 degree CTS value, TDC learn will automatically update as soon as the engine is started in step five.



4L80E

TCC surge or chuggle when road speed is between 40-50 mph (Continued)

Note: On most 1996 applications the value displayed on the scan tool (TDC offset) will remain at 0.00 (At step 5) until the TDC learn has been completed. On most 1997 and later applications, the value displayed on the scan tool will remain at the previous value until the TDC learn has been completed.

TDC offset should read between -1.25 and -1.50. Once the relearn is complete, check the TDC offset value displayed on the scan tool again. If the offset value is not correct, shut off the engine, loosen the pump bolts and rotate it in the desired direction, tighten the bolts and repeat the TDC offset learn procedure.

On L56 (EGR equipped 6.5L Diesel) applications, if the timing is correct and the problem is eliminated when the EGR is disconnected, replace the EGR with part number 12530288.

**The EGR is located
behind the dipstick**



4L80E

Planetary gear noise in 1st and 2nd gears only

Some 4L80E transmissions may exhibit excessive planetary gear noise when operating in 1st and 2nd gears. This noise will resemble the noise developed from HD 4L80E applications which use straight-cut gears. Upon inspection, you will notice some irregular wear lines on the reaction planetary carrier pinion teeth and possibly on the sun and ring gear teeth. These wear lines run parallel to the transmission center line. The wear may look like dark lines on the gear teeth, grooves in the gear teeth or bronze lines on the gear teeth.

This concern can be caused by either:

Ä A reduction in the volume of lube oil feeding the planetary. This problem is typically caused by pump cavitation, a restricted filter or damaged oil pan, or a cooler flow rate problems.

Ä Output shaft misalignment. This concern is the most common cause of the noise on 97 and later applications. Misalignment of the output shaft will cause side loading of the planetary. This problem generally leads to the technician replacing the planetaries only to have a repeat failure within 5-20 thousand miles.

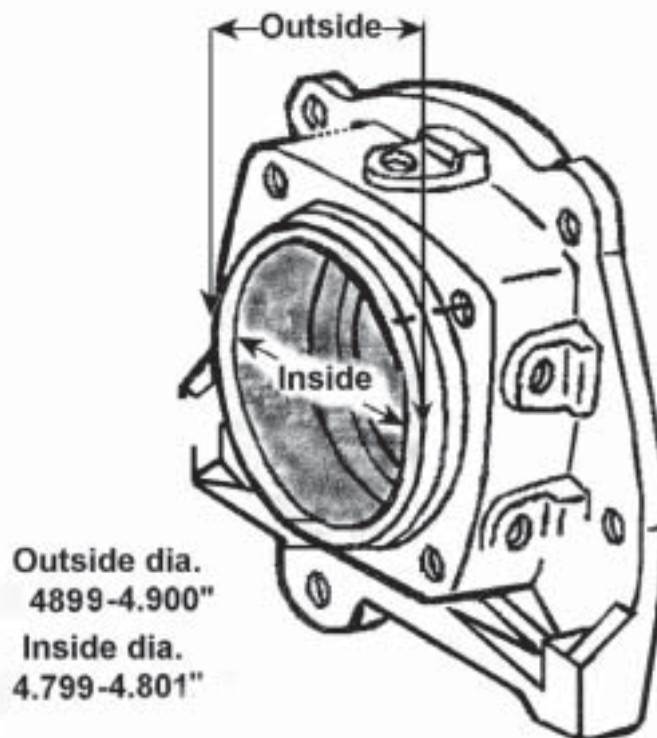


4L80E

Planetary gear noise in 1st and 2nd gears only

If shaft alignment is suspected on a 4wd application, inspect the 4wd adapter. We have measured brand new adapters that have had excessive offset! To inspect the transfer case adapter measure the transfer case pilot inside and outside diameter. The outside diameter specification is 4.799"-4.801" while the inside diameter specification is 4.899"-4.900".

If the measurements are not correct, replace the adapter. On 2wd applications a common cause of the concern is the position of the output shaft bushing. If the bushing or bore was machined off center, side loading of the shaft will occur. On 2wd applications, you will typically be able to see that the bushing is worn off center. Replace the bushing or the case as necessary.



4L80E HD/4L85E

Product Updates

Several midyear changes were made to the 2001 4L80E HD model transmissions. These changes were also carried over to the 4L85E transmission. The changes were designed to improve the transmissions durability. These changes include:

Part number call out	GM part number
Overrun clutch housing	Included in the kit only
Overrun clutch spring	Included in the kit only
Overrun clutch snap ring	24216149
Overdrive roller clutch	12431003
Overdrive carrier	24215530

Some of the components are only available by ordering an upgrade kit part number 24222160



AC-Delco Kit #24222160

4L85E

2002 Models

The 4L80E HD has been replaced by the 4L85E. The 4L85E is used in vehicles equipped with the 8.1 L gas engine (RPO L18).

Identification

Model Tag: 02CAP or 02CCP

RPO Code: MN8

Features:

- Ä The speed sensor bolts. New part number 11517516
- Ä The forward clutch wave plate. New part number 24205560
- Ä Overrun clutch spring retainer. New part number 24216149



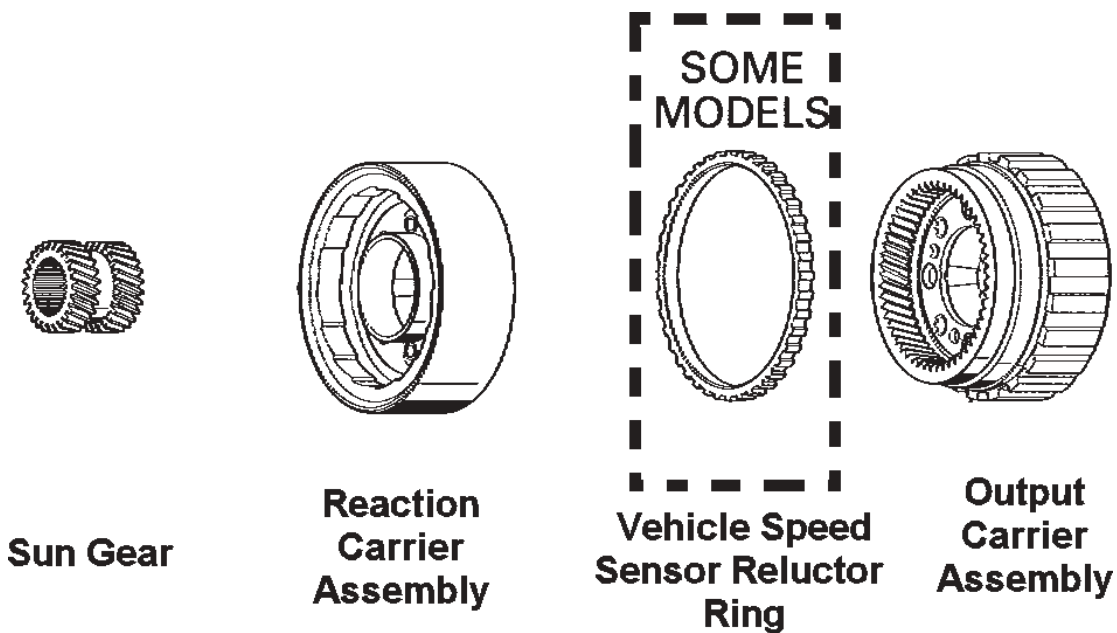
4L85E

2002 Models (Continued)

The 4L85E uses a five-Pinion reaction and output carrier.

- Ä Reaction carrier part number 24215026
- Ä Output carrier 2WD models part number 24214966
- Ä Output carrier 4WD models part number 24215388

(NOTE: The straight cut gears used in the 4L80HD applications are no longer available from GM. If a 4L80E HD planetary requires replacement, update the unit with the part numbers listed above for the 4L85E applications.



LCT 1000

Incorrect Pressure Switch Assembly Readings

Allison transmissions used in GM truck applications may indicate the wrong pressure switch assembly readings for 5th gear and/or reverse range. Vehicles that have had the TCM reprogrammed or vehicles built after March 2001 may have an incorrect switch sequence. Incorrect values may be displayed when monitoring the transmission operation with a scan tool when those values are compared to the listings in the shop manual. This may lead to misdiagnosis of the PSA or its circuits.

Programming changes dealing with the scan tool interface can lead to the incorrect sequence for the application. The chart below lists the correct sequence for the LATER (after March 0f 2001) Allison calibrations.

NOTE: Switch C/D and E are normally open while switch R is normally closed. Your scan tool may display the switch values as open/closed or as on/off. On=closed, Off=open

On applications built after March 2001 or on units that have been reprogrammed, Switch "C" will read "Open" (OFF) when the transmission is in reverse while those built earlier will read "Closed" (ON).

LCT 1000

Incorrect Pressure Switch Assembly Readings

Range	Switch C	Switch D	Switch E	Switch R
5th - Late	Closed / ON	Open / OFF	Closed / ON	Open / OFF
5th - Early	Open / OFF	Open / OFF	Closed / ON	Open / OFF
4th	Closed / ON	Open / OFF	Closed / ON	Open / OFF
3rd	Closed / ON	Open / OFF	Open / OFF	Open / OFF
2nd	Open / OFF	Open / OFF	Open / OFF	Open / OFF
1st	Open / OFF	Closed / ON	Open / OFF	Open / OFF
Neutral	Closed / ON	Closed / ON	Closed / ON	Open / OFF
Reverse-Late	Open / OFF	Closed / ON	Closed / ON	Closed / ON
Reverse- Early	Closed / ON	Closed / ON	Closed / ON	Closed / ON

LCT 1000 (RPO M74)

Flare When Accelerating From a Stop

LCT 1000 applications may experience a condition described as a “flare” or “neutral” condition when coming to a stop or accelerating from a stop. A harsh engagement may occur as the unit reengages 1st gear. Many times, when the condition is present, input speed will be present even though the transmission is being commanded to 1st gear with TP and VSS values at 0.

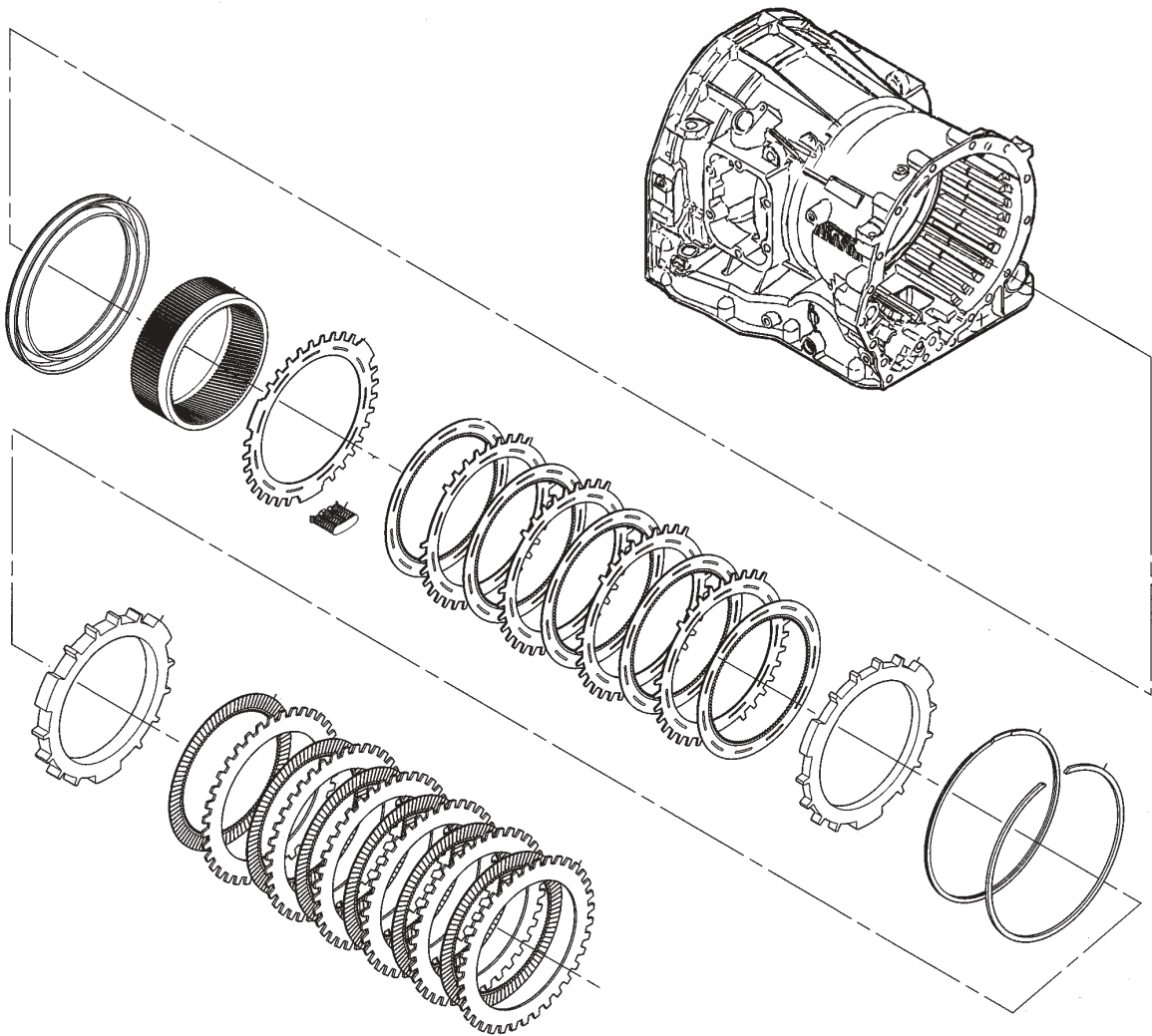
The most common cause for this concern is:

- Ä Leakage in the C5 clutch or its circuit: If you perform a clutch test using your scanner, you will generally notice the condition when the 2-1 downshift is commanded. This will be indicated by a delay in line pressure response when the C5 Clutch is commanded to apply.
- Ä Sticking valves: Most of the sticking-valve-related concerns have proven to be temperature related with this transmission.
- Ä TCM calibration: An updated calibration has been released aimed at improving this condition. The updated calibration was released in March 2002. Check the GM web site to see if your vehicle has been updated with the new calibration.
<http://calid.gm.com/vci/>

LCT 1000 (RPO M74)

Flare When Accelerating From a Stop (Continued)

C-5 Clutch Assembly



LCT 1000 RPO M74

PRNDL Inoperative

A visual inspection of the PRNDL display may no longer be present, while other times it may indicate the incorrect position or an incomplete display. In addition, an erratic shift, no shift or several other related shift concerns may be present. The MIL will also be ON in most instances and a DTC may be set relating to the NSBU switch/circuit. This condition is very common on applications that are operated in wet or muddy conditions.

- Water intrusion into the NSBU switch (neutral safety switch)

During normal operation the TCM sends battery voltage to each of the NSBU switches (A, B, C, and P connector C1). As the switch changes position, each switch is connected to ground via circuit 451 pin D of connector C2.

NSBU Switch Table

Selector Position			A	B	C	P
	P		OFF	ON	ON	OFF
	R		OFF	OFF	ON	ON
	N		ON	OFF	ON	OFF
5	5	5	ON	OFF	OFF	ON
3	4	4	OFF	OFF	OFF	OFF
2	2	3	OFF	ON	OFF	ON
1	1	1	ON	ON	OFF	OFF
ON = Open Circuit OFF = Grounded Circuit The NSBU Switch has only four positions available in the forward ranges. Therefore, one range position will be omitted at the selector. This position may be 2nd, 3rd, 4th or 5th range depending upon chosen calibration.						

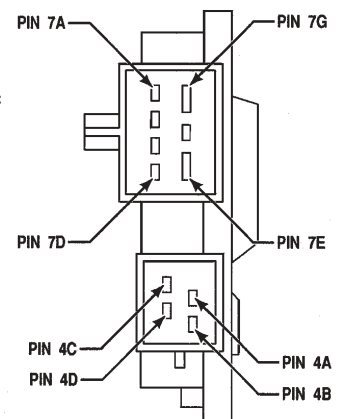
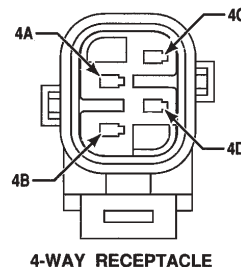
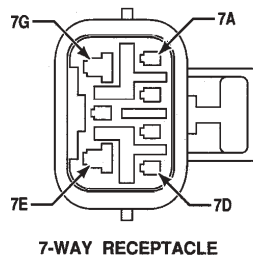
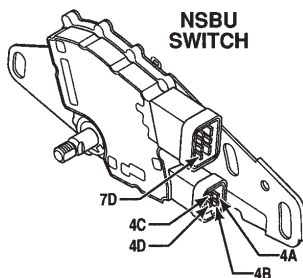
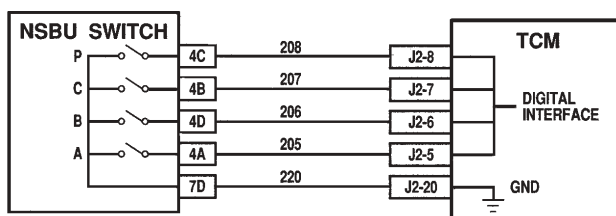
LCT 1000 RPO M74

PRNDL Inoperative

To separate switch concerns from the wiring and TCM, proceed as follows:
Disconnect C1 and C2 connectors

1. Monitor the NSBU values with a scan tool.
2. Using jumper wires connect two wires at a time between the appropriate pin in connector C1 and pin D in connector C2 (with the key on). Leave the other two pins in connector C1 open. Alternate the pins as shown in the chart below. The PRNDL and the scan tool should show the range indicated in the chart.
3. If the proper range is indicated as the jumper sequence is varied, replace the switch. If the proper range is not indicated check the wiring before replacing the TCM.

ON= OPEN CIRCUIT
OFF= GROUNDED CIRCUIT



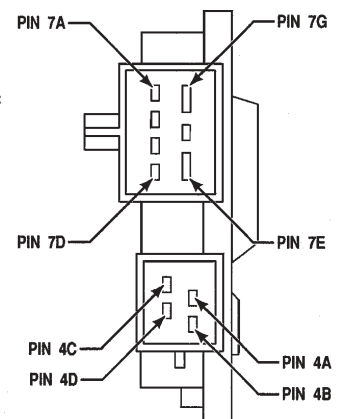
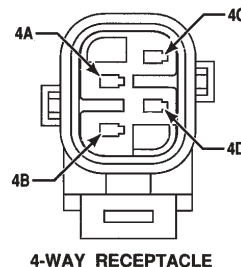
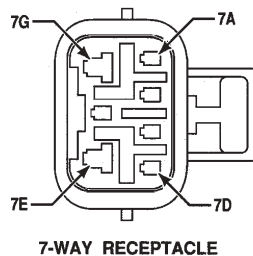
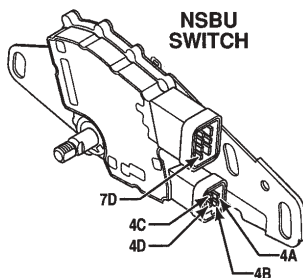
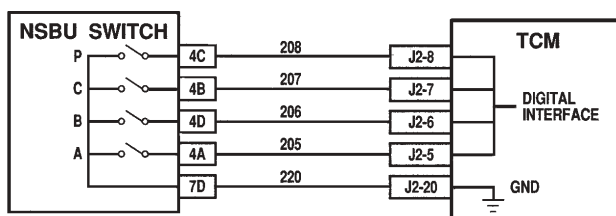
LCT 1000 RPO M74

PRNDL Inoperative

To separate switch concerns from the wiring and TCM, proceed as follows:
Disconnect C1 and C2 connectors

1. Monitor the NSBU values with a scan tool.
2. Using jumper wires connect two wires at a time between the appropriate pin in connector C1 and pin D in connector C2 (with the key on). Leave the other two pins in connector C1 open. Alternate the pins as shown in the chart below. The PRNDL and the scan tool should show the range indicated in the chart.
3. If the proper range is indicated as the jumper sequence is varied, replace the switch. If the proper range is not indicated check the wiring before replacing the TCM.

ON= OPEN CIRCUIT
OFF= GROUNDED CIRCUIT



LCT 1000

Quicklearn Procedure

The Allison LCT series transmission utilizes a quick learn (Also known as Fast learn) procedure designed to shorten the amount of time that it takes for the TCM adaptive-learning strategy to adjust for variations in clutch volume and apply time. By performing the quick learn functions, the amount of time that is required for TCM adaptive learning is reduced significantly. The Quick learn function requires a compatible fully functional scan tool. Quick learn should be performed if:

- Ä The transmission was replaced/rebuilt or repaired
- Ä The solenoids were replaced
- Ä The TCM was replaced or recalibrated

Quick learn is accomplished in 4 parts, they are:

Ä PARK MODE: With the vehicle in the park range the scan tool will repeatedly cycle the C3/C4 and C5 clutches on/off. This function will not only purge air from the system but it will also adjust for engagement time variation due to return spring load values, solenoid flow rates as well as seal/bushing leakage.

Ä DRIVE: With vehicle in drive range the scan tool will cycle the C1 clutch to adjust for engagement time variation due to return spring load values, solenoid flow rates as well as seal/bushing leakage.

LCT 1000

Quicklearn Procedure (continued)

Ä 3RD/4TH : Following the above procedures clutch volume for the C2 clutch requires the vehicle now be driven. To properly learn the C2 clutch volume the vehicle must complete at least three 3-4 shifts at steady throttle. This procedure does not require the use of a scan tool.

NOTE: If the scan tool harness becomes disconnected or if you lose communications with the TCM during the quick learn process, default actions may occur. If you were in Drive when the failure occurred, ranges other than drive may not be available. If you were in Reverse when the failure occurred, ranges other than reverse may not be available.

To perform a park/reverse/drive quick learn the following conditions must be met:

1. No DTCs are stored
2. NSBU is operating correctly
3. Speed sensors are operating correctly
4. TFT is between 104-212 F (40-100c)
5. Parking brake is set
6. Transfer case is in 2wd range
7. TP values are 0%
8. A compatible scan tool is being used

Now follow the instructions on the scan tool for the “FAST” (Quick) learn procedure.

NOTE: Block the wheels during the test procedures

LCT 1000 8.1L Engine

Harsh Down Shifts, Harsh Garage Shifts

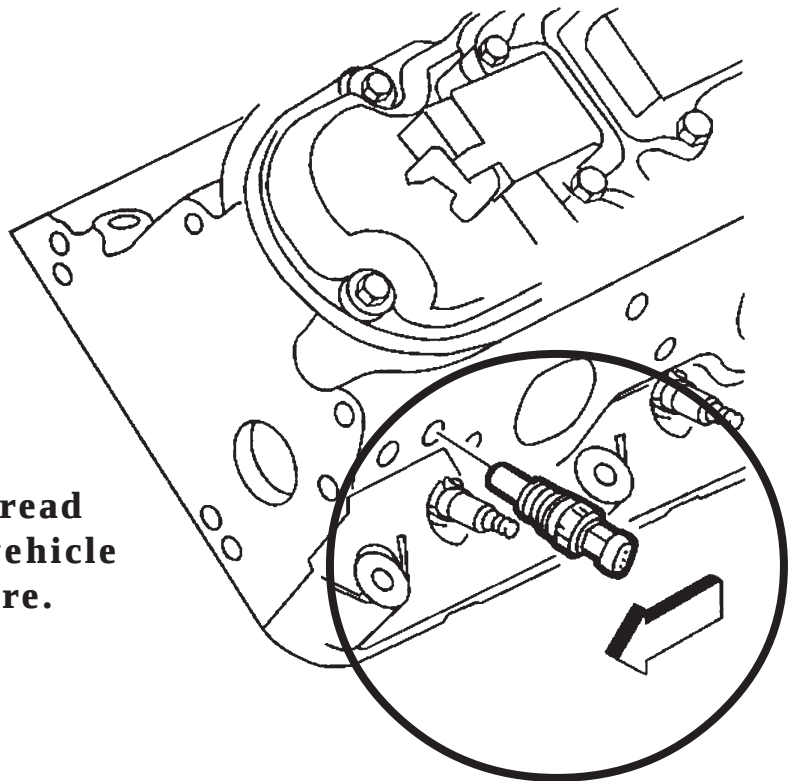
Some customers may complain of the following symptoms:

- Ä Harsh 3-2, 2-1 down shifts
- Ä Harsh garage shifts
- Ä Temperature Gauge reads low
- Ä Drivability concerns, Possible Rich fuel trim DTCs may be set

The most common cause of this problem is related to the coolant temperature sensor reading. Generally, ECT DTC's will not be set.

Replace the ECT sensor

Generally the ECT will read about 60°F (15c) with the vehicle at full operating temperature.



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AX4S

Vibration After Overhaul ***(3.8L Only) Possible Broken Flexplate***

A Vibration or broken Flexplate on models between 1995-2001 that are equipped with 3.8L engines may be caused by the misalignment of the converter to flexplate. The Flexplate has an alignment paint dot on the flexplate and torque converter from the factory. This dot is there to ensure proper alignment.



AX4S/AX4N

New Pump Bearings

When replacing the pump bearing on a AX4S or AX4N use the new updated bearing assembly which has a built in seal. The seal is used to enhance lubrication to the bearing for longer life expectancy.

AX4N

Part# XF1Z-7G184-AA

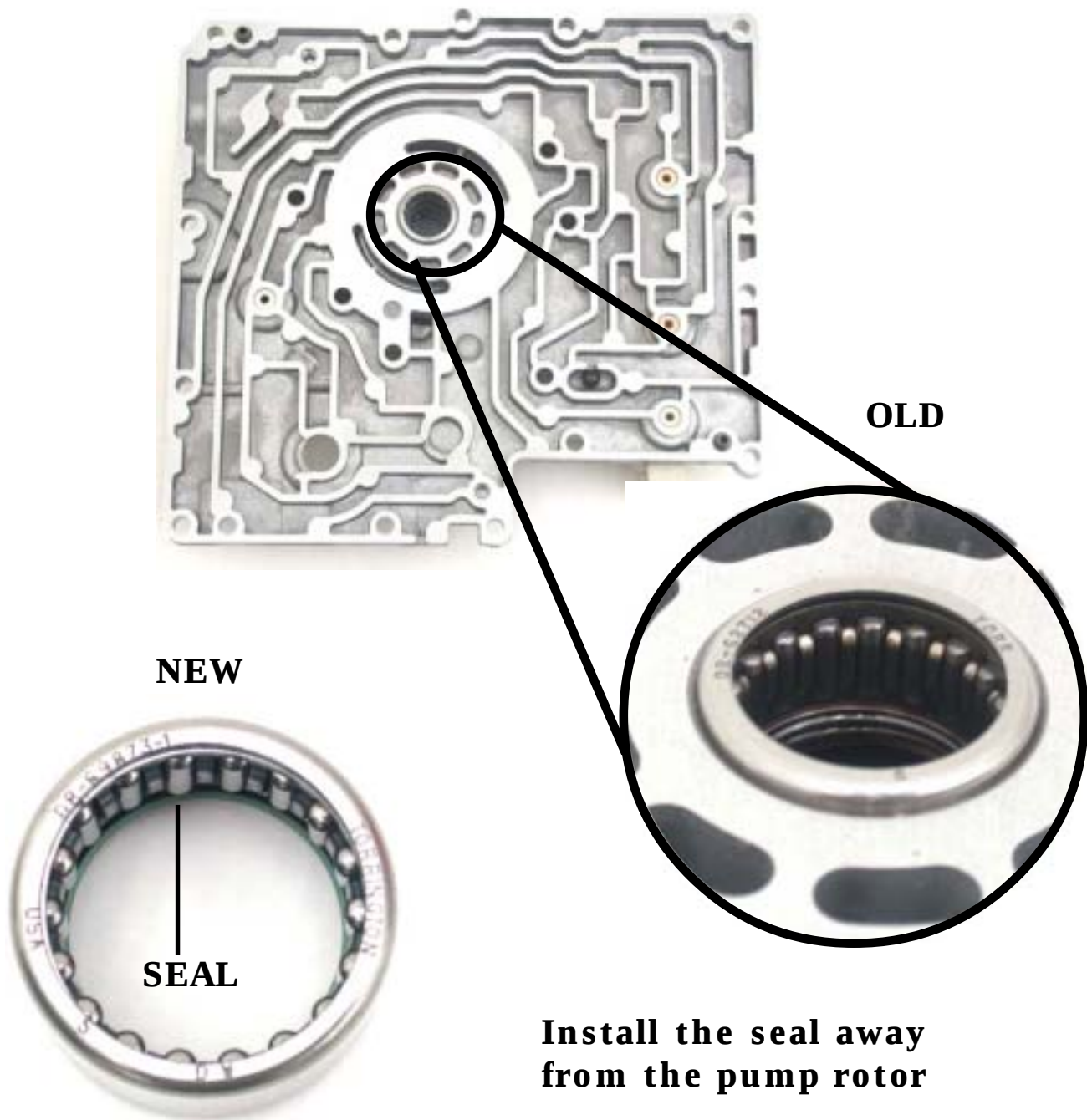


AX4S

Part# XF2Z-7G184-AA

AX4S/AX4N

New Pump Bearings



AX4N

Harsh 1-2 Shift

There are a number of problems related to this symptom including:

- Ä Wrong Gaskets***
- Ä Wrong Separator Plate***
- Ä Damaged Accumulator Piston***
- Ä Wrong Accumulator Spring***
- Ä Valve Body Wear***

AX4N

Harsh 1-2 Shift

Seperator Plate and Gasket

Lincoln 1995-97	(stamped 11)	part #F50Z-7Z490-A
Lincoln 1998.....	(stamped 84)	part #F80Z-7Z490-AA
Lincoln 1999-00	(stamped 90)	part #FX3Z-7Z490-AA
Taurus/Sable 1994-95 w/3.0L	(no stamp)	part #F5DZ-7Z490-A
Taurus/Sable 1996-97 w/3.0L 2V	(stamped 13)	part #F6DZ-7Z490-B
Taurus/Sable 1998-99 w/3.0L 2V	(stamped 87)	part #F8DZ-7Z490-BA
Taurus/Sable 1996-97 w/3.0L 2V	(stamped 14)	part #F6DZ-7Z490-A
Taurus/Sable 1998-99 w/3.0L 4V	(stamped 86)	part #F8DZ-7Z490-AA
Taurus SHO 1996-97 w/3.4L	(stamped 15)	part #F6DZ-7Z490-D
Taurus SHO 1998-99 w/3.4L	(stamped 85)	part #F8DZ-7Z490-CA
Taurus/Sable 2000	(stamped 03)	part #YF1Z-7Z490-CA
Taurus/Sable 2001-03	(stamped 05)	part #1F1Z-7Z490-AA



AX4N

Harsh 1-2 Shift

Damaged Accumulator Piston

A Damaged Accumulator Piston assembly can cause a number of shifting problems from late, early, harsh, soft and more. When reassembling this unit pay close attention to the housing and piston areas. If the piston is worn or the housing scored the chances of the piston cocking in the bore are increased.



Check the Piston housing for wear, grooves, or scoring

Check the Piston and Rod assembly for wear



AX4N

Harsh 1-2 Shift

Wrong Accumulator Spring

VEHICLE	1-2 ACCUMULATOR	COLOR
95-02	F5DZ-7G267-A	ORANGE
95-96 SHO ONLY	F6DZ-7G267-A	PURPLE
97-01 SHO ONLY	F7DZ-7D397-AA	PLAIN

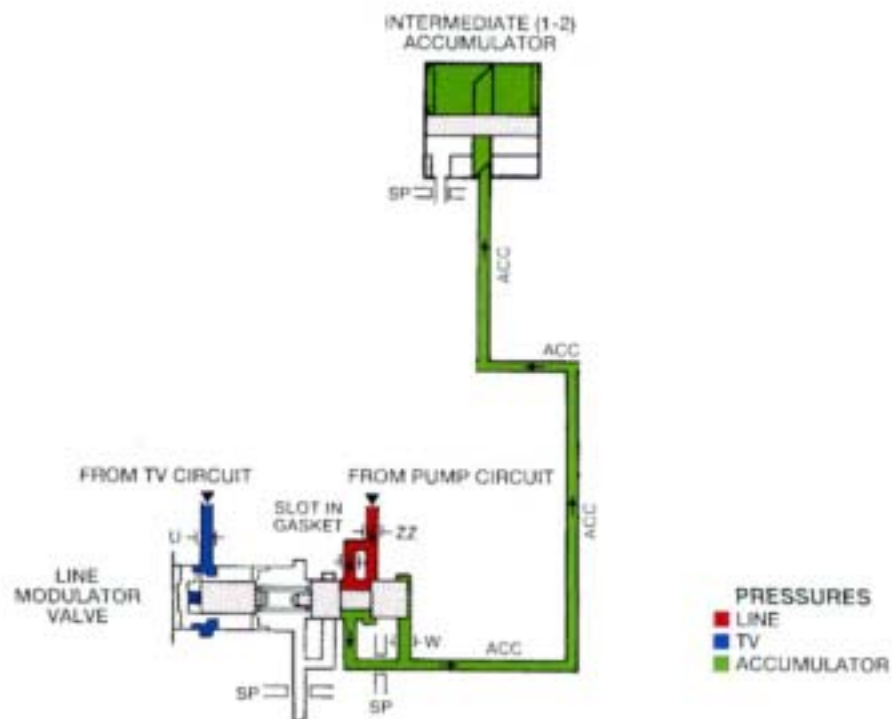


AX4N

Harsh 1-2 Shift

Accumulator Hydraulic Circuits

Fluid under pressure in the pump circuit moves to the line modulator valve, where it enters the accumulator circuit. The accumulator circuit provides variable hydraulic backpressure to the accumulators for five apply components. The variable pressure of fluid in the TV circuit is controlled by the pcm and changes the position of the line modulator valve. When TV pressure is lower, accumulator circuit pressure is lower. The results in softer shift feel provided by the accumulators during shifts when engine input torque is lower. When TV pressure is higher, accumulator circuit pressure is higher. This results in firmer shift feel provided by the accumulators during shifts when engine torque is higher. Damage to the Line Modulator Valve can result in no modulation of the valve and allowing direct line oil to influence the Accumulator.



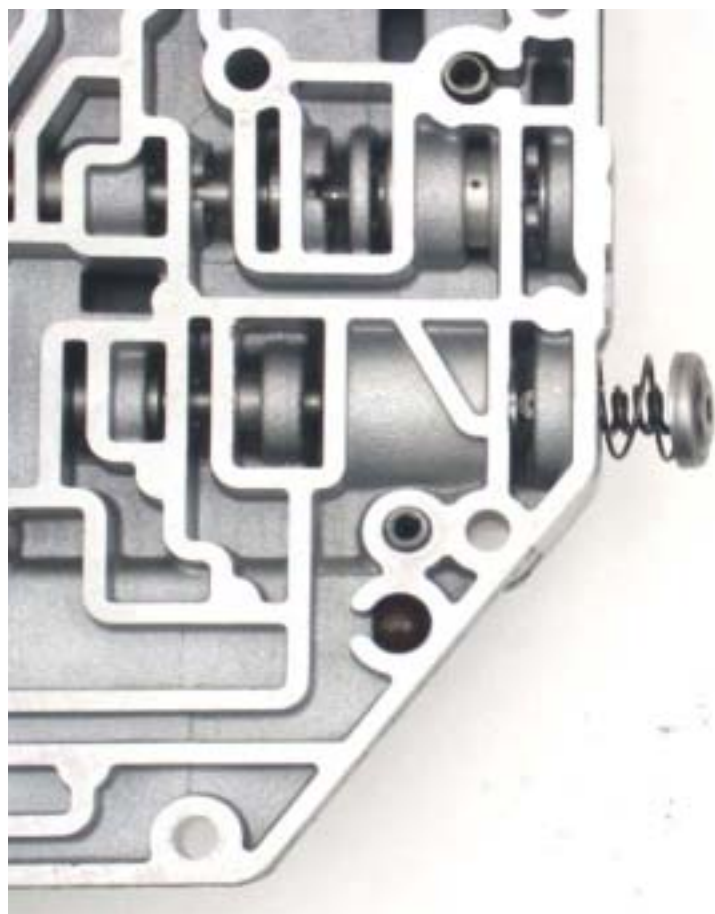
AX4N

Harsh 1-2 Shift

Valve Body Wear

Check for wear at the Line Pressure Modulator valve and sleeve assembly. If the sleeve is damaged you can replace it with an E4OD Line Pressure Modulator Valve and Sleeve assembly. The E4OD Line Pressure Modulator valve is smaller in size and allows less oil to the back side of the Accumulator apply side during operation resulting in a softer shift.

Damage to the Line Modulator Valve may result in a Slide Bump, Harsh Shift, or dragging shifts.



E4OD Line Pressure Modulator Valve and Sleeve



AX4N

Harsh 1-2 Shift

Incorrect Clutch Pack Clearance

1995-96

Forward Clutch (.040-.059) wave spring
Direct Clutch (.050-.069)
Intermediate (.050-.069) wave spring
Reverse (.038-.064) wave spring
Low-intermediate clutch (.050-.075) wave spring

1997-98

Forward Clutch (.050-.059) wave spring
Intermediate Clutch (.050-.069) no wave spring SHO
Direct Clutch (.050-.069)
Reverse 97 all (.038-.064) wave spring
Reverse 98 SHO (.049-.072) wave spring
Reverse 98 except SHO (.040-.063) wave spring
Low-intermediate clutch (.050-.075) wave spring

1999

Forward Clutch (.050-.069) wave spring
Intermediate (.050-.069) no wave spring SHO
Direct Clutch (.050-.069)
Reverse Clutch SHO (.050-.072) wave spring
Reverse Clutch except SHO (.040-.063) wave spring
Low-intermediate Clutch (.050-.075) wave spring

2000-03

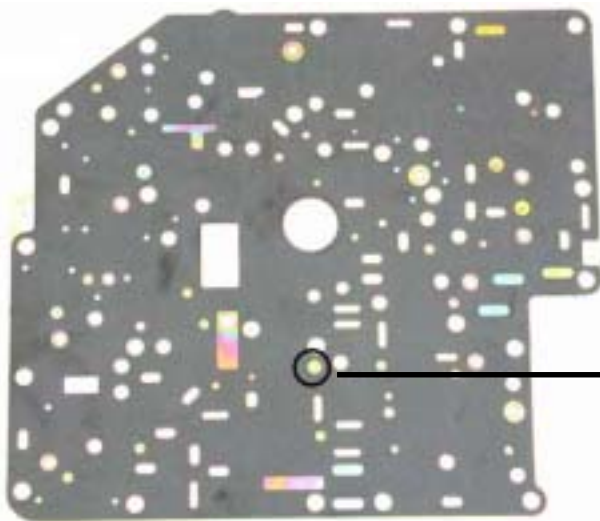
Forward Clutch (.040-.059) wave spring
Intermediate Clutch (.050-.069) wave spring
Direct Clutch (.050-.069)
Reverse Clutch (.050-.072) wave spring
Low-intermediate clutch (.050-.075) wave spring

AX4N

Harsh 4-3 Downshift

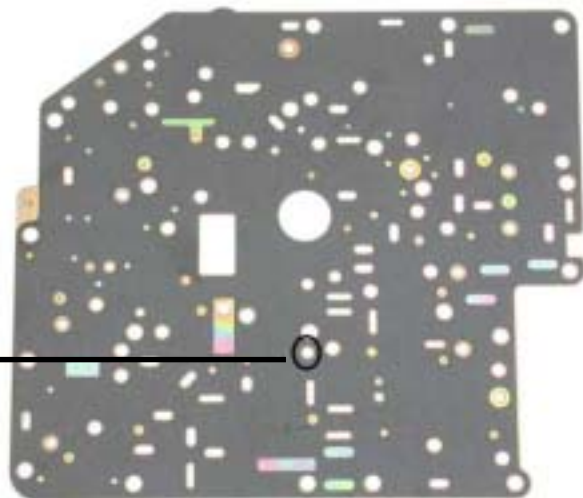
Wrong Seperator Plate

Many times the wrong seperator plate may be changed inenvertantly. Pay close attention to the O/D Servo exhaust orifice size, these sizes are not all the same.



00.095"

**Exahuast orifice from the
O/D Servo**



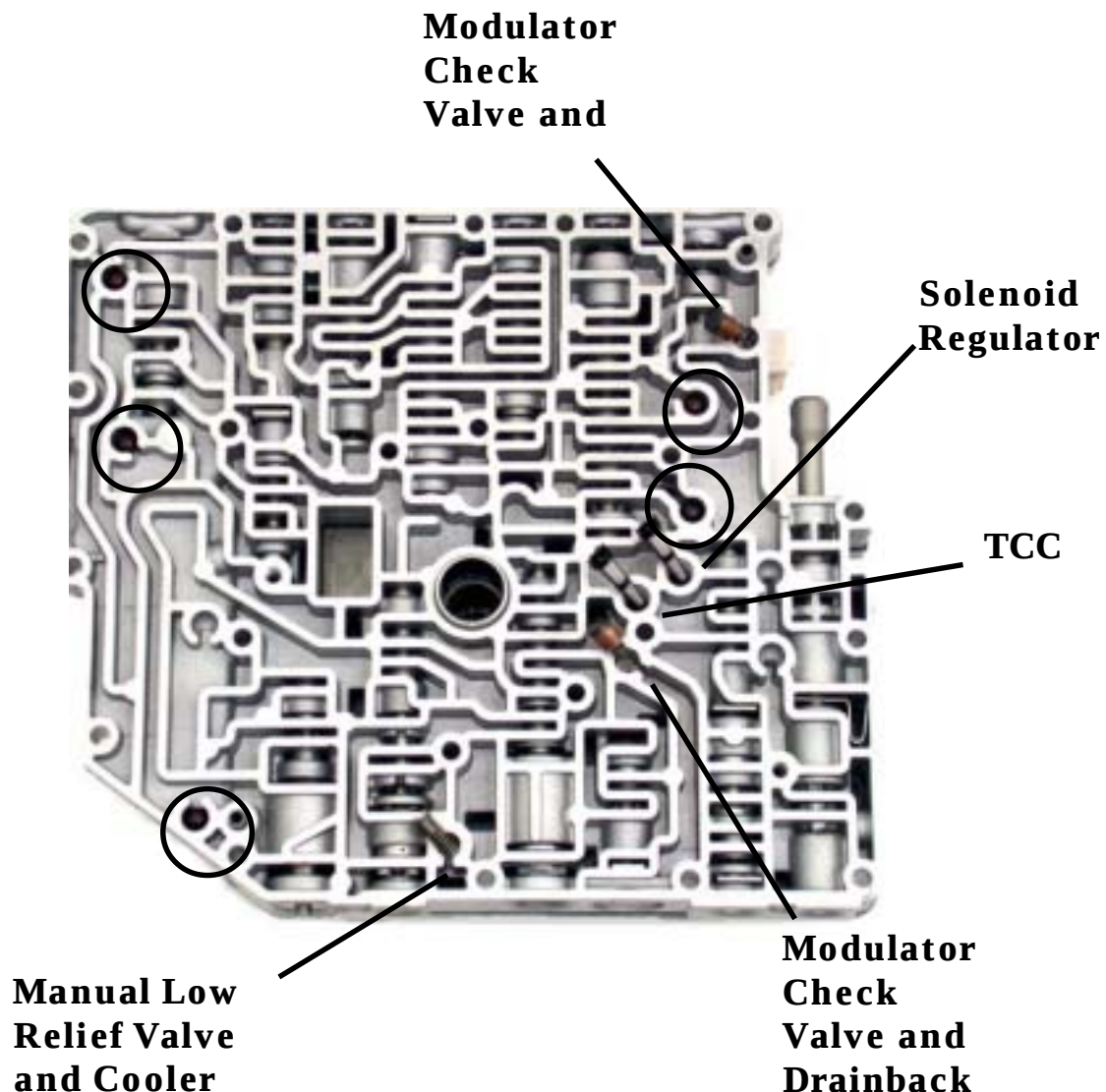
00.218"

AX4N

Check Ball and Relief valve

Locations

The locations of the check balls haven't changed over the years, however the springs have gone through some changes. Listed on the previous page are the spring sizes and weights.



AX4N

2001-On Check Ball and Relief Valve Location

**Manual Low
Relief Valve
and Cooler
Bypass Spring**



Spring Weight
7.00 lbs.
Spring size
.634" in

**Modulator
Check
Valve and
Drainback
Spring**



Spring Weight
1.00 lbs.
Spring size
.754" in

**Solenoid
Regulator
Fliter**



**TCC
Fliter**



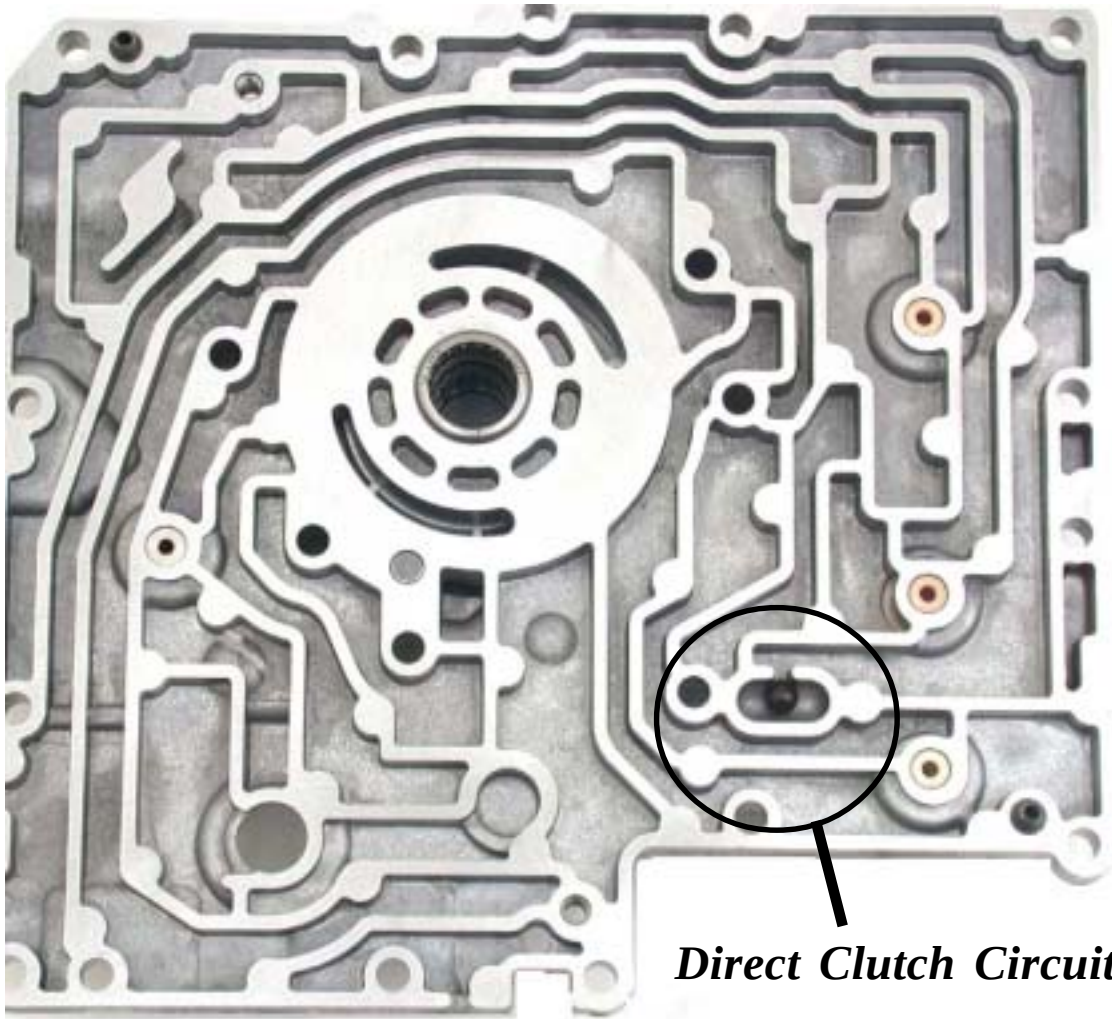
**Modulator
Check
Valve and
Spring**



Spring Weight
1.75 lbs.
Spring size
.673" in

AX4N

Check Ball Location

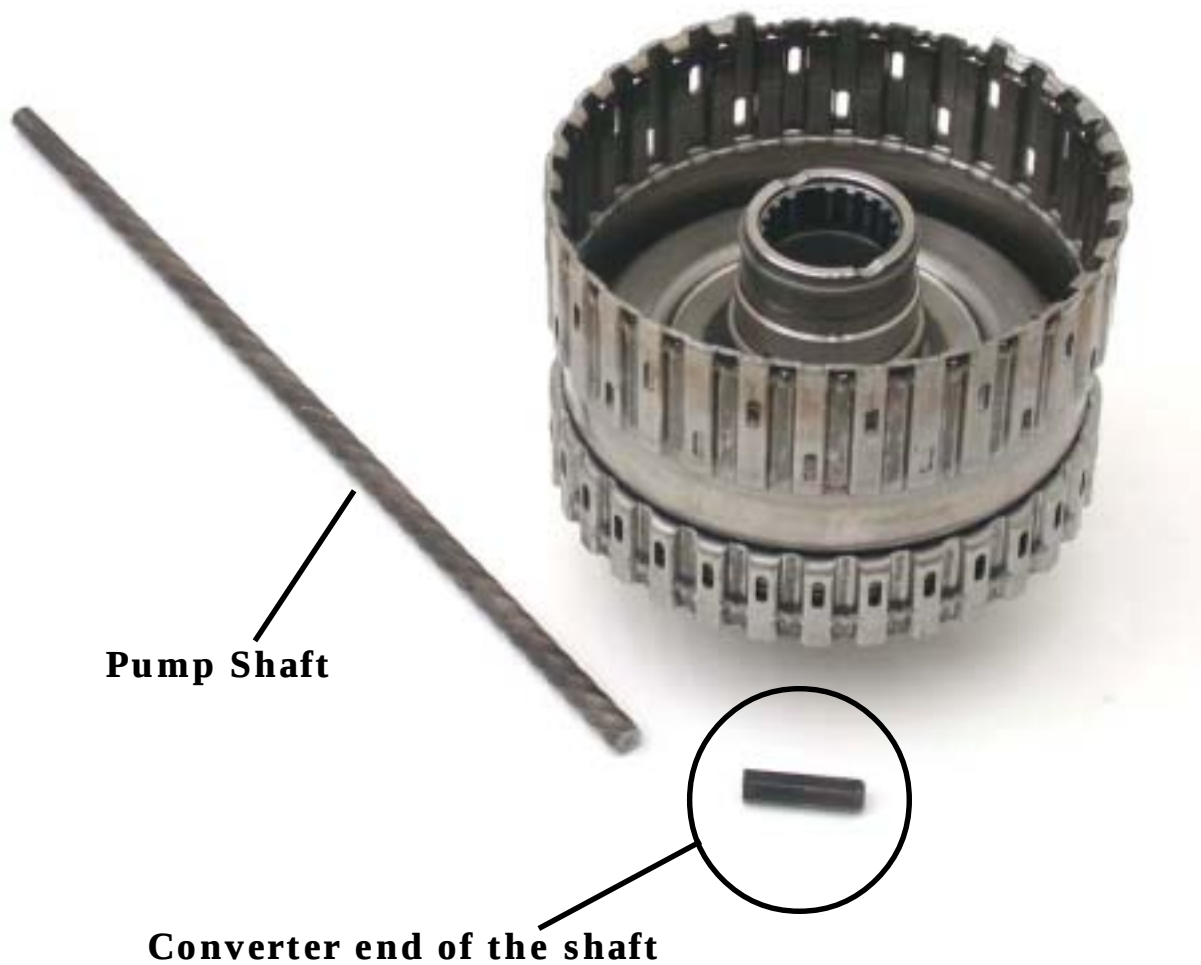


Direct Clutch Circuit

CD4E

No Movement After Overhaul

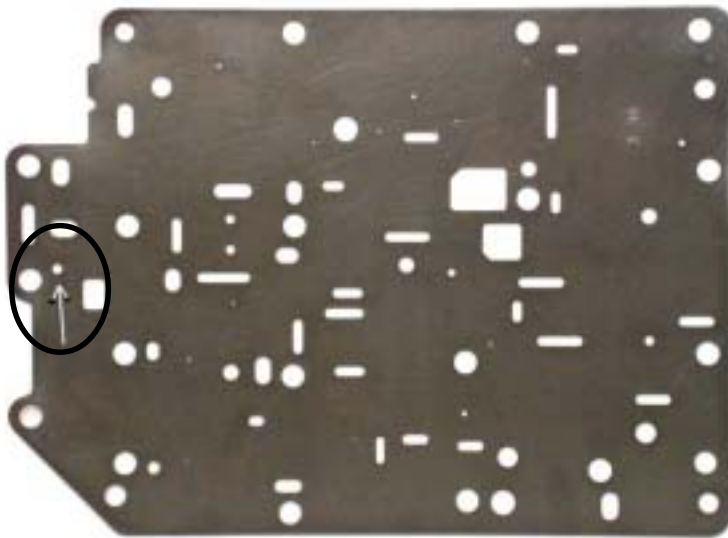
High Pressure caused by excessive clearance in the pressure regulator bore is causing the pump shaft to twist.



CD4E

Valve Body Mismatch

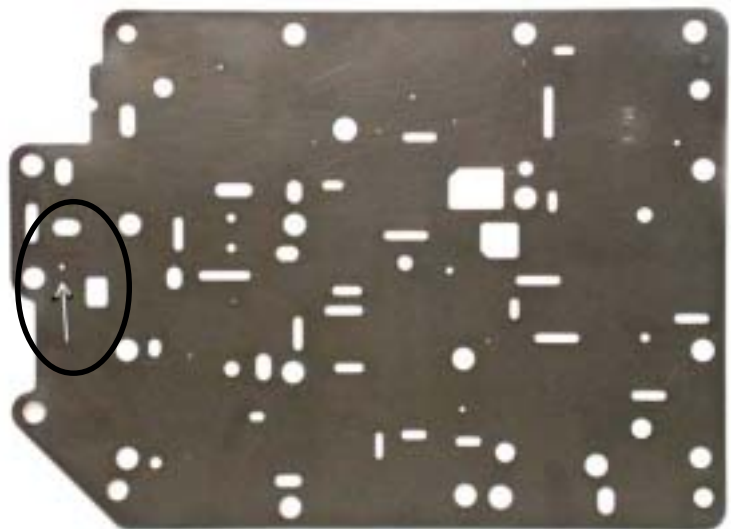
The Separator plate can be an easy identification tool when interchanging the valve bodies. The location of the Forward feed hole is much larger on the 98' and later valve bodies.



98' and later

***0.120" With Wave plate
in FWD clutch***

94'-98' Models
***0.090" No Wave plate
in FWD clutch***



CD4E

Valve Body Interchange

A wrong gear start from a stop or fourth gear in manual low condition may occur if the valve body was replaced with the wrong valve body. Early, 1994-'97 and Late (1998-on) valve bodies can be identified by the Pull-In valve assembly and are not interchangeable? They must match vehicle.



CD4E

Valve Body Interchange with Harsh Forward Engagement or 3-4 Bind

Forward clutch assemblies with a wave plate are intended for use on later style valve bodies with the larger Forward feed orifice. Forward clutch assemblies without the wave plate are intended for use on earlier style valve bodies with the small forward feed orifice. If the Earlier style Drum assembly is installed to a Late model vehicle a harsh Forward engagement may be felt. This is due to the large feed hole in the Separator plate assembly.

EARLY 94-97



LATE 98-on



CD4E

Valve Body Interchange with Harsh Forward Engagement or 3-4 Bind

**1st
Design
W/
shallow
dish**



**2nd
Design
W/
deep
dish**



**1st
Design
0.315"**

**2nd
Design
0.400"**

CD4E

Valve Body Interchange with Harsh Forward Engagement or 3-4 Bind

**1st Design 0.200"
Shallow Dish**

**2nd Design 0.310"
Deep Dish**



**1st Design 0.595"
Shallow Dish**

**2nd Design 0.680"
Deep Dish**

CD4E

Valve Body Interchange with Harsh Forward Engagement or 3-4 Bind

A 3-4 Bind may be caused the Clearance of the Coast Clutch being incorrect. Install the coast clutch piston into the forward piston, then stack 2 coast clutch steels, 2 frictions and the forward apply plate on top. Clearance should be around 0.050" in.

Other causes of this may be:

- Ä Forward Sprag (seized or wrong rotaion)
- Ä Cracked Forward piston
- Ä Crossleaks into the Coast Clutch



CD4E

Drives Forward in Neutral, Binds in Reverse

After rebuild, when hot car drives forward in Neutral and binds in Reverse. This problem occurs after a Forward/Direct drum has been replaced. Care needs to be taken when replacing the forward/direct clutch drum. Make sure that the piston slides into the drum bore with a top clearance (top of drum bore for outer seal) of at least .010 or more. Always feel outer seal riding surface for being smooth. If it appears that the top area of the drum where the seal rides is ballooned inward and not a true straight flat surface, do not use this drum as it will swell when hot locking the forward piston from returning to its relaxed position. This creates a mechanical bind on the piston not releasing the forward clutches



Look at the Ridges in the Drum and Piston surface area

Make sure the Piston can sit in the Drum with a .010" feeler gauge



CD4E

Ratio Error Codes P0732, P0733, etc.

Turbine Speed Sensor Application

Some of the most troublesome codes to deal with are ratio error codes. These codes can be caused by a number of different concerns:

- Ä Poor Line Pressure
- Ä Slipping Clutches
- Ä Bad Solenoids
- Ä Wrong Fluid
- Ä Bad Input from Engine Sensor
- Ä Ignition Noise or Alternator Noise entering the VSS signal

Make sure you have the correct Turbine Speed sensor on the transaxle, the older sensors have a much broader range of voltage then the new sensors.

RPM	Hz	Old	New
Idle	00	.9-1.	.3-.8
2000	135	2.5	1.8
3000	206	3.5	2.4
4000	270	4.4	2.7



1S7Z-7M101-KA



F7RZ-7M101-KA

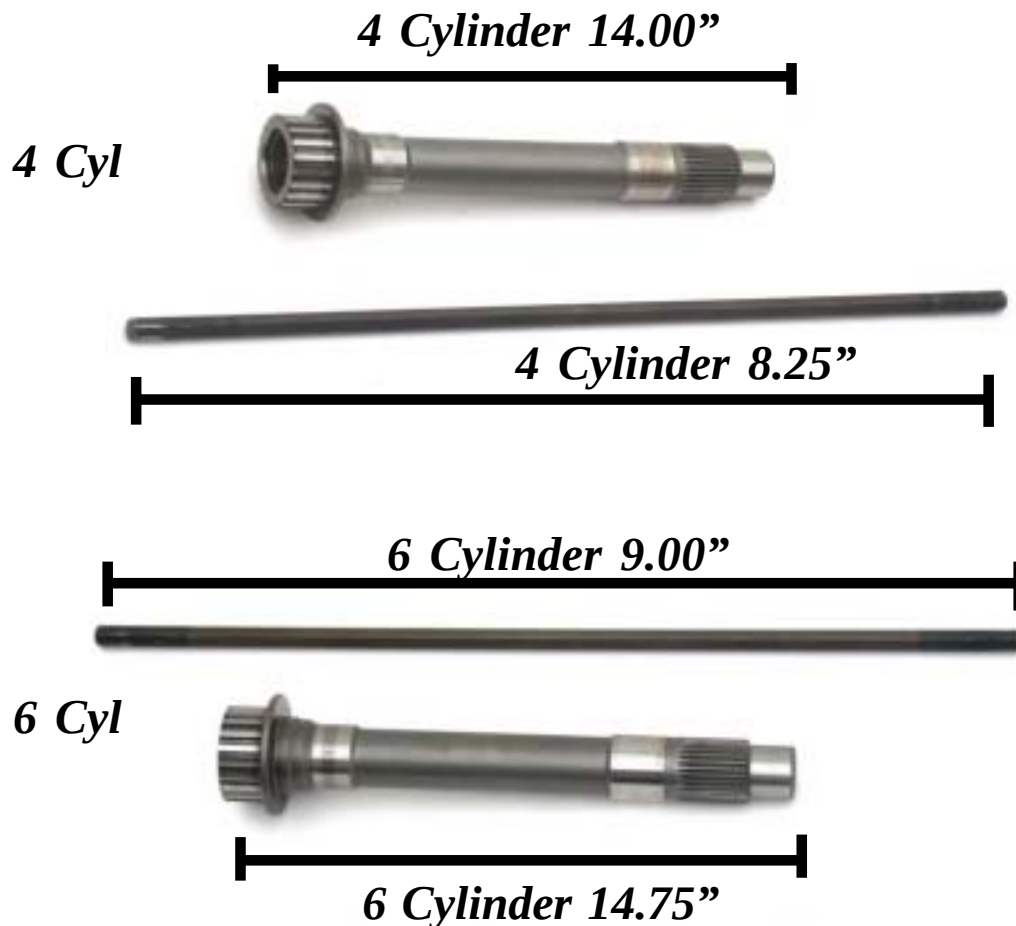
CD4E

Pump Shaft Identification

Pump, Converter, Engine Damage

It is very important to make sure you use the correct pump shaft and input shaft for the correct application. Mismatching the Input or Pump shafts may cause damage to the Pump, Crank Shaft Thrust Bearing, Converter and other internal parts.

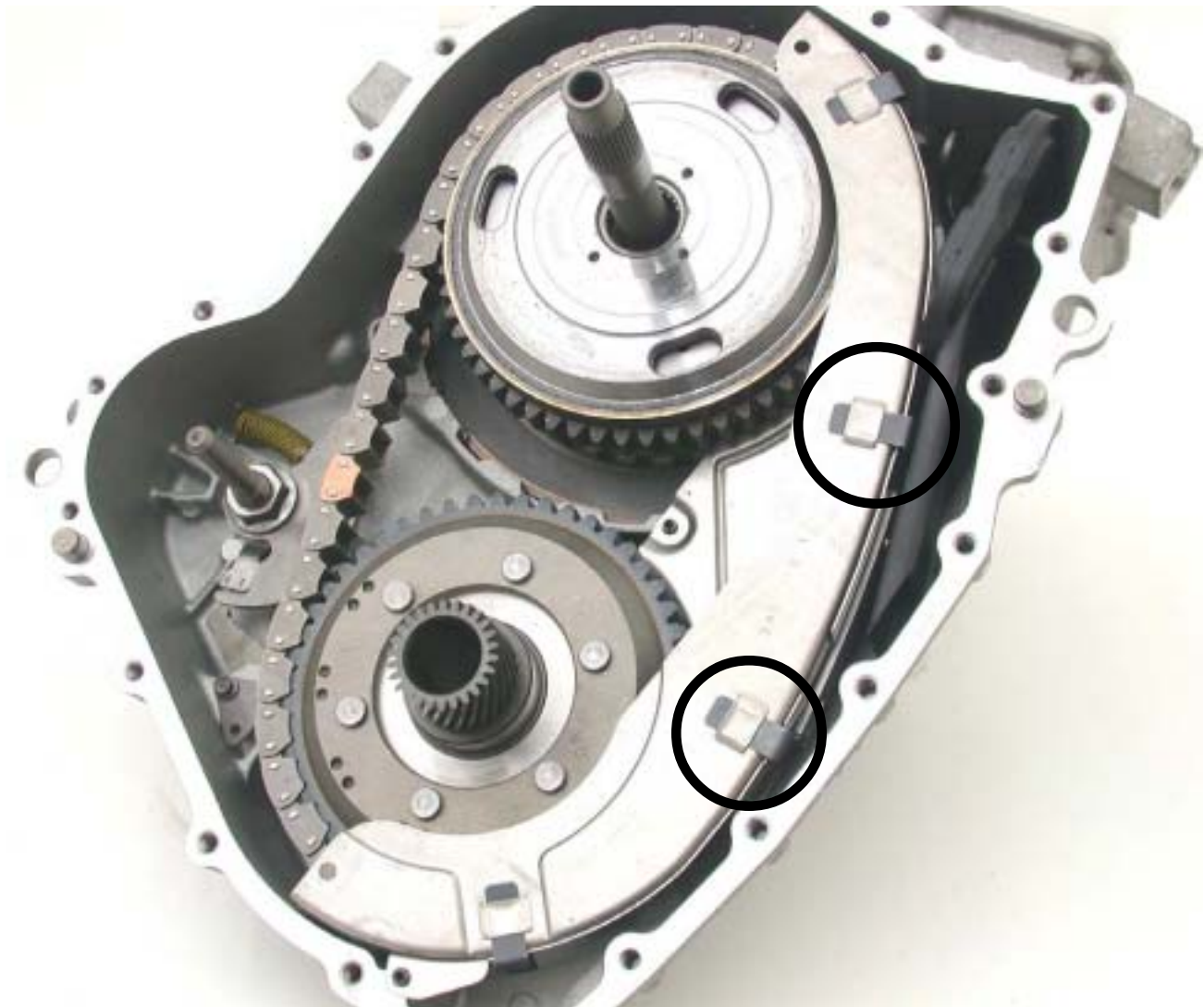
The Shafts are different in length between the 4Cyl. and 6Cyl. engines.



CD4E

Fluid Leaks Out Of The Dipstick Tube

The most common cause of this problem is the Chain cover not properly assembled. The chain cover has Four (4) snaps that connect to the shield. This shield is typically misplaced or not installed at all.



CD4E

Proper Sprag Rotation

No Forward movement or Binds in fourth can be caused by the Forward sprag damaged or incorrectly installed

Race freewheels counter-clockwise while holding the sun gear stationary



F4E-III

Clutch and Band Application

Gearshift Lever Position	Gear	2-4 Band	Re- verse Clutch	Low/ Re- verse Clutch	3-4 Clutch	Coast- ing Clutch	For- ward Clutch	One-Way (Sprag) Clutch		One-Way (Roller) Clutch	
								Drive	Coast	Drive	Coast
R	Reverse		D	H							
(D)	First						D	D	OR	H	OR
(D)	Second	H					D	D	OR		
(D)	Third				D	A ¹	D	D	OR		
(D)	Fourth	H			D		A ²	OR	OR		
D	Third				D	A ¹	D	D	OR		
L ³	Second	H				A ¹	D	D	OR		
L	First			H ¹		A ¹	D	D	OR	H	OR
Planetary Member		Rear (Large) Sun Gear and Drum	Rear (Large) Sun Gear and Drum	Front Planet	Front Planet	Primary (Small) Sun Gear	One- Way (Sprag) Clutch	Primary (Small) Sun Gear		Front Planet	

¹ For engine braking only.

² Applied but does not transfer power.

³ For overspeed protection only (during manual downshift).

OR = Overrunning.

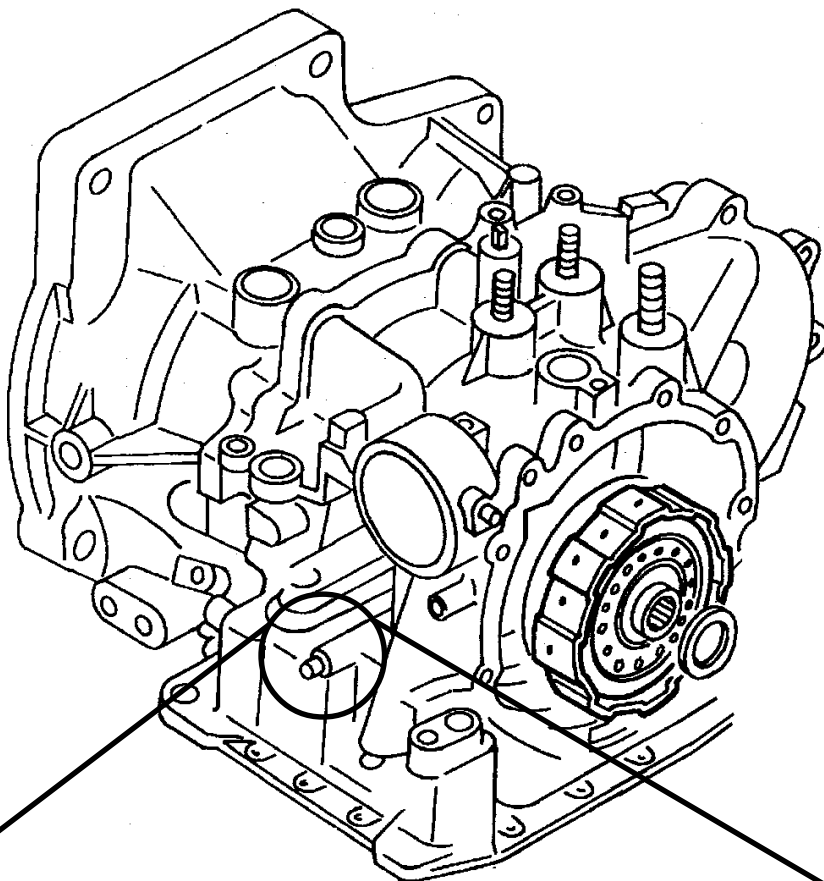
D = Driving.

H = Held.

A = Applied.

F4E-III

Pressure Specifications



Range	Line Pressure, (psi)	Line Pressure, (psi)
	P, (D), D, L	R
Idle	(62-81)	(110-120)
Stall Speed	(140-152)	(217-248)

F4E-III

Solenoid Firing Order

Shift Pattern				
	SSA (1)	SSB (2)	SSC (3)	TCC
Reverse				
1ST		X	X ^A	
2nd	X	X	X ^A	X ^A
3rd During Shift			X ^A	X ^A
3rd After Shift	X			X ^A
4th	X		X	X ^A

*Can be commanded by the PCM during shift.

Coast Down Shift				
	SSA (1)	SSB (2)	SSC (3)	TCC
4th	X		X	X ^A
Above 20 mph				
Below 20 mph			X	
Below 10 mph				
Stop 0 mph		X	X	

FAILSAFE			
	SSA (1)	SSB (2)	SSC (3)
Reverse			
2nd in Manual Low			
3rd in Manual 2 and D Position			

F4E-III

Solenoid Failure Chart

SSA (1) Always OFF			
	SSA (1)	SSB (2)	SSC (3)
Reverse			
1st		X	X
2nd		X	
3rd			X
3rd			

SSB (2) Always OFF			
	SSA (1)	SSB (2)	SSC (3)
Reverse			
4th	X		X
3rd	X		
3rd			X
3rd			

SSC (3) Always OFF			
	SSA (1)	SSB (2)	SSC (3)
Reverse			
1st		X	
2nd	X	X	
3rd	X		
3rd			

F4E-III

Solenoid Failure Chart

SSA (1) Always ON			
	SSA (1)	SSB (2)	SSC (3)
Reverse			
2ND	X	X	X
2nd	X	X	
3rd	X		
4th	X		X

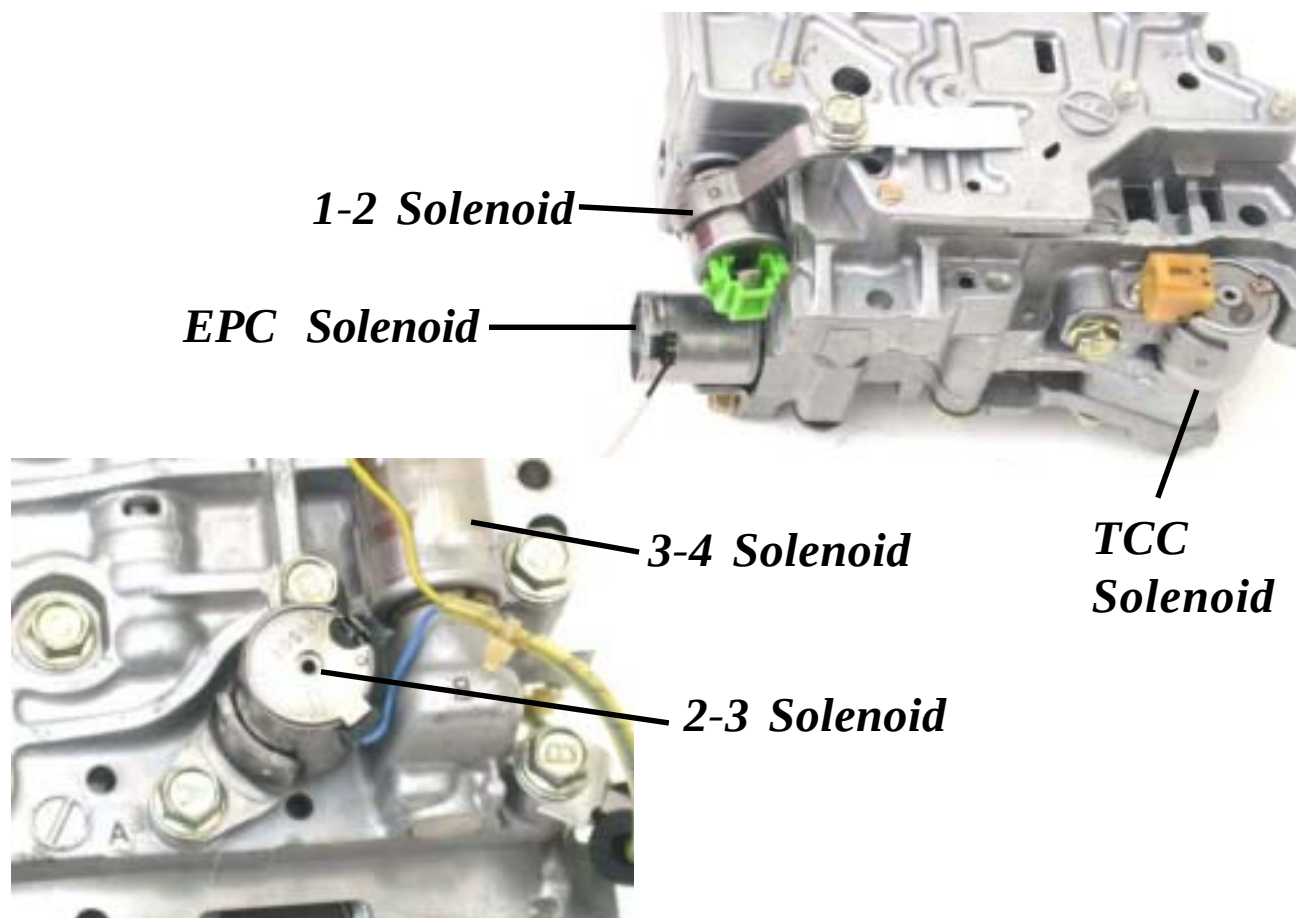
SSB (2) Always ON			
	SSA (1)	SSB (2)	SSC (3)
Reverse			
1ST		X	X
2nd	X	X	X
2ND	X	X	
1ST		X	

SSC (3) Always ON			
	SSA (1)	SSB (2)	SSC (3)
Reverse			
1ST		X	X
2nd	X	X	X
3rd with Engine Braking			X
4th	X		X

F4E-III

Solenoid Specifications

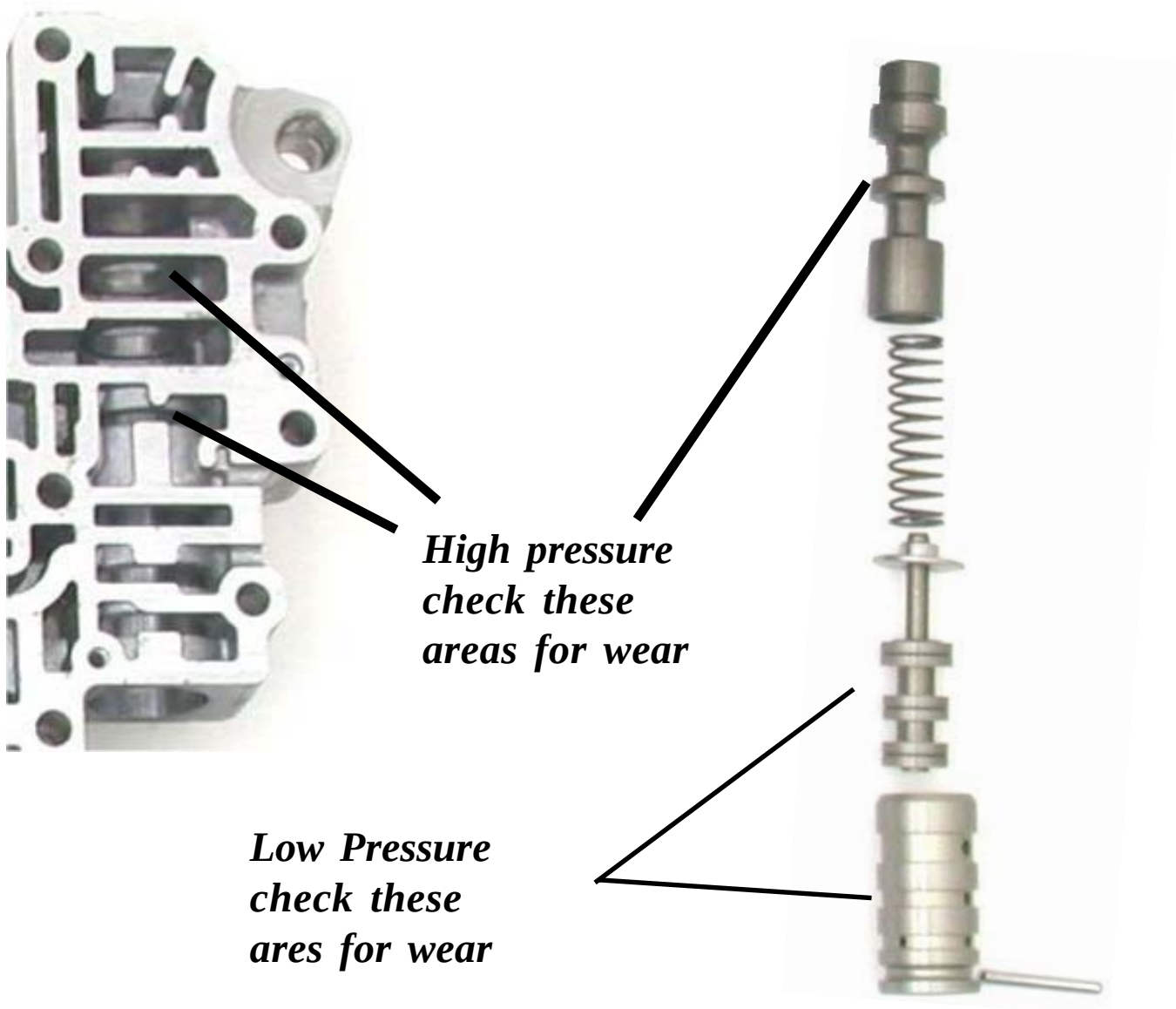
F4E-III Solenoid Specifications	
Solenoid	ohms
1-2	12-20
2-3	12-20
3-4	12-20
TCC	12-20
EPC	1-4



F4E-III

High / Low Pressure

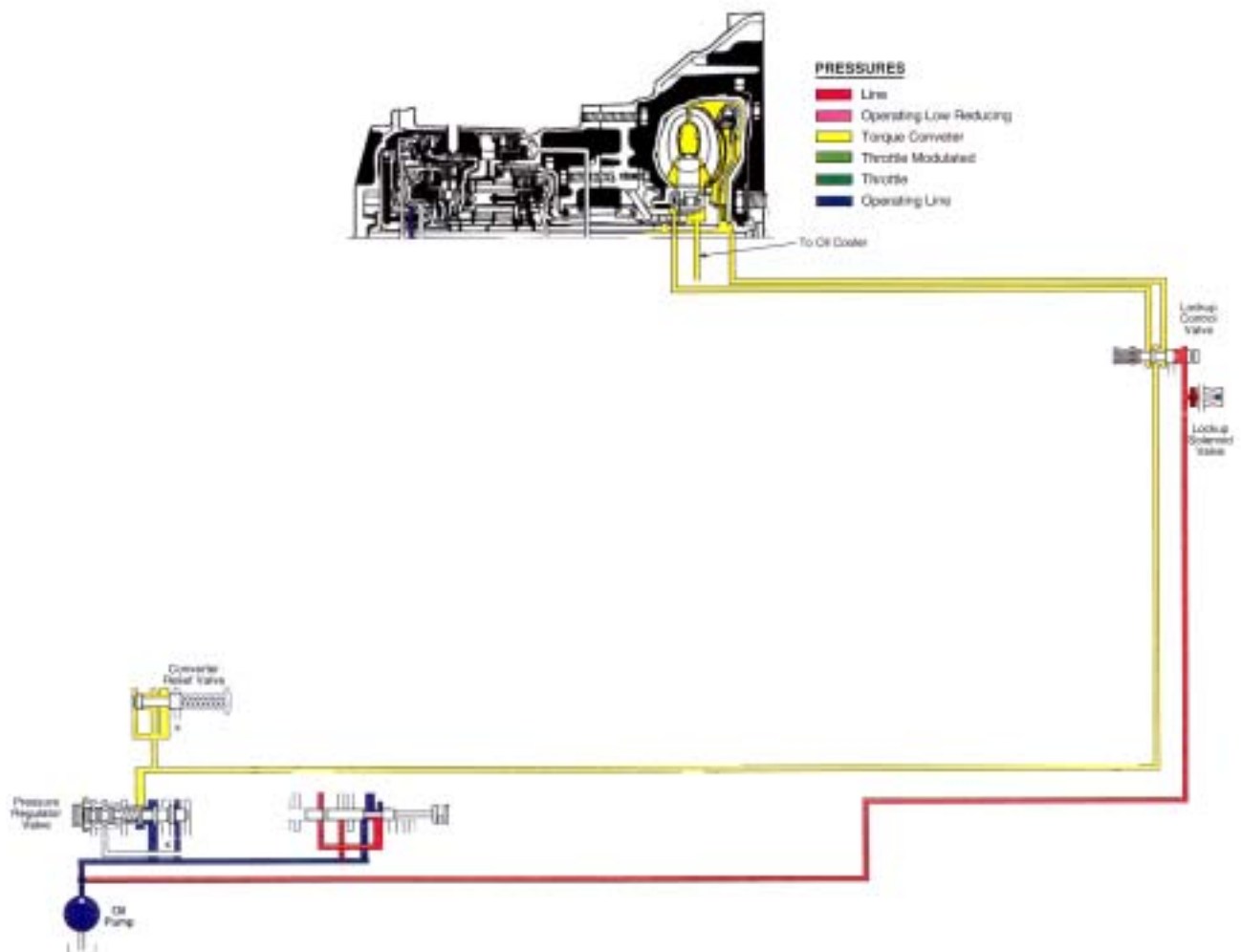
High Pressure caused by Pressure Regulator bore wear.



F4E-III

No Movement in all Gears after Rebuild

Typically caused by a damaged Pressure Regulator circuit, this problem is usually associated with a plant failure. During your rebuild procedure make sure the Pressure Regulator Valve assembly is not damaged. A damaged PR Valve can create high line pressure, this can cause no cooler flow resulting no movement.



F4E-III

Ratio Codes

Ratio codes can be very difficult to diagnose because of the many different components that can cause this problem. Diagnostic Trouble Codes P0781, P0782, P0783, P1731, P1732, P1733 indicate incorrect ratios and no specific gear. In order for these codes to set, the problem has to happen four times consecutively. Diagnostic Trouble Codes P0741 or P1728 are also ratio codes that can be perceived as only torque converter codes. In order for these codes to set the problem has to happen five times consecutively. Here are some of the items to look at when diagnosing Ratio Codes:

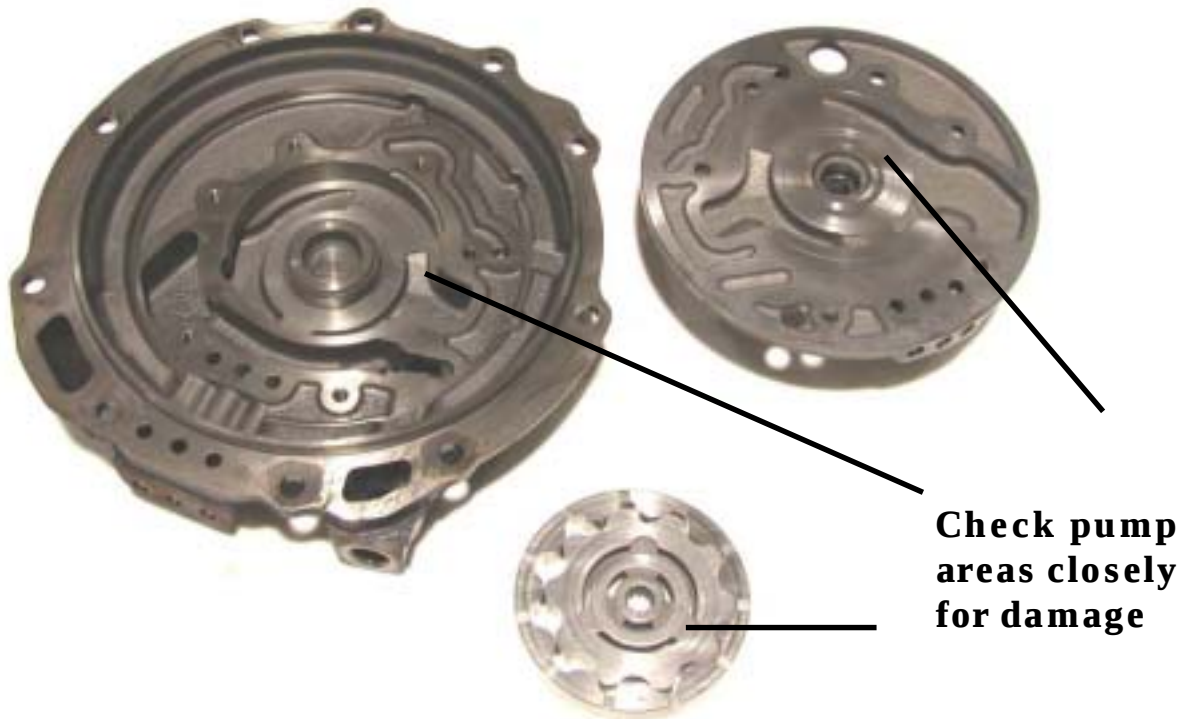
- ***Fluid Pump***
- ***Filter***
- ***Valve Body Wear***
- ***Seals***
- ***Drums***
- ***Speed Sensors***
- ***Accumulators***

F4E-III

Ratio Codes (Continued)

Pump

The front pump support and gear provides the volume of fluid required to charge the torque converter, main control valve body, cooling system, lubrication system, and hydraulic apply devices. The front pump support and gear is shaft driven by the torque converter cover. The sideclearance should be no more than .002, .0015 or less is preferred.



F4E-III

Ratio Codes (Continued) ***Filter***

If a transmission repair is being performed for a contamination-related failure, always use a new filter and grommet. Many people think that simply cleaning a screen filter will work, but this is not always the case. Small particles can become lodged in the screen and restrict flow, causing slips, and ratio errors.



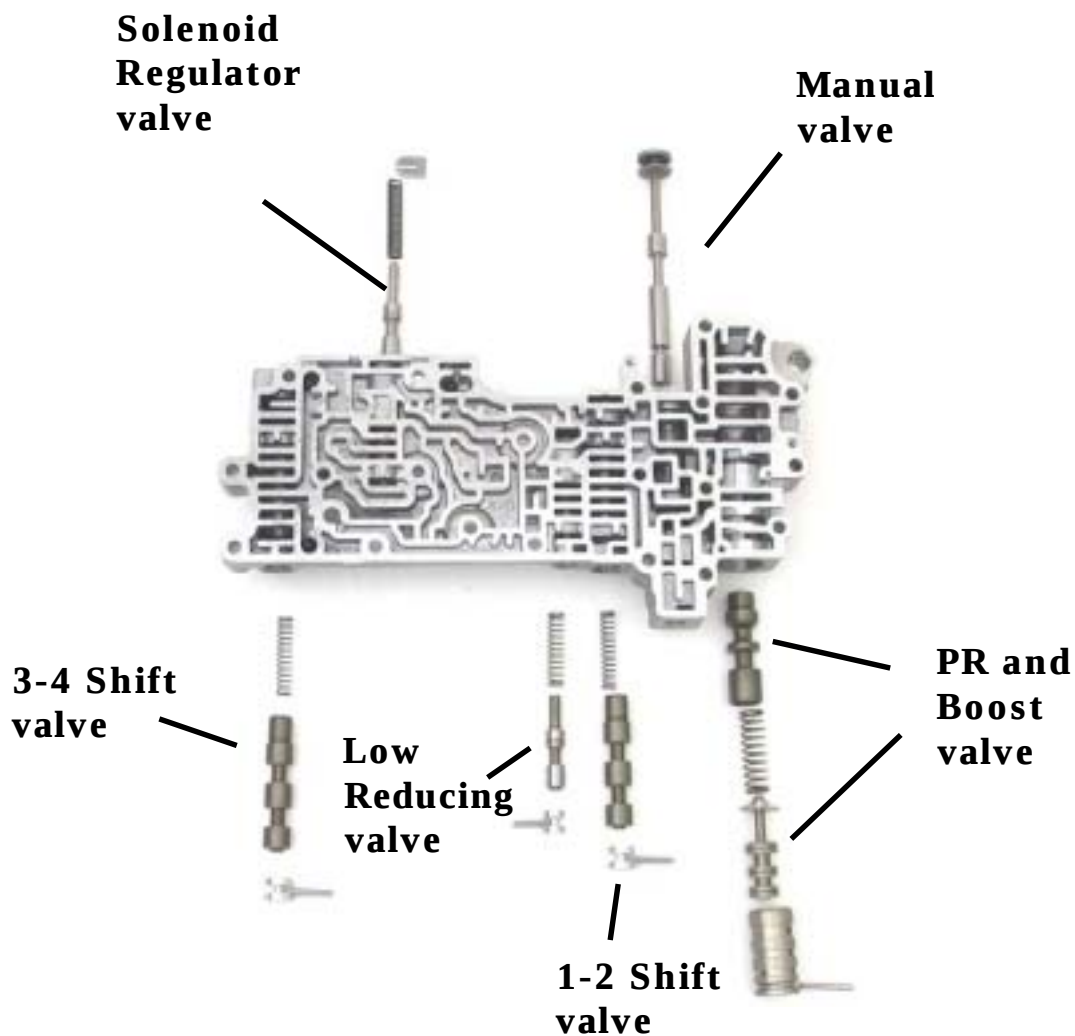
F4E-III

Ratio Codes (Continued)

Valve Body Wear

The valve body consists of four sections: the upper control valve body, main control valve body, premain control valve body, and the lower control valve body. The main control valve body also contains the electronic pressure control solenoid.

Wear in the 1-2 shift valve can cause a ratio code simply by not stoking properly and slowing down the timing the PCM is expecting.



F4E-III

Ratio Codes (Continued)

Seals and Drums

A bad seal or drum can be a difficult problem to diagnose. Some areas to look at are the sealing surfaces of the piston and drum assembly. A slipping Forward clutch can cause sluggish engagements into Drive. Here again knowing what's applied will help you diagnosis this unit quickly.



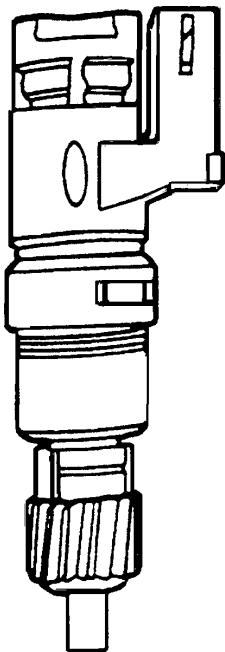
F4E-III

Ratio Codes (Continued)

Speed Sensors

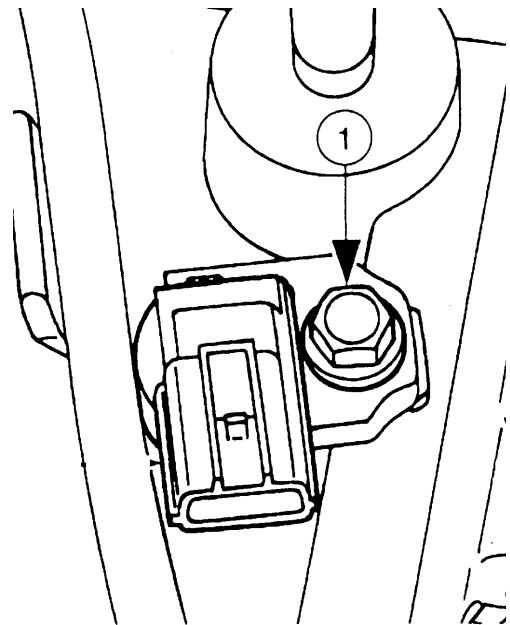
The vehicle speed sensor (VSS) is located above the differential on the transmission case. The VSS rotates a cable and the instrument cluster generates a DC signal and sends the signal to the PCM, in some cases the VSS generates the signal to the PCM. The TSS sensor provides converter turbine shaft speed information for torque converter clutch (TCC) control strategy. The information is also used in determining static electronic pressure control (EPC) pressure setting during shifts. The values below are approximate, the important point is that the frequency rise is linear and smooth.

Failure: All or some shifts missing, erratic shift pattern, Stall when put into gear, late/early shift speeds, no TCC, Erratic pressure rise.



VSS 150-250 ohms

80mph-	170 Hz +/-
60mph-	130 Hz +/-
30mph-	75 Hz +/-
15mph-	40 Hz +/-
00mph-	00 Hz +/-



TSS 150-250 ohms

F4E-III

Ratio Codes (Continued)

Accumulators

Accumulators — 1-2



Spring
Length 3.425
Diameter 0.630
Coil 0.080

Accumulators — 2-3



Outer Length **2.729**
Outer Diameter **0.580**
Outer Coil **0.078**

Inner Length **2.665**
Inner Diameter **0.396**
Inner Coil **0.052**

F4E-III

Ratio Codes (Continued)

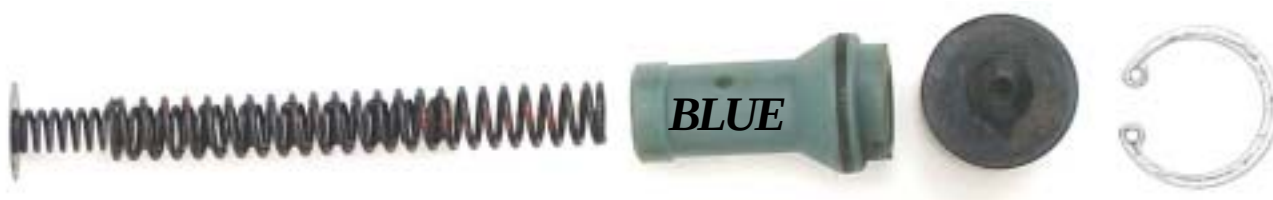
Accumulators — N-D



Outer Length	2.954
Outer Diameter	0.580
Outer Coil	0.062

Inner Length	2.802
Inner Diameter	0.420
Inner Coil	0.047

Accumulators — N-R

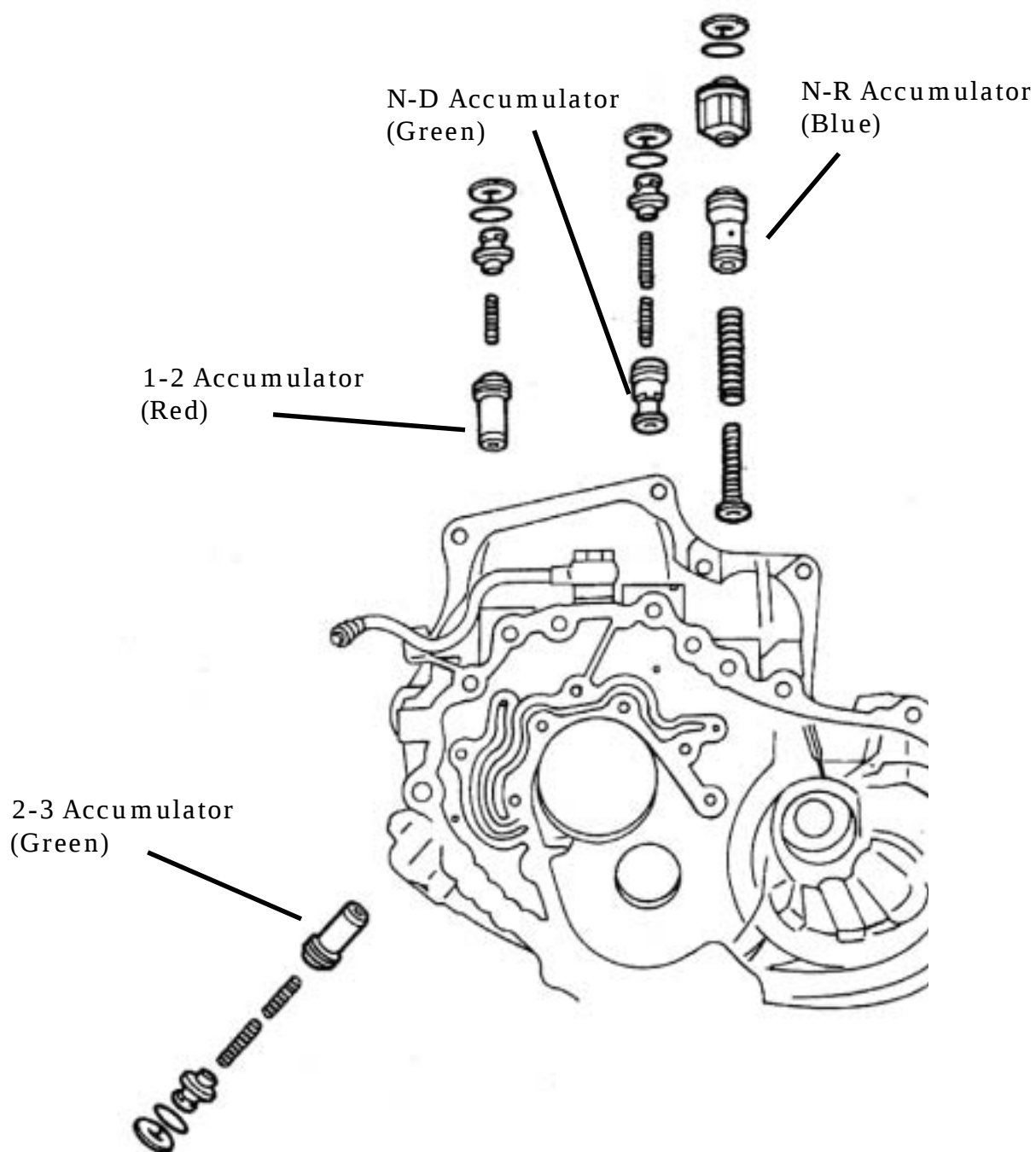


Outer Length	4.134
Outer Diameter	0.553
Outer Coil	0.066

Inner Length	3.657
Inner Diameter	0.384
Inner Coil	0.050

F4E-III

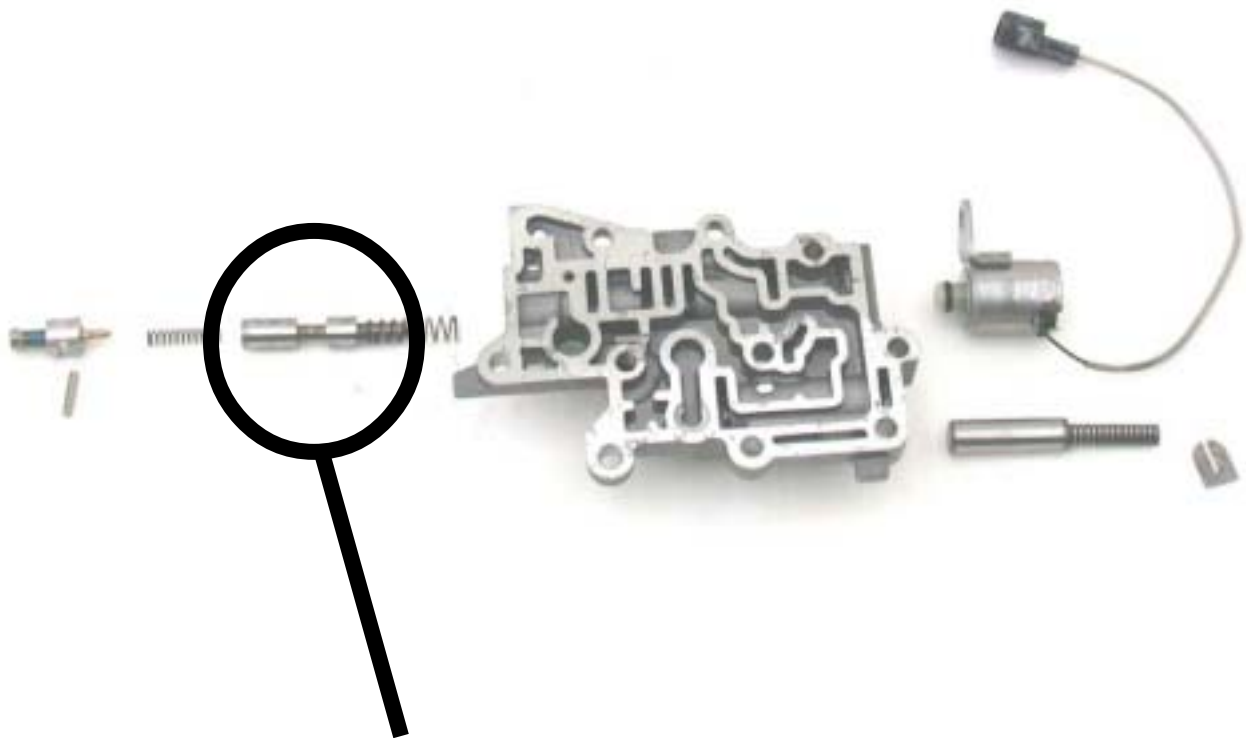
Accumulator Reference



F4E-III

No Line Rise W/ Good EPC Command

No Line rise can be caused by a sticking pressure modifier valve or a damaged spring. The Line Pressure Modulator Valve is responsible for modulating the EPC pressure and distributing it to the appropriate valves.



Check the valve for scoring and make sure the valve bore is clean of debris.

F4E-III

***After Rebuild, Slipping 2nd and 4th,
No 2nd and 4th***

**The Orifice size
is .020" in**

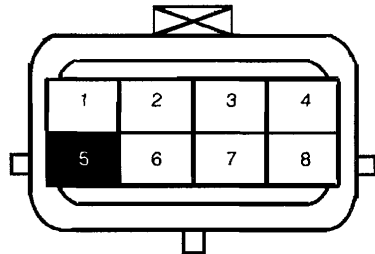


**Always take the time
to remove the servo
apply orifice.**

F4E-III

Jump Testing the Transmission

Ford's F4EIII



Transmission Connector Identification

ID	Function
1	EPC Solenoid
2	TFT Sensor (-)
3	Shift Solenoid 3
4	Shift Solenoid 1
5	Empty
6	TFT Sensor (+)
7	TCC Solenoid
8	Shift Solenoid 2

Signal Monitor Connection

Backprobe the terminals with the harness connector still connected.

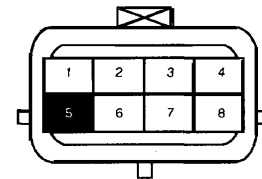
Red Boot Terminal 4
Yellow Boot Terminal 8
Green Boot Terminal 3

Black Boot,
Yellow Boot; Black Band
Green Boot; Black Band, All connect to ground

Electronic Pressure Control

Backprobe the terminals with the harness connector still connected.

To check the electronic pressure control signal, connect the positive (+) lead of your high-impedance voltmeter to terminal 1, connect the negative (-) lead to ground.



Solenoid Sequence

Gear	SS1	SS2	SS3
1	OFF	ON	ON
2	ON	ON	ON
3	OFF	OFF	OFF
4	ON	OFF	ON

Note: Shift solenoids are normally closed feed/bleed system type.

This is the shift pattern you should see with your signal monitor:

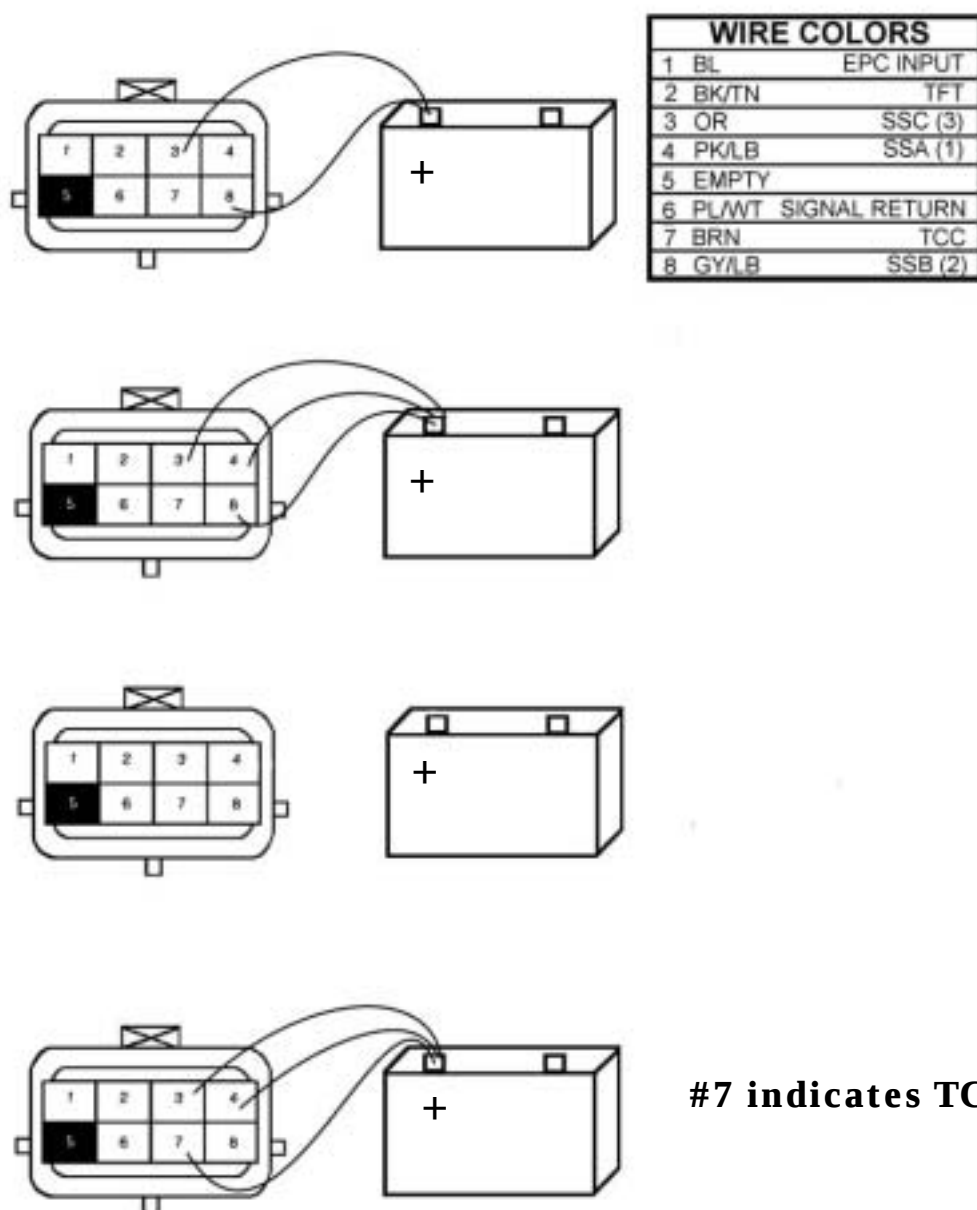
Transmission Shift Pattern			
First Gear			
Second Gear			
Third Gear			
Fourth Gear			

All three LEDs are required to check the shift command pattern.

F4E-III

Jump Testing the Transmission

F4E-III connector assembly viewed from the terminal side.



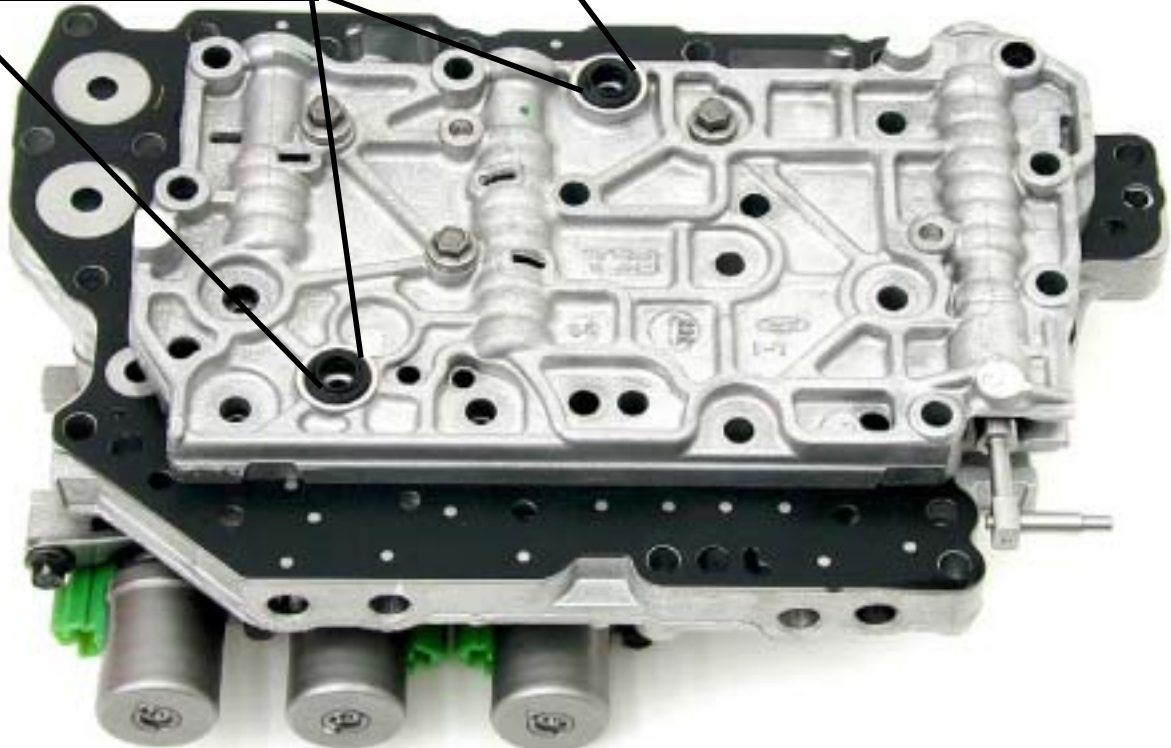
4F27E

Servo Seal Damaged

It is important to install the Servo seal to the Valvebody correctly make sure there are no tears in the lip of the seal and that there is no knicks on the Valvebody seal surface. Make sure you torque the Valvebody to specifications and air check the unit after. A loose valve body can cause the seals to tear from the oil pressure passing the feed.



***Torque Valve Body
to 80 lb-in.***



4F27E

Final Drive Gear Set

A reprogram is available for the PCM (Powertrain Control Module) to accept an earlier gearset in a late vehicle. In Early 2002 Ford introduced a reprogram for this interchange.

If the transaxle has a part number on it that starts with an X for the year 2000 (ex:XS4P) it contains the older gear set. Transaxles with part numbers that begin with 1 for the year 2001 (ex: 1S4P) it contains a newer gear set.

To identify the correct reprogram locate the tear tag on the door and match the tag number with the following chart.

The early output gear has 87 teeth and the transfer gear has 83 teeth

The late output gear has 59 teeth and the new transfer gear has 57 teeth.

**Transfer
Gear**



**Output
Gear**

4F27E

Final Drive Gear Set

2000 Model Year 4F27E Transaxle with SPI Engine

Use this chart as a guide to upgrade the PCM calibrations when rebuilding or repairing a transmission and using the new gear ratio with the SPI engine

Rebuild/Replace
4F27E FN Trans
Part Number
1S4P-CF
(New 3.733 FDR)

Original Calibration	Original PCM	Tear Tag		New Calibration	New PCM	Tear Tag
0AK15S0511	98A8-12A650-AMH	FVV7	>	0AK15S0511	YU7Z-12A650-DA	00Q0
0AK15S0512	98A8-12A650-AMJ	FVV8	>	0AK15S0512	YU7Z-12A650-DA	00Q0
0AK15S0513	98A8-12A650-AMK	FVV9	>	0AK15S0513	YU7Z-12A650-DA	00Q0

2000 Model Year 4F27E Transaxle with Zetec Engine

Use this chart as a guide to upgrade the PCM calibrations when rebuilding or repairing a transmission and using the new gear ratio with the Zetec engine

Rebuild/Replace
4F27E FN Trans
Part Number
1S4P-DF
(New 3.956 FDR)

Original Calibration	Original PCM	Tear Tag		New Calibration	New PCM	Tear Tag
0AK15Z0511	98A8-12A650-AHH	LDC7	>	0AK15Z0511	YU7Z-12A650-DVA	N U0
0AK15Z0512	98A8-12A650-AHJ	LDC8	>	0AK15Z0512	YU7Z-12A650-DVA	N U0

2001 Model Year 4F27E Transaxle with SPI Engine

Use this chart as a guide to upgrade the PCM calibrations when rebuilding or repairing a transmission and using the new gear ratio with the SPI engine

Rebuild/Replace
4F27E FN Trans
Part Number
1S4P-CF
(New 3.733 FDR)

Original Calibration	Original PCM	Tear Tag		New Calibration	New PCM	Tear Tag
1AK1AS0507	1S4F-12A650-LD	BVP3	>	1AK1AS0516	1M5Z-12A650-M8	QOW1
1AK1AS0510	1S4F-12A650-LE	BVP4	>	1AK1AS0516	1M5Z-12A650-M8	QOW1
1AK1AS0515	1M5F-12A650-MA	QOW0	>	1AK1AS0516	1M5Z-12A650-M8	QOW1
1AK1AS0A06	1S4F-12A650-ACC	RXV2	>	1AK1AS0A16	1M5Z-12A650-N8	IB E1
1AK1AS0A10	1S4F-12A650-ACD	RXV3	>	1AK1AS0A16	1M5Z-12A650-N8	IB E1
1AK1AS0A15	1M5F-12A650-NA	B E0	>	1AK1AS0A16	1M5Z-12A650-N8	IB E1

2001 Model Year 4F27E Transaxle with Zetec Engine

Use this chart as a guide to upgrade the PCM calibrations when rebuilding or repairing a transmission and using the new gear ratio with the Zetec engine

Rebuild/Replace
4F27E FN Trans
Part Number
1S4P-DF
(New 3.956 FDR)

Original Calibration	Original PCM	Tear Tag		New Calibration	New PCM	Tear Tag
1AK1AZ0509	1S4F-12A650-MF	JFR5	>	1AK1AZ0510	1U7Z-12A650-EA	K8 M0
1AK1AZ0510	1S4F-12A650-MG	JFR6	>	1AK1AZ0510	1U7Z-12A650-EA	K8 M0
1AK1AZ0515	1S4F-12A650-PA	CJW0	>	1AK1AZ0516	1M5Z-12A650-P8	CJW1
1AK1AZ0A09	1S4F-12A650-ADF	SZR5	>	1AK1AZ0A10	1U7Z-12A650-FAA	VVM0
1AK1AZ0A10	1S4F-12A650-ADG	SZR6	>	1AK1AZ0A10	1U7Z-12A650-FAA	VVM0
1AK1AZ0A15	1M5F-12A650-RA	XAU0	>	1AK1AZ0A16	1M5Z-12A650-R8	XAU1

4F27E

2 / 4 Band Adjustment

Band adjustment is crucial during a rebuild. Many times a repeat failure of the band will occur because the specified bolt was not installed. This tool can be purchased from the after market.

OTC# 307-416



4F27E

2 / 4 Band Adjustment

When an adjustment is necessary be sure to follow the procedure listed below:

- Ä Tighten the band select gauge tool to 45 lb-in
- Ä Back out the gauge 3 ½ turns
- Ä Holding the tool bolt in position, lightly seat the nut and washer against the transaxle case
- Ä Remove the tool without changing the position of the nut on the bolt



4F27E

2 / 4 Band Adjustment

- Ä Compair the 2 / 4 band anchor bolt with the measurement tool
- Ä If the adjustment is off use the chart to verify the correct pin



Anchor Bolt Selection Chart		
Part Number	Bolt Head Number	Bolt Length
XS4Z9F206GB	7	39.0 mm
XS4Z9F206FB	6	38.5 mm
XS4Z9F206EB	5	38.0 mm
XS4Z9F206DB	4	37.5 mm
XS4Z9F206CB	3	37.0 mm
XS4Z9F206BB	2	36.5 mm
XS4Z9F206AB	1	36.0 mm



4R44/55E and 5R44/55E

Low Line Pressure at WOT, Slipping

Explorer, Ranger, Aerostar, Mountaineer

Low line pressure at WOT, separator plate gasket blown, erratic EPC pressure are some common problems with 1995 -2002 4R and 5R series transmissions.

Some other complaints may be:

- Ä No Line Rise at WOT
- Ä No 2nd Gear
- Ä No 3rd Gear
- Ä No engine breaking in Manual 1
- Ä Slipping shifts and/or delayed engagements
- Ä DTCs P0732, P0733, or P1762 may be present

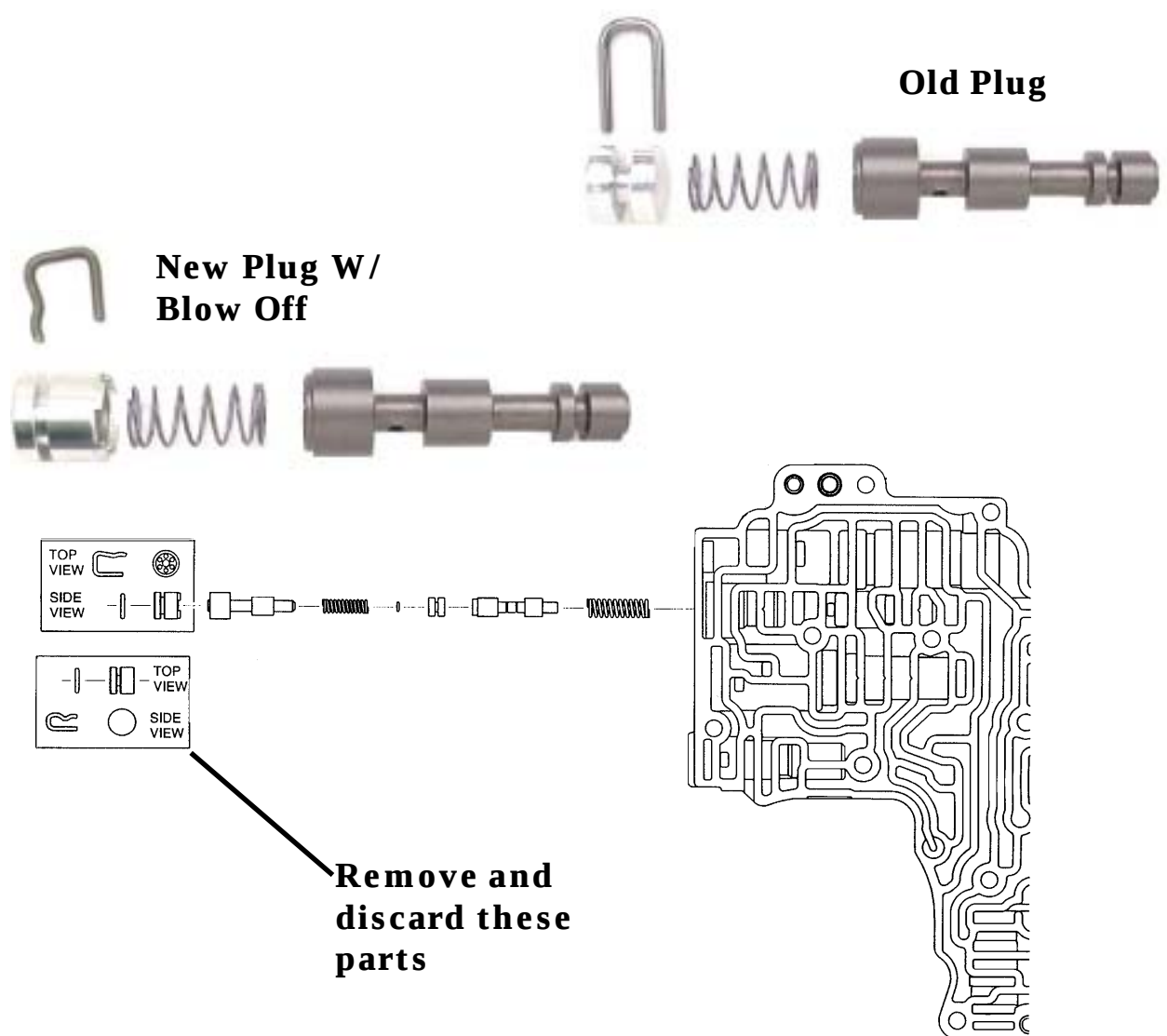
The separator plate orifice sizing has been changed to repair this problem, a new Separator plate is now available from Ford. In some cases due to heavy contamination the Valve Body will need to be replaced if there isn't a heavy amount debris in the pan refer to chart for specific separator part number. If it is determined the valve body needs replacing refer to chart on the opposite page.



4R44/55E and 5R44/55E

Low line Pressure at WOT

When replacing the separator plate and EPC blow off plug, remove and discard the old solid plug and clip assembly. The new plug has a check valve in the plug that allows excessively high EPC oil pressure to escape without damaging the valve body or other internal complaints.



4R44/55E and 5R44/55E

Low line Pressure at WOT

Procedure A - Parts Application Chart			
Vehicle Application	Engineering Description	Qty.	New Service Part
96 Aerostar 3.0L/4.0L 95/96 3.0L/4.0L Ranger/Explorer 95/96 2.3L Ranger	95/96 Models ONLY		
	Control Assy - Main	1	F5TZ-7A100-CB
	Control Assy - Main	1	F5TZ-7A100-CB
	Control Assy - Main	1	F57Z-7A100-RA
97 2.3L Ranger 97 3.0L OHV Ranger/Aerostar 97 4.0L OHV Ranger/Aerostar 97 4.0L OHV Explorer/Mountaineer 97 4.0L SOHC Explorer/Mountaineer	97 Models ONLY	1	
	Control Assy - Main	1	F77Z-7A100-FA
	Control Assy - Main	1	F77Z-7A100-GA
	Control Assy - Main	1	F79Z-7A100-AA
	Control Assy - Main	1	F77Z-7A100-HA
	Control Assy - Main	1	F77Z-7A100-JA
98/01 2.5L Ranger 98/00 3.0L Ranger 98/00 4.0L - EI Ranger 98/00 4.0L - EI Explorer 98/00 4.0L - SOHC	1998-2001 Models ONLY		
	Control Assy - Main	1	XL2Z-7A100-AB
	Control Assy - Main	1	XL2Z-7A100-BB
	Control Assy - Main	1	XL2Z-7A100-CB
	Control Assy - Main	1	XL2Z-7A100-DB
	Control Assy - Main	1	XL2Z-7A100-EB
2001/2002 2.3L Ranger 2001/2002 3.0L Ranger 2001/2002 4.0L-SOHC	2001-2002 Models ONLY		
	Control Assy - Main	1	1L5Z-7A100-AB
	Control Assy - Main	1	1L5Z-7A100-BC
	Control Assy - Main	1	1L5Z-7A100-CC

4R44/55E and 5R44/55E

Low line Pressure at WOT

Procedure B - Parts Application Chart			
Vehicle Application	Engineering Description	Qty.	New Service Part
95/97 Models - ALL	95/97 Models ONLY Separator Plate to Case Gasket	1	2L5Z-7C155-AA
95/97 Models - ALL	Separator Plate to Main Control Gasket	1	2L5Z-7D100-BA
95/96 Models - ALL	95/96 Models ONLY Plate - Valve Body Separator	1	F5TZ-7A008-CA
		1	
97 2.3L Ranger	97 Models ONLY Plate - Valve Body Separator	1	F77Z-7A008-AB
97 3.0L OHV Ranger/Aerostar	Plate - Valve Body Separator	1	F77Z-7A008-AB
97 4.0L OHV Ranger/Aerostar	Plate - Valve Body Separator	1	F77Z-7A008-CB
97 4.0L OHV Explorer/Mountaineer	Plate - Valve Body Separator	1	F77Z-7A008-DB
97 4.0L SOHC Explorer/Mountaineer	Plate - Valve Body Separator	1	F77Z-7A008-EB
	1998-2001 Models ONLY		
98/01 2.5L Ranger	Plate - Valve Body Separator	1	1L5Z-7Z490-DA
98/00 3.0L Ranger	Plate - Valve Body Separator	1	1L5Z-7Z490-EA
98/00 4.0L - EI Ranger	Plate - Valve Body Separator	1	1L5Z-7Z490-FA
98/00 4.0L - EI Explorer	Plate - Valve Body Separator	1	1L5Z-7Z490-GA
98/00 4.0L - SOHC	Plate - Valve Body Separator	1	1L5Z-7Z490-HA
	2001-2002 Models ONLY		
2001/2002 2.3L Ranger	Plate - Valve Body Separator	1	1L5Z-7Z490-AA
2001/2002 3.0L Ranger	Plate - Valve Body Separator	1	1L5Z-7Z490-BA
2001/2002 4.0L-SOHC	Plate - Valve Body Separator	1	1L5Z-7Z490-CA

5R55N

Clutch and Band Application

Band/Clutch Application Chart A							
	Overdrive Band	Intermediate Band	Reverse Band	Intermediate Clutch	Forward Clutch	Direct Clutch	Coast Clutch
Park							
Reverse			A	A		A	
Neutral							
1st					A		
2nd	A				A		
3rd				A	A		
4th				ANE	A	A	A
5th	A				A	A	
1st a			A		A		A
2nd a	A		A		A		A
3rd a		A		A	A		A
4th a				ANE	A	A	A
Manual 3rd		A		A	A		A
Manual 2nd	A		A		A		
Manual 1st			A		A		A

A=Applied

ANE=Applied but Not Effected

5R55N

Sprag Application

Sprag and One Way Clutch Application Chart							
	Input One-Way Clutch		Low One-Way Clutch		Intermediate One-Way Clutch		Engine Braking
	Drive	Coast	Drive	Coast	Drive	Coast	
Park							
Reverse	H	OR	NE		ORI		YES
Neutral							
1st	H	OR	H	OR	NE		NO
2nd	OR	OR	H	OR	NE		NO
3rd	H	OR	OR	OR	H		NO
4th	H	OR	OR	OR	OR		NO
5th	OR	OR	OR	OR	OR		YES
1st a	H	OR	H	OR	NE		YES
2nd a	OR	OR	H	OR	NE		YES
3rd a	H	OR	OR	OR	H		YES
Manual 3rd	H	OR	OR	OR	H		YES
Manual 2nd	OR	OR	H	OR	NE		YES
Manual 1st	H	OR	H	OR	NE		YES

5R55N

Pressure Specification



Main Line Tap

Line Pressure Chart						
Transmission	Vehicle Application	Range	Idle	WOT Stall	Idle	WOT Stall
			EPC	EPC	Line	Line
5R55N	Lincoln LS 3.0L	P/N	5	5	125-165	
		R	70-90	112-134	110-150	290-360
		D5/D4	0-15	112-134	110-150	210-260
		M5/M4	0-15	112-134	76-116	210-260
		M3	0-15	112-134	110-150	210-260
		M2/M1	0-15	112-134	92-132	210-260
5R55N	Lincoln LS 3.9L	P/N	5	5	125-165	
		R	70-90	112-134	92-132	290-360
		D5/D4	0-15	112-134	110-150	210-260
		M5/M4	0-15	112-134	110-150	210-260
		M3/M2/M1	0-15	112-134	110-150	210-260

5R55N

Pressure Specification



**Alternate Main
Line Tap**

Line Pressure Chart						
Transmission	Vehicle Application	Range	Idle	WOT Stall	Idle	WOT Stall
			EPC	EPC	Line	Line
5R55N	Lincoln LS 3.0L	P/N	5	5	125-165	
		R	70-90	112-134	110-150	290-360
		D6/D4	0-15	112-134	110-150	210-260
		M5/M4	0-15	112-134	76-116	210-260
		M3	0-15	112-134	110-150	210-260
		M2/M1	0-15	112-134	92-132	210-260
5R55N	Lincoln LS 3.9L	P/N	5	5	125-165	
		R	70-90	112-134	92-132	290-360
		D6/D4	0-15	112-134	110-150	210-260
		M5/M4	0-15	112-134	110-150	210-260
		M3/M2/M1	0-15	112-134	110-150	210-260

5R55N

Solenoid Application Chart

Solenoid Operation Chart								
Base Gearshift Selector Position	Powertrain Control Module (PCM) Commanded Gear	5R55N Solenoid States						
		SSA	SSB	SSC	SSD	PCA	PCB	PCC
P/N	P	ON	OFF	OFF	ON	L1	C2	L
R	R	ON	OFF	OFF	ON	L	H3	H
D5	1	ON	OFF	OFF	ON	C	L	L
	2	ON	OFF	ON	ON	L	C	L
	3	ON	ON	OFF	ON	C	L	L
	4	OFF	OFF	OFF	ON	C	L	H
	5	OFF	OFF	ON	ON	C	C	H
D4	1	ON	OFF	OFF	ON	C	L	L
	2	ON	OFF	ON	ON	L	C	L
	3	ON	ON	OFF	ON	C	L	L
	4	OFF	OFF	OFF	OFF	C	C	H
3	3	ON	ON	OFF	OFF	C	C	L
2	2	ON	OFF	ON	OFF	C	C	L
1	1	ON	OFF	OFF	OFF	C	C	L

*** Failsafe for this unit is Fourth, Second and Reverse**

5R55N

Solenoid Failure Chart

SSA ALWAYS "OFF"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	3	3
2	2	2
3	3	3
4	4	4
5	5	

1=Manual

SSB ALWAYS "OFF"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	1	1
4	4	4M
5	5	

1=Manual

SSC ALWAYS "OFF"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	1	1
3	3	3
4	4	4
5	4	

1=Manual

SSD ALWAYS "OFF"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1/1M	1/1M
2	2M	2M
3	3/3M	3M
4	4/4M	4M
5	5	

1=Manual

5R55N

Solenoid Failure Chart

SSA ALWAYS "ON"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	1	1M
5	2	

1=Manual

SSB ALWAYS "ON"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	3	3
2	2	2
3	3	3
4	4	4M
5	5	

1=Manual

5R55N

Pressure Control Solenoid Failure

PC A "HIGH"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	4	4M
5	5	

1=Manual

PC B "HIGH"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	4	4M
5	5	

1=Manual

PC B "LOW"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	1	1
3	3	3
4	3	4
5	3	

5R55N***Pressure Control Solenoid Failure***

PC C "LOW"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	3	3
5	1.1	

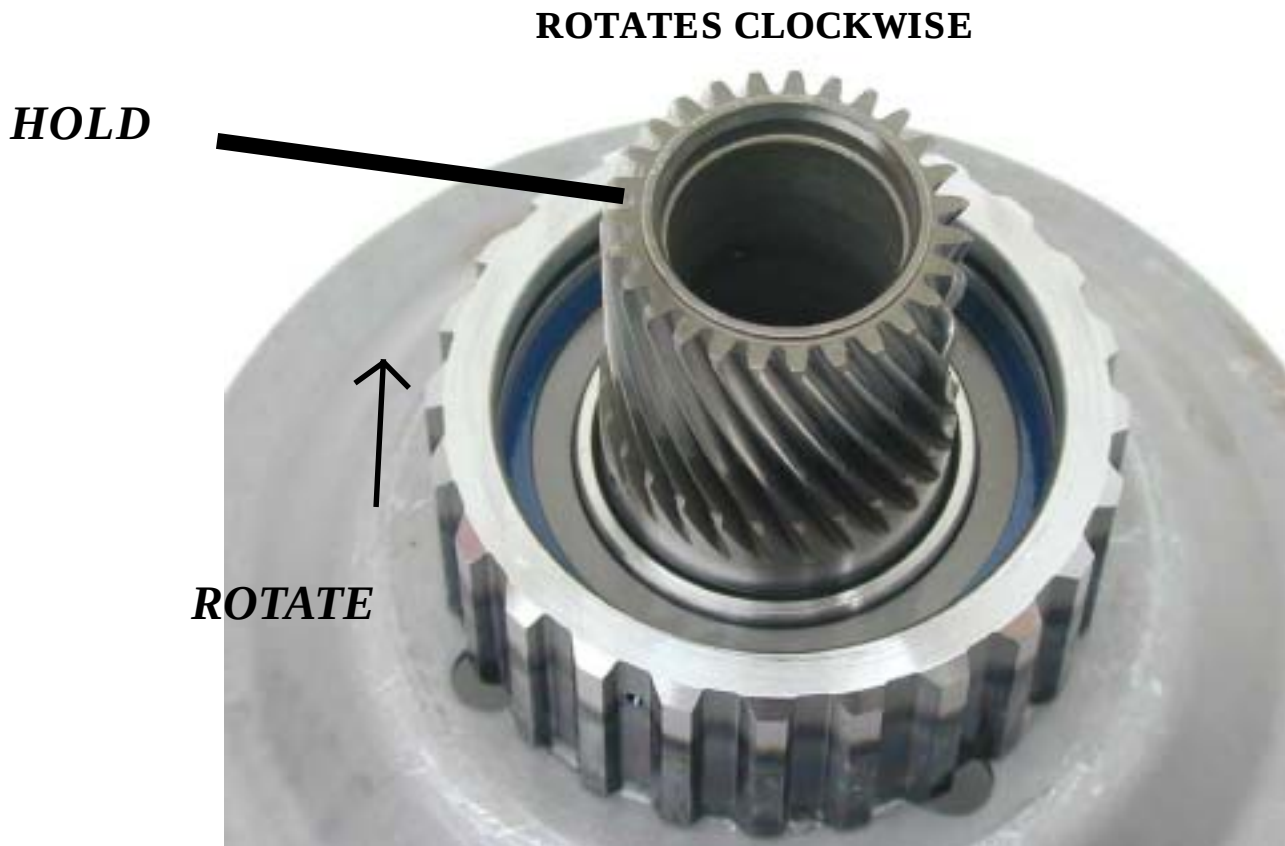
PC B "HIGH"	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	4	4M
5	5	

1=Manual

5R55N

Intermediate Sprag Rotation

A damaged intermediate sprag will cause a bind in third and fourth or no third or fourth condition.



4R70W

Solenoid Codes P0750, P0751, etc. and/or Erratic Shifting

Intermittent TCIL flashing may be caused by the internal solenoid hard shell harness being distorted or not being fully seated between the solenoid and the harness.



Check the Mating Surfaces

This Pin is
damaged



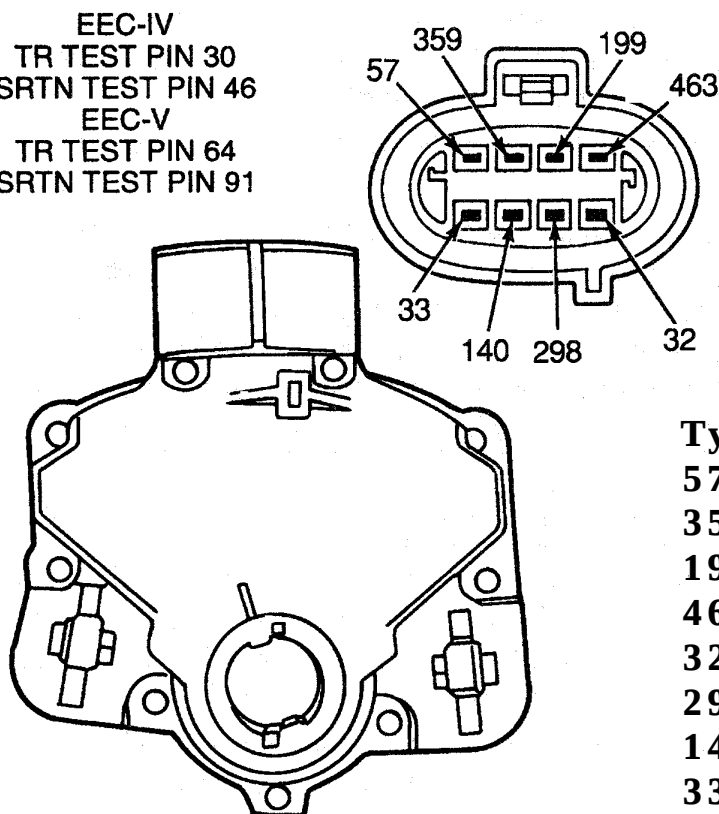
4R70W

Downshifts at High Speeds

This problem is usually caused by the Manual Lever Position Sensor/Transmission Range Sensor voltage rising because of a bad ground or damaged MLP sensor making the PCM believe the transmission was manually downshifted. To verify this concern monitor the MLP/TR sensor on the scanner or at the sensor signal pin. If voltage changes during the drive or when road shock is applied make sure the connections and wiring is good, then replace the sensor.

Diagnostic Trouble Codes: Two Digit -67, Three Digit 634, 654, 667, 668, Four Digit - P0705, P0707, P0708, P1705

EEC-IV
TR TEST PIN 30
SRTN TEST PIN 46
EEC-V
TR TEST PIN 64
SRTN TEST PIN 91



Typical Pin Identification

57=Ground
359=Signal Return
199=MLP to PCM
463=Neutral Sense (4X4)
32=Starter Circuit
298=Fused Accy Feed
140=Backup Lamp
33=Starter Circuit

4R70W

Downshifts at High Speeds

There are a few differences between the TransmissionRange sensor and the Manual Lever Position Sensor. The TR sensor refers to four pins at the PCM, where as the MLP refers only to one pin at the PCM.

Transmission Range Selector Level Position	Resistance (ohms)		Range Volts
	Min	Max	
P	3770	4607	3.97-4.85
R	1304	1593	3.24-3.96
N	660	807	2.55-3.11
D	361	442	1.88-2.30
2	190	232	1.23-1.51
1	78	95	0.61-0.75

Gear	TR4	TR3*	TR2	TR1
Park	0 volts	0 volts	0 volts	0 volts
Reverse	11.5 volts	1.7 volts	0 volts	0 volts
Neutral	0 volts	1.7 volts	11.5 volts	0 volts
Drive	11.5 volts	1.7 volts	11.5 volts	11.5 volts
M 2	11.5 volts	0 volts	0 volts	11.5 volts
M 1	0 volts	0 volts	11.5 volts	11.5 volts

* TR3 has 5 volts supplied to a 270 ohm resistor. If 5 volts is present at PCM pin 64 for TR3 then the circuit is open.

4R70W

Repeat Intermediate Diode Failure

Typically caused by flooding solenoids this problem can give you trouble if not diagnosed completely. The Diode sprag is considerably stronger than the older roller one-way clutches, however the cause is still the same. During a forced down shift from 4-2, SS1 and SS2 are commanded OFF. If the solenoids are worn or inoperative they don't exhaust properly causing the solenoids to flood and hold the 3-4 valve in its 4th gear position (no Forward clutch fill). Because the PCM command for second gear happens the 2-3 shift valve is stroked to the 2nd gear position and the 3-4 shift valve is held up in the 4th gear position, this causes the feel of Neutral, O/D Band applied, direct clutch applied, no intermediate, no forward. When this happens the customer or technician removes his/her foot from the accelerator the line pressure drops and the intermediate clutches catch. When this happens the Sprag is hammered and wear or breakage occurs.



4R100

2nd Gear slips or No 2nd

The common cause for this problem is duability of the Intermediate Diode sprag. A new drum and sprag assembly was introduced last year in ATRA Bulletin #642. When a replacemnet is necessary you may need to replace the piston and return spring also. The new Drum deletes the thrust washer assembly and has a smaller piston travel area.

Part #'s

E9TZ-7A089-B	Intermaediate sprag
1C3Z-7B164-BA	Clutch Plates
YC3Z-7D044-AA	4 Plate Drum 5.4L and 6.8L
YC3Z-7D044-BA	5 Plate Drum 7.3L only
F3TZ-7G401-AA	Thrust Washer#7



4R100

Intermediate Clutches Burnt

A common failure of the Intermediate clutch is almost always caused by lack of feed oil to the piston, typically due to case damage, one modification you can do is install a rubber gasket/seal around the feed hole of the Intermediate clutch drum. There are a few things your going to need to do before this repair.

Parts needed:

1 = PC 7/32" 16 mml oil resistant hose

1 = Razor Blade

1 = C6 Direct Clutch Return Spring



4R100

Intermediate Clutches Burnt



Seat hose at the bottom of the channel case

With hose extended through case, trim it with the razor blade.



Make sure it is flush against the case.

4R100

Intermediate Clutches Burnt



Cut specification



Spring specification

Should be less then a 1/8 of an inch above the seperator plate

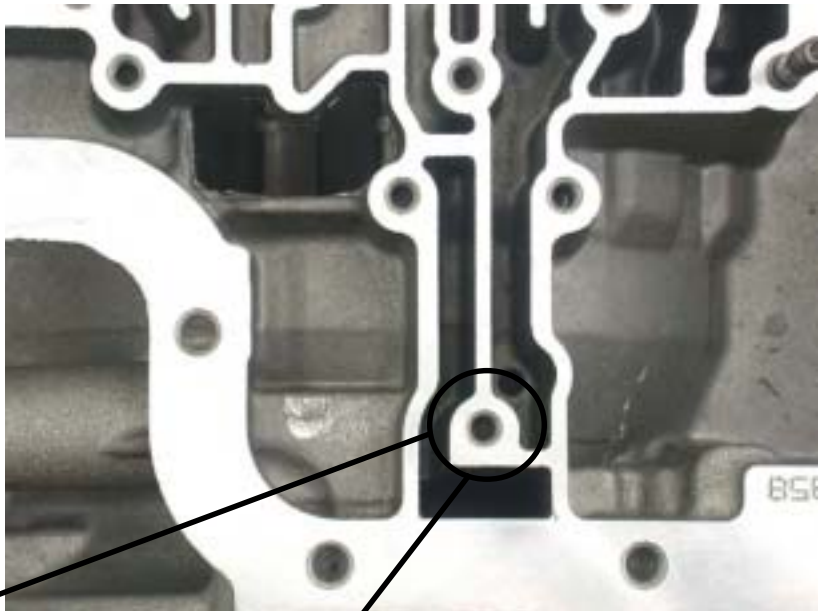


4R100

No/Slipping Reverse, No/Slipping Manual Low

A No Reverse or Manual low condition can be caused by the Low/Reverse plate bolts being too long and bottoming out in the case. Signs of this are evident when initial inspection shows the tip of the bolt and the bottom of the case having signs of damage

Discard these types of bolts. Install thread-only bolts.



4R100

Vehicle Speed Sensor Input when Vehicle is Stationary

An erratic 1-2 upshift or 2-1 downshift may be caused by a VSS input while the vehicle is stationary. Monitor the VSS on you scanner, if the scanner shows a VSS signal with the KEY ON and the ENGINE OFF. It may be necessary to install a jumper kit from FORD. This kit replaces the computer's current ground wires with a single body ground cable.

Part # 1C3Z-13N850-AA



4R100

Vehicle Speed Sensor Input when Vehicle is Stationary

To install the jumper kit:

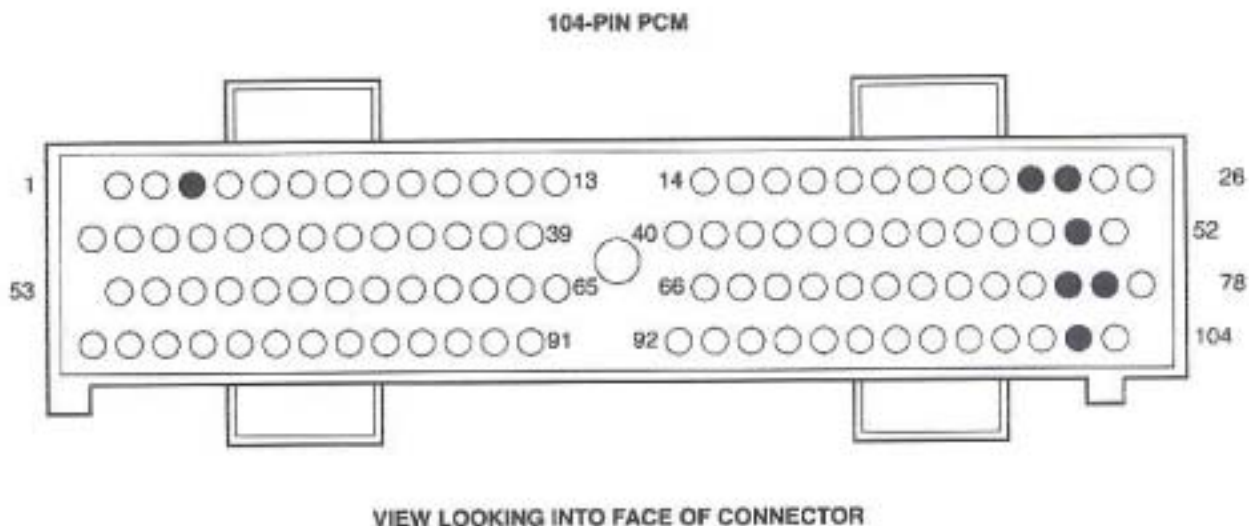
1. Disconnect the battery negative cable.
2. Remove the ground screw from under the dash.
(Left side of the brake pedal)
3. Drill a 6mm (1/4) hole near the original ground screw location and clean to bare metal. (**make sure you can attach a nut behind the bolt**)
4. Using a new bolt and nut attach the original ground eyelets to the sheet metal.



4R100

Vehicle Speed Sensor Input when Vehicle is Stationary

5. Remove the PCM connector and shield.
6. Remove the RED locking plate from the front of the connector.
7. Remove the wires from pins 3, 23, 24, 51, 76, 77, 103.
8. Install the jumper kit to the PCM in the locations that you removed in the previous step.
9. Reinstall all the necessary componets and retest the system.



TorqShift 5R110W

Description

The transmission features include:

- Ä six speeds.
- Ä a fully automatic transmission.
- Ä direct electronic shift control.
- Ä optional power take-off.

The main operating components include:

- Ä a torque converter clutch.
- Ä six multiple-disc friction clutches.
- Ä two mechanical diode one-way clutches (OWC).
- Ä three planetary gear sets.



5R110W

Clutch Application Chart

Tow Haul OFF							
Range	Engine Braking	Forward Clutch	Coast Clutch	Overdrive Clutch	Intermediate Clutch	Direct Clutch	Low/Reverse
Park							A (a)
R			A			A (d)	A (a)
N							A (a) (c)
O/D 1		A				A (a) (c)	
O/D 2		A		A			
O/D 3		A			A		
O/D 4 (b)	YES	A		A	A		
O/D 5		A				A	
O/D 6	YES	A		A		A	

Gear Ratio	
1st	3.09-1
2nd	2.2-1
3rd	1.538-1
4th	1.096-1
5th	1
6th	0.712-1
Reverse	2.88-1

(a) Commanded pressures viewed on scanner

(c) 30 psi until 3 mph

(d) Clutch applied through the manual valve

5R110W

Clutch Application Chart

Tow Haul ON							
Range	Engine Braking	Forward Clutch	Coast Clutch	Overdrive Clutch	Intermediate Clutch	Direct Clutch	Low/Reverse
Park							A (a) (c)
R			A			A(d)	A (a)
N							A (a) (c)
O/D 1	YES	A	A				A (a)
O/D 2	YES	A		A			A (a)
O/D 3	YES	A	A		A		
O/D 4	YES	A		A	A		
O/D 5	YES	A	A			A	
O/D 6	YES	A		A		A	

Manual Position							
Range	Engine Braking	Forward Clutch	Coast Clutch	Overdrive Clutch	Intermediate Clutch	Direct Clutch	Low/Reverse
P							A (a) (c)
R			A			A (d)	A (a)
N							A (a) (c)
M1	YES	A	A				
M2	YES	A		A			A
M3	YES	A	A		A		A

5R110W

Pressure Specification

Pressure can be measured at the main line tap on the drivers side of the transmisison. All of the other pressures are going to be monitored using your scanner.

Gear	Idle Speed	WOT Stall	kPa	psi
P, N	344 (50)	—	172 (25)	—
R	689 (100)	2,206 (320)	413 (60)	1,407 (204)
(D)	483 (70)	2,206 (320)	276 (40)	1,379 (200)
3	551 (80)	1,793 (260)	331 (48)	1,172 (170)
2	551 (80)	1,482 (215)	338 (49)	952 (138)
1	551 (80)	1,861 (270)	338 (49)	1,213 (176)

(a) = commanded pressure as viewed on diagnostic equipment.

Pressure Chart C

NOTE: Actual and Commanded pressures will vary based on calibration and transmission adaptive strategies. All pressures listed are approximate.

Gear	Commanded (a) — SSPC-C pressure kPa (psi)		Commanded (a) — SSPC-D pressure kPa (psi)	
	Idle Speed	WOT Stall	Idle Speed	WOT Stall
P, N	0	—	0	—
R	0	0	0 (b)	0 (b)
(D)	0	0	0	0
3	572 (83)	1,765 (256)	0	0
2	0	0	0	0
1	0	0	0	0

Pressure Chart D

NOTE: Actual and Commanded pressures will vary based on calibration and transmission adaptive strategies. All pressures listed are approximate.

Gear	Commanded (a) — SSPC-E pressure kPa (psi)	
	Idle Speed	WOT Stall
P, N	207 (30)	—
R	758 (110)	0
(D)	207 (30)	0
3	0	0
2	586 (85)	1,461 (212)
1	572 (83)	1,765 (256)

(a) = commanded pressure as viewed on diagnostic equipment.

5R110W

Pressure Specification

Pressure Chart B

NOTE: Actual and Commanded pressures will vary based on calibration and transmission adaptive strategies. All pressures listed are approximate.

Gear	Commanded (a) — SSPC-A pressure kPa (psi)		Commanded (a) — SSPC-B pressure kPa (psi)	
	Idle Speed	WOT Stall	Idle Speed	WOT Stall
P, N	0	—	0	—
R	758 (110)	2,068 (300)	0	0
(D)	0	0	0	0
3	572 (83)	1,765 (256)	0	0
2	0	0	586 (85)	1,461 (212)
1	572 (83)	1,765 (256)	0	0

(a) = commanded pressure as viewed on diagnostic equipment.

Shift Speeds

NOTE: All shift speeds are for normal mode, not with tow/haul on.

Throttle Position	(D)Position Shift	Speed Tow/Haul OFF MPH	Speed Tow/Haul OFF Km/H	Speed Tow/Haul ON MPH	Speed Tow/Haul ON Km/H
Closed	6-5	21-28	34-45	40-53	64-85
	5-3	14-20	23-32	26-35	41-56
	3-2	—	—	18-24	29-39
	3-1	6-9	10-14	—	—
	2-1	—	—	8-11	13-18
Minimum Throttle TP Voltage 1.25 Volts	1-2	8-11	13-18	14-19	23-31
	2-3	12-16	19-26	19-26	31-42
	3-4 (a)	16-21	26-34	16-21	26-34
	3-5	16-21	26-34	28-37	45-60
	4-6 (a)	24-32	39-51	41-54	66-87
Wide Open	5-6	24-32	39-51	44-58	71-93
	1-2	20-28	32-45	20-27	32-43
	2-3	28-39	47-63	28-38	47-61
	3-4 (a)	41-55	66-89	41-55	66-89
	3-5	41-55	66-89	41-55	66-89
	4-6 (a)	61-81	98-130	62-81	100-130
	5-6	66-87	106-140	66-88	106-142

(a) indicates cold strategy

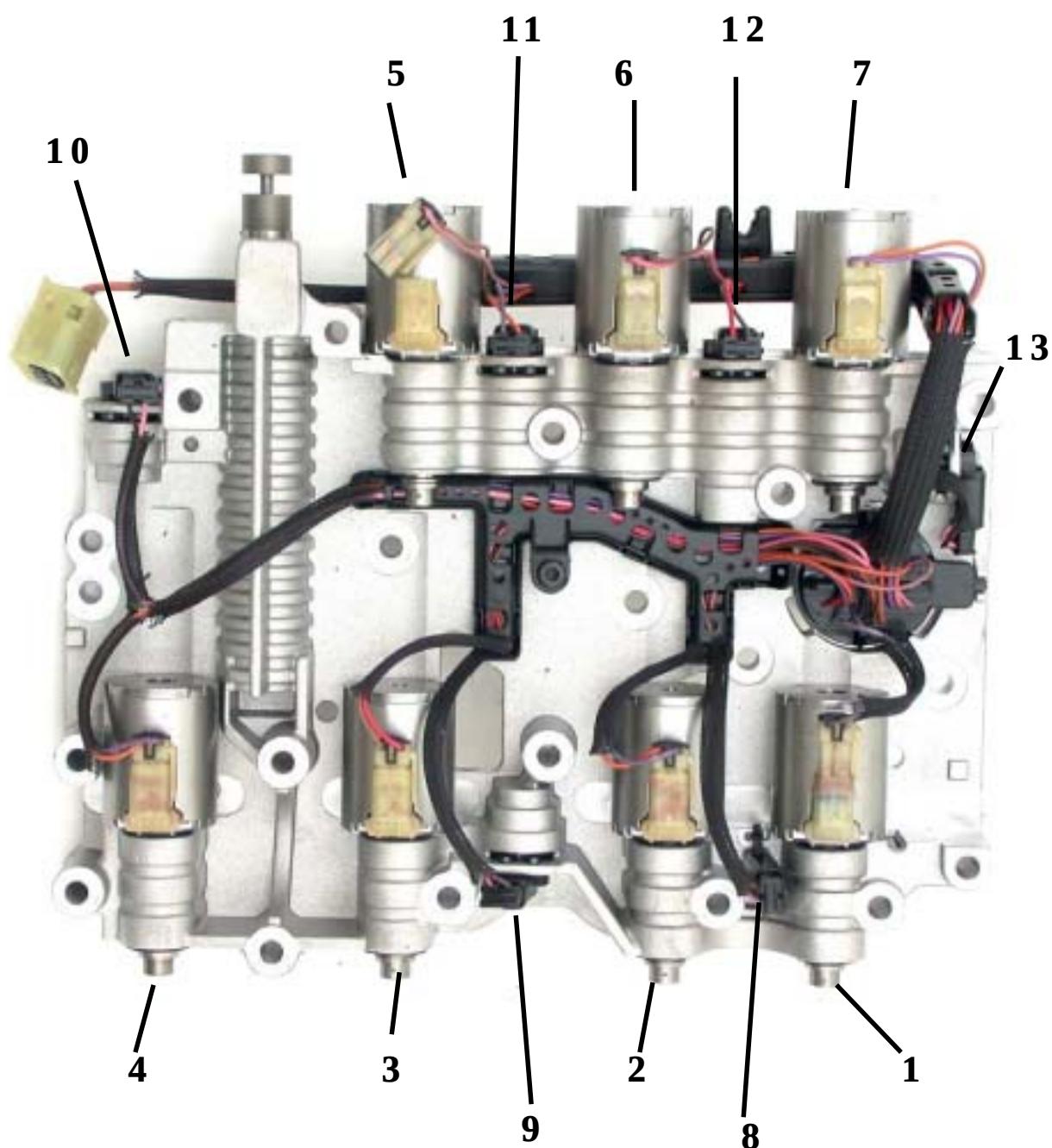
5R110W

Solenoid Specification Chart

1	PC-A	4.7 ohms +/- (line pressure)
2	TCC	4.7 ohms +/- (torque converter clutch)
3	SSPC-B	4.7 ohms +/- (overdrive)
4	SSPC-A	4.7 ohms +/- (coast clutch)
5	SSPC-E	4.7 ohms +/- (low/reverse clutch)
6	SSPC-D	4.7 ohms +/- (direct clutch)
7	SSPC-C	4.7 ohms +/- (intermediate clutch)
8	TFT	200K ohm scale (transmission fluid temperature)
9	PS-B	0.5 ohm +/- (overdrive pressure switch)
10	PS-A	0.5 ohm +/- (coast clutch pressure switch)
11	PS-E	0.5 ohm +/- (low/reverse pressure switch)
12	PS-D	0.5 ohm +/- (direct clutch pressure switch)
13	PS-C	0.5 ohm +/- (intermediate clutch pressure switch)
14	TR-P	(transmission range sensor) not shown here

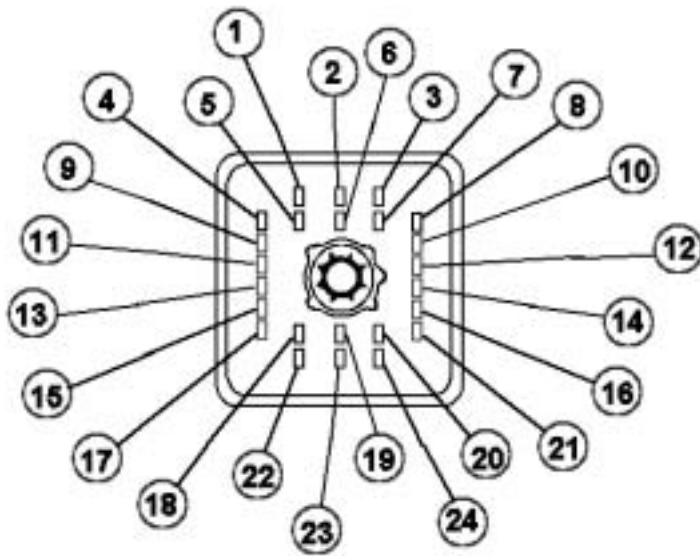
5R110W

Solenoid Specification Chart



5R110W

Valve Body Wiring



**Connector
shown from the
valve body
connector side**



5R110W

Valve Body Wiring

+Pin Number	Description	PCM Connector	Int. Wire Color Pin No. 1	Int. Wire Color Pin No. 2	Int. Wire Color Pin No. 3
1	SSPC-E	13	Light Green	Gray	—
2	Not Used	—	—	—	—
3	SSPC-B	10	Red	Light Green	—
4	SSPC-D	12	Brown	Pink	—
5	SSPC-C	11	Yellow	Purple	—
6	Not Used	—	—	—	—
7	Solenoid VPWR (a)	7	—	—	—
8	TCC	14	Dark Blue	Orange	—
9	PS-C	19	White	Black	—
10	PC-A	17	Light Blue	White	—
11	PS-D	20	Red	Dark Green	—
12	SSPC-A	9	Purple	Yellow	—
13	PS-E	21	Dark Blue	Orange	—
14	PS-A	17	Black	White	—
15	TR-P Signal	25	—	Light Blue	—
16	PS-B	18	Brown	Pink	—
17	TR-P Ground	22	—	—	Tan
18	TFT Signal	26	Tan	Gray	—
19	Not Used	—	—	—	—
20	Solenoid VPWR (a)	7	—	—	—
21	VPWR for TR-P Sensor only	1	Orange	—	—
22	SGNRTN (b)	30	—	—	—
23	Not Used	—	—	—	—
24	VPWR (a)	7	—	—	—
(a) See negative pins for SSPC-x.					
(b) See negative pins for PS-x.					

Mazda to Ford Conversion

Sometimes, you won't be able to scan Mazda vehicles with the 4R/5R series transmissions using Mazda ID from the VIN. If you run into this, enter your scan tool data as if you were working on a Ford vehicle. This chart will help you with the conversion.

Conversion Mazda I.D. to Ford I.D.									
Mazda VINs			Year	Model	Disp	Ford VINs			
10th	4th	8th				10th	2nd	5th	8th
M	C	X	91	Navajo	4.0L	M	F	U	X
N	C	X	92	Navajo	4.0L	N	F	U	X
P	C	X	93	Navajo	4.0L	P	F	U	X
R	C	X	94	Navajo	4.0L	R	F	U	X
R	C/D	A	94	B2300	2.3L	R	F	R	A
R	C/D	U	94	B3000	3.0L	R	F	R	U
R	C/D	X	94	B4000	4.0L	R	F	R	X
R	G	C	94	626/MX6	2.0L	R	Z	T	A
S	G	C	95	626/MX6	2.0L	S	Z	T	A
S	C/D	A	95	B2300	2.3L	S	F	R	A
S	C/D	U	95	B3000	3.0L	S	F	R	U
S	C/D	X	95	B4000	4.0L	S	F	R	X
T	C/D	A	96	B2300	2.3L	T	F	R	A
T	C/D	U	96	B3000	3.0L	T	F	R	U
T	C/D	X	96	B4000	4.0L	T	F	R	X
V	C/D	A	97	B2300	2.3L	V	F	R	A
V	C/D	U	97	B3000	3.0L	V	F	R	U
V	C/D	X	97	B4000	4.0L	V	F	R	X
W	C/Y	C	98	B2500	2.5L	W	F	R	C
W	C/Y/Z	U	98	B3000	3.0L	W	F	R	U
W	C/Y/Z	X	98	B4000	4.0L	W	F	R	X
X	C/Y	C	99	B2500	2.5L	X	F	R	C
X	C	U	99	B3000	3.0	X	F	R	U
X	YZ	V	99	B3000	3.0L FF	X	F	R	V
X	C/D/Y/Z	X	99	B4000	4.0L	X	F	R	X
Y	C/Y	C	00	B2500	2.5L	Y	F	R	C
Y	C/Y/Z	U	00	B3000	3.0L	Y	F	R	U
Y	Y	V	00	B3000	3.0L FF	Y	F	R	V
Y	C/Y/Z	X	00	B4000	4.0L	Y	F	R	X
1	Y	C	01	B2300	2.3L	1	F	R	C
1	Y	D	01	B2500	2.5L	1	F	R	D
1	YZ	U	01	B3000	3.0L	1	F	R	U
1	YZ	E	01	B4000	4.0L	1	F	R	E

NOTES:

NOTES:

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31th

Delayed Engagement

Some 2000 Dodge (NS) Caravan, Plymouth (NS) Voyager, Dodge (PL) Neon, Plymouth (PL) Neon, Dodge (P2) Neon (Export Market), Plymouth (P2) Neon (Export Market) vehicles may exhibit intermittent delayed transaxle engagement of greater than 30 seconds on an initial cold start in -1°C (30°F) or colder temperatures. This may be due to interference between the front pump assembly and transaxle case. Here are a few things to check before the replacement of the pump.

Ä Make sure the fluid level correct?

Ä Make sure linkage adjustment correct?

Ä Does delay occur in both Drive & Reverse?

Ä Does delay occur in -1°C (30°F) or colder weather?

Ä Does transaxle engage when RPM is raised?

Ä Does transaxle engage properly after the initial cold delay?

If the answers to the above questions were YES, the most likely cause of the condition is due to interference between the pump housing and the transaxle case. Perform the following Repair Procedure. If the answers were NO, further diagnosis will be required to determine the cause of the condition.

Parts Required

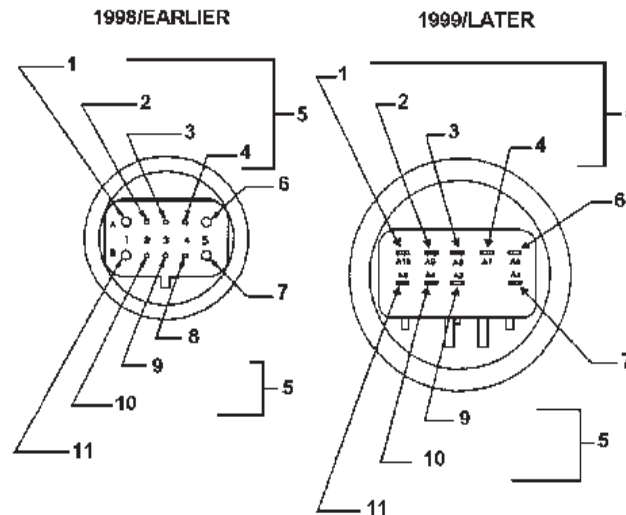
<u>Qty.</u>	<u>Part Number</u>	<u>Description</u>
1	05016410AB	Pump Assembly
1	04269661AB	Pump Gasket

Note: This information applies to models equipped with a 31th transaxle built between July 21, 1999 and February 3, 2000 (MDH 072100 and 0203XX). The transaxle date numbers involved are between 3872 to 4058 (10,000-day calendar) and 0010 to 0340 (Julian date code).

41TE and 42LE

1999-up Transmission Range Sensor harness kits

A new Transmission Range Sensor (TRS) was designed for the 1999 model year transaxles. The outside diameter of the pass through connector was increased as well as the terminals being changed from a pin type to a blade type. Early model 1999 vehicles were built with 1998 style transaxles and used a jumper harness. The jumper harness converted the 1999 vehicle harness to accept the 1998 transaxle TRS connector. These vehicles can accept the 1999 transaxle by simply removing the jumper harness. When installing a 1999 transaxle into a 1998 and prior vehicle a replacement harness must be installed.



LOOKING INTO SENSOR CONNECTOR	
1	PRNDL1 (C1)
2	PRNDL2 (C2)
3	PRNDL3 (C3)
4	PRNDL4 (C4)
5	TO TRANSMISSION CONTROLLER
6	REVERSE LIGHTS LOW
7	REVERSE LIGHTS HIGH
8	SPARE (EMPTY)
9	THERMISTOR LOAD
10	THERMISTOR SUPPLY
11	PARK/NEUTRAL START GROUND

41TE and 42LE

1999-up Transmission Range Sensor harness kits

Important: The replacement harness wire colors may not match the wire colors on the vehicle. Use the figure below and only change one wire at a time.

Part # 05014473AA....41TE Splice Kit (Modifies 1998 and earlier vehicle TRS harness to be compatible with a 1999 transaxle)

Part # 05014474AA....42LE Splice Kit (Modifies 1998 and earlier vehicle TRS harness to be compatible with a 1999 transaxle)

41TE
KIT # 05014473AA



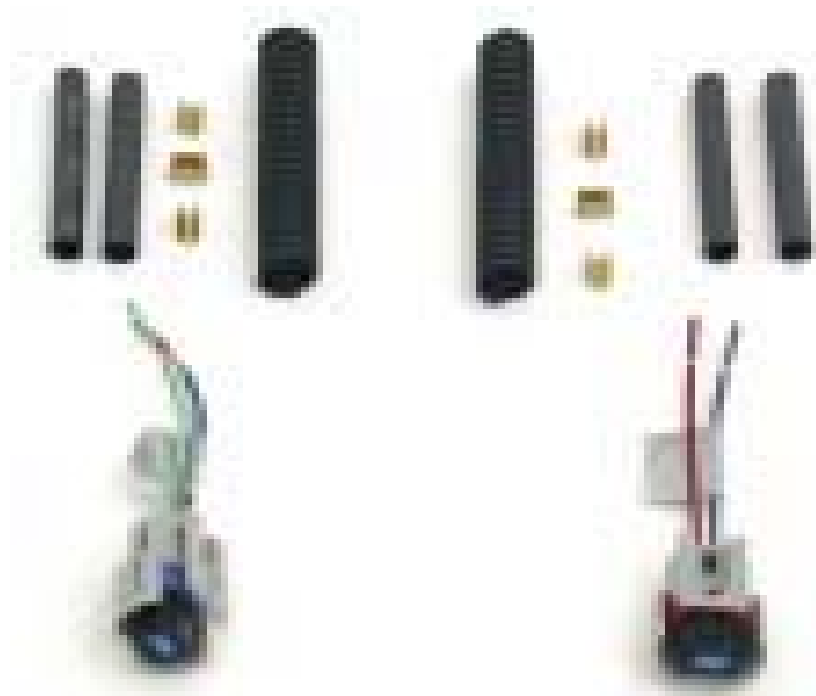
42LE
KIT # 05014474AA



41TE and 42LE

Speed Sensor faults and/or Ratio concerns

The input and output speed sensor supplier was changed for the 1998 model year 42LE and on August 8, 1998 for the 41TE. The terminal positions are slightly different between the new and old sensors. When a new speed sensor is installed on an early vehicle the terminals may spread resulting in a poor contact. Intermittent loss of speed sensor signals, ratio errors and cruise control complaints may occur. Any time a speed sensor is changed in an early vehicle the connector should also be updated.



Part # 05014471AA
Output Speed Sensor
connector kit

Part # 05014469AA
Input Speed Sensor
connector kit

41TE

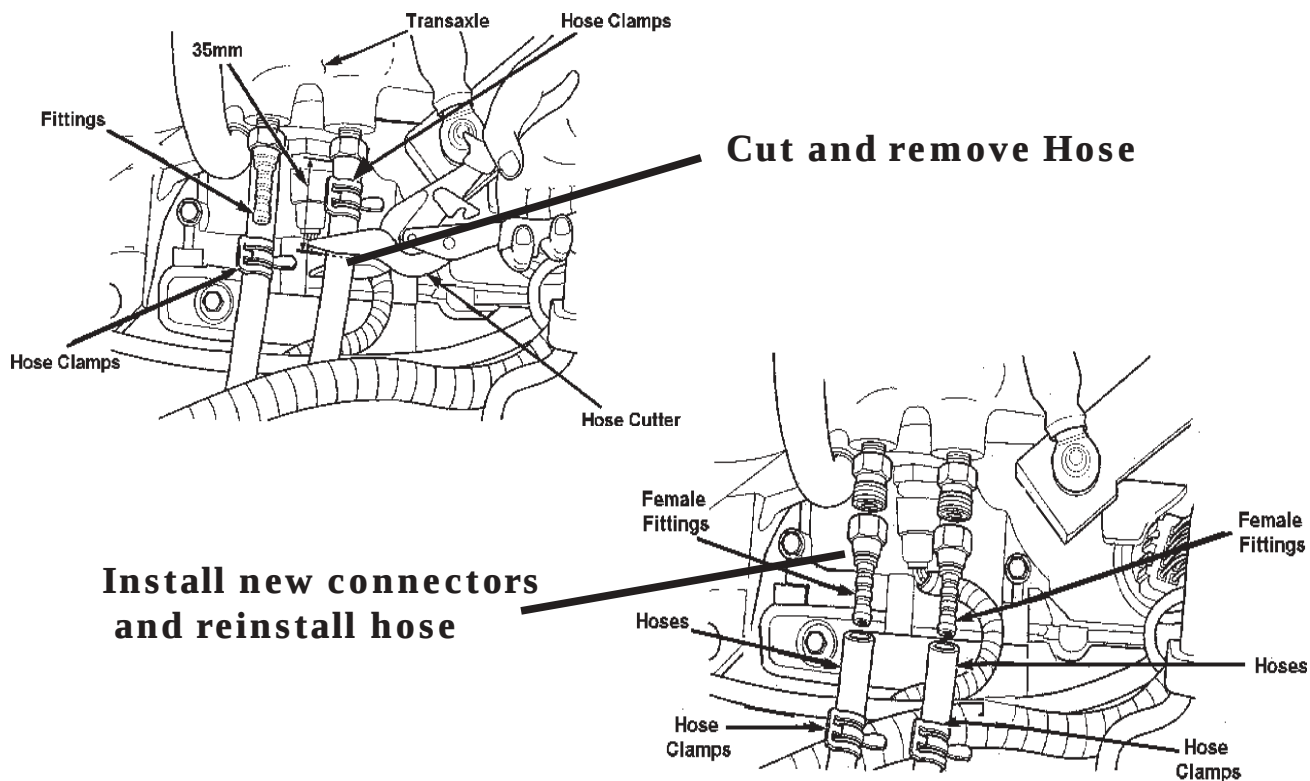
Transaxle Cooler Line Splice Kit

Application: Chrysler (JR) Sebring, Sebring Convertible, Dodge (JR) Stratus Sedan, Plymouth (PL) Neon, Chrysler (PT) PT Cruiser, Chrysler (RG) Voyager (International Market), Chrysler (RS) Town & Country, Voyager, and Dodge (RS) Caravans

A connector kit has been released to make transaxle cooler line service easier. This kit should be installed whenever a service is performed that requires cooler line removal from the transaxle. This will make the lines easy to remove and install should service be required at a later time. An instruction sheet is included with each kit that details installation procedures.

Parts Required

Qty.	Part Number	Description
1	05016918AA	Kit, Transmission Cooler Line Connector



41TE

Auxiliary Differential Vent

An auxiliary vent tube assembly has been released for service on 1993-2000 Chrysler (LH) Concorde, LHS, New Yorker, 300M, 1993-2000 Dodge (LH) Intrepid, 1993-2000 Eagle (LH) Vision, and 1997-2000 Plymouth (PR) Prowler to provide improved differential case venting. In cold climate areas, under certain driving conditions, pressure can build up in the differential case forcing fluid out through the primary vent tube at the top of the differential. Fluid can collect on the top of the differential case and/or drip to the ground.

Parts Required

<u>Qty.</u>	<u>Part Number</u>	<u>Description</u>
1	05011589AA	Vent Tube Assembly Kit

- 1) Clean all fluid from the differential case.
- 2) Drain the differential fluid by removing the differential drain and fill plugs.
- 3) Install the differential drain plug. Tighten to 7 N.m (60 in-lbs.).
- 4) Fill the differential with 32 ounces of Mopar 75W-90 Gear Lubricant, P/N 04549624.
- 5) Install the revised differential fill plug from the vent tube kit.
- 6) Install the new vent tube assembly into fill plug and orient the tube between ribs on the differential cover.

Note: Be sure vent tube is not contacting any metal surfaces on differential cover.



41TE/AE, 42LE

No Response From TCM When Using Generic Scan Tools

2000 Chrysler (GS) Voyager (European Market), Chrysler (JA) Cirrus, Dodge (JA) Stratus, Plymouth (JA) Breeze, Chrysler (JX) Sebring Convertible, Chrysler (NS) Town & Country, Dodge (NS) Caravan, Plymouth (NS) Voyager, Plymouth (PR) Powler built prior to the dates in the above table may not respond properly to diagnostic requests from some aftermarket generic scan tools. In these cases, the aftermarket generic scan tool may indicate that the Transmission Control Module (TCM) is not responding. This may lead to unnecessary diagnostic procedures and or replacement of good TCM's.

Parts Required

<u>Qty.</u>	<u>Part Number</u>	<u>Description</u>
1	04669020	Label, Authorized Software Update
1	04275086	Label, Authorized Modification

This involves selectively erasing and reprogramming the Transmission Control Module (TCM) with new software.

Note: This information applies to vehicles equipped with a 41TE/AE or 42LE automatic transaxle built prior to the following dates:

41TE

Erroneous Body Control Module Diagnostic Trouble Code

Town & Country, Caravan, and Voyager units with 41TE transaxles may exhibit erroneous body module codes caused by the PRNDL switch. Determine if each PRNDL indicators in the dash turn on when the ignition is turned on for about 10 seconds (illuminated at the same time). After 10 seconds they should go out. If all PRNDL indicators DO NOT become boxed at the same time, the DTC is erroneous and the DTC should be cleared, it is not necessary to replace the BCM.

Note: Chrysler has not received any reports of this DTC being set by an actual failure in the PRNDL system.

45RFE

Transmission Quality Enhancements for the 1-2, 2-3, and 4-3 Shifts

Some 2000 Dodge Dakota, Durango 1999-2000 Jeep Grand Cherokee vehicles equipped with a 45RFE transmission may experience the following shift quality issues:

•• harsh 2-3 upshift causing a powertrain clunk or shudder when accelerating.

•• harsh 1-2 upshift during light or wide open throttle conditions.

•• harsh 4-3 kickdown shift during low speed, light throttle conditions.

The revision of the TCM software addresses the above shift quality conditions for all vehicles, and adds a final gear ratio to the Grand Cherokee transmission only.

Note: This applies to vehicles equipped with a 4.7L engine and a 45RFE automatic transmission built before August 16, 1999 (MDH 081600).

This involves selectively erasing and reprogramming the Dakota, the Durango, or the Grand Cherokee Transmission Control Module or TCM (with calibration 99Ver9.0, 00Ver8.5, or 00Ver9.0). And reprogramming the Grand Cherokee Powertrain Control Module or PCM (with calibration 99Call9A or 00Call6A).

47RE

Harsh Engagement When the TCC is Applied

Some 2000-2001 Dodge Ram Truck owners may complain that their transmission exhibits a harsh engagement. This harsh engagement will occur when the transmission is in or enters 3rd gear or overdrive (O/D). The customer may not be able to determine whether the harsh engagement is the result of a gearshift or is the result of a torque converter clutch (TCC) engagement.

Determine if the harsh engagement is the result of the transmission torque converter clutch engagement. The following steps are recommended.

1)Verify that the transmission fluid level is correct and that the transmission throttle cable is properly adjusted.

2)Drive the vehicle at a constant speed between 28 to 31 KM/H (45 to 50 MPH).

3)Make sure that the transmission is in O/D and the TCC is locked-up. If necessary, the DRB III may be used to create a custom monitor to display the needed transmission states.

4)While maintaining a constant speed, lift your foot off of the accelerator pedal and then reapply the accelerator pedal, but with a deeper (wider) throttle position while still maintaining O/D. The transmission should not be allowed to shift out of O/D during this maneuver, but the maneuver should cause the TCC to temporarily disengage.

Note: This applies to vehicles equipped with an 8.0L gasoline engine and a 47RE automatic transmission built between September 15, 1999 and August 14, 2000 (MDH 091500 to 081400).

47RE

Harsh Engagement When the TCC is Applied (continued)

- 5) Allow the vehicle to accelerate until TCC engagement occurs. Note if the TCC engagement is harsh.
- 6) Steps 2 through 5 may need to be repeated several times to verify TCC engagement.
- 7) If a harsh engagement is noted during TCC lock-up, then perform the REPAIR PROCEDURE.
- 8) If a harsh engagement is not observed during TCC engagement, or if a harsh engagement occurs during the 2-3 or the 3-O/D shift, then additional diagnosis is required.

Parts Required

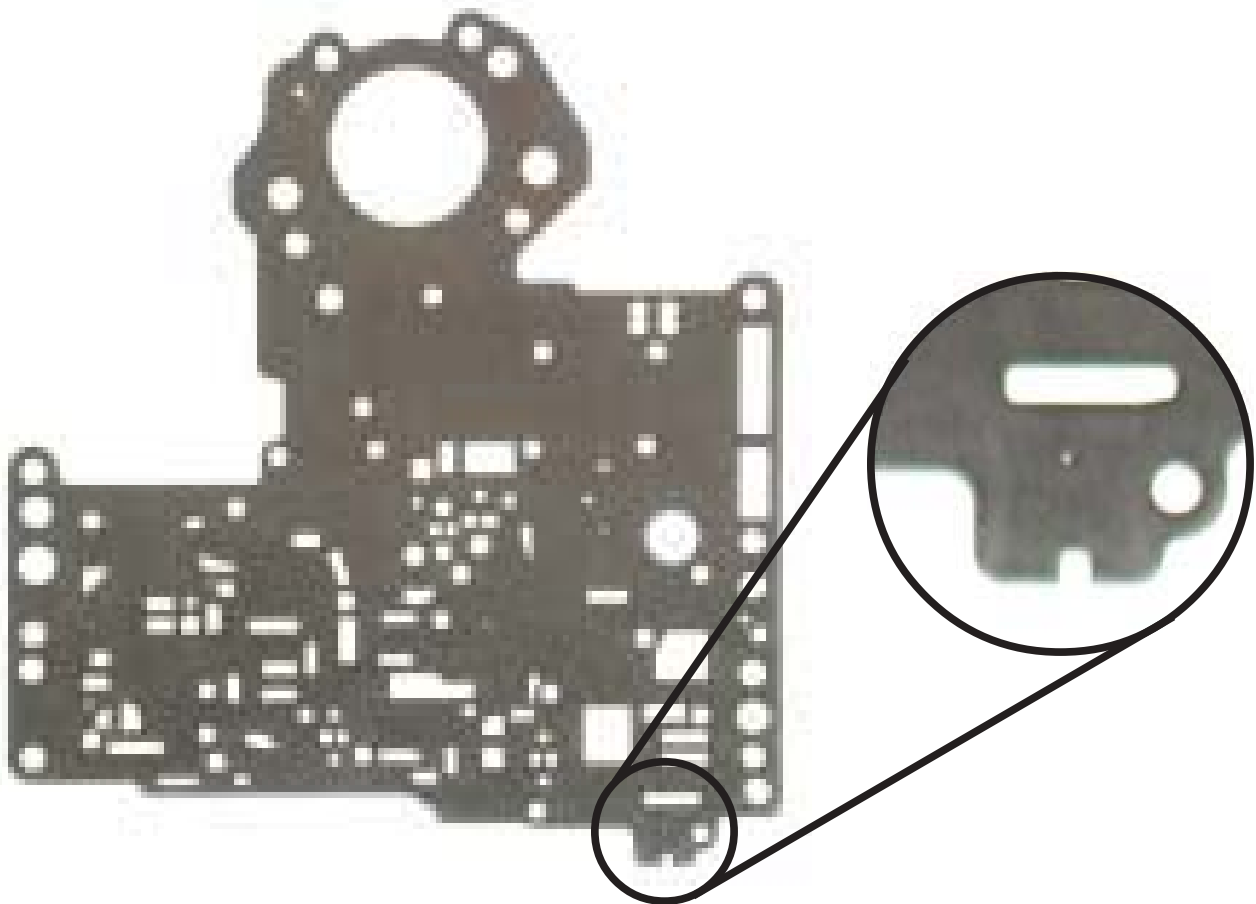
<u>Qty.</u>	<u>Part Number</u>	<u>Description</u>
1	52118048AB	Plate, Valve Body Upper Housing Separator
1	02464324AB	Gasket, Transmission Oil Pan
AR (10)	05010124AA	ATF-3, Transmission Oil Type 7176 (2000 M.Y.)
AR (10)	05013457AA	ATF+4, Transmission Oil Type 9602 (2001 M.Y.)

47RE

Harsh Engagement When the TCC is Applied (continued)

1)Inspect the new separator plate P/N 52118048AB. The correct plate will have a 3mm (0.118 inch) wide slot at the torque converter clutch lock-up vent circuit.

Note: The slot in the seperator plate shown below should be approximately 3 mm (0.118 in) wide. Wider slots, although they provide for a quicker TCC apply may make this probmel worse..



5.9L Diesel

Erratic Torque Converter Clutch

Some 1998-99 Dodge (BR/BE) Ram Trucks may experience a surge like condition while in 4th gear. This may be caused by the Torque Converter Clutch (TCC) unlocking and locking when it should be consistently locked. The cause of this erratic operation has been identified as electrical noise from the Throttle Position Sensor (TPS) or Alternator.

Drive the vehicle with a helper monitoring the PCM. Warm the engine and verify the transmission fluid temperature is greater than 32°F and consistent. Operate the vehicle with an output shaft speed greater than 2200 rpm. Verify that the brake switch shows a released status that is consistent and verify the park/neutral status reads D/R and is consistent. While keeping the output shaft speed above 2200 rpm, hold the throttle so the TPS reads 1 volt. Monitor the TC clutch status, it should be consistently locked. If the TC clutch status shows unlocking / locking, look to see if the TPS volts are fluctuating by 0.2 volts or more. If the conditions are met, perform the REPAIR PROCEDURE. If a surge like condition is felt but the above test does not confirm the TCC unlocking/locking occurrence, further diagnosis and testing will be required.

This involves selectively erasing and reprogramming the Powertrain Control Module (PCM) with new software (calibration changes 98call2 & 99call4).

Note: This information applies to vehicles equipped with a 5.9L 24 valve diesel engine and automatic transmission built between January 1, 1998 and December 18, 1998 (MDH 010198 & 121898).

47RE

Delayed Upshift/No TCC Engagement 30-50 MPH

Some 1999-2000 Dodge (BR/BE) Ram Trucks may experience a condition where the transmission may seem to have a delayed 3-4 upshift, while moderately accelerating from 30-50 MPH (48 to 80 KM/H). The customer may also note high engine rpm's while operating in 3rd or 4th gear. This condition may be caused by a delay in the engagement of the transmission torque converter clutch (torque converter lockup).

This involves the replacement of the transmission valve body upper housing separator plate.

Note: This applies to vehicles equipped with a federal market (NAA) 5.9L – 24V diesel engine and built between March 2, 1999 (MDH 030299) and October 1, 1999 (MDH 100199).

42/44/46/47/ *RE and RH*

“Buzz”, “Whining”, or “Moaning”

Some vehicles may exhibit an intermittent noise from the transmission when reverse gear is selected. This noise has been described as a buzz, whining, or moaning like noise. The noise is most noticeable when transmission fluid temperature is below 38° C (100° F). This condition is caused by a resonance of the transmission regulator valve system. Other items that can cause this are: Air in valve system or out of the internal parts. Possible cracked pump housing, a torn pump gasket, an under filled transmission, restricted filter or cooler flow, or an out of specification valve and or valve body. Mostly affected transmissions built after Aug 1, 1995

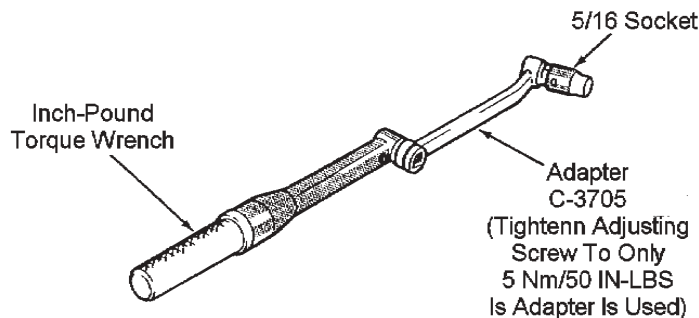
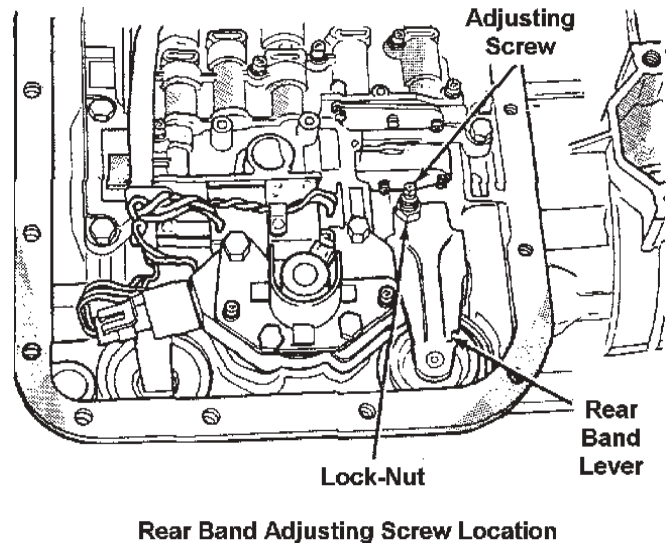
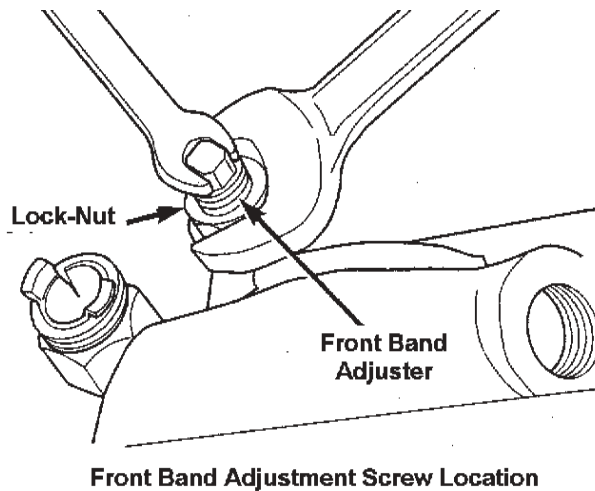
Updated (STEEL) Pressure Regulator Valve:
Part # 04130169



42RE thru 47RE

Front & Rear Band Adjustments

It is important to note that Band Adjustments vary from unit to unit, from year to year. Refer to the chart below to know what the band adjustment is for each of these units. Harsh 1-2, and or Slide Bump on 1-2 shifts as well as reverse engagements problems may occur if this adjustment is done incorrectly. In adjusting, torque the ancor to 72 in lbs and back off number of turns listed.



Front Band Adjustment Adapter Tool

42RE thru 47RE

Front & Rear Band Adjustments

1994 – 1995 Jeep Cherokee 42RE

Front Band:

72 in lbs. Back off 3 5/8 turns

Rear Band:

72 in lbs. Back off 4 turns

1996 (Jeep and Dodge line)

42RE – 44RE

Front Band:

72 in lbs. back off 2 7/8

Rear Band:

72 in lbs. back off 2 turns

46RE – 47RE

Front Band:

72 in lbs. back off 2 7/8 turns

Rear Band:

72 in lbs. back off 2 turns

1997 (Jeep and Dodge line)

42RE

Front Band:

72 in lbs. back off 3 5/8 turns

Rear Band:

72 in lbs. back off 2 turns

44RE

Front Band:

72 in lbs. back off 2 1/4 turns

Rear Band:

72 in lbs. back off 4 turns

1997

46RE

Front Band:

72 in lbs. back off 2 7/8 turns

Rear Band:

72 in lbs. back off 2 turns

47RE

Front Band:

72 in lbs. back off 1 7/8 turns

Rear Band:

72 in lbs. back off 3 turns

1998 (Jeep and Dodge line)

42RE

Front Band:

72 in lbs. back off 3 5/8 turns

Rear Band:

72 in lbs. back off 4 turns

44RE

Front Band:

72 in lbs. back off 2 1/4 turns

Rear Band:

72 in lbs. back off 4 turns

42RE thru 47RE

Front & Rear Band Adjustments

1999

44RE

Front Band:

72 in lbs. back off 2 ¼ turns

Rear Band:

72 in lbs. back off 4 turns

46RE

Front Band:

72 in lbs. back off 2 7/8 turns

Rear Band:

72 in lbs. back off 2 turns

47 RE

Front Band:

72 in lbs. back off 1 7/8 turns

Rear Band:

72 in lbs. back off 3 turns

1999 (Jeep and Dodge line)

42RE

Front Band:

72 in lbs. back off 3 turns

Rear Band:

72 in lbs. back off 4 turns

2000 (Jeep and Dodge line)

42RE

Front Band:

72 in lbs. back off 3 turns

Rear Band:

72 in lbs. back off 4 turns

44RE

Front Band:

72 in lbs. back off 1 7/8 turns

Rear Band:

72 in lbs. back off 4 turns

2000

46RE

Front Band:

72 in lbs. back off 2 7/8 turns

Rear Band:

72 in lbs. back off 2 turns

47RE

Front Band:

72 in lbs. back off 1 7/8

Rear Band:

72 in lbs. back off 3 turns

2001 (Jeep and Dodge)

42RE

Front Band:

72 in lbs. back off 3 turns

Rear Band:

72 in lbs. back off 4 turns²

44 RE

Front Band:

72 in lbs. back off 1 7/8 turns

Rear Band:

72 in lbs. back off 4 turns

46RE

Front band:

72 in lbs. back off 2 7/8 turns

Rear Band:

72 in lbs. back off 2 turns.

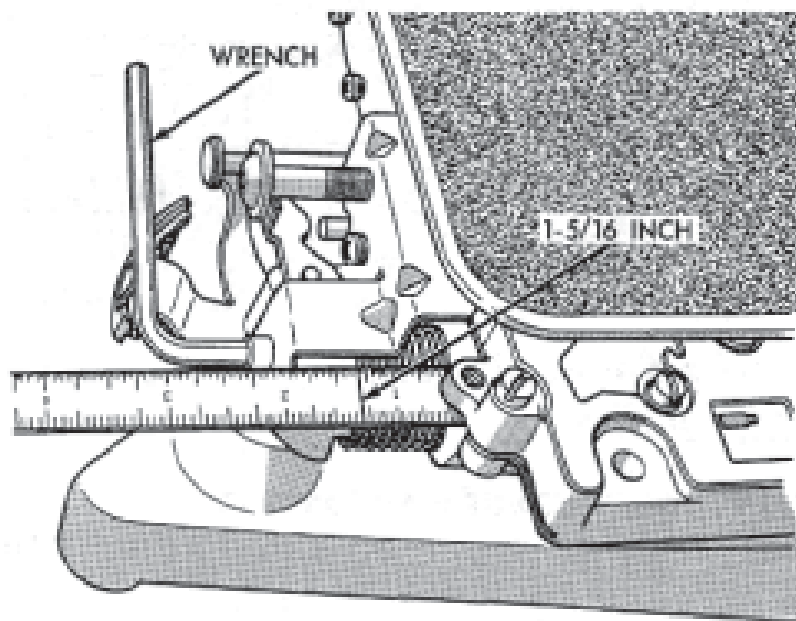
413, 670, 727, 904, RH and RE

Proper Regulator Valve adjustments

All Chrysler/Dodge units that have a T.V. controlled line rise will have the same adjustments for both the T.V. valve circuit as well as the Pressure Regulator valve pre-adjustment.

Pressure Regulator Valve: From the face of the valve body to the bottom of the adjustor plate for the regulator spring the measurement is $1 \frac{5}{16}$ ".

Note: The $1 \frac{5}{16}$ " setting is an approximate setting. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure. By adjusting the screw one complete turn will change the line pressure approximately $1 \frac{2}{3}$ psi. Counterclockwise will raise pressure – clockwise will lower pressure.



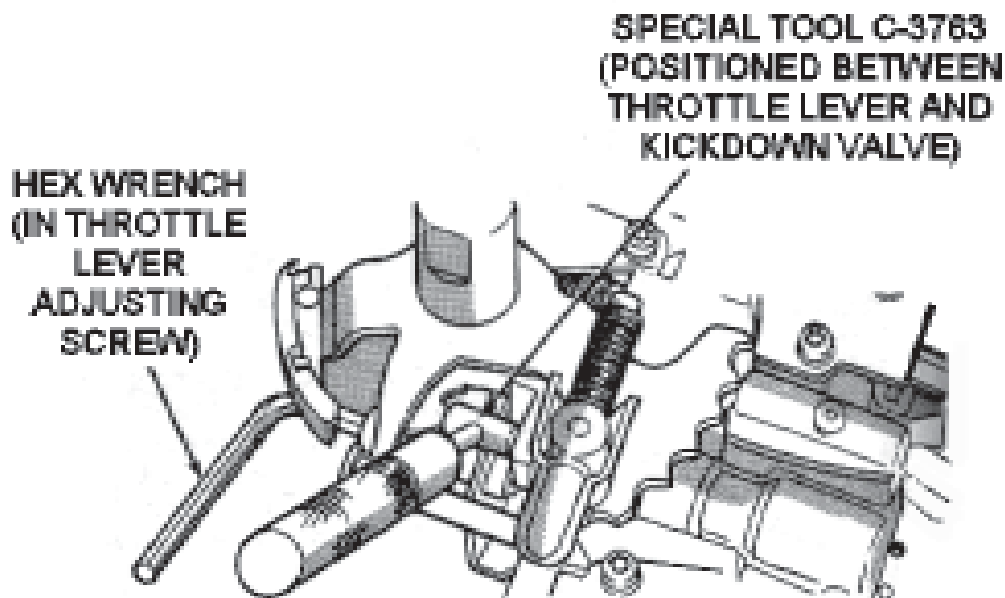
Line Pressure Adjustment

413, 670, 727, 904, RH and RE

Throttle Valve adjustments

T.V. Valve Adjustment: A special tool from Miller Tools # C3763 is used to measure the gap distance between the throttle lever and the kickdown valve. With the tool in place, there should be no movement of the T.V. valve (valve bottomed into its bore – no movement).

Note: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.



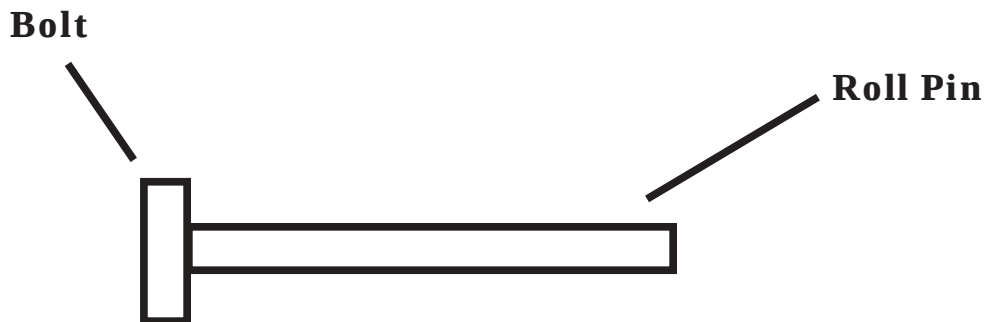
THROTTLE PRESSURE ADJUSTMENT

413, 670, 727, 904, RH and RE Pressure Regulator Valve and T.V. Valve adjustments Tool

Parts required:

- 1: Shouldered bolt (Minimum 1" shoulder 3/8 bolt)
- 1: Roll Pin (Minimum 3" long 1/8 wide)

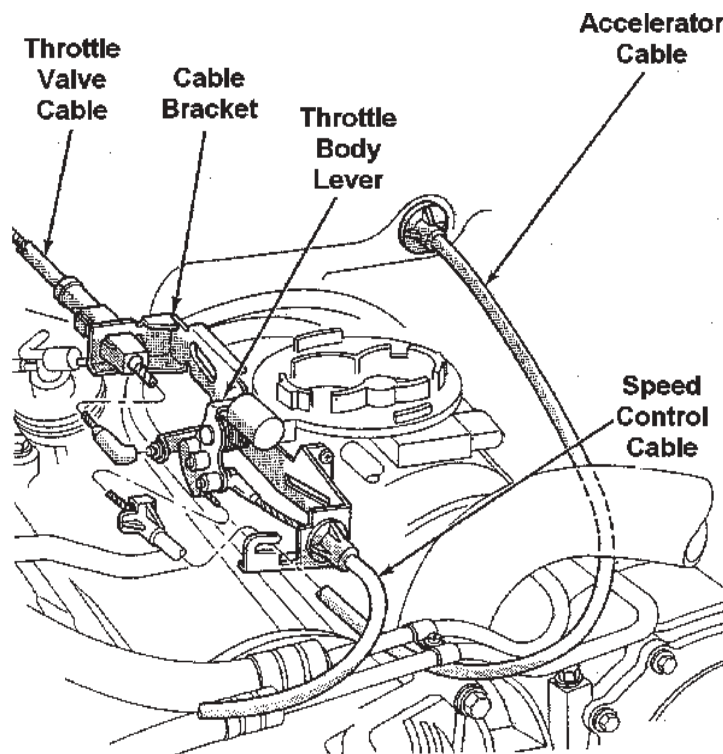
Procedure: Cut the head and thread section off of the bolt leaving just the shoulder section to work with. Out of the round stock that you now have in your hands, you need to make the overall length **.627** long! Carefully do this at the grinding wheel keeping a cup of water handy so you do not burn your fingers. This is the same measurement of the Miller tool C3763 used for the Throttle valve adjustment. Drill through the side of the round slug with a 1/8 drill and install roll pin with a length of at least 3" into gauge slug. Measure up from the bottom of the roll pin **1-5/16"** and file or cut into the roll pin a notch for measuring the Pressure Regulator spring height. Now you have a tool that does both jobs so no need hunting down 2 separate tools!



42/44/46/47/ RH and RE

Throttle Valve Cable Adjustment

When adjusting the Throttle Cable on any Chrysler/Dodge with the 42 series through 47 series RE and RH transmissions, the procedure is the same. The cable must be adjusted to the minimum side of the adjustment. The throttle lever on the transmission and the throttle plate at engine must move simultaneously. Adjustment is made at throttle body. Unsnap the cable from the throttle body. The cable end and the centering ball on the throttle body must line up together. If not, release cable snap-lock and adjust to achieve this measurement.



Throttle Valve Cable Attachment - At Engine

Note: Be sure that as the cable is pulled forward and centered on the throttle lever stud. Due to the angle at which the cable housing enters the spring housing, the cable housing may bind slightly and create an incorrect adjustment

Honda/Acura Contents

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Honda / Acura TCC does not lockup during cold weather

1996-97 Civic with A24A and Accord with AOYA or MPOA. When ambient temperature is less than 30°F, the PCM will not allow Lockup. If the coolant temperature never exceed 176°F during normal driving, replace the thermostat.



1998-up Prelude and Accord units with three shift solenoids and two CPC solenoids with this concern can be caused by installing the Reverse sleeve upside-down. Make sure that all the Reverse gears are installed correctly.



Reverse Selector Hub

97 and Later All except CVT Electrical System



Honda / Acura

Solenoid Information

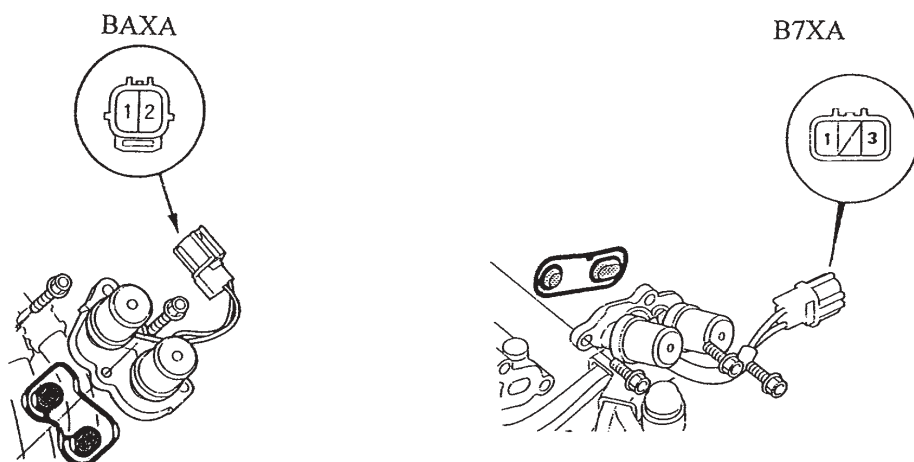
1997 and Later All (except CVT)

Position	Gear Position	Shift Control Solenoid Vavle		
		A	B	C
D4, D3	Shifting from N position	ON	ON	ON
	Stays in 1st	OFF	ON	ON
	Shifting gears between 1st and 2nd	ON	ON	ON
	Stays in 2nd	ON	ON	OFF
	Shifting gears between 2nd and 3rd	ON	OFF	OFF
	Stays in 3rd	ON	OFF	ON
D4	Shifting gears between 3rd and 4th	OFF	OFF	ON
	Stays in 4th	OFF	OFF	OFF
2	2nd	ON	ON	OFF
1	1st	OFF	ON	ON
R	Shifting from P and N position	OFF	ON	ON
	Stays in reverse	OFF	ON	OFF
P	Park	OFF	ON	OFF
N	Neutral	OFF	ON	OFF

Honda / Acura

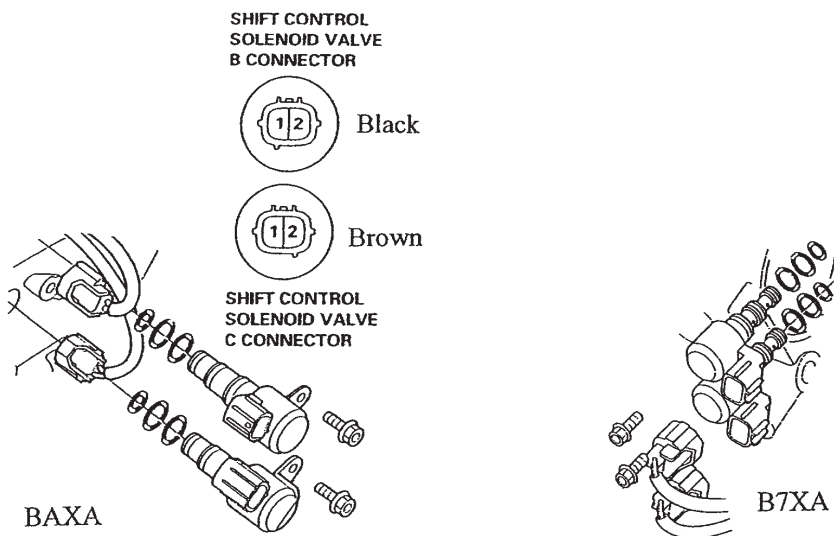
Solenoid Information

Lockup Control Valve / Shift Control Solenoid Valve A assembly



Lockup solenoid resistance (terminal 1 to solenoid body) = 12 to 25 ohms
 Shift control solenoid A resistance (terminal 2 or 3 to solenoid body) = 12 to 25 ohms

Shift Control Solenoids B and C



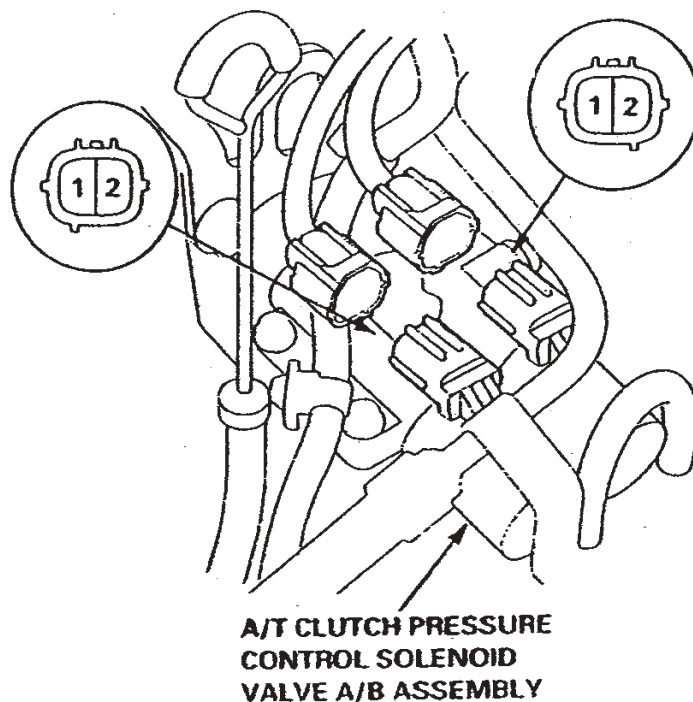
Shift Solenoid B and C resistance (between terminals 1 and 2) = 12-25 ohms.
 Note: There should be no continuity from the solenoid body to either terminal

Honda / Acura *Solenoid Information*

When checking the solenoids for resistance the resistance is measured at 5 ohms from terminal to terminal. If you measure the resistance from the terminal to the housing the resistance will read open.

**A/T CLUTCH PRESSURE
CONTROL SOLENOID
VALVE B CONNECTOR**

**A/T CLUTCH PRESSURE
CONTROL SOLENOID
VALVE A CONNECTOR**



A4RA, B4RA, M4RA Models Harsh Shifts and Engagement Complaints

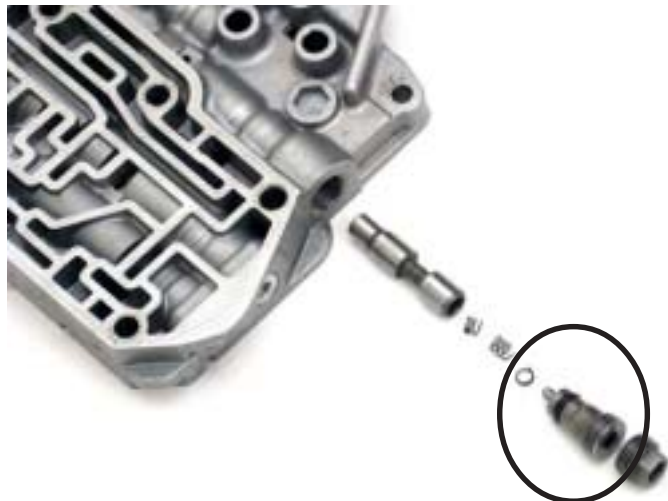
A common cause for this complaint is a broken CPC valve spring. These springs are available through the aftermarket. The spring pressure is calibrated by an adjustable spring seat. Record the location and number of turns while removing the spring seat.

Before disassembly it will be necessary to count the number of turns on the spring seat plug to ensure the correct pressure.



**Most Fall
between 3-4
Turns**

**NOTE: Before
disassembly turn the
CPC spring seat in
counting the turns in
until it bottoms out.
Simply reverse the
order during
reassembly.**



A4RA, B4RA, M4RA Model Harsh Shifts and Engagement Complaints



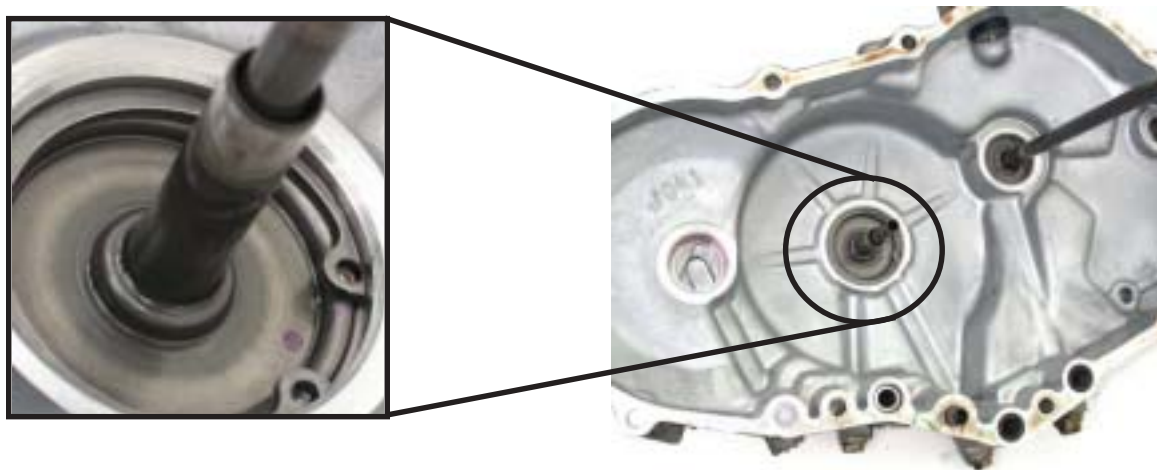
**Measure the
turns and record
for reassembly**



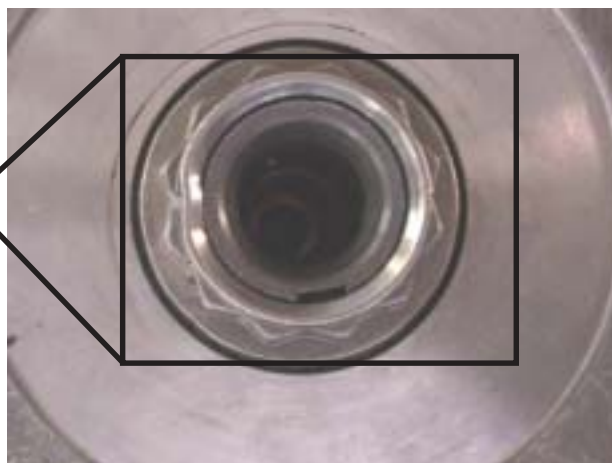
Honda / Acura Bushings Damage

It is very common for these models to have a bind in Reverse. This problem may be caused by a worn bushing in the 4th clutch tube. ATRA recommends that this bushing be replaced during overhaul.

Honda only services the bushing as part of the support shaft. However they are available through the aftermarket



Damaged Bushing area



Honda

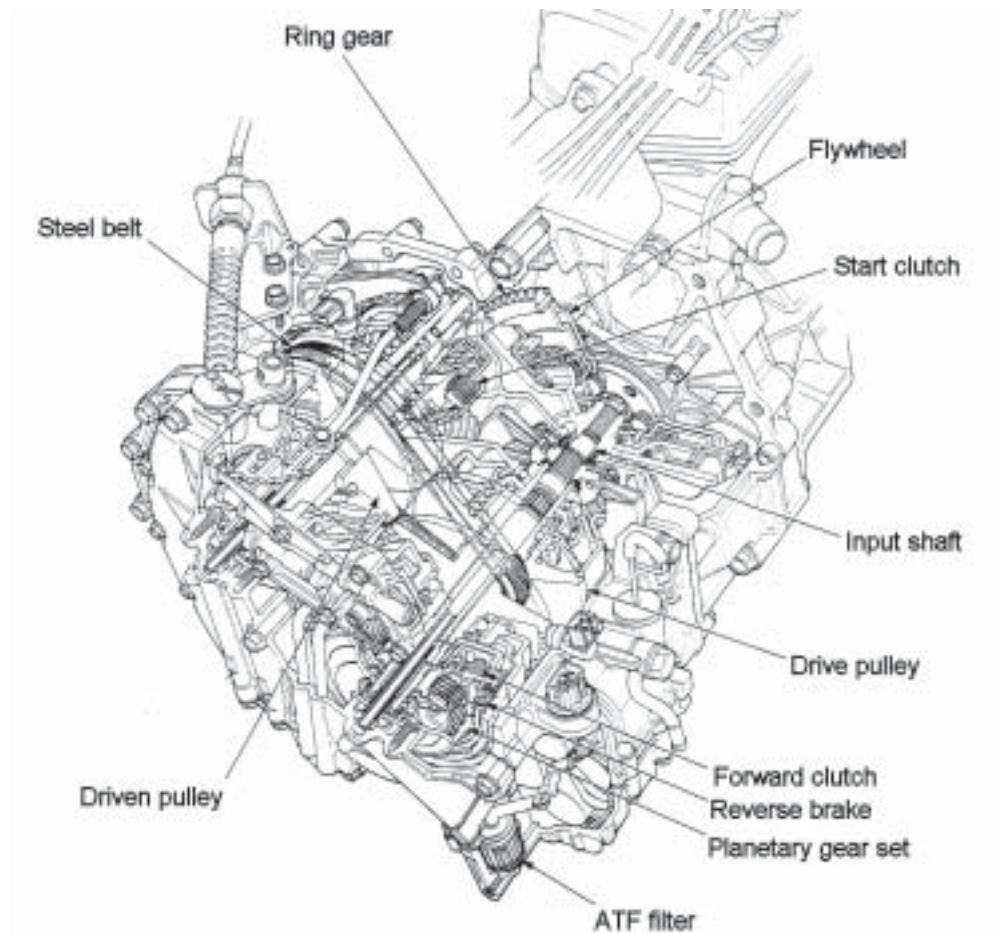
CVT Preliminary Information

Honda Civic HX models starting in 1996 have been using a CVT transmission. Its use of a metal segmented belt and variable width pulleys is similar to the Subaru Justy ECVT.

Forward and reverse rotation is possible by the application of one of two clutches acting on a Ravigneaux planetary assembly.

Fixed Gear Ratios

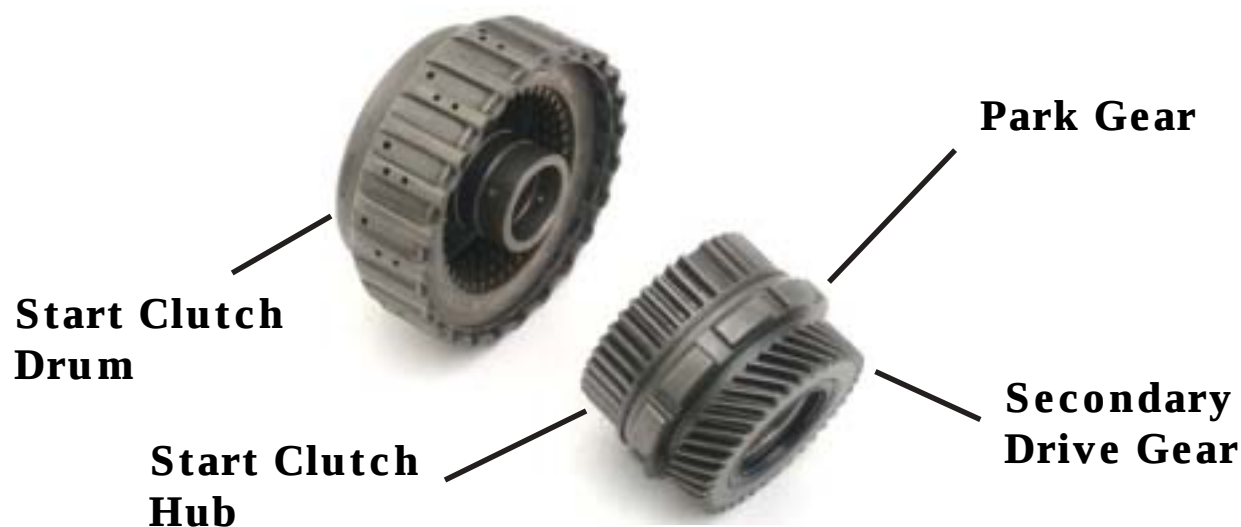
Planetary in Reverse	2.499
Secondary.....	1.333
Final.....	4.357
Variable Forward Ratios.....	2.466-.449



Honda

CVT Information

The START clutch couples the driven pulley to the secondary gear shaft of the final drive gear. The START clutch is released when the vehicle is stopped. As soon as acceleration is needed the START clutch applies. Torque from the driven pulley is transferred to the final drive gear via the secondary gear shaft.



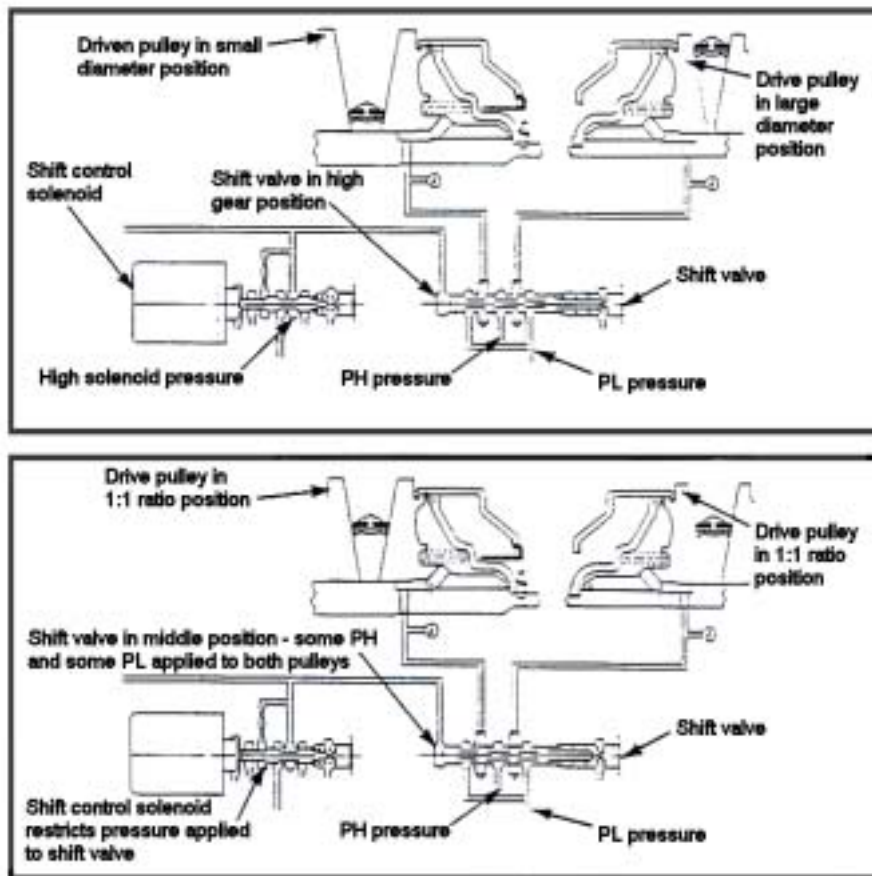
Honda

CVT Information

In the forward range, the correct gear ratio for the vehicle is achieved by the drive and driven pulleys. Pressure to control the width of both pulleys comes from the Pressure High-Pressure Low (PH-PL) valve. This valve responds to control signal oil from the Shift Control Linear Solenoid.

The PH-PL valve maintains the correct pressure between both drive and driven pulleys. This is important to keep the belt in contact with both pulleys. At low speeds the drive pulley narrows and the belt rides high. At high speeds the drive pulley widens and the belt rides lower. Remember, the PH-PL valve is also making the driven pulley width change, but opposite of the drive pulley.

When pressure in both drive and driven pulleys are equal, the belt will ride in the middle of both pulleys and the ratio will be about 1:1.

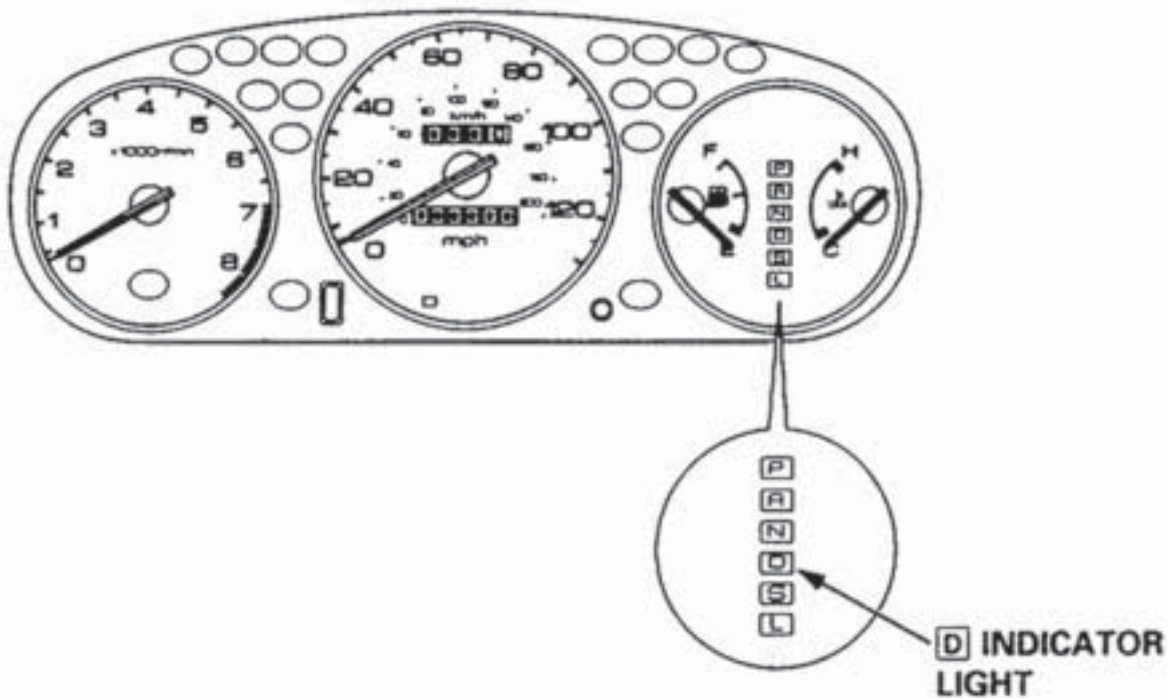


Honda

CVT Information

Fail Safe

When the computer detects a circuit or transmission fault, the “D” light stays on. The transmission will still drive forward and reverse. All solenoids are turned off. The only ratio available in failsafe is the high or overdrive ratio. A Pitot tube, located inside a “spinning trough of oil” allows the vehicle to hydraulically apply and release the start clutch.

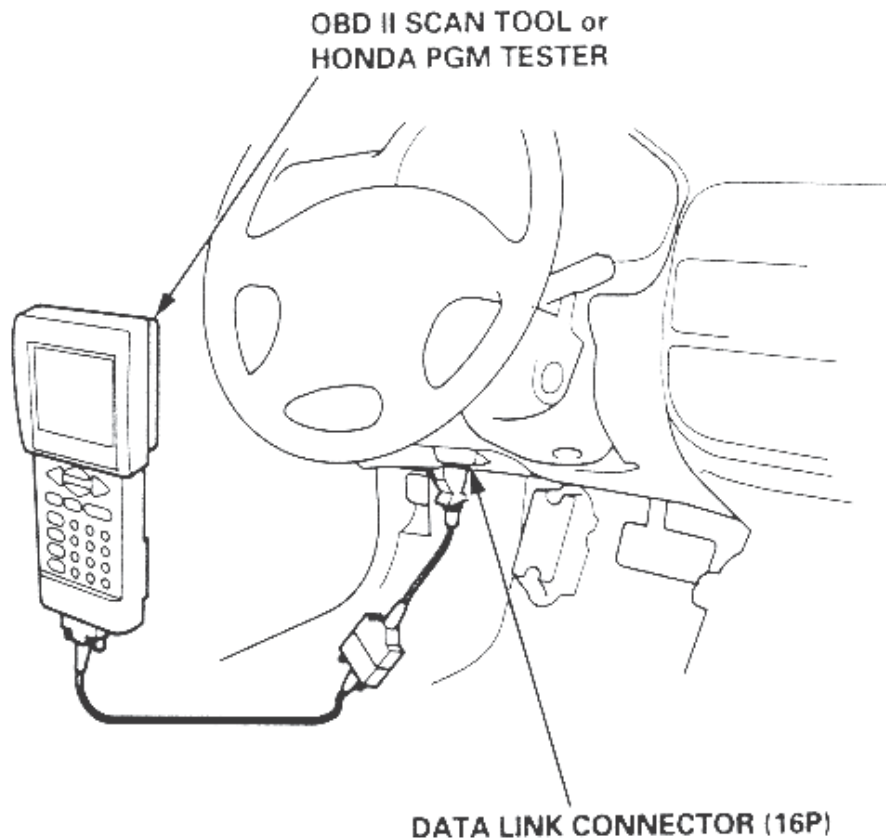


Honda

Retrieving Codes

Since the transmission starts out in a high ratio, the start clutch generates a lot of heat while taking off from a stop. It's very important to correct and clear computer problems as the start clutch will fail under prolonged failsafe operation.

These units have been known to have erratic solenoid and valve body problems, even when no codes are present. To confirm that the unit works in failsafe, unplug the wiring. If the unit starts out in the high range in forward and reverse, suspect a solenoid or computer related problem. If the unit still operates erratically, suspect internal pressure, valve body or clutch problems.



Honda

Fluid Specification

The CVT requires Honda CVT fluid Honda p/n 08798-9018. When Overhauling the CVT the unit will take 6.8 quarts and 4.1 quarts when servicing.



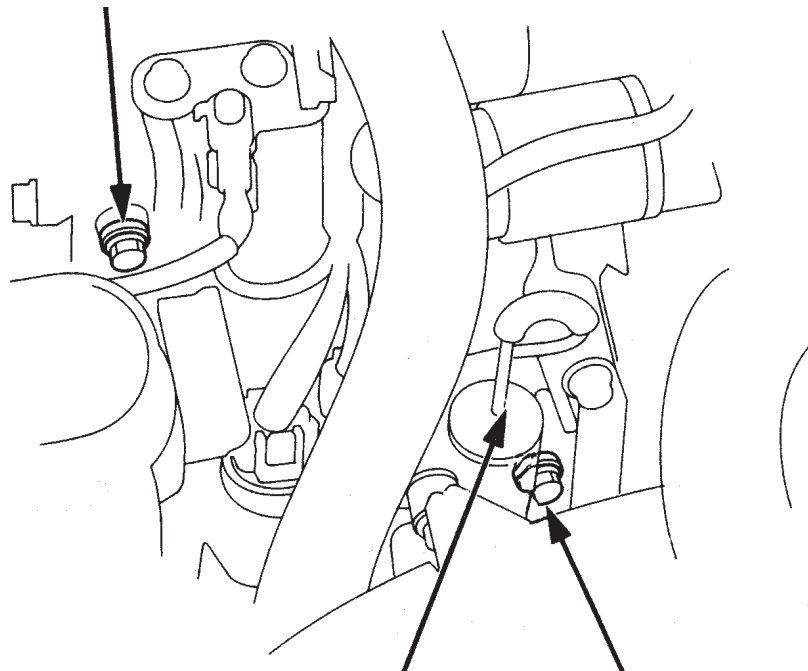
Honda

CVT Pressures

There are 6 pressure ports. Use the following pressure chart to confirm hydraulic operation. Note: in failsafe the driven pulley pressure may be above 500psi.

Pressure Port	Gear Selector	Accepted psi
Forward Clutch.....	Drive.....	203-253 @ 1,500 rpm
Reverse Brake.....	Reverse.....	203-253 @ 1,500 rpm
Drive Pulley.....	Neutral.....	28-101 @ 1,500 rpm
Driven Pulley.....	Neutral.....	218-334 @ 1,500 rpm
Lubrication.....	Neutral.....	Above 30 @ 3,000 rpm

Reverse Brake Pressure Tap (Marked with “LUB”)



ATF Dipstick

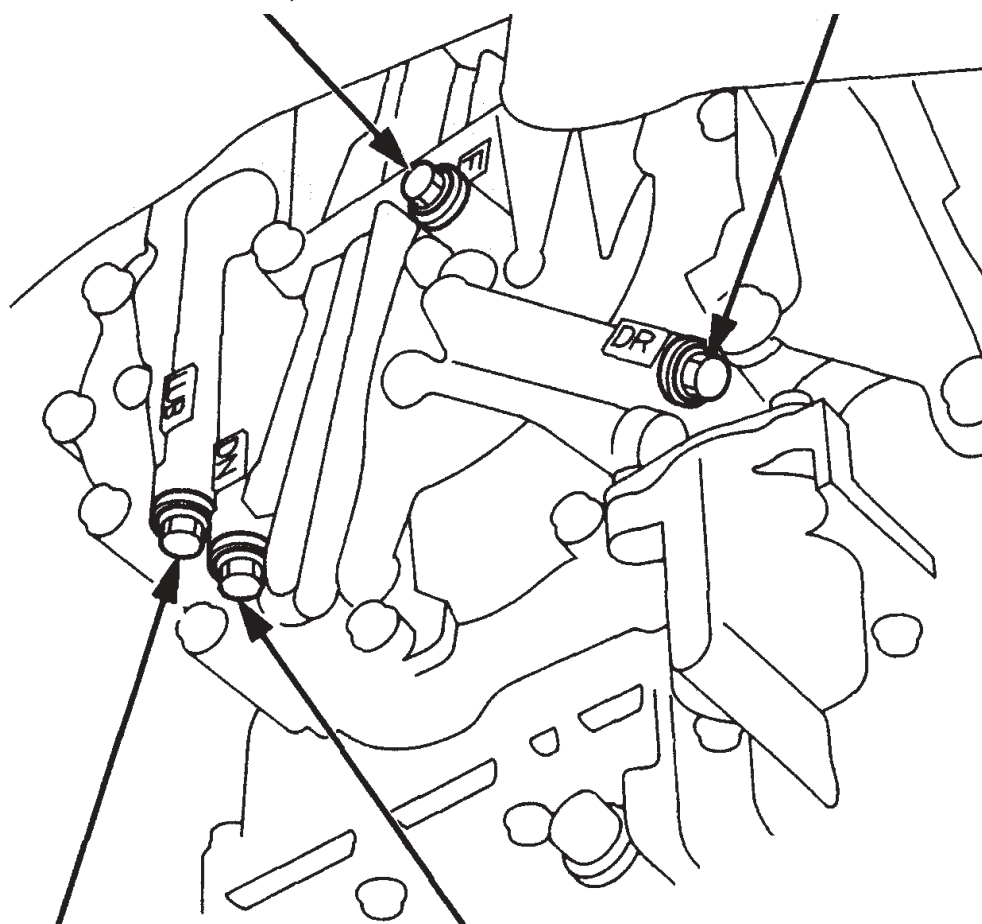
**Start Clutch
Pressure Tap
(Marked with “SC”)**

Honda

CVT Pressures

**Forward Clutch
Pressure Tap
(Marked with 'F')**

**Drive Pulley
Pressure Tap
(Marked with "DR")**



**Lube Pressure Tap
(Marked with "LUB")**

**Driven Pulley
Pressure Tap
(Marked with "DN")**

Honda

CVT Stall Speeds

A stall test can be used to detect problems in the start, forward or reverse clutches. Follow these steps:

1. Block the front wheels and set the parking brake.
2. Make sure A/C is off and engine is at operating temperature.
3. Connect a tachometer or scan tool to read engine rpm.
4. Start engine and select D.
5. Apply brakes and fully depress accelerator. Note engine rpm.
- Do not stall test transmission longer than 6-8 seconds.**
6. Allow transmission to cool for 2 minutes and repeat test for S, L and R.

Stall Specifications

Gear Range	Normal	Accepted Range
D	2500rpm	2350-2650rpm
L, S & R	3000rpm	2800-3100rpm

RESULTS

Stall too high in D, L & S

Check fluid, filter, Stuck PH
Regulator, Slipping Forward
Or Start Clutches

Stall too high in R

Check fluid, filter, Stuck PH
Regulator, Slipping Reverse
Or Start Clutches

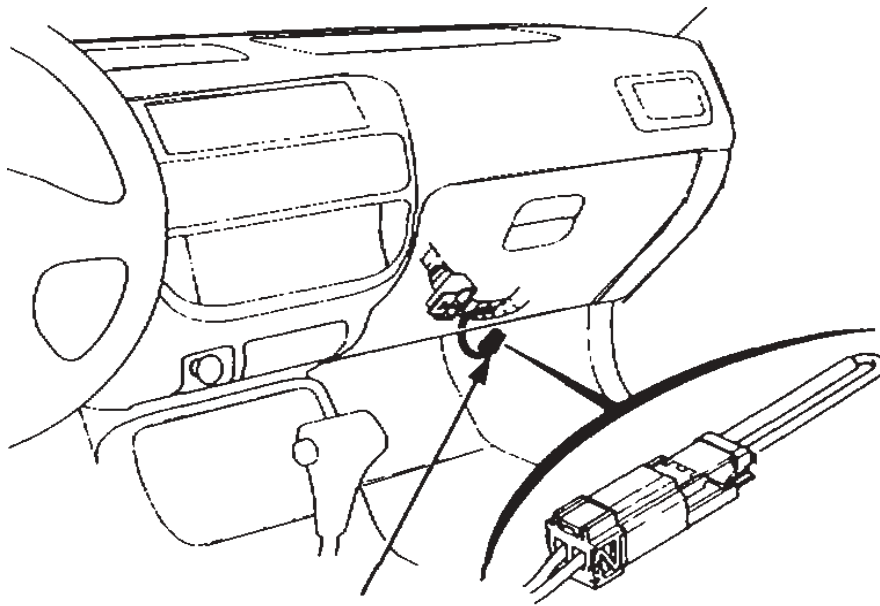
Stall too low in D, L, S & R

Engine Output Low, Faulty
Start Clutch, Stuck Shift Valve

Honda

CVT Break in Procedure

After overhaul of the engine or transmission, or any transmission computer related work has been done, the start clutches need to be calibrated.



**Service Check
Connector (2P)**

**A simple
jumper wire
can be used
for this
procedure**

When the following parts are repaired or replaced, the PCM or TCM must memorize the feedback signal for the start clutch control.

- PCM or TCM
- Transmission assembly
- Lower valve body assembly
- Engine assembly or overhaul

Procedure for 1996 model only:

Caution: Do not use this procedure for 1997 and newer vehicles.

1. Engage the parking brake, and block the front wheels securely.
2. Jump the Service Check connector as shown. (The Service Check Connector is located under the dash on the passenger side of the vehicle.)

Honda

CVT Break in Procedure

3. Start the engine and warm it up to normal operating temperature (the radiator fan comes on twice.)
4. Fully depress the brake pedal and accelerator for 20 seconds with the gear selector in the D position (full power stall).
5. Shift into N or P. To store the engine negative pressure in memory, let the engine idle in N or P for one minute under the following conditions:
 - With the brake pedal depressed.
 - With the A/C switch off.
 - With the combination light switch off.
 - With the heater fan switch off.
 - Turn OFF all other electrical accessories.
6. Shift into “D” position and let the engine idle for two minutes to store the feedback signal in memory under the same conditions as in step 5.
7. Connect a scantool and verify the TCM has completed the start clutch calibration.

NOTE: *The TCM will not store the feedback signal when the CVT fluid temperature is below 104° F (40°C) even if the engine coolant temperature reaches normal operating temperature.*

- Repeat these procedures until the start clutch calibration is shown to be completed in scan tool data.
8. Disconnect the jumper from the Service Check Connector.

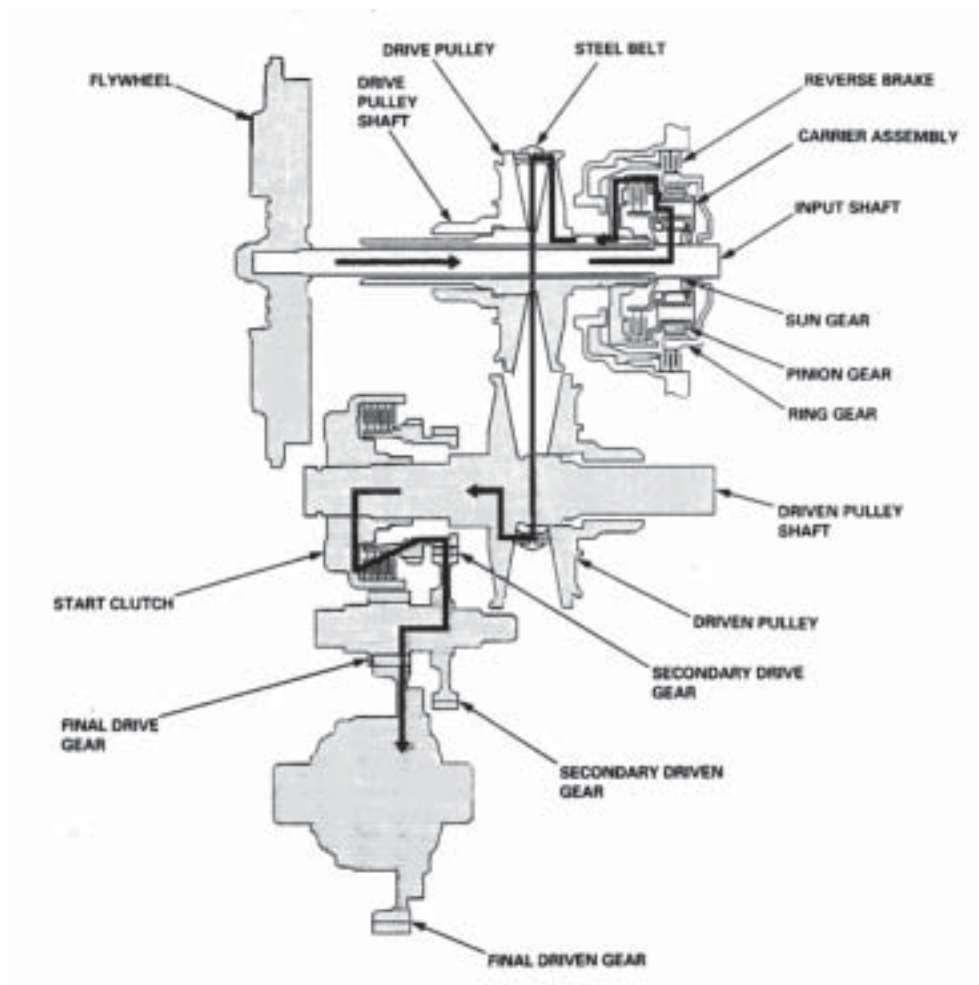
Procedure for 1997 - 2000 Vehicles:

The TCM ('97-'98 vehicles) and PCM ('99 and newer) memorize the feed back signal when you drive the vehicle as follows:

- After warming up the engine (the radiator fan comes on).
- Shift into “D” position.
- Turn off all electrical accessories.
- Drive the vehicle up to 37 m.p.h. (60 km/h).
- After speed reaches 37 mph (60 km/h), release the accelerator for 5 seconds.

Honda / Acura Noise Idling in Reverse

A certain amount of noise should be expected while the unit is idling in reverse. You may need to explain what is taking place to a customer who questions the noise.



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Eclipse

Scanner Access

On 1995-1998 Eclipse 2.0L vehicles equipped with the 41TE transaxle must be scanned using the Domestic Primary Cartridge. The MITSU-1 Y-cable must be connected to the OBD-II and the Mitsubishi twelve pin diagnostic connector. Personality Key number seven must be installed in the OBD-II adapter. Use VIN# chart below to manipulate the scanner to access codes. It is not necessary to install the 2nd, 3rd, or 8th digets for the 97-98 cartridges.

1997 and 1998 Primary Cartridge

10th.....use actual vehicle VIN#
5th.....U

1999-On Primary Cartridge

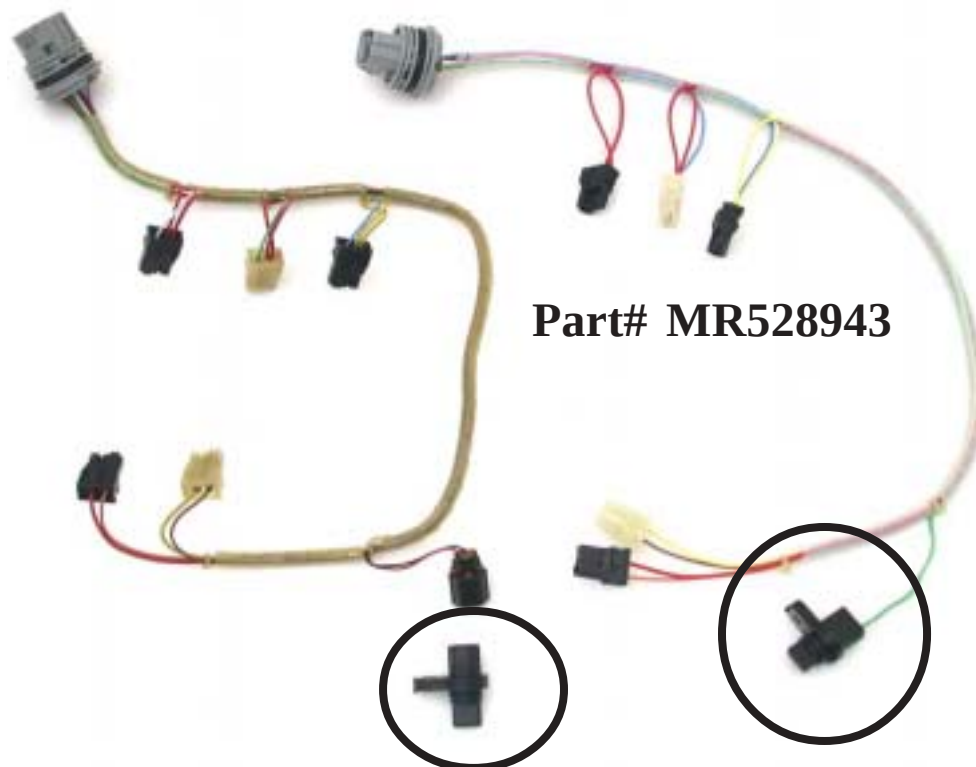
10th.....use actual vehicle VIN#
2nd.....E
3rd.....3
5th.....U
8th.....Y



F4A41/42/51

Internal Harness Change

The internal harness was changed in September of 2000. The ATF Temperature sensor is now an integral part of the harness. The old harness is still used in the truck series and the sensor is still available.



ATF Temperature	Resistance (Ohms)
32°F	16.7-20.5K
68°F	7.3-8.9K
104°F	3.4-4.2K
176°F	1.0-1.2K
212°F	.57-0.69K

R/V4A51

Pressure Tap Location and Specifications



Pressure specifications are in PSI.

Gear Selected	Engine RPM	Underdrive (UC)	Reverse (RC)	Overdrive (OC)	Low-Reverse Brake (LB)	Second Brake (2B)	Torque Converter Release (TR)	Torque Converter Apply (TA)
Park	2500				30-50		30-50	
Reverse	2500		185-255		185-255		75-100	
Neutral	2500				30-50		30-50	
1st Gear	2500	145-155			145-155		75-100	
2nd Gear	2500	145-155				145-155	75-100	
3rd Gear	2500	110-130		110-130				75-100
4th Gear	2500			110-130		110-130		75-100

NOTE: Torque Converter apply pressure can vary between 0-50 PSI during gear changes while driving when the Torque Converter is not applied.

R/V4A51

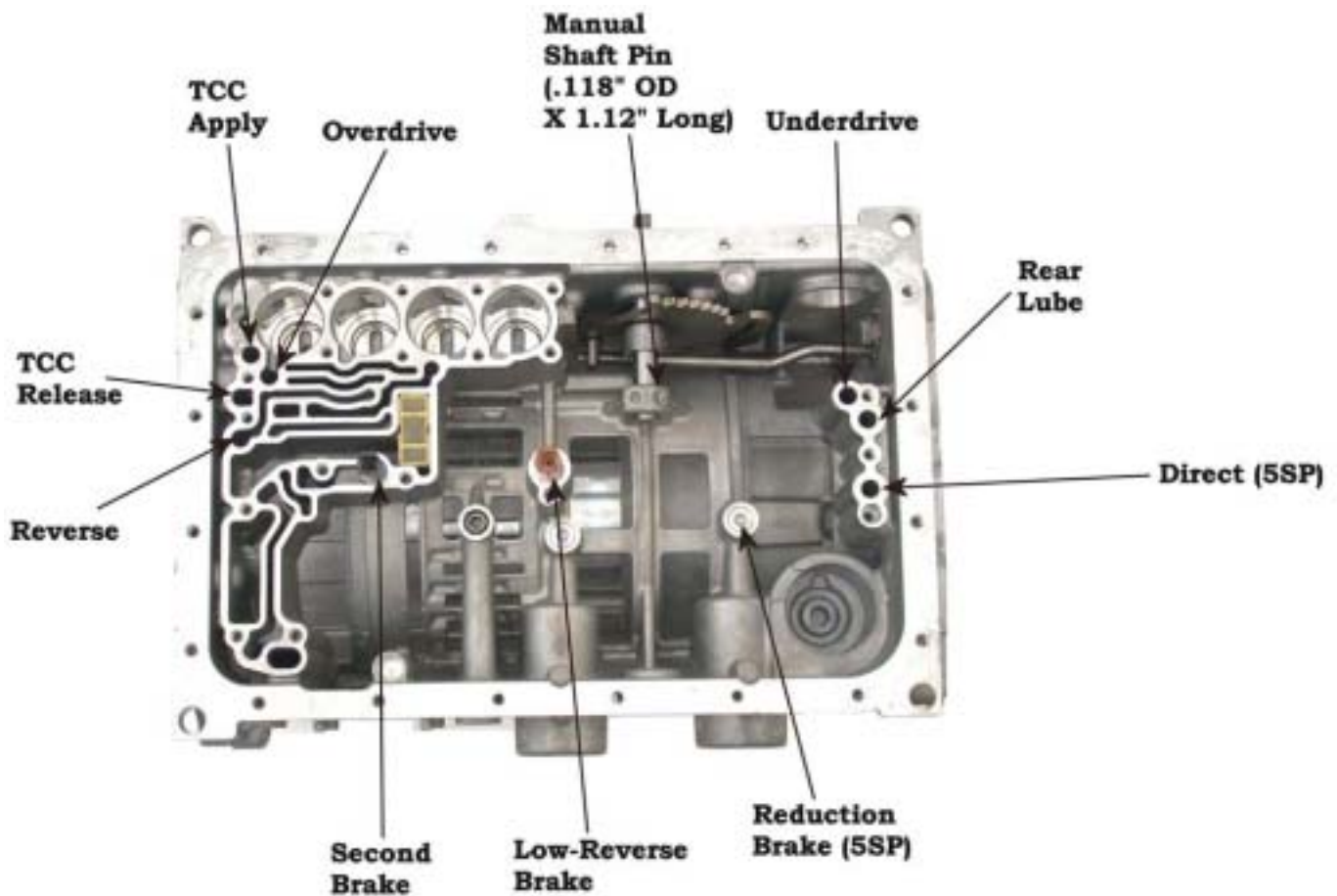
Pressure Tap Location and Specifications



Standard Hydraulic Pressure Test										
Measurement Condition			Standard Hydraulic Pressure MPa (psi)							
Selector Lever Position	Shift Positon	Engine Speed (r/min)	Underdrive Clutch Pressure (UD)	Reverse Clutch Pressure (RV)	Overdrive Clutch Pressure (OD)	Direct Clutch Pressure (DIR)	Low-Revers-e Clutch Pressure (LR)	Second Brake Pressure (2ND)	Reducti-on Brake Pressure (RED)	Torque Convert-er Pressure (DR)
P	-	2,500	-	-	-	-	0.22 - 0.36 (32-52)	-	1.01 - 1.05 (147 - 152)	0.25 - 0.39 (37 - 57)
R	Reverse	2,500	-	1.27-1.77 (185-256)	-	-	1.27-1.77 (185-256)	-	1.27 - 1.77 (185 - 256)	0.50 - 0.70 (73 - 101)
N	-	2,500	-	-	-	-	0.22 - 0.36 (32-52)	-	0.22 - 0.36 (32-52)	0.25 - 0.39 (37 - 57)

R/V4A51

Air Test Points



R/V4A51

No Park Engagement

The split roll pin used in the park rod assembly may break due to fatigue in the roll pin. The pin should be inspected during repairs. A ratcheting noise may be heard while transmission is put into park. A stuck in park may also be noticed due to the pin breaking and leaving the rod in the transmission tail park lever assembly.



R/V4A51

Overheating Problems, Foaming Concerns

Most overheating problems with 1999-2001 model Motero Sports are caused by improper fluid levels. The early dipstick level-full area is difficult to read, because of this, a new dipstick and pan were introduced to lower the level in the pan.

Part# MR593383...Pan, Filter, Dipstick

Part# MR951878...Dipstick O-Ring



NOTE: All of the 1999 models flash the “N” indicator light 2 times per second to indicate overheating conditions. The 2000-2001 two wheel drive models also use the “N” indicator. The 2000-2002 four wheel drive models have a separate ATF temperature light.

NOTES:

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Nissan

Harsh 1-2

RE4F04A

Make sure the 1-2 accumulator control check ball is in the correct location. There is another pocket near this one which orifices the 3-2 servo release oil. But this pocket has never had a check ball installed here in the RE4F04A units.

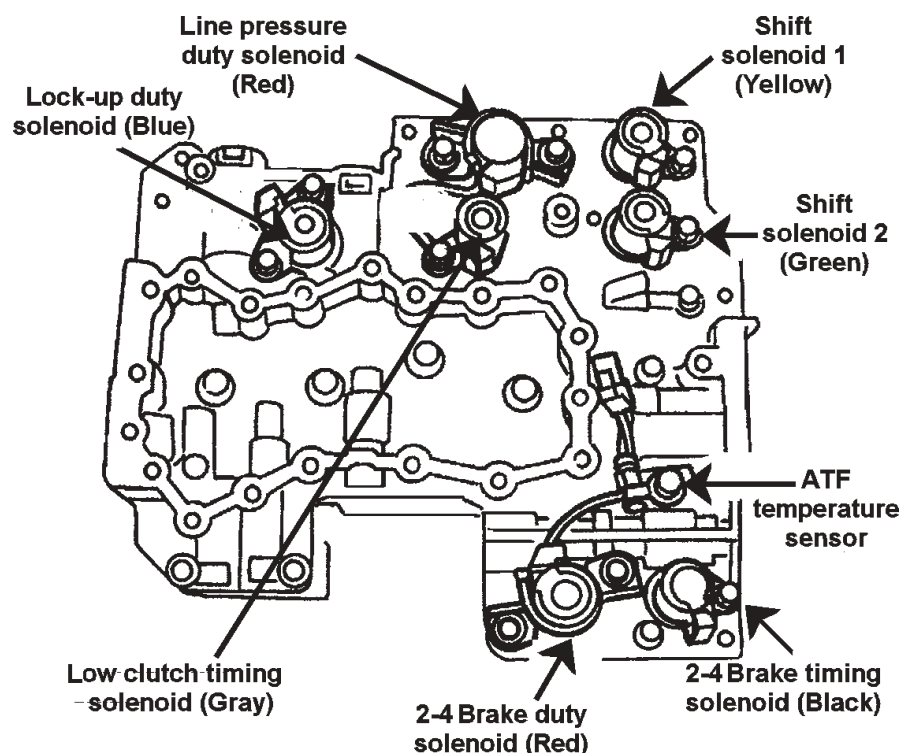


Subaru

1999 Subaru 4-AT

Since 1999, Subaru vehicle are equipped with a modified EC8 transmission. The 2-4 Band is replaced with a 2-4 Brake Clutch. Lockup apply is modulated and capable in all forward ranges. The accumulators are now part of the valve body.

There are a total of seven solenoids. Four of the solenoids control similar circuits found in the EC8 transmission. One of the additional solenoids modulate the Low Clutch (Forward Clutch) apply rate. The other two solenoids modulate and control the 2-4 Brake Clutch and one TFT sensor.



Subaru

Clutch and Brake Operation

Subaru						
Range	Low Clutch	High Clutch	2-4 Brake	Reverse	Low/ Reverse	One-Way Clutch
Park						
R				A	A	
N						
D4		A	A			A
D3	A	A				
D2	A		A			
D1	A					
M1	A					

Subaru

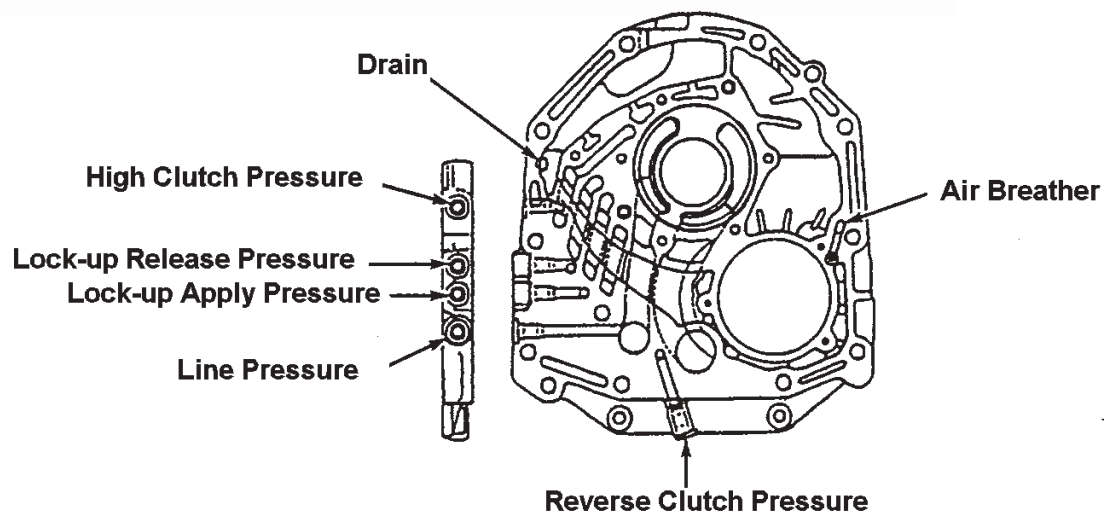
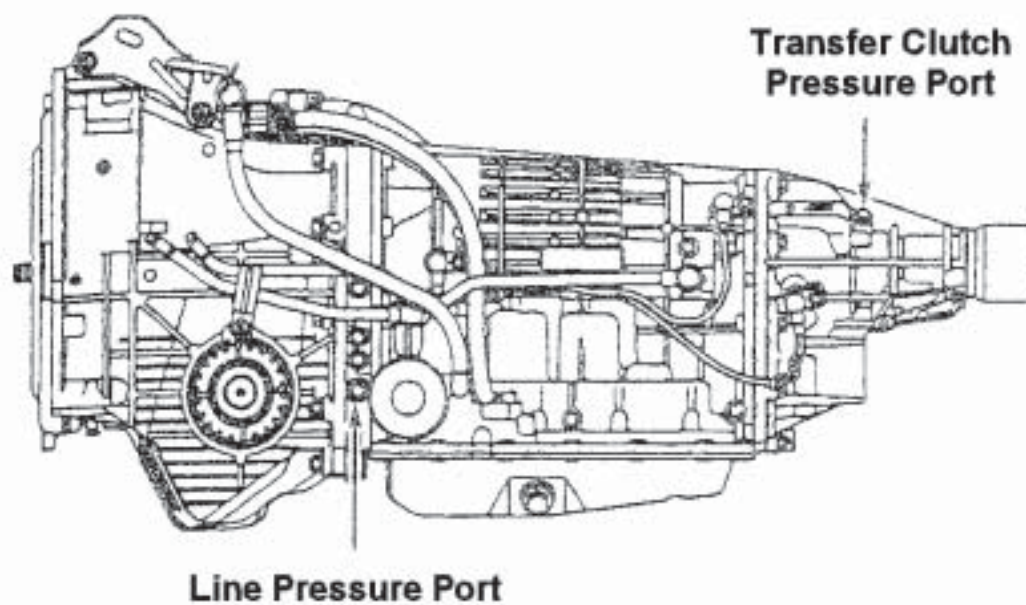
Pressure Specifications

Pressure Specifications		
Main Line	At Idle	WOT
Selector In D	44-60 psi	—
Selector In R	—	220-250 psi
Selector In 2	—	164-190 psi

Pressure Specifications		
Transfer		
Test Condition	Selector	Pressure
AWD Mode		
Idle	In Drive	135-158 psi
2/3 Throttle	In Drive	31-43 psi
FWD Mode	In Park at 2000 rpm	zero psi

Subaru

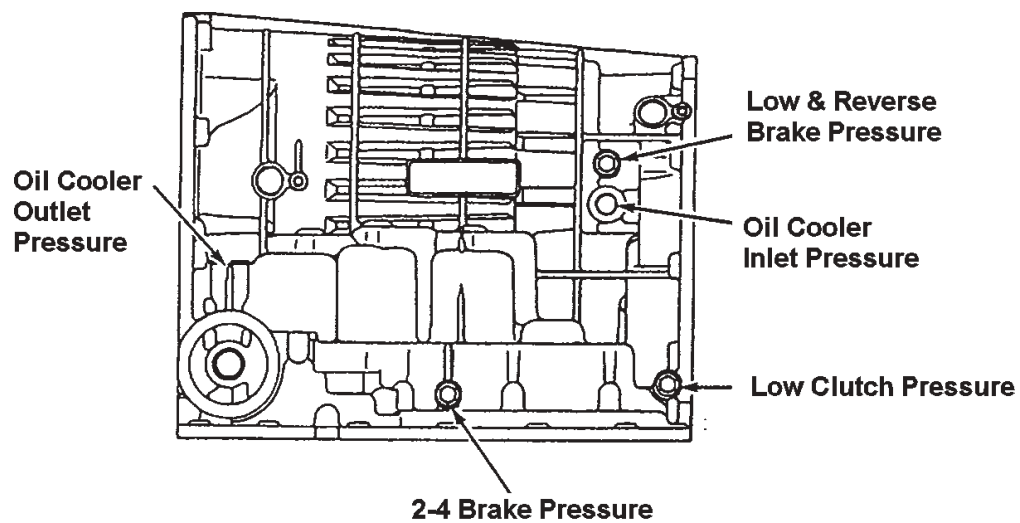
Pressure Port Identification



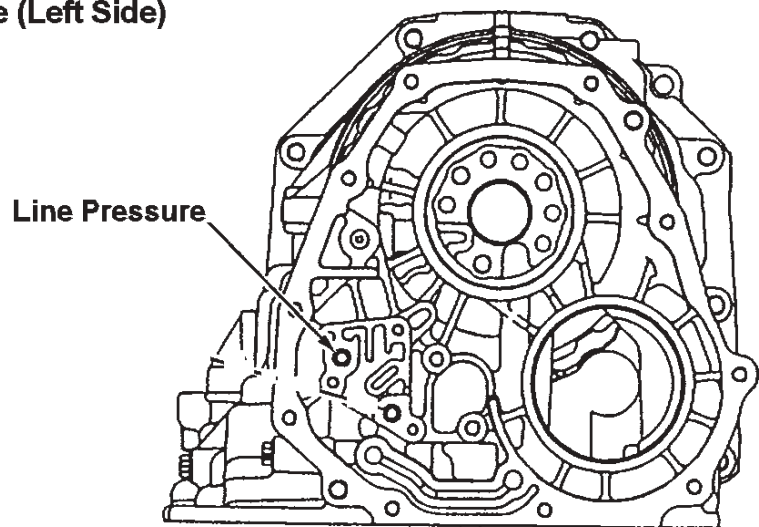
Oil Pump Housing

Subaru

Pressure Port Identification



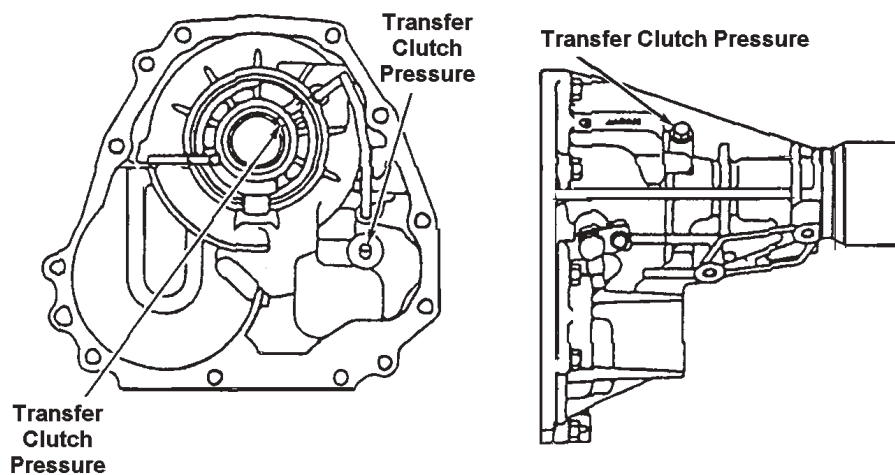
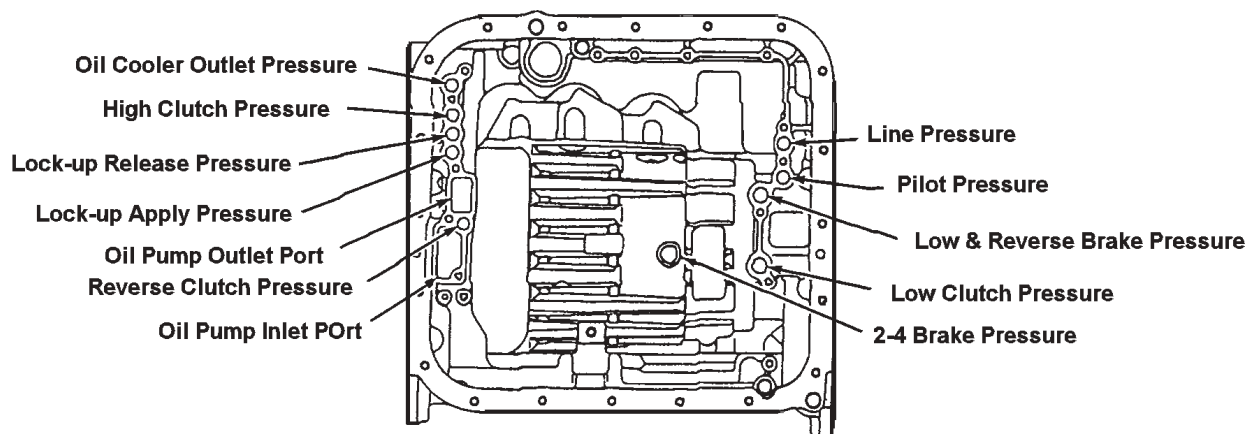
Transmission Case (Left Side)



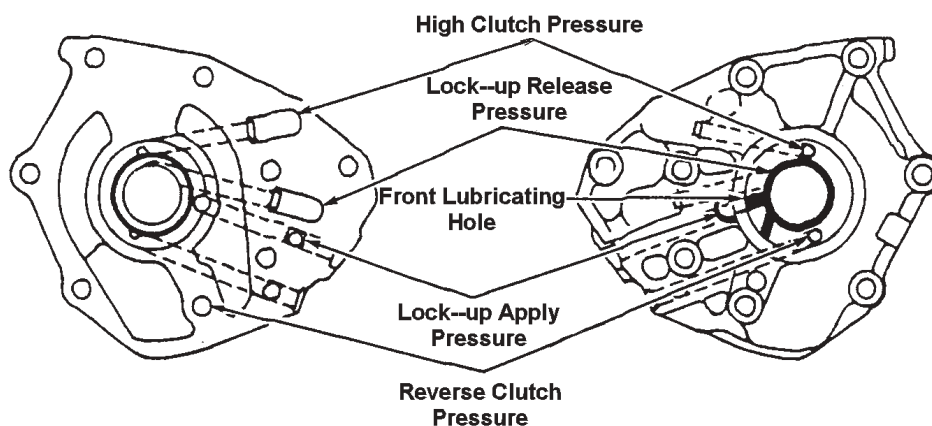
Transmission Case (Right Side)

Nissan/Subaru

Case Passage Port Identification



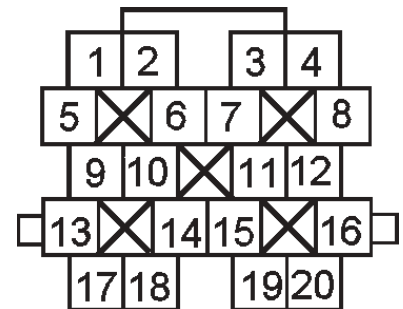
Extension Case



Subaru

Solenoid Information

Solenoid Information		
Solenoid Command	Solenoid No.1	Solenoid No. 2
1st Gear	On	On
2nd Gear	Off	On
3rd Gear	Off	Off
4th Gear	On	Off

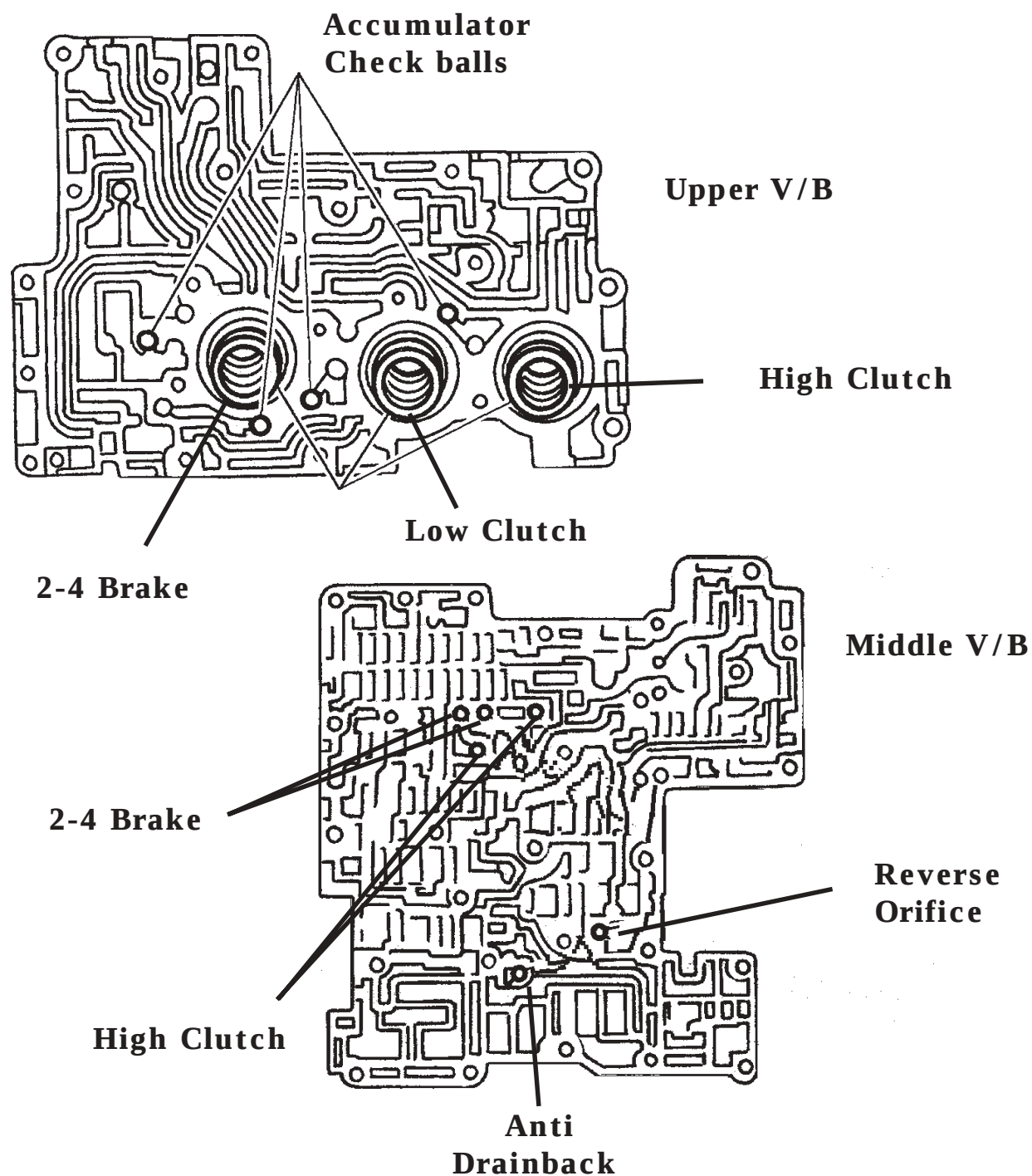


Transmission Connector Pin Colors		
Connector Pin No.	Circuit	Wire Color
1	Solenoid 1	Green
2	Solenoid 2	Yellow
3	Low Clutch Solenoid	Gray
4	2-4 Timing Solenoid	Black
5	Line Pressure Solenoid	Red
6	Transfer Clutch Solenoid	Brown
9	2-4 Solenid	Yellow/Red
11	ATF Sensor	Orange
12	ATF Sensor	White
13	Lockup Solenoid	Blue
16	Ground	Black

These colors are on the transmission side of the connector. The colors are different on the vehicle harness side.

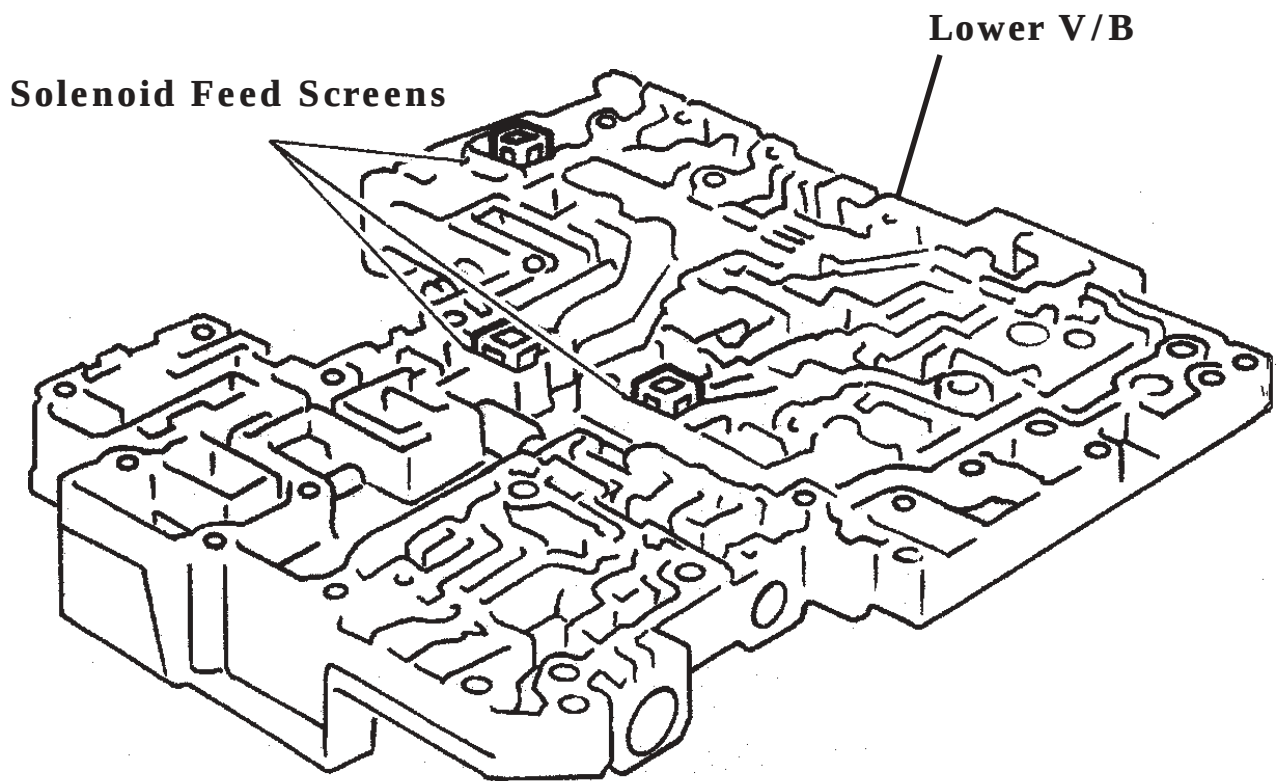
Subaru

Valvebody Information



Subaru

Valvebody Information



Subaru

Code Retrieval

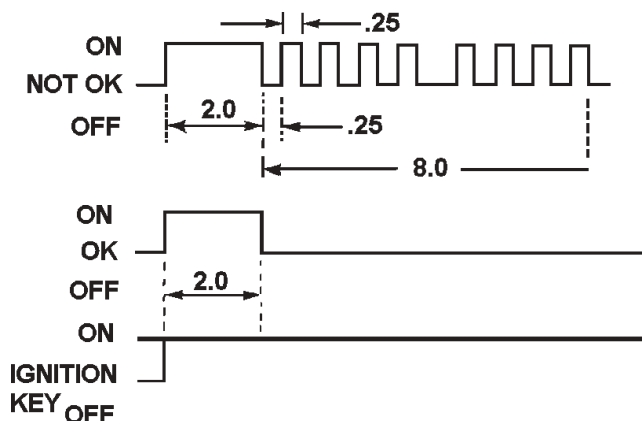
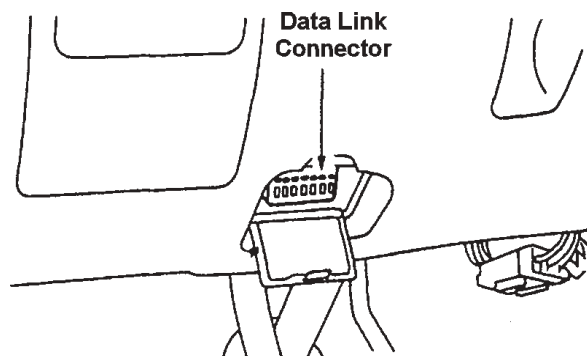
Codes maybe obtained with a scan tool through the Data Link Connector located behind a cover at the lower dash panel. Codes can also be obtained manually by using the AT Oil Temp Light. Manual code method can only retrieve some of the codes.

Normally the AT Oil Temperature light should stay lit for 2 seconds then go out, after the ignition is switched on. If a malfunction is present, the AT Oil Temp. Light keeps blinking for 8 seconds.

When you complete the following steps, the AT Oil Temperature light will display long and short flashes. The Long flashes will equal the number 10, the short flashes will equal the number 1.

- STEP 1. If light keeps blinking, test drive vehicle above 12 MPH then stop.
- STEP 2. Turn ignition off, then switch ignition on. Place gear selector in 1st.
- STEP 3. Turn ignition off and then back on. Move gear selector in sequence of 2-1-2-3-D.
- STEP 4. The AT Oil Temperature light should now blink codes.

To clear codes, remove No. 4 fuse located in main fuse box behind hood release.



Subaru

Subaru 4-AT DTC

DTC Definitions

AT Temp. Light/OBDII

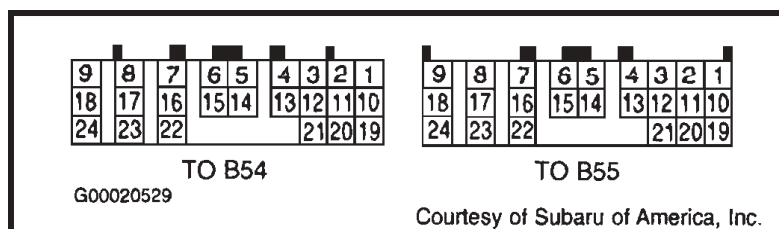
Definition

11/P0725	Engine rpm
27/P0710	ATF Temp. Sensor
31/P1700	TPS
33/P0720	VSS No. 2
36/P0715	TSS
38/P1106 or P1106	Engine Torque Signal
45/P0100	MAP
71/P0753	Shift Solenoid No. 1
72/P0758	Shift Solenoid No. 2
73/P1703	Low Clutch Timing Solenoid
74/P1704	2-4 Brake Timing Solenoid
75/P0748	Line Pressure Solenoid
76/P1705	2-4 Brake PWM Solenoid
77/P0743	Lockup PWM Solenoid
79	Transfer Clutches Solenoid
93/P0500`	VSS No. 1
P0703	Brake Switch
P0705	Range Sensor
P0731	1 st Gear Ratio Incorrect
P0732	2 nd Gear Ratio Incorrect
P0733	3 rd Gear Ratio Incorrect
P0734	4 th Gear Ratio Incorrect
P0740	TCC Malfunction
P1115	Engine Torque Control Cut Signal Input High
P1116	Engine Torque Control Cut Signal Input Low
P1701	Cruise Control Set Signal Incorrect
P1702	Transaxle Diagnosis Input Signal Circuit Input Low
P1722	Transaxle Diagnosis Input Signal Circuit Input High
P1742	Transaxle Diagnosis Input Signal Circuit Malfunction

All Other Codes.....Engine Related

Subaru

Subaru TCU Pin Charts



Check with Ignition ON.					
Content	Connector	Terminal No.	Measuring conditions	Voltage (V)	Resistance to body (ohms)
Back-up power supply	B55	6	Ignition switch OFF	10—13	—
Ignition power supply	B54	23	Ignition switch ON (with engine OFF)	10—13	—
	B54	24			
Inhibitor switch	B55	23	Select lever in "P" range	Less than 1	—
			Select lever in any other than "P" range (except "N" range)	More than 8	
	B55	22	Select lever in "N" range	Less than 1	—
			Select lever in any other than "N" range (except "P" range)	More than 8	
	B55	17	Select lever in "R" range	Less than 1	—
			Select lever in any other than "R" range	More than 8	
	B55	8	Select lever in "D" range	Less than 1	—
			Select lever in any other than "D" range	More than 8	
	B55	18	Select lever in "3" range	Less than 1	—
			Select lever in any other than "3" range	More than 8	
	B54	10	Select lever in "2" range	Less than 1	—
			Select lever in any other than "2" range	More than 8	
	B54	1	Select lever in "1" range	More than 8	—
			Select lever in any other than "1" range	More than 8	
Brake switch	B55	24	Brake pedal depressed	More than 10.5	—
			Brake pedal released	Less than 1	
AT Oil temp warning light	B54	3	Light On	Less than 1	—
			Light Off	More than 9	

Subaru

Subaru TCU Pin Charts

Check with Ignition ON.					
Content	Connector	Terminal No.	Measuring conditions	Voltage (V)	Resistance to body (ohms)
Throttle position sensor	B55	2	Throttle fully closed	0.2—1.0	—
			Throttle fully opened	4.2—4.7	
Throttle position sensor power supply	B55	1	Ignition switch ON (with engine OFF)	4.82—5.3	—
ATR Temperature sensor	B55	11	ATF Temperature 68°F (20°C)	1.6—2.0	2.1k—2.9k
			ATF Temperature 176°F (80°C)	0.4—0.9	275—375
Rear vehicle speed sensor	B55	3	Vehicle stopped	0	450—650
			Vehicle speed at least 12MPH (20km/h)	More than 1 (AC range)	
Front vehicle speed sensor	B55	5	Vehicle stopped	0	450—650
			Vehicle speed at least 12MPH (20km/h)	More than 1 (AC range)	
Torque converter turbine speed sensor	B55	12	Engine idling after warmup (D range)	0	450—650
			Engine idling after warmup (N range)	More than 1 (AC range)	
Vehicle speed output signal	B55	13	Vehicle speed at most 6MPH (10km/h)	Less than 1 < More than	—
Engine speed signal	B55	4	Ignition switch ON (with engine OFF)	More than 10.5	—
			Ignition switch ON (with engine ON)	8—11	
Cruise set signal	B54	11	When cruise control is set (Set lamp ON)	Less than 1	—
			When cruise control is not set (Set lamp OFF)	More than 6.5	
Torque control signal 1	B54	13	Ignition switch ON (with engine ON)	More than 4	—
Torque control signal 2	B54	21	Ignition switch ON (with engine ON)	More than 4	—
Torque control cut signal	B54	2	Ignition switch ON	8	—
Intake manifold pressure signal.	B54	20	Engine idling after warmup	0.4—1.6	—

Subaru

Subaru TCU Pin Charts

Check with Ignition ON.					
Content	Connector	Terminal No.	Measuring conditions	Voltage (V)	Resistance to body (ohms)
Shift solenoid 1	B54	7	1st to 4th gear	More than 9	10—16
			2nd to 3rd gear	Less than 1	
Shift solenoid 2	B54	6	1st to 2nd gear	More than 9	10—16
			3rd to 4th gear	Less than 1	
Line pressure duty solenoid	B54	9	Ignition switch ON (with engine OFF) Throttle fully closed after warm-up	1.5—4.0	2.0—4.5
			Ignition switch ON (with engine OFF) Throttle fully opened after warm-up	Less than 0.5	
Lock-up duty solenoid	B54	16	When lock-up occurs	More than 8.5	10—17
			When lock-up is released	Less than 0.5	
Transfer duty solenoid	B54	15	Fuse on FWD switch	More than 8.5	10—17
			Fuse removed from FWD switch (with throttle fully open and with selector lever in 1st gear)	Less than 0.5	
2-4 brake duty solenoid	B54	8	Throttle fully closed (with engine OFF) after warming up	1.5—5.0	2.0—4.5
			Throttle fully open (with engine OFF) after warming up	Less than 0.5	
2-4 brake timing solenoid	B54	5	1st gear	Less than 1	10—16
			3rd gear	More than 9	
Low clutch solenoid	B54	14	2nd gear	Less than 1	10—16
			4th gear	More than 9.1	
FWD switch	B55	14	Fuse removed	6—16	—
			Fuse installed	Less than 1	—
2-4 brake dropping resistor	B54	17	Throttle fully closed (with engine OFF) after warming up	More than 8.5	2.0—4.5
			Throttle fully open (with engine OFF) after warming up	Less than 0.5	

Subaru

Subaru TCU Pin Charts

Check with Ignition ON.					
Content	Connector	Terminal No.	Measuring conditions	Voltage (V)	Resistance to body (ohms)
Line pressure dropping resistor	B54	18	Throttle fully closed (with engine OFF) after warming up	More than 8.5	2.0—4.5
			Throttle fully open (with engine OFF) after warming up	Less than 0.5	
FWD indicator light	B54	12	Fused ON FWD switch	Less than 1	—
			Fuse removed from FWD switch	More than 9	
ABS signal	B54	19	ABS switch ON	Less than 1	—
			ABS switch OFF	6.5—15	
Sensor ground line 1	B55	10	—	0	—
Sensor ground line 2	B55	21	—	0	—
System ground line	B55	19	—	0	Less than 1
	B55	9			Less than 1
AT diagnosis signal	B54	4	Ignition switch ON	Less than 1< >More than 4	—
Data link signal (Subaru Select Monitor)	B55	7	—	—	—

VOLVO

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AW50-42LE

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Hard or Slow Engagement

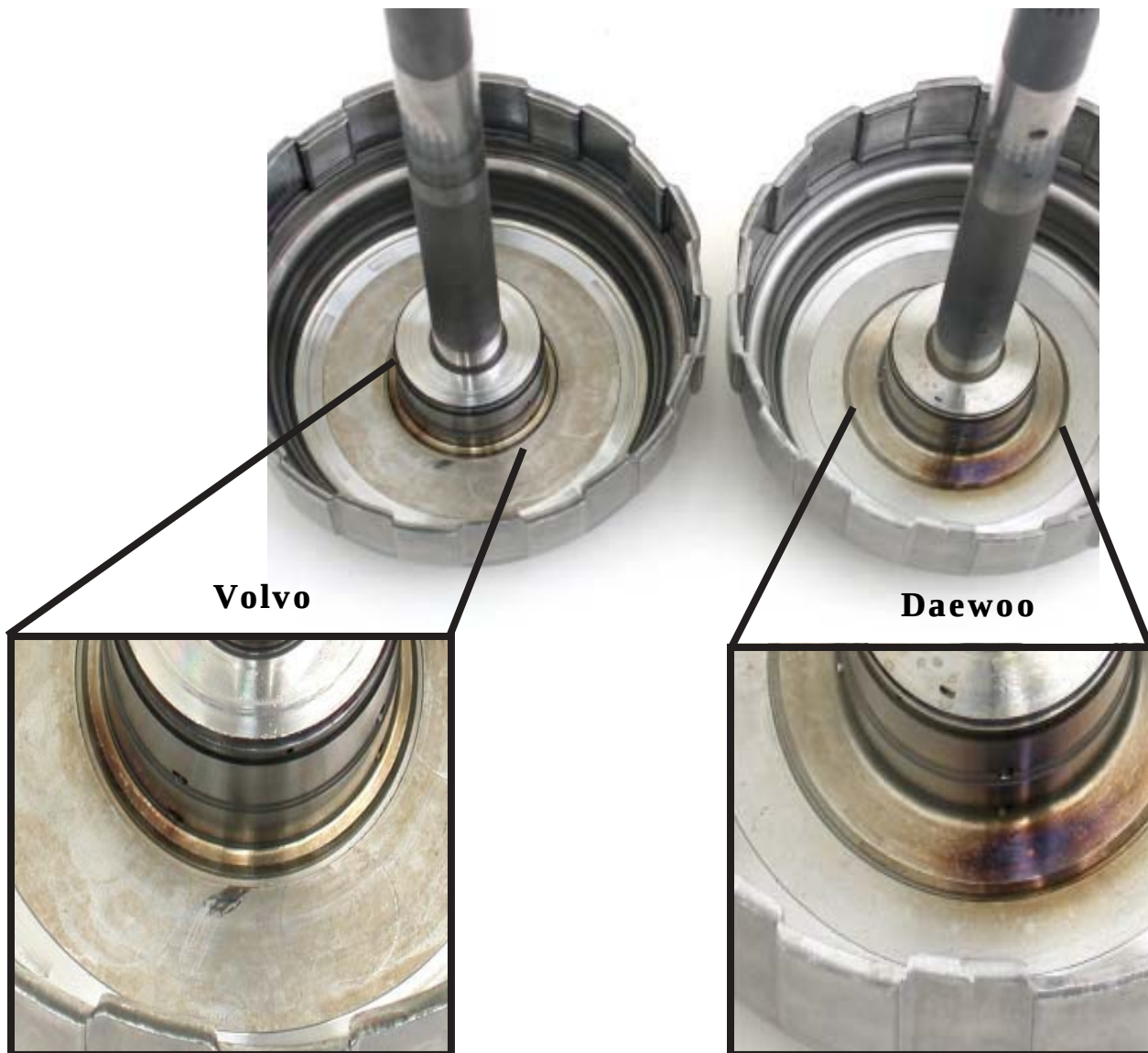
Forward and / or Reverse 248

AW50-42LE

Cracked Input Drum

A common failure on these units is a cracked input drum. This part is not serviced separately. Besides buying a complete unit from Volvo, the only option has been to buy a good used one.

The Difference between the Daewoo drum and the Volvo drum is in the weld area. The weld area for the new drum from Daewoo has a stepped area for durability.



AW50-42LE

Cracked Input Drum

The Daewoo Leganza also uses a similar FWD AW transmission. Internal transmission parts for the Leganza are available. The Daewoo part number for the input drum is 3570150A021. The discount price from a local dealer is about \$350.00. This part has the identical dimensions as the Volvo part with the addition of a widened support flange where the shaft is welded to the drum.

The other option is to buy the matching forward piston (part no. 3560250A010) and direct piston (part No. 3560650A011) from Daewoo for about \$130.00 for both parts.

In order to use this input drum, the forward piston has to be relief cut .065". This relief allows for the additional support flange of the input drum. We cut a forward piston and found over .090" of material still left in the piston wall.



**Make sure these areas are cut to .065" this will allow you to use the old piston assembly with the new drum.
2.825" Diameter
0.065" Depth**

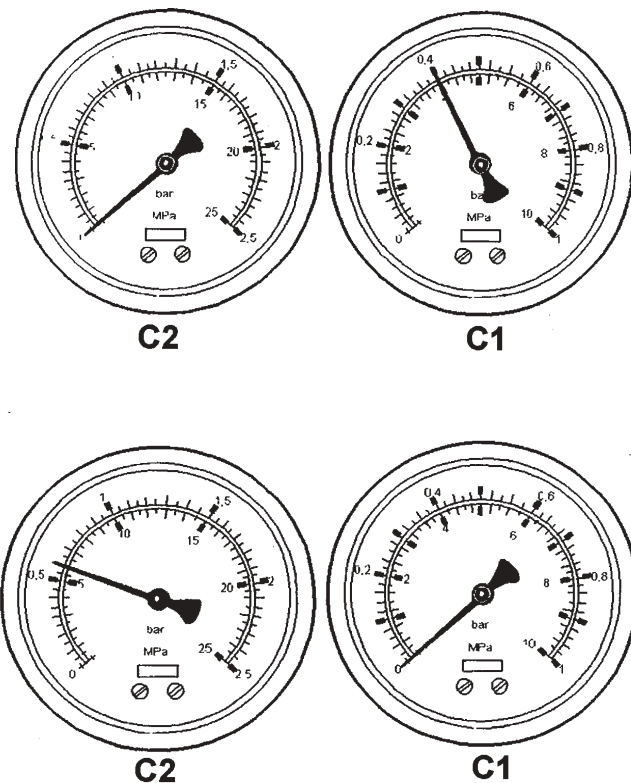
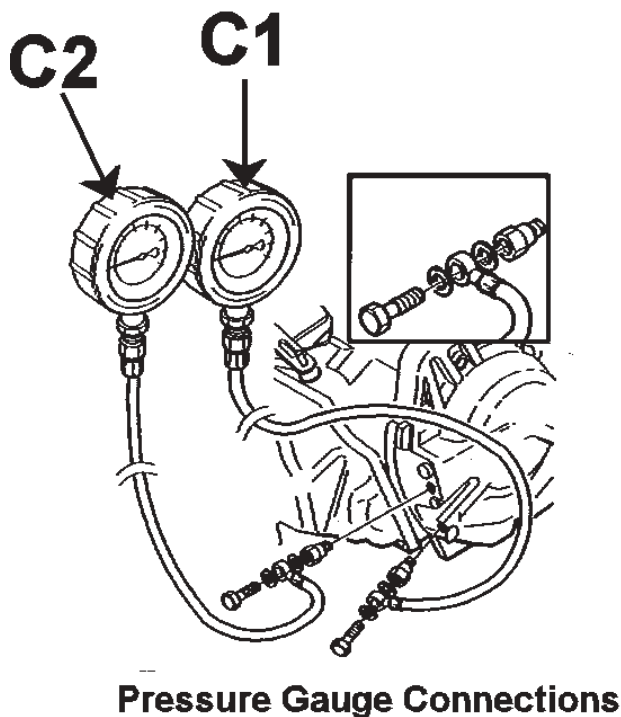
Volvo

Rear of Original C1 Clutch

AW50-42LE

Hard or Slow Engagemnet Forward and/or Reverse

This maybe caused by worn seal rings in the rear cover. These rings control the oil to the C1 and C2 clutches. The C1 clutch is one of the forward elements. The C2 clutch is one of the reverse elements. Both these clutches are enclosed in the input shaft and drum. To check the C1 and C2 clutches, attach two pressure gauges to the transmission as shown. Move gear selector to "D". The C1 clutch pressure should be 57 psi and the C2 clutch pressure stay at zero. Move gear selector to "N". Wait three seconds and check the pressures again.



AW50-42LE

Hard or Slow Engagemnet Forward and/or Reverse

Move the gear selector to “N”. Wait three seconds and move gear selector to “R”. The C2 pressure gauge should read 85 psi and the C1 pressure stay at zero. Move gear selector to “N”. Wait three seconds and check the pressures again.

If the clutch pressures do not work right, the seal rings or ring support are worn. A new rear transmission cover with a steel ring support is available from Volvo. The kit part No. is 9463445 and cost about \$180.00. This kit includes a rear cover, three Teflon rings, an O-ring, a steel washer, four seals and eight mounting bolts.

The rear cover can be replaced with the transmission on the car. Volvo allows their technicians 2.5 hours to R & R the cover.



Volkswagen Contents

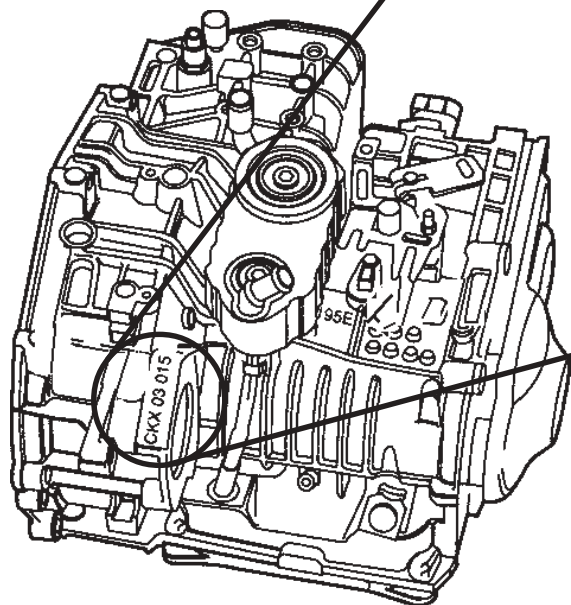
096/01M

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096/01M

Transaxle Identification

In 1993, VW vehicles used an 096 Phase 2 transaxle. As early as 1994, the 01M transaxle was installed. This transaxle used a different shift strategy and TCC was PWM controlled. The Identification tags can be found on the side of the transaxle or underneath the filter. The chart below will help you identify the gear ratio of the unit you're working on.



Gear Ratios

096

2.0L (CNK)	4.22
2.8L (CFF)	3.70

01M

1.8L (CKX)	4.53
2.0L (CLK, DYK)	4.22
2.8L (CCB, DCE, ECM)	3.70
Diesel (CK2, ECN)	3.27

Model and TCM Applications

The TCM application is based on the PCM. This is because some TCMs receive the TPS signal from ECM. The location of a 4-cylinder engine code is shown here on top of the engine block below the intake manifold, 6-cylinder engine codes are located at the front of the block



Model and TCM Applications

	Engine Code	TCM Part No.
Golf		
1993	2.0L ABA	096 927 731A
	2.8L AAA	096 927 731C
1994	2.0L ABA	096 927 731BH
	2.8L AAA	096 927 731CE
1995	2.0L ABA	096 927 731AT
	2.8L AAA	096 927 731BA
95-96 2.0L	(ABA)	
	USA	01M 927 733 EB
	Calif	01M 927 733 EA
	2.8L (AAA)	
	From 1H-S-072 799	01M 927 733 FJ
	From 1H-T-000 001	01M 927 733 CB
97-99	2.0L (ABA)	01M 927 733 CA
	2.8L (AAA)	01M 927 733 CB
	(AHU)	01M 927 733 BJ
Jetta		
95-96	2.0L (ABA)	
	USA	01M 927 733 EB
	Calif	01M 927 733 EA or CA
	2.8L	
	(Trans. No. F1B-S-XXX XXX)	01M 927 733 FJ
	(Trans. No. F1H-T-XXX XXX)	01M 927 733 CB
97-98	2.0L (ABA)	01M 927 733 CA
	2.8L (AAA)	01M 927 733 CB
	(ABU)	01M 927 733 BJ
99		
	(ALH)	01M 927 733 CA
	(ABG)	01M 927 733 CA
	(APP)	01M 927 733 CA
	(AWD)	01M 927 733 CA
	(AWM)	01M 927 733 CA
	(AVH-ABG)	01M 927 733 CA

Clutch Apply Chart

Even though the 096 and 01M use the same clutch layout, the elements in use is different. Note the difference between the 2-3 and 3-4 shifts between the 096 phase 2 and the 01M.

K1 = Fwd Clutch

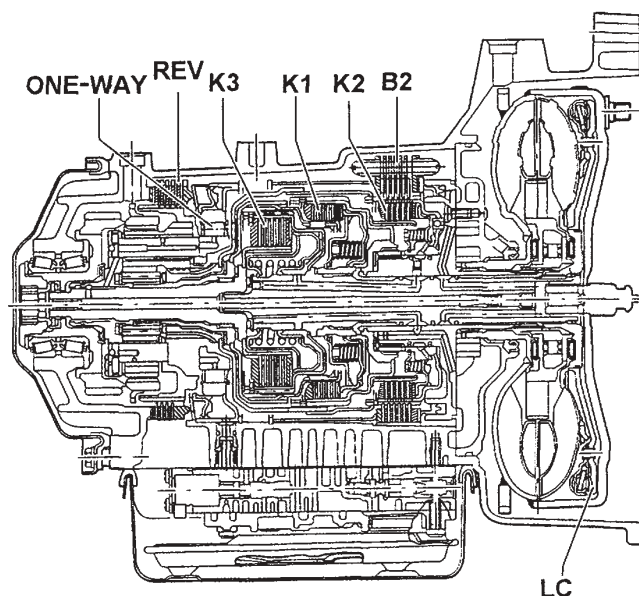
K2 = Rev. Input (096); Rev. Input and 3rd Clutch (01M)

K3 = 3 / 4 (096); 4th Clutch (01M)

B1 = Man. Low and Rev. Brake

B2 = 2nd/4th Brake

F1 = Low Roller



096 Phase 2

Gear	B1	B2	K1	K2	K3	F	LC	GEAR RATIO
Man Low	●		●					
Reverse	●			●				2.88
Dr. 1H			●			●		2.71
Dr. 1M			●			●	●	
Dr. 2H		●	●					1.44
Dr. 2M		●	●				●	
Dr. 3H			●		●			1.00
Dr. 3M			●		●		●	
Dr. 4H		●			●			0.74
Dr. 4M					●		●	

01M Transmission

Gear	B 1	B 2	K 1	K 2	K 3	F	L C	GEAR RATIOS
R	X			X				2.88
1H			X			X		2.71
1M			X			X	X	
2H		X	X					1.44
2M		X	X				X	
3H			X	X				1.00
3M			X	X			X	
4H		X			X			0.74
4M		X			X		X	

X = clutches, brakes or free wheel engaged

H = hydraulic

M = mechanical

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Servicing

There is no dipstick on the Phase 2 096 and 01M transaxles. A standpipe is located in the oil pan. The oil level is correct when the level of oil in the pan is even with the top of the standpipe. If the oil is too high, the excess oil will spill out when the inspection plug is removed. The following steps must be followed for the level to be correct.

Step 1) Make sure the vehicle is level.

Step 2) Start the engine and warm it up to about 85-95 degrees F.

Step 3) Run the gear selector through all ranges ending in Park.

Step 4) Remove the inspection plug.

Step 5a) Allow excess oil to run out and replace inspection plug.

Step 5b) If needed, remove RED fill cap and add oil.

Order the replacement RED cap under VW 014 301 485 (cost \$2.00)

Or in a service kit 01M 398 998

The service capacity is about 3 qts (an overhaul takes about 6 qts.)



**Allow
transmission
oil to run out
of the stand
pipe.**

Pressure and Fluid Specifications

The 096 uses Dextron.....01M requires VW synthetic ATF

VW Synthetic ATF

G 052 162 A1 (.5L)

G 052 162 A2 (1.0L) about \$15.00/liter

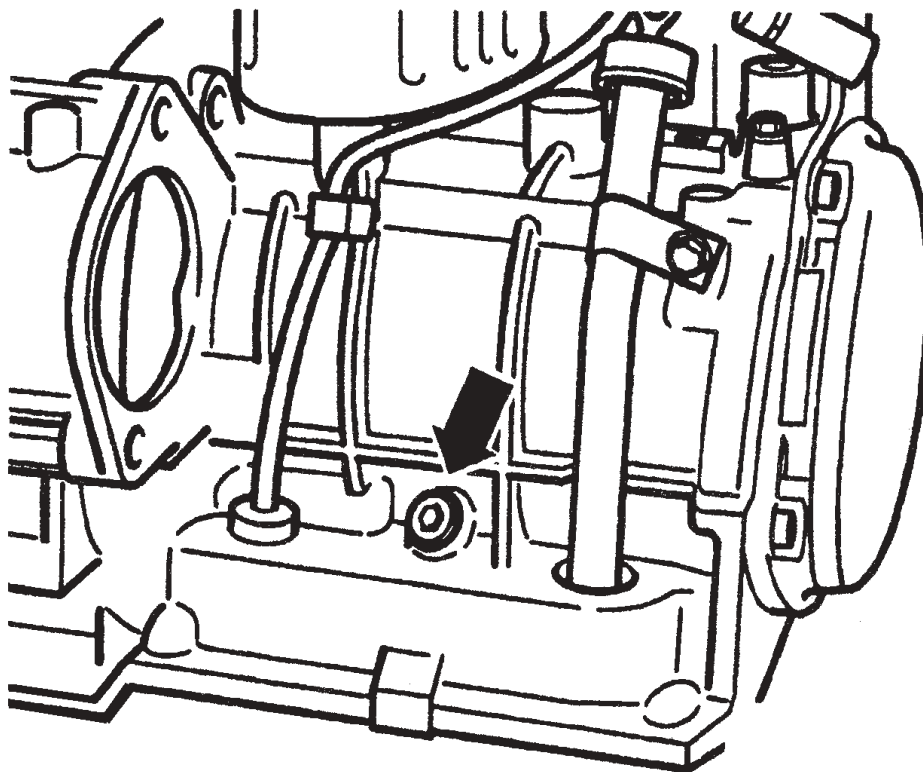
VW Synthetic 75 W90 gear oil

G 052 145 A1 (.5L)

G 052 162 A2 (1.0L)

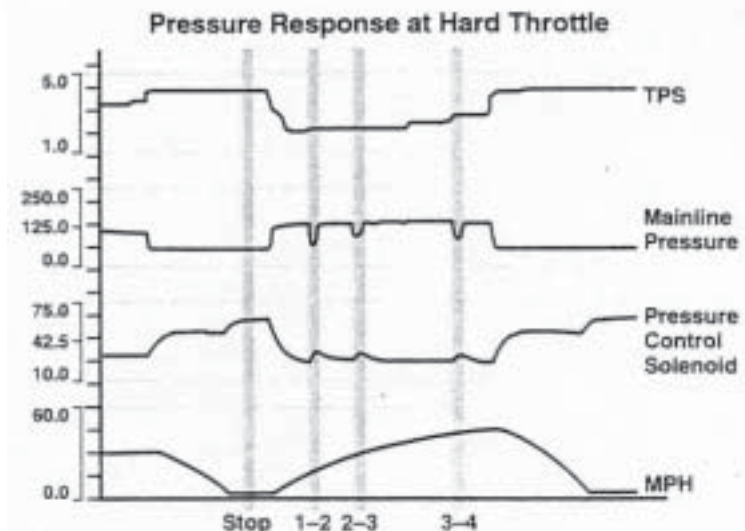
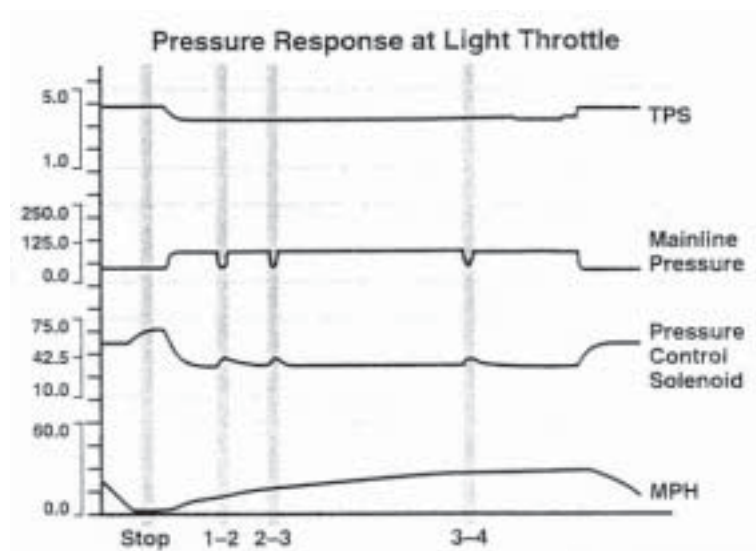
Use a 0-400 psi pressure gauge.

	Idle	2000 RPM W/ Wiring Disconnected
D	49-55	146 164
R	94-109	334-348



Pressure Response Charts

These charts display the change in line pressure in response to TPS and vehicle speed. Note the drop in pressure during the shift. The pressure can drop down as low as 60-75 lbs. and then return to line pressure. This is normal. During engagements and each shift, the number 5 solenoid is cycled. This solenoid hydraulically operates three orifice control valves. There is one valve for each of the following clutches: B2, K1 and K2. Each valve bleeds clutch apply oil back to the pan. All three orifice control valves operate during all forward shifts. In Reverse, the number 5 solenoid works to cushion the B1 clutch and the K2 orifice control valve cushions the K2 clutch.



01M / 096

Rebuilding Tips

This unit can be a money maker. The owners like driving their VWs, and these cars hold their resale value. The dealers charge \$4,000-5,000 for an exchange unit plus any computer and/or electrical repairs the car may need. In some areas, the closest dealer maybe 100+ miles away.

The truth is, this unit is very easy to build. Service parts, information and scan tools are now readily available. The aftermarket has or will soon release replacement parts for the valve body. Most of the units don't require any more than a master kit, filter, a couple of solenoids, a new wire harness, converter and don't forget \$100.00 in VW ATF (if it's an 01M). This still leaves at least a \$3,000 margin. The most common hard part damage seems to be the K3 clutch, the pump and occasionally the planets. The only red herring left is the valve body. If it's worn out or can't be fixed, the only options would be to spend \$500.00 at the dealer or get a guaranteed valve body from a supplier.

NOTE: Replace all moulded pistons during overhaul.

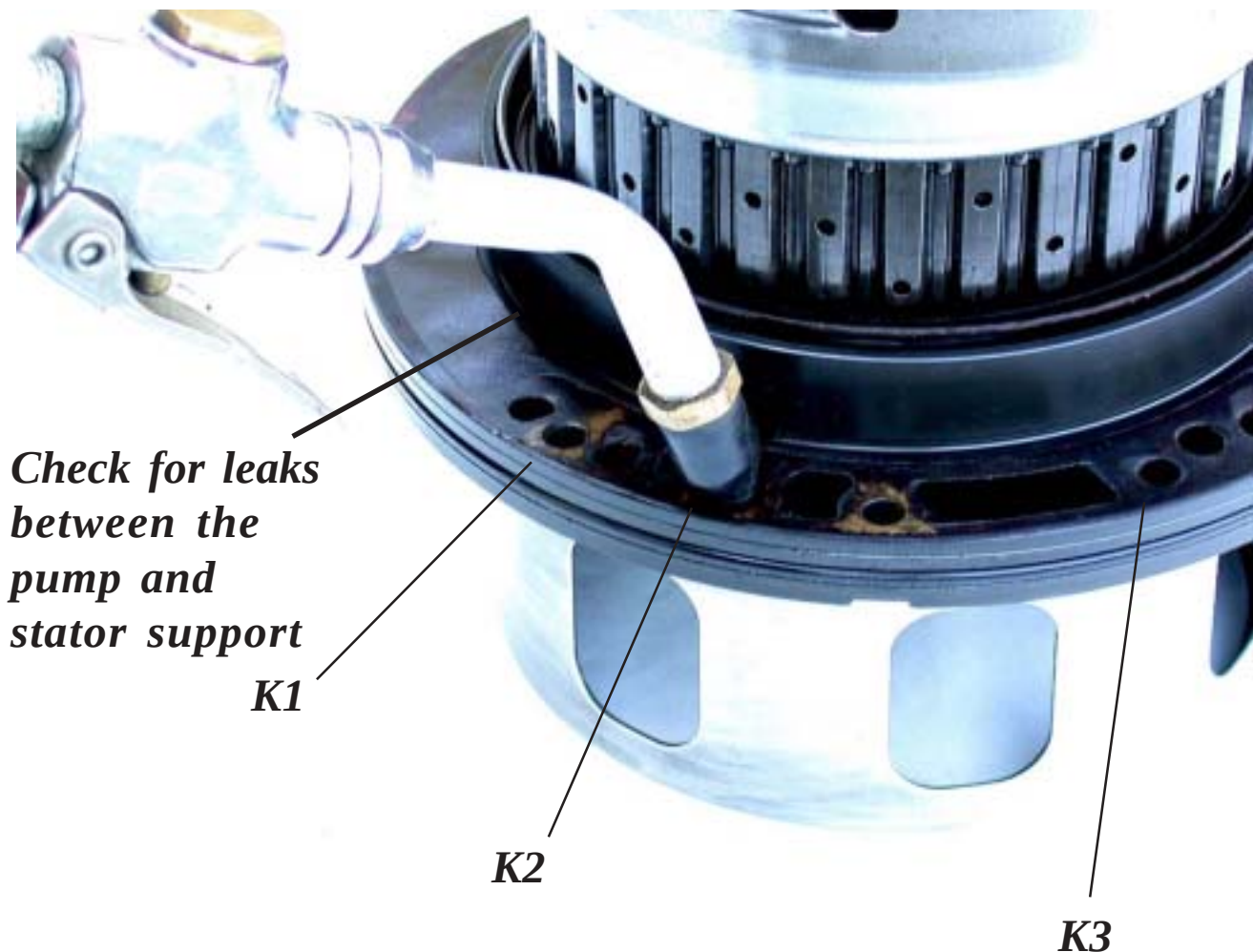


01M / 096

Rebuilding Tips

Pump Warpage

To check for proper clutch operation, air check the clutches stacked on top of oil pump before disassembly and during reassembly. This checks for leaks in the oil pump assembly.

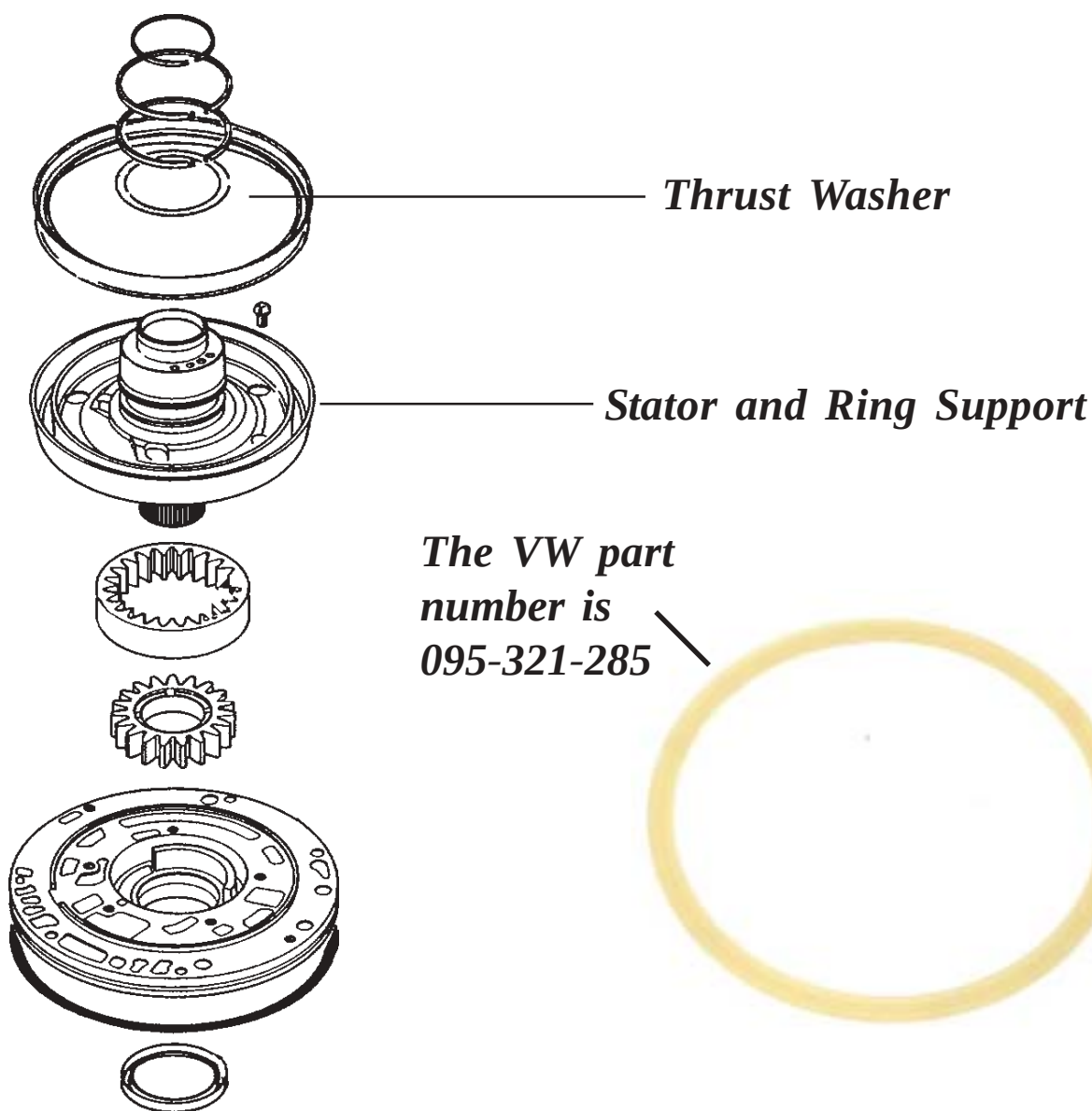


01M / 096

Rebuilding Tips

Stator Support Thrust Washer

Always replace the Stator Support thrust washer during the rebuild. This washer retains a major amount of heat and becomes very brittle. Failing to replace this washer may lead to premature failure of the washer after overhaul and major damage to the transmission.



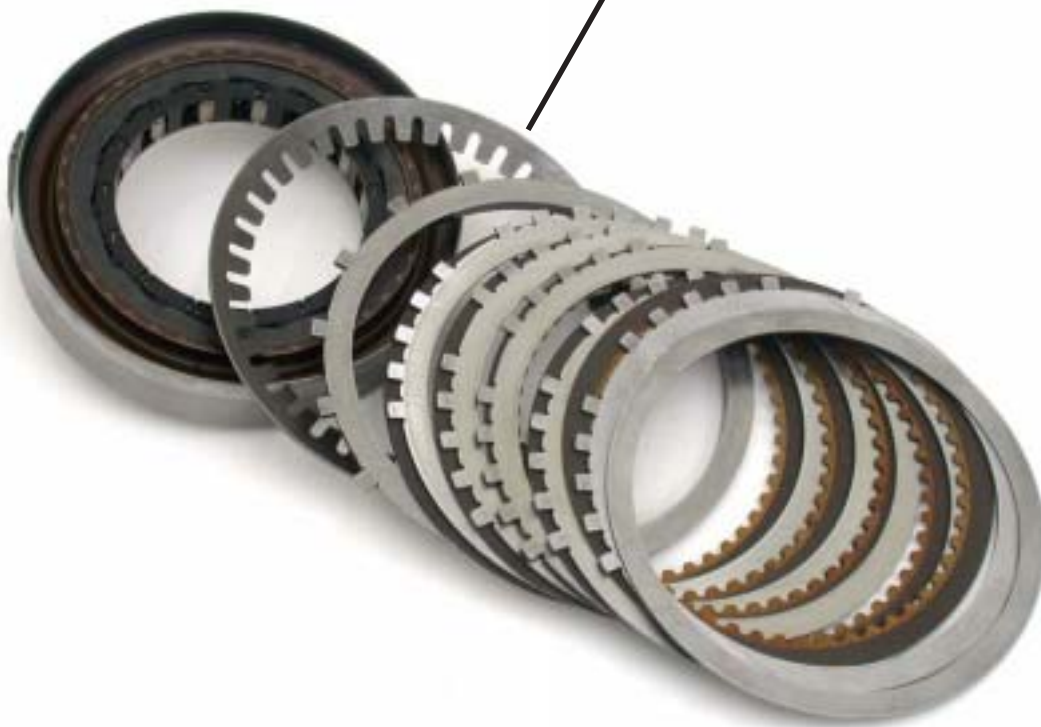
01M / 096

Rebuilding Tips

B1 clutch

During the assembly of the B1 clutch make sure to install the diaphragm spring with the cone up. Always be aware of the location of the wave spring. If the wave spring is installed incorrectly a clutch failure or harsh/soft engagements may be felt.

**Wave
Spring
Location**



01M / 096

Rebuilding Tips

B2 clutch

During the assembly of the B2 clutch make sure the wave plate is installed against the B2 piston.

**Make sure
the wave
plate sits
under the
thick
pressure
plate**



01M / 096

Rebuilding Tips

Solenoid Description (NXX shown on scanner)

- #1 N88 = K1/B1 Shift Solenoid (EV1)
- #2 N89 = B2 Shift Solenoid (EV2)
- #3 N90 = K3 Shift Solenoid (EV3)
- #4 N91 = TCC Solenoid (EV4) (Non-PWM on 096 / PWM on 01M)
- #5 N92 = Shift Apply Feel Solenoid (EV5)
- #6 N93 = EPC Solenoid (EV6)
- #7 N94 = 3rd and 4th Control Solenoid (EV7) (O96)
- #7 N94 = K1 Clutch Kickdown Control Solenoid (EV8) (O1M)

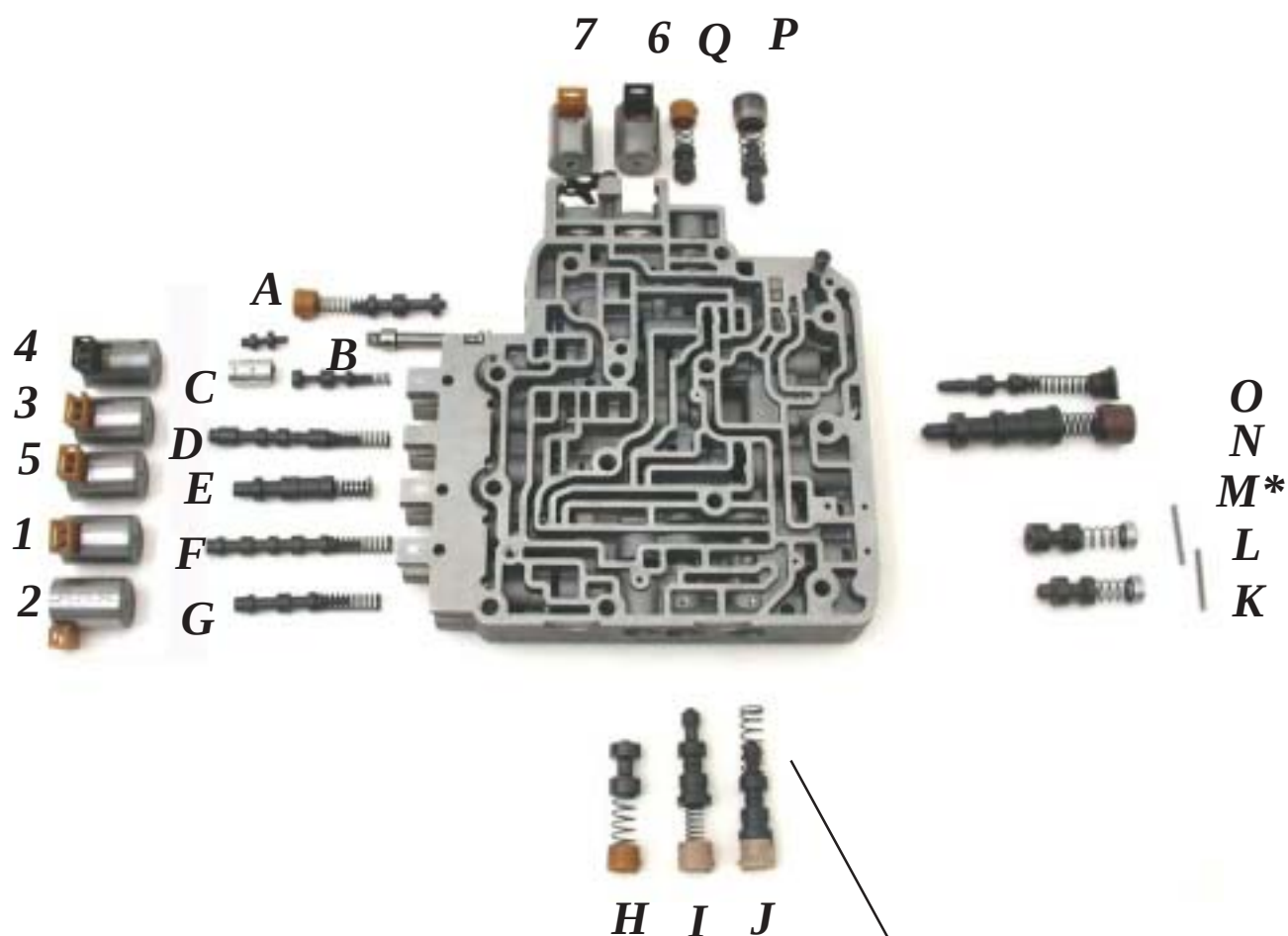
Valve Description

- A = Manual Low Valve
- B = Manual Valve
- C = TCC Modulator Valve
- D = K3 Shift Valve
- E = B1/Shift Control Valve
- F = K1/B1 Shift Valve
- G = B2 Shift Valve
- H = B2 Orifice Control Valve
- I = 3-4 Regulator Valve
- J = 2-3 Regulator Valve (O96)/Blocked (O1M)
- K = K1 Orifice Control Valve
- L = K2 Orifice Control Valve
- M = Boost Control Valve (Not Shown)
- N = Main PR
- O = Converter Regulator Valve
- P = Solenoid Feed Limit Valve
- Q = Manual 1 Regulator Valve

01M / 096

Rebuilding Tips

01M Valve Body Exploded View



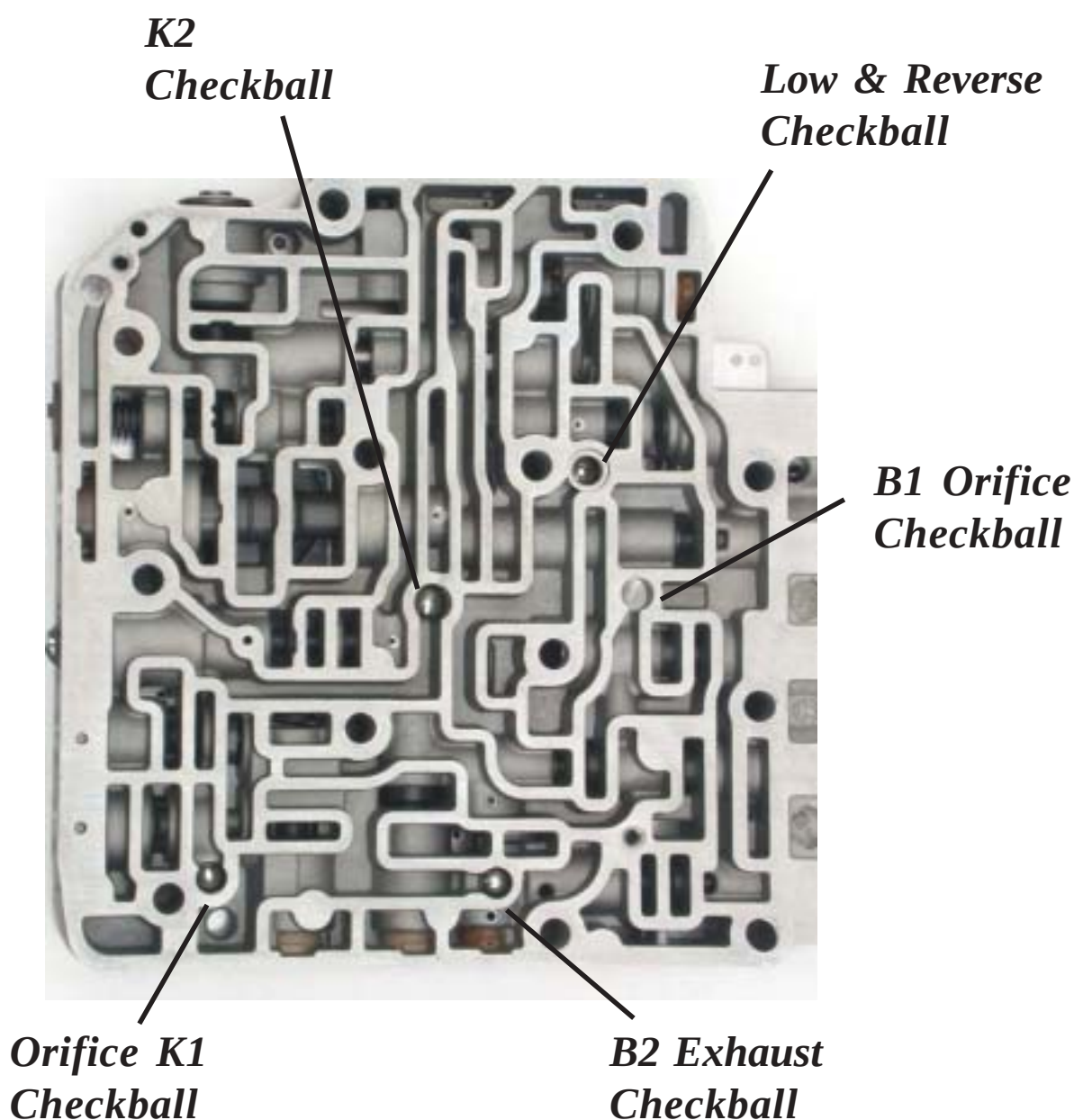
*096 Valve First
01M Spring First*

** M - Not Shown*

01M / 096

Rebuilding Tips

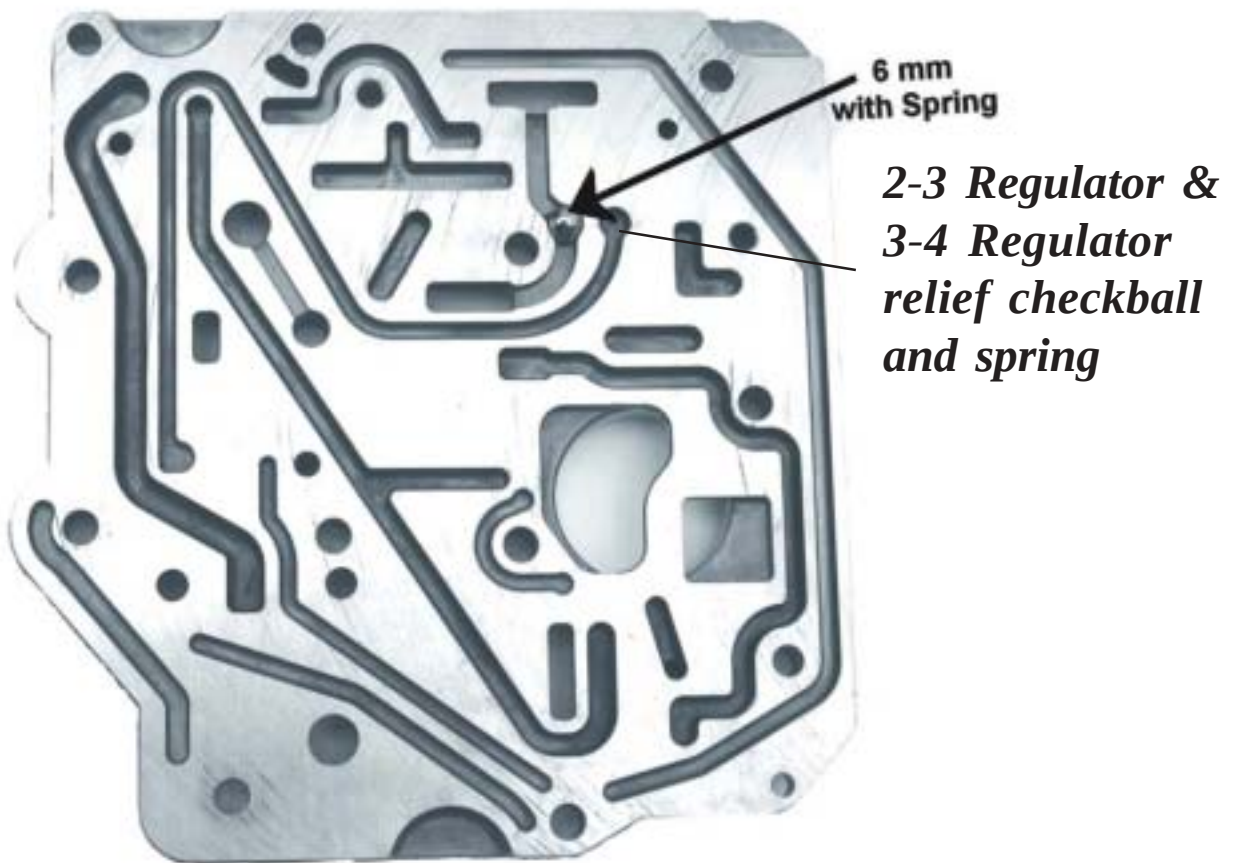
01M Check Ball Locations



01M / 096

Rebuilding Tips

Check Ball Locations

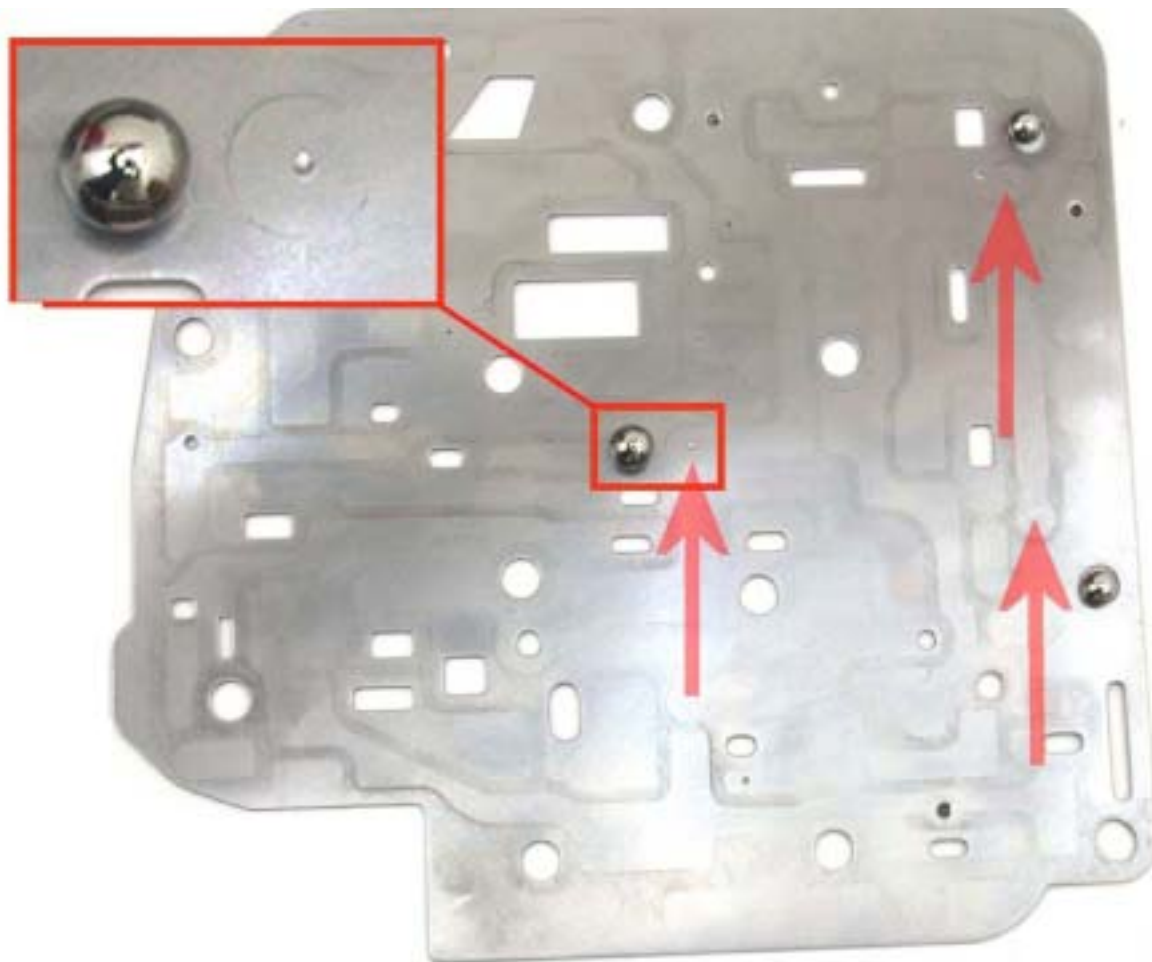


01M / 096

Rebuilding Tips

01M Check Ball Locations

Another way to identify the checkball location is to locate the “Dimples” in the separator plate. However not all separator plates will have these dimples, locate the check ball area if a check ball was in the valve body it will surely leave a mark on the separator plate.



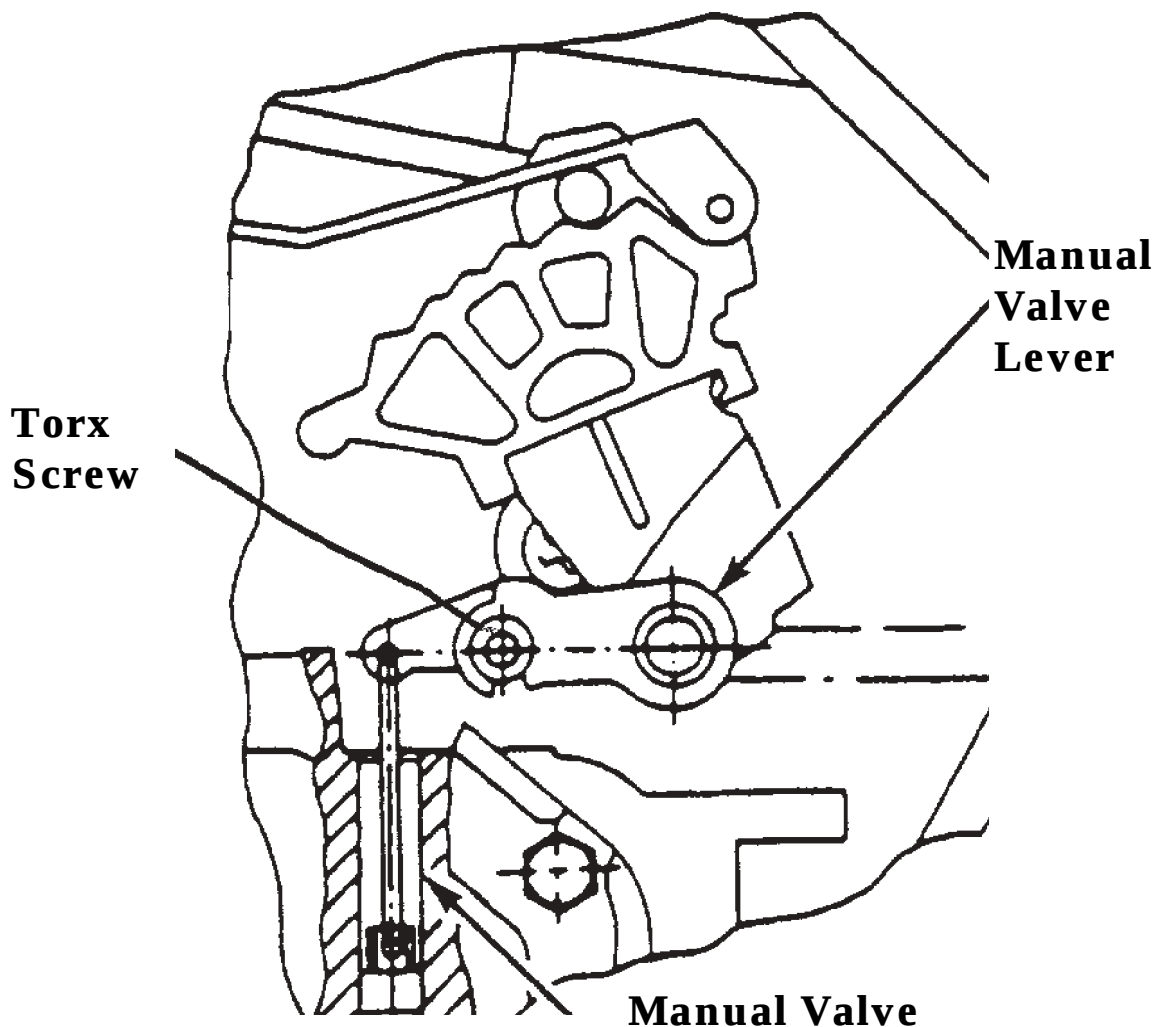
01M / 096

Rebuilding Tips

Adjusting the Manual Valve

If the line pressure in D is low, but correct in Manual 3, suspect a misadjusted manual valve. To Adjust the manual valve properly you must first:

1. Select the Park position
2. Loosen the Torx screw
3. Bottom out the Manual Valve in the Valvebody
4. Tighten Torx screw



01M / 096

Rebuilding Tips

Rebuild Specifications		
Clutch Clearances		
B1	5 Clutches	.047"
B2	5 or 6	.070"-.076"
K1 ¹	5 Plates	.060"-.075"
K2 ¹	5 Plates	.070"-.080"
K3		.010"- .012" / friction
Endplay		
Planet geartrain / carrier		.009"-.014"
K2 to K1		.023"-.040"
Input shaft		.019"-.047"
Torque Specifications		
Drive gear hex head nut		184 ft. lbs.
Driven gear nut		184 ft. lbs.
Diff. cover bolt		84 Inch lbs.
Input shaft / Planet bolt		22 ft. lbs.
Manual valve lever screw		35 Inch lbs.
Oil pan bolt		108 Inch lbs.
Oil pump bolt		70 Inch lbs. + ¼ Turn
Transfer gear cover bolt		70 Inch lbs.
Transfer / Pinion shaft seal retainer		150 ft. lbs.
Valve body bolt		44 Inch lbs.

¹ personnel observations

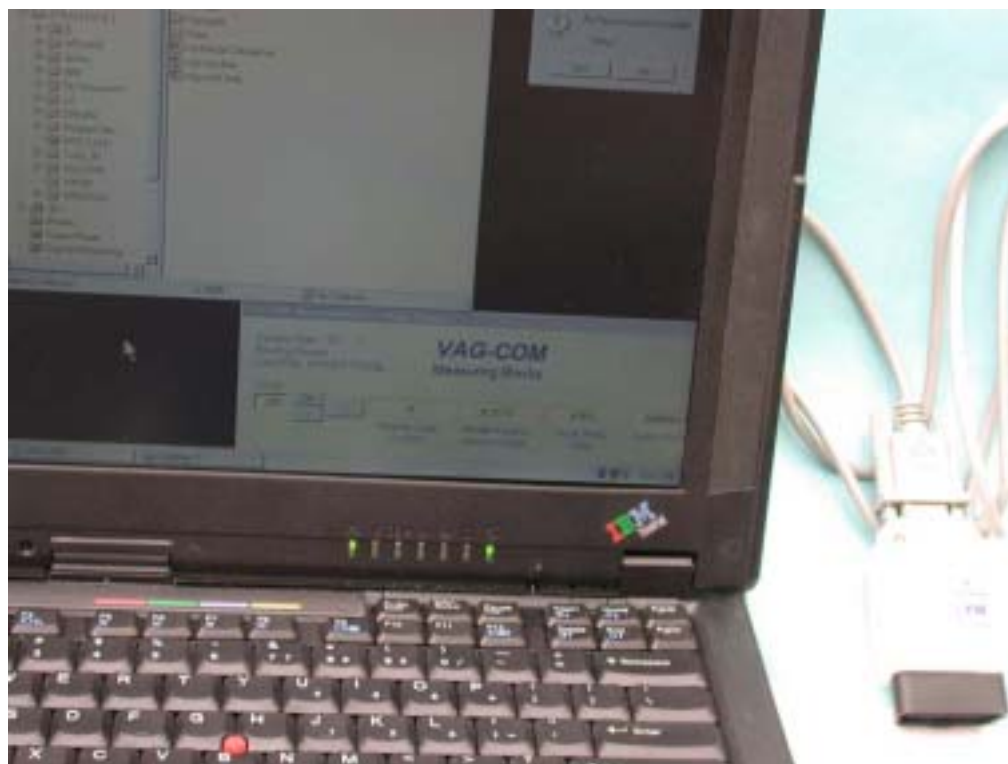
Electronic Diagnosis

Scanning for Codes and Data

In order to scan the TCU, you must have a VAG1551/2 or VAG compatible scanner. VAG stands for Volkswagen Audi Group. Depending on your current shop equipment, you can get one from Ross-Tech for \$250.00. Their software is downloaded into your PC or laptop. AST, BAUM and others, offer similar software or stand alone scanners from \$650.00-2,500.00. Or you could take the car to a dealer (if they are local) to get codes and scan data.

Why buy a specialized scanner? My current scanner can access the TCU under Generic.

Using your current scanner under Generic mode will clear codes and retrieve select codes. A VAG type scanner will retrieve all codes, display the data stream and reset the TCU base values. These cars are known to have lots of connector and wiring problems. With a scanner, you can pinpoint the problem. Also, when the battery is disconnected, these cars may stay in limp until the TCU is reset or all codes are cleared.



Electronic Diagnosis

Scanning for Codes and Data (continued)

Limp Mode

Limp mode on a 096 or 01M is 3rd gear in any forward range and Reverse. In limp mode, either the D position light stays on no matter where the gear selector is moved to or all PRNDL positions will light up.



Electronic Diagnosis

Scanning for Codes and Data (continued)

VAG Code Definitions

VAG DTC	Description
00258	Open Or Short to Ground Or Faulty Solenoid No. 1
00260	Open Or Short to Ground Or Faulty Solenoid No. 2
00262	Open Or Short to Ground Or Faulty Solenoid No. 3
00264	Open Or Short to Ground Or Faulty Solenoid No. 4
00266	Open Or Short to Ground Or Faulty Solenoid No. 5
00268	Open Or Short to Ground Or Faulty Solenoid No. 6
00270	Open Or Short to Ground Or Faulty Solenoid No. 7
00281	Open In Wiring, Faulty Vehicle Speed Sensor (VSS) Or Impulse Wheel Loose
00293	Open In Wiring Or Faulty Transmission Range (TR) Switch
00297	Open In Wiring Or Faulty Transmission VSS
00300	Open In Wiring Or Faulty Transmission Temperature Sensor
00518	Open Or Short In Wiring Or Faulty Throttle Position Sensor ^{1,2}
00529	Open In Wiring, Engine Speed Information Missing
00532	Battery Faulty Or Poor Voltage Supply To Solenoid Valves
00545	Open Or Short To Ground (No Communication Between ECM & TCM)

Electronic Diagnosis

Scanning for Codes and Data (continued)

VAG Code Definitions

00596	Short In Wiring Between Solenoid Valves
00638	Open Or Short To Ground (No Communication Between ECM & TCM)
00641	ATF Temperature Too High Or Faulty ATF Temperature Sensor
00652	Gear Ratio Error/Hydraulic Malfunction (Clutch Or Valve Body Faulty)
00660	Open Wiring Or Incorrect Signal From TP Sensor (Faulty TP Sensor)
65535	Faulty TCM

1 - On 6-cylinder or diesel engine models, TP signal is sent through ECM to TCM

2 - On vehicles with CAN-Bus system, TCM checks signal from TP sensor only, not TP sensor operation. On Vehicles without CAN-Bus system, wire to TCM from TP sensor for signal is also checked. If DTC is retrieved from TCM or TP sensor, retrieve ECM DTC and repair first.

Electronic Diagnosis

Scanning for Codes and Data (continued)

Generic Codes

Use this chart to convert generic codes to VAG codes. Some codes are not available under generic mode.

Example: A very common code is 00652 for gear ratio or gear slip code. Only a VAG type scan tool can display this code.

Generic DTC Interchange

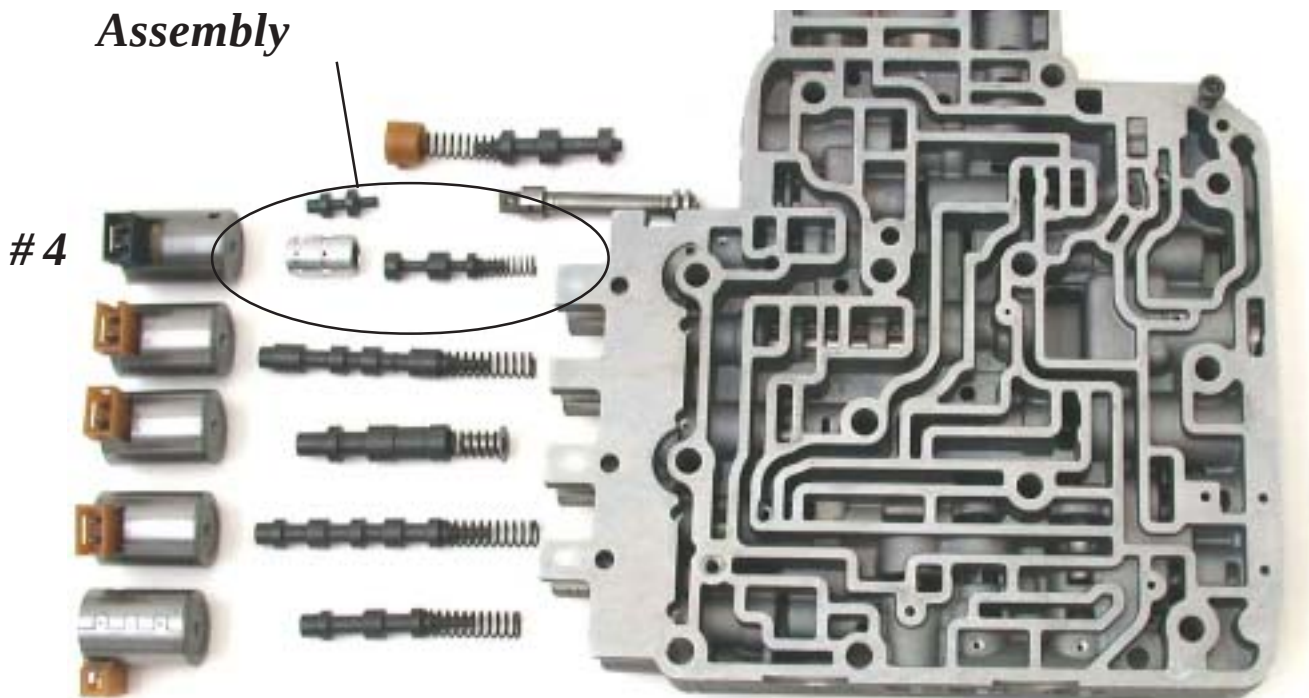
Generic	VAG DTC	Definition
P0120	16505 (00518)	TPS
P0501	16885 (00281)	VSS
P0715	17099 (NA)	TSS
P0722	17106 (00297)	OSS
P0725	17109 (00529)	RPM
P0748	17132 (00268)	EPC
P0753	17137 (00258)	Solenoid 1
P0758	17142 (00260)	Solenoid 2
P0763	17147 (00262)	Solenoid 3
P0768	17152 (00264)	Solenoid 4
P0773	17157 (00266)	Solenoid 5
P1778	18186 (00270)	Solenoid 7

01M / 096

Kills Engine in Gear and/or Engine Code P1582 (Idle Too Low)

This problem is usually caused by a clogged TCC solenoid #4 or a worn TCC boost valve and sleeve. Since the TCU has the ability to turn lockup on in any forward gear, a short circuit or bad TCU may also cause the TCC to kill the engine in gear.

TCC Solenoid and Valve Assembly



01M / 096

Neutral or Flare on Take Off

This is usually caused by no line rise. Using a VAG scanner, make sure the computer commands lower amperage during acceleration. If not, check TPS, scan the PCM and TCM to locate the electrical problem. If the TCU works correctly, replace or clean the # 6 EPC solenoid.

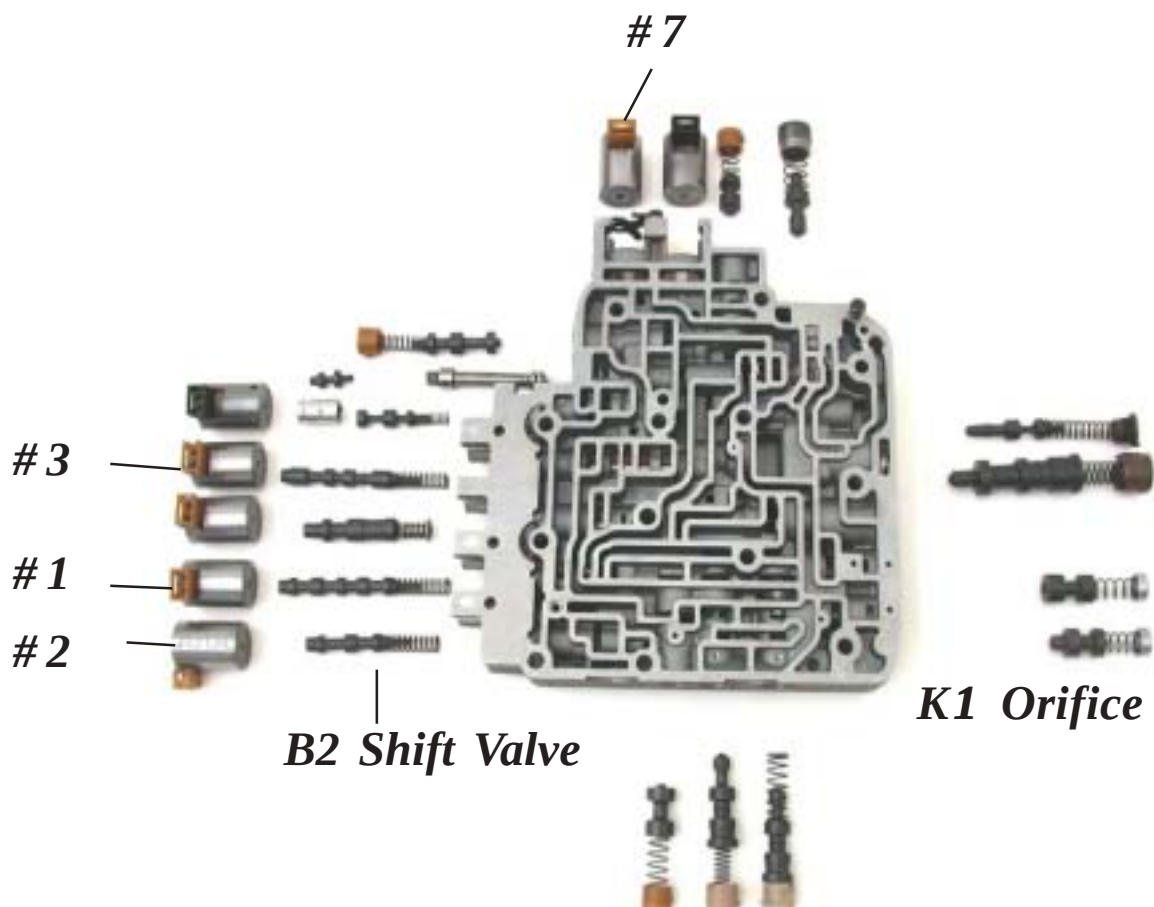


01M / 096

Momentary 3-4 Bind or Flare

If a momentary bind occurs, the K1 clutch may not be exhausting fast enough. Make sure solenoid #1 and solenoid #7 are not plugged. Check the K1 shift valve, 3-4 shift control and K1 orifice control valves can stroke freely in their bores .

If a flare occurs, the B2 or K3 clutch circuits are coming on too slow. If 2nd gear works good, check solenoid #3 and make sure it's not plugged. Make sure the K3 shift valve strokes freely in it's bore. If the K3 shift valve strokes freely and you still have this problem try installing a lighter shift valve spring. If 2nd gear is also soft, install a 20-30% stronger B2 orifice control spring.



01M / 096

Hard or Slide Bump 1-2

This is a common complaint after overhaul. The driver may have “lived” with this problem for a long time. It’s usually caused by low line rise or general wear in the valve body. If this is the only complaint and line rise looks good, turn the boost control valve end cap one turn in. Some builders make a habit of turning this cap $\frac{1}{2}$ in during overhaul.



***Turn Boost Sleeve in
One Turn Clockwise***

01M / 096

Shuttle Shifts 1-2-1-2 or 3-4-3-4

Feels like high gear starts, then bangs after you start rolling. This is usually an installer created problem. The wiring for the speed sensors are easy to cross up. Make sure the turbine speed sensor wires are Green and Red and the Output Speed Sensor wires are Yellow and White. A VAG scanner will display MPH while sitting still.

If the two speed sensors are installed correctly, check the valve body for stuck valves or solenoid malfunctions.



***OSS =
Yellow and
White Wires***

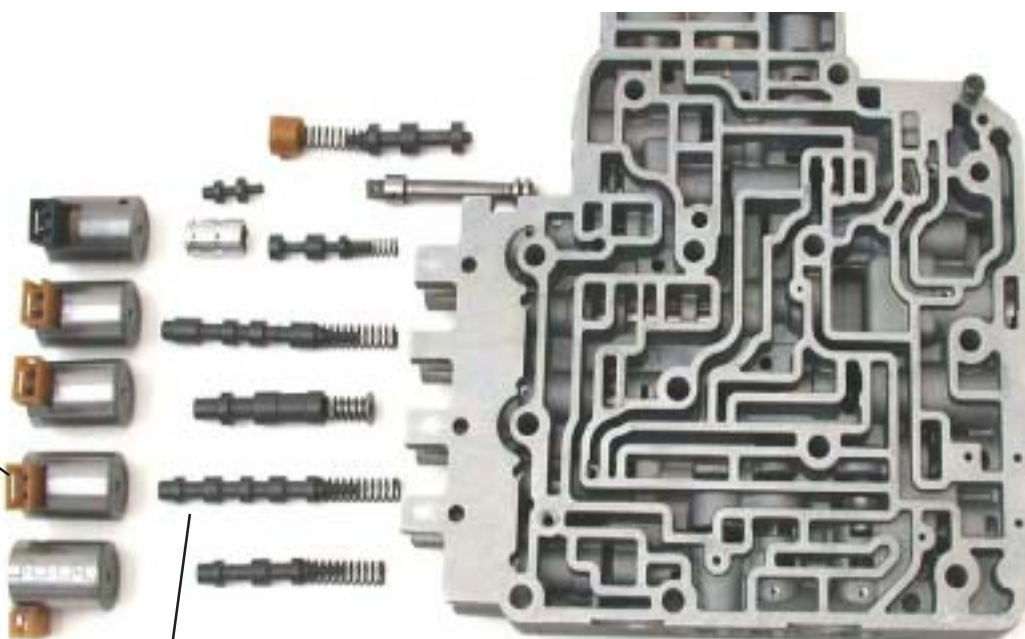
***TSS =
Green and
Red Wires***

01M / 096

No Forward Except Manual Low

This condition is caused by the K1 clutch not holding. Pull the valve body and air check the K1 clutch. If it air checks, look for a stuck K1 shift valve or plugged #1 solenoid.

**#1
K1/B1
Solenoid**



K1 Shift Valve

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Conversion Tables

Area		
Multiply	By	To Obtain
In ²	645.2	mm ²
In ²	6.452	cm ²
In ²	0.0069	Ft ²
Ft ²	0.0929	m ²
Ft ²	144.0	In ²
m ²	10.764	Ft ²
cm ²	0.155	In ²
mm ²	0.00155	In ²
area of a circle = ϕr^2 area of a cylinder = $\phi r^2 h$		
$\phi = 3.14$ r = Radius h = Height		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Continued...

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

* The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

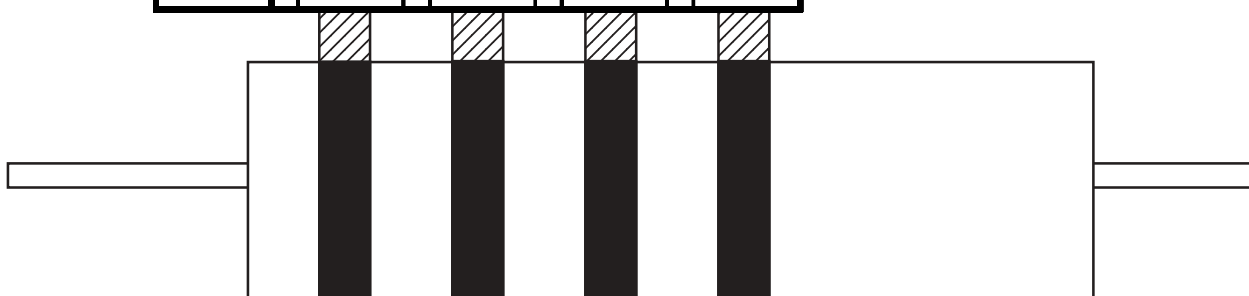
Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	0	—
Brown	1	1	1	—
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Brown	—	—	—	1%
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%

**Brown
1%**



So if the bands are:

Blue	Green	Yellow	Silver
6	5	0,000	±10%
Red	Violet	Brown	Gold
2	7	0	±5%
White	Orange	Violet	Plain
9	3	0,000,000	±20%

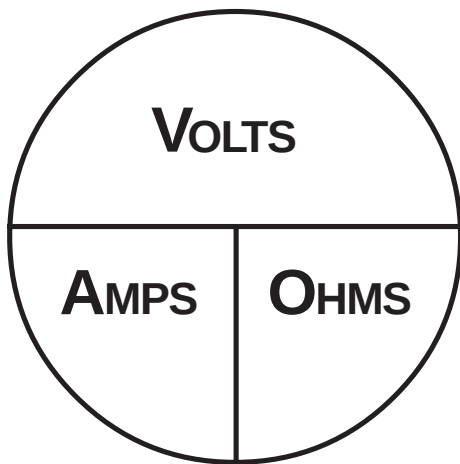
The resistor value is:

= 650 kΩ, ±10%

= 270 Ω, ±5%

= 930 MΩ, ±20%

Ohm's Law



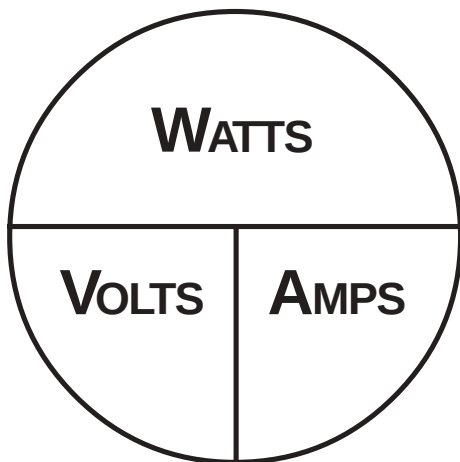
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

Multiple Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

Schematic Symbols

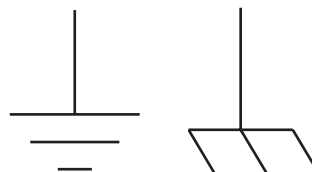


Battery

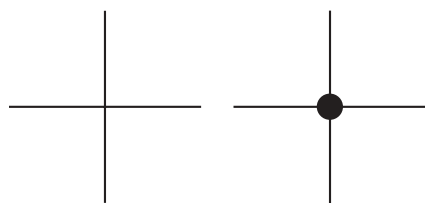
+V



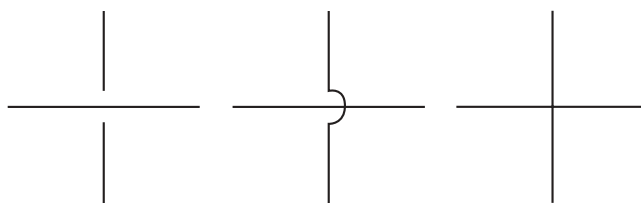
Power



Ground



Connected Wires



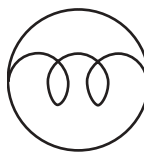
Unconnected Wires



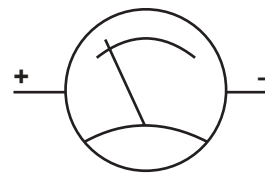
Fuse



Circuit Breaker



Bulb

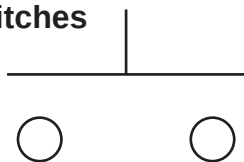


Meter

Pushbutton Switches



NC Switch

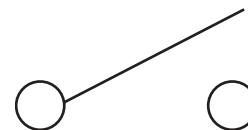


NO Switch

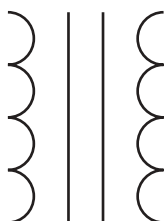
On/Off Switches



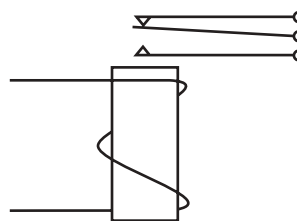
NC Switch



NO Switch



Transformer (Coil)



Relay

Schematic Symbols (continued)



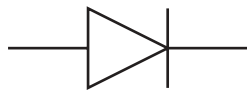
Fixed Resistor



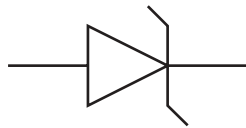
Variable Resistor



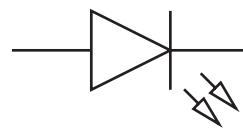
Potentiometer



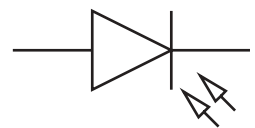
Diode



Zener Diode



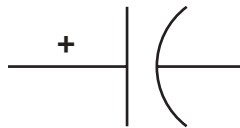
LED



Photodiode



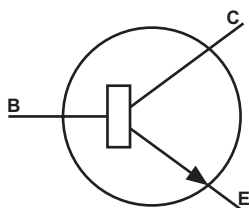
Fixed Capacitor



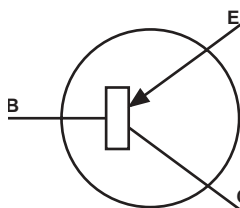
Fixed Capacitor (Polarized)



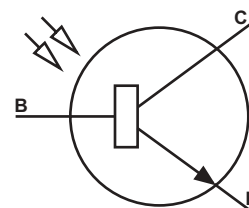
Variable Capacitor



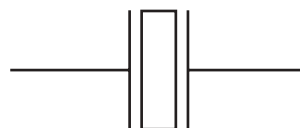
NPN Transistor



PNP Transistor



Phototransistor



Crystal

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition system.

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Continued...

Glossary of Electrical Terms (cont)

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less

change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific direction, or the LED won’t light.

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm’s Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). $\text{Ohms} \times \text{Amps} = \text{Volts}$; $\text{Volts} \div \text{Ohms} = \text{Amps}$; $\text{Volts} \times \text{Amps} = \text{Watts}$.

Open Circuit — An incomplete electrical path that won’t provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won’t operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component’s operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won’t prevent the other legs

Continued...

Glossary of Electrical Terms (cont)

from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the voltage signal, based on its position along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device controlling the circuit.

Resistance — The ability of a circuit or device to

reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely be dealing with open and close to control hydraulic flow, to allow the transmission to shift gears, control lockup, and control line pressure.

Continued...

Glossary of Electrical Terms (cont)

Thermistor — A semiconductor that varies resistance based on temperature. There are two types of thermistor: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). The NTC thermistor is more common — as the temperature goes up, its resistance goes down.

Transistor — A semiconductor that operates as an electronic “relay.” Transistors allow a low current circuit to control power or ground to a high current circuit.

Variable Resistor — A one- or two-wire sensor that modifies a voltage signal based on stress or temperature. Thermistors are the most common type of variable resistor in today’s cars and trucks.

Voltage — The pressure in an electrical system, that pushes current through the circuit. One volt of pressure is necessary to push one amp of current through one ohm of resistance. Sometimes called the circuit’s potential.

Voltmeter — Electrical test device that measures the voltage potential in a circuit. Displays its reading in volts.

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kV	Kilovolt
AC	Alternating current	kW	Kilowatt
B, b	Base electrode, units with single base	kWH	Kilowatt hour
°C	Degrees Celsius or centigrade	lb	Pound
C	Capacitance, capacitor	M	Mega; x1,000,000
C, c	Collector electrode	m	Milli; one-one thousandth; 1/1000; 0.001
cm	Centimeter	mf, mfd	Microfarad
cu	Cubic	MHz	Megahertz
db	Decibels	mm	Millimeter
DC	Direct current	NC	Normally closed
dm	Decimeter	Nm	Newton-meter
DPDT	Double-pole, double-throw switch	NO	Normally open
DPST	Double-pole, single-throw switch	R	Resistance; resistor
E, e	Emitter electrode	SPDT	Single-pole, double-throw switch
E, e	Voltage	SPST	Single-pole, single-throw switch
mf	Microfarad	t	Time
°F	Degrees Fahrenheit	T	Temperature
F, f	Frequency	V, v	Volt; voltmeter
flu	Fluid	V _{BB}	Base supply voltage (DC)
FM	Frequency modulation	V _{BC}	Base-to-collector voltage (DC)
g	Gram	V _{BE}	Base-to-emitter voltage (DC)
gnd, grd	Ground	V _{CB}	Collector-to-base voltage (DC)
Hg	Mercury	V _{CC}	Collector supply voltage (DC)
Hz	Hertz	V _{CE}	Collector-to-emitter voltage (DC)
I	Current	V _{EB}	Emitter-to-base voltage (DC)
I _B	Base current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _C	Collector current (DC)	v _{ee}	Emitter supply voltage (DC)
I _E	Emitter current (DC)	V _F	Forward voltage (DC)
k	x1000	W	Watt; work
kg	Kilograms	w	Watt
kHz	Kilohertz	wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	$1/128$	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	$15/128$	2.9769		
0.0156	$1/16$	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	$1/8$	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	$17/128$	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	$3/128$	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	$9/64$	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	$3/16$ -24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	$1/32$	0.7925			0.1484	$19/128$	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	$5/32$	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	$3/16$ -32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	$5/128$	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	$21/128$	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	$3/64$	1.1913		0-80 NF	0.1719	$11/64$	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	$7/128$	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	$23/128$	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1653		4.2000		5.5mm - 0.80
0.0625	$1/16$	1.5875			0.1820		4.6228	14	12-28 NF
0.0635		1.6129	52		0.1850		4.6990	13	12-32 NEF
0.0670		1.7018	51		0.1875	$3/16$	4.7625		
0.0700	$9/128$	1.7780	50	2-56 NC 2-64 NF	0.1890		4.8006	12	
					0.1910		4.8514	11	
0.0730		1.8542	49		0.1935		4.9149	10	14-20 NS
0.0760		1.9304	48		0.1953	$25/128$	4.9606		
0.0781	$5/64$	1.9837			0.1960		4.9784	9	
0.0785		1.9939	47	3-48 NC	0.1990		5.0546	8	
0.0810		2.0574	46		0.2010		5.1054	7	$1/4$ -20 NC
0.0820		2.0828	45	3-56 NF					14-24 NS
0.0860	$11/128$	2.1844	44	4-36 NS	0.2031	$13/64$	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	$3/32$	2.3825		$1/8$ -32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	$1/4$ -24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	$27/128$	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	$1/4$ -28 NF
0.1015		2.5781	38	$1/8$ -40NF 5-40NC	0.2188	$7/32$	5.5575		$1/4$ -32 NEF
					0.2210		5.6134	2	
0.1016	$13/128$	2.5806			0.2266	$29/128$	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	$1/4$ -40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	$7/64$	2.7788			0.2344	$15/64$	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	²⁹ / ₆₄	11.5087		¹ / ₂ -20 NF
0.2422	³¹ / ₁₂₈	6.1519							¹ / ₂ -24 NS
0.2460		6.2484	D		0.4609	⁵⁹ / ₁₂₈	11.7069		
0.2500	¹ / ₄	6.3500	E		0.4688	¹⁵ / ₃₂	11.9075		
0.2570		6.5278	F	⁵ / ₁₆ -18 NC	0.4766	⁶¹ / ₁₂₈	12.1056		
0.2578	³³ / ₁₂₈	6.5481			0.4800		12.1920		14mm - 2.00
0.2610		6.6294	G		0.4844	³¹ / ₆₄	12.3038		⁹ / ₁₆ -12 NC
0.2656	¹⁷ / ₆₄	6.7462			0.4922	⁶³ / ₁₂₈	12.5019		
0.2660		6.7564	H		0.5000	¹ / ₂	12.7000		14mm - 1.50
0.2720		6.9088	I	8mm - 1.25	0.5039		12.8000		14mm - 1.25
				⁵ / ₁₆ -24 NF	0.5156	³³ / ₆₄	13.0962		⁹ / ₁₆ -18 NF
0.2734	³⁵ / ₁₂₈	6.9444			0.5312	¹⁷ / ₃₂	13.0962		⁵ / ₈ -11 NC
0.2770		7.0358	J		0.5469	³⁵ / ₆₄	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	⁹ / ₁₆	14.2875		
0.2813	⁹ / ₃₂	7.1450		⁵ / ₁₆ -32 NEF	0.5781	³⁷ / ₆₄	14.6837		⁵ / ₈ -18NF
0.2891	³⁷ / ₁₂₈	7.3431							³/₈-18NPT
0.2900		7.3660	L		0.5787		14.7000		16mm - 1.50
0.2950		7.4930	M		0.5938	¹⁹ / ₃₂	15.0825		¹¹ / ₁₆ -11 NS
0.2969	¹⁹ / ₆₄	7.5413			0.6094	³⁹ / ₆₄	15.4788		
0.3020		7.6708	N		0.6220		15.8000		18mm - 2.50
0.3047	³⁹ / ₁₂₈	7.7394			0.6250	⁵ / ₈	15.8750		¹¹ / ₁₆ -16 NS
0.3110		7.8994		9mm - 1.25	0.6406	⁴¹ / ₆₄	16.2712		
0.3125	⁵ / ₁₆	7.9375		³ / ₈ -16 NC	0.6562	²¹ / ₃₂	16.6675		³ / ₄ -10 NC
0.3160		8.0264	O		0.6614		16.8000		18mm - 1.50
0.3190		8.1026		9mm - 1.00	0.6719	⁴³ / ₆₄	17.0663		
0.3203	⁴¹ / ₁₂₈	8.1356			0.6875	¹¹ / ₁₆	17.4625		³ / ₄ -16NF
0.3230		8.2042	P		0.7008		17.8000		20mm - 2.50
0.3270		8.3058		9mm - 0.75	0.7031	⁴⁵ / ₆₄			¹/₂-14 NPT
0.3281	²¹ / ₆₄	8.3337			0.7187	²³ / ₃₂			
0.3320		8.4328	Q	³ / ₈ -24 NF	0.7344	⁴⁷ / ₆₄			
0.3359	⁴³ / ₁₂₈	8.5319			0.7500	³ / ₄			
0.3390		8.6106	R	¹/₈-27 NPT	0.7656	⁴⁹ / ₆₄			⁷ / ₈ -9 NC
0.3430		8.7122		10mm - 1.50	0.7812	²⁵ / ₃₂			
0.3438	¹¹ / ₃₂	8.7325			0.7969	⁵¹ / ₆₄			
0.3480		8.8392	S		0.8125	¹³ / ₁₆			⁷ / ₈ -14 NF
0.3500		8.8900		10mm - 1.25	0.8228		20.9000		22mm - 1.50
0.3516	⁴⁵ / ₁₂₈	8.9306			0.8281	⁵³ / ₆₄			⁷ / ₈ -18 NS
0.3580		9.0932	T	10mm - 1.0	0.8425		21.4000		24mm - 3.00
0.3594	²³ / ₆₄	9.1288			0.8437	²⁷ / ₃₂			
0.3672	⁴⁷ / ₁₂₈	9.3269			0.8594	⁵⁵ / ₆₄			
0.3680		9.3472	U	⁷ / ₁₆ -14 NC	0.8750	⁷ / ₈			1-8 NC
0.3750	³ / ₈	9.5250			0.8779		22.3000		24mm - 2.00
0.3770		9.5758	V		0.8906	⁵⁷ / ₆₄			
0.3820		9.7028		11mm - 1.50	0.9062	²⁹ / ₃₂			
0.3828	⁴⁹ / ₁₂₈	9.7231			0.9219	⁵⁹ / ₆₄			1-12 NF
0.3860		9.8044	W						³/₄-14 NPT
0.3906	²⁵ / ₆₄	9.9212		⁷ / ₁₆ -20 NF	0.9375	¹⁵ / ₁₆			1-14 NS
0.3970		10.0838	X		0.9531	⁶¹ / ₆₄			
0.3984	⁵¹ / ₁₂₈	10.1194			0.9687	³¹ / ₃₂			
0.4040		10.2616	Y		0.9844	⁶³ / ₆₄			
0.4063	¹³ / ₃₂	10.3200			1.0000	1			
0.4130		10.4902	Z	12mm - 1.75					
0.4141	⁵³ / ₁₂₈	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	²⁷ / ₆₄	10.7163		¹ / ₂ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	⁵⁵ / ₁₂₈	10.9144							
0.4375	⁷ / ₁₆	11.1125		¹/₄-18NPT					
0.4453	⁵⁷ / ₁₂₈	11.3106							

2004

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The 4L60E-Late Shift Correction Package 1998 & up (K4L60E-L)

The 4L60E-L Kit helps to eliminate the following problems: ✓ Code 1870
✓ Delayed engagements ✓ Slide bump 2nd & 3rd ✓ 3-4 clutch burn-up
✓ Help for worn plates ✓ Provides more lube oil ✓ Regular and Heavy duty applications ✓ Improves overall transmission performance

- Includes PWM PowerValve to correct code 1870 problems and still maintain normal computer strategy of the converter.
- Includes oversized checkballs to give new life to the original worn separator plate.



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The Chrysler 42/46/47-RE Late Shift Correction Package helps eliminate the following problems: ✓ Premature band failure ✓ Inadequate line pressure ✓ Slow engagements ✓ Premature clutch failure ✓ Lower 2-3 shift RPM ✓ Full time lube ✓ Rapid fill manual valve ✓ Regular, Heavy Duty, Gas & Diesel

- The governor control valve limits excess governor pressure caused by increased mainline operating pressure needed for Heavy Duty use.
- Allows building the unit for extreme heavy duty applications without fear of getting governor sensor code 1763
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2004 TECHNICAL SEMINAR



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Dennis Madden
Chief Executive Officer

Welcome to the 2004 ATRA Technical Seminar! As you're probably already aware, this is ATRA's 50th year of serving the automatic transmission industry.

As with any major milestone, this year's anniversary has caused us to examine the changes that have taken place over the last half century. And nowhere are those changes more evident than in this, our annual technical seminar program.

This year — our 50th year — marks another milestone in the evolution of the ATRA technical seminar. Because this year, for the first time, the ATRA seminar manual has been developed and printed in full color!

Having worked on several seminar manuals myself I know what it takes to produce a seminar. Lance Wiggins and the ATRA Technical staff have really pull out all the stops this year; another sign of the new things coming out of the "New" ATRA.

This seminar, along with everything else at ATRA is a group effort, with a lot of effort in the background that nobody ever sees. I could not be more delighted with the staff here at ATRA.

ATRA is changing all the time: with the new items like the 3-year Golden Rule warranty, to give your customer that added peace of mind; point-of-sale items to make your shop look even more professional; Nation-wide advertising and referral services, getting more consumers into ATRA Members' shops. These are just a few of the changes you've seen in the past year, and it's only the beginning.

On behalf of the ATRA staff, and the ATRA Chapters that work so hard to bring you this seminar, welcome.

Sincerely,

A handwritten signature in black ink, appearing to read 'Dennis Madden'.

Dennis Madden,
ATRA, CEO

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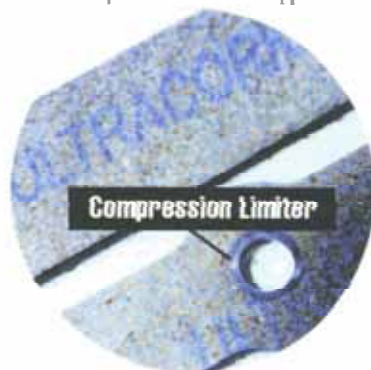
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820351	Chrysler	A404, 413 Sprocket CVR	1.79 ea.	5
820352	Chrysler	404 FWD Gear Box	1.83 ea.	5
820345	Chrysler	A604 Ultradrive Oil Pan	1.93 ea.	5
820353	Chrysler	A604 Diff Oil Pan	1.57 ea.	5
820354	Chrysler	A604 End Cover	1.43 ea.	5
820355	Chrysler	42LE / A606	2.42 ea.	5
820356	Ford	C-6	1.85 ea.	5
820357	Ford	C-4	1.18 ea.	5
820359	Ford	Jatco 3N71B (17 Bolt)	1.98 ea.	5
820360	Ford	AOT, AOD, FIOD	1.78 ea.	5
820361	Ford	ATX Valve Body Cover	2.10 ea.	5
820362	Ford	ATX Oil Pan	1.90 ea.	5
820346	Ford	A4LD W/4 Notches	1.78 ea.	5
820289	Ford	AXOD Oil Pan (1986-96)	3.78 ea.	5
820323	Ford	AXOD Control Cover (1986-96)	2.56 ea.	5
820394	Ford	AX4S Oil Pan (1996 & up)	5.10 ea.	3
820395	Ford	AX4S Control Cover (1996 & up)	4.35 ea.	3
820364	Ford	Probe 4EAT	1.98 ea.	5
820348	Ford	E4OD (1989-95)	3.10 ea.	5
820396	Ford	4R100 (1996 & up)	5.90 ea.	3
820365	Ford	AODE	3.98 ea.	5
820366	Ford	CD4E Main Control CVR	3.58 ea.	5
820367	Ford	AX4N Oil Pan (Early)	3.98 ea.	5
820397	Ford	AX4N Oil Pan (1995 & up)	6.90 ea.	3
820368	Ford	AX4N Main Control CVR (Early)	3.58 ea.	5
820398	Ford	AX4N Main Control Cover (1995 & up)	5.90 ea.	3
820369	GM	Powerglide	1.98 ea.	5
820370	GM	TH-350, 350C, 250, 250C	1.44 ea.	5
820371	GM	TH-400	1.74 ea.	5
820372	GM	TH-180, 180C	1.82 ea.	5
820373	GM	TH-200, 200C	1.62 ea.	5
820374	GM	T-125, 125C	1.86 ea.	5
820375	GM	TH-125, 125C Sprocket CVR	1.50 ea.	5
820376	GM	TH-200-4R	2.18 ea.	5
820377	GM	TH-440 Side Case Cover	2.24 ea.	5
820349	GM	TH700R4	1.50 ea.	5
820378	GM	TH-440-T4 Oil Pan	2.28 ea.	5
820379	GM	4T60E	2.07 ea.	5
820182	GM	4T80E	2.70 ea.	5
820380	Mitsubishi	KM170 Combo	1.69 ea.	5
820381	Mitsubishi	KM 177	3.00 ea.	5
820382	Mitsubishi	F4A33	1.80 ea.	5
820383	Nissan	RL3F01A, RN3F01A FWD	1.90 ea.	5
820384	Nissan	RE4R03A	1.98 ea.	5
820385	Subaru	4 Spd	2.24 ea.	5
820386	Toyota	3 & 4 Spd. A40, A40D	1.60 ea.	5
820387	Toyota	A-340	2.30 ea.	5
820388	Toyota	A-540-E	2.56 ea.	5
820389	Toyota	A540 93-ON	2.54 ea.	5

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Lance Wiggins
Technical Director



This year ATRA is proud to be celebrating its 50th year serving the automatic transmission repair industry. A lot of changes have taken place over five decades of transmission repair, and those changes are coming faster every year.

It's because of those changes that technical training has become an integral part of today's transmission repair industry. It's just not possible anymore to get by with a measure of common sense and a decent technical aptitude. To remain profitable, today's technicians need up-to-date training on an ongoing basis.

To that end, ATRA is pleased to present its 2004 Technical Seminar. Packed with countless hours of research and development, writing, editing, photography and layout, this year's seminar will stand out as one of the most demanding and useful technical training programs ever developed for this industry.

And, for the first time, this year's technical manual has been produced in *full color*. With over 300 pages of up-to-the-minute technical information, the 2004 Technical Seminar Manual will remain a valuable resource long after the seminar is just a memory.

We're confident that you'll find this year's seminar presentation and technical manual both informative and profitable. In fact, we're so sure you'll be satisfied with what you learn in this program, we guarantee it!

So, on behalf of the entire ATRA staff, the international board of directors, and all of the ATRA members worldwide, we'd like to thank you for helping to make our first 50 years memorable. And we're happy to welcome you as we ring in the next half-century of transmission repairs, by taking part in the 50th anniversary edition of the ATRA 2004 Technical Seminar.

A handwritten signature in cursive script that reads 'Lance Wiggins'.

ATRA Technical Team (continued)



Randall Schroeder
Senior Technician
and Seminar Speaker



Steve Garrett
Technical Advisor, Seminar
Speaker, Service Engineer



Bill Brayton
Technical Advisor and
Seminar Speaker



Kelly Hilmer
Director of
Online Director



David Skora
Senior Technician,
Seminar Speaker



Mike VanDyke
Technical Advisor
and Seminar
Speaker



Mike Brown
Technical Advisor



Larry Frash
Technical Advisor,
Seminar Speaker,
Design Artist



Pete Huscher
Technical Advisor



Shaun Velasquez
Web Designer



Frank Pasley
GEARS Magazine

ATRA Staff

It's difficult enough getting the seminar book researched, written, pictured, edited, and printed let alone getting it out to the seminar attendees. This is where the ATRA Staff comes in.

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GEARS Managing Editor: Rodger Bland

GEARS Magazine: Frank Pasley
Jeanette Troub

Paul Morton

Julia Garcia

Director of Finance Sharon Young

Membership : Jody Wintermute

Rosa Smith

Valerie Mitchell

Vanessa Velasquez

Chris Klein

Kim Smith

Jim Spitson

Bookstore Manager: Mike Helmuth

ATRA Bookstore: Jake Silvio

Rick Eastwood

Without the ATRA team, it would be very hard to accomplish the task at hand. Please enjoy the seminar.

Lance Wiggins

ATRA, Technical Director

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ALL GM Applications

2ND Calibration Website Available

Condition/Cause/Correction: In our example we are looking at updates for the 4L65E application, hard shift complaints. We are going to search the following complaint vehicle VIN 3GNEK13T13G159032 a 2003 Chevrolet Avalanche. GM now has another web site available which looks and operates a little different from the one you may be familiar. The other site is still in operation. Access to this web site is still free and should be accessed before attempting to repair most OBD II vehicles. This web site will give you information regarding updates for various controllers on your vehicle as well as what the update was designed to address. The web site is located on a different server than before and can be accessed by searching the following from your web browser search bar. Search for the following: <http://calid.gm.com>

All GM

Vehicles with EPC

Clearing the vehicle shift adapts

Harsh shifts after overhaul may be caused by the incorrect shift pressure command. It is necessary to always clear the shift adapts with your scanner anytime repair work has been done.

Clearing the adapts can also be done by disconnecting the battery and touch the positive cable to the negative cable. If you choose to clear the adapts by disconnecting the battery, please note that ALL PCM adapts will be lost and the vehicle will operate erratically. Typically, the EGR valve will open and close erratically causing the vehicle to surge back and fourth.

DTC Changes,

New DTCs For 2004

The following charts represent which DTC's are new for 2004 as well as new updated 2004 DTC numbers for previous year applications

*** INDICATES THAT THE DTC IS NOT USED ON ALL OF THE MODEL APPLICATIONS**

DTC	DESCRIPTION	5L40/50E	AF23/33	HONDA	VT25E	4T40/45E	4L60E/65E /80/85E	4T65E	4T80E
P0115	ECT sensor/circuit	C							
P0120	TP sensor/circuit	B							
P0501	VSS performance			A					
P0572	Cruise Brake SW Low Voltage	C				C			
P0573	Cruise Brake SW High Voltage	C				C			
P0718	Input speed Intermittent			B					
P0746	PCS 1 stuck OFF			B					
P0747	PCS 1 stuck ON			B					
P0776	PCS 2 stuck OFF			B					
P0777	PCS 2 stuck ON			B					
P0780	Incorrect shift pattern			B					
P0787	3-2 Solenoid Circuit Low Voltage						B		
P0788	3-2 Solenoid Circuit High Voltage						B		
P0815	Upshift switch circuit	C *				C		C *	
P0816	Downshift switch circuit	C *				C		C *	
P0826	Up/Down shift switch circuit	C *				C		C *	
P0847	TFP Switch 2 Circuit Low Voltage			C					
P0848	TFP Switch 2 Circuit High Voltage			C					
P0872	TFP Switch 3 Circuit Low Voltage			C					
P0873	TFP Switch 3 Circuit High Voltage			C					
P0897	Transmission Fluid Life								C

DTC Changes,

New DTCs For 2004

The following charts represent which DTC's are new for 2004 as well as new updated 2004 DTC numbers for previous year applications

*** INDICATES THAT THE DTC IS NOT USED ON ALL OF THE MODEL APPLICATIONS**

DTC	DESCRIPTION	5L40/50E	AF23/33	HONDA	VT25E	4T40/45E	4L60E/65E/80/85E	4T65E	4T80E
P0962	PCS 1 Circuit Voltage Low		A	A	B				
P0963	PCS 1 Circuit Voltage High		A	A	B				
P0966	PCS 2 Circuit Voltage Low		A	A	B				
P0967	PCS 2 Circuit Voltage High		A	A	B				
P1740	Torque Reduction Signal Circuit	B							
P1750	1-2 Shift Valve Performance					C		C *	
P1876	Up and Down Shift Switch Performance	C *				C			
P1877	Up and Down Shift Switch Performance	C *				C			
P2637	Transmission Torque Delivered Circuit	B							
P2761	TCC-PWM Solenoid Circuit						B *		
P2763	TCC-PWM Solenoid Circuit High Voltage			A		A	B *	B	B
P2764	TCC-PWM Solenoid Circuit Low Voltage			A		A	B *	B	B
P2769	TCC Enable solenoid Circuit Low Voltage			A			B *		
P2770	TCC Enable solenoid Circuit High Voltage			A			B *		
P2771	4WD Low Circuit						B *		
P2796	Auxiliary Pump Relay Circuit						B *		
DTC	DESCRIPTION	5L40/50E	AF23/33	HONDA	VT25E	4T40/45E	4L60E/65E/80/85E	4T65E	4T80E
P2797	Aux Pump Performance						B *		
U0100	Loss of Communication with The ECM	B							
U2139	Loss of Communication with The CIM	C							

Type A DTC'S- Emission's related MIL-ON DTC set during the 1ST Failure.

Type B DTC'S- Emission's related, DTC set on 1ST failure MIL-ON during the second consecutive failure

TYPE C DTC'S- Non-Emission related DTC set on 1ST failure no MIL-ON, although message may/may not be displayed on the driver information center (DIC) during the 1ST failure.

4L60E/4L80E/LCT1000/4T40E/ 4T65E/4T80E

Loss of power, Shift related concerns

When scanning the vehicle you may notice a P0171 and/or P0174 DTC's (Lean Codes) are set. These codes can be in conjunction with a loss-of-power complaint.

Many vehicles are being equipped with reusable air filters. Most companies selling this type of filter require a special oil to be used on the filter element.

Since most MAF sensors operate by measuring the amount of energy it takes to keep the sensing element a specified temperature (Usually 125°C) above the temperature of the incoming air, a film of oil on the sensing element will dramatically shift the grams per second value the sensor sends to the PCM. This leads to fuel and spark timing changes, which ultimately lead to the above concerns.

To correct the condition, clean the filter with the cleaning kit recommended by the filter manufacture and be careful not to over oil the filter element. In addition you will need to clean or replace the MAF sensor. If you choose to clean the element, electric circuit board cleaner is the best product to use, although some technicians use brake clean or other products. Be sure not to damage the sensing element or the deflector screen or the sensor will not operate properly. In addition, some filter manufactures recommend using "their" MAF sensor if you are installing their filter. Some of the aftermarket sensors contain burn off routines that are designed to clean the sensor element. Many of the aftermarket sensors require a grounding bracket kit to assure their sensor is grounded.

4T40E/4T45E

Updates

2004 Model Year Changes for the 4T40E and 4T45E Transmissions

The vehicles and models affected are 2004 Chevrolet Cavalier, Classic Malibu, Oldsmobile Alero, Pontiac Grand Am, and Sunfire. Some of the updated parts include:

1. New Spacer Plate for Electronic Range Selector Mode Models (Malibu)
2. New Hydrophobic Filter/Vent and Filler Cap with Case Baffle
3. Valve Body Assembly, TCC Control Valve
4. Decontaminated Transmission Fluid Pressure (TFP)
5. Two DTCs were also removed: P1815 Transmission Fluid Pressure (TFP) Valve Position Switch – Start in Wrong Range and P1817 Transmission Fluid Pressure (TFP) Valve Position Switch
6. New NSBU (Neutral Safety Backup) Switch

Electronic Range Selector Mode Models (Z body Malibu)

The electronic range selector mode has the following new DTCs:

P0815 – Upshift Switch Circuit

P0816 – Downshift Switch Circuit

P0826 – Up and Down Shift Switch Circuit

P0876 – Up and Down Shift Switch (Performance – Range Switch not in D3)

P1877 – Up and Down Shift Switch (Performance – Range Switch in D3)

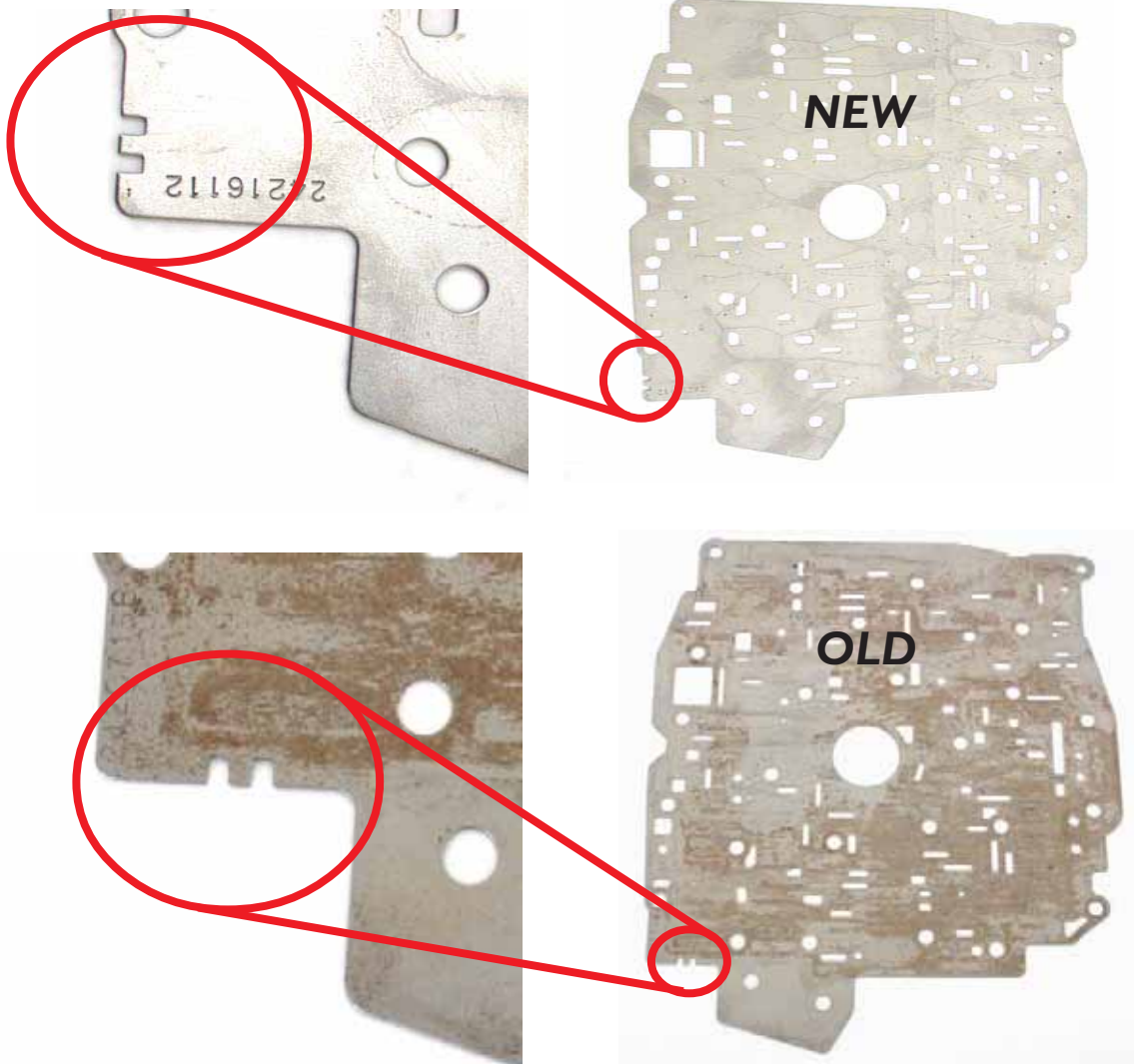
4T40E/4T45E

Updates (continued)

New Spacer Plate for Electronic Range Selector Mode Models (Z body Malibu classic)

The new spacer plate has one notch for TAP (Turbo Application) models and two notches for all other models.

**New Seperator part#
24216112 (two notch)**



4T40E/4T45E

Updates (continued)

Valve Body Assembly, TCC Control Valve

The new TCC control valve is larger in diameter and the step at the end of the valve is smaller by 4.4mm to prevent the valve from sticking in the end of the bore. The valve body bore was made larger in diameter when compared to the old one.

The previous design was sticking in the end of the bore leading to converter drain back issues. This was a huge issue as the unit would leave people stranded because the converter would not fill unless the valve was freed up.

This step reduced the valve diameter at the end of the valve by 4.4mm



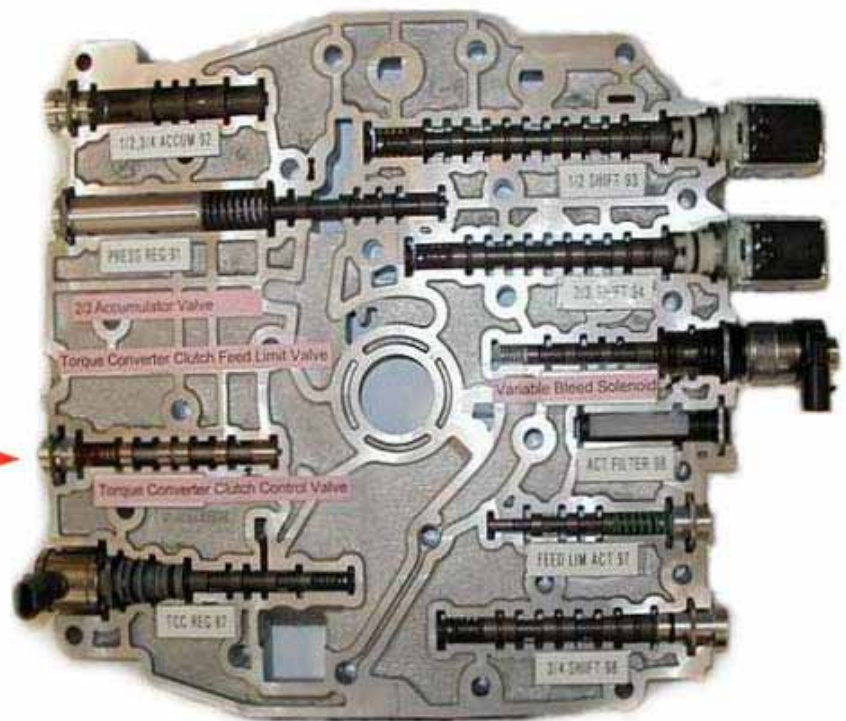
This is the measurement of the old style valve.

4T40E/4T45E

Updates (continued)

The valve body under went several changes for the '04 model year (in addition to the TCC control valve info on the previous page) including the TCC feed valve being eliminated. The valve body was machined to accept the decontented TFP. It needs to be noted that a major change also occurred in the channel plate when all the valve body changes occurred so it will NOT back service previous years.

**The New TCC
control valve
made of anodized
steel**



4T40E/4T45E

Updates (continued)

New Hydrophobic Filter/Vent and Filler Cap with Case Baffle

A new hydrophobic filter/vent and filler cap with case baffle has been added to prevent water entering through the vent. The new caps are different colors, one red and the other black.

**The Red cap is for
2003 and prior**



**The Black cap is for
2004.**



4T40E/4T45E

Updates (continued)

Decontented Transmission Fluid Pressure (TFP)

Three pressure switches have been eliminated on 2004 models. The three switches that remain are: TCC release, drive and reverse. The color of the plastic has changed from black to gray. The additional functions are now done by the redesigned NSBU switch.

Two DTCs were also removed

P1815 Transmission Fluid Pressure (TFP) Valve Position Switch – Start in Wrong Range and P1817 Transmission Fluid Pressure (TFP) Valve Position Switch – Reverse with Drive Ratio.

This switch is only for 2003 and prior models with the black color base.



This switch is for 2004 and on models with a gray color base.

Part# 24217544



4T40E/4T45E

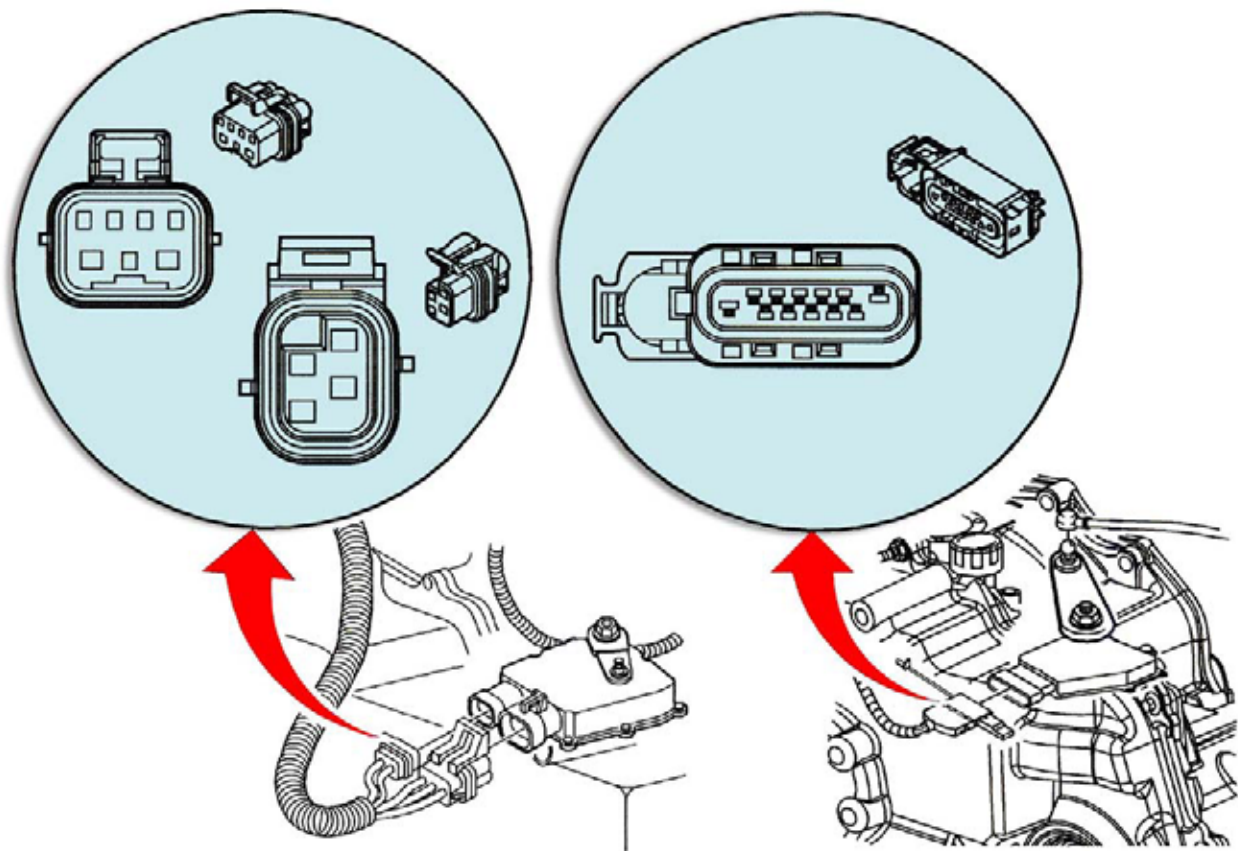
Updates (continued)

New NSBU (Neutral Safety Back Up) Switch

A new NSBU switch with one large connector replaces the switch with two connectors. In the graphic, the two connectors are for 2003 and prior while the one large connector is for 2004.

2003-Prior

2004-On



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4T40E/4T45E

Updates (continued)

New PCS solenoid

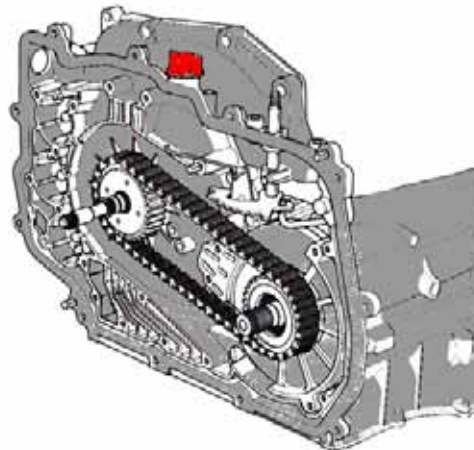
A bosch PCS was implemented for all 4T40E/45E applications (same as the 4T65E we covered last year even the same part number) The updated PCS is in all 2004 4T40E/45E applications.

Part Number
10478146



New Drive Chain

In January 2004, the drive chain and sprockets were updated to a new “ZX design”. The redesign uses an “inverted” tooth chain. The update was for durability. The new chain and sprockets are 5/8" wide and available in 35/35 or 32/37 sprocket tooth counts only. The old chains were 7/8 inch and 3/4 inch wide. The 33/37 sprocket tooth count applications are the previous design. The updated chain and sprockets can back service previous years although you will have to change the chain and sprockets as a set.



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4T40E/4T45E

Updates (continued)

New Washers for the Input Carrier

Coated “Bat Wing” washers were implemented on the input carrier pinions. In addition, both the input and the reaction carrier pinion pin diameter was reduced and one more needle was added to each pinion gear/pin to improve the pinion life on higher torque applications. The Bearing that sits on the end of the reaction carrier was also updated adding another needle to it. The updates help prevent spalling. The updated parts will back service previous years. This was an update on all 4T45E applications for 2004.



4T40E/4T45E

Updates (continued)

New Pump needle bearing

The oil pump bearing was updated to improve the life of the pump. The cage was removed and one more needle was added to the bearing. This was an update on all 2004 models.

New 2004-On

2003-Proir



4T40E/4T45E

Updates (continued)

New Axle Seal

The axle seal material was changed. The update is designed to improve seal life during cold temperature operation. The updated seal went into production on April 16, 2003 as a running change for late 2003 and all 2004 models

New Reverse Clutch Assembly

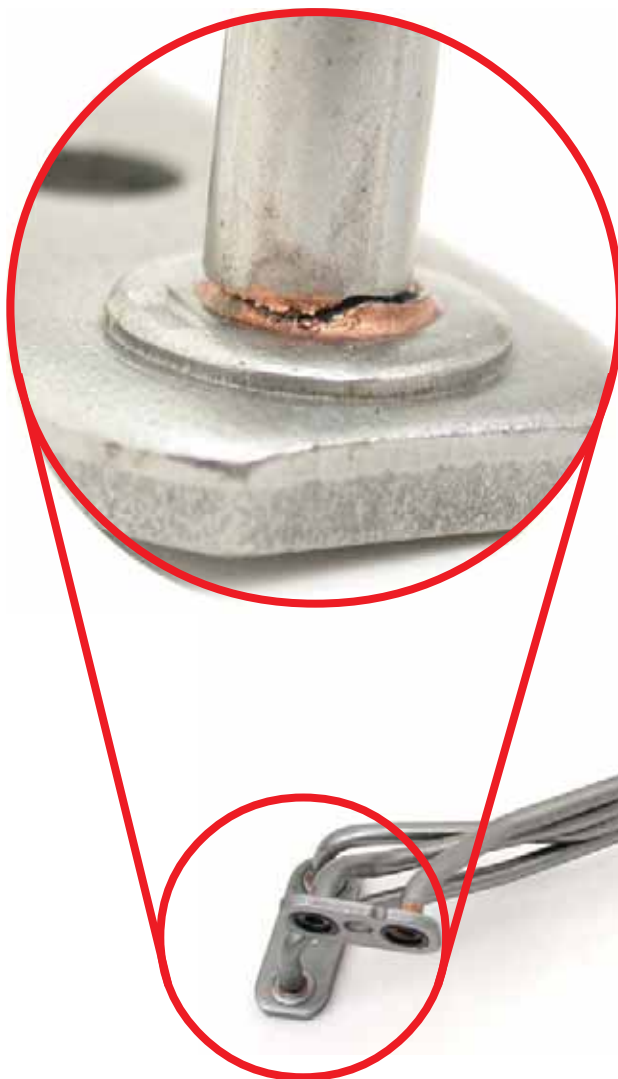
A running change for the 2003 model year was the reverse input clutch assembly. The bottom of the snap ring groove was moved down to make the groove wider. A new stiffer snap ring was implemented. The feed orifice for the center seal area was changed from 1.71mm on 1995-2003 models to 1.87mm on 2003-2005 models. The part number then changed for the drum kits, the 1995-2003 reverse input clutch kit number is 2420541 while the part number for the 2003-2005 application is 24223014. This change occurred on December 4th 2002 for the 2003 model year.

4T40E/4T45E

Slips in Forward

Cracked Oil Feed Tube

A cracked Oil Feed Tube may be the cause of a no forward or slips in forward condition. When installing the tube assembly to the case make sure there is no debris caught under the plate area before torquing the tube bolts. This may cause the tube assembly to crack. Make sure to check all tubes during disassembly and reassembly.



**Torque the feed
pipe bolts to
106 inch lbs**

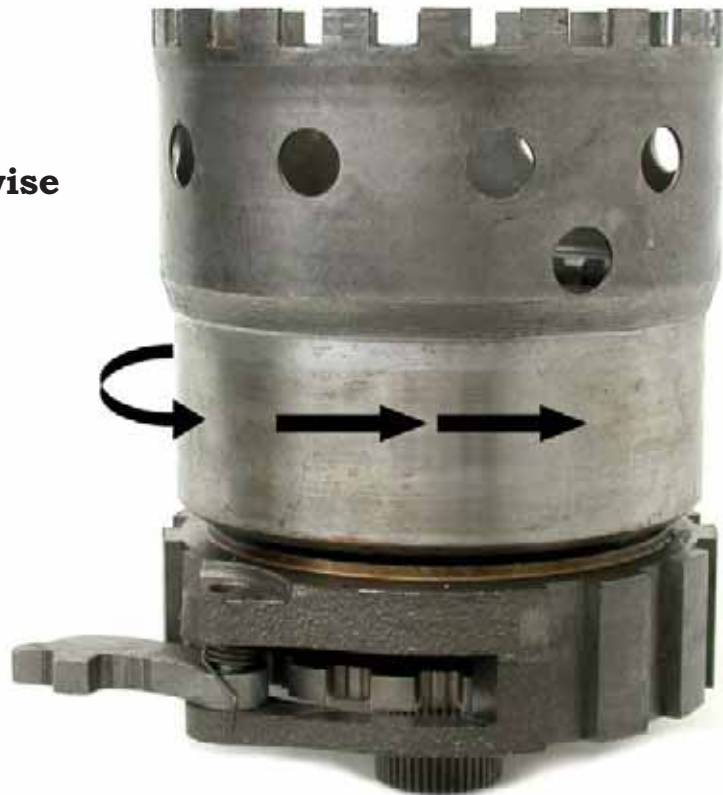
4T40E/4T45E

Low Roller Clutch Rotation

A failure to the Low Roller clutch assembly will result in a NO FORWARD condition in the O/D range.

NOTE: It will usually work on the lift

**Rotates
counter clockwise**



4T40E/4T45E

2nd Roller Clutch Rotation

The outer race of the 2nd roller clutch rotates in a clockwise direction.



4T40E / 4T45E

Multiple Codes, Slips, Failsafe

DTCs P0753, P0758, P1860, C1223, C1224 or C1275

Other complaints: Transmission slips in 4th Gear, Stuck in 2nd Gear or SES/TCS light illuminated, DTCs:

P0753-1-2 Solenoid Circuit Failure
P0758-2-3 Solenoid Circuit Failure
P1860-TCC Solenoid Electrical Fault
C1223-2 Wheel Speed Sensor
C1224-2 Wheel Speed Sensor
C1275- ABS System Failure

This may be caused by the wiring being damaged or the Evap Emission Vent Solenoid failing. The models affected by this are 2002-2004 Chevrolet Cavalier and 2002-2004 Pontiac Sunfire with 2.2L Engine (VIN F – RPL L61)

Both causes should be examined when a vehicle is brought in for the above concern.

4T40E / 4T45E

Multiple Codes, Slips, Failsafe

Wiring and Conduit Inspection (continued)

Cause #1:

Possible water intrusion at the transmission to the front end vehicle harness. This harness is located near the transmission breakout and is protected by plastic split tube type conduit and electrical tape. In some cases, the split may be facing upward which will increase the tendency of the conduit to hold water. Eventually, the #107 splice to the transmission may become corroded and become non-conductive.



Correction #1:

Locate the conduit for the transmission breakout directly above the transmission oil cooler lines. Remove the electrical tape wrap from the plastic conduit and peel the conduit open. With the conduit open, examine the splices inside for signs of corrosion. Splice #107 (part of circuit 439, PINK) is located approximately 13 in forward of the transmission breakout point. Examine the splice for signs of corrosion. If corrosion is found, repair the splice. Use only a GM Crimp and Seal splice. Strip back the wire until clean, non-corroded wire is available.

4T40E / 4T45E

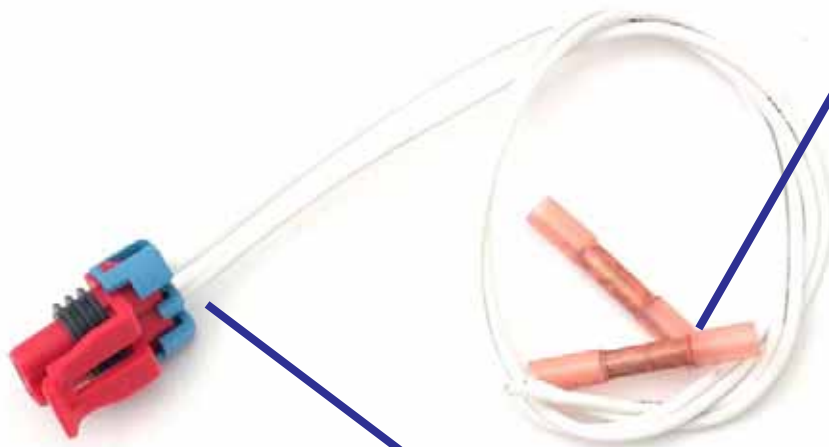
Multiple Codes, Slips, Failsafe (continued)

Evaporative Emissions Canister Vent Solenoid retainer

Cause #2 The Evaporative Emissions Canister Vent Solenoid retainer may have come loose, allowing the associated wire harness to contact the axle. Abrasion of the wire against the axle may rub through the insulation creating a short to ground.

1. The Evaporative Emissions Vent Solenoid is retained by a molded in, plastic extension. The retainer has molded in ridges that create an interference fit to the underbody. Under some instances, the retainer may have not been fully seated when installed.
2. Remove the jumper harness from the Evaporative Emissions Vent Solenoid and repair the harness as necessary.

Connector, GM Crimp n' Seal Butt End Part# 12089189



Connector, Body Harness Extension Part# 12101858

4T40E / 4T45E

Multiple Codes, Slips, Failsafe (continued)

The fastener style used to retain the Evap vent solenoid does not click when properly installed. This is normal, try to seat the fastener as deeply as possible without using excessive or damaging force.

Inspect the retainer for damage. Additionally, examine the solenoid body for any signs of damage. If the retainer and solenoid body appear in good condition, verify that the fastener holds properly by pulling on the solenoid body to check that it is retained. If the fastener will not retain properly or there are signs of damage, replace the Evap Vent Solenoid.

Discard and replace the jumper harness with P/N 12101858, lower the vehicle and clear all DTCs.

Part Number
22622022

Description
Valve, Evap Canister Vent



4T65E/4T45E

Tap Shifts

2004 Pontiac (W body) Grand Prix GTP equipped with the 4T65E and the 2004 Chevrolet (Z body) Malibu Classic equipped with the 4T40E/4T45E have a new feature referred to with the following terms ; “Tap Shifts”(Touch Activated Power), “Electronic Range Select Mode” (ERS) or as “DSC” (Driver Controlled Shifts) depending on the application and which literature you are referencing . Both applications give the customer the ability to upshift and downshift the transmission by moving a button. The button on the Malibu is located in the shift lever while the Grand Prix uses a set of paddles mounted on the spoke of the steering wheel.

Operation:

The addition of the TAP shift system led to several transmission changes including the valve body, spacer plate, channel plate and even the friction materials depending on the application. Several changes were also made to the vehicle wiring and to the PCM/BCM to make the TAP shift system function.

The system consists of the following:

- TAP switches- The tap switches are momentary contact type switches. In addition to the switch contacts, the switch assembly contains a series of dropping resistors (A voltage divider circuit).
- A fuse controls power to the switch assembly. On the W car application the “Cruise” fuse located in the IP fuse block controls the system while the Z car uses the “Run/Crank” fuse located in center console fuse block for operation.
- The shift lever position indicator is attached to the shift lever and is used to enable or disable TAP operation on the Malibu (Z body) application.
- The IMS is used to enable or disable TAP operation on Grand Prix (W body) applications.
- The PCM receives the input from the TAP switches and then commands the transmission to shift to the gear commanded by the customer. The voltage value received by the PCM from the switches varies based on whether the customer is commanding an upshift or a down shift.
- A BCM interface via the serial data line, is used on the Malibu to tell the PCM when the shifter has been moved into the proper position so the TAP shifts can be enabled.

4T65E/4T45E

Tap Shifts

Malibu Operation:

To operate the TAP system on the Malibu, the customer must first place the shift selector into the “Low” (L) position. If the shifter is in any other position, the PCM will inhibit the shift. The BCM monitors the shifter enable circuit via circuit 5525. When the shifter is placed in L position, the voltage on circuit 5525 is pulled low by the shift lever indicator switch, enabling the Tap Shifts to function. When the voltage is pulled low the “Driver Shift Control” parameter on the scan tool will display “Active” as a value. When the Driver Shift Control parameter reads Active, the BCM will inform the PCM via serial data that the TAP shift function should be enabled. The PCM then looks at typical inputs such as VSS and Engine load to determine if the shifts should be allowed and if so, when the shift should occur. When the shifter is in the “L” position the transmission range sensor (PRNDL switch) will indicate D3 range as the manual valve is actually in D3 range. The PRNDL switch values for circuits A, B, C and P will display “LOW” for all of the switch circuits.

When the shifter is placed in any other range, the voltage on circuit 5525 will be high and the Tap Shift function will no longer operate. If the shifter is in any range other than L the scan tool parameter displayed as “Driver Shift Control” will read “Inactive”. When the Driver Shift Control parameter reads Inactive, the BCM will inform the PCM via serial data that the TAP shift function should be disabled. When the customer presses the upshift button, battery voltage is fed through a 4.42K resistor to the PCM via circuit 5526. The resulting voltage drop is then recognized as an upshift command. To command a downshift, the customer presses the button in the opposite direction. Battery voltage is fed through a 1.5K resistor to the PCM through circuit 5526.

4T65E/4T45E

Tap Shifts

Malibu Operation (continued):

The voltage level available at the PCM when the switch is moved to the downshift position is different than the value at the PCM when the driver commanded an upshift to occur. . The scan tool parameter that displays the shift switch voltage values is called out as “Shift Voltage Request”.

Typical TAP Shift switch values with the engine running are as follows:

No Button Pushed- .65 Volts

Upshift Button Pushed - 1.78 Volts

Downshift Button Pushed- 3.4 Volts

NOTE: It should be noted that the above values will vary with battery voltage. If the voltage is being monitored with the engine off, key on the voltage values will be lower than those shown above.

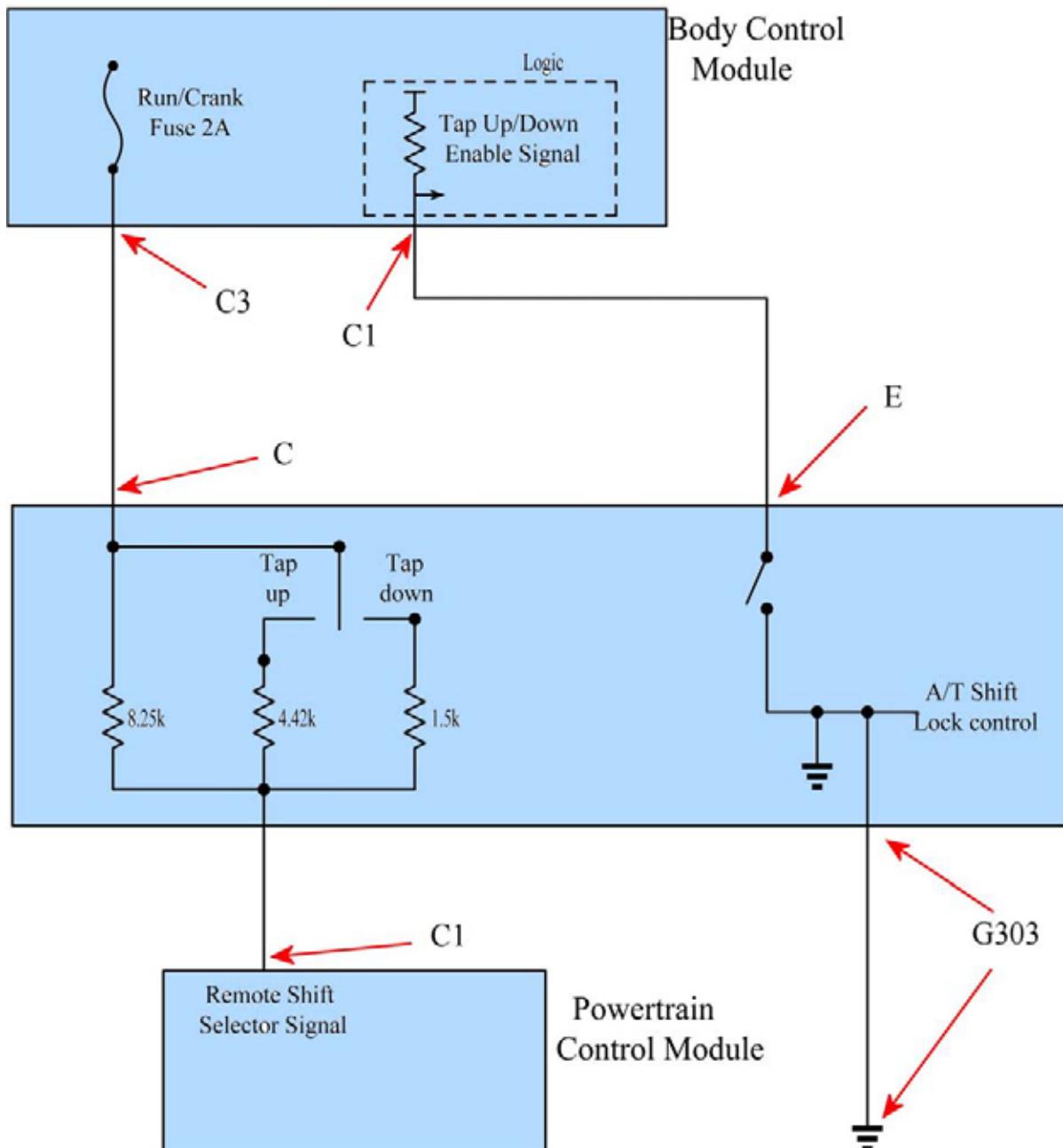
NOTE: On the Z body applications the BCM also communicates with the IPC regarding shifter position, as well as TAP command values. When the shifter is placed in the “L” position the PRNDL indicator in the dash will display L3 as a value. As the downshift TAP button is pressed the indicator will display L2 and then L1 if the button is pressed again. If a TAP upshift is commanded the PRNDL will display L2 and then L3 if the button is pressed again.

NOTE: It should be noted that the transmission cannot be TAP shifted if the vehicle is stationary. The indicator in the dash will change but the transmission will not shift. In addition, some TAP upshifts will be inhibited if the road speed is too low.

4T65E/4T45E

Tap Shifts

Z car TAP Shift



4T65E/4T45E

Tap Shifts

Pontiac Grand Prix GXP Super Charged Operation:

To enable the TAP Shift system on the Grand Prix the customer must have the shifter in the “M” position. If the shifter is in any other position, the TAP shift feature will not function. The shifter position on the W car is determined by the IMS, which is mounted inside the transmission. When the shifter is in the M position, the HUD (Heads Up Display) digits will decrease in size. In addition, the HUD will change from showing the PRNDL position to showing the commanded TAP gear.

NOTE: If the engine is not running the HUD will always read “3” in M range and the scan parameter will indicate only 3rd gear commanded even if you push or pull on the paddles commanding a shift to occur.

The scan tool parameter for the IMS will display “Drive 3” when the shifter is in the M position. IMS circuits A, B, C and P will all display a “LOW” value on the scan tool. In addition, the “Driver Shift Control” parameter will change to “ACTIVE” enabling TAP shifts to occur.

The W car uses two switches mounted on each side of the steering wheel center spoke. The left switch is the master, in which a series of resistors are housed. The right switch is simply a single pole double throw type switch.

If the driver pushes one of the switches an upshift will be commanded. If the driver pulls on one of the switches a downshift will occur. When an upshift is commanded, battery voltage will be fed through a 4.42K resistor to the PCM via circuit 1996. A downshift command will cause battery voltage to be fed through a 1.5K resistor to the PCM on circuit 1996.

Typical TAP Shift switch values with the engine running are as follows:

No Button Pushed- .65 Volts

Upshift Button Pushed - 1.70 Volts

Downshift Button Pushed- 3.35 Volts

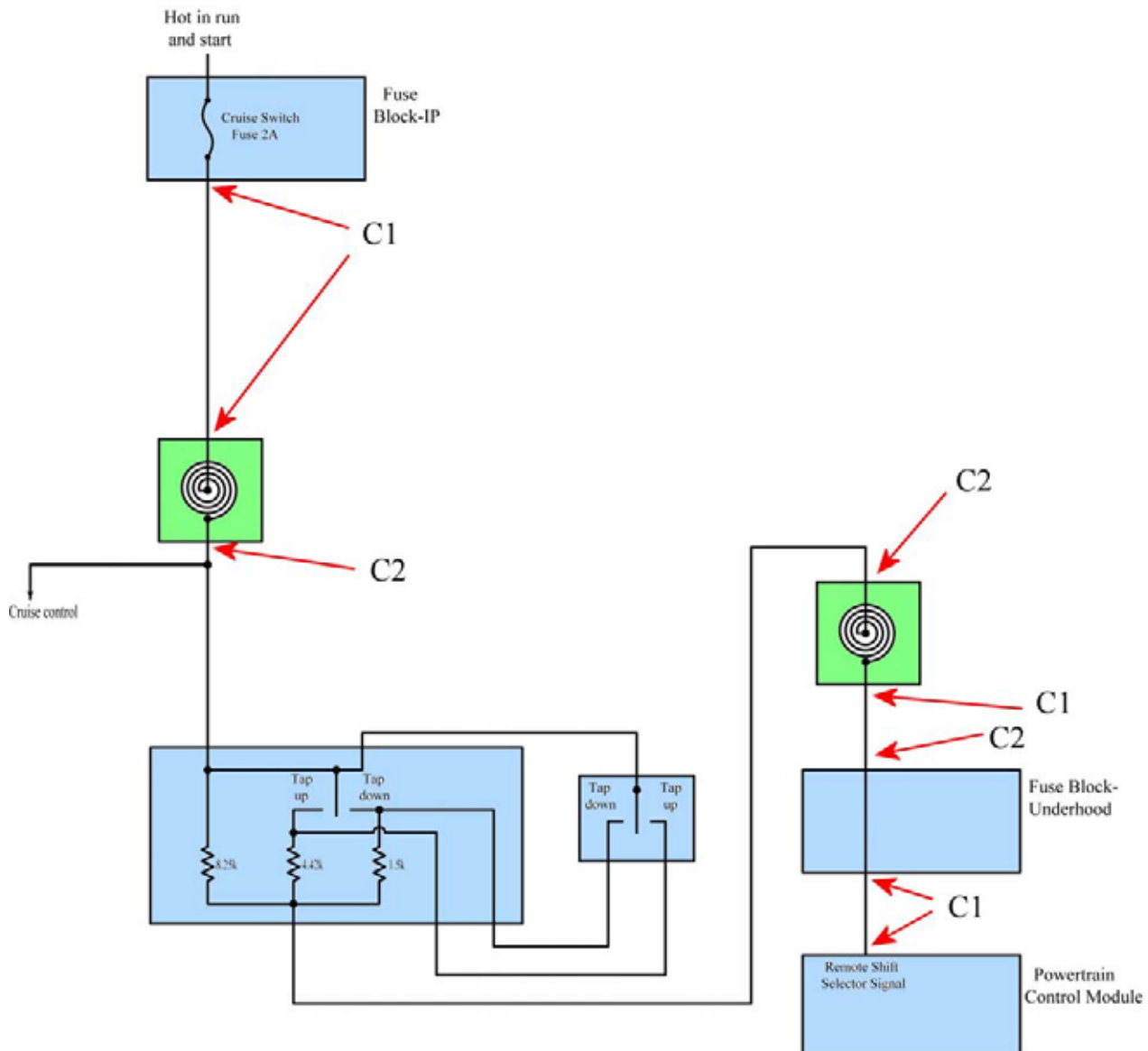
NOTE: It should be noted that the above values will vary with battery voltage. If the voltage is being monitored with the engine off, key on the voltage values will be lower than those shown above.

NOTE: It should be noted that the transmission cannot be TAP shifted above 2nd gear if the vehicle is stationary. In addition, some TAP upshifts will be inhibited if the road speed is too low.

4T65E/4T45E

Tap Shifts

W car TAP Shift



4T65E/4T45E

Tap Shifts

Diagnostics:

Several new DTC's are available for the TAP system, they include: P0815, P0816, P0826, P1876 and P1877

P0815 will set if:

- P0826 is not set
- No PSM/PSA DTC's are set (Z body)
- No IMS DTC's (W body)
- The engine is running
- It has been at least 6 seconds since the shifter range had been changed
- The PCM detects the upshift signal for longer than 2 seconds in park or 5 minutes in D4 range

If a P0815 sets the PCM will

- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

P0816 will set if:

- P0826 is not set
- No PSM/PSA /Range DTC's are set (Z body)
- No IMS DTC's are set (W body)
- The engine is running
- It has been at least 6 seconds since the shifter range had been changed
- The PCM detects the downshift signal for longer than 2 seconds in park or 5 minutes in D4 range

If a P0816 sets the PCM will

- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

4T65E/4T45E

Tap Shifts

Diagnostics:

P0826 will set if:

- The engine is running
- The PCM detects an invalid voltage value on circuit 5526 (Z body) circuit 1996 (W body) for longer than 5 seconds

If a P0826 is set the PCM will:

- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

P1876 (Z body only) will set if:

- No TAP system DTC's are set
- No PSA/PSM/RANGE DTC's are set
- Engine is running
- The PCM detects the TAP enable circuit is "ACTIVE" and the transmission is in D4 range
- The condition lasts longer than 3 seconds

If a P1876 is set the PCM will:

- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

P1877 (Z body only) will set if:

- No TAP system DTC's are set
- No PSA/PSM/RANGE DTC's are set
- Engine is running
- The PCM detects the TAP enable circuit is "INACTIVE" and the transmission is in L range
- The condition lasts longer than 3 seconds

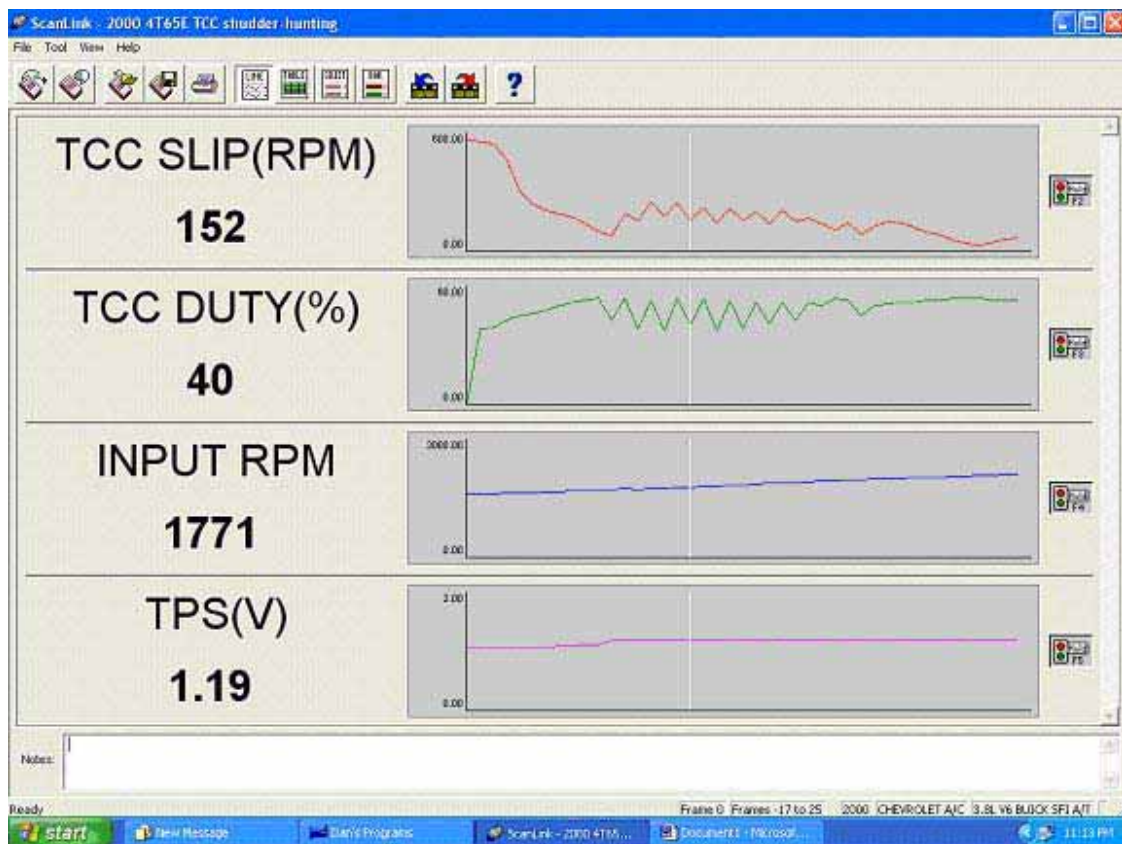
If a P1877 is set the PCM will:

- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

4T60E / 4T65E

TCC Slip

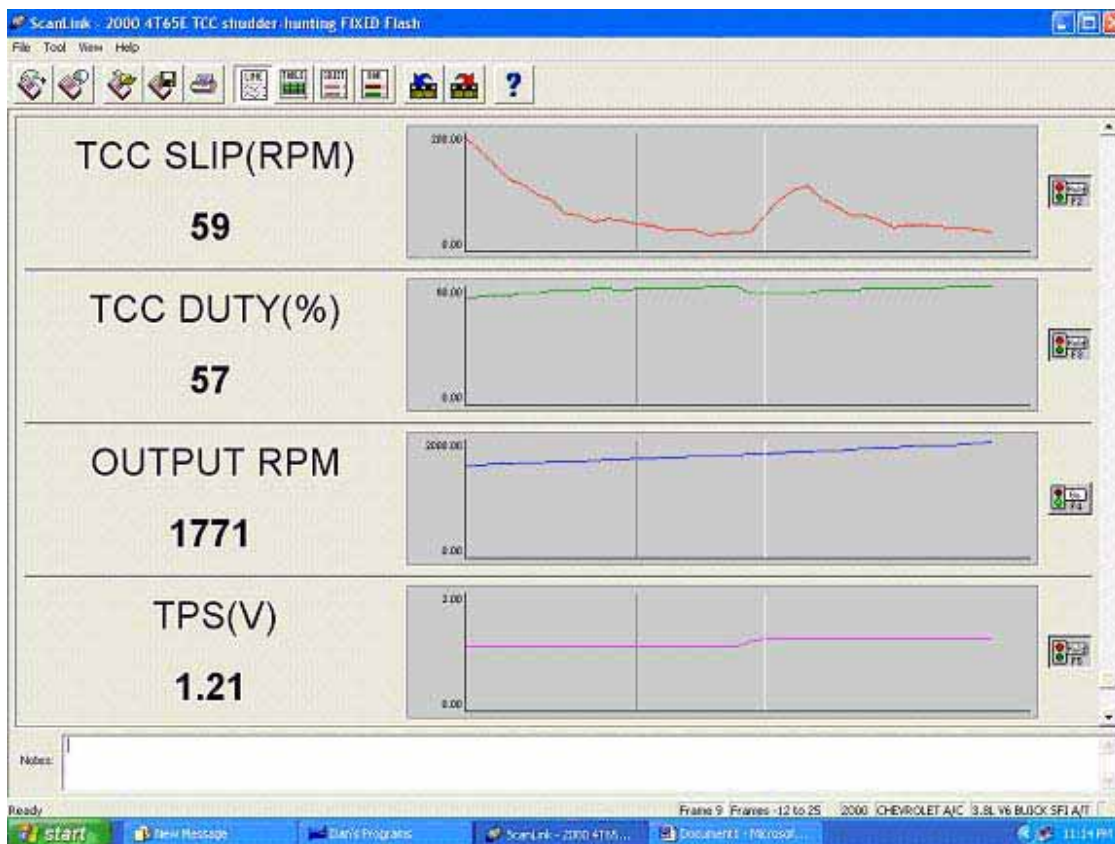
Many TCC related complaints are caused by computer programming problems. The chart below shows the TCC Slip speed is varying about 100 RPMs about every 1.5-2 seconds. This isolation feels a little like an engine misfire, but smoother. It is apparent the computer is commanding the TCC to be erratic. First determine if there is a input causing your problem. If all of your inputs are at their perspective specifications, try reprogramming the computer.



4T60E / 4T65E

TCC Slip (continued)

Here's the same vehicle after the processor was reprogrammed. Notice the TCC duty cycle is steady, as well as the slip. The slight increase in the TCC slip is from a slight dip of the throttle. Trying to correct this problem mechanically might be impossible.



4T65E

Codes P0753/P0758/P1860

2000/2004 Pontiac H Cars Buick C/H Cars

Some 4T65E Pontiac Bonneville (H Body), Buick LeSabre (H Body) and Buick Park Avenue (C Body) applications may exhibit any combination of the following DTCs, P0753, P0758 or P1860. P0753 and P1860 seem to be the most common combination of DTCs that are setting. In addition, the default actions for those DTC's will be in effect if the DTCs are set. As with other conditions on today's vehicles, it is common for the above symptoms to be intermittent. To set the DTCs the following must occur:

P0753 will set if:

The PCM commands the 1-2 shift solenoid ON and the feedback voltage is HIGH for more than 5 seconds

OR

The PCM commands the 1-2 shift solenoid OFF and the feedback voltage is LOW for more than 5 seconds

If a P0753 is set the PCM will:

Turn on the MIL (SES light) on the second consecutive failure

Command Maximum line pressure

Inhibit 3-2 downshifts when VSS is greater than 30 MPH (48 km/h)

Freeze shift adapts

P0758 will set if:

The PCM commands the 2-3 shift solenoid ON and the feedback voltage is HIGH for more than 5 seconds

OR

The PCM commands the 2-3 shift solenoid OFF and the feedback voltage is LOW for more than 5 seconds

4T65E

Codes P0753/P0758/P1860 (continued)

2000/2004 Pontiac H Cars Buick C/H Cars

If a P0758 is set the PCM will:

Turn on the MIL (SES light) on the second consecutive failure
Command Maximum line pressure
Inhibit TCC
Command 2nd gear
Freeze shift adapts

P1860 will set if:

The PCM commands the TCC solenoid to 90% or greater duty cycle and the feedback voltage is HIGH for more than 5 seconds

OR

The PCM commands the TCC shift solenoid 10% or less duty cycle and the feedback voltage is LOW for more than 5 seconds

If a P1860 is set the PCM will:

Turn on the MIL (SES light) on the second consecutive failure
Inhibit TCC
Inhibit 4th gear if in hot mode
Freeze shift adapts

Several items may cause the conditions listed above. One of the common areas that seems to occur with great frequency, is a poor connection at the “under hood fuse block”. The pin and its location vary based on the vehicle model. On H-car applications inspect connector C-3 pin E7 for damage. On C- car applications inspect connector C-2 pin E4 for damage. In most instances you will find the terminal lock tab damaged. This will allow the terminal to back out, leading to the intermittent concern.

4T65E

Codes P0753/P0758/P1860 (continued)

2000/2004 Pontiac H Cars Buick C/H Cars

To inspect the pins, remove the under hood fuse block or under hood junction block and flip it upside down. On H cars, connector C-3 is the black 68 pin connector. On C cars, connector C2 is the brown 68 pin connector. On C car applications pin E4 is fed from the IGNFD 10A fuse while H cars feed pin E7 though the 10 A TRANS fuse.

To repair the condition, replace the terminal or repair the collapsed locking tab.

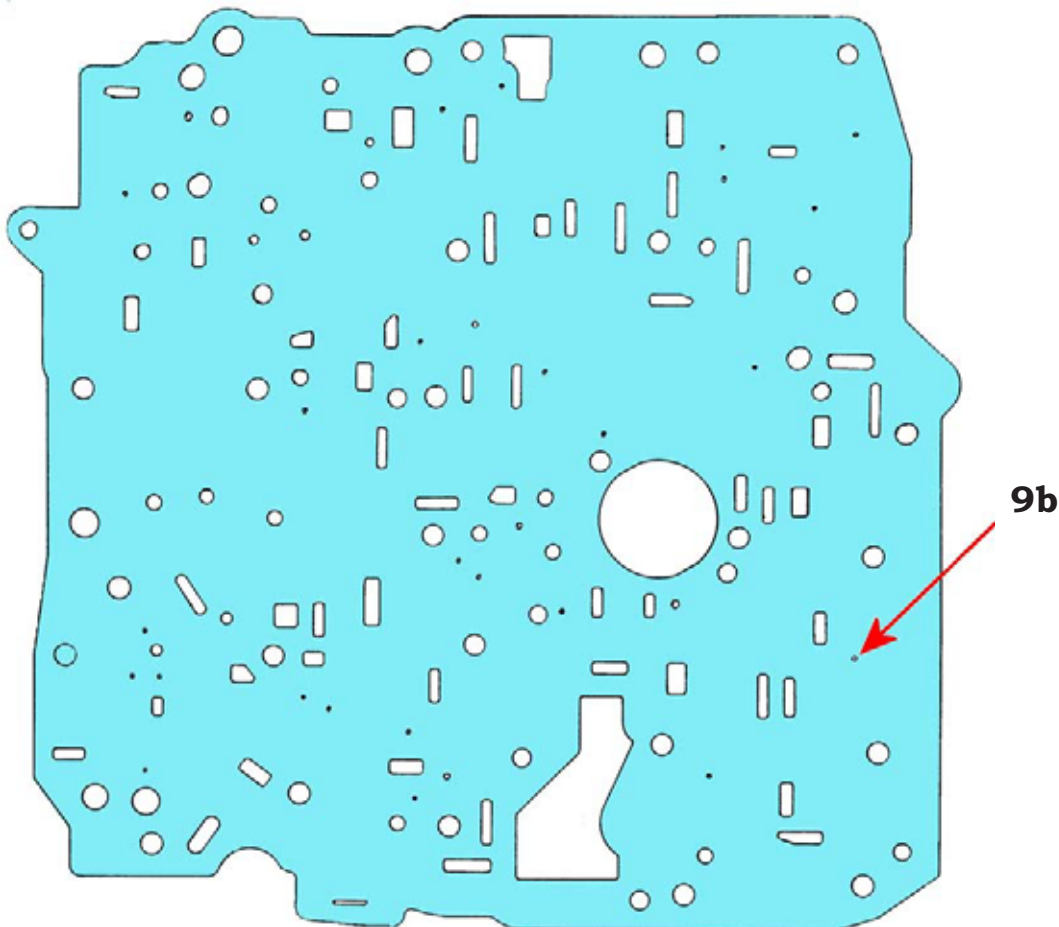
Remove the under hood fuse block or under hood junction block and flip it upside down.



4T65E

P0741, Excessive TCC Slip, No TCC Apply

Orifice 9b is too small, not allowing enough TCC Signal / PWM oil to the TCC Reg. Apply valve

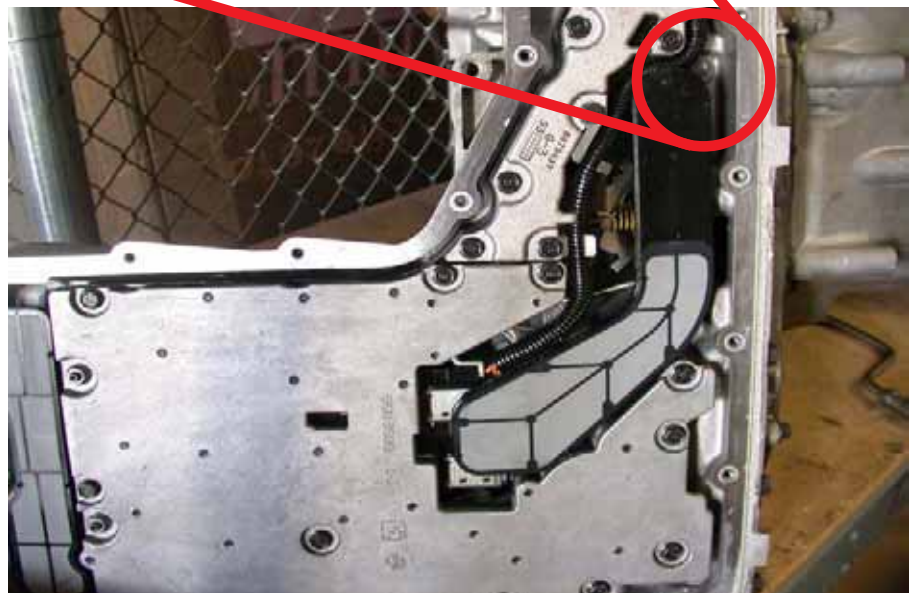


Enlarge orifice 9b with .020" to .030" drill

4T80E

Refill Procedures

When servicing a 4T80E transmission it is necessary to remove the plug from inside the case to drain the side cover of it's oil. This plug is located near the chain cover. Fluid level that is not correct may be caused by not reinstalling the plug.

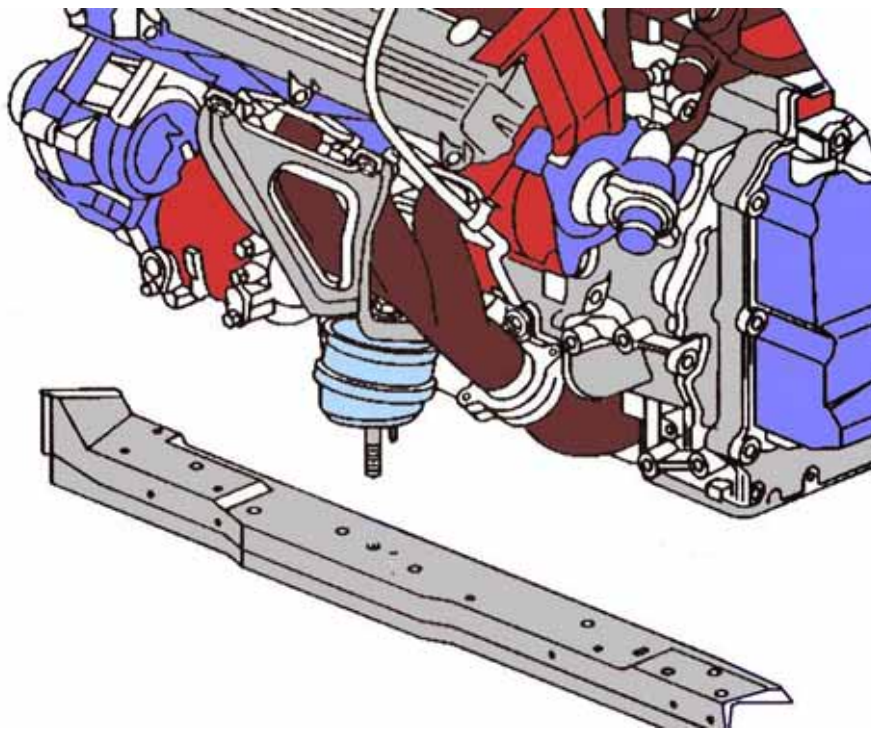


4T80E

“Clunk” During a Garage Shift and/or a “Thud” Noise When Accelerating

Many (K- Car) Northstar equipped 4T80E vehicles may have aggressive garage shifts. The condition may have gotten progressively worse or may have developed all at once. In addition a “Thud” noise when accelerating from a stop may also be felt. An oil leak from the motor mount may also be present on the garage floor or drive way.

This is a common issue on the Northstar applications and it is generally caused by a cracked front engine mount. The mount generally cracks in the area of the stud where it mounts to the frame.



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4T80E

Erratic VSS Signal

4T80E Northstar applications may experience an erratic speedometer reading, as well as other conditions such as a TCS (Transmission Control Switch) light on, and a possible C1295 DTC. Some conditions may also lead to shift related concerns.

In some instances the customer may comment that the speedometer is reading high (up to 150 MPH) even though the car may not be moving. In some instances the speedometer may drop out while driving. Either of the above conditions may be intermittent or may have occurred only after the engine, transmission or alternator was replaced.

Typically one of the following is responsible for the conditions:

- 1. A bad 3A ground wire typically located near the alternator**
- 2. The Transmission harness is rubbing on the cooling hose clamps in the area of the coolant recovery jug.**

Repair the harness or ground connection



4T40E/4T45E

2003/2004 Ratio and Application chart

This year's seminar book includes an update to the charts contained within the 2002 seminar book. The 2002 seminar book contains listings for 1995-2002 4T40E/45E applications. The 4T45E/40E utilizes several different final drive, drive/driven sprocket and torque converter combinations. Installing the wrong transmission, drive/driven sprockets, final drive or torque converter can result in several different ratio error or slip DTC's. If a ratio error, maximum adapt or TCC slip DTC is present, and the unit has been previously repaired or replaced, the converter, final drive ratio and/or drive to driven sprocket ratio could possibly be incorrect for your application. Refer to our chart to determine what final drive and drive/driven sprocket ratios are available for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

RPO codes for the 4T40E/45E applications

RPO CODE DESCRIPTION

LG8-3.1L V-6 ENGINE
L61- 2.2L 4 CYL ENGINE
L42- 2.2L 4 CYL ENGINE
LA1- 3.4L V-6 ENGINE
L81- 3.0L V-6 ENGINE
LX9- 3.5L V-6 ENGINE

RPO CODE DESCRIPTION

FY1- 3.05 FINAL DRIVE
FR9- 3.29 FINAL DRIVE
F83- 3.05 FINAL DRIVE
FX2- 3.29 FINAL DRIVE
FR3- 3.29 HD FINAL DRIVE

NOTE: The effective ratio available at the transmission drive shafts will include the final drive ratio and the drive/driven sprocket ratio.

RPO	Effective ratio
FY1	3.63
FR9	3.29
F83	3.05
FR3	3.69
FX2	3.91

4T40E/4T45E

2003/2004 Ratio and Application chart

Application	Year	Model Codes	Drive/Driven	Final Drive	SRTA Part #
N-BODY CHEV LG8 MN4	2003	3WCR	35/35	3.05	24224355
N, ZJ & J BODY CHEV,PONT OLDS, SATURN L61, L42,MN4	2003	3PCR	32/38	3.29	24224356
N-BODY PONT,OLDS LA1 MN5	2003	3WXJ	35/35	3.05	24224358
N-BODY PONT LA1 MN5	2003	3MXJ	35/35	3.29	24224359
ZJ-BODY L300 SATURN L81 MN5	2003	3FDJ	33/37	3.29	24224360
N, ZJ & J BODY CHEV, PONT, OLDS, SATURN L61 L42 MN4	2004	4PCR	32/38	3.29	24227118
N-BODY PONT- OLDS LA1 MN5	2004	4WXJ	35/35	3.05	24227119
N-BODY PONT	2004	4MXJ	35/35	3.29	24224359
ZJ-BODY L300 SATURN L61 MN5	2004	4FDJ	33/37	3.29	
Z-BODY CHEV LX9 MN5	2004	4ERJ	35/35	3.05	24227122
Z-BODY EXTENDED CHEV LX9 MN5	2004	4ETJ	35/35	3.29	24224355
Z-BODY CHEV L61 MN5	2004	4EBJ	32/38	3.05	24227436

4T65E

2003/2004 Ratio and Application chart

This year's seminar book includes an update to the charts contained within the 2002 seminar book. The 2002 seminar book contains listings for 1997-2002 4T65E applications. The 4T65E utilizes several different final drive, drive/driven sprocket and torque converter combinations. Installing the wrong transmission, drive/driven sprockets, final drive or torque converter can result in several different ratio error or slip DTC's. If a ratio error, maximum adapt or TCC slip DTC is present, and the unit has been previously repaired or replaced, the converter, final drive ratio and/or drive to driven sprocket ratio could possibly be incorrect for your application. Refer to our chart to determine what final drive and drive/driven sprocket ratios are available for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

RPO codes for the 4T65E applications

RPO CODE DESCRIPTION		RPO CODE DESCRIPTION	
MN3-4T65E Transmission		LB8	2.5L Engine
MN7-4T65E HD Transmission		L46	3.0L Engine
M76-4T65E AWD Transmission		LG8	3.1L Engine
M15-4T65E Advanced Electronic Controls		LA1	3.4L Engine
		LQ1	3.4l DOHC Engine
FQ3	2.86 Final drive	LX5	3.5L DOHC Engine
FR2	3.29 Final drive	L36	3.8L Engine
F83	3.05 Final drive	L67	3.8L Engine Super charged
FR9	3.29 Final drive	L32	3.8L Engine
FV4	3.71 Final drive	LY7	3.6L Engine

Police/taxi special equipment options (SEO) 9C1, 9C3, 9C6

NOTE: The effective ratio available at the transmission drive shafts will include the final drive ratio and the drive/driven sprocket ratio.

RPO	Effective ratio
FQ3	2.86
FR9	3.29
F83	3.05
FR2	2.93

4T65E

2003/2004 Ratio and Application chart

Application	Year	Model Codes	Drive/Driven	Final Drive	SRTA Part #
C-BODY	2003	3FFB	35/35	3.05	24224273
L36 MN3					
H-BODY	2003	3PAB	35/35	2.86	24224275
L36 MN3					
H-BODY	2003	3PBB	35/35	3.05	24224276
L-36 MN3					
C-BODY	2003	3FCB	37/33	3.29	24224280
L67 MN7					
H-BODY	2003	3CHB	37/33	3.29	24224281
L67 MN7					
W-BODY	2003	3XAB	37/33	3.29	24224284
L67 MN7					
PONT/BUICK					
B&U BODY	2003	3BCB	35/35	3.29	24224288
LA1 M15					
W-BODY	2003	3RDB	35/35	2.86	24224290
CHEV					
LA1 M15					
W-BODY	2003	3RNB	35/35	3.05	24224291
PONT/BUICK					
LG8 M15					
W-BODY	2003	3LCB	35/35	3.29	24224292
CHEV					
POLICE/TAXI					
L36 M15	2003	3LBB	35/35	3.05	24224293
W-BODY					
CHEV/BUICK					
L36 M15	2003	3LDB	35/35	3.29	24224294
W-BODY					
CHEV/PONT					
L36 M15	2003	3CXB	35/35	3.29	24224295
B&U BODY					
LA1 M76	2004	4FFB	35/35	3.05	24224282
C-BODY					
L36 MN3	2004	4PAB	35/35	2.86	24224312
H-BODY					
L36 MN3					

4T65E

2003/2004 Ratio and Application chart

Application	Year	Model Codes	Drive/Driven	Final Drive	SRTA Part #
H-BODY L-36 MN3	2004	4PBB	35/35	3.05	24224289
C-BODY L67 MN7	2004	4FCB	37/33	3.29	24224283
W-BODY L32 OR L6/ MN7 PONT/CHEV	2004	4CAB	37/33	3.29	24224300
W-BODY Pont L32 MN7	2004	4CBB	35/35	3.29	24224301
W-BODY BUICK L67 MN7	2004	4KNB	37/33	3.29	24227445
W-BODY PONT LG8 M15	2004	4RNB	35/35	3.05	24227449
W-BODY CHEV POLICE/TAXI L36 M15	2004	4LCB	35/35	3.29	24227446
W-BODY CHEV/BUICK PONT L36 M15	2004	4LBB	35/35	3.05	24224302
W-BODY CHEV L36 M15	2004	4LDB	35/35	3.29	24227447
W-BODY CHEV LA1 M15	2004	4RDB	35/35	3.29	24227448
B&U BODY LA1 M15	2004	4BCB	35/35	3.29	24227438
B&U BODY LA1 M76	2004	4CXB	35/35	3.29	24224309
B BODY BUICK LY7 M76	2004	4VCB	35/35	3.29	24224310

4T80E

2003/2004 Ratio and Application chart

This year's seminar book includes an update to the charts contained within the 2002 seminar book. The 2002 seminar book contains listings for 1992-2002 4T80E applications. The 4T80E utilizes several different final drive and torque converter combinations. Installing the wrong transmission, final drive or torque converter can result in several different ratio error or slip DTC's. If a ratio error, maximum adapt or TCC slip DTC is present, and the unit has been previously repaired or replaced, the converter or the final drive ratio could possibly be incorrect for your application. Refer to our chart to determine what final drive and drive/driven sprocket ratios are available for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

RPO codes for the 4T80E applications:

RPO CODE DESCRIPTION

LD8- 4.6L NORTHSTAR ENGINE
L37- 4.6L NORTHSTAR ENGINE
L47- 4.0L NORTHSTAR ENGINE
FW2- 3.06 FINAL DRIVE
F13- 3.48 FINAL DRIVE
FV4- 3.71 FINAL DRIVE

RPO CODE DESCRIPTION

FP3- 2.73 FINAL DRIVE
F79- 2.97 FINAL DRIVE
F17- 2.84 FINAL DRIVE
FV3- 3.11 FINAL DRIVE
FR9- 3.29 FINAL DRIVE
MH1- 4T80E TRANSMISSION

NOTE: ALL 2003/2004 4T80E APPLICATIONS USE AN IMS

4T80E

2003/2004 Ratio and Application chart

APPLICATION	YEAR	MODEL CODE	CONVERTER	FINAL DRIVE	SRTA PART #
K-BODY LD8 MH1	2003	3AAN	VCC	3.11	24224454
K-BODY L37 MH1	2003	3AJN	TCC	3.71	24224453
K-BODY L37 MH1	2003	3MLN	VCC	3.71	24224455
G-BODY L47 MH1	2003	3MSN	VCC	3.71	24224456
K-BODY LD8 MH1	2004	4AAN	VCC	3.11	24224454
K-BODY L37 MH1	2004	4AJN	TCC	3.71	24224453
K-BODY L37 MH1	2004	4MLN	VCC	3.71	24224455

4L60E/65E

Low Power, Shudder

1999-2003 4.8L, 5.3L, 6.0L Engines

Some customers may comment that their vehicle appears to be losing power, usually intermittently. In addition, the customer may comment that the vehicle seems to shudder on acceleration when the condition is present.

The vehicle may be operating in “Low Power Mode”. This condition can be triggered by several conditions including a faulty PSM/PSA. If the switch indicates that the transmission has shifted to neutral when the vehicle is actually being driven at highway speeds, the PCM may command the system into low power mode. If you note that the PSM is changing state, check the switch and wiring and replace the switch if you cannot isolate a specific cause.



4L60E

Burned 3-4 Clutch, Slip DTC's Set

Condition: 4L60E applications setting slip DTC's may have problems with the 3-4 clutch. Upon inspection you may find the 3-4 clutches are burned.



4L60E

Burned 3-4 Clutch, Slip DTC's Set

Cause/Correction: Several items have been found as causes for 3-4 clutch damage. If 3-4 clutch damage is suspected or if the clutch is found to be damaged inspect the following:

1. 3-4 Piston seals damaged, cut
2. 3-4 Piston cracked
3. Housing cracked
4. Turbine shaft cracked (inspect the inside of the stator support sleeve for damage)
5. 3-4 feed hole restricted
6. Pump passages incorrectly drilled or cross leaks present
7. Turbine shaft seals damaged
8. 3-4 clutch check ball leaking (620)
9. 3-4 check ball plug in the end of the turbine shaft leaking
10. Bleed orifice leaking or missing
11. Turbine shaft leaking around splines that attach it to the drum
12. TCC inoperative
13. Engine modifications have been performed that allow the engine to exceed the transmissions maximum torque capacity
14. PCS or its valving is sticking or faulty (Remember the quality spill on the PCS, Look at your build date)· Pump sleeve incorrectly positioned
15. Partially sticking 2-3 shift valve
16. Improper PCM calibration loaded
17. 3rd accumulator check ball #7, not sealing or servo orifice cup plug missing/damaged (2-4 band will be burned also)
18. Leaking servo seals (on 3rd piston) (2-4 band will be burned also)

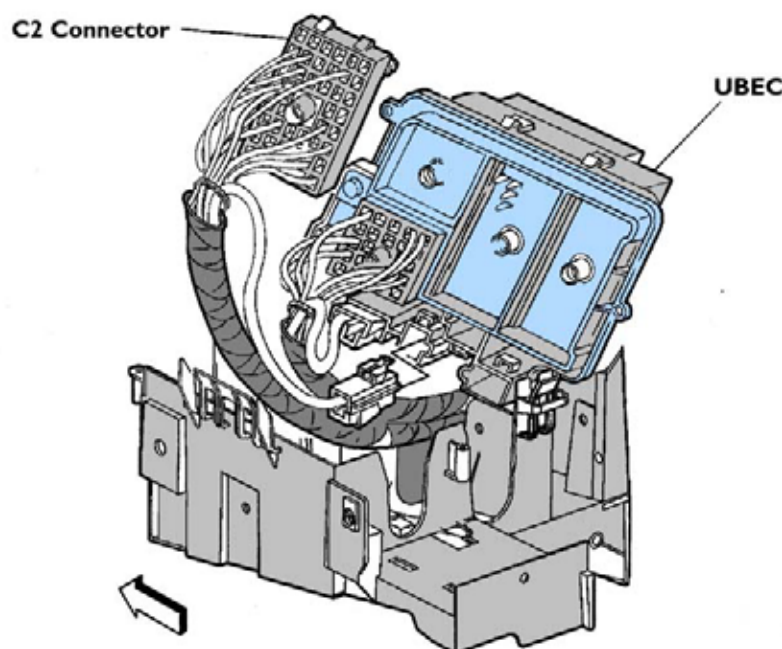
4L80E/85E and 4L60E/65E

Failsafe, 2nd or 3rd Gear Only

1999 and later C-K Truck applications may experience a condition that results in the transmission defaulting into 2nd gear (4L80E/85E) or 3rd gear (4L60E/65E) when the shifter is placed in the OD position. In addition, several DTCs may set, which relate to electrical faults in the solenoids or there circuits.

Although the ignition switch has been a common cause of this concern and a new updated ignition switch (As outlined in previous seminar manuals) has been released the problem may not be corrected by replacing the ignition switch.

Always check circuit 1020 at the UBEC (Under hood Electrical Center) Connector C-2, terminal F-2 for a poor crimp condition. In many instances the terminal is crimped over the top of some of the wiring insulation leading to a poor connection. In most instances this condition is intermittent. Wiggle the wires at connector C-2 while monitoring the voltage on circuit 1020. If a terminal crimp issue is present replace the terminal using the special crimping pliers designed for the GM terminals.



4L60E/65E, 4L80E/85E

Multiple Codes Set

4.8L, 5.3L, 6.0L Applications codes P1514, P1515, P1516, P1518

Some customers may comment that they have an SES light which is often accompanied by a lack of power condition (Vehicle operating in the reduced power mode and the reduced power light may have been on also). In many instances the customer mistakes the lack of power condition with a possible transmission problem as the transmission is no longer as responsive to throttle input as it was prior the condition occurring. In addition, you will generally find a P1516 set. To Set a P1516 the following conditions must occur:

1. The TAC (Throttle Actuator Control) module detects that the desired and the actual throttle positions are not within a calibrated range of each other. (Greater than a 2 degree error in the amount the throttle was commanded to move and the actual amount it moved)
2. Neither the PCM nor the TAC module can determine the actual throttle position.
3. Both of the TP sensor values are invalid (Both have DTCs set). The above conditions are met for more than 1 second.

4L60E/65E, 4L80E/85E

Multiple Codes Set (continued)

4.8L, 5.3L, 6.0L Applications codes P1514, P1515, P1516, P1518

In some instances you may find any/all of the following DTCs set:

P1514-TAC system Performance
P1515-TAC system Performance
P1516-TAC system Performance
P1518-TAC Module Serial Data Fault

As with all other DTCs, this concern is usually intermittent. Prior to replacing parts for this concern, make sure to check the vehicle's battery and charging system; Low battery voltage can result in the above DTCs setting. If battery and charging system operations are okay inspect the APP system connections.

Check the TAC module connectors and the PCM connectors for proper pin tension, proper terminal crimp and moisture intrusion into the connectors. In addition, the plastic connector tab (TPA) may be missing, allowing for an intermittent contact. If no problems are found, check the following grounds before replacing any parts.

On C/K trucks inspect ground wire G103 (PCM) and G104 (TAC Module) for corrosion and tightness. The G103 ground wire is located at the back of the passenger side cylinder head on the block just above the bellhousing. The G104 ground wire is located at the back of the drivers side cylinder head on the block just above the bellhousing. Some applications also utilize a G108 ground wire, which is located on the lower driver's side of the block.

4L60E

2002 Trailblazer/Envoy 4.2L applications shift concerns

Condition: Some T-truck applications may exhibit any or all of the following shift related concerns

- **Delayed downshifts**
- **1-2 shift quality**
- **Cold start shift quality**
- **Cooling fan noise**

Cause/Correction: An updated calibration has been released to address the above concerns. Several different calibrations have been released so be sure you have the latest transmission calibration installed prior to attempting to repair any of the concerns. The latest calibration addresses all of the issues in one calibration load. Use your scan tool to identify the vehicles current software level. Access the GM calibration web site (<http://calid.gm.com>) or (<http://calid.gm.com/vci/>) to find if your vehicle has an updated calibration available

4L60/65E

Updates

New 3/4 clutch plates

A running change is scheduled for the 3-4 clutches to improve clutch durability. The 6.0L C/K truck and the N truck (H2 Hummer) are scheduled to receive the updated design 7 plate packs for the 2004 model year. The updated clutch pack will fit into the current input housing. The updated design is scheduled to be implemented into other applications in 2005.

New parking pawl actuator

A running change was implemented on October 10th 2003 for the 2004 model year. The update is a new design park pawl actuator rod. The updated design lessens the chance that the manual linkage (shifter) will get stuck in park.

New 5 pinion Corvette carrier

In 2004 all 5 pinion Corvette 4L65E carriers will receive two updates. The “bat wing” washers used on all Corvette reaction carriers will be coated with PTFE (Teflon) to increase the life of the carrier, when it is operated at high speeds. The updated carriers will no longer use the oil dam on the end of the reaction carrier. In addition, the carrier pins are no longer cross drilled.

New Reaction Sun Shell

An updated reaction sun shell went into production in December 2003 as a running change for the 2004 model year. The shell update is designed to address the spline strippage issue that has plagued the current design since the last update was made. The new shell is made of 1020 steel and then carbon treated for hardening. The updated shell can be identified by its dark color. The part number remains the same.

4L60/65E

Updates (continued)

New Pump

In an attempt to increase the pump output for high RPM operation, a major change was implemented for the 4L60E/65E pumps at SOP 2004. The high volume pump uses a redesigned pump body. The redesigned body contains an offset slide and a smaller rotor. The updated design parts can be identified by the dimples imprinted in the rotor and slide. The updated rotor will have two dimples, one at each converter drive lug location. The updated slide will have a dimple on the lug where the priming spring rides. The updated rotor and slide are not designed for use in the earlier design pump bodies as component interference may occur. Although, the complete updated pump body (with the rotor, slide and vanes) can be used for 1997 and later applications. The part number for the high volume pump body assembly (includes rotor, vanes and slide) is 24230110. The part numbers for the 5 different selective high volume rotor/vane kits are 24219538, 24219539, 24219540, 24219541 and 24219542. The pump cover part number remains the same for all 1997 and later pumps.

A major change has occurred to the pump, case and the pump outer seal as a running change in January 2004 for the 2004 model year. The pump outer seal groove has been moved in the pump cover on the interim design (It was moved 1.6mm). As the design is fully implemented, the seal groove in the pump cover will be eliminated. In addition, the chamfer in the front of the case has been changed. The revised lead in bore in the front of the case is required for the new seal design to operate correctly. The updated full circle compression style design will seal as the bellhousing is tightened. The installation process has also changed:

First the pump must be installed, followed by the seal and then the bellhousing. All parts must be torqued to specifications as the seal relies on the proper clamp load to function properly. There will be no back service for the updated seal, case or pump with the previous designs. The updated full circle seal part number is 24226315.

4L60/65E

Updates (continued)

New Pump (continued)

A running change implemented on December 15th 2003 for the 2004 model year updated the pump priming springs used on the 4L60E/65E applications. The two pump priming springs used on previous applications are being replaced by the single “conical” shaped priming spring. The spring is the same part number as the one used on the 5L40E application and can be used to back service pumps used on 1997 and later models.

New oil pan

A running change implemented on December 15th 2003 for the 2004 model year updated the oil pan used on the 4L60E/65E applications. The drain plug has been removed and an integral dipstick stop is molded into the pan design.. The updated pan will back service previous year applications.

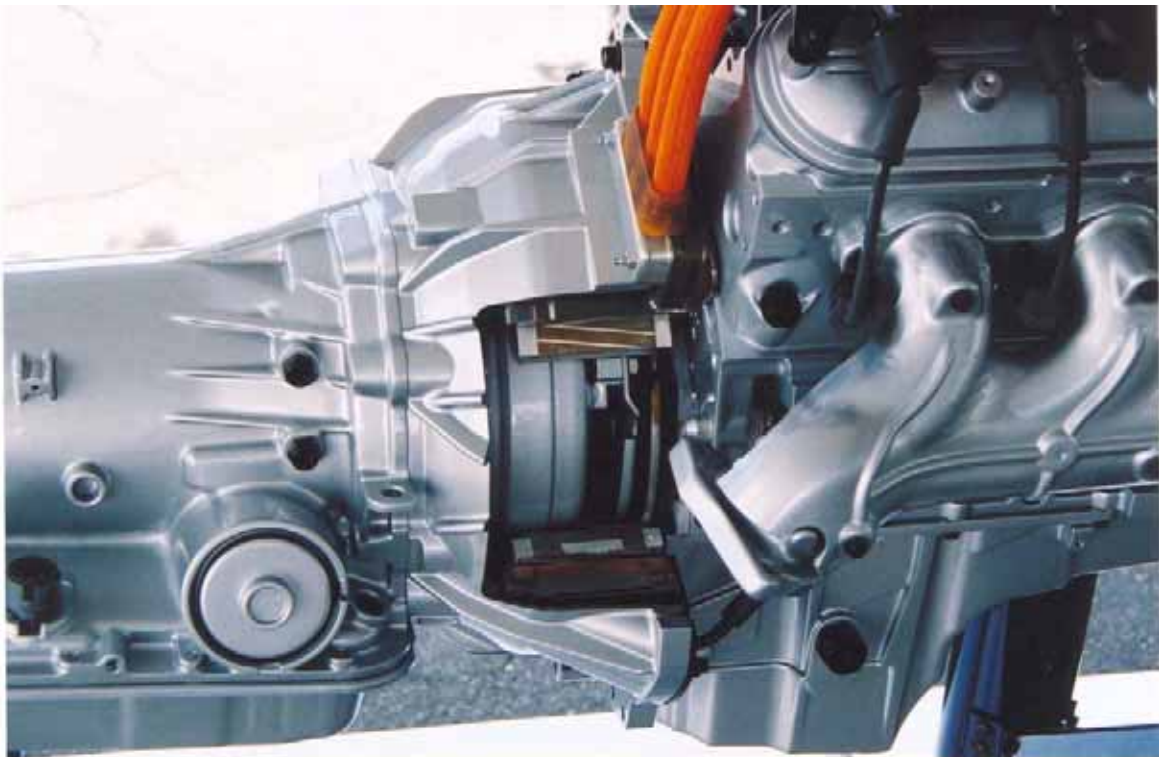
4L60/65E

Updates PHT

PHT (Parallel Hybrid Truck)

The PHT (Parallel Hybrid Truck) will be introduced in March of 2004. This vehicle operates on both gasoline and electric power. The new transmission will be a highly modified 4L60E PHT (RPO M33). Several changes have occurred with the M33 application, they include:

A new Bell housing - The updated bellhousing contains not only the torque converter but also the stator and rotor assembly. The Starter and the Alternator have been replaced by the stator and rotor assembly. The PHT design significantly improves fuel economy because the engine is shut off when the vehicle is stationary unless the A/C or Defrosters are on. As the customer steps on the accelerator pedal the vehicle will be driven by the electrical system until such time that the computer deems it necessary to restart the engine.



4L60/65E

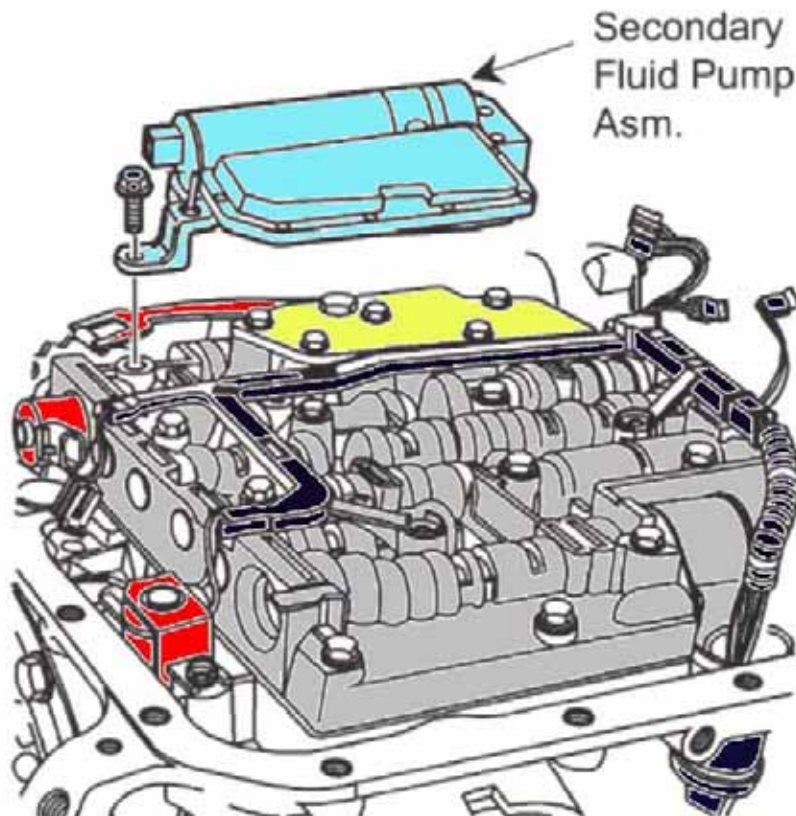
Updates PHT (continued)

Secondary Electric Fluid Pump

A secondary electric fluid pump is mounted to the valve body area and will keep the transmission operational even if the engine is not running. To diagnose the pump and its circuit two new DTCs have been developed: P2796 and P2797.

Updated wiring harness

An updated internal wiring harness includes a connector for the secondary fluid pump.



4L60/65E

Updates PHT (continued)

New TFP Switch

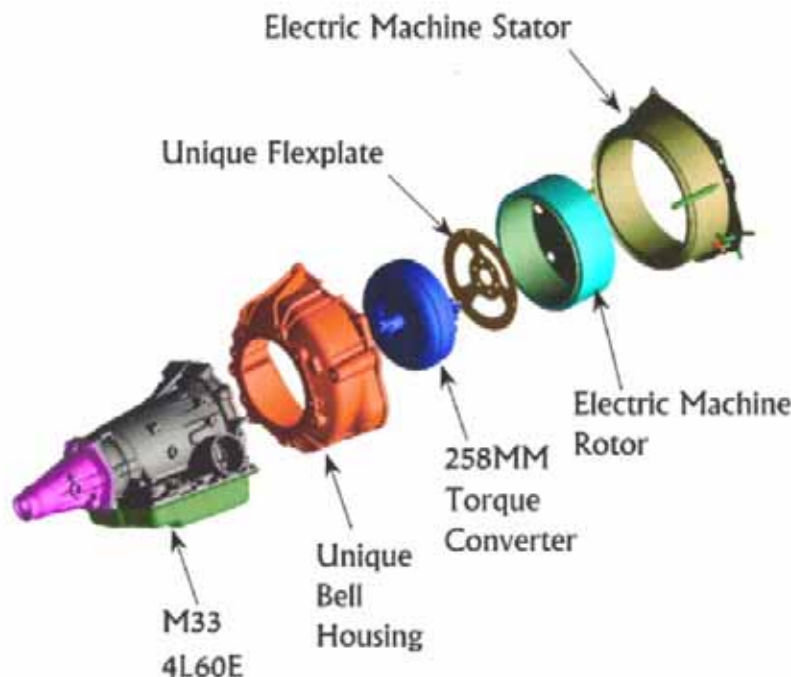
TFP switches operate at a different tension (For D2 switch) so the TFP switch assembly is a different part number. One of the new functions for the TFP is to determine if the secondary pump is running or not. The PHT TFP switch uses a different color connector (White) for identification compared to the standard TFP (Black)

New Checkball location

A check ball has been added to the valve body for secondary pump operation. The check ball will be called out as number 399 in the schematics.

New Input Shaft and Torque Converter

The input shaft and torque converter were updated to accommodate the PHT changes.



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4L80E/85E/4L60E/65E/4T65E/ 4T40E

Miss, Surge, Chuggle, Possible DTC's

Condition: As you are well aware, an engine misfire is many times misconstrued by the customer as a transmission problem. In many cases you will see misfire DTC's stored which are specific to the cylinder in question on OBD II applications (IE; P0301=#1 cylinder, P0302=#2 cylinder) or a random misfire DTC such as P0300 may be set.

Starting with the 1984 model year many GM vehicle applications started to implement crank trigger ignition systems. Starting with the 1994 model year many of these systems made major software changes which led to additional service requirements such as crankshaft relearn procedures. In addition, GM software started to measure and display misfire counts so you could view misfire per cylinder on your scan tool. Starting with 1999 model year many GM engine applications started to implement a new design injector known as the "Multec II" or "peanut injector".

Cause/Correction: Two areas that are "commonly overlooked" when it comes to misfire concerns on today's vehicles are centered around the design of the Multec injector and crankshaft sensor relearning procedures.

To isolate a misfire on an OBD II application, monitor the "current and history" misfire accumulators with your scan tool. Typically you will see the misfire accumulators incrementing upward when the misfire is present. From that information you will generally be able to isolate it to a specific cylinder or cylinders. Two areas to check on crank triggered Multec design applications is the operation of the injector and the crank trigger circuit.

CRANK TRIGGER- Many times the problem with the misfire is not due to the sensor itself (exceptions are the 2001-04 8.1L truck engine and the Northstar 4.0L and 4.6L engines which commonly fail) but rather to the fact the sensor and its hardware need to be relearned. Relearning is required when any of the following occur:

- PCM/ECM replaced/reprogrammed

- Engine replaced

- Sensor replaced

- Front cover replaced (those that mount the sensor in the cover)

- Crankshaft has been replaced

4L80E/85E/4L60E/65E/4T65E/ 4T40E

Miss, Surge, Chuggle, Possible DTC's

It is a good practice to relearn the sensor anytime you have an actual or false misfire condition. Many times the learned value seems to get “lost” and the misfire condition will simply go away after the relearn has been done.

Relearning a crankshaft sensor is really quite simple. First, your scan tool must be capable of conducting the relearn procedure. Secondly, simply follow the directions on your scan tool to relearn the sensor.

MULTEC- As with other injector designs the Multec injector can be come restricted and may require cleaning. To determine if the complaint is due to a restricted/dirty injector you can either run an injector balance test or simply clean the injectors. GM has always contended that the most effective cleaner on the market is “top engine cleaner” part # 12346535. Mix 10% top engine cleaner with gasoline and place it into your injector cleaning equipment. Disable the fuel pump and block the return line. Start the engine and allow it to operate on the cleaning solution. Once the injectors are clean you should recommend the customer run over the counter injector cleaner at regular intervals when he/she fills with gas. The most effective products seem to be those that contain “TecRon”. One other area to be aware of with the Multec design is the electrical connections at the injector. We have seen several cases where a condition know as fretting is starting to occur. Fretting is basically a tiny rubbing action (due to normal vehicle vibrations) that occurs between two electrical surfaces or pins. This action causes microscopic corrosion which leads to insulating oxidizing formations on the terminals. This has a drastic effect on the current flow through the injector leading to the misfire concern. You will not be able to see fretting with the naked eye. Fretting is a common cause of intermittent misfire complaints. Another source of concern with the Multec design is pin tension at the injector connector. Since the terminals are so small on this design connector the female pins tend to expand leading to a connection issue.

To address the injector issues check the terminal pin tension when ever a misfire concern is present. If the terminal is enlarged you will need to either resize it or replace the terminal. If fretting is suspected clean the terminals with “electric circuit board cleaner” (NAPA CRC 091843). Once the terminals are clean, coat the female terminals of all the injector connectors with dielectric compound (GM# 12377900 or NAPA 765-1190)

4L80E

Servo Updates

Reverse engagement upgrade

1997 and later 4L80Es received an upgrade to the reverse-2nd accumulator to improve the harsh reverse engagement concern. These parts may be interchanged in earlier units as long as the entire assembly is used.

Part numbers:

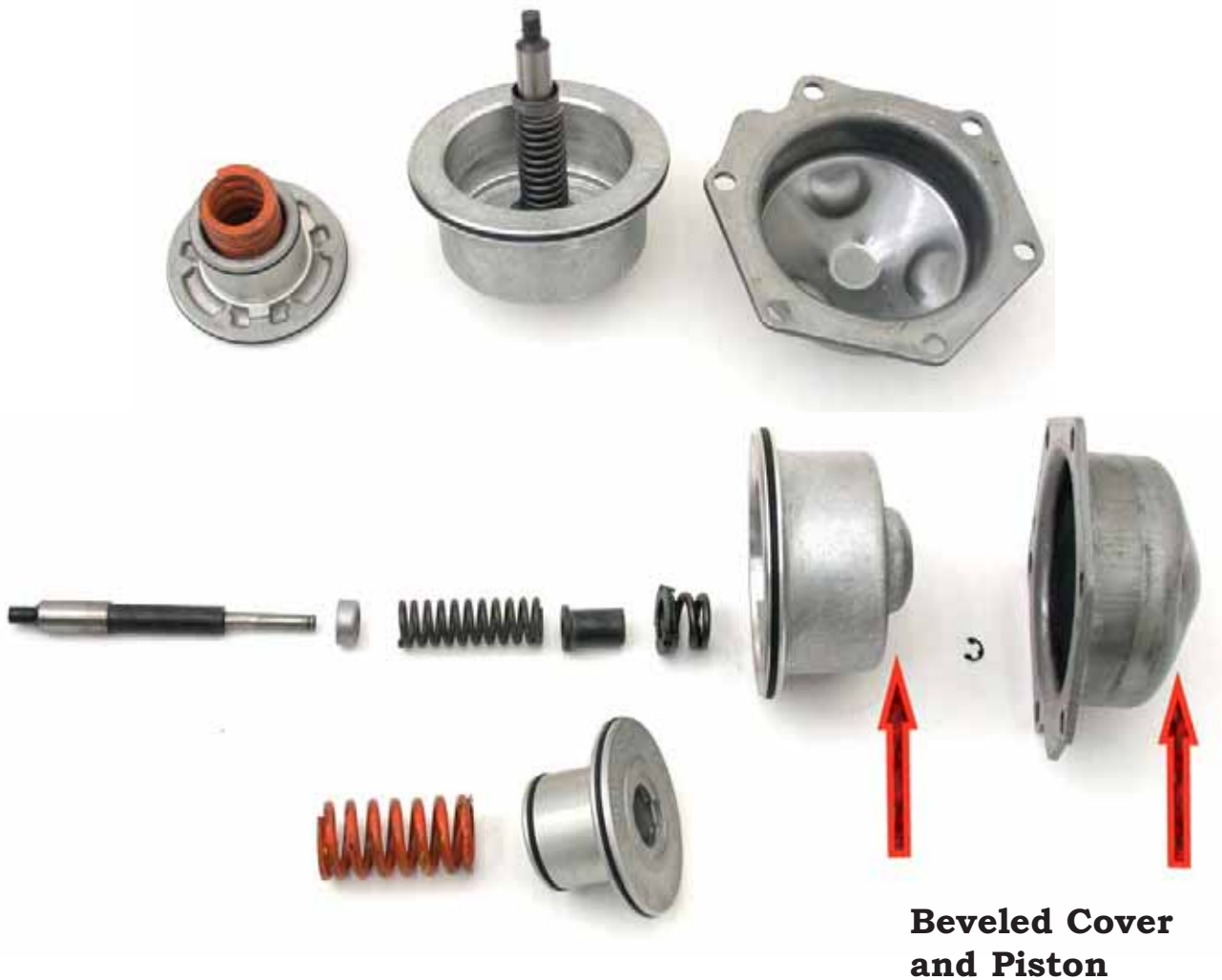
1: Bolt (M8X1.25X20)		8676000
2: Rear Servo Cover		24202280
3: Gasket		8675728
4: Clip		18015044
5: Rear Servo Piston		24202985
6: Piston Seal		8623430
7: Accumulator Assist Spring		24202987
8: Outer Seal		
9: Rear Accumulator Piston-(includes seals)		24205250
10: Inner Seal		
11: Spacer		24202986
12: Rear Servo Spring		8623666
13: Spring Retainer		862366414
14: Rear Band Apply Pin	(3.303")	24202577
	(3.331")	24202580
	(3.359")	24202578
	(3.387")	24202581
	(3.415")	24202579
	(3.443")	24202582
	(3.471")	24202583
15: Accumulator Spring		8655843

4L80E

Servo Updates (continued)

New design supercedes all previous 4L80E servos

The new servo assembly has a beveled cover and requires assembly when purchased.



4L80E/80HD

No Upshift (continued)

6.5L Diesel No upshift at TP values greater than 50%

Some 1992 and later 6.5L diesel applications with a mechanical diesel injection pump (Engine VIN F) may exhibit some upshift related concerns. Typically, the vehicle will not upshift to 2nd gear when TP values are above 60% or to 3rd gear when TP values exceed 50%.

In addition, other concerns may be regarding the amount of power and RPM the engine can produce. In most instances, if the customer is questioned correctly prior to you working on the vehicle, the service advisor will discover recent repairs have been performed.

The basics need to be performed prior to replacing parts for this condition, these include:

- 1. Lift pump pressure (Spec 5-9 Psi)**
- 2. Lift Pump Volume (Spec ½ pint in 15 seconds)**
- 3. Check the fuel filter for water or restrictions**
- 4. Check the air intake for restrictions**
- 5. Check the Exhaust for restrictions**
- 6. Compression (Spec 380 Psi minimum, and even between cylinders)**
- 7. TP sensor operation and adjustment is correct**
- 8. Turbo Operating correctly (2 PSI boost minimum during snap acceleration)**

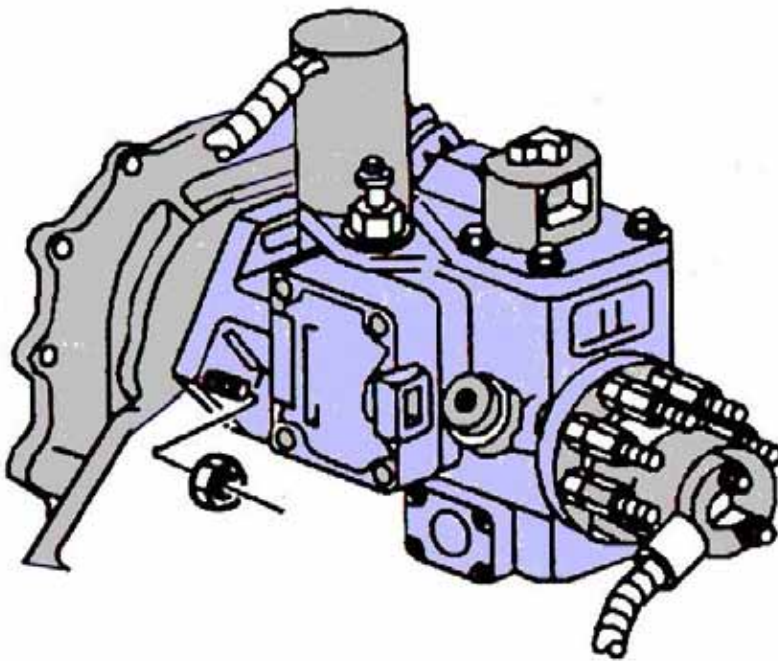
4L80E/80HD

No Upshift (continued)

6.5L Diesel: No upshift at TP values greater than 50%

If all of the previous checks are okay or if the injector pump has been recently replaced, the most likely cause of the concern is that the wrong part number injector pump was installed, or the pump advance is too low. If the wrong pump was installed, its governor setting may limit the maximum engine rpm to something less than the vehicle was designed for. If this condition occurs the customer will increase the throttle opening in an attempt to increase acceleration. This action causes the upshifts to be delayed.

If the pump is determined to be the cause it will need to be replaced or repaired.



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4L80E

Slip Codes

1999 and later 4L80E applications may exhibit excessive TCC slip and in many instances may have a slip related DTC set.

As with other applications several areas can cause the excessive slip condition. One of the most common causes on late model applications is cracks forming on the TCC apply plate. If the typical causes for the condition fail to address the root cause of the condition, replace the torque converter.



"Photo courtesy of Precision Torque Converters of New Hampton"

4L80E

Slips, Flares When Shifting Into 3rd Gear, Damaged Direct Clutches

Slips, flares, delayed shift into 3rd gear, or burned direct clutches. In many cases this condition is temperature related. The problem typically improves if line pressure is elevated. In most instances you will be able to see the extended shift time on the scan tool by noting the “shift time error” parameter. If you look at the shift adapt values you will typically see evidence that the PCM is trying to correct for the condition.

Several common areas should be looked at for this concern, they include:

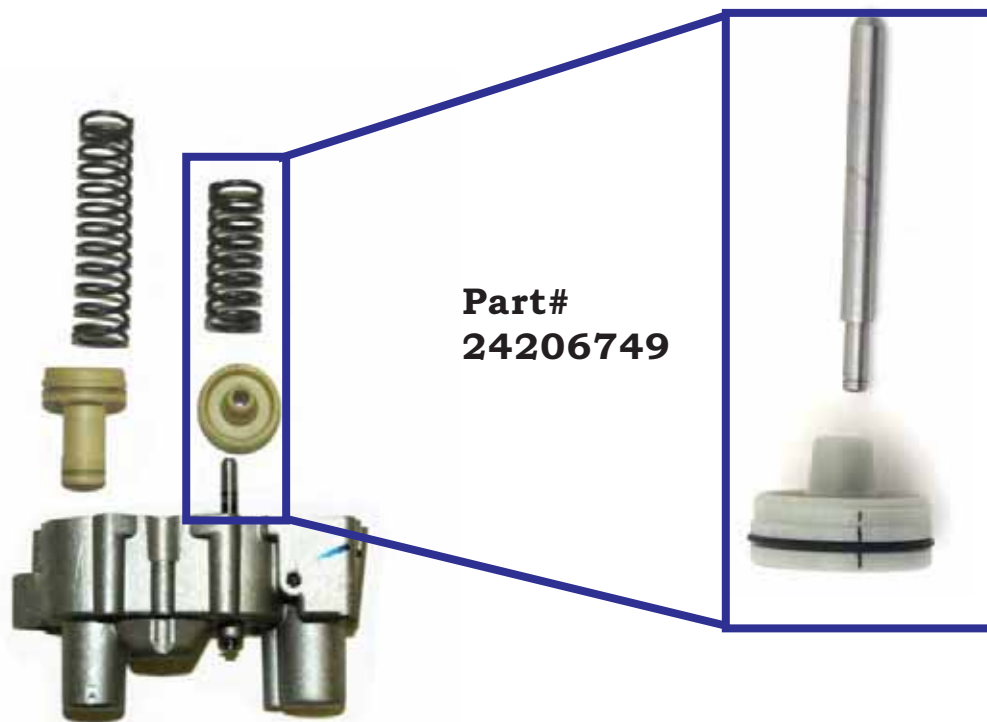
1. Pinched rings on the center support. If this condition is present the ring will stick in the groove preventing it from sealing properly
2. Improper loading of the center support assembly during overhaul (not preloading the support correctly) or reusing the center support bolt
3. Direct clutch seals damaged
4. Distorted/undersized 3rd accumulator piston seals. (Usually the condition will be worse cold and improve as the transmission warms up)

4L80E

Slips, Flares When Shifting Into 3rd Gear, Damaged Direct Clutches (continued)

Updated seal/piston/pin design is available for the 3rd and 4th accumulators under the following part numbers:

1. Accumulator piston kit - This kit includes the seals for both pistons, piston seals and 4th accumulator pin and is sold under GM part number 24206749
2. The 3rd and 4th large seals are available separately under GM part number 08661647
3. The small seal for the 3rd accumulator (most common cause) is available under GM part number 08661639



4L80E/85E

Updates 2004

An updated PCS. As with the 4L60E/65E application all 2004 4L80E/85E transmissions will use the Borg Warner design PCS. This update was done for durability reasons. The updated PCS is not recommended for earlier applications as valve spring changes were also implemented to allow solenoid to be used. It should be noted that the connector for the solenoid will not plug into the previous design harness.

An updated magnet was introduced. The Borg Warner PCS is very sensitive to fine metal (Ferrous) debris. As a safe guard the updated pan magnet was installed. It is actually the older style round design magnet seen in GM applications for many years.

Part # 24224905



4L80E/85E

Updates 2004

An updated internal transmission harness. The harness was redesigned to accommodate the updated PCS. In addition as a running change the material the wire insulation is made of will change from a fluropolymer to a cross link polyester. The material change is designed to improve the durability of the harness as it is a more heat resistant material.

An oil pan update is planned for applications built after December 2003. The updated pan will eliminate the drain plug on most applications and it will include a dipstick stop. The updated pan can be used to back service previous model years.

4th clutch backing plate was updated.

The Forward clutch drum bushing material and machining process are scheduled as a running change for the 2004 model year. The updated bushing will be coated with PTFE to prevent galling. In addition, the machining process, finish and clearances for the bushing will also change. This update is planned because of durability concerns with the bushing.

5L40E

No Reverse

A No Reverse condition can be caused by the TCC solenoid not functioning correctly. Reverse oil flows through the TCC Solenoid. An internal fault can cause the solenoid to exhaust the reverse oil.

The vehicles affected are: 2003 Cadillac CTS built prior to May 2003 built prior to Transmission serial number 849522 (February 10, 2003)

1. Raise and support the vehicle.
2. Remove the transmission fluid drain plug.

NOTE: If the transmission is already burnt, remove and repair transmission.

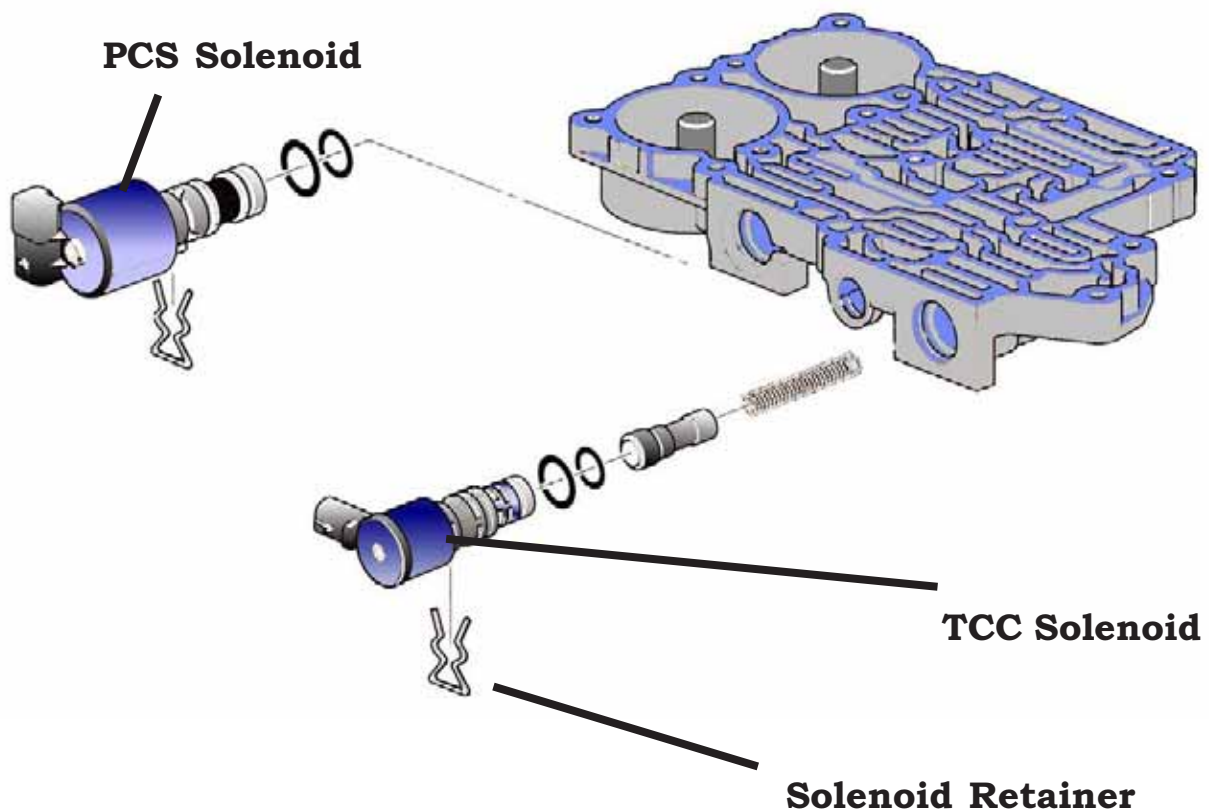
NOTE: If the transmission fluid is “normal” color and no burnt odor, continue with the next step of replacing the TCC solenoid.



5L40E

No Reverse (continued)

Remove and inspect the TCC solenoid from the transmission. The plastic connector may be labeled “2690”. The “2690” TCC PWM solenoid is the suspect solenoid and should NOT BE REUSED. The new TCC PWM solenoid, P/N 96042599, is labeled “7792” and should be the ONLY solenoid used.



Part Number
96042599 TCC PWM Solenoid

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LCT 1000

PRNDL Flashes, Default Actions Present

CONDITION: As was covered in previous seminar manuals, an updated PRNDL switch is available for the LCT 1000. The updated switch is more resistant to moisture intrusion making it more reliable. A faulty PRNDL switch can set several DTC's. Many of the DTC's have default actions that can range in severity from turning on the MIL to preventing the vehicle from moving. One of the concerns with the 2001-02 design software is that it may leave the customer stranded when a PRNDL DTC is set even though the system could operate without a PRNDL switch.

CAUSE/CORRECTION: After the updated PRNDL switch has been installed you and your customer may want to consider updating the vehicle software. An updated calibration is now available that will prevent the default actions the TCM normally assigns for a PRNDL switch DTC from being implemented for up to 50 warm up cycles. In other words, when the updated software is installed, the switch would need to fail 50 times before most of the default actions would occur. One exception to this is the MIL which will still be illuminated when a PRNDL DTC is set. The updated software will allow the customer ample time to get the vehicle in for service.

Refer to (<http://calid.gm.com>) or (<http://calid.gm.com/vci/>) for calibration information on this issue.

LCT 1000

Known Wiring Concerns

CONDITION: Several areas have come to light that may cause multiple/various DTC's to set, default actions to occur, neutral only conditions, a flashing PRNDL display as well as several other symptoms.

CAUSE/CORRECTION: If you get an Allison LCT 1000 with any type of "strange" operation or you find electrical related DTC's inspect the following areas:

1. **Power Steering Return Line Clamp- Chaffs the TCM harness on the clamp in the reservoir area.**
2. **Body Pinch Weld- Chaffs the harness coming from the transmission in the bellhousing, body area.**
3. **Transmission Pass Thru Connector- Chaffs the harness on the exhaust hanger bracket. In addition this connector is very difficult to plug into the transmission so in many cases it is not fully seated. Make sure the plug in is fully seated.**
4. **TCM Cover- Chaffs the harness at the TCM connector area. Many times the wiring will be wedged under the cover.**
5. **Valve Body- Chaffs the harness on the valve body**
6. **TCM connectors not fully seated**
7. **Ground G103 (Gas) G105 and G105 (Diesel) and G110 may be loose or corroded.**
8. If a problem with the wiring is found, repair the concern and reposition the wiring if needed.

NOTE:

It should also be noted when you are looking for wiring problems or when you are checking voltage/resistance values on the wiring, circuit 1020 connector C1 terminal 2 and 4 made a change at the start of production for the 2003 model year. 2001/02 models had a wire in the terminal number 2 position. 2003/04 applications "DO NOT" have a wire in the number 2 cavity although it may be shown in the service manual wiring schematic.

LCT 1000

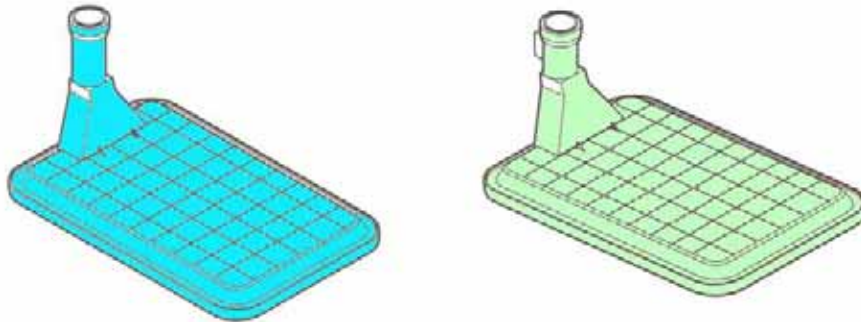
Pump Noise

Many Allison LCT 1000 owners comment regarding the amount of pump noise that is present with their Allison applications. It should be noted that some pump noise is considered “NORMAL” by Allison. Please make certain you and your customer have watched the “Video Tape” provided to the customer by GM. In addition, make sure you compare the complaint vehicle with other like vehicles prior to attempting to repair this condition. If the complaint vehicle is deemed “ABNORMAL” proceed with the repair.

Cause/Correction: Several items can lead to excessive pump noise, they include: Restricted filters - The LCT 1000 uses two filters, one is a spin-on design while the other is similar to other GM applications. Both filters have undergone updates. The spin-on filter seal material was changed to improve its elasticity in cold temperatures.

The suction filter was also updated by:

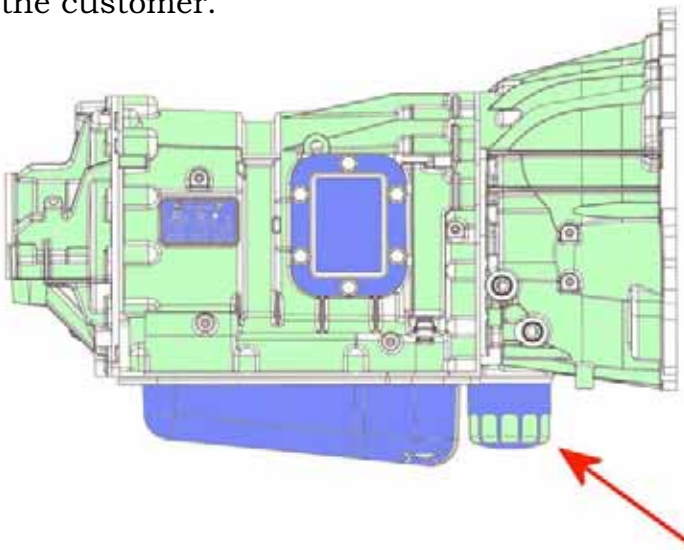
1. Making the body wider to increase the flow area.
2. The filter material was changed to improve the filtration rate while reducing the amount of contamination that the control main filter would need to control
3. A cold temperature bypass was added with a “screen over bypass” incorporated to prevent large debris from entering the pump during bypass operation



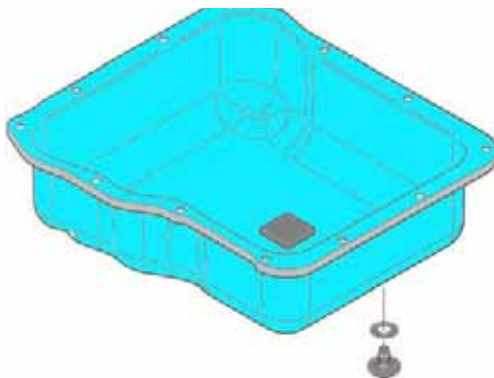
LCT 1000

Pump Noise (continued)

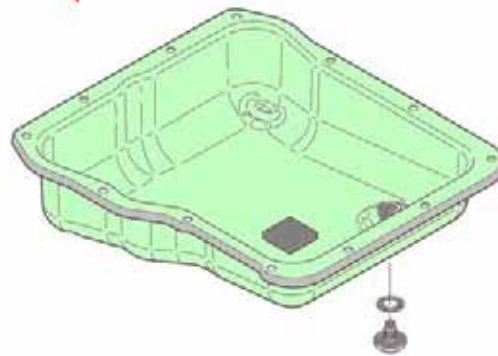
The updated filters went into production on 2002 models with build dates greater than 6310122178 (Indianapolis) and 6320028313 (Baltimore). The updated GM and Allison part numbers are 29537965 (Shallow pan) 29537966 (Deep pan).
NOTE: It is common for DTC P0701 (Transmission Control System Performance) to set during a fluid/filter service. If the DTC sets, clear the codes before returning it to the customer.



The updated GM and Allison part number is 29539579



29537966 (Deep pan)



29537965 (Shallow pan)

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LCT 1000

Pump Noise (continued)

The pump may have excessive wear. Several pumps have been found to have opposite corner wear leading to very excessive pump noise (See Illustration) Visually inspect the pump, measure the pump for wear as outlined in the service manual. If the pump is worn replace the pump or the damaged parts. Several updates have been made to the pump, housing gasket and pump wear plate.

These updates were done to improve pump prime time, reduce low speed pump noise and improve idle cooling. The new parts were implemented from build dates 6310144856 (Indianapolis) 6320047965 (Baltimore) transmissions.

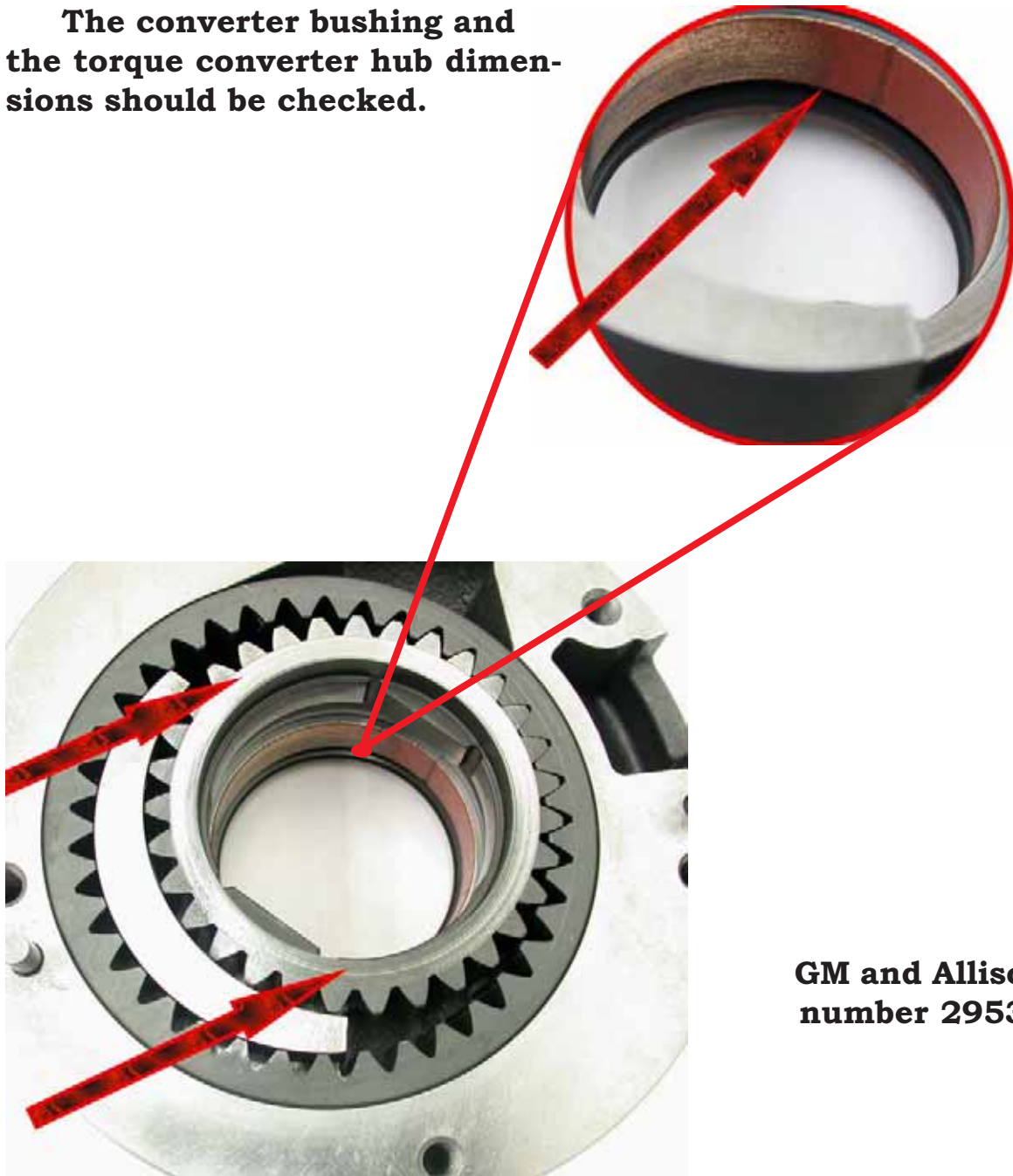
The updated pump is available under GM and Allison part number 29539580. The updated pump eliminated the two finger slots, cast into the body of the pump. In addition, the position of the crescent was also offset. It can be identified by the updated casting number 29539852 stamped into the body of the pump. The updated pump wear plate. Allison part number 29539616 added a metering groove in the pumping chamber area. The updated housing gasket (GM and Allison part number 29540130) eliminated two pressure slots in the pump area and strengthened the gasket by adding material to the gasket, in the pump area. The updated parts will back service the previous applications if used as a complete package.

NOTE: Always double check the part numbers before ordering. Numerous updates have occurred with many of the part numbers. GM is adding Allison part numbers as a common practice, so check the Allison part number with your local GM suppliers. You may find the part now available from your local GM source.

LCT 1000

Pump Noise (continued)

The converter bushing and the torque converter hub dimensions should be checked.



**GM and Allison part
number 29539580**

LCT 1000

Delayed/Lack of Engagement Forward and Reverse

2001-03(RPO M74)

Several different scenarios may be described by the customer including: MIL on delayed engagement forward/reverse after the vehicle has been left sitting for as little as 10 minutes (severe cases) to as much as several days before the condition will occur. The delayed engagement may last anywhere from a few seconds to several minutes. The customer may also comment that the transmission appears to be slipping after a cold start.

No engagement, forward or reverse, 0 psi line pressure, pump will not prime unless the engine speed is raised to at least 1400 RPM. As the engine speed is raised the line pressure will normalize and the engagement problem will no longer be present. This type of condition can occur after the vehicle has been left sitting for as little as 10 minutes with the engine off. Once the line pressure normalizes, the condition will not occur again unless the engine is shut off again.

Any combination of the following PSM DTCs:

- P0701-Transmission Control System Performance
- P0708-Transmission Range Sensor Circuit High
- P0840-Pressure Control Switch Solenoid C Circuit
- P0841-Pressure Control Switch Solenoid C Circuit Stuck Open
- P0843-Pressure Control Switch Solenoid C Circuit High
- P0845-Pressure Control Switch Solenoid D Circuit
- P0846-Pressure Control Switch Solenoid D Circuit Stuck Open
- P0848-Pressure Control Switch Solenoid D Circuit High
- P0870-Pressure Control Switch Solenoid E Circuit
- P0871-Pressure Control Switch Solenoid E Circuit Stuck Open
- P0875-Pressure Control Switch Solenoid E Circuit High
- P1709-Pressure Control Switch Solenoid E Circuit
- P1710-Pressure Control Switch Solenoid E Circuit Stuck Open
- P1713-Pressure Control Switch Solenoid E Circuit High

When reviewing the freeze frame information, you will generally note that the DTCs were set within 30 seconds of engine run time.

LCT 1000

Delayed/Lack of Engagement Forward and Reverse (continued) 2001-03(RPO M74)

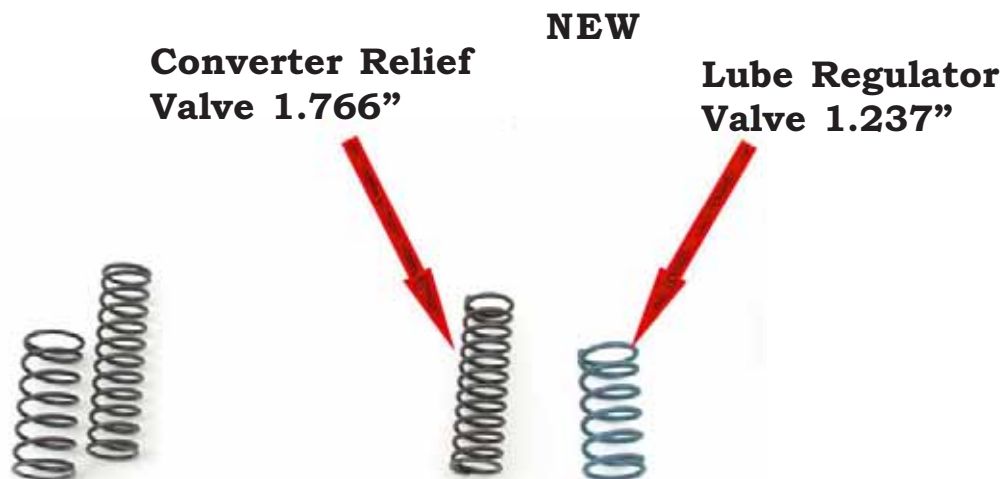
The torque converter may be draining back. This allows air into the cooler circuit which then migrates to the suction side of the pump, leading to cavitation and loss of prime. The most common cause is the lube regulator valve or the torque converter relief valve is sticking. Both valves are located in the front support assembly. Make sure the valves are clean and free, then install the updated springs for both valves. The updated springs are designed to eliminate valve sticking as an issue. The updated lube regulator valve spring tension was increased to attain 40 Psi of lube pressure. This allows air to be purged through the lube circuit rather than through the pump suction circuit. The updated springs were implemented into production after transmission build date break points S/N 6310234829 (Indianapolis) S/N 6320154492 (Baltimore). The springs are available under separate part numbers from GM and Allison. The part numbers are as follows:

Converter Relief Spring- #29541296

Lube Regulator Spring- #29540523

GM Kit- #88996718 major gasket and parts kit

NOTE: It should be noted that the lube regulator valve is available in two different designs. They are interchangeable. The change reduced the leading edge diameter of the valve land to lessen bore damage and sticking concerns



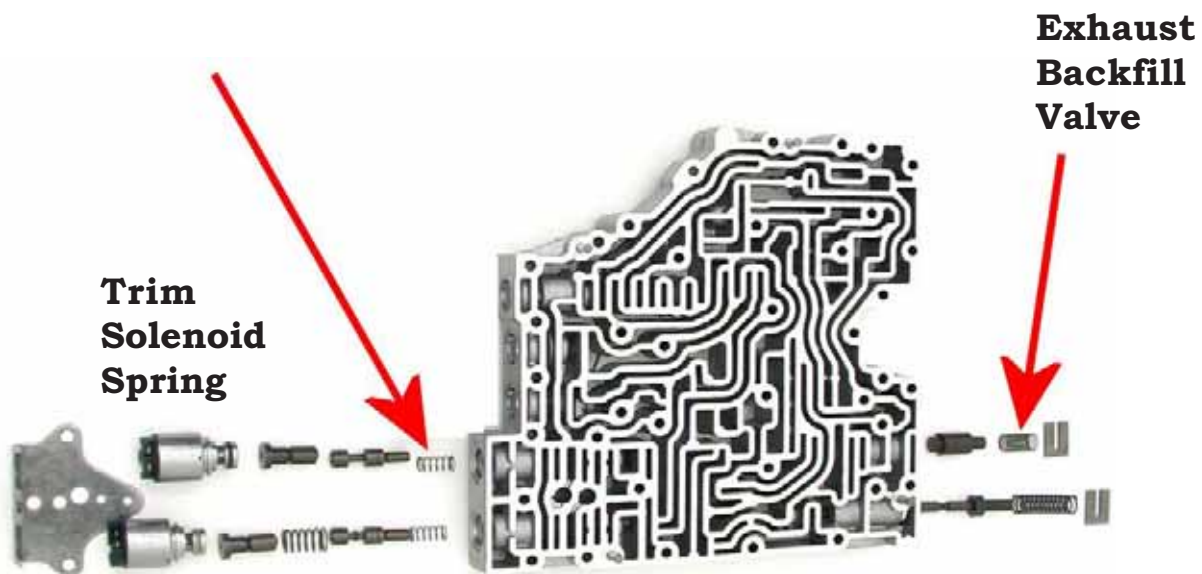
LCT 1000

Clutch Failure After Repair

During repairs on the LCT 1000 it is common for technicians to clean and inspect the various valves and springs. One area that has been a concern with this unit is intermixing springs as they sometimes appear to be the same. Even though the springs may appear to be the same in size and shape they may not be. If the “exhaust backfill” spring is intermixed with the “Trim solenoid” gain spring clutch failure will occur as the back fill pressure will be high enough to keep the clutch partially applied.

CAUSE/CORRECTION: In an attempt to limit the chances of this type of failure from occurring in your shop always keep the springs separated and in the correct positions on your work bench as perform repairs on the hydraulic system. To help identify the exhaust back fill springs they have now been color coded. The color codes are as follows:

1. **NO COLOR-** Introduced 6/99
2. **Orange stripe-** Introduced 7/00
3. **Light green stripe-** Introduced 7/01
4. **Solid Green-** Introduced 9/01



LCT 1000

P0731 SET

Some Allison LCT 1000 applications may set an intermittent or hard DTC P0731. In addition the default actions for the DTC may be present even if the problem is not currently present. P0731 will set if:

1. Engine running
2. Output speed exceeds 200 RPM
3. Turbine speed is present
4. DTC's P0708, P0875, P0876, P0721, P0722, P0716, P0717 are not present
5. 1st gear is commanded by the TCM
6. The calculated gear ratio is higher/lower than 3.10
7. The above concern is present for longer than 20 seconds

If a P0731 is set the TCM will:

1. Default to 2nd or 5th gear
2. When the shifter is moved to reverse the transmission may lock into neutral and the PRNDL may flash
3. MIL ON
4. Shift adapts frozen
5. TCC inhibited

Cause/Correction: Several different areas may cause this DTC to set, they include:

1. Incorrect TCM software calibration
2. Hydraulic or mechanical problems with the C1 or C5 Clutch (Do a clutch test) (C1 clutch has had apply issues on 01-03 models)
3. Solenoid failure (Trim A)
4. Trim Valve sticking
5. Poor connection at the Transmission pass through connector (Common)
6. Erratic VSS or Turbine sensor values (a common cause is terminal 15, connector C2, circuit 821 not seated properly at the TCM connector)

LCT 1000

P0731 SET

Cause/Correction: Several different areas may cause this DTC to set, they include:

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2. Hydraulic or mechanical problems with the C1 or C5 Clutch (Do a clutch test) (C1 clutch has had apply issues on 01-03 models)
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6. Erratic VSS or Turbine sensor values (a common cause is terminal 15, connector C2, circuit 821 not seated properly at the TCM connector)



**Trim
Solenoid A**

LCT 1000

Shift Concerns, Possible DTC's Set

Some 2001-2002 Allison LCT 1000 transmissions may exhibit any/all of the following concerns:

- Excessively hard shifts when cold (Firm shifts are normal)
- Delayed 2-1 downshifts when coming to a stop
- Shift busyness
- Flare/bump during low speed coast down conditions when the throttle is reapplied

In addition the technician may find one or more of the following DTC's set:

- P0708
- P0847
- P0872
- P0875
- P1711
- P1713

Cause/Correction: A recalibration is available to address the above concerns. Visit the GM calibration web site to see if it is available for you particular application. (<http://calid.gm.com>) or (<http://calid.gm.com/vci/>)

LCT 1000

Lack Of Scan Tool Communication

Applications equipped with the LCT 1000 transmission may experience any or all of the following conditions:

- 1. Your scan tool is unable to communicate with the TCM**
- 2. TCCM DTCs may be set**
- 3. ABS failure, erraitc operation**
- 4. The Transmission may not operate properly (failsafe)**

The condition may be caused by a bad ground. Check the G110 Ground wire which is located on the driver's side front body mount frame bracket. Clean the frame contact area, the ground wire, and install a star washer before tightening the ground.

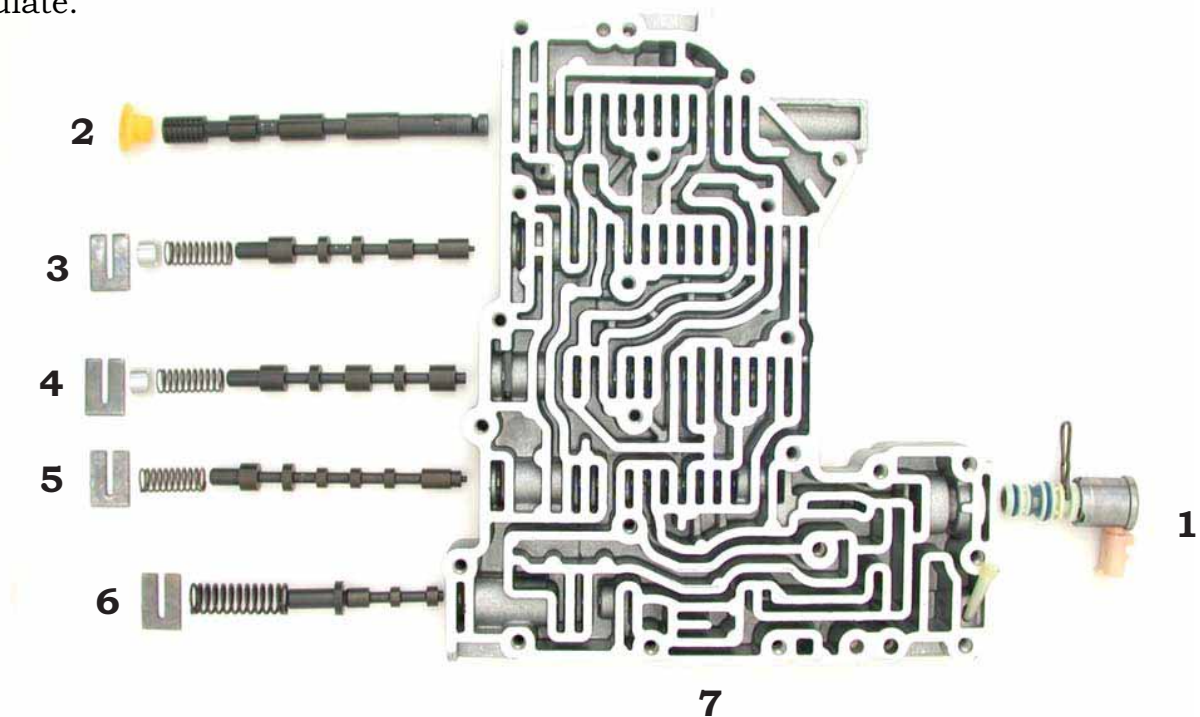
If the condition is still present, check and clean the G102 ground wire (6.6 L-Duramax) which is located on the lower RH passenger side corner of the engine block. On 8.1 L gas applications check/clean the G103 ground wire which is located on the passenger side cylinder head at the back corner.

LCT 1000

Valve Body Identification

Shift Valve Body Assembly

The LCT 1000 valve body does not have as much wear as you may expect due to the nature of the unit. The valves are only used to switch the fluid and not used to regulate.

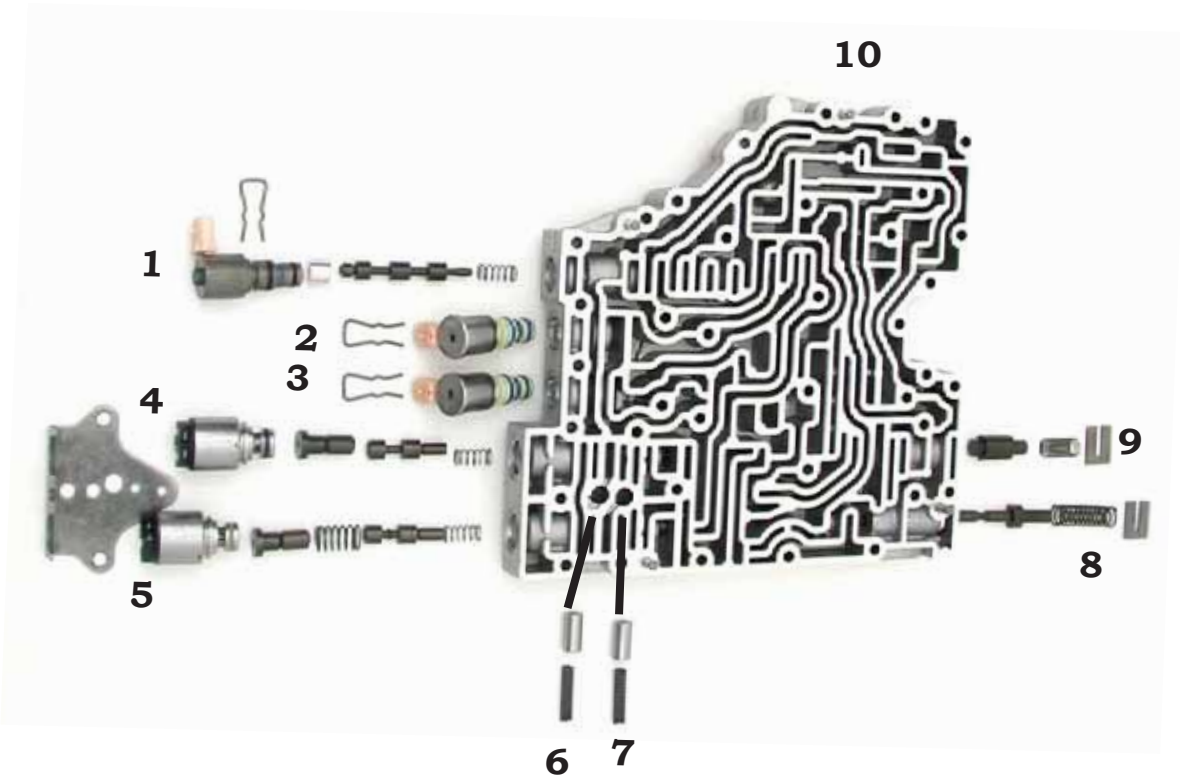


ID	Description
1	SSC ON/OFF
2	Manual Valve
3	D Shift Valve and Spring
4	E Shift Valve and Spring
5	C Shift Valve and Spring
6	Control Main Valve
7	Shift Valve Body

LCT 1000

Valve Body Identification (continued)

Main Valve Body Assembly

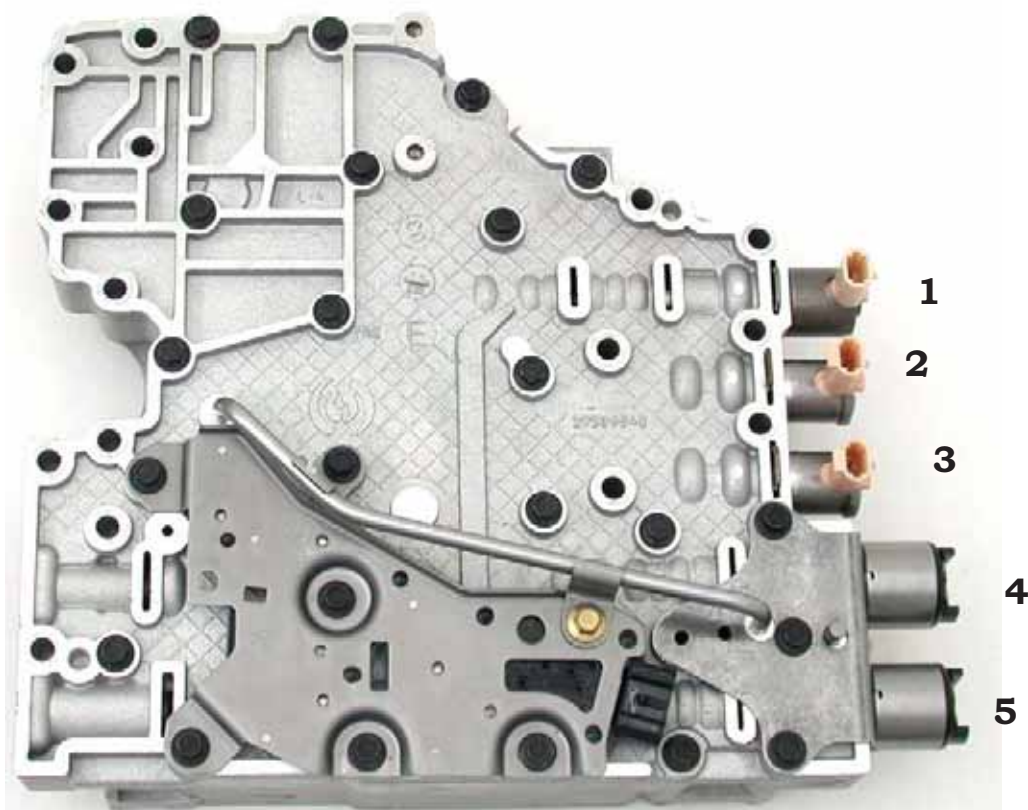


ID	Description
1	F Trim Solenoid PWM
2	D Solenoid ON/OFF
3	E Solenoid ON/OFF
4	B Trim Solenoid PWM
5	A Trim Solenoid PWM
6	Accumulator Plug and Spring for Trim Solenoid B
7	Accumulator Plug and Spring for Trim Solenoid A
8	Control Relief Valve
9	Exhaust Backfill Valve
10	Main Valve Body

LCT 1000

Valve Body Identification (continued)

Main Valve Body Assembly

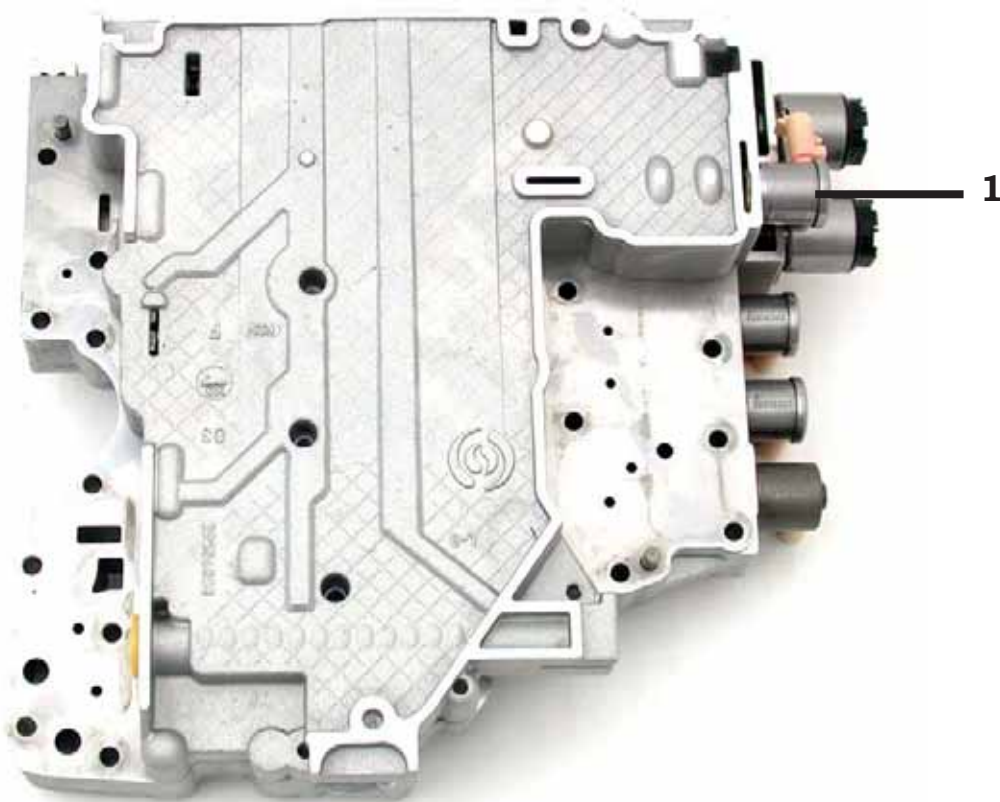


ID	Description	Resistance
1	F Trim Solenoid PWM	11.0 ohms
2	D Shift Solenoid ON/OFF	22.0 ohms
3	E Shift Solenoid ON/OFF	22.0 ohms
4	B Trim Solenoid PWM	5.9 ohms
5	A Trim Solenoid PWM	5.9 ohms

LCT 1000

Valve Body Identification (continued)

Shift Valve Body Assembly



ID	Description	Resistance
1	C Shift Solenoid ON/OFF	22.0 ohms

FORD Contents

All

Flexplate Failures 103

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4R100

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TORQSHIFT

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All

Flexplate Failures

Diagnosing Flexplate Failures

Flexplate cracking on various, engine applications are common. The cracking on these flexplates can be seen either around the crankshaft or torque convert bolt hole patterns. In severe situations, the outer portion is completely separated from the mounting areas.

The following causes for cracked flexplate failures:

- 1) Out of balance engine or torque converter.
- 2) Bad starter drive can cause teeth or ring gear to wear rapidly or break off. Teeth can also break when engine is running and starter is engaged.
- 3) Failure to torque the flexplate bolts to proper specifications and in proper sequence.
- 4) Some applications may require starter shims to be used. If these shims are not used when the starter is installed, improper alignment could occur and damage to the flywheel will result.
- 5) Poor quality parts.
- 6) Missing Dowel pins.

GM & Ford Transmissions

Electronic Pressure Controlled

- 1) Connect a 0-400 psi gauge to the main line test port.
- 2) Set the parking brake firmly.
- 3) Start the vehicle and place the selector in the overdrive position and record the pressure reading at idle.
- 4) Place your left foot firmly on the brake pedal and with your right foot press accelerator pedal fully and record the pressure.
- 5) Follow steps 3 & 4 in reverse position.

Compare your results to the chart below if your readings are not within specs. You will need to correct the problem before the vehicle is put into service.

Caution – Do not exceed more than 3 seconds on stall test!

Ford

<u>Trans</u>	<u>In OD at Idle</u>	<u>In OD at Stall</u>	<u>In R at Idle</u>	<u>In R at Stall</u>
AXODE/AX4N	45-85	175-220	50-80	260-320
AODE/4R70W	50-80	160-210	80-120	260-320
E4OD/4R100	50-70	160-190	80-110	240-310
4R55E	65-100	190-250	110-165	235-350
CD4E	45-70	160-185	65-80	250-300

General Motors

<u>Trans</u>	<u>In OD at Idle</u>	<u>In OD at Stall</u>	<u>In R at Idle</u>	<u>In R at Stall</u>
4L30E	45-55	145-170	55-70	185-215
4L60E	50-65	160-190	55-70	290-340
4L80E	50-70	150-190	55-75	260-300
4T65E	55-75	190-220	70-85	240-300
4T80E	50-70	230-250	80-95	270-310

These are approximate specifications.

Ford

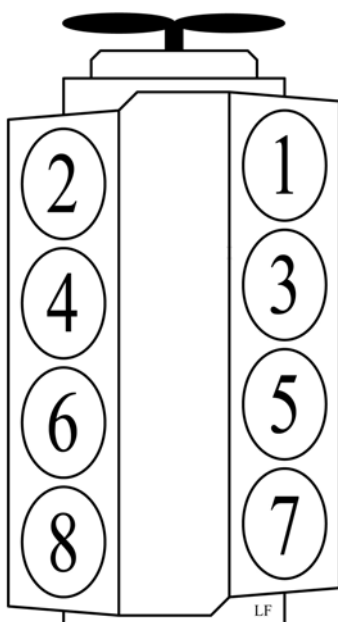
Cylinder Contribution Test

7.3L Diesel Cylinder Contribution Self Test

The Cylinder Contribution Self Test is a functional test of the PCM performed OnDemand with the engine running, A/C off and engine oil temperature above 70°F.

This test will determine if all cylinders are contributing equally to engine performance. The PCM will test all 8 cylinders continuously during the test: The test checks for cylinder-to-cylinder changes in engine rpm, and sets a code if the rpm change is not within a pre-calibrated range.

This test checks for weak injectors or low compression cylinders. A fault must be present at the time of testing for the KOER Cylinder Contribution Self Test to detect a fault, so the engine operating condition at which the idle is the worst will produce the best test results. For automatic transmission vehicles, the best results are reached with the parking brake set and the transmission in DRIVE. If a fault is detected, a Diagnostic Trouble Code (DTC) will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.



Ford

Injector Test

7.3L Diesel Injector Electrical Self Test

Injector Electrical Self Test is a functional test of the PCM performed on demand with the key on and the engine off.

This test determines if the injector circuits and solenoids are electrically operating without fault. All injectors will first buzz (audible feedback of the injector solenoids energizing the injector valves) together for approximately 2 seconds, then each injector will buzz for approximately 1 second in numerical order (1 through 8).

The IDM (Injector Driver Module) stores all historical IDM fault codes; to ensure that the DTC is a hard fault, you must first clear continuous DTCs (be sure to record all IDM fault codes before clearing). After clearing, re-run self test; a fault must be present at the time of testing for the KOEO Injector Electrical Self Test to detect the fault. If a fault is detected, a Diagnostic Trouble Code (DTC) will be the output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.

Ford

Parameter Identifications and Description

<i>Parameter Identification (PID) List</i>		
Acronym	Description	Measurement Units
4x4L	4x4 Low Switch	ON/OFF
ACCS	Air Conditioning Clutch Status	ON/OFF
AP	Accel Pedal Position Sensor	Volts
ARPMDES	Ancillary Engine Speed Desired	RPM
BARO	Barometric Pressure Sensor	PSI
BARO V	Barometric Pressure Sensor Actual	Volts
BPP_BOO	Brake ON/OFF Switch	ON/OFF
BPA/SW	Brake Pressure Applied	ON/OFF
CCS	Coast Clutch Solenoid	ON/OFF
CCSF	Coast Clutch Solenoid Fault	ON/OFF
CCP/PNP	Clutch Pedal Position/Park Neutral Position Switch	ON/OFF
CPP/TCS	Clutch Pedal Position/TCS	ON/OFF
CRUISE	Cruise Control Mode (Driving)	ON/STNDBY/TAPUP/TAPDN
DTC CNT	Diagnostic Trouble Code Count	DTC No.
EBP	Exhaust Back Pressure	PSI (Absolute)
EBP V	Exhaust Back Pressure Actual	Volts
EOT	Engine Oil Temperature	Degrees C (F)
EOT_V	Engine Oil Temperature Voltage	Volts
EPC*	Electronic Pressure Control	PSI
EPC V	Electronic Pressure Control Actual	Volts
EPR	Exhaust Pressure Regulator	Percent
FLI	Fuel Level Input	Percent
FLI V	Fuel Level Input Actual (Voltage)	Volts
FP	Fuel Pump Control	Duty Cycle (100% = On)
FUEL PW	Fuel Pulse Width	Milliseconds
GEAR	Transmission Gear 4R100 Only (Driving)	Trans. Gear

Ford

Parameter Identifications and Description (continued)

GPC	Glow Plug Control Duty Cycle	Percent
GPC TM	Glow Plug Control Time	Seconds
GPL TM	Glow Plug Lamp Time	Seconds
GPML	Glow Plug Monitoring Left Bank	Amp
GPML	Glow Plug Monitoring Right Bank	Amp
IAT*	Intake Air Temperature	Degrees
IAT V	Intake Air Temperature Actual	Volts
ICP	Injector Control Pressure Sensor	PSI
ICP V	Injection Control Pressure Actual	Volts
IPR	Injector Control Pressure Regulator	Percent
IVS	Idle Validation Switch	ON/OFF
MAP	Manifold Absolute Pressure Sensor	PSI (Absolute)
MAP_Hz	Manifold Absolute Pressure Frequency	Hertz
MAP_V	Manifold Absolute Pressure Actual	Volts
MAT	Manifold Air Temperature	Degrees
MAT V	Manifold Air Temperature Actual (Voltage)	Volts
MFDES	Mass Fuel Desired	Milligrams
MGP	Manifold Gauge Pressure	PSI
MIL	Malfunction Indicator Light	ON/OFF
OSS	Transmission Output Shaft Speed	RPM
PBA	Parking Brake Applied	ON/OFF
PERDEL 1	Percent Delta Cylinder #1 (Misfire Data)	Percent
PERDEL 2	Percent Delta Cylinder #2 (Misfire Data)	Percent
PERDEL 3	Percent Delta Cylinder #3 (Misfire Data)	Percent
PERDEL 4	Percent Delta Cylinder #4 (Misfire Data)	Percent
PERDEL 5	Percent Delta Cylinder #5 (Misfire Data)	Percent
PERDEL 6	Percent Delta Cylinder #6 (Misfire Data)	Percent
PERDEL 7	Percent Delta Cylinder #7 (Misfire Data)	Percent
PERDEL 8	Percent Delta Cylinder #8 (Misfire Data)	Percent
RPM	Engine Speed	RPM
SCCS	Speed Control Command Switch	Volts
SCCS M	Speed Control Command Switch Mode	Mode

Ford

Parameter Identifications and Description (continued)

SS1	Shift Solenoid No. 1 — 4R100 Only	ON/OFF
SS2	Shift Solenoid No. 2 — 4R100 Only	ON/OFF
SS1F	Shift Solenoid #1 Output Fault	ON/OFF
SS2F	Shift Solenoid #2 Output Fault	ON/OFF
SS3	Shift Solenoid #3 Commanded ON	ON/OFF
SS3F	Shift Solenoid #3 Output Fault	ON/OFF
TCC	Torque Converter Clutch	ON/OFF/Percent
TCCA	Torque Converter Clutch Primary Circuit Monitor	ON/OFF
TCCF	Torque Converter Clutch Output Fault Detected	ON/OFF
TCCMACT	Torque Converter Modulator Actual	ON/OFF
TCCMCMD	Torque Converter Modulator Commanded	ON/OFF
TCIL	Transmission Control Indicator Lamp	ON/OFF
TCILF	Transmission Control Indicator Lamp Out Fault	ON/OFF
TFT	Transmission Fluid Temperature	Degrees
TFT V*	Transmission Fluid Temperature Sensor Actual	Volts
TRANRAT	Transmission Ratio	Ratio
TORQUE	Engine Torque	Lb/Ft
TPREL	Low Idle Throttle Position	V
TR	Transmission Range Sensor Position	PARK, REV, NTRL, OD, DRIVE,
TR D	Transmission Range Sensor Digital Signal	O's/1's
TR V	Transmission Range Sensor Actual	Volts
TSS/ISS	Transmission Turbine Input Speed Sensor	RPM
VFDES	Volume Fuel Desired	Cubic Millimeters
VPWR	Vehicle Power Supply	Volts
VREF	Vehicle Reference Voltage	Volts
VS SET	Vehicle Speed Setting	MPH
VSS	Vehicle Speed Sensor	MPH
WGC	Wastegate Control	Duty Cycle

Ford 4X4

(ESOF) Electronic Shift On the Fly (continued)

Stuck in 4X4, Erratic 4X4 Operation

Vehicles between the years of 1995-1999 exhibiting inadvertent 4X4 Hi or Low shift events, 4X4 and/or Low Range indicator flashing or solid or vehicle stuck in 4L after uncommanded shift may be caused by the 4X4 shift motor.

Install a YL1Z-7G360-AA shift motor on vehicles built before 12/99. The YL1Z-7G360-AA shift motor with a grey contact plate cover replaces the prior design F75Z-7G360-AA motor with a blue contact plate cover. Grey-cover shift motors contain improved sense plate material and shift motor terminal upgrades. For vehicles already equipped with the latest style shift motor, refer to the following service procedure for details.

Uncommanded Shift to 4L

Parking Maneuvers/Gear Lever Transitions: Symptoms noted during a lower speed uncommanded shift to 4L event include:

1. Front end binding or hopping while turning
2. Bind feel in drivetrain when backing up and/or turning
3. Audible clunking or grinding noises, and/or
4. Amber low range light illuminated

If the Generic Electronic Module (GEM) receives a false mode switch input during or shortly after the Digital Transmission Range Sensor (DTR) indicates a Neutral range, an uncommanded shift is possible if remaining 4L pre-conditions are met. The pre-conditions (besides transmission in neutral range) include: service brake depressed, and vehicle speed less than 3 mph. A false switch input may also set a P1812 (4-wheel drive mode select circuit failure) or P1815 (4-wheel drive mode select short circuit to ground) DTC in the GEM.

Check mode switch circuits 682 (dark blue) for short to power and 780 (dark blue wire) for ground short, loose connections at inline connectors, and chafes.

Monitor the mode switch “Parameter Identification Display” (PID) 4WD_SW for false readings while slightly pushing in and wiggling the mode switch knob.

Ford 4X4

(ESOF) Electronic Shift On the Fly (continued)

Uncommanded Shift to 4X4 High (continued)

Replace the mode switch if it fails testing, or repair wiring on circuits 682 or 780 if fault indicated. If the tests pass, inspect the build date stamped on the GEM and replace the GEM if the GEM is built prior to 9/98.

Test drive the vehicle for proper 4X4 operation in all modes. Include parking lot maneuvers and transmission gear range lever transitions. Check for DTCs in the GEM. Clear any codes present and cycle ignition.

Road Speed: Reported symptoms for a higher speed uncommanded shift to 4L event include:

1. Rapid deceleration
2. High engine revving possibly accompanied by a P1270 DTC in the PCM
3. Clunk/grind noise
4. Speedometer may spike higher than actual speed.
5. After the initial event, the vehicle may exhibit restricted vehicle top speed without 4X4 indicators illuminated but possible MIL (Malfunction Indicator Lamp) on.

Monitor contact plate A,B,C,D PIDS. (sequentially read starting with plate A then B, then C, finally D). With Mode Switch in;

1. A4WD, plate PIDS should read "OCCO"
2. 4H PIDS should read "COOC"
3. 4L PIDS should read "COCO"

If contact plate PIDS DO NOT correspond to the set 4WD position, check for continuity/shorts/moisture/corrosion in the vehicle side of the transfer case shift motor connector (toward the GEM). Visually inspect all terminals, pins, crimps, and connectors closely. Repair any wiring conditions in the contact plate circuits as necessary.

Road test at speeds above 10 mph with mode switch in both A4WD and 4H to see if the condition returns. Clear DTCs from GEM (even if no DTCs exist) and cycle the ignition. Clear DTCs from the PCM if a P1270 (engine RPM or vehicle speed limiter reached) code was initially present.

Ford 4X4

(ESOF) Electronic Shift On the Fly (continued)

Uncommanded Shift to 4X4 High (continued)

1. Autolock Strategy (Expedition/Navigator Vehicles Only):

Uncommanded 4H shifts with red 4X4 light on “solid” while driving in Automatic Mode may be a vehicle characteristic if driven off-road or under slippery conditions.

The GEM Autolock strategy commands the transfer case clutch to minimum duty cycle and engages 4H (with mode switch still set to A4WD) to prevent continuous cycling from prematurely wearing the clutch. This is design intent. Excessive tire circumference variations or axles with unmatched gear ratios can result in unexpected Autolock function as well. For more detail check the speed sensor section below.

Once the condition that caused the Autolock strategy to activate is no longer present, the system stays in 4H until the operator cycles the ignition key or sets the mode switch to 4H then back to A4WD.

2. Transfer Case Speed Sensors (Expedition/Navigator Vehicles Only):

If an uncommanded shift to 4H occurs on hi-traction surfaces, check the TRA_FSP (T-case front speed sensor) and TRA_RSP (T-case rear speed sensor) PIDS for excessive speed sensor variation between the front and rear transfer case speed sensors.

If the PIDS show sensor inputs are not within 1-2 mph of each other during steady-state driving with possible DTCs P1836 (T-Case front speed sensor) /P1837 (T-Case rear speed sensor), first verify tire pressures, sizes, circumference within 1/4" among all four tires, and front and rear axle gear ratios for matching.

If the ratios match and tire sizes are okay, check associated circuits and replace the speed sensor(s) or repair the wiring as necessary.

After any repairs, road test while comparing scanner GEM PIDS TRA_FSP and TRA_RSP to PCM VSS signal. Verify all three PIDS match each other within 1-2 mph.

Ford 4X4

(ESOF) Electronic Shift On the Fly (continued)

Uncommanded Shift to 4X4 High (continued)

A false mode switch input on circuits 682 and/or 780 (dark blue wire) could be interpreted by the GEM as operator requesting a 4H shift. Under this condition, the GEM will command shift motor movements to match the false switch input. The red 4X4 indicator light will illuminate just as if the operator moved the switch. If the condition became intermittent, the 4X4 range and also the indicators could switch back and forth between A4WD/2H and 4H.

Check the mode switch circuits between the GEM and dash for chafing, shorts, crimps, and continuity. Repair the wiring if faults found. If the wiring is okay, replace the mode switch itself. After any repair, pull DTCs from the GEM, even if there are no DTCs available. Always go thru the ritual of clearing codes.

Stuck in 4X4 Low at all Times

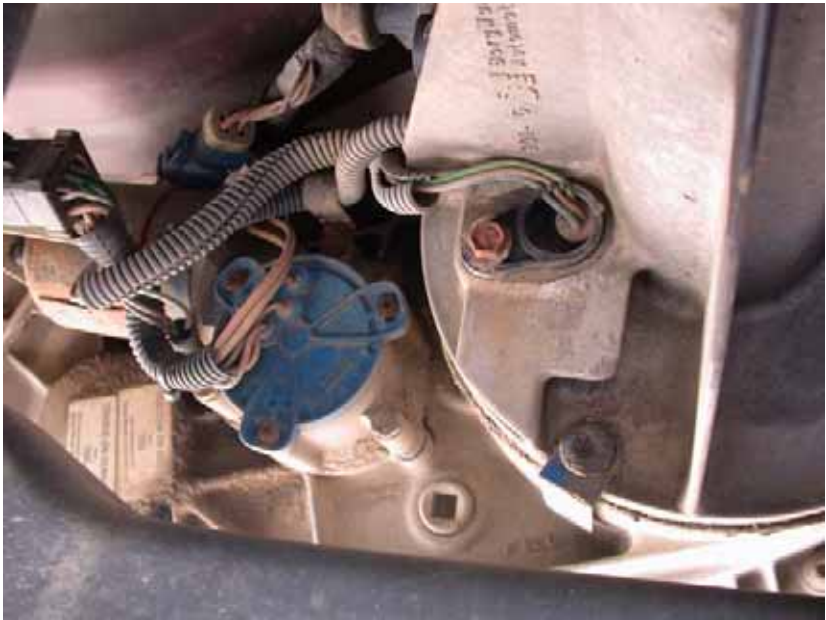
Customers describing an uncommanded shift to 4L shortly after start-up and then unable to shift the transfer case. Associated symptoms could include valid GEM DTCs being erased and false DTCs such as C1107 (4WABS module failure) present. If the transfer case is stuck in 4X4, re-establishing normal shift motor operation is possible by putting the mode switch in 4L with the trans gear lever in neutral, service brake depressed, and vehicle stationary.

A new GEM program has been updated to address this concern, if the GEM needs to be replaced, the new program is already installed in the new GEM.

Ford 4X4

(ESOF) Electronic Shift On the Fly (continued)

Old Number
F75Z-7G360-AA



New Part Number
w/ gray connector
YL1Z-7G360-AA



AX4S

No Movement

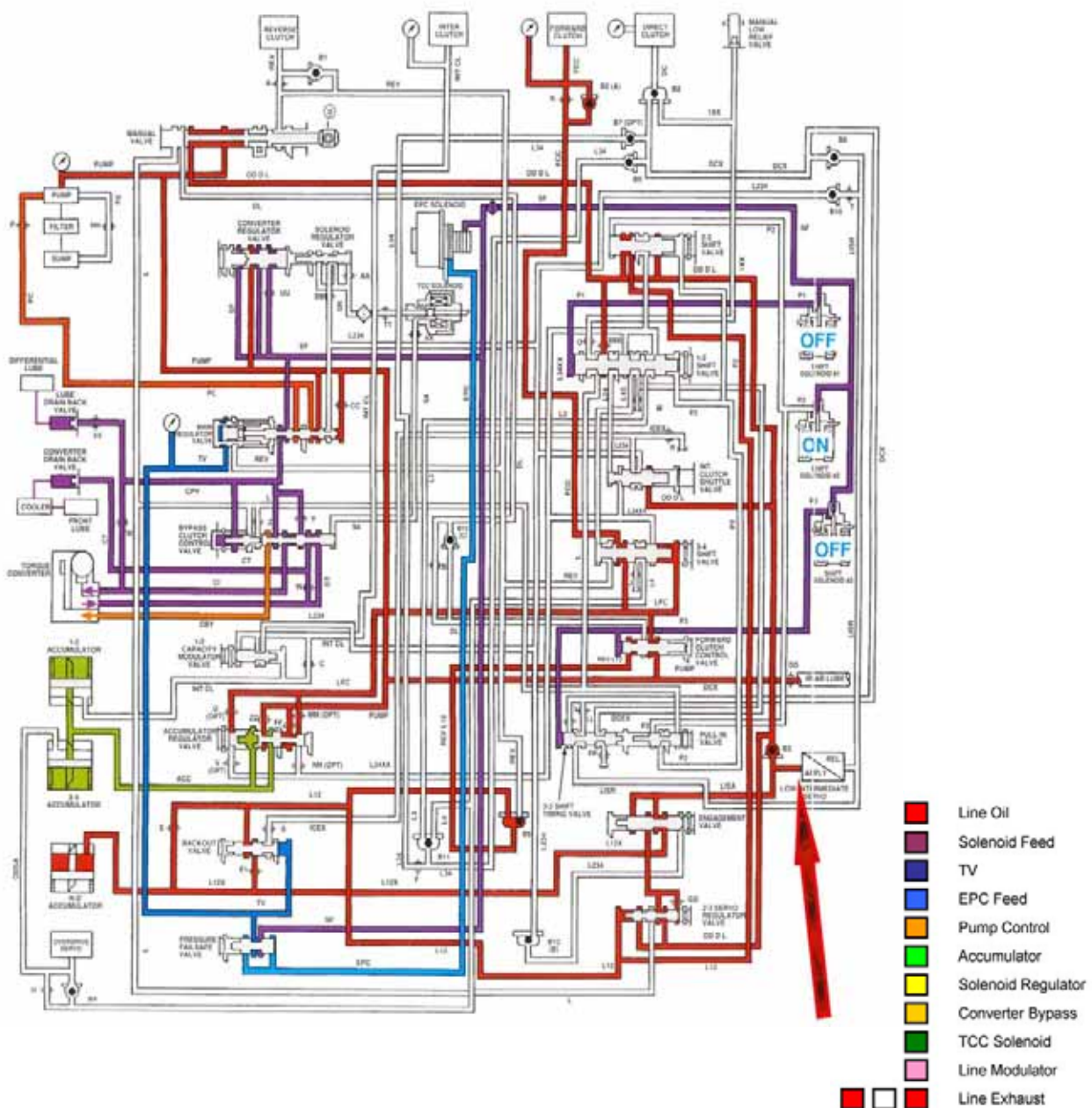
A no movement condition can be caused by the front clip breaking in the Low/Intermediate servo assembly.



AX4S

No Movement (continued)

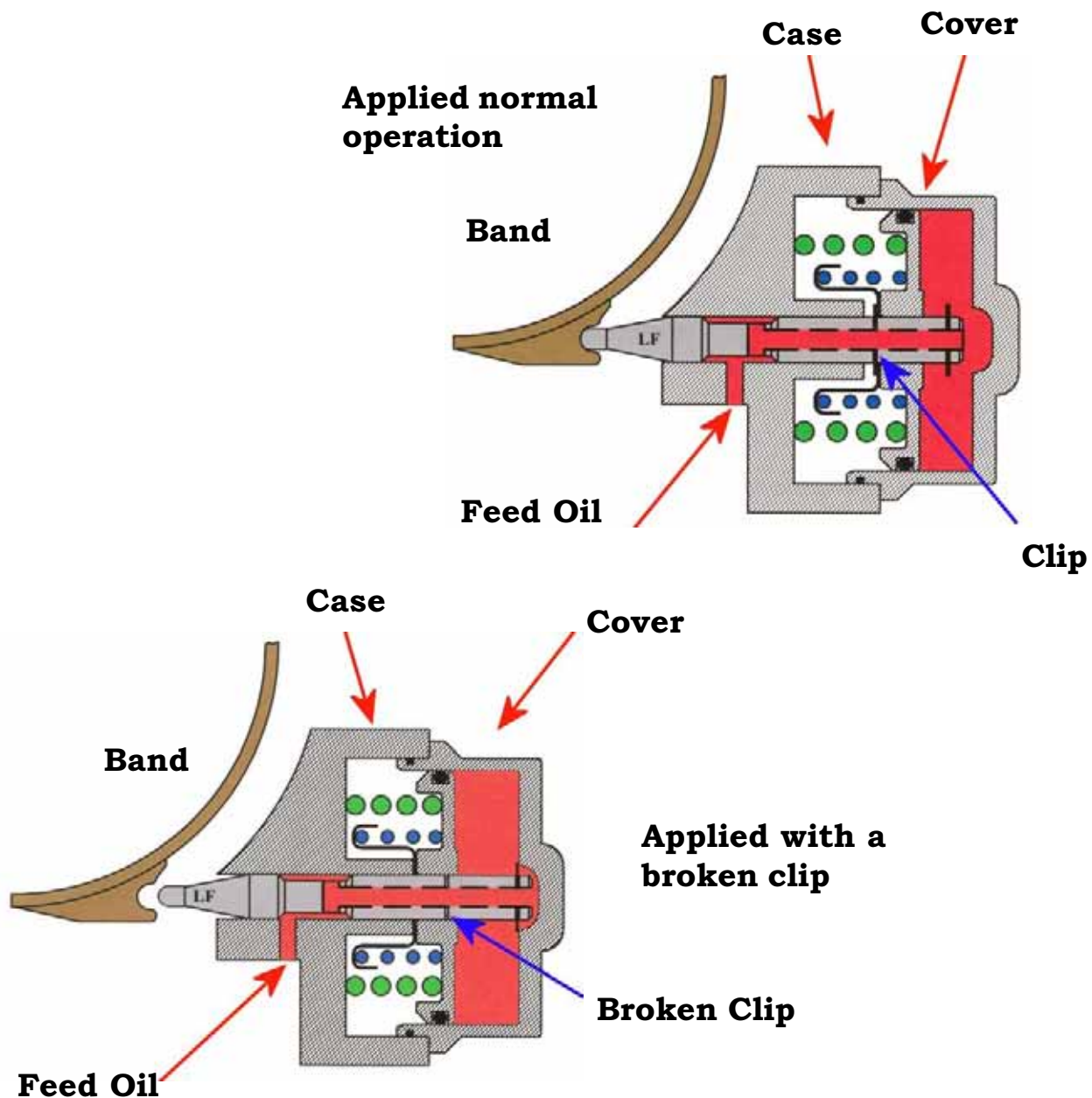
The Low-Intermediate servo is applied in 1st and 2nd drive gear, and is released in 3rd. The hydraulic diagram shows a typical AX4S 1st gear application.



AX4S

No Movement (continued)

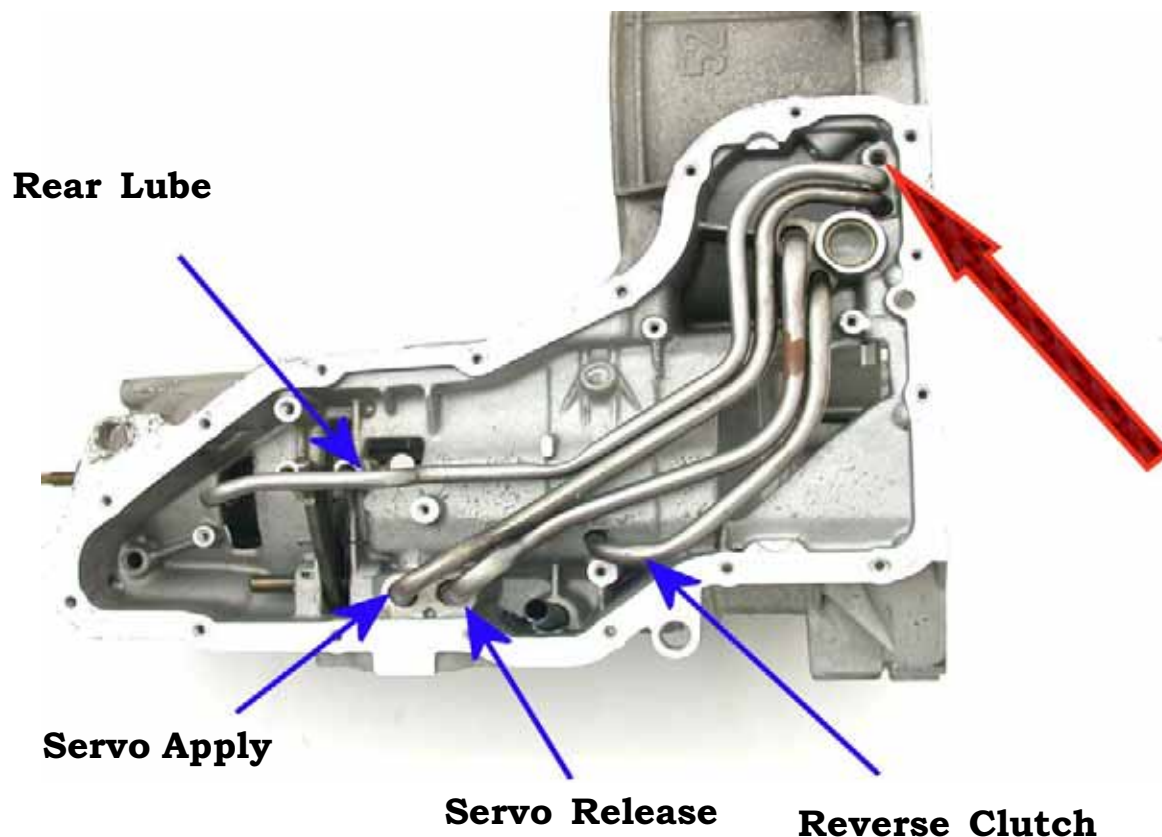
Oil enters the servo through the case and is directed to the top of the servo piston. If the clip is broken the piston will bottom out and the servo apply rod will be stationary and not apply the band.



AX4S

No Rear Lube Tube

All 1999 and newer AX4S transmissions have only four tubes in the bottom of the transmission. A new tube now incorporates the differential speedometer lube transfer tube that was deleted from production.

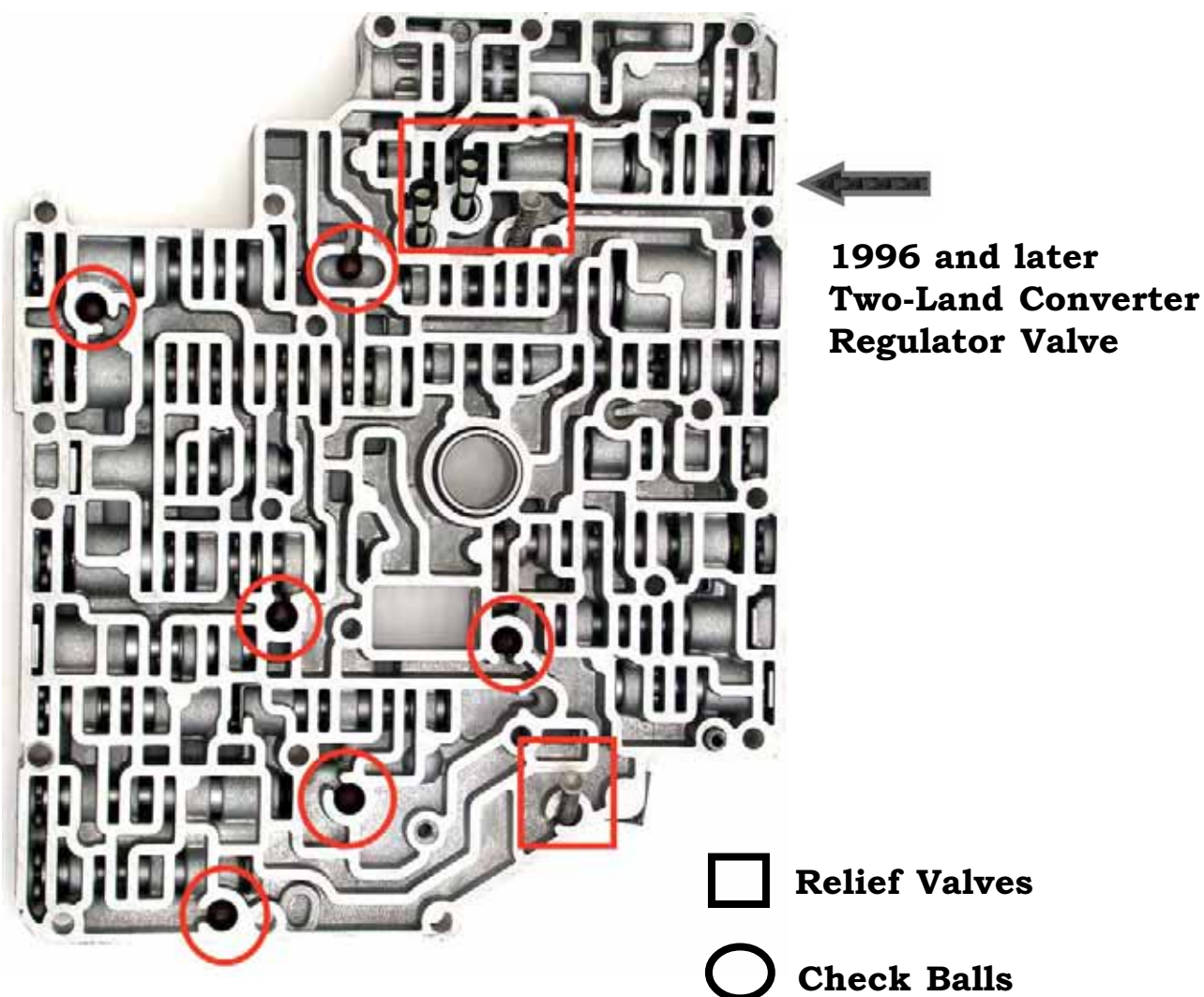


AX4S

Valve Body Interchange

1996-1998 Valve Body Assembly

From 1996-1998 all AX4S valve bodies are interchangeable. These valve bodies have six Checkballs and two relief valves.

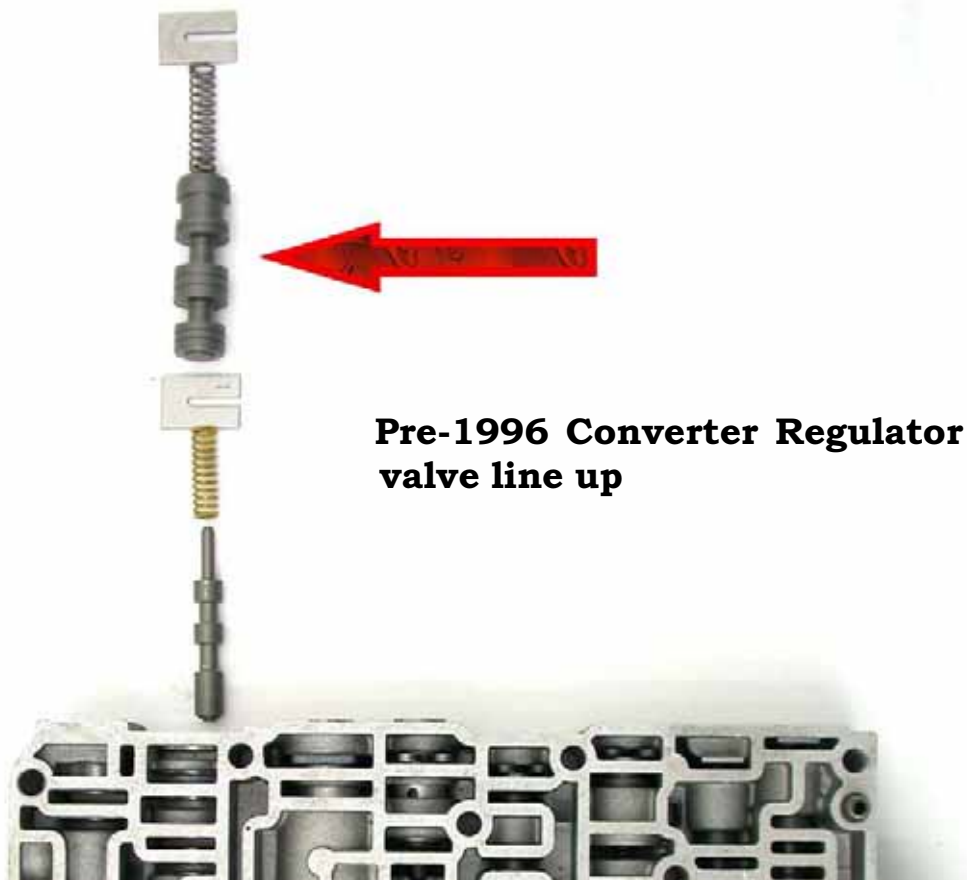


AX4S

Valve Body Interchange (continued)

Pre-1996 Converter Regulator Valve Assembly

The Pre-1996 Converter regulator valve has four lands and is not interchangeable with later valve bodies.

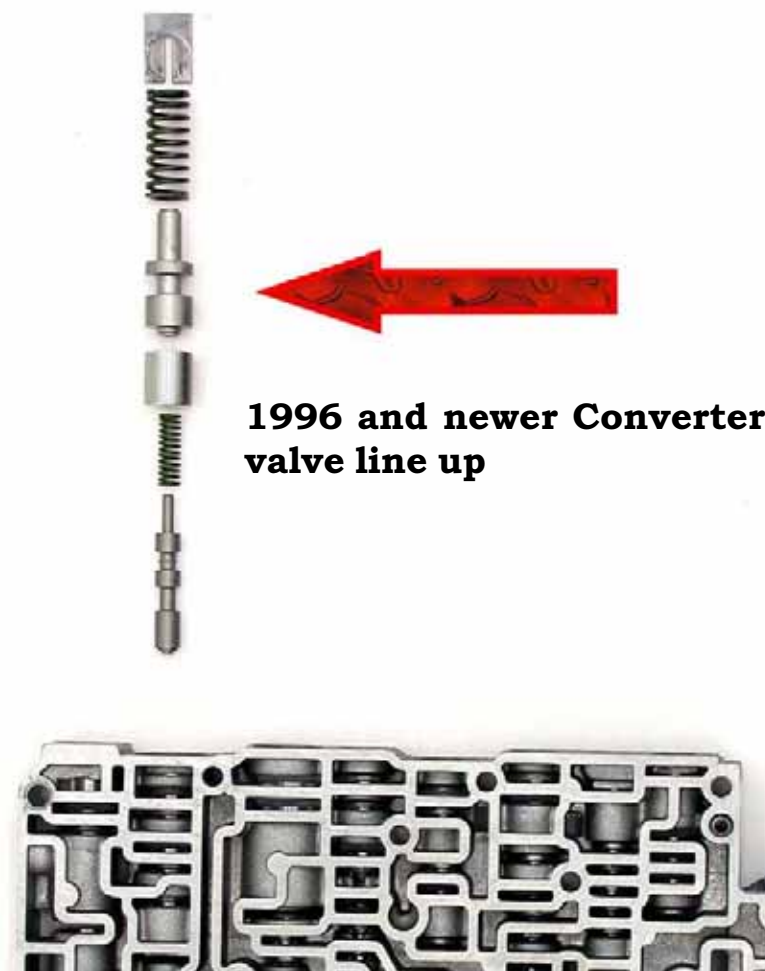


AX4S

Valve Body Interchange (continued)

1996 and Newer Converter Regulator Valve

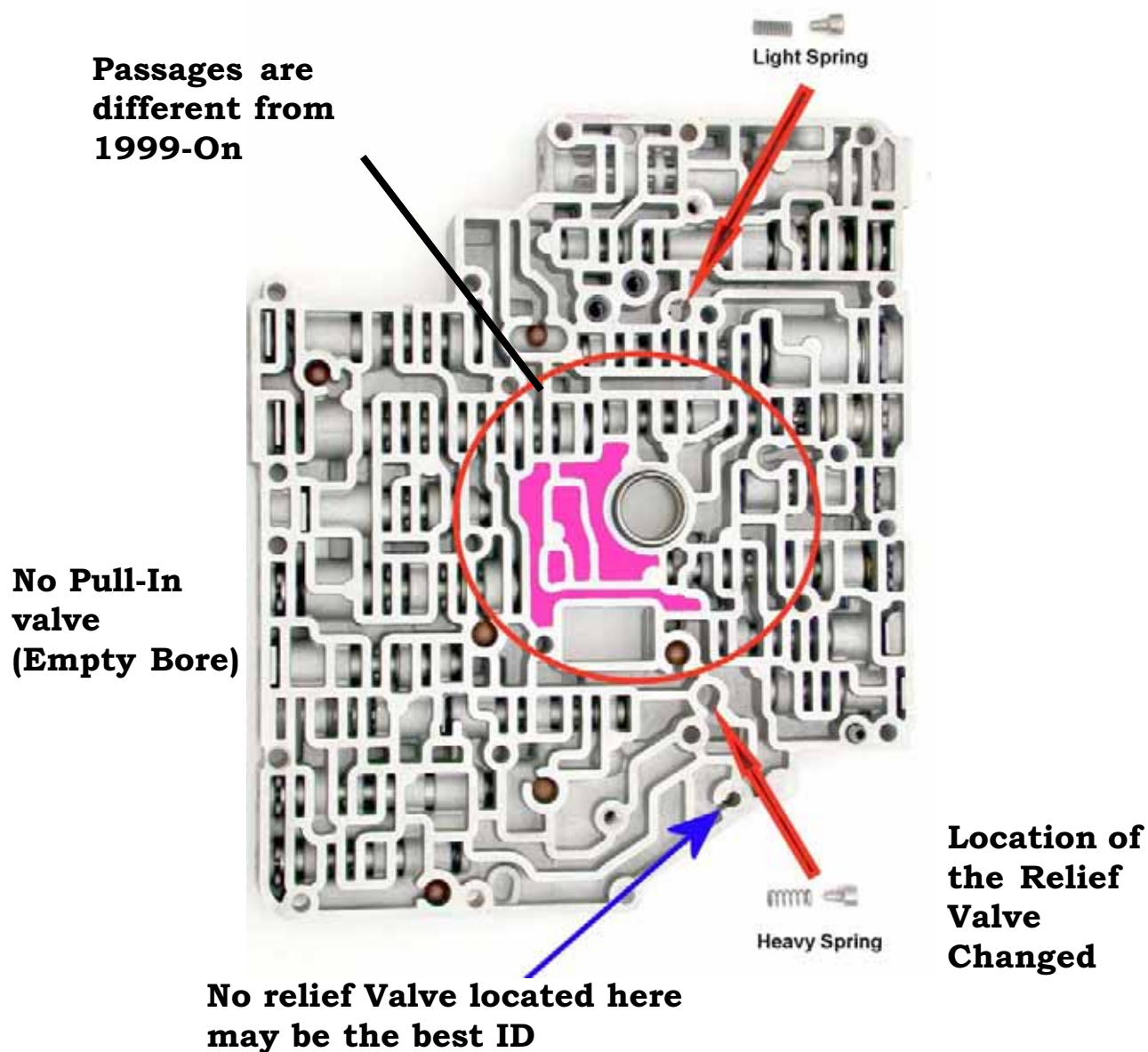
The 1996-1998 Converter regulator valve has two lands and is not interchangeable with later models



AX4S

Valve Body Interchange (continued)

1999 and Newer Valve Body Assembly



AX4S

Valve Body Interchange (continued)

Separator Plate Codes

Beginning April 19, 1994, the AX4S transaxles contain bonded main control separator plate gaskets. AX4S applications, both the valve body and pump body contain separator plates bonded with gaskets.

If service is required on a main control assembly containing a separator plate with a bonded gasket, service the separator plate with the correct application from the following charts.

AX4S Pump Separator Plate Application Chart		
#ID	Vehicle	Part Number
#AH	1994-95 3.0L and 3.8L Taurus/Sable	F5DZ-7R167-A
#AH	1994 3.8L Continental	F5DZ-7R167-A
#AH	1994-95 3.2L Taurus SHO	F5DZ-7R167-A
#AH	1995 3.8L Windstar	F5DZ-7R167-A
#51	1995 3.0L Windstar	F58Z-7R167-A
#51	96-97 All Engine Sizes- Taurus, Sable, Windstar	F58Z-7R167-A
#66	1999-UP 3.0L Windstar	XF2Z-7R167-AA

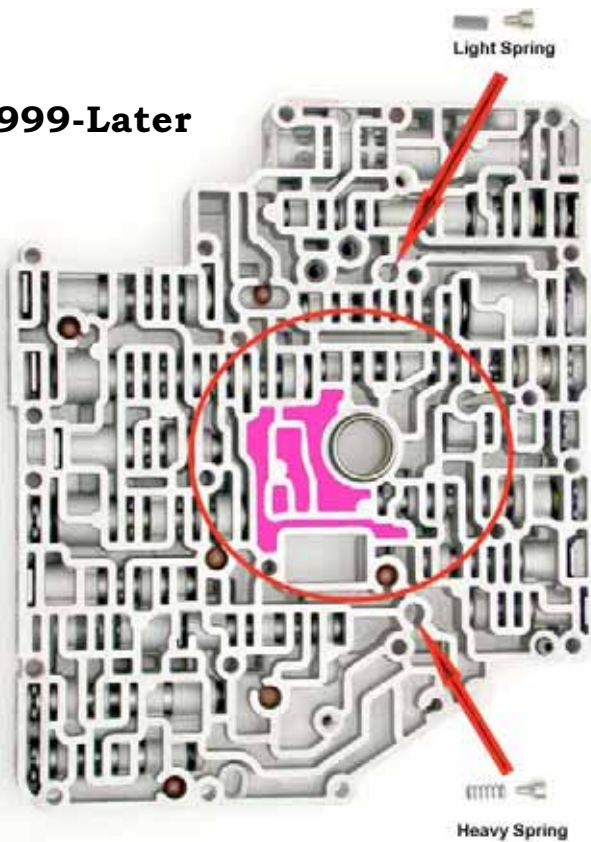
AX4S Valve Body Separator Plate Application Chart		
ID #	Vehicle	Part Number
#58	1995 3.8L Windstar	F58Z-7Z490-A
#43	1995 3.0L Windstar	F58Z-7Z490-B
#31	1994-95 3.2L Taurus SHO	F5DZ-7Z490-B
#40	1994-95 3.0L Taurus/Sable	F5DZ-7Z490-C
#41	1994-95 3.8L Taurus/Sable	F5DZ-7Z490-D
#41	1994 Continental	F5DZ-7Z490-D
#42	1996-97 3.0L Windstar, Taurus, Sable Replaces #63 & #97	F6DZ-7Z490-FB
#47	1996-97 3.8L Windstar	F68Z-7Z490-A
#98	98-Up 3.0L Taurus, 3.0/3.8L Windstar	F88Z-7Z490-AA

AX4S

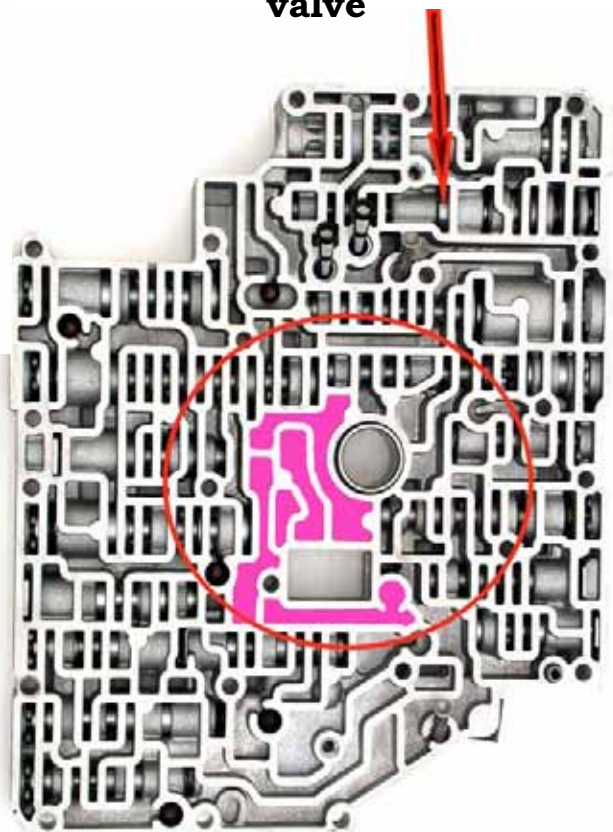
Valve Body Interchange (continued)

Areas of difference

1999-Later



1996-1998
two land
valve

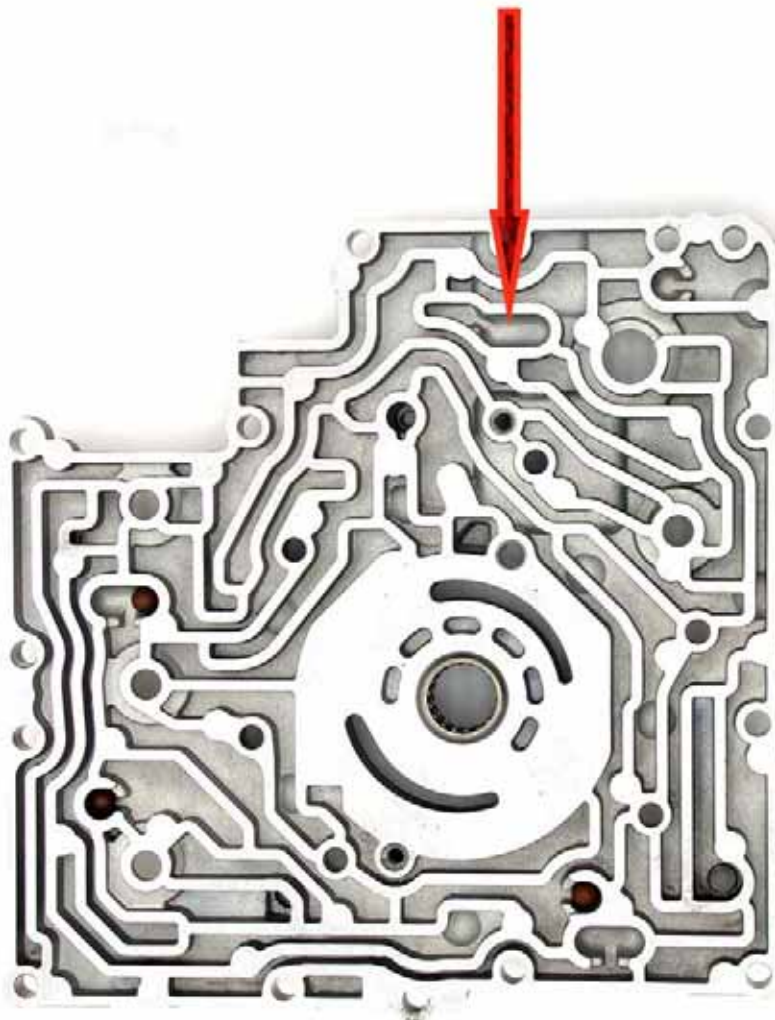


AX4S

Valve Body Interchange (continued)

1999 -On Pump Body Assembly

1999 - On AX4S pump bodies do not have a CB “5” checkball. One easy way to determine if your plate and valve body are correct is the number of holes over the CB “5” checkball bathtub. One hole means no check ball, two holes means a check ball is required.



AX4S and AX4N

EPC Solenoids

The AX4S and AX4N EPC solenoids are interchangeable, they have the same resistance, and connector. The only difference is the bracket, which is removable and can be swapped if necessary. The cost is about \$10 less then the AX4N solenoid.

New part # AX4S
F8DZ-7G383-BB



New part # AX4N
F8DZ-7G383-AB

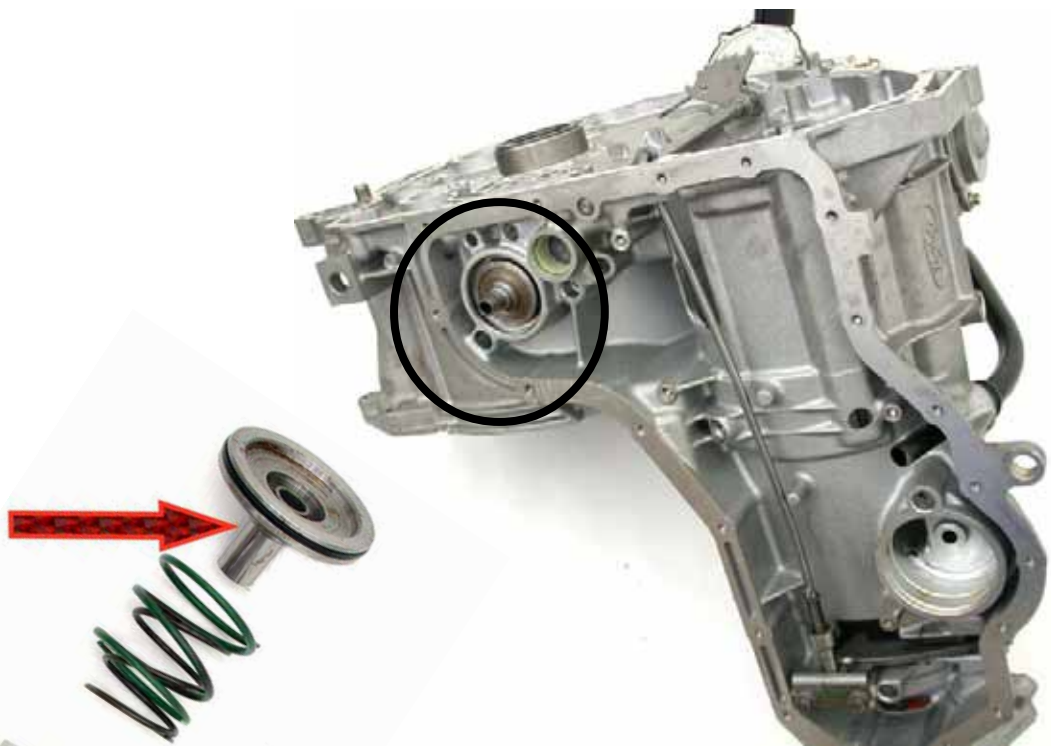


AX4N

Delayed Engagement

A delayed engagement may be caused by a worn or damaged neutral drive accumulator pin. The pin seals the oil between the accumulator and the forward clutch. When the pin is worn or damaged the forward clutch oil pressure is lost.

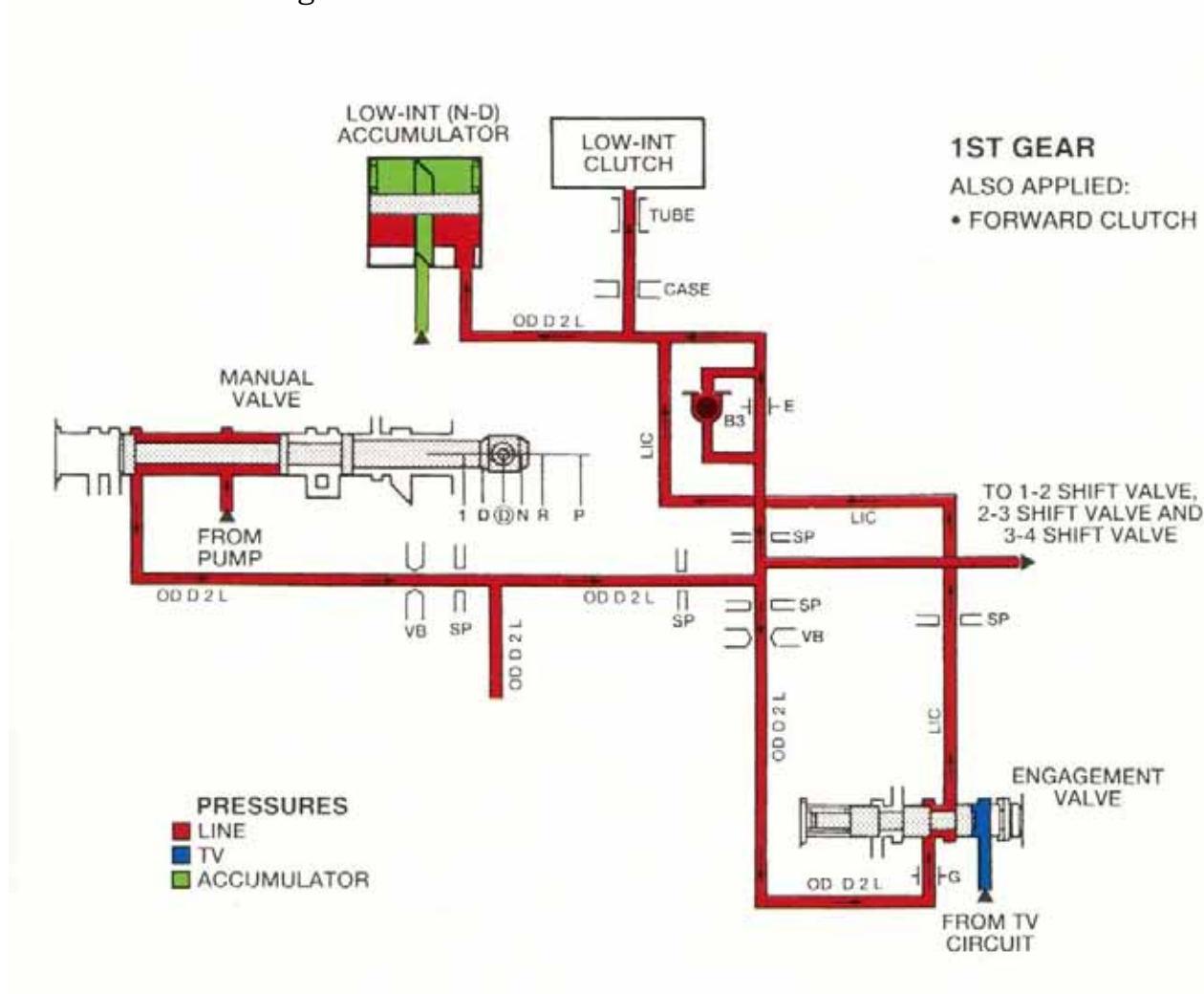
Check for wear here.



AX4N

Delayed Engagement (continued)

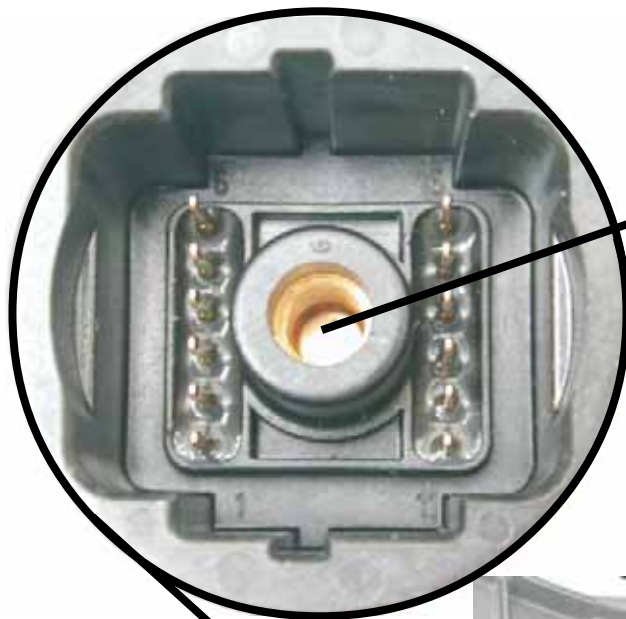
The green oil is modulated pressure from the line modulator valve. It enters the accumulator through the accumulator pin. The Red oil is line oil that comes from the 1-2 shift valve and applies the forward clutch while using the N-D accumulator to cushion the application. If the pin becomes worn it allows the line oil to enter the accumulator regulator circuit.



5R55N/W/S

Multiple Solenoid Codes

Multiple codes that won't clear may be caused by a bad or loose connection at the solenoid connector. This concern is especially found after overhaul and during the installation. The bolt on the connector has to bottom out on the solenoid block.



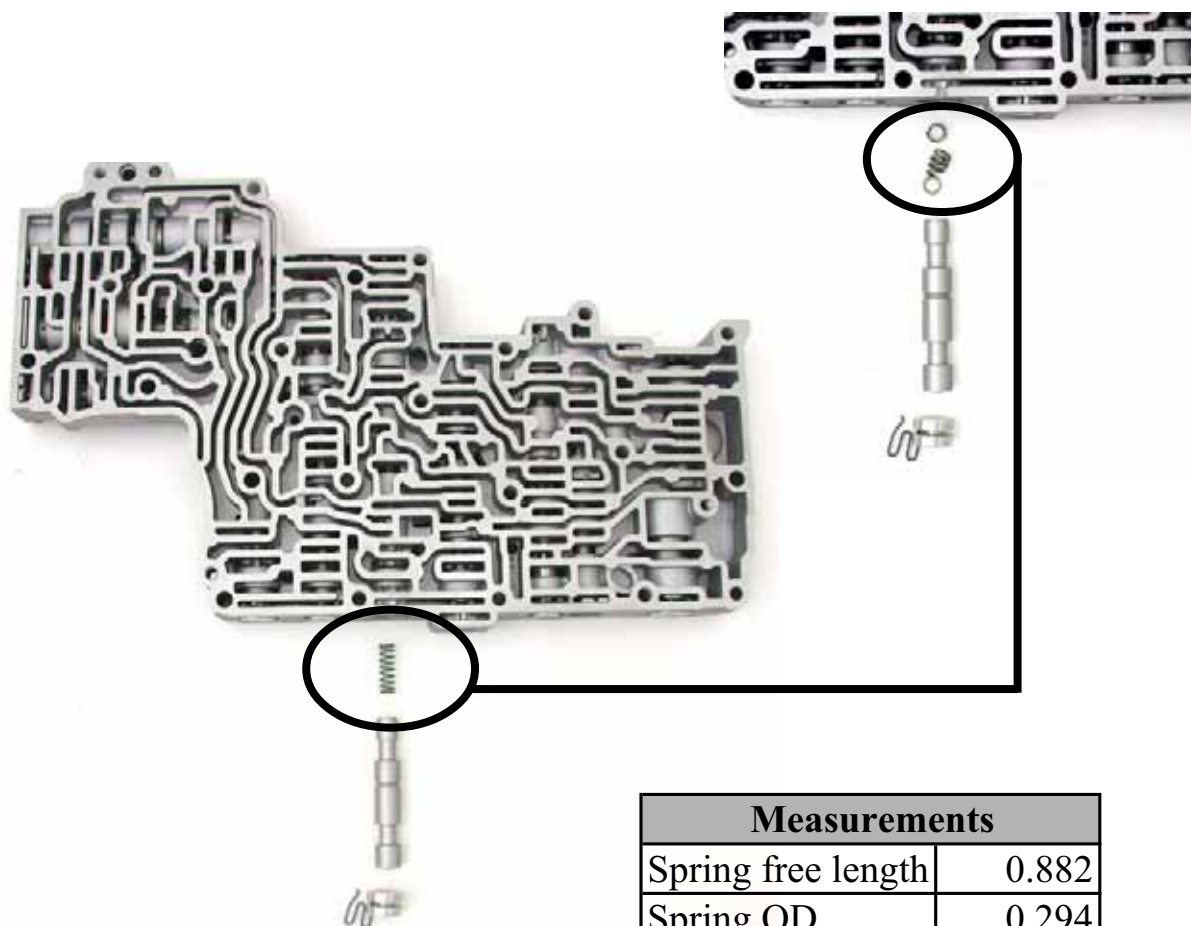
**The Depth of the
solenoid bolt hole
is 0.470\"/>**



5R55N only

No 4th and No 5th

The 4-3 pre-stroke intermediate band control valve spring may break due to the spring being machined incorrectly. Also, a code P0795 (Pressure Control Solenoid C circuit failure or shorted) may be present.

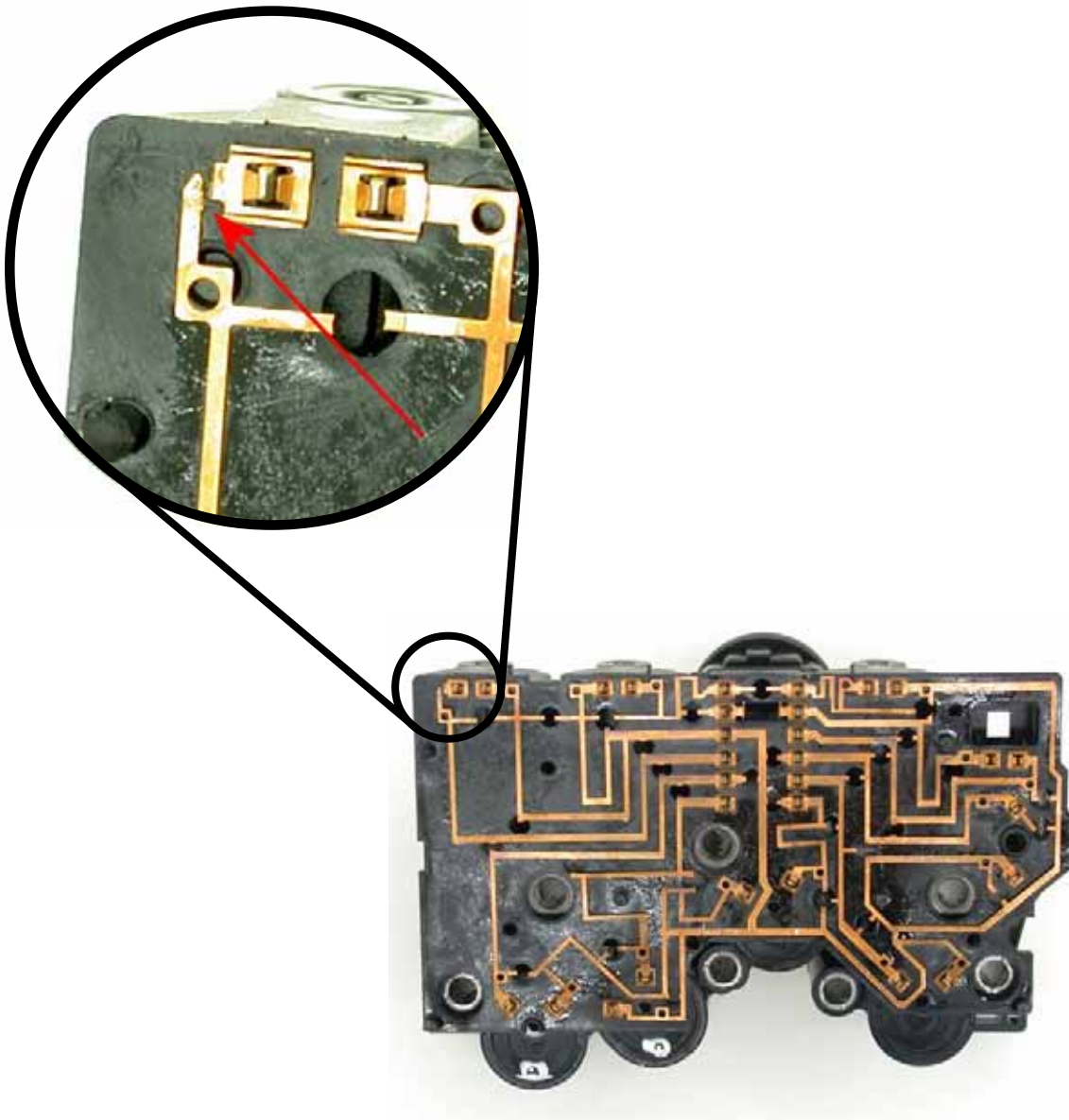


Measurements	
Spring free length	0.882
Spring OD	0.294
Spring wire size	0.034

5R55N/W/S

Solenoid Failure

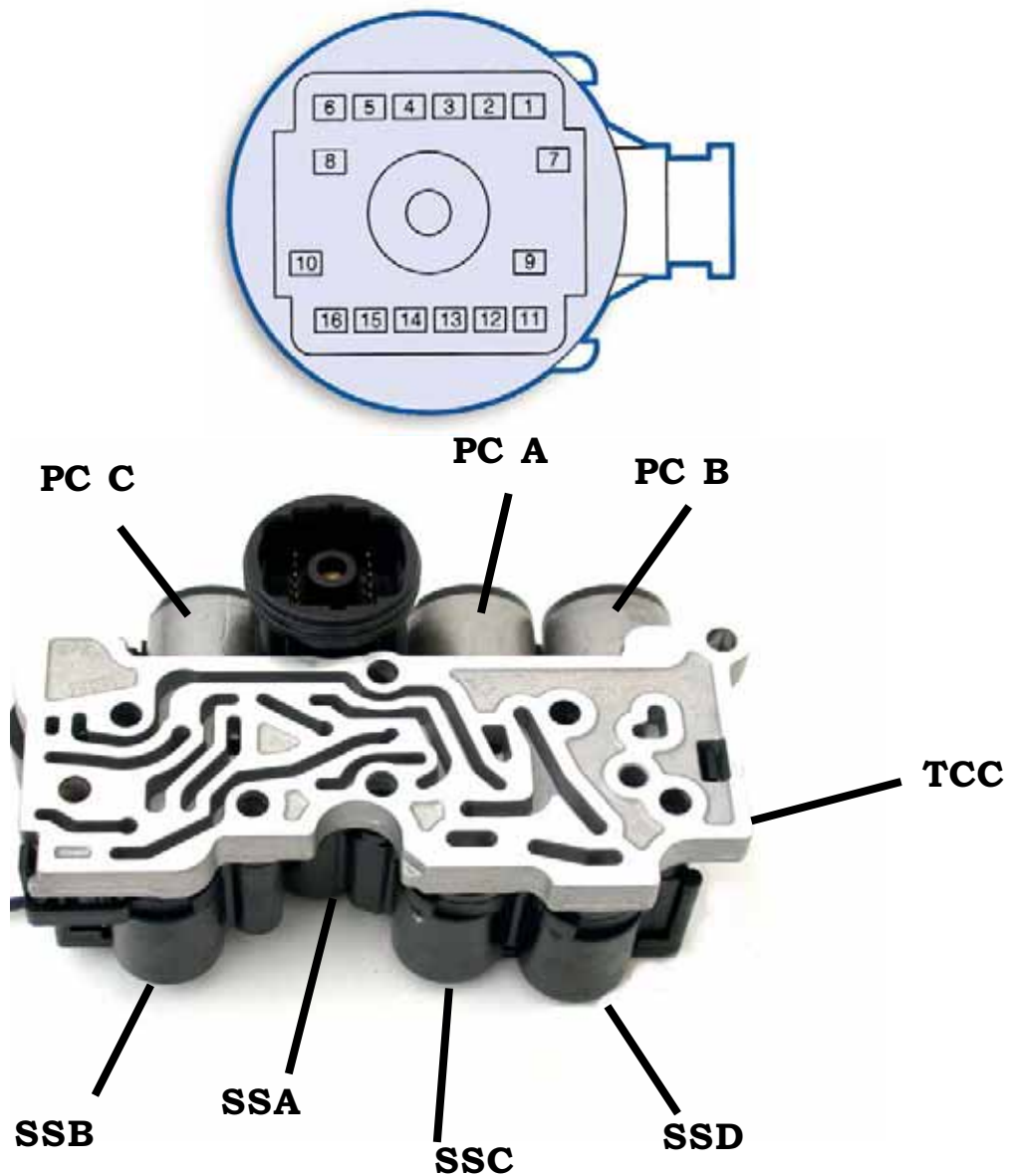
Multiple codes, with gears missing may be caused by a broken solenoid block circuit. This can be caused by the plastic housing rubbing on the circuit board.



5R55N/W/S

Solenoid ID

When testing the solenoids on the bench, you'll need to use the harness connector illustration on this page.



5R55N/W/S

Solenoid ID (continued)

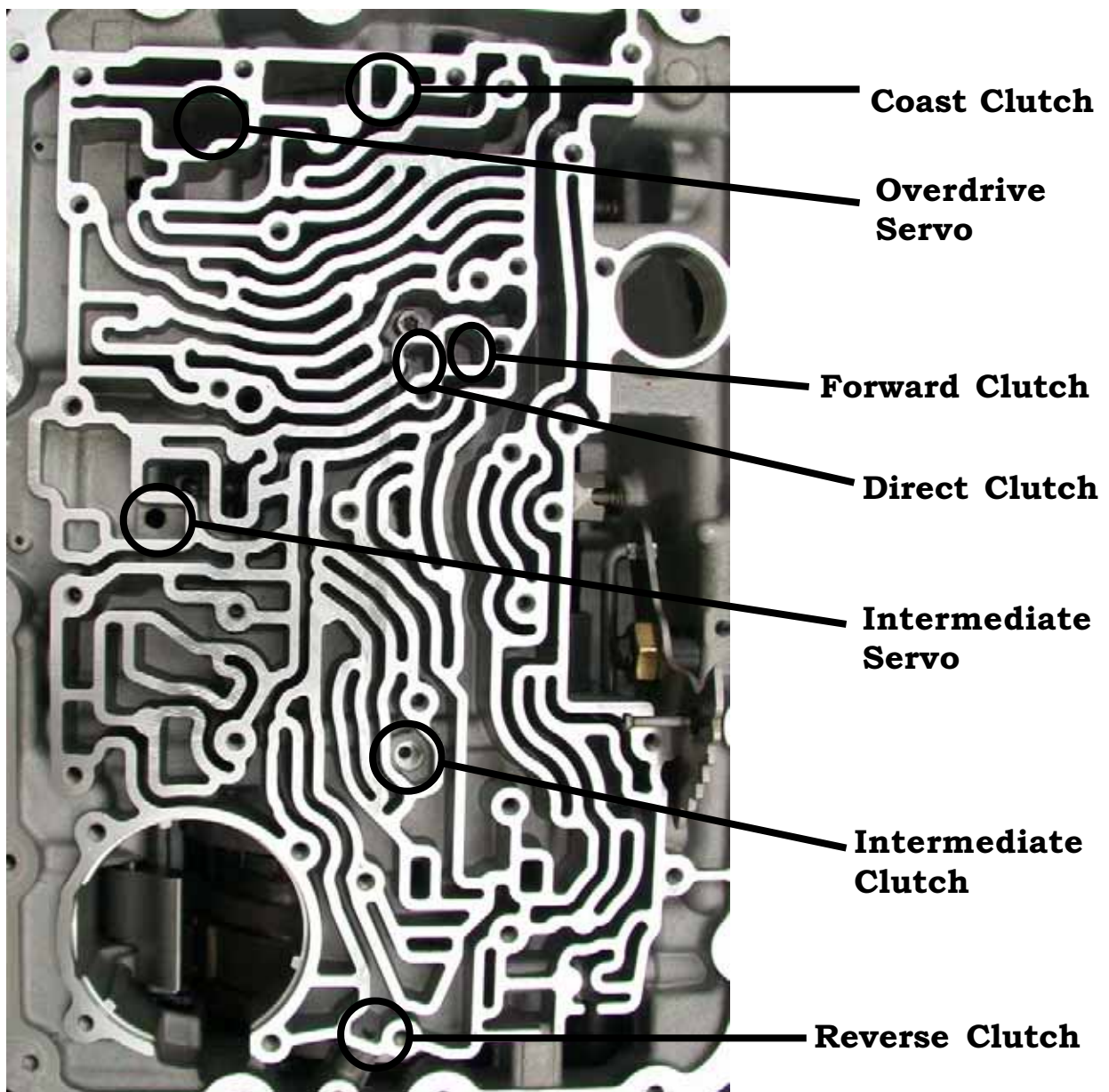
ID	Resistance
PC A	3.3-7.5 ohms
PC B	3.3-7.5 ohms
PC C	3.3-7.5 ohms

ID	Resistance
SSA	16-45 ohms
SSB	16-45 ohms
SSC	16-45 ohms
SSD	16-45 ohms
TCC	9-16 ohms

Pin#	5R55W/S	5R55N
1	PC B	PC A
2	TFT sensor	TFT sensor
3	SS +	SS +
4	PC C	PC B
5	SSD	SSD
6	SSC	SSC
7	N/A	N/A
8	N/A	N/A
9	N/A	N/A
10	N/A	N/A
11	PC A	PC C
12	Sig Return	Sig Return
13	N/A	RP Switch
14	TCC	TCC
15	SSB	SSB
16	SSA	SSA

5R55N

Air Checks



5R55N

Delayed Engagements

Vehicles built prior to 10/17/2000 with the 5R55N transmission may exhibit delayed reverse or drive engagements, harsh upshifts or downshifts, erratic upshifts, or delayed downshifts near 20 mph. This may be caused by the calibration of the Powertrain Control Module (PCM).

If the condition is valid, first repair all Diagnostic Trouble Codes (DTCs) that may be present. If the condition is still present or returns after repair, the PCM must be reprogrammed.

Refer to the following PCM calibration information chart. After reprogramming has been completed, the transmission adaptive strategy for pressure control on engagements must be updated.

1. Install your scanner and monitor the Transmission Fluid Temperature (TFT). Warm the transmission fluid to at least 54°C (130°F) as indicated by the TFT.
2. Perform five (5) engagements from park to reverse. Each engagement must be 5 seconds apart.
3. Perform five (5) engagements from drive to reverse. Each engagement must be 5 seconds apart. Perform five (5) engagements from reverse to drive.
4. Perform five (5) engagements from neutral to drive. Each engagement must be 5 seconds apart.

Calibration Chart

PCM CALIBRATION INFORMATION						
Application	Old Part Number (-12A650-)	Tear Tag	New Part Number (-12A650-)	Old Calibration	New Calibration	NGS/WDS Qualifier
LS - 3.0L, 5R55N	XW4F-JJ	VAV0	XU7Z-TA	9LDA-AAH	9LDA-AAH	WDS B14.3 Release
LS - 3.0L, 5R55N w/SST	XW4F-KH	DYZ0	XU7Z-SA	9LDA-ACG	9LDA-ACG	WDS B14.3 Release
LS - 3.0L, 5R55N	1U7A-JA	MSU1	1U7Z-JB	1LQ16B0507	1LQ16B0507	WDS B14.3 Release
LS - 3.0L, 5R55N w/SST	1U7A-KA	DJY1	1U7Z-KB	1LQ16S0507	1LQ16S0507	WDS B14.3 Release
LS - 3.9L, 5R55N w/SST	1U7A-HA	MFF1	1U7Z-HB	1LQ19S0506	1LQ19S0506	WDS B14.3 Release
LS - 3.9L, 5R55N w/3.31 axle	1U7A-DA	KQI1	1U7Z-DB	1LQ18B0506	1LQ18B0506	WDS B14.3 Release
LS - 3.9L, 5R55N w/3.58 axle	1U7A-GA	KSF1	1U7Z-GB	1LQ19B0506	1LQ19B0506	WDS B14.3 Release
LS - 3.9L, 5R55N 50 States w/SST	1U7A-FA	FMS1	1U7Z-FB	1LQ18S0506	1LQ18S0506	WDS B14.3 Release

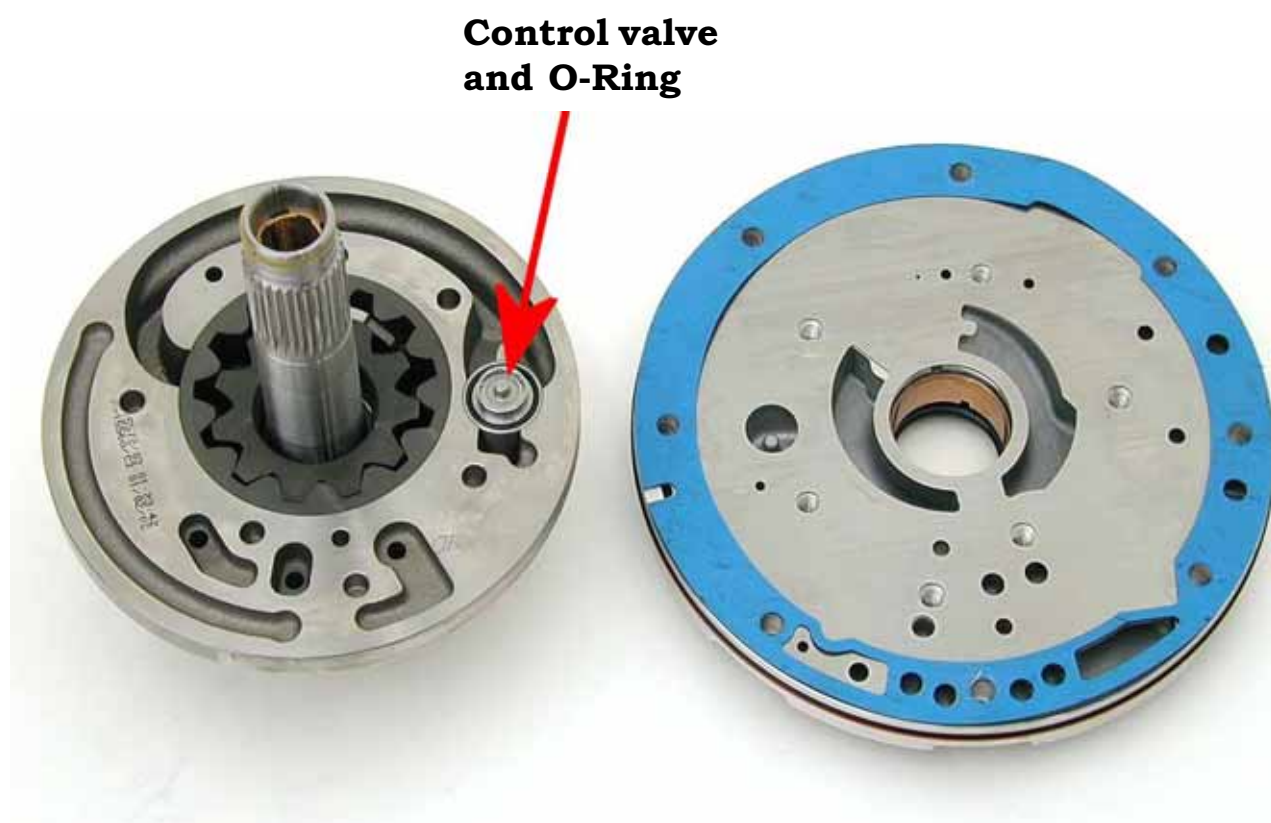
5R55N/W/S

No and/or Slow Engagement

5R55N/W/S Flow Control Valve

A Delayed engagement after sitting when hot or cold may be caused by the flow control valve o-ring missing, destroyed, or the control valve is stuck in the OPEN position.

The flow control valve is used to help control the volume output of the pump.

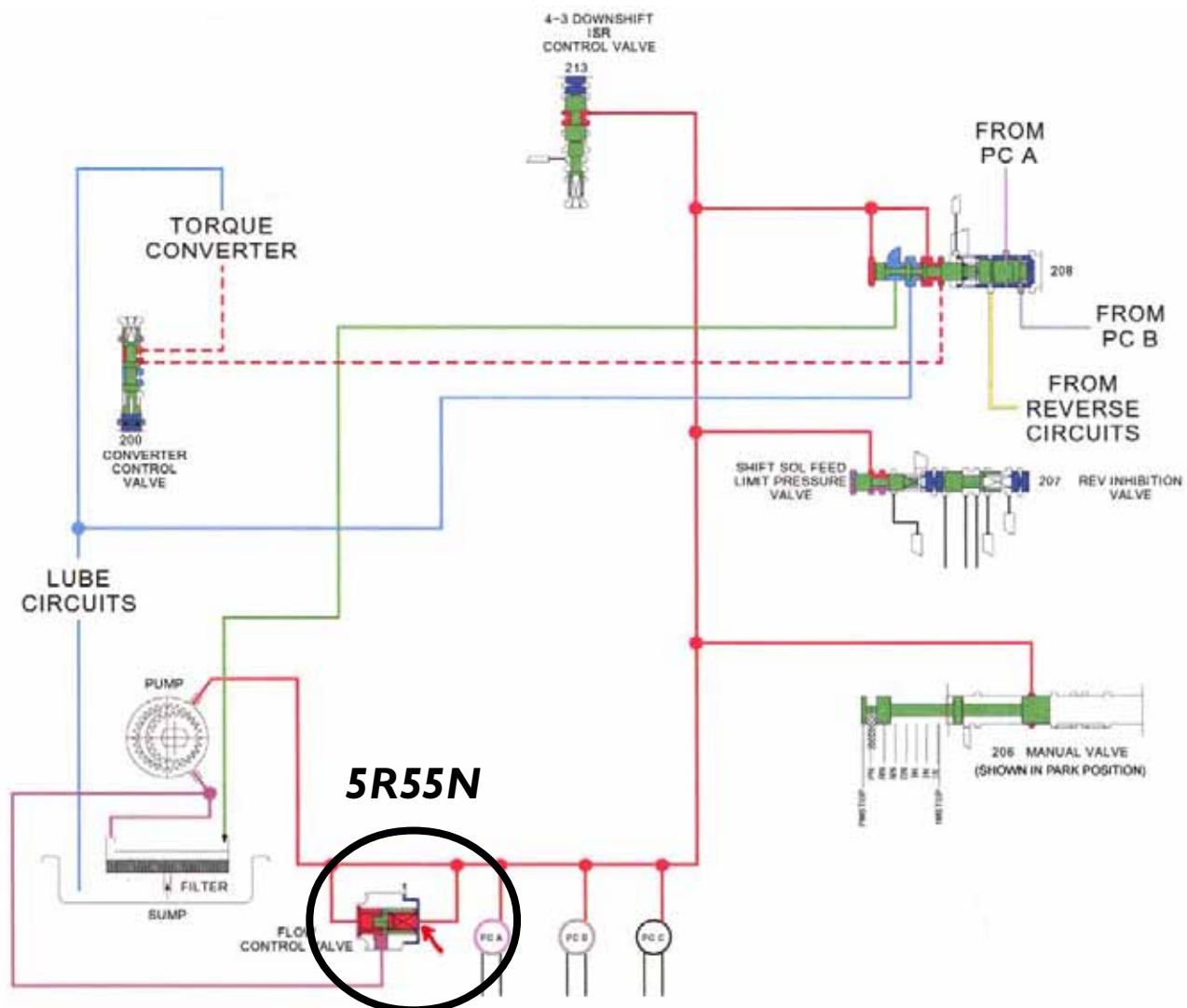


5R55N/W/S

No and/or Slow Engagement (continued)

5R55N/W/S Flow Control Valve

The flow control valve works like a high pressure blow off valve. As main line oil is distributed the flow control valve is used to make sure pressure does not become excessive. If the pressure exceeds the maximum limit, the valve simply opens and allows the oil to drain back into the pump intake.

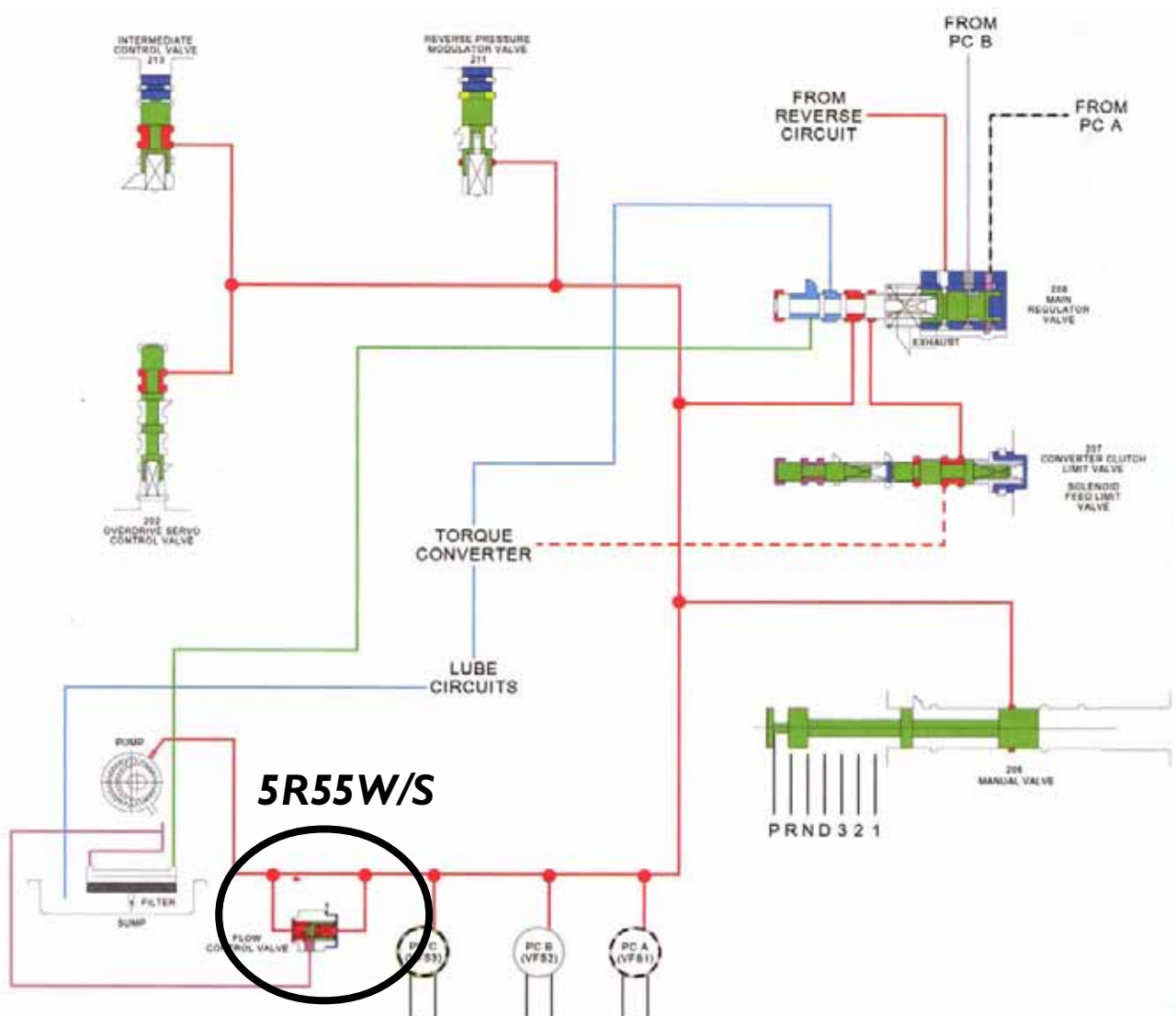


5R55N/W/S

No and/or Slow Engagement (continued)

5R55W/S Flow Control Valve

The flow control valve works like a high pressure blow off valve. As main line oil is distributed, the flow control valve makes sure pressure does not become excessive. If the pressure exceeds the maximum limit, the valve simply opens and allows the oil to drain back into the pump intake.



5R55N/W/S

No and/or Slow Engagement (continued)

Make sure during reassembly that the oil seal is attached to the valve assembly.



E4OD

Failsafe with No Codes

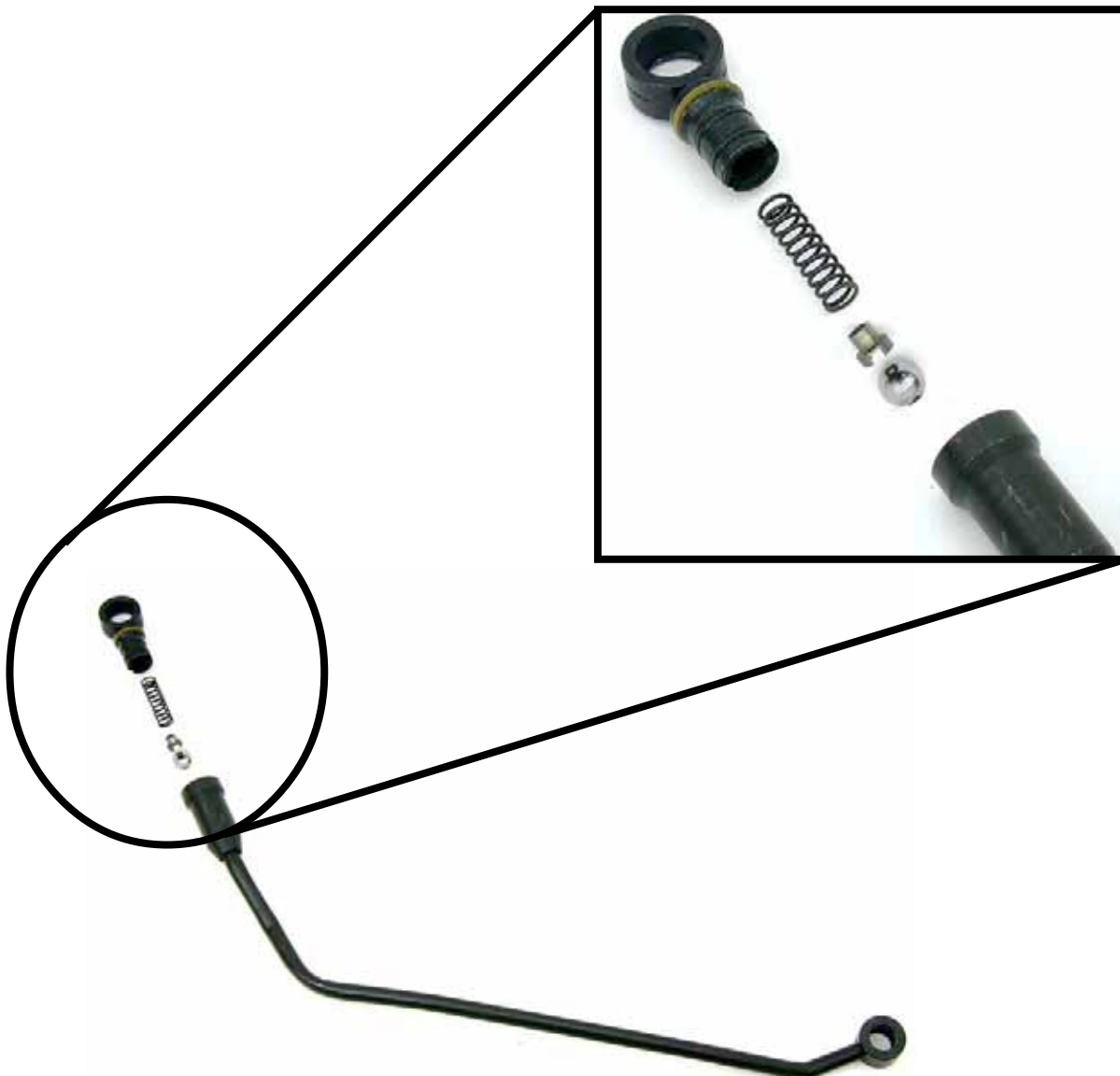
When diagnosing an E4OD in failsafe with no codes, attempt to create a code by disconnecting a solenoid or sensor I.E.: MAF, TPS, MLP, MAP.

Any one of these inputs should cause the check engine light or TCS light to illuminate. If the check engine light or TCS light fails to illuminate suspect a failed PCM. Always go through the normal procedures of checking the PCM powers and grounds before attempting to reprogram the PCM before replacing it.

4R100

Bypass Tube

Dissassembly and re-Assembly of the bypass tube may be necessary due to heavy contamination. Simply pull the top off the cooler fitting adapter while holding the tube, and the sealed fitting will release from the tube assembly.



TorqShift

Lack of Power, Slow Reverse, or Lurching at a Stop

Reprogramming the PCM

A lack of power condition, slow reverse after cold soak, lurching at a stop (zero mph) may be caused by a reprogramming fault. If a complaint of this nature comes in to your shop, monitor the Accelerator Pedal Position sensor and RPM.

The Transmission may think it is getting a false signal from the APP sensor. In some cases the APP sensor is bad causing this false reading. This fault in the programming of the computer is causing the engine to ramp up as if the accelerator were pushed down. This may surprise the customer sitting at a stop and severe damage may occur.

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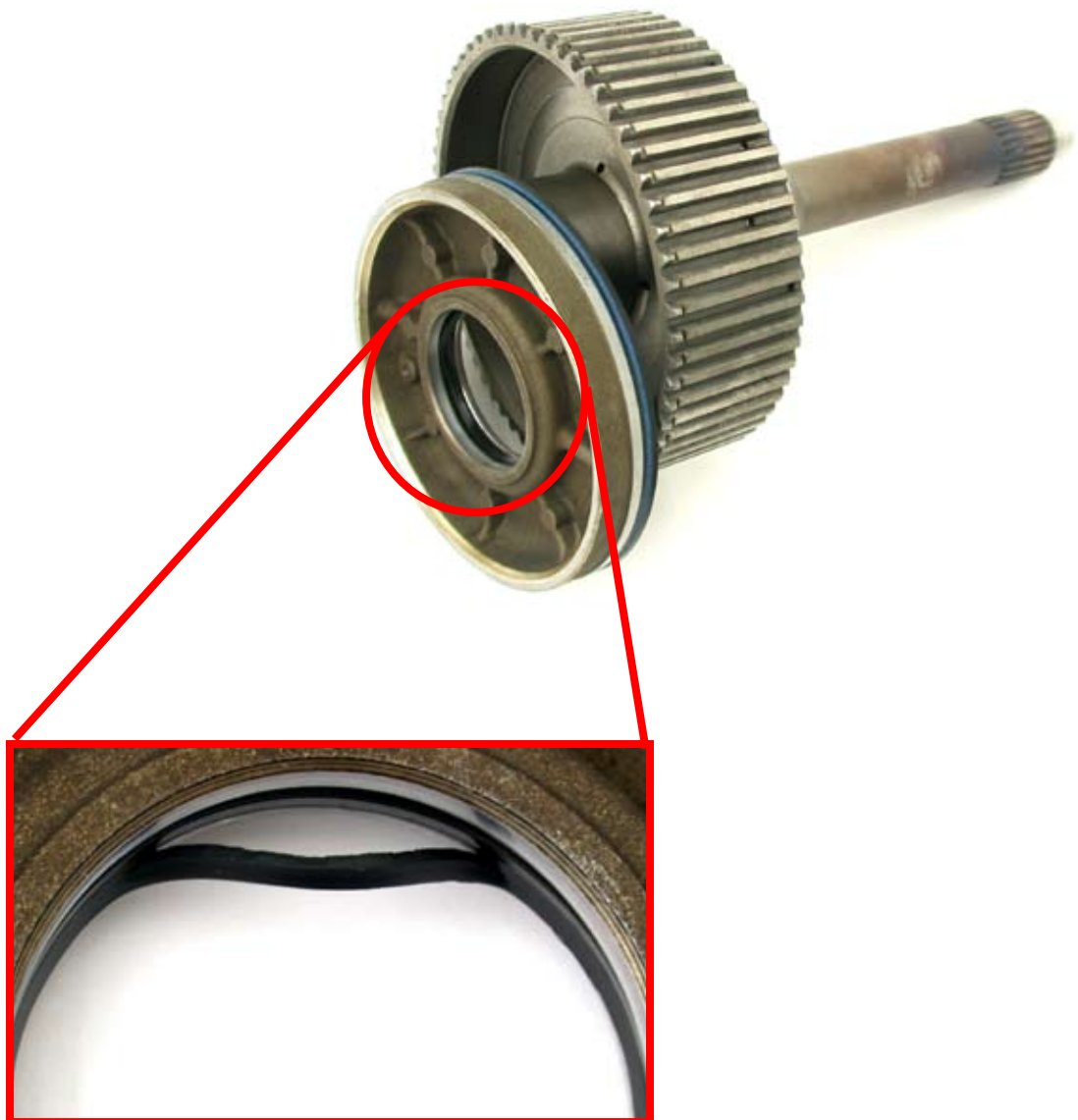
Sun Gear.....166

46RE

No Forward

A no movement concern first thing in the morning may be present, but the reverse engagement is good. The transmission may also fall out of gear while driving hot or cold weather. This concern may be caused by the inner lip seal of the Forward drum having shrunk or being torn/ripped.

In some extreme cases during the winter months this seal can shrink and never apply.



42/44RE

Updated Parts

Chrysler has released a new direct clutch outer seal for the 42RE and 44RE transmissions. The drum, piston and outer seal have all been revised for the 2000 and up models. The outer piston is located in the drum rather than the piston. The inner clutch seal is located in the same place and carries the original OEM part number.

Part Number
4058487 AB



ALL RE Series

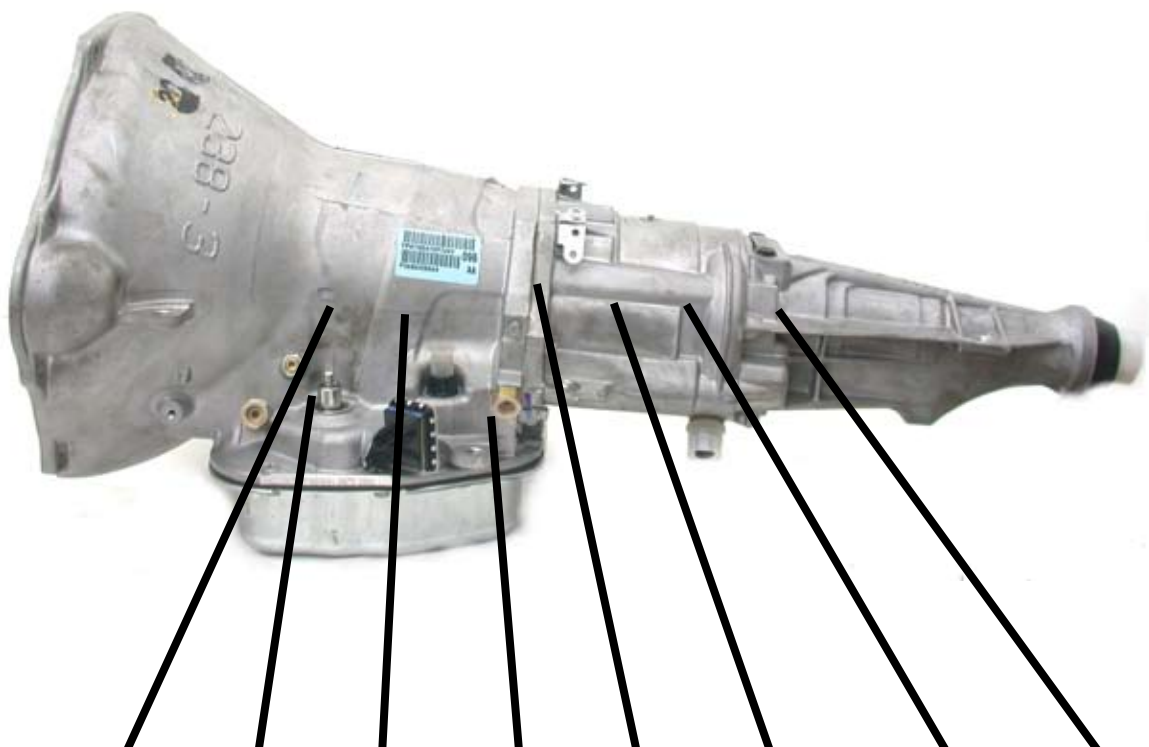
TCC Shuttle

Reflashing the ECM can correct this problem. It can also make the shift feel better and firmer. An added bonus is the program will make the doors lock when the vehicle starts to move.



48RE

New Transmission



SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVER- RUNNING CLUTCH	OVER- DRIVE CLUTCH	DIRECT CLUTCH	OVER- RUNNING CLUTCH
REVERSE	X			X			X	
DRIVE- FIRST			X		X		X	X
DRIVE- SECOND		X	X				X	X
DRIVE- THIRD	X		X				X	X
DRIVE- FOURTH	X		X			X		
MANUAL SECOND		X	X				X	X
MANUAL FIRST			X	X	X		X	X

48RE

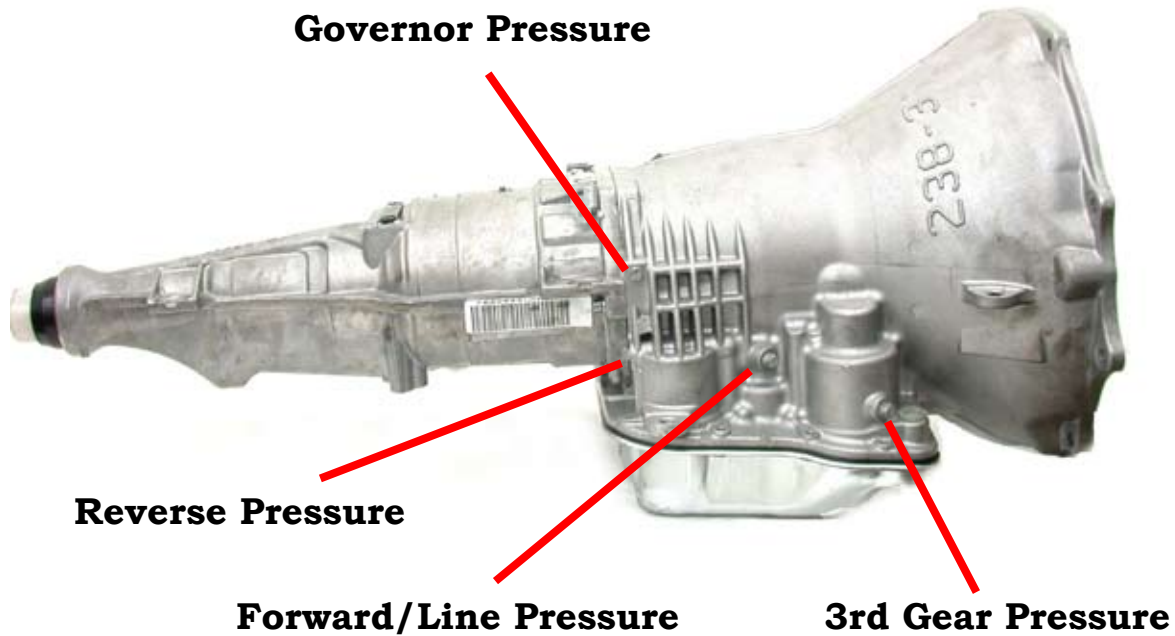
Pressure Tap Locations

The 48RE transmission has several different pressure ports to choose from. In many cases, it's a good idea to have two pressure gauges. Keep in mind that in reverse the pressure can exceed 280 PSI, so always use a 0-300 or 0-400 PSI gauge when testing reverse pressure. Despite the number of pressure taps, there is no mainline pressure tap. Use the chart below to compare your results to the factory specifications.

RANGE	ACCUMULATOR		FRONT SERVO		REAR SERVO		OD CLUTCH		GOVERNOR PRESSURE
	IDLE	WOT	IDLE	WOT	IDLE	WOT	IDLE	WOT	
P/N	0	0	0	0	0	0	0	0	0
R	0	0	145-175	230-280	145-175	230-280	0	0	0
Drive 1st	55-60	90-100	0	0	0	0	0	0	Pressure should be zero at a stop and increase about 1 PSI per MPH
Drive 2nd	55-60	90-100	0	0	0	0	0	0	
Drive 3rd	55-60	90-100	55-60	90-100	0	0	0	0	
Drive 4th	55-60	90-100	55-60	90-100	0	0	55-60	90-100	
MANUAL 2	55-60	90-100	0	0	0	0	0	0	
MANUAL 1	55-60	90-100	0	0	55-60	55-60	0	0	

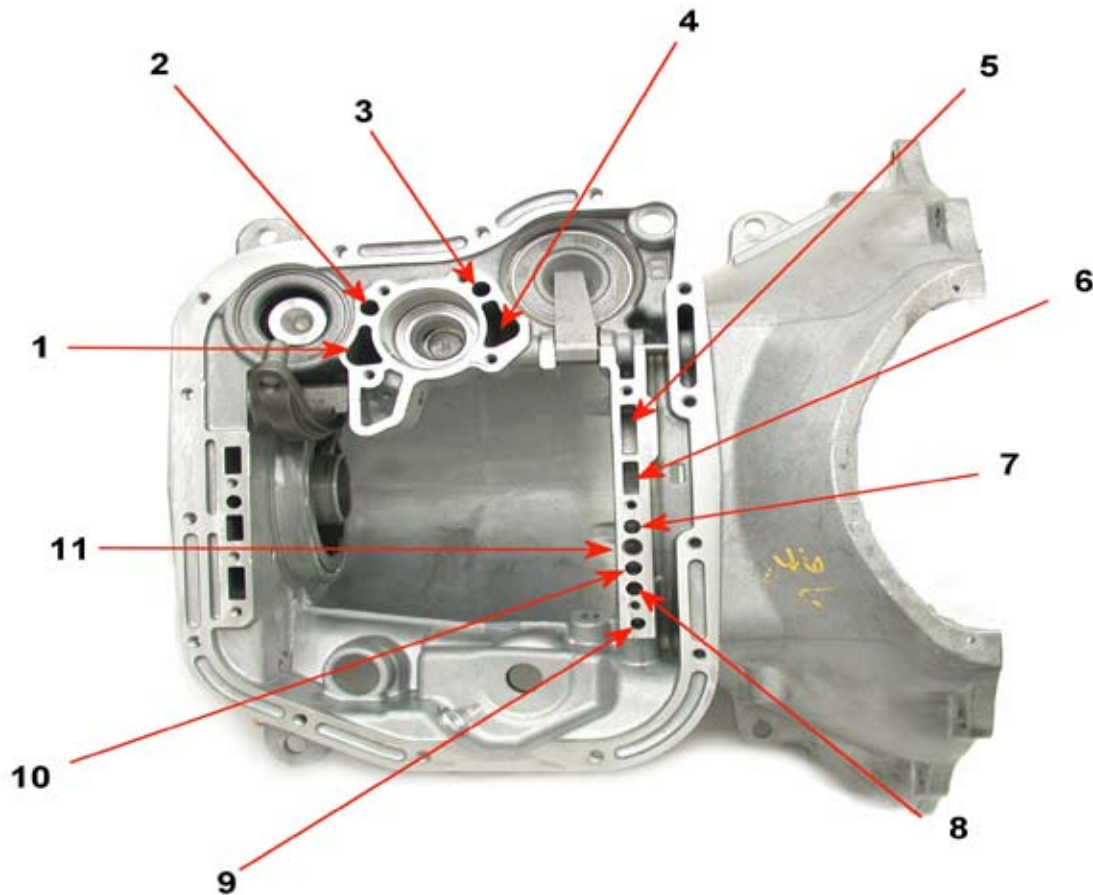
48RE

Pressure Tap Locations (continued)



48RE

Air Test



Location	Air Pressure Test Passage
1	Line Pressure to Accumulator
2	Rear Servo Apply
3	Front Servo Apply
4	Front Servo Release
5	Pump Suction
6	Pump Pressure
7	Front Clutch apply
8	From Torque Converter
9	To Cooler
10	To Torque Converter
11	Rear Clutch Apply

48RE

Six Pinion Planets

The rear planetary assembly has changed to a steel-housed six pinion carrier. This change also caused a change to be made in the washer design between the ring gear and planetary.

The rear ring gear has also changed to have a larger lube reserve area and increase in welds to hold the hub to the ring area. The back of this annulus is also machined to allow for the changes in the reverse drum. This is NOT interchangeable with earlier 46RE or 47RE transmissions.

Oil Groove



48RE

Six Pinion Planet (continued)

The front planet changed to a six pinion steel carrier. A damper ring is added to calm down vibrations during reduction speeds of the planet. The front annulus gear is also machined with a larger lube oil reserve groove at the bottom of the ring gear for extra cooling. With the change in the planetary.

Damper ring



Oil reserve groove



48RE

Rear Clutch Drum

Not many noticeable changes have been made to this drum and input shaft. The splined area of the input shaft has changed to have deeper radius grooves for strength.

Deeper radius grooves for strength.



48RE

Pump Assembly

Changes to the pump include directional gears, and the addition of a new Teflon ring housed on the stator support shaft. The change to the reaction shaft makes the torque converter not serviceable to the 46RE or 47RE. The 48RE converter is a beefier design, able to be used on the 48RE transmission only.



Teflon ring



48RE

O/D Direct Clutch

Major changes have occurred in the OD direct clutch stackup. There are now 23 single-sided clutches. The pressure plate is still the second-design plate measuring out at 0.085" on the lug ears.



48RE

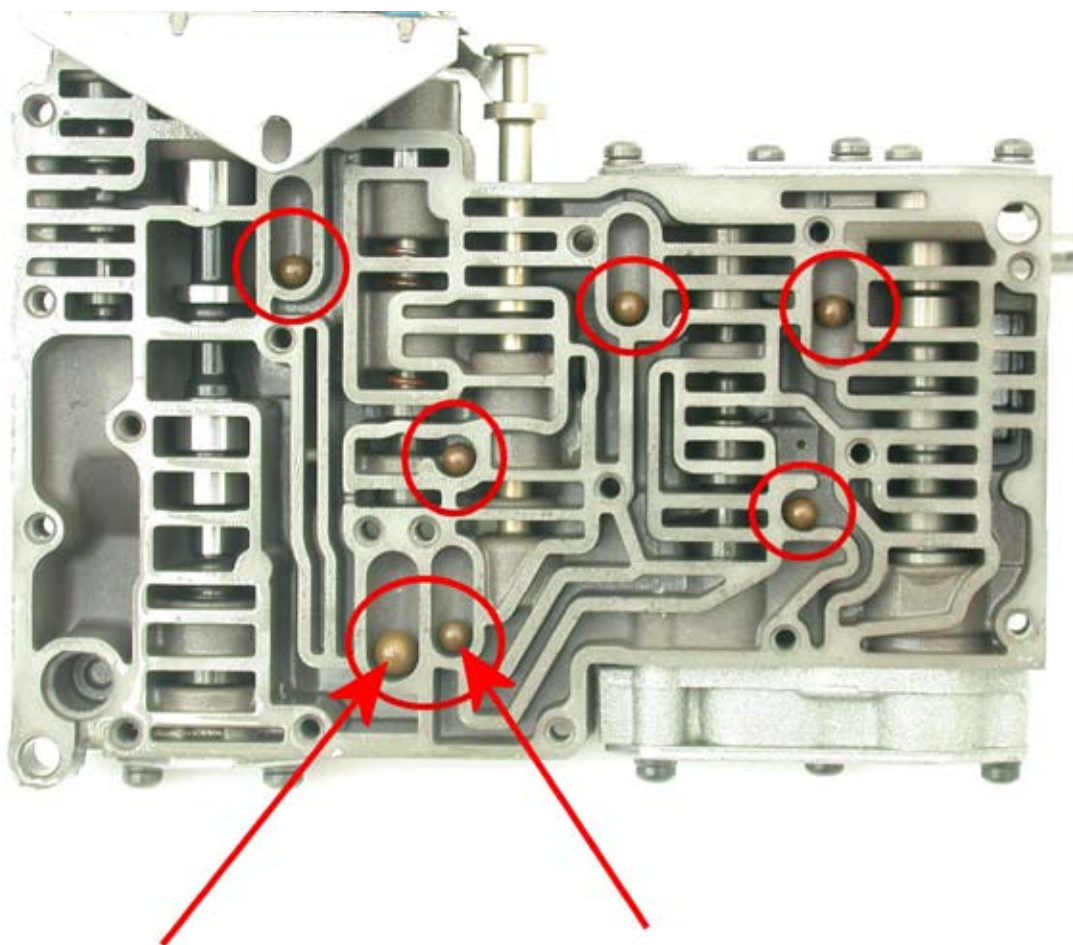
Reverse Servo and Apply Lever

The Low/Reverse servo has changed to allow for greater holding strength and torque load. The apply lever is changed to a new ratio to increase clamping force onto the redesigned Low/Reverse band.



48RE

Checkball Locations

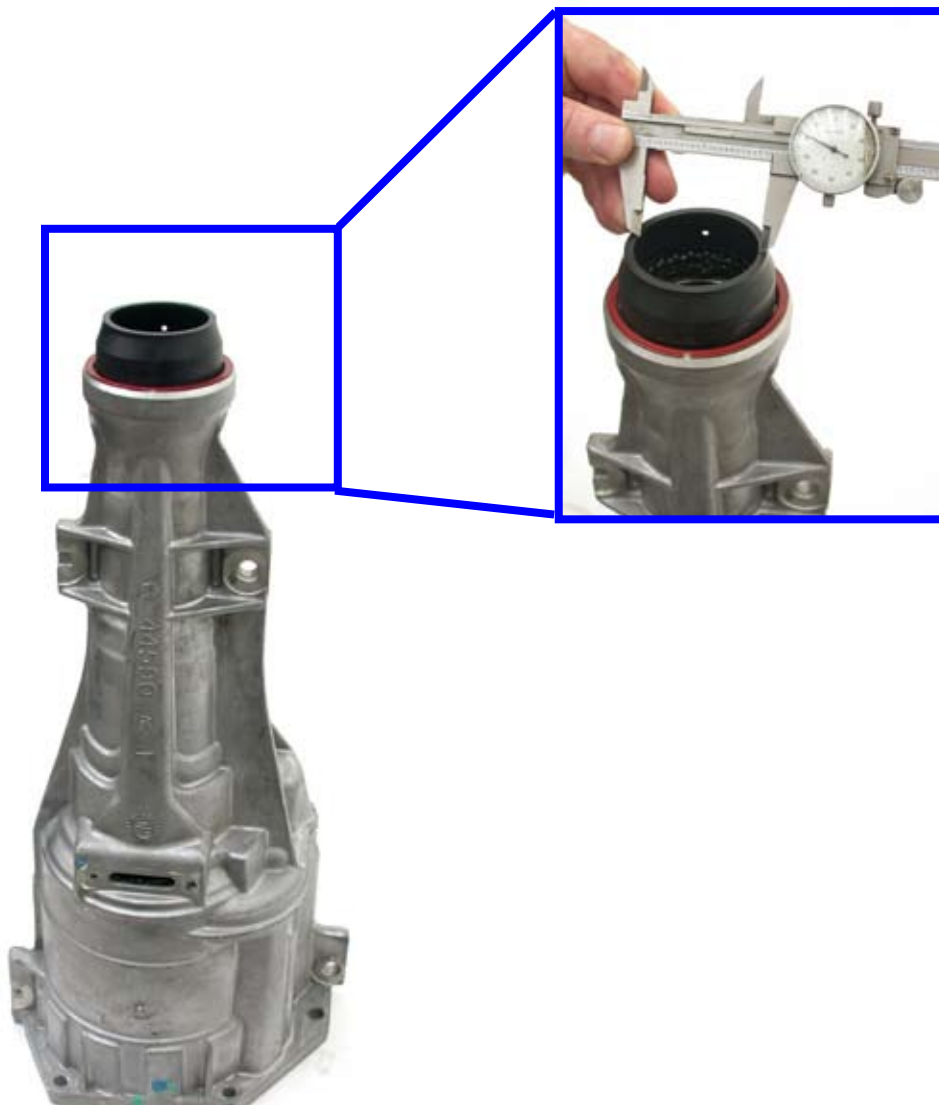


Dirfferent size checkballs

48RE

Extension Housing Seal

The output shaft bushing and seal have changed. The new seal and bushing are much larger than the earlier 46RE and 47RE. This change means there is a new housing that can not be interchanged. It is used on the 48RE only.



48RE

Sun Gear

The sun gear shell has increased in thickness by 0.055" for strength. The sun gear has also undergone some changes that allow for more lube oil flow to the planetaries.



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4L30E

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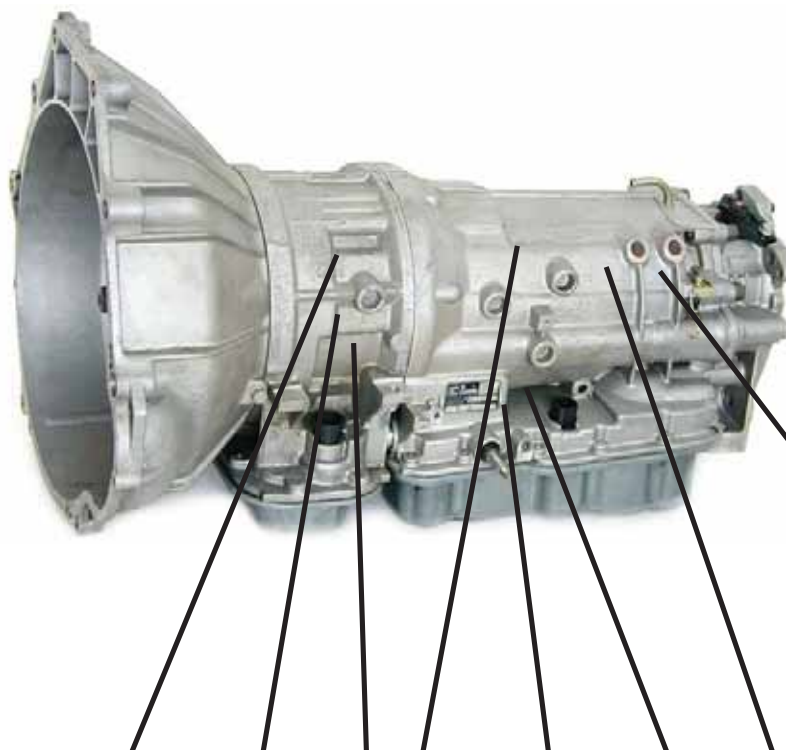
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4L30E

Clutch and Band Application Chart



RANGE	GEAR	1-2/3-4 SOL. N.C.	2-3 SOL. N.O.	OVERDRIVE ROLLER CLUTCH	OVERRUN CLUTCH	FOURTH CLUTCH	THIRD CLUTCH	REVERSE CLUTCH	SECOND CLUTCH	PRINCIPLE SPRAG ASSEMBLY	BAND ASSEMBLY	ENGINE BRAKING
P-N		OFF	ON		APPLIED							NO
R	REVERSE	OFF	ON	LD	APPLIED			APPLIED		LD		NO
D	1st	OFF	ON	LD	APPLIED					LD	APPLIED	NO
	2nd	ON	ON	LD	APPLIED				APPLIED	FW	APPLIED	YES
	3rd	ON	OFF	LD	APPLIED		APPLIED		APPLIED	NE		YES
	4th	OFF	OFF	FW		APPLIED	APPLIED		APPLIED	NE		YES
3	1st	OFF	ON	LD	APPLIED					LD	APPLIED	NO
	2nd	ON	ON	LD	APPLIED				APPLIED	FW	APPLIED	YES
	3rd	ON	OFF	LD	APPLIED		APPLIED		APPLIED	NE		YES
2	1st	OFF	ON	LD	APPLIED		APPLIED			LD	APPLIED	YES
	2nd	ON	ON	LD	APPLIED				APPLIED	FW	APPLIED	YES
1	1st	OFF	ON	LD	APPLIED		APPLIED			LD	APPLIED	YES

LD = LOCKED IN DRIVE

FW = FREEWHEELING

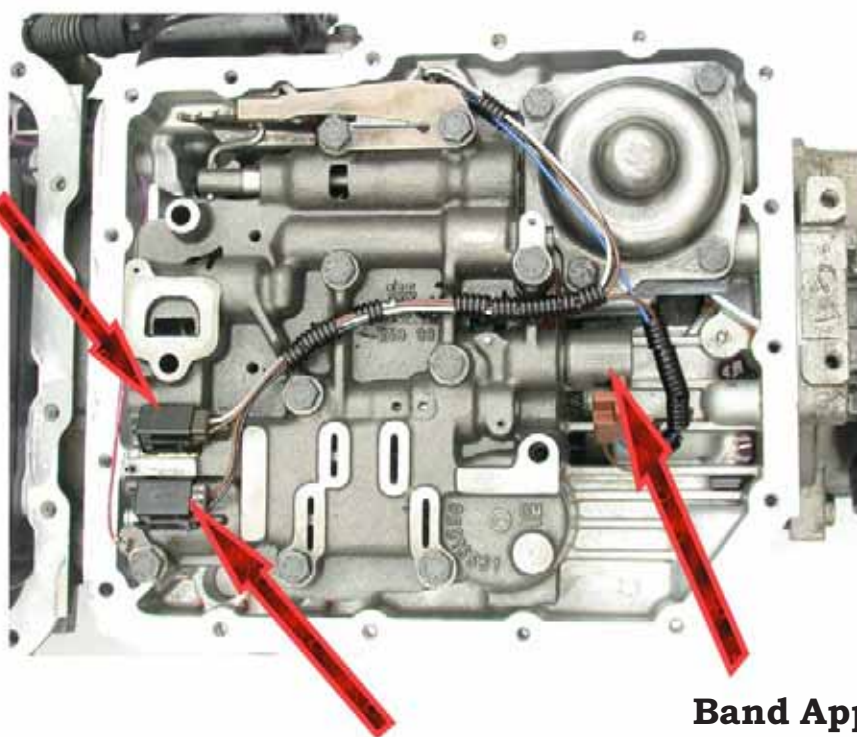
NE = NOT EFFECTIVE

4L30E

Solenoid Identification

Always check the resistance of the solenoids and visually check the wire harness for damage. Keep in mind, the 2-3 shift solenoid is “normally open” and the 1-2/3-4 shift solenoid is “normally closed”.

**2-3 Shift
Solenoid
17-24 ohms
normally
open**



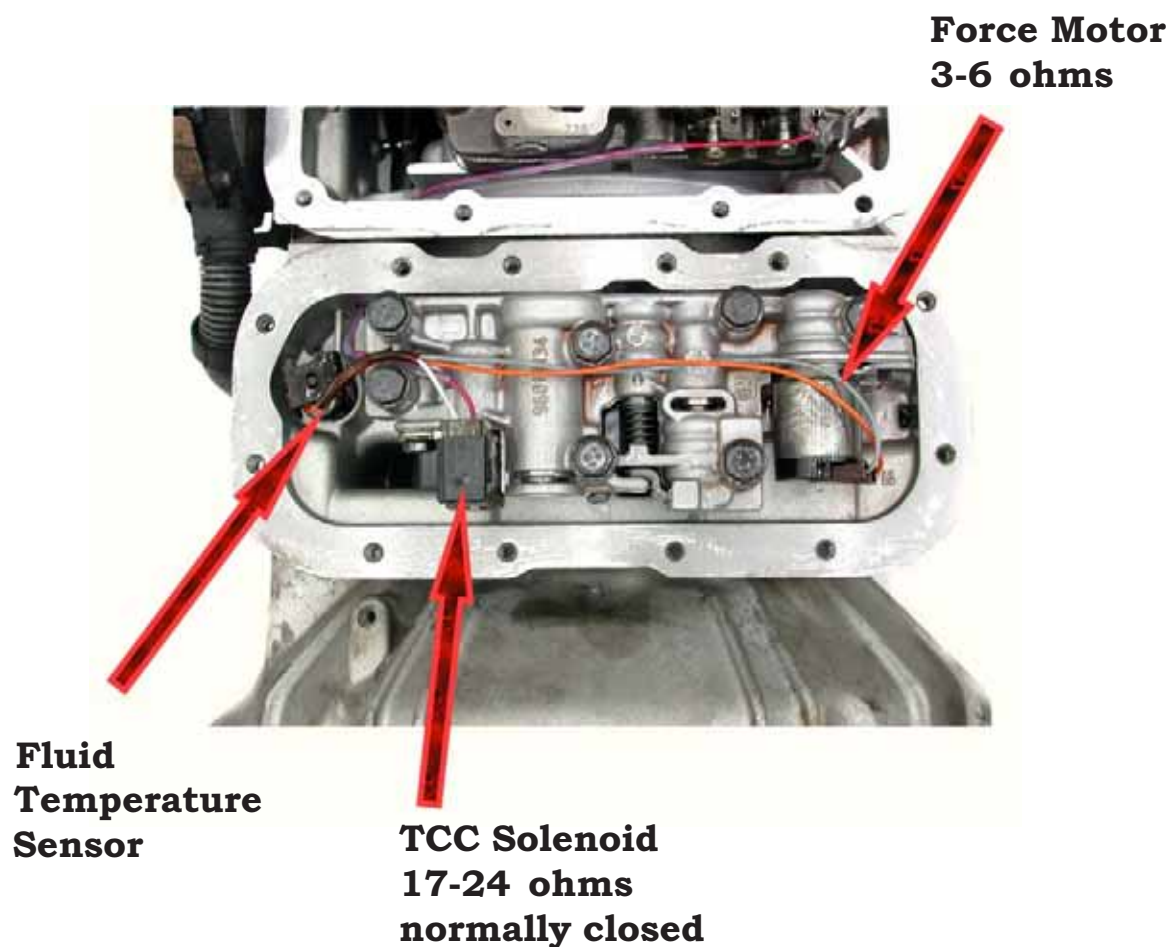
**1-2/3-4 Shift
Solenoid
17-24 ohms
normally
closed**

**Band Apply
Solenoid 9-14
ohms PWM**

4L30E

Solenoid Identification (continued)

Always check the resistance of the solenoids and visually check the wire harness for damage.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation

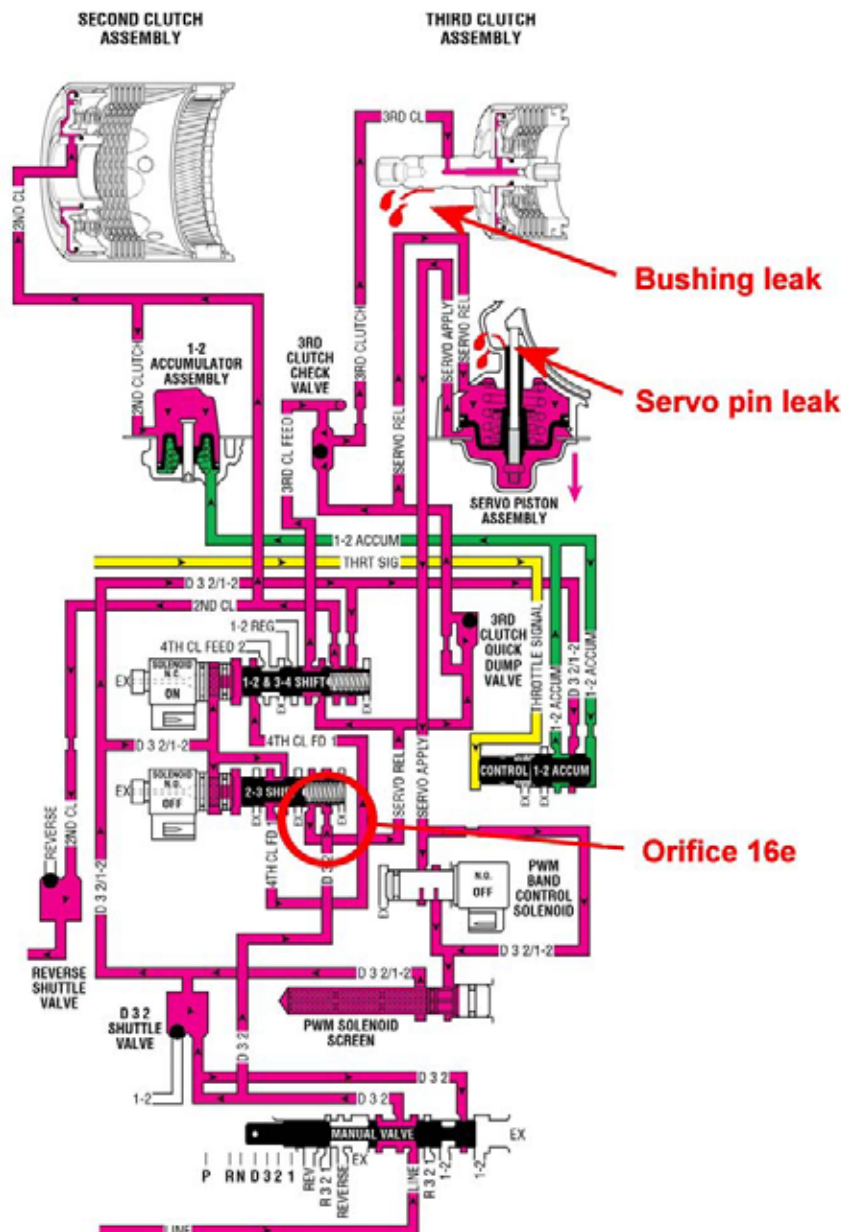
A common cause for the Band failure is the band being partially applied and dragging in 3rd or 4th gear. This is usually caused by insufficient servo release pressure, which can be the result of leaks in the 2nd clutch and/or 3rd clutch circuits. In this section we are going to review the servo release and related oil circuits, as well as what you need to check on every overhaul to prevent band failure.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

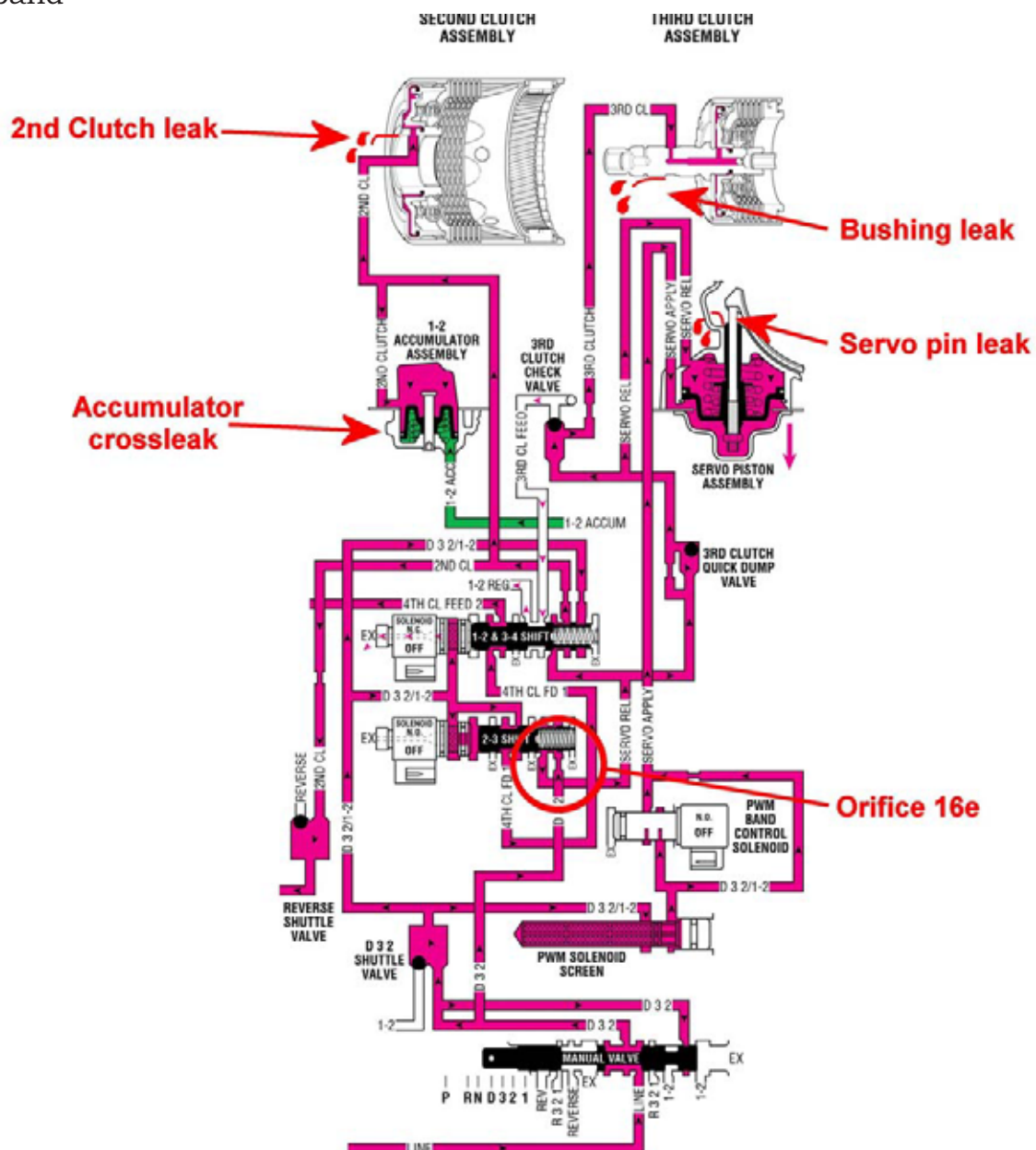
In third gear, the servo release and 3rd clutch are being fed through the #16e orifice.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

In fourth gear the 2nd clutch, is also fed through the #16e orifice. A leak in the second clutch circuit will cause a loss of servo release oil, resulting in a dragging band



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

The 2nd clutch drum is a common failure. Closely inspect the drum for cracks in the ring bore chamfer.

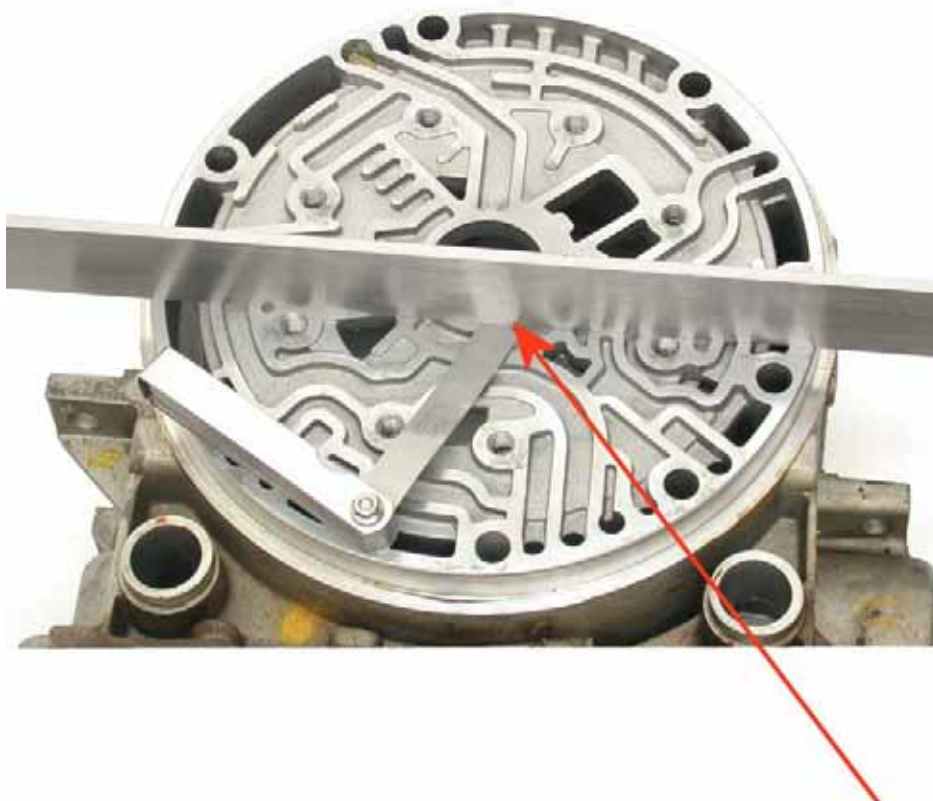


Check here for cracks

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

Always use a straight edge and a feeler gauge across the adapter case in several places to check it for possible warpage. The bolt holes are usually the high spots. You should not be able to fit a 0.0015" feeler gauge under the straight edge surface. If you can, your adapter case is warped.



Any gap under the straight edge should not exceed 0.0015"

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

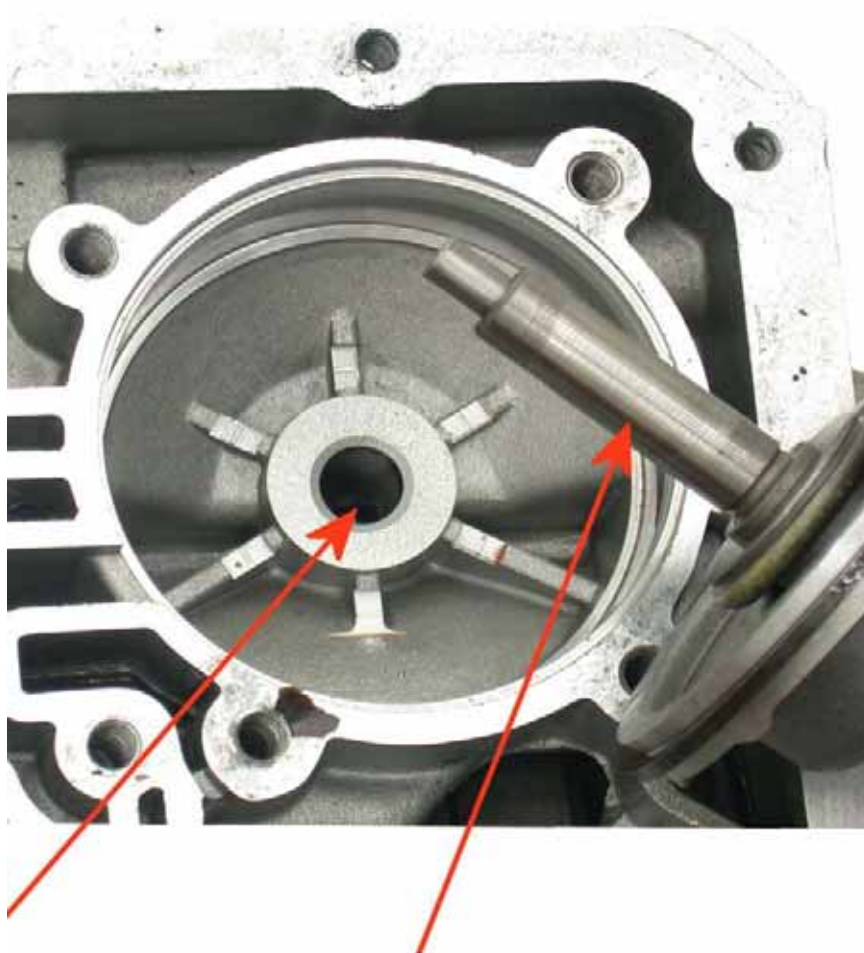
When checking the center support for warpage, use the same technique as the adapter case. Center support warpage should not exceed 0.0015". Check the 3rd clutch drum shaft and center support bushing for wear or scoring. Keep in mind, the bushing seals the apply circuit; there are no sealing rings in this location.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

After removing the servo from the bore, check the inside area for wear.



Check for wear in these locations

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

The servo release pressure port should always be drilled and tapped in the location shown below. Servo release pressure should be checked after every rebuild. There should be no more than 10 psi difference between the servo release pressure and main line pressure in 3rd and 4th gear.

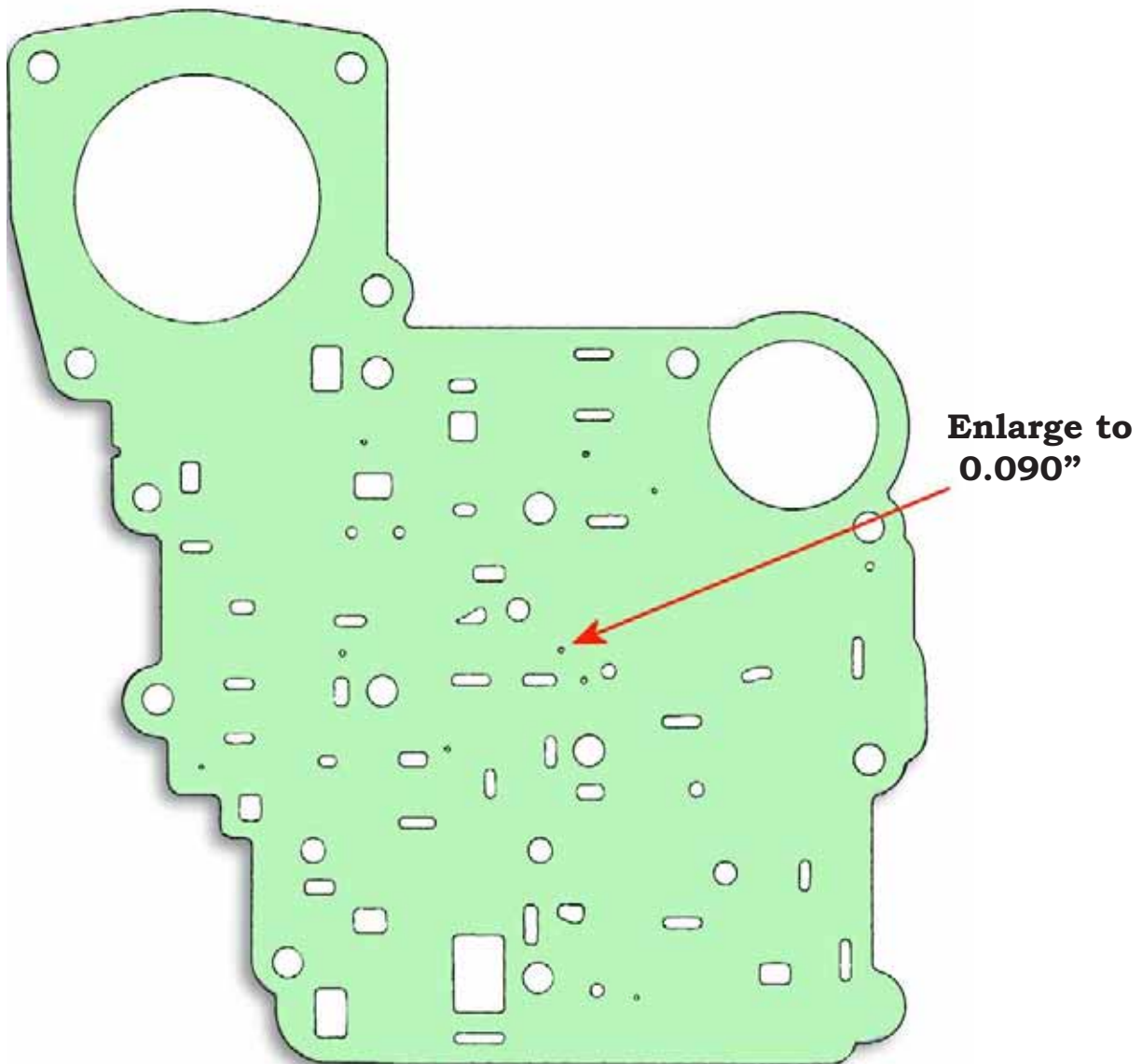
**Drill and Tap
the hole with an
1/8" pipe tap**



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

As a preventative measure you can enlarge the feed orifice hole #16e to 0.090”.

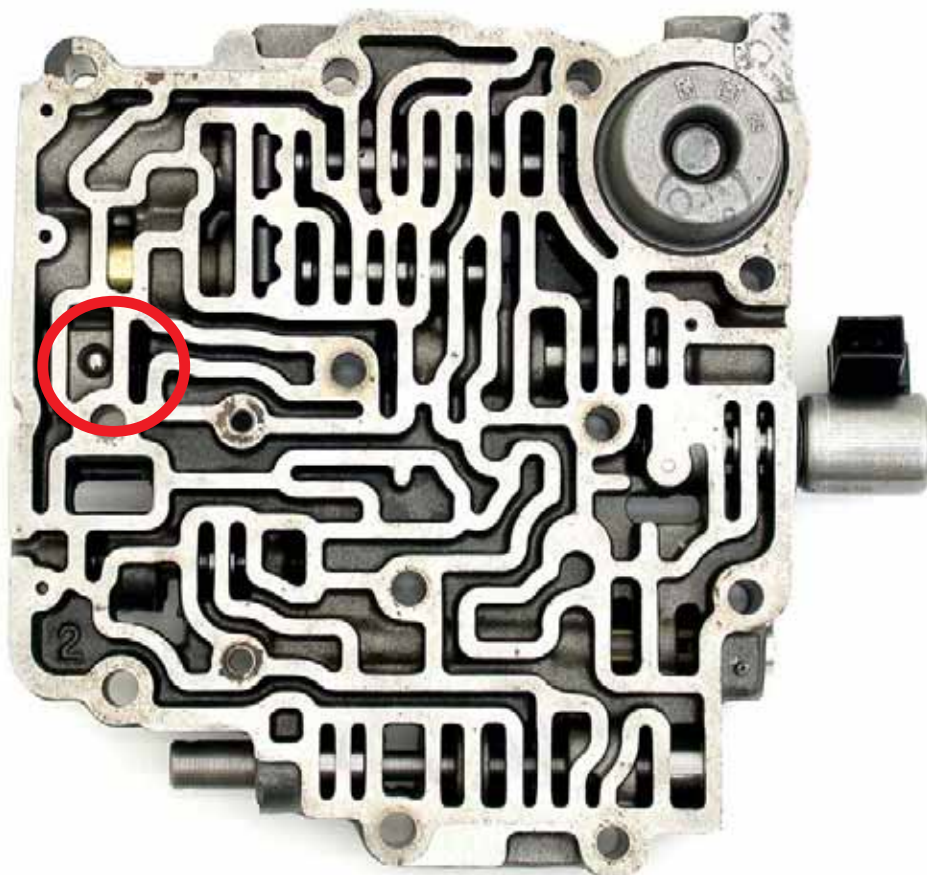


4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

A bindup condition in 4th gear may be caused by a missing or leaking 3rd clutch checkball. When this checkball is missing, 1-2 servo release pressure can leak in 4th gear causing the 1-2 band to apply.

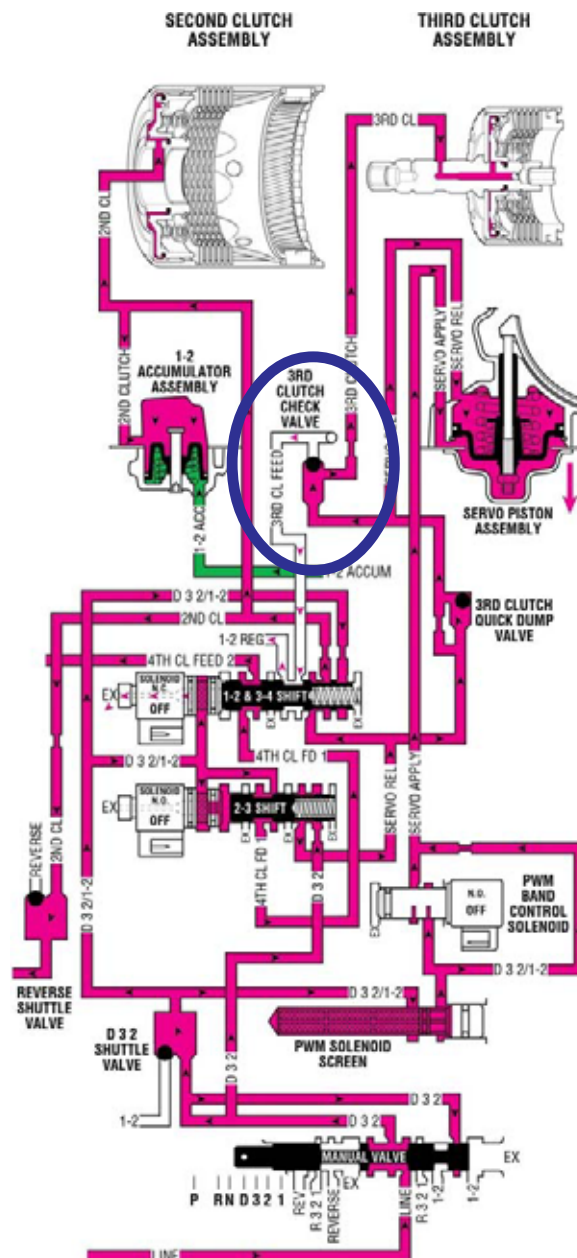
**3rd clutch
checkball**



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

A missing or leaking 3rd clutch checkball can cause the 1-2 servo release pressure to leak in 4th gear causing the 1-2 band to apply.



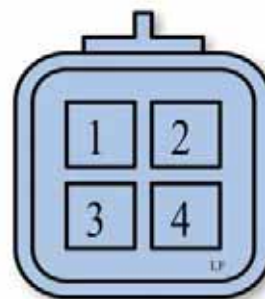
4L30E

Case Connector ID

4 Pin Main Case Connector

Pin	Function
1	2-3 Shift solenoid
2	Band apply solenoid
3	1-2/3-4 Shift solenoid
4	Ground from computer (Type 1 only)
	B+ from computer (All others)

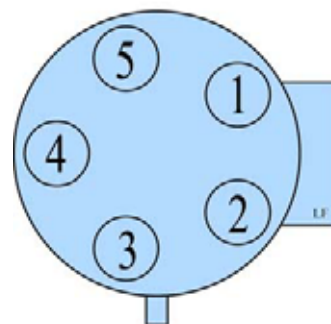
Solenoid	Pins	Resistance
2-3 Shift solenoid	1 and 4	17-24ohms
Band apply solenoid	2 and 4	9-14 ohms
1-2/3-4 Shift solenoid	3 and 4	17-24 ohms



5 Pin Adapter Case Connector

Pin	Function
1	Fluid temperature sensor
2	TCC solenoid
3	Force motor (+)
4	Force motor (-)
5	Fluid temperature sensor

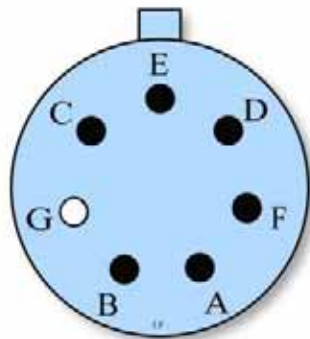
Solenoid	Pins	Resistance	
Force motor	3 and 4	3-6 ohms	
TCC solenoid	2 and ground	17-24 ohms	
Fluid temperature sensor	1 and 5	-40°F (-40°C)	672K ohms
		32°F (0°C)	65K ohms
		68°F (20°C)	25K ohms
		176°F (80°C)	2.5K ohms
		248°F (120°C)	780 ohms
		302°F (150°C)	370 ohms



4L30E

Case Connector ID (continued)

7Pin Main Case Connector



Pin	Function
A	2-3 Shift solenoid
B	Band apply solenoid
C	1-2/3-4 shift solenoid
D	B+ from computer
E	Fluid temperature sensor (-)
F	Fluid temperature sensor (+)
G	Not used

Solenoid	Pins	Resistance
2-3 Shift solenoid	D and A	17-24 ohms
Band apply solenoid	D and B	9-14 ohms
1-2/3-4 Shift solenoid	D and C	17-24 ohms
Fluid temperature sensor	E and F	-40°F (-40°C) 672K ohms
		32°F (0°C) 65K ohms
		68°F (20°C) 25K ohms
		176°F (80°C) 2.5K ohms
		248°F (120°C) 780 ohms
		302°F (150°C) 370 ohms

Solenoid	Pins	Resistance
Force motor	2 and 4	3-6 ohms
PWM TCC	1 and 3	9-14 ohms



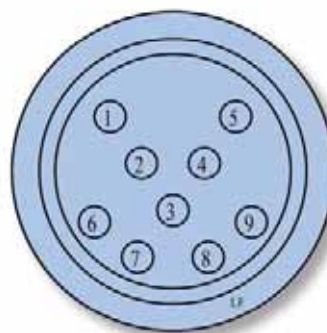
Pin	Function
1	PWM TCC (+)
2	Force motor (+)
3	PWM TCC (-)
4	Force motor (-)

4L30E

Case Connector ID (continued)

9 Pin Main Case Connector (BMW)

Pin	Function
1	Force motor
2	Fluid temperature sensor
3	Force motor
4	Fluid temperature sensor
5	2-3 Shift solenoid
6	B+ from computer
7	TCC solenoid
8	Band apply solenoid
9	1-2/3-4 Shift solenoid



Solenoid	Pins	Resistance	
2-3 Shift solenoid	6 and 5	17-24 ohms	
Band apply solenoid	6 and 8	9-14 ohms	
1-2/3-4 Shift solenoid	6 and 9	17-24 ohms	
Force motor	1 and 3	3-6 ohms	
TCC solenoid	6 and 7	17-24 ohms	
Fluid temperature sensor	2 and 4	-40°F (-40°C)	672K ohms
		32°F (0°C)	65K ohms
		68°F (20°C)	25K ohms
		176°F (80°C)	2.5K ohms
		248°F (120°C)	780 ohms
		302°F (150°C)	370 ohms

4L30E

Computer Types

Asian models

Type 1

1990-1993 Isuzu Rodeo and Trooper

Type 2

1994-1995 Isuzu Rodeo, Trooper, Amigo and Honda Passport

Type 3

1996-1999 Isuzu Rodeo, Trooper, Amigo, Vehicross, Honda Passport and Acura SLX

German models

Type 5

1997-1998 Cadillac Catera

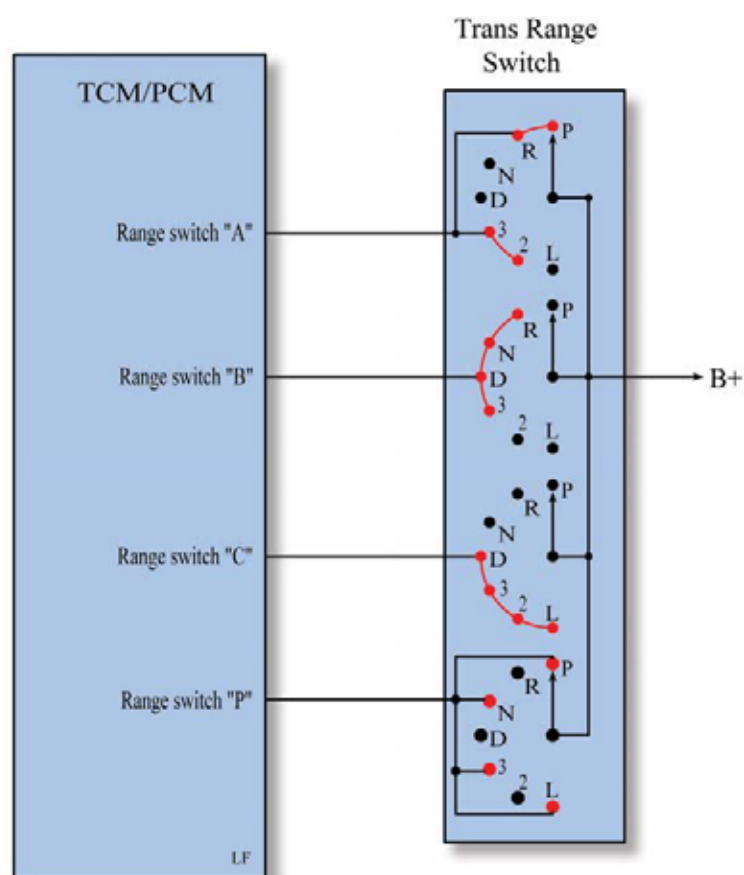
Type 6

1996-2001 BMW

1999-2001 Cadillac Catera

4L30E

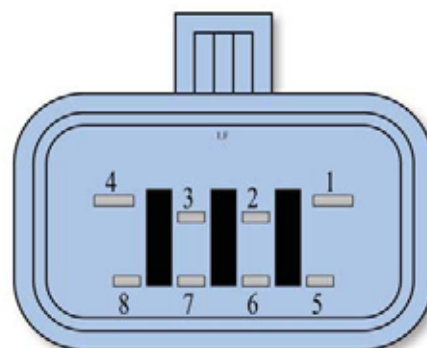
Range Switch All (except BMW)



Range switch voltages (all except BMW)							
	P	R	N	D	3	2	L
Switch "A"	B+	B+	0v	0v	B+	B+	0v
Switch "B"	0v	B+	B+	B+	B+	0v	0v
Switch "C"	0v	0v	0v	B+	B+	B+	B+
Switch "P"	B+	0v	B+	0v	B+	0v	B+

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Range Switch All (except BMW) (continued)

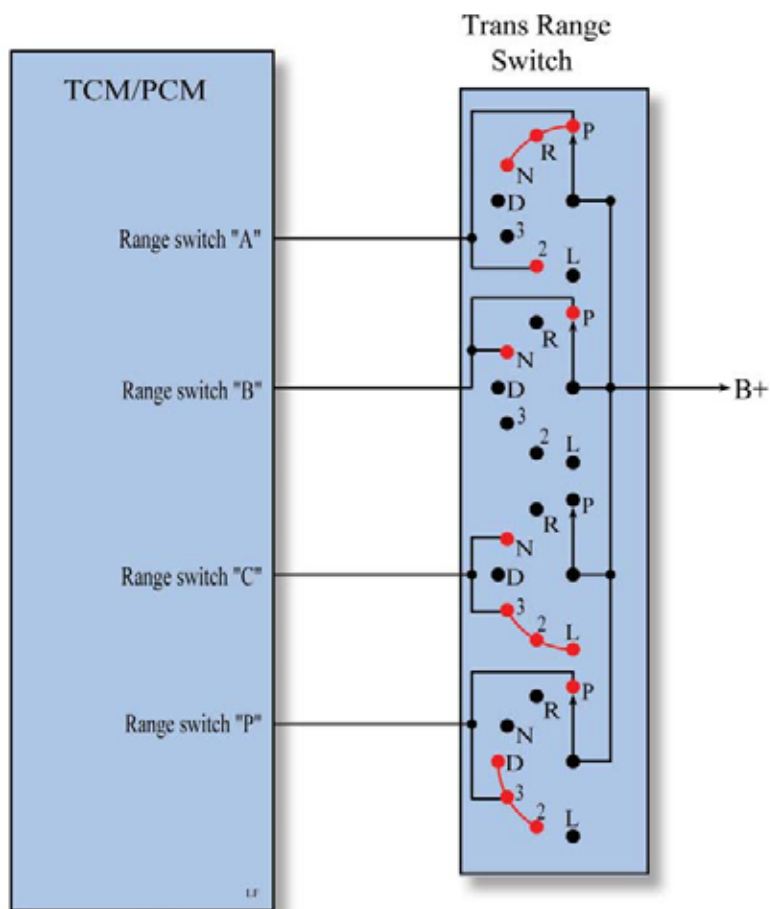


Range switch continuity (all except BMW)							
	P	R	N	D	3	2	L
Pins 5 to 8	•	•			•	•	
Pins 5 to 7		•	•	•	•		
Pins 5 to 6				•	•	•	•
Pins 5 to 3	•		•		•		•

Note: • =continuity

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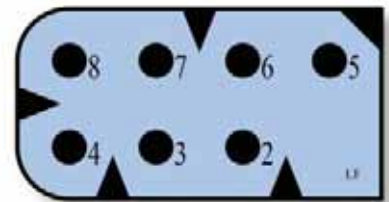
Range Switch BMW (only)



Range switch voltages (BMW)							
	P	R	N	D	3	2	L
Switch "A"	B+	B+	B+	0v	0v	B+	0v
Switch "B"	B+	0v	B+	0v	0v	0v	0v
Switch "C"	0v	0v	B+	0v	B+	B+	B+
Switch "P"	B+	0v	0v	B+	B+	B+	0v

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Range Switch BMW (only) (continued)



Range switch continuity (BMW)							
	P	R	N	D	3	2	L
Pins 5 to 4	•	•	•			•	
Pins 5 to 7	•		•				
Pins 5 to 6			•		•	•	•
Pins 5 to 8	•			•	•	•	

Note: • =continuity

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VSS (Pulse Generator)

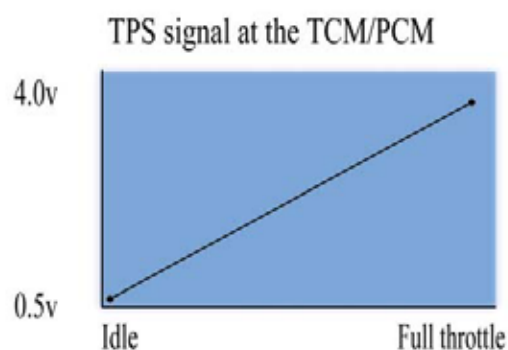
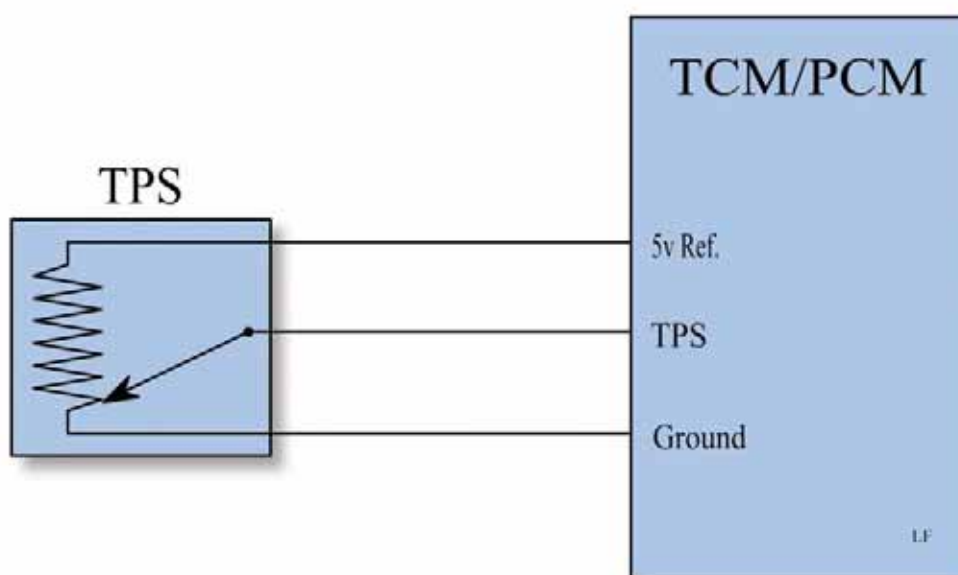
The VSS voltage output is 1-30 volts AC when the output shaft is spinning. The resistance is 2.8-3.0K ohms.



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TPS Circuit Types 1-3

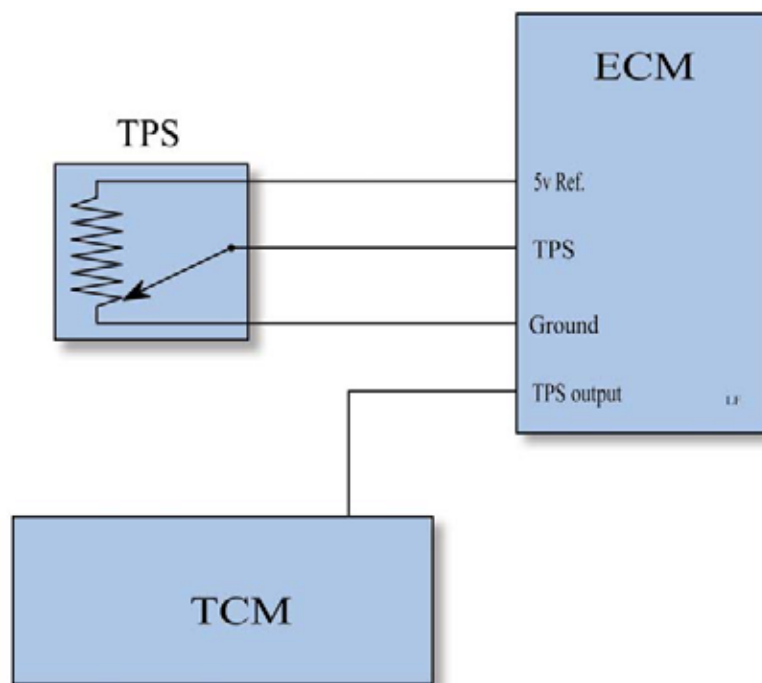
When working on vehicles with either type 1, 2, or 3 computer system, the TPS voltage can be monitored at the TPS and/or the TCM/PCM.



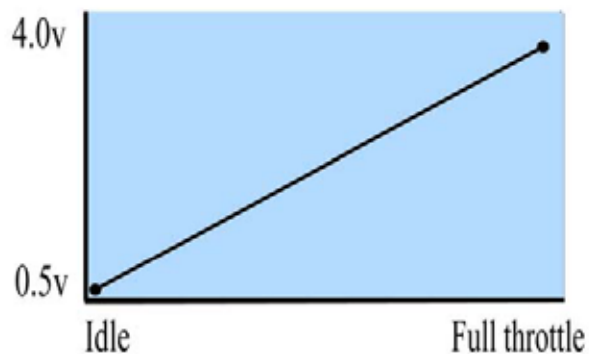
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TPS Circuit Type 5

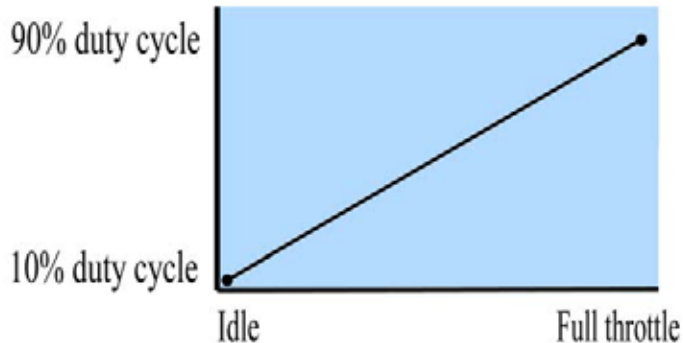
When working on a vehicle with a type 5 computer, the TPS voltage can be monitored at the TPS only. The ECM converts the TPS signal to a varying duty cycle and sends this signal to the TCM. Therefore, when monitoring the TPS signal at the TCM, you must set your voltmeter to read duty cycle.



TPS signal at the TPS



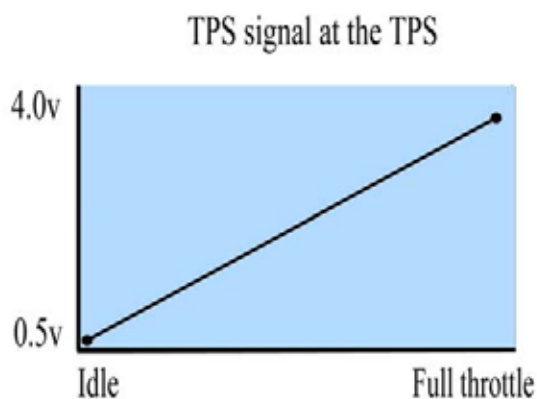
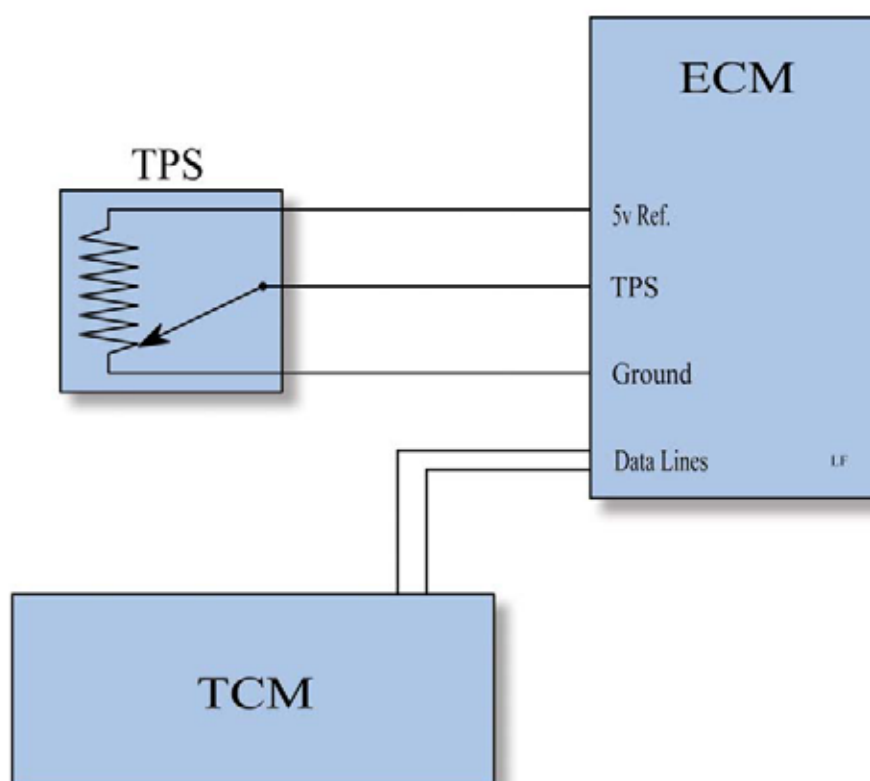
TPS signal at the TCM



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TPS Circuit Type 6

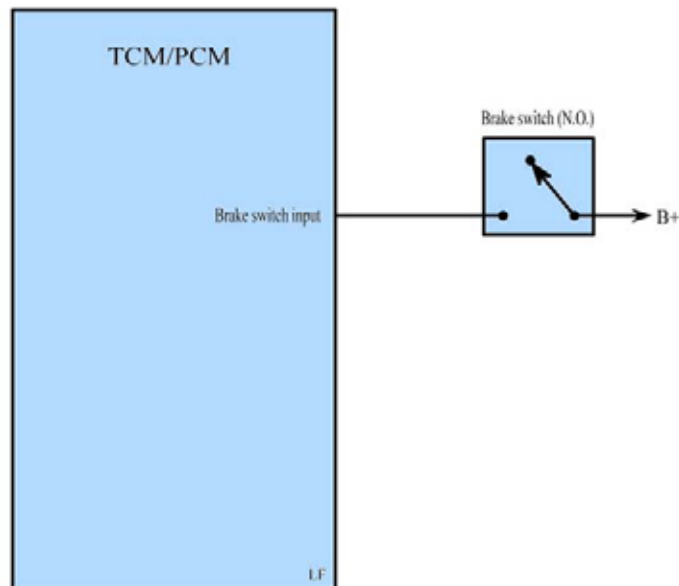
When working on a vehicle with a type 6 computer, the TPS voltage can be monitored at the TPS only. The ECM transmits the TPS signal to the TCM through the data lines and CAN NOT be monitored at the TCM with a voltmeter.



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Brake Switch Circuit All (except Type I)

With the exception of the type 1 computer system, the brake switch simply sends a signal to the TCM/PCM when the brake pedal is depressed. The computer uses this input to decide whether or not to command lockup.



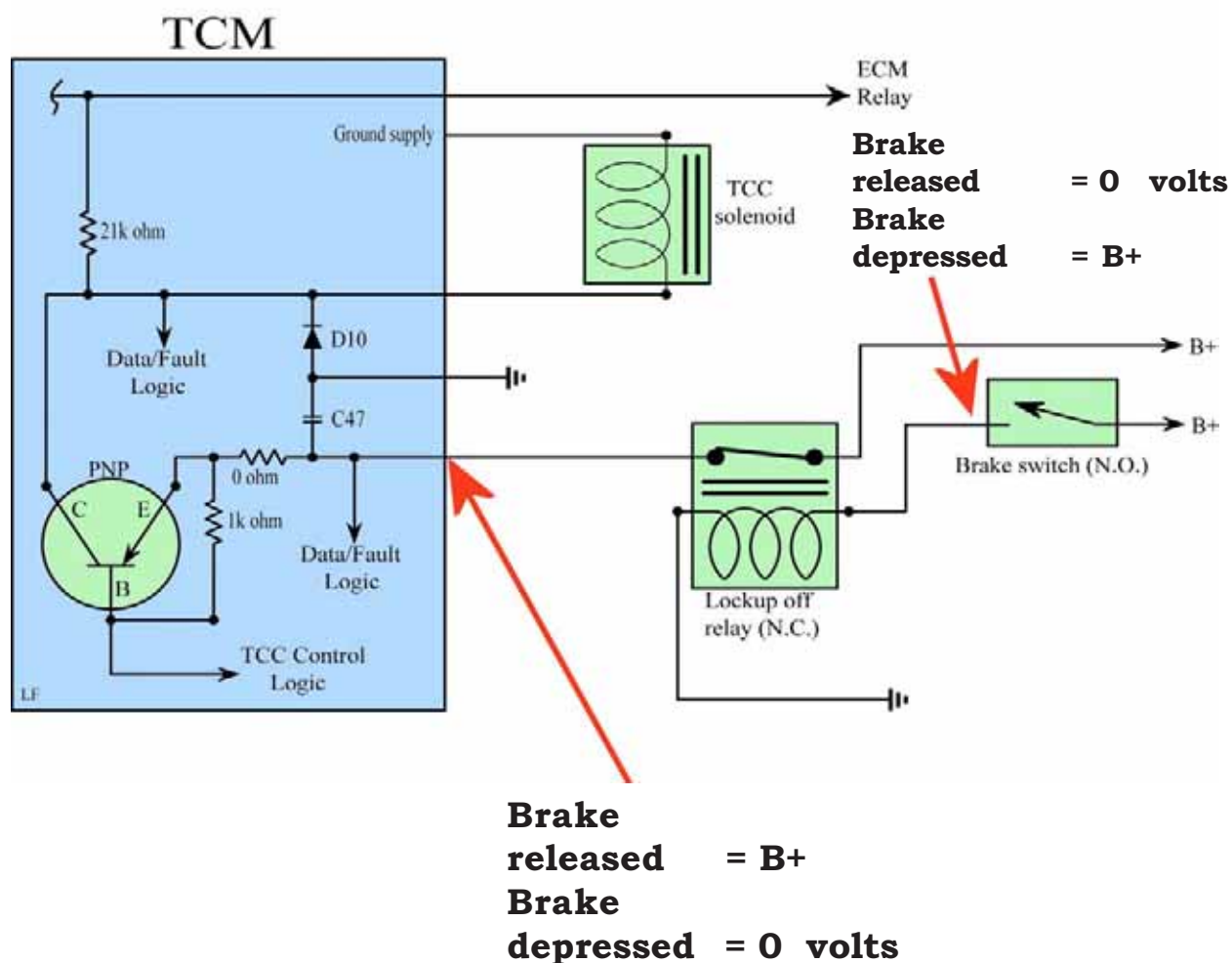
Brake released = 0 volts

Brake depressed = B+

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Brake Switch Circuit Type I

Although the computer decides whether or not to command lockup, the type 1 computer actually uses the voltage from the lockup off relay to turn the TCC solenoid on. A bad brake switch or a bad lockup off relay can cause a “no TCC apply” without setting any trouble codes.



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Diagnosing at the TCM

Removing the shield from the TCM (type 1, 5 and 6 connectors)

Remove the screw from the connector shield.



Remove the tape and/or tie from the harness.



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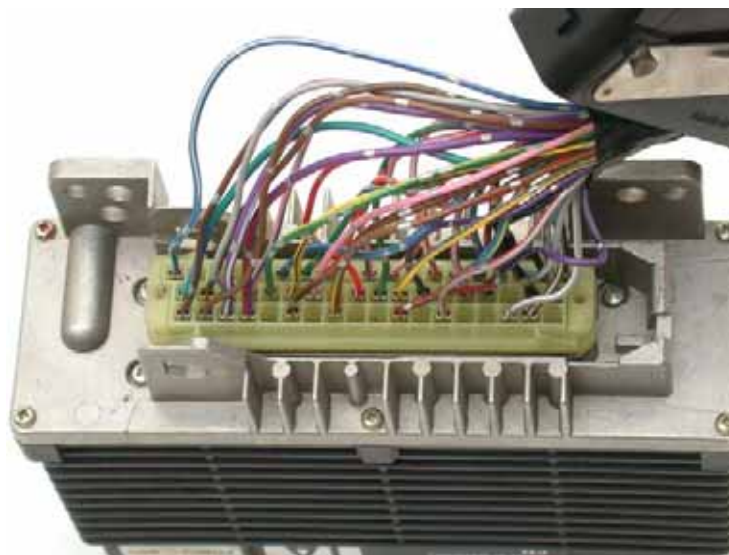
Diagnosing at the TCM (continued)

Removing the shield from the TCM (type 1, 5 and 6 connectors)



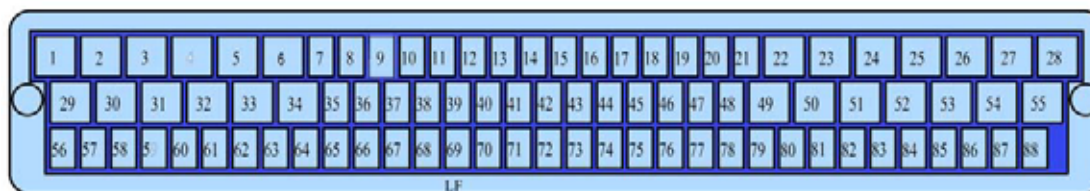
Slide the shield up the harness and away from the connector

Reconnect the computer connector



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TCM Pin Charts (Type I)



Pin	Function	Condition	Signal
1	A/C request	Compressor off	< 1v
		Compressor on	B+
2	Cruise control		
3	N/A	-	-
4	N/A	-	-
5	N/A	-	-
6	TPS (varying voltage)	Idle	0.5 v
		Full throttle	4.0 v
7	Power mode indicator	Light off	B+
		Light on	< 0.1v
8	Range selector pin C	Manual D, 3, 2 & L	B+
		All others	0v
9	N/A	-	-
10	Winter mode indicator	Light off	B+
		Light on	< 0.1v
11	Engine RPM (some models)	Engine running	DC frequency
12	N/A	-	-
13	Diagnostic	-	-
14	VSS ground	Always	< 0.1v
15	Kickdown switch	Full throttle	< 0.1v
		All others	B+
16	Ground	Always	< 0.1v
17	Ground	Always	< 0.1v
18	Ground	Always	< 0.1v

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TCM Pin Charts (Type I) (continued)

Pin	Function	Condition	Signal
19	Ground	Always	< 0.1v
20	VSS signal	Vehicle stopped	0v AC
		Vehicle moving	Above 1v AC
21	A/C cut relay		
22	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
23	Range selector pin A	Manual P, R, 3, 2	B+
		All others	0v
24	5 V reference voltage	Key off	0v
		Key on	5v
25	Diagnostic enable	Normal	B+
		During code retrieval	0v
26	Range selector pin B	Manual R, N, D, 3	B+
		All others	0v
27	N/A	-	-
28	Keep alive power	Always	B+
29	Check trans indicator	Light off	B+
		Light on	< 0.1v
30	Coolant temp	Engine temp cold	5v
		Engine temp warm	< 0.1v
31	Winter mode switch	Switch released	B+
		Switch depressed	< 0.1v
32	N/A	-	-
33	Range selector pin P	Manual P, N, 3 & L	B+
		All others	0v
34	Power mode switch	Switch released	B+
		Switch depressed	< 0.1v
35	N/A	-	-
36	Ground	Always	< 0.1v
37	Ignition	Key off	0v
		Key on	B+

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TCM Pin Charts (Type I) (continued)

Pin	Function	Condition	Signal
38	TCC Solenoid	Lockup off	0v
		Lockup on	B+
39	Brake switch	Brake released	B+
		Brake depressed	< 0.1v
40	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
41	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
42	N/A	-	-
43	2-3 solenoid	Solenoid off	0v
		Solenoid on	B+
44	N/A	-	-
45	Band apply solenoid	During drive engagement	Approx. 75% duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 kickdown & 3-2 coast down	25%-75% Duty cycle
46	N/A	-	-
47	N/A	-	-
48	1-2 / 3-4 solenoid	Solenoid Off	0v
		Solenoid On	B+
49	N/A	-	-
50	Barometric sensor (some models)		
51	N/A	-	-
52	N/A	-	-
53	Reference voltage	Key off	0v
		Key on	5v
54	Solenoid ground	Normal operation	< 0.1v
		W/solenoid codes	B+
55	Engine RPM (some models)	Engine running	DC frequency

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TCM Pin Charts (Type 2)



Pin	Function	Condition	Signal
A1	N/A	-	-
A2	1-2/3-4 Solenoid	Sol on	< 1v
		Sol off	B+
A3	2-3 Solenoid	Sol on	< 1v
		Sol off	B+
A4	Keep alive power	Always	B+
A5	N/A	-	-
A6	N/A	-	-
A7	Power from ECM main Relay	Key off	0v
		Key on	B+
A8	Power from ECM main Relay	Key off	0v
		Key on	B+
A9	Band apply solenoid	During drive engagement	Approx. 75% Duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 kickdown & 3-2 coast down	25%-75% Duty cycle
A10	A/T fluid temp light	Light off	B+
		Light on	< 0.1v
A11	Winter mode indicator light	Light off	B+
		Light on	< 0.1v
A12	Output speed sensor	Wheels stopped	0V
		Wheels spinning	Above 1v AC
B1	N/A	-	-
B2	N/A	-	-
B3	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms

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TCM Pin Charts (Type 2) (continued)

Pin	Function	Condition	Signal
B4	Cruise control	Button depressed	< 1v
		Button released	B+
B5	Kickdown switch	Full throttle	< 0.1v
		All others	B+
B6	Winter mode switch	Button released	B+
		Button depressed	< 0.1v
B7	N/A	-	-
B8	Power switch	Button released	B+
		Button depressed	< 0.1v
B9	Power indicator light	Light off	B+
		Light on	< 0.1v
B10	R&L output to antilock brake system (some models)	-	-
B11	VSS shield ground	Always	< 0.1v
B12	VSS signal ground	Always	< 0.1v
C1	Ground	Always	< 0.1v
C2	N/A	-	-
C3	Sensor ground (some vehicles)	Always	< 0.1v
C4	N/A	-	-
C5	TPS (varying voltage)	Idle	0.5v
		Full throttle	4.0v
C6	Ground	Always	< 0.1v
C7	TCC solenoid	Sol off	0v
		Sol on	B+
C8	Data link	Key off	0v
		Key on	5v
C9	N/A	-	-
C10	Check trans indicator light	Light off	B+
		Light on	< 0.1v
C11	N/A	-	-
C12	Power relay output to main case solenoid	Key off	0v
		Key on	B+
C13	N/A	-	-

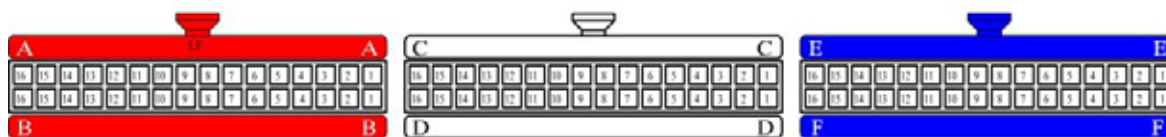
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TCM Pin Charts (Type 2) (continued)

Pin	Function	Condition	Signal
C14	Fluid temp sensor ground	Always	< 0.1v
C15	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
C16	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
D1	Ground	Always	< 0.1v
D2	BARO sensor		
D3	5 volt reference (some vehicles)	Key off	0v
		Key on	5v
D4	Trans range position "P"	P, N, 3, L	B+
		All others	0v
D5	Trans range position "C"	D, 3, 2, L	B+
		All others	0v
D6	Trans range position "B"	R, N, D, 3	B+
		All others	0v
D7	Trans range position "A"	P, R, 3, 2	B+
		All others	0v
D8	A/C on input	Compressor off	< 1v
		Compressor on	B+
D9	Brake input	Brake released	0v
		Brake depressed	B+
D10	N/A	-	-
D11	N/A	-	-
D12	Engine RPM signal	Engine running	DC frequency
D13	N/A	-	-
D14	Coolant temp switch from ECM	Cold	5v
		Warm	< 0.1v
D15	N/A	-	-
D16	Diagnostic input	During diagnostics	0v
		All others	5v

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TCM Pin Charts (Type 3)



Pin	Function	Condition	Signal
A1	5v reference to TPS	Key off	0v
		Key on	5v
A2	Knock sensor		
A3			
A4	Keep alive power	Always	B+
A5	Idle air control valve		
A6	Idle air control valve		
A7	Idle air control valve		
A8	Idle air control valve		
A9	Fluid temp light	Light off	B+
		Light on	< 0.1v
A10	Winter mode indicator light	Light off	B+
		Light on	< 0.1v
A11	Power mode indicator light	Light off	B+
		Light on	< 0.1v
A12	EHCUC		
A13	Malfunction indicator lamp		
A14	Check trans indicator light	Light off	B+
		Light on	< 0.1v
A15	VSV duty solenoid		
A16	Band apply solenoid	During drive engagement	Approx.50-75% Duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 Kickdown & 3-2 coast down	25%-75% (-) Duty cycle
B1			
B2	Ignition coil #4		
B3	Ignition coil #2		

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TCM Pin Charts (Type 3) (continued)

Pin	Function	Condition	Signal
B4	Ignition coil #6		
B5	Fuel tank sensor		
B6	Vapor sensor		
B7	EGR		
B8	Intake air temperature sensor		
B9			
B10	Power steering pressure switch		
B11			
B12	Tail relay		
B13	Class 2 data		
B14	A/C compressor relay		
B15	Low fuel warning light		
B16	Fuel gauge		
C1	Injector #4		
C2	2-3 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
C3	Injector #6		
C4	Ignition coil #1		
C5	Crank position sensor		
C6			
C7	Ground	Always	< 0.1v
C8	Ground	Always	< 0.1v
C9	Ground	Always	< 0.1v
C10	Tachometer		
C11	VSV intake air		
C12	AC generator		
C13	Canister purge		
C14	O2 B		
C15	O2 B		
C16	O2 D		
D1	Injector #2		
D2	TCC solenoid	Solenoid off	< 1v
		Solenoid on	B+
D3	Injector #1		

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TCM Pin Charts (Type 3) (continued)

Pin	Function	Condition	Signal
D4	Serial data	Key on	5v
D5	Ignition coil #5		
D6	Ignition coil #3		
D7	VSS (meter)	Wheels turning	DC frequency
D8	Ground	Always	< 0.1v
D9	Ground	Always	< 0.1v
D10	Mass air flow		
D11	Cam position sensor		
D12	O2 C		
D13	O2 C		
D14	O2 A		
D15	O2 A		
D16	O2 D		
E1	VSS (+)	Wheels stopped	0V
		Wheels spinning	Above 1v AC
E2	VSS (-)	Always	< 0.1v
E3	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
E4	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
E5	Ignition	Key off	0v
		Key on	B+
E6	EGR		
E7	Trans range position "B"	R, N, D, 3	B+
		All others	0v
E8	TPS	Idle	0.5v
		Full throttle	4.0-4.3v
E9	Coolant temperature	Operating temp	Approx 2.0-2.5 v
E10			
E11			
E12	Trans range position "A"	P, R, 3, 2	B+
		All others	0v
E13	To fuel pump relay		

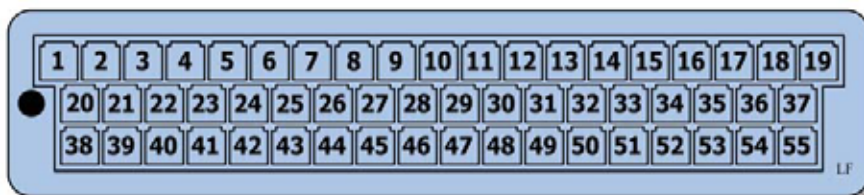
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TCM Pin Charts (Type 3) (continued)

Pin	Function	Condition	Signal
E14	Power relay output ok to excep TCC Solenoid	Key off	0v
		Engine running	B+
E15	A/C thermo relay		
E16	Power from PCM main relay	Key off	1.0-2.0v
		Key on	B+
F1			
F2	Trans range position "C"	D, 3, 2, L	B+
		All others	0v
F3	Trans range position "P"	P, N, 3, L	B+
		All others	0v
F4	Brake switch	Brake released	0v
		Brake applied	B+
F5	Power switch	Switch released	B+
		Switch depressed	< 0.1v
F6	Winter mode switch	Switch released	B+
		Switch depressed	< 0.1v
F7	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
F8	MAP sensor	Idle	1.0-1.4 v
		Full stall	4.5-4.9v
F9			
F10	Cruise control	Off	B+
		On	< 1v
F11	Kickdown switch	Full throttle	< 0.1v
		All other	B+
F12	Serial data		
F13	Injector #3		
F14	1-2/3-4 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
F15	Injector #5		
F16	Power from PCM main relay	Key off	1.0-2.0v
		Key on	B+

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TCM Pin Charts (Type 5) (continued)



Pin	Function	Condition	Signal
1	P/N out	In Park or neutral	< 0.1v
		All other ranges	9.0-13.5v
2	N/A	-	-
3	VSS (+) (between pin 3 & 5)	Wheels spinning	Above 1v AC
4	Torque control output to ECM	During upshift	Varies duty cycle 3-4 pulses
5	VSS (-) (between pin 3 & 5)	Wheels spinning	Above 1v AC
6	N/A	-	-
7	Sport mode indicator	Light off	B+
		Light on	< 0.1v
8	Trans range position "C"	D, 3, 2, L	B+
		All others	0v
9	Traction control torque reduction request input (always 100 Hz)	Normal	80-90% duty
		Active	30-40% duty
10	N/A	-	-
11	Engine RPM signal	Engine running	DC frequency
12	Winter mode indicator light	Light off	B+
		Light on	< 0.1v
13	Serial data		
14	N/A	-	-
15	Kickdown switch (some models)	Full throttle	< 0.1v
		All other	B+
16	Fluid temp sensor ground	Always	< 0.1v
17	N/A	-	-
18	VSS shield ground	Always	< 0.1v
19	Ground	Always	< 0.1v
20	N/A	-	-

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TCM Pin Charts (Type 5) (continued)

Pin	Function	Condition	Signal
21	A/C request input	Compressor off	< 1v
		Compressor on	B+
22	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
23	Trans range position "A"	P, R, 3, 2	B+
		All others	0v
24	N/A	-	-
25	N/A	-	-
26	Trans range position "B"	R, N, D, 3	B+
		All others	0v
27	N/A	-	-
28	Keep alive power	Always	B+
29	Check trans indicator light	Light off	B+
		Light on	< 1v
30	N/A	-	-
31	Winter mode switch	Switch released	B+
		Switch depressed	< 0.1v
32	Data output to ECM		
33	Trans range position "P"	P, N, 3, L	B+
		All others	0v
34	Sport mode switch	Switch released	B+
		Switch depressed	< 0.1v
35	Ground	Always	< 0.1v
36	N/A	-	-
37	Ignition	Key off	0v
		Key on	B+
38	TCC solenoid	Solenoid off	B+
		Solenoid on	< 1v

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TCM Pin Charts (Type 5) (continued)

Pin	Function	Condition	Signal
39	Brake switch	Brake released	< 1v
		Brake depressed	B+
40	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
41	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
42	N/A	-	-
43	2-3 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
44	Torque reduction signal	Varies with TPS	25-60%
45	Band apply solenoid	During drive engagement	Approx. 75% Duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 Kickdown & 3-2 coast down	25%-75% Duty cycle
46	N/A	-	-
47	N/A	-	-
48	1-2/3-4 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
49	N/A	-	-
50	N/A	-	-
51	N/A	-	-
52	N/A	-	-
53	N/A	-	-
54	Power relay output to 1-2/3-4, 2-3, band apply and TCC solenoids	Key off	0v
		Key on	B+
		W/solenoid codes	0v
55	TPS signal from ECM (always 100 Hz)	Idle	9-10 % duty
		Full throttle	88-90% duty

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TCM Pin Charts (Type 6)



Pin	Function	Condition	Signal
1	N/A	-	-
2	Shifter lock solenoid (some models)	Solenoid off	B+
		Solenoid on	< 1v
3	N/A	-	-
4	Band apply solenoid	During drive engagement	Approx. 75% Duty cycle
		Above 8-10 MPH	0% Duty cycle (sol off)
		During a 3-2 or 3-1 kickdown & 3-2 coast down	25%-75% Duty cycle
5	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
6	Ground	Always	< 0.1v
7	N/A	-	-
8	Trans range position "B"	(Catera) R, N, D, 3	B+
		(BMW) P, N	B+
		All others	0v
9	Trans range position "P"	(Catera) P, N, 3, L	B+
		(BMW) P, D, 3, 2	B+
		All others	0v
10	Brake switch (some models)	Brake released	0v
		Brake depressed	B+
11	N/A	-	-
12	Sport mode switch (some models)	Sport mode off	B+
		Sport mode on	0v
13	Manual (winter) mode switch	Manual mode off	B+
		Manual mode on	0v
14	VSS (-) (between pin 14 & 42)	Wheels spinning	Above 1v AC

4L30E

TCM Pin Charts (Type 6) (continued)

Pin	Function	Condition	Signal
15	VSS shield ground	Always	< 0.1v
16	N/A	-	-
17	Sport mode indicator light (some models)	Light off	B+
		Light on	< 1v
18	Kickdown switch (some models)	Full throttle	0 v
		All other	B+
19	ABS/ASC signal (some models)		
20	Auto mode switch (some models)	Auto mode off	B+
		Auto mode on	0v
21	Fluid temp ground	Always	< 0.1v
22	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
23	N/A	-	-
24	N/A	-	-
25	Check trans indicator (some models)	Light off	B+
		Light on	< 1v
26	Keep alive power	Always	B+
27	Manual (winter) mode indicator	Light off	B+
		Light on	< 1v
28	Ground	Always	< 0.1v
29	N/A	-	-
30	1-2/3-4 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
31	N/A	-	-
32	TCC solenoid	Solenoid off	B+
		Solenoid on	< 1v
33	2-3 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
34	Ground	Always	< 0.1v
35	N/A	-	-
36	Trans range position "A"	(Catera) P, R, 3, 2	B+
		(BMW) P, R, N, 2	B+
		All others	0v

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TCM Pin Charts (Type 6) (continued)

Pin	Function	Condition	Signal
37	Trans range position "C"	(Catera) D, 3, 2, L	B+
		(BMW) N, 3, 2, L	B+
		All others	0v
38	N/A	-	-
39	N/A	-	-
40	Engine RPM signal (some models)	Engine running	DC frequency
41	N/A	-	-
42	VSS (+) (between pin 14 & 42)	Wheels spinning	Above 1v AC
43	N/A	-	-
44	N/A	-	-
45	Auto mode indicator	Light off	B+
		Light on	< 1v
46	A/C compressor on signal (some models)	Compressor off	B+
		Compressor on	0v
47	N/A	-	-
48	Brake switch test signal (some models)	Brake released	B+
		Brake depressed	0v
49	CAN LOW (some models)		2.5v
50	CAN HIGH (some models)		2.5v
51	Serial data (some models)		
52	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
53	Power relay output to 1-2/3-4, 2-3, band apply and TCC solenoids	Key off	0v
		Key on	B+
		W/solenoid codes	0v
54	Ignition	Key off	0v
		Key on	B+
55	Ignition (some models)	Key off	0v
		Key on	B+
56	N/A	-	-
57	Cruise control signal (some models)		
58	N/A	-	-
59	N/A	-	-
60	Program voltage from data link (some models)		
61	N/A	-	-

4L30E

TCM Pin Charts (Type 6) (continued)

Pin	Function	Condition	Signal
62	N/A	-	-
63	N/A	-	-
64	N/A	-	-
65	N/A	-	-
66	N/A	-	-
67	N/A	-	-
68	N/A	-	-
69	N/A	-	-
70	N/A	-	-
71	N/A	-	-
72	N/A	-	-
73	N/A	-	-
74	N/A	-	-
75	N/A	-	-
76	N/A	-	-
77	N/A	-	-
78	N/A	-	-
79	N/A	-	-
80	N/A	-	-
81	N/A	-	-
82	Connected to pin 83 (some models)		
83	Connected to pin 82 (some models)		
84	N/A	-	-
85	CAN LOW (some models)		2.5v
86	CAN HIGH (some models)		2.5v
87	RXD Data Link (some models)		B+
88	TXT Data link (some models)		B+

NOTES:

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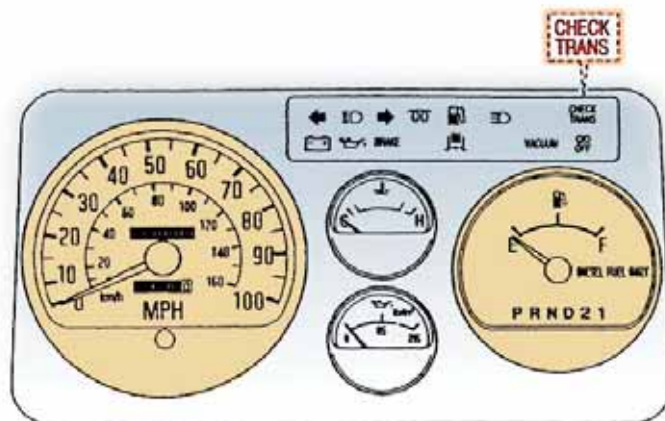
450-43LE

Self-Diagnostic Information

NPR, FUSO

There are only 13 components that will cause the “Check Trans” light to illuminate.

1. Vehicle Speed Sensor #1
2. Engine Speed Sensor
3. Transmission fluid sensor
4. Inhibitor Switch
5. Throttle Position Sensor
6. Vehicle Speed Sensor#2
7. SS#1
8. SS#2
9. Timing Solenoid
10. TCC Solenoid
11. EPC Solenoid
12. Exhaust Brake Solenoid
13. Engine Warming sensor



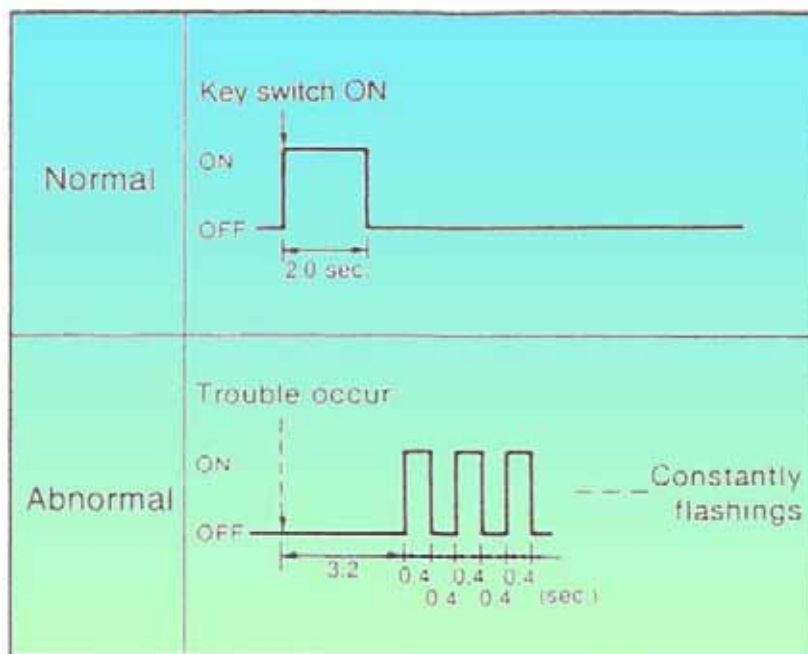
450-43LE

Checking for Codes

As a pretest procedure, the “Check Trans” light will come ON when the ignition key is turned to the ON position. This tests the operation of the light bulb and connection from the TCM to the check engine light.

When the Throttle Position Sensor, Vehicle Speed Sensor, Solenoids, or any one of the 13 components start to malfunction when the vehicle is running, the “Check Trans” light will start to blink to warn the driver.

The “Check Trans” light begins to blink as soon as a problem occurs during driving conditions and keeps blinking until it is corrected.

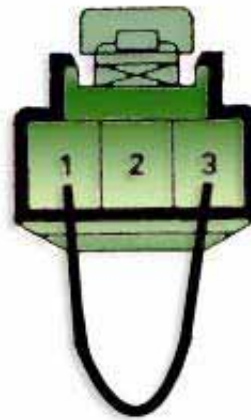


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Self- Diagnostic Results

The DLC (Data Link Connector) is a Green three-pin connector and it is tied to the support bracket located under the brake and clutch fluid tank.

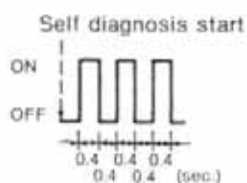
A DTC can be retrieved by jumping a wire from terminal 1 (Black/White) and terminal 3 (Black) located at both ends of the Data Link Connector.



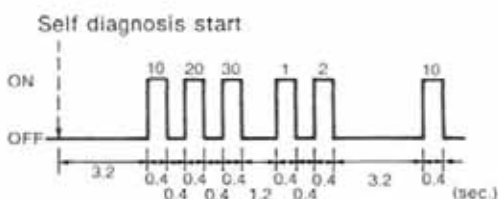
Green Three Pin Connector

When no problem exists, the display flashes “1” repeatedly. When a malfunction exists, the DTC is displayed three times repeatedly. When two or more DTCs are generated, they are all displayed three times repeatedly, one at a time, starting with the lowest code number first.

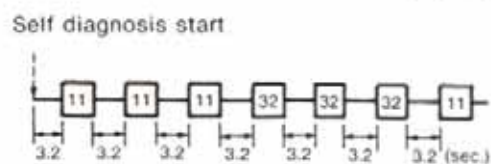
A. NORMAL



B. DIAGNOSTIC TROUBLE CODE "32"



C. DIAGNOSTIC TROUBLE CODE "11" AND "32"



Codes

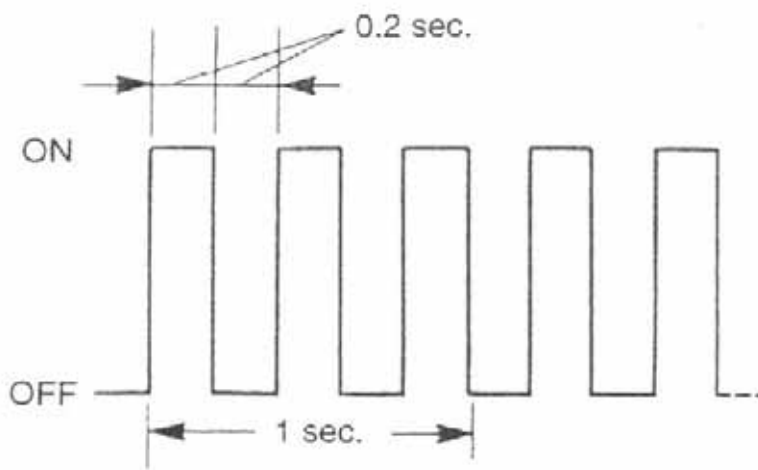
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Clearing Codes

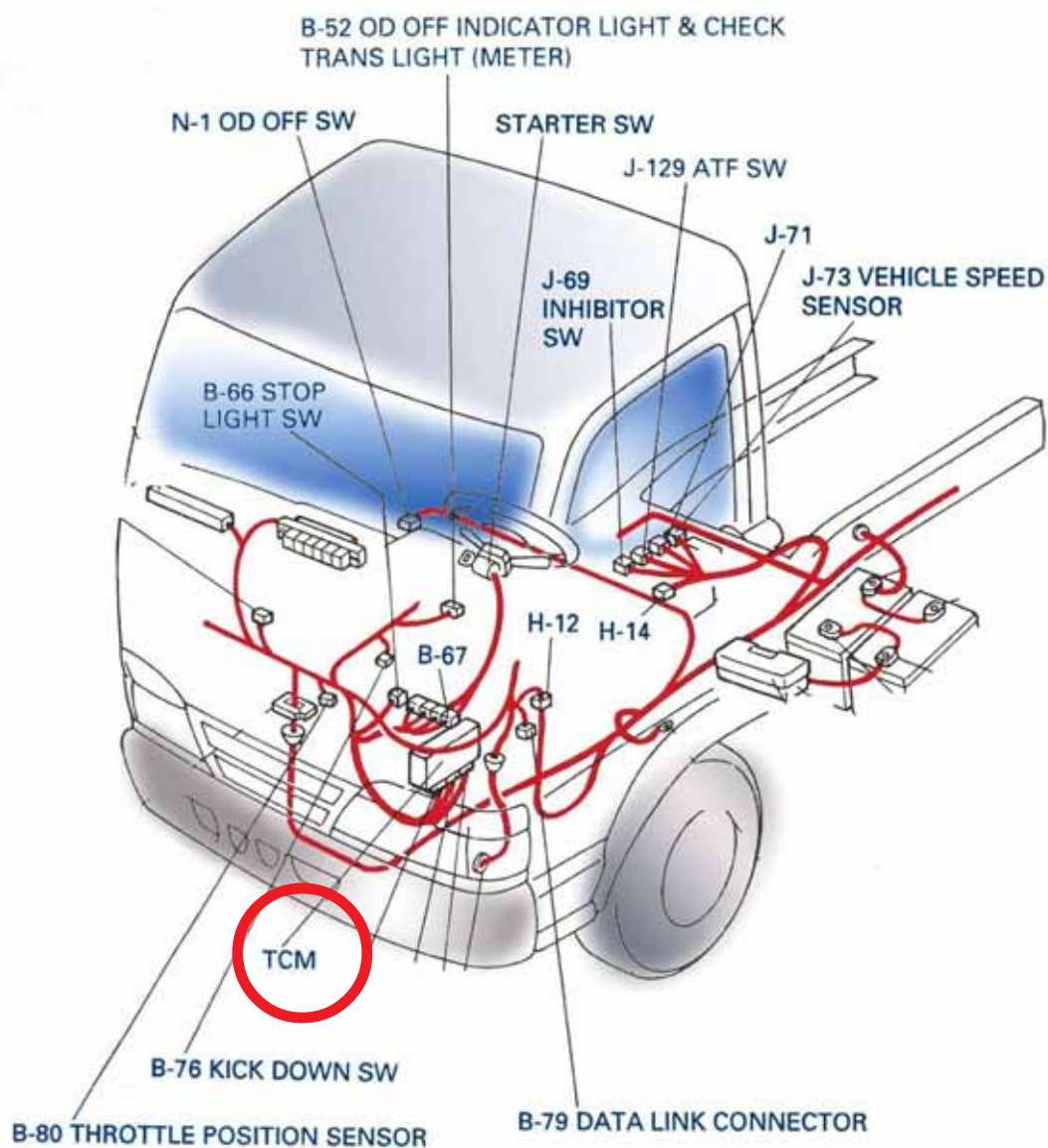
You can use the factory scan tool (Tech 2 or Mastertech), to clear the codes. However, if a Factory scan tool is unavailable, perform the following operation.

1. Turn the key switch to the ON position, but DO NOT start the engine.
(=No Engine RPM/No vehicle speed)
2. Connect a jumper terminal to pins 1 and 3 of the DLC.
(=Self-diagnostic is started)
3. Select "N" (Neutral) Range
(="N" range signal is sent)
4. Depress brake pedal fully
(=Brake switch is ON)
5. Depress accelerator pedal fully.
(=Kick-down switch is ON)
6. The Check Trans light will flash rapidly ("ON"-0.2 sec, "OFF"-0.2 sec) for ten seconds if the clear memory operation is successful.



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Component Locations



450-43LE

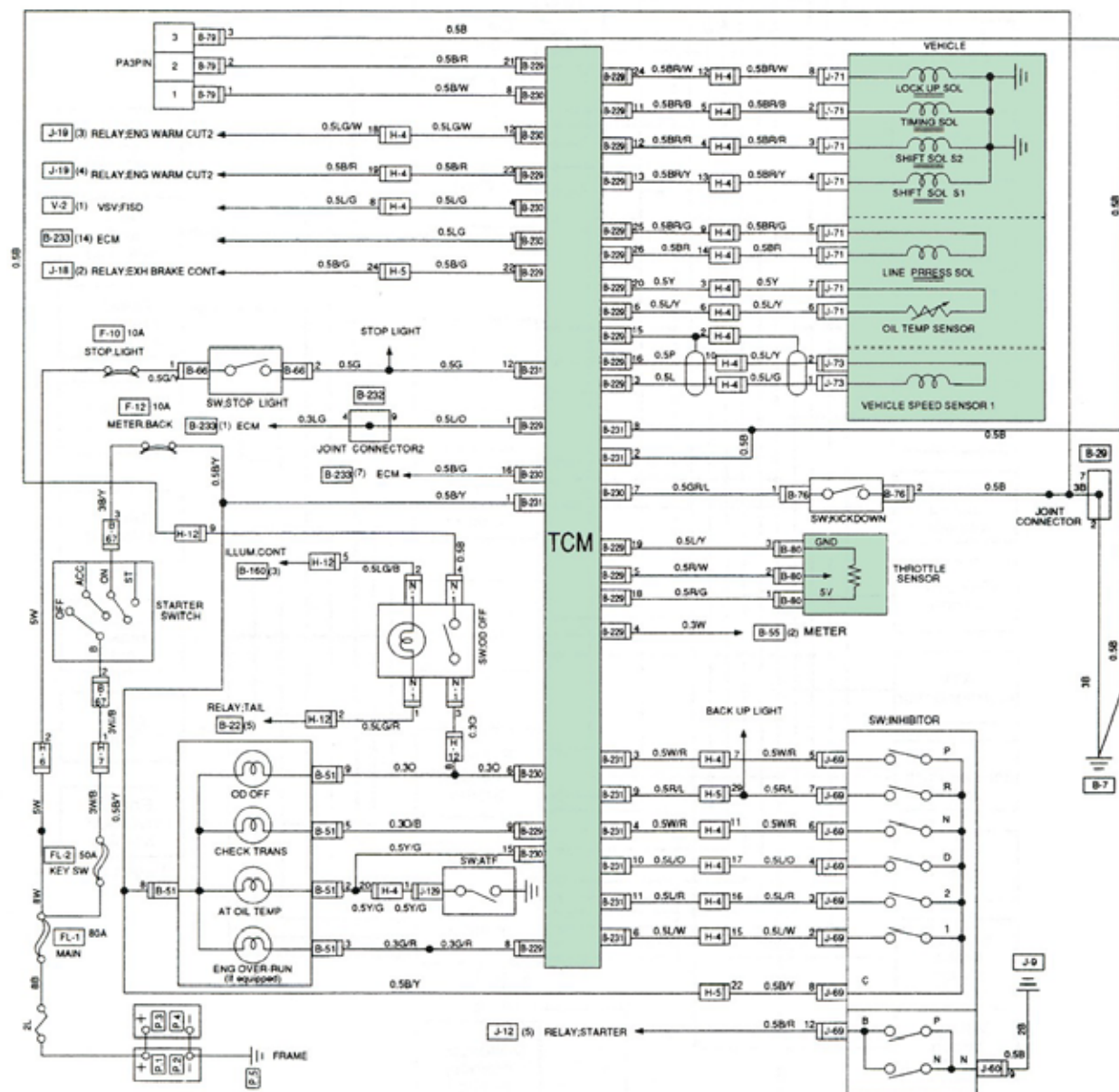
Wiring Diagram

Color Abbreviations:

L-Blue
W-White
R-Red

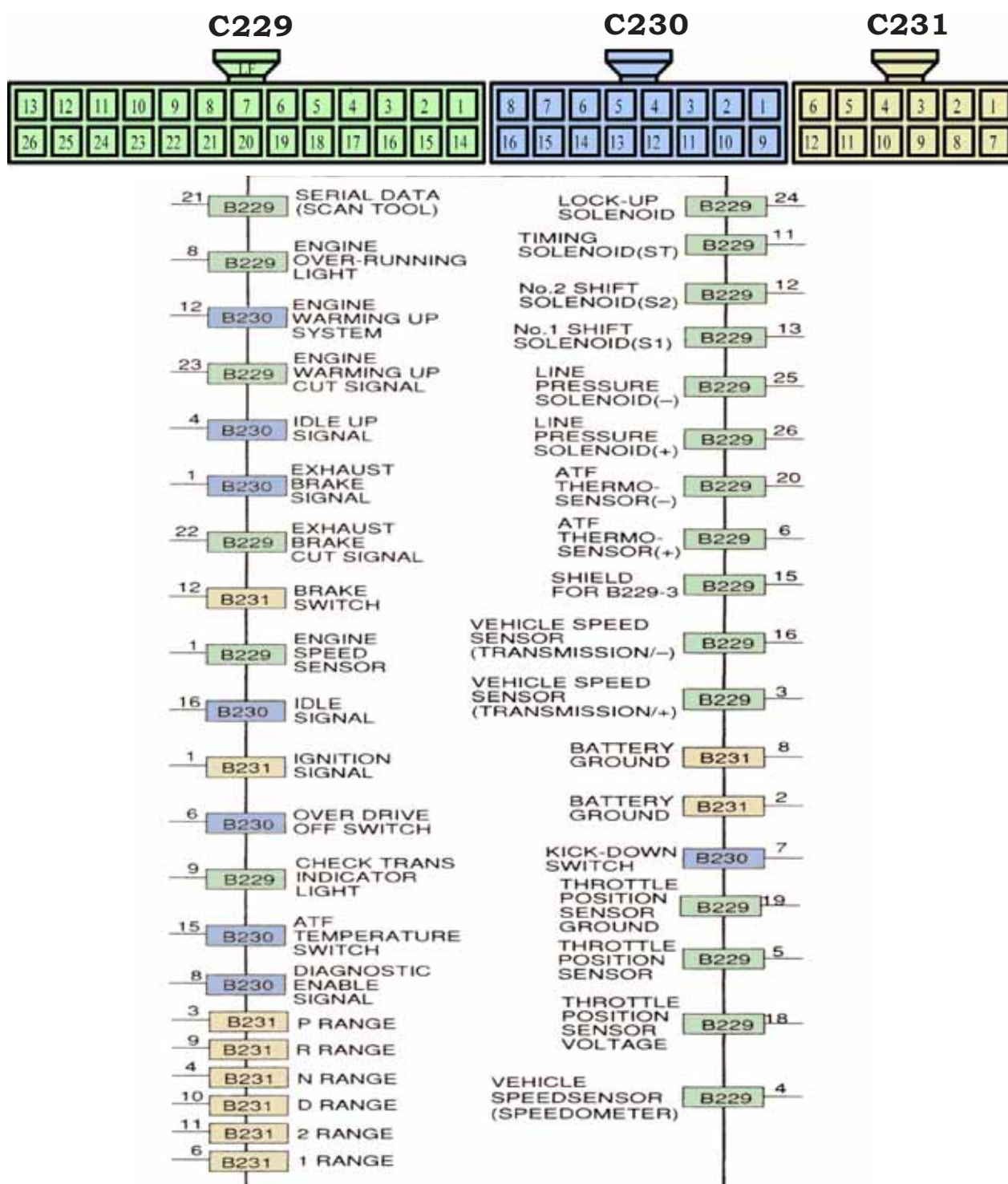
G-Green
P-Purple
O-Orange

B-Black
Y-Yellow



450-43LE

TCM Pin Location



450-43LE

TCM Specifications



TCM Terminal No. (Wire Color)		Standard Voltage	Inspection Condition	Signal Type	Circuit
Tester (-)	Tester (+)				
B231-2 (B) or B231-8 (B)	B229-1 (L/O)	More than 1.0 (Intermittent AC)	At an engine speed of approx. 1,000 RPM	Input	Engine speed sensor
	B229-2	Not used	—	—	—
B229-16 (P)	B229-3 (L)	More than 0.35 (AC)	Vehicle speed 24 km/h (15 mph) (Voltage increases in proportion to the speed)	Input	Vehicle speed sensor (Transmission)
		0	Vehicle stopped		
B231-2 (B) or B231-8 (B)	B229-4 (L/G)	0-5	Vehicle moved at slowest possible speed at least 1 meter	Input	Vehicle speed sensor (SPEEDOMETER)
B229-19 (L/Y)	B229-5 (R/W)	3.8-4.5	Accelerator pedal fully closed	Input	Throttle position sensor
		0.5-1.8	Accelerator pedal fully opened		
B229-20 (Y)	B229-6 (L/Y)	0.9	ATF temp. approx. 10 °C (50 °F)	Input	ATF thermosensor
		0.3	ATF temp. approx. 40 °C (104 °F)		
B231-2 (B) or B231-8 (B)	B229-7	Not used	—	—	—
	B229-8 (B/W)	10-16	Engine speed more than 3,800 RPM	Output	Engine overrunning light (if equipped)
		Less than 1.0	Engine speed less than 3,700 RPM		
	B229-9 (O/B)	10-16	Normally state	Output	Check trans light
		Less than 3.0	In order to 2 seconds when after the key switch "ON"		
	B229-10	Not used	—	—	—
	B229-11 (R/B)	10-16	Shift up to 2nd or 3rd kick down to 1st	Output	Timing solenoid (ST)
		Less than 1.0	Normally state		
	B229-12 (BR/R)	10-16	Driving at "D2" and "D3" (No.2 shift solenoid (S2) "ON")	Output	No.2 shift solenoid (S2)
		Less than 1.0	Driving at "D1" and "D4" (No.2 shift solenoid (S2) "OFF")		

AC: Alternating Current ATF: Automatic Transmission Fluid TCM: Transmission Control Module

450-43LE

TCM Specifications (continued)

TCM Terminal No. (Wire Color)		Standard Voltage	Inspection Condition	Signal Type	Circuit
Tester (-)	Tester (+)				
B231-2 (B) or B231-8 (B)	B230-4 (L/G)	10-16	Air conditioner compressor "ON"	Input	Engine idle up
		Less than 1.0	Air conditioner compressor "OFF"		
	B230-5	Not used	—	—	—
	B230-6 (O)	10-16	O/D OFF switch "OFF"	Input	O/D OFF switch
		Less than 1.0	O/D OFF switch "ON"		
	B230-7 (GR/L)	10-16	Accelerator pedal "released"	Input	Kick down switch
		Less than 1.0	Accelerator pedal "depressed"		
	B230-8 (B/W)	10-16	Self diagnosis "OFF"	Input	Data link connector
		Less than 1.0	Self diagnosis "ON"		
	B230-9	Not used	—	—	—
	B230-10	Not used	—	—	—
	B230-11	Not used	—	—	—
	B230-12 (LG/W)	10-16	QWS switch "ON"	Input	Engine warming up
		Less than 1.0	QWS switch "OFF"		
	B230-13	Not used	—	—	—
	B230-14	Not used	—	—	—
	B230-15 (Y/G)	10-16	Normally state	Input	ATF thermo switch
		Less than 1.0	ATF temperature more than 147 °C		
	B230-16 (B/G)	10-16	Engine speed more than 880 RPM	Input	Idle signal
		Less than 1.0	Accelerator pedal full closed. Engine speed 400-880 RPM		

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TCM Specifications (continued)

TCM Terminal No. (Wire Color)		Standard Voltage	Inspection Condition	Signal Type	Circuit
Tester (-)	Tester (+)				
B231-2 (B) or B231-8 (B)	B231-1 (BY)	10-16	Key switch "ON"	Source	Battery voltage
	B231-3 (W/R)	10-16	Selector "P" range	Input	"P" range switch
		Less than 1.0	Selector other than except "P" range		
	B231-4 (W/R)	10-16	Selector "N" range	Input	"N" range switch
		Less than 1.0	Selector other than except "N" range		
	B231-5	Not used	—	—	—
	B231-6 (L/W)	10-16	Selector "1" range	Input	"1" range switch
		Less than 1.0	Selector other than except "1" range		
	B231-7	Not used	—	—	—
	B231-9 (R/L)	10-16	Selector "R" range	Input	"R" range switch
		Less than 1.0	Selector other than except "R" range		
	B231-10 (L/O)	10-16	Selector "D" range	Input	"D" range switch
		Less than 1.0	Selector other than except "D" range		
	B231-11 (L/R)	10-16	Selector "2" range	Input	"2" range switch
		Less than 1.0	Selector other than except "2" range		
	B231-12 (G)	10-16	Stop light "ON"	Input	Stop light
		Less than 1.0	Stop light "OFF"		

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Sprag Rotation

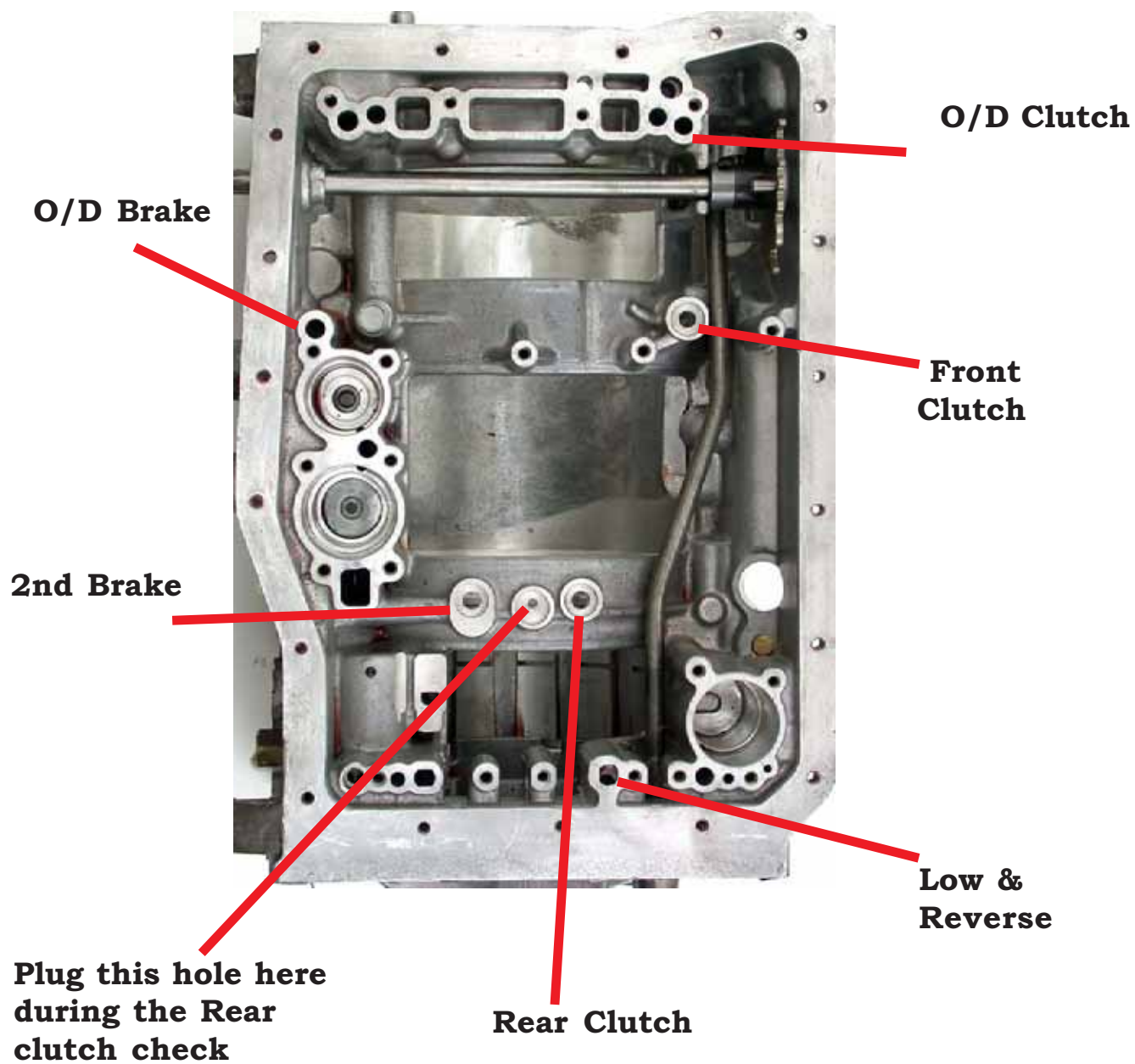
Low One-way Clutch

The Low one-way clutch is connected to the case and the Planetary rotates clockwise.



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Air Checking

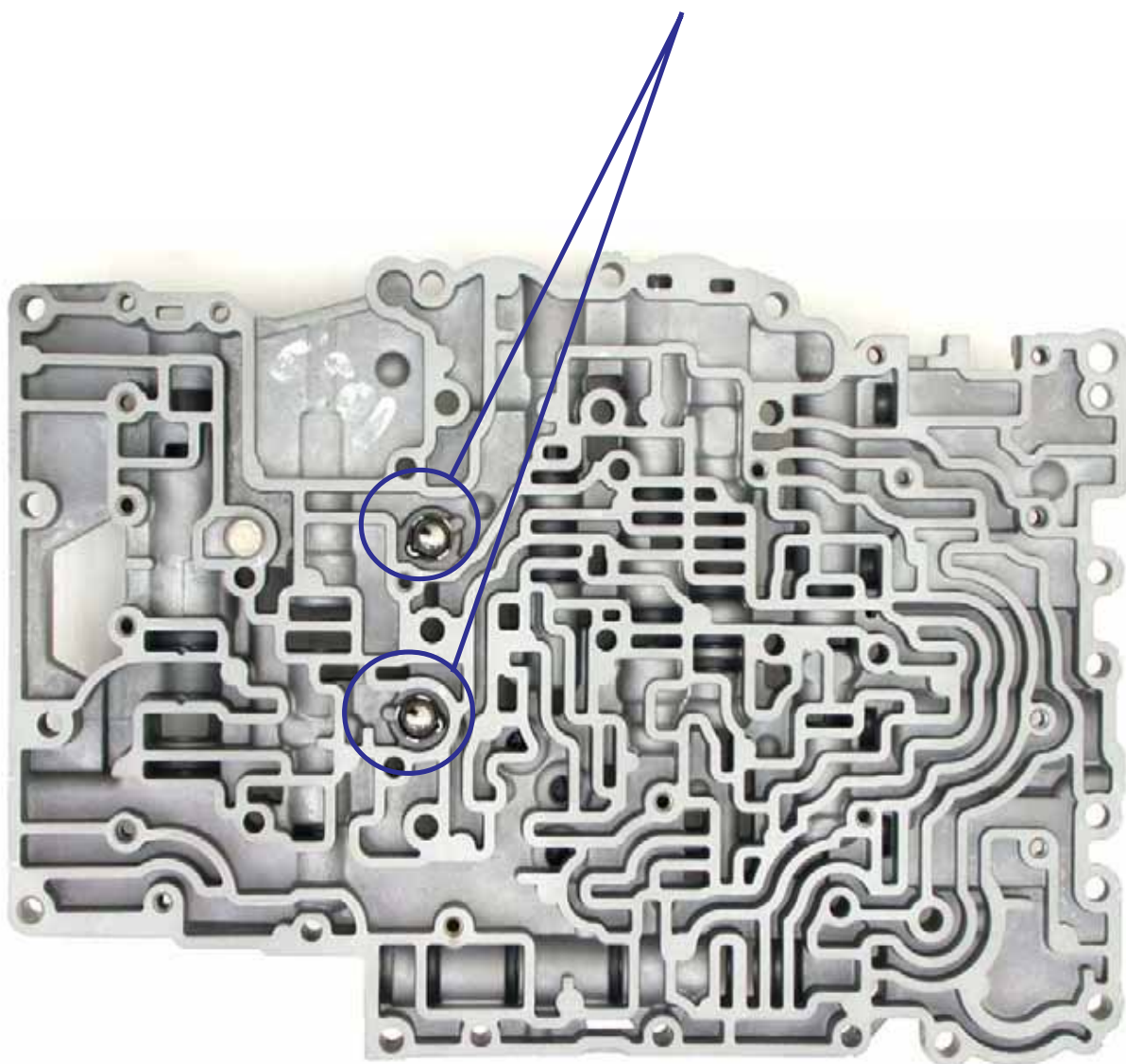


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Checkball Location

Lower Valve body

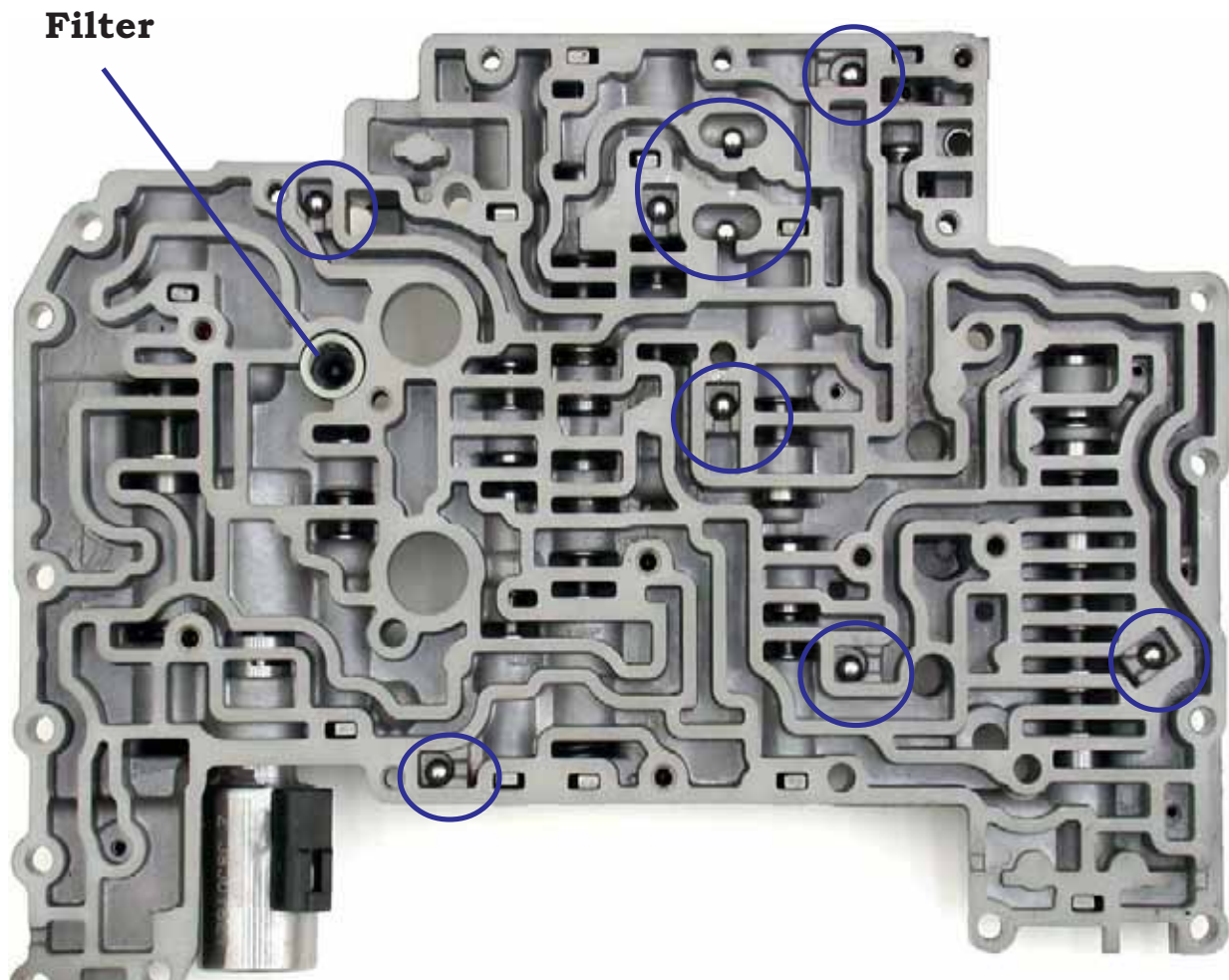
Relief Valve and Check ball



450-43LE

Checkball Location (continued)

Upper Valve Body



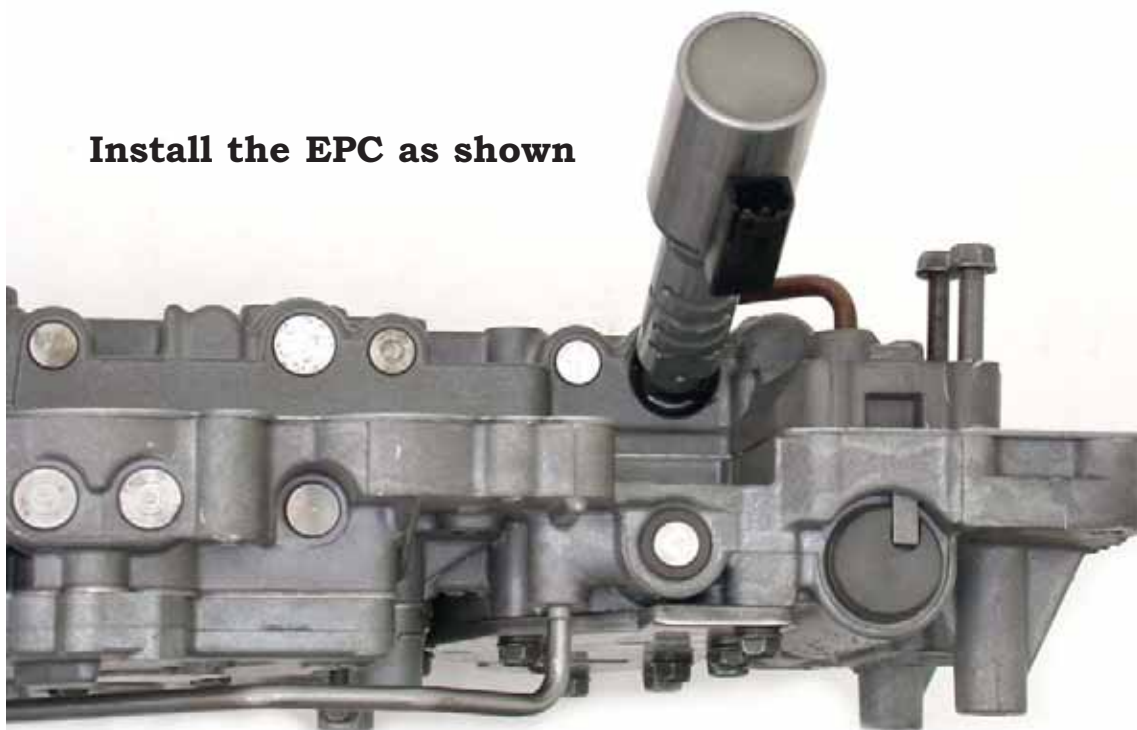
450-43LE

EPC Location

The EPC solenoid can be installed upside down. Be sure when reinstalling the EPC solenoid that the slots are pointing toward the worm tracks on the upper valvebody.

Description	Resistance
EPC	3.5-5.5 ohms

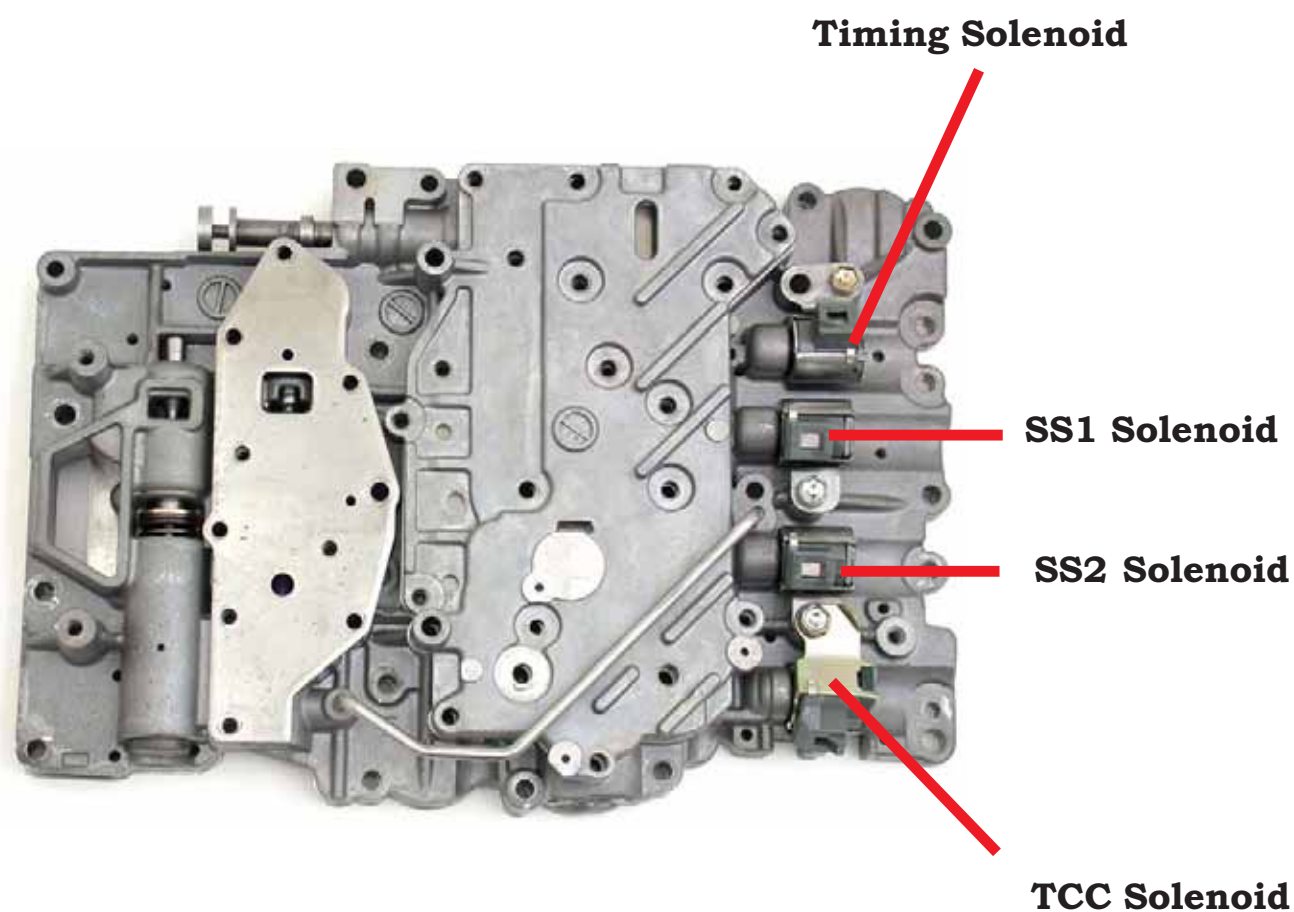
Install the EPC as shown



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Solenoid Location

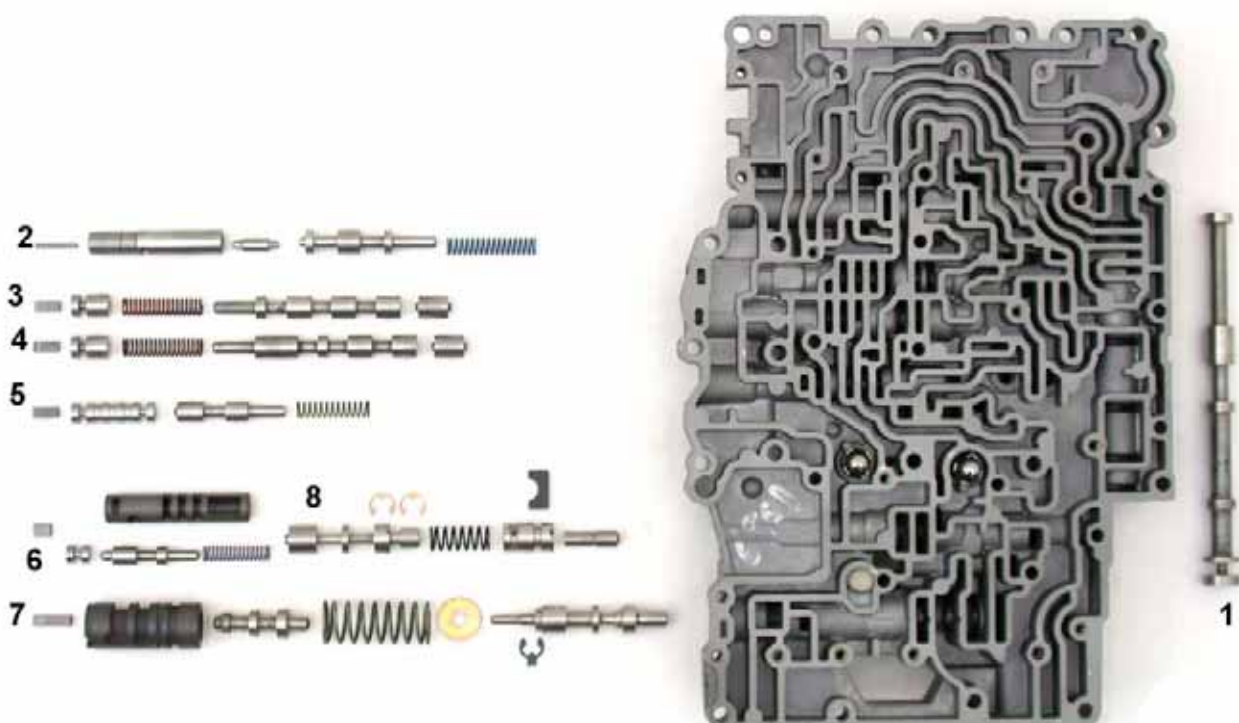
Description	Resistance
SS1	10-20 ohms
SS2	10-20 ohms
TCC	10-20 ohms
Timing	10-20 ohms



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Valve Body Exploded View

Lower Valve Body

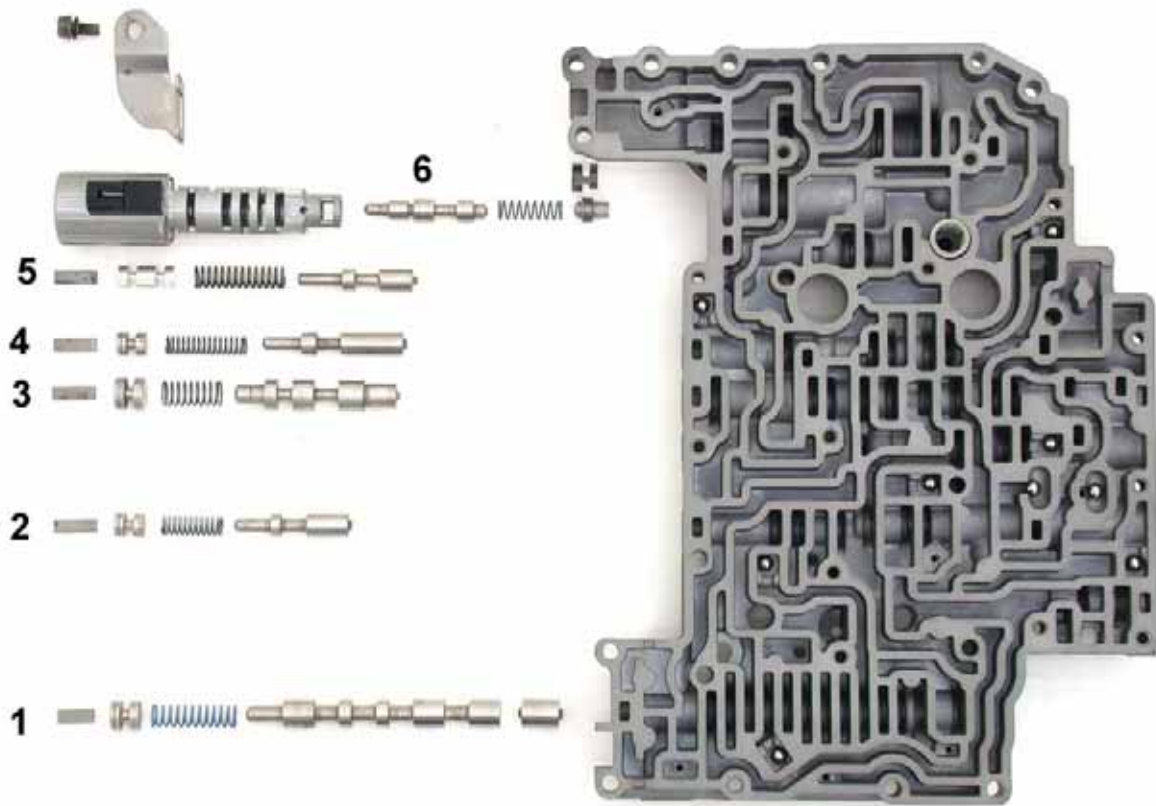


ID	Description
1	Manual Valve
2	2-3 Timing Valve
3	1-2 Shift Valve
4	3-4 Shift Valve
5	CO Exhaust Valve
6	Cut-Back Valve
7	Pressure Relief Valve
8	Lock-Up Control Valve

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Valve Body Exploded View (continued)

Upper Valve Body

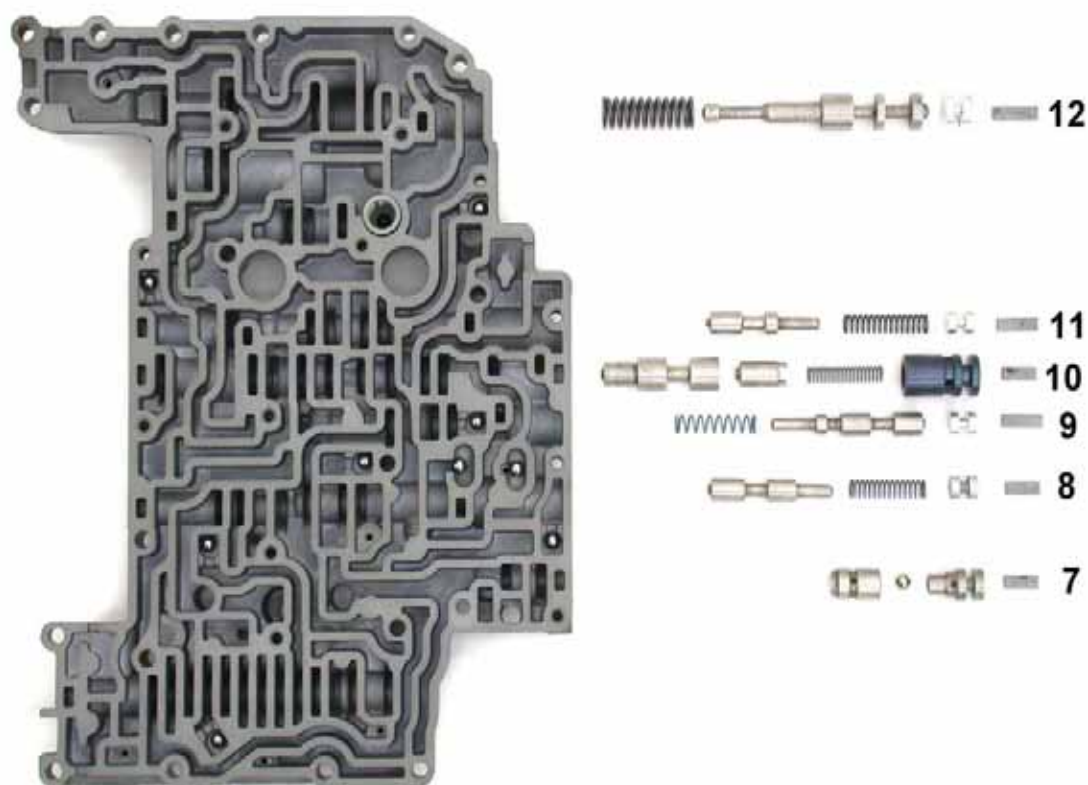


ID	Description
1	2-3 Shift Valve
2	Orifice control Valve
3	Accumulator Control Valve
4	Lock-Up Signal Valve
5	Reducing Valve
6	Throttle Valve

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Valve Body Exploded View (continued)

Upper Valve Body (continued)



ID	Description
7	Check Valve
8	Low Inhibitor Valve
9	Low coast Modulator Valve
10	Reverse Inhibitor Valve
11	Modulator Valve
12	Secondary Regulator Valve

450-43LE

Erratic TCC Operation

Missing Lock-Up control valve clip

The Lock-Up control valve clip may fall out during the disassembly of the valve body. Take extra measures during the reassembly to ensure the clip is installed correctly

Correct location and installation



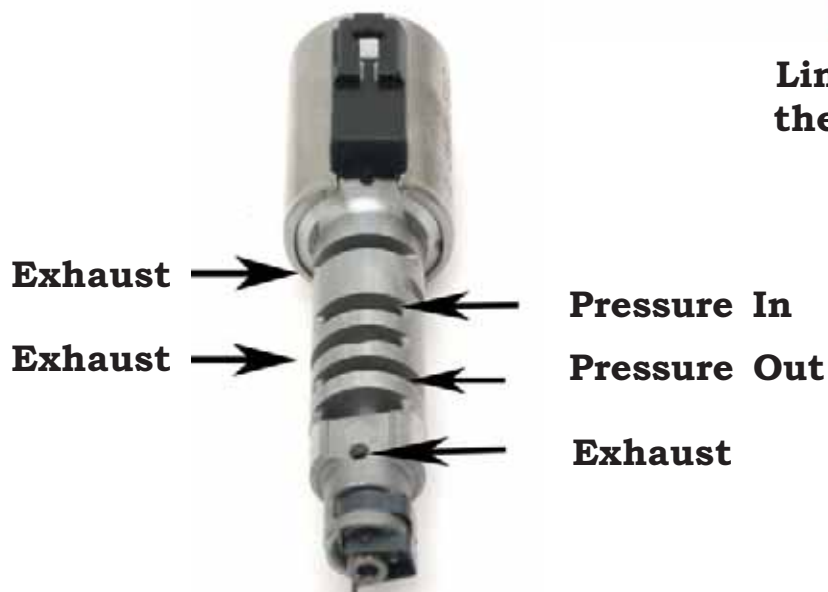
450-43LE

Low Line Pressure

The correct installation of the EPC solenoid is critical. The EPC should be facing the Lower valve body. If you're not sure about the location or installation, look inside the valve body bore. The lands will help you locate the correct position.



Line pressure from the regulator valve



NOTES:

Honda

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Civic CVT

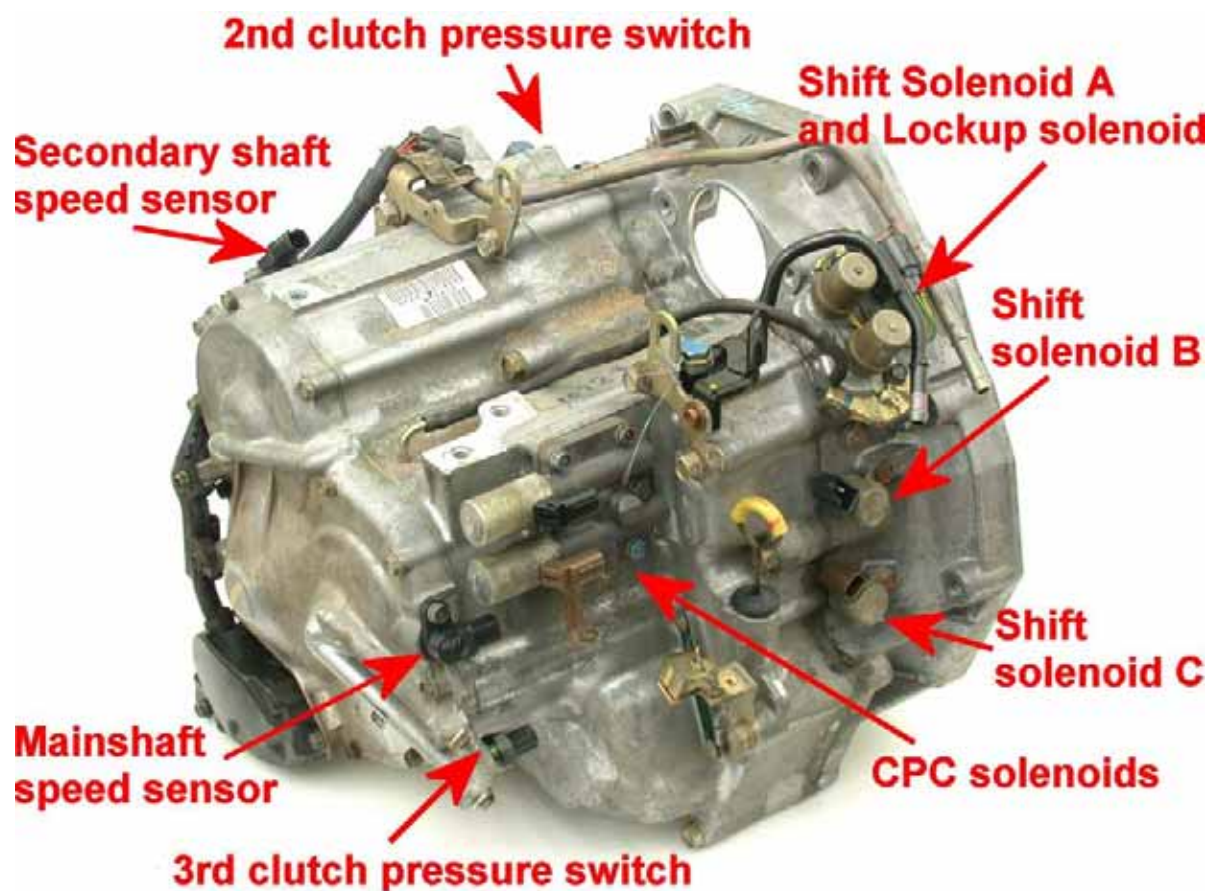
Valve Body and Solenoid ID..... 262

BAXA, MAXA, B7XA

4 Cylinder Unit

Component Identification

Below is an illustration showing various electrical components used in the BAXA, MAXA, and B7XA family transaxles used on 4 cylinder vehicles.

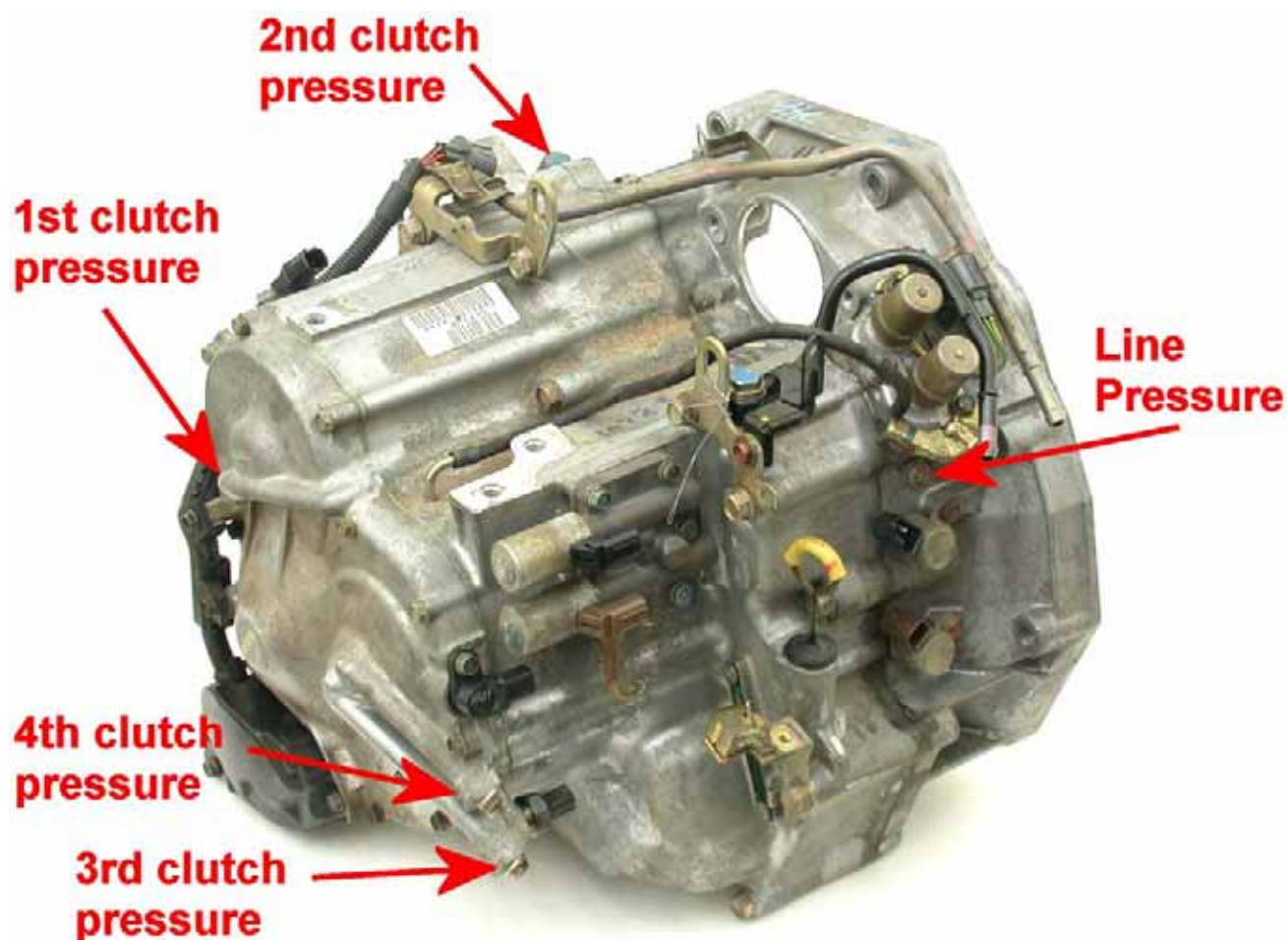


BAXA, MAXA, B7XA (continued)

4 Cylinder Unit

Pressure Taps

Pressure specifications are 120-130 psi. Line pressure will boost to approximately 300 psi at full throttle.

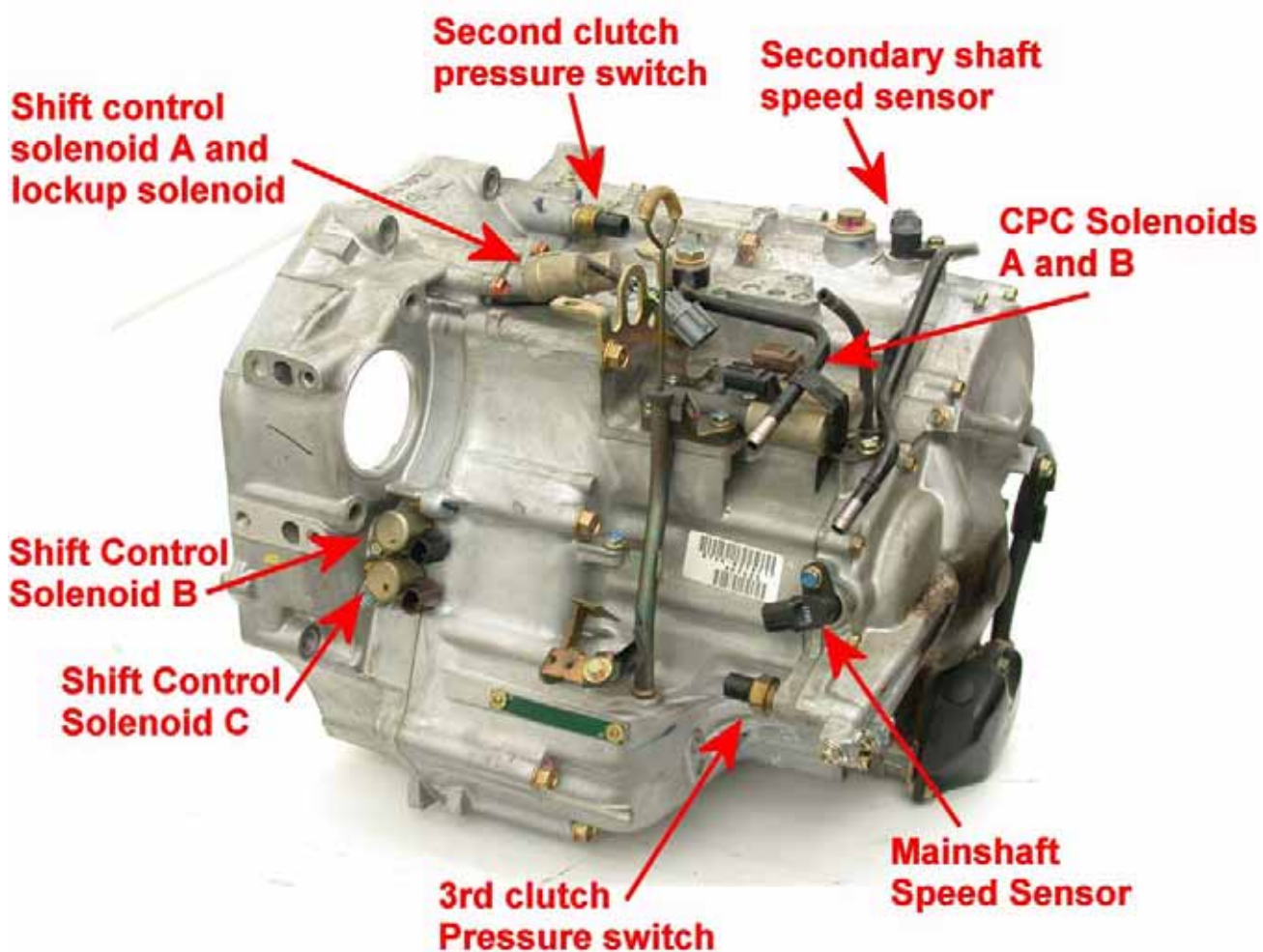


BAXA, MAXA, B7XA (continued)

V6 Unit

Component Identification

Below is an illustration showing various electrical components used in the BAXA, MAXA, and B7XA family transaxles used on V6 vehicles.

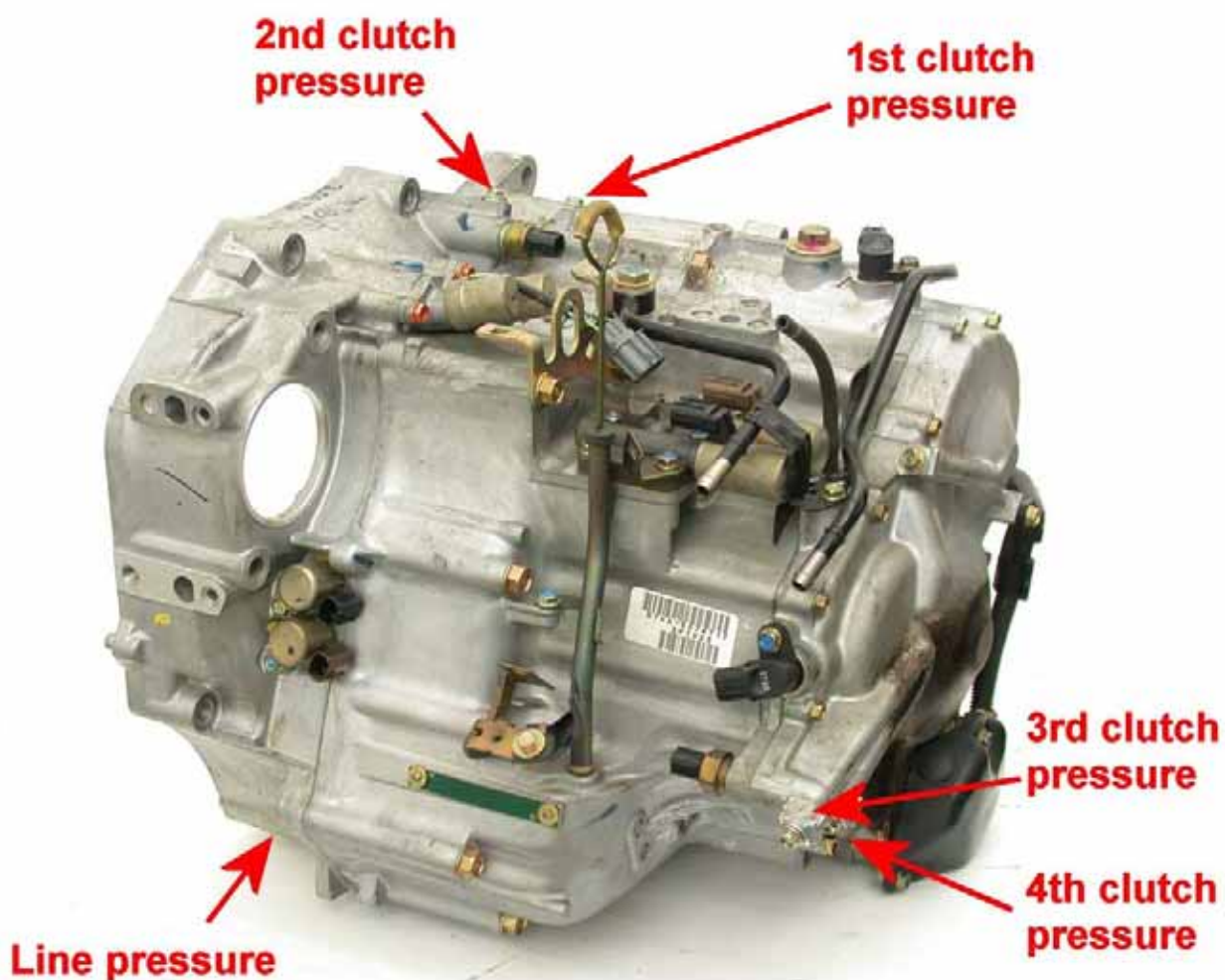


BAXA, MAXA, B7XA (continued)

V6 Unit

Pressure Taps

Pressure specifications are 120-130 psi. Line pressure will boost to approximately 300psi at full throttle.



BAXA, MAXA, B7XA *(continued)*

Erratic Shifts/Quality

Contamination CPC/Linear Solenoids

Many shift quality complaints including flares, harsh shifts, soft shifts, and engagement feel problems can be caused by contaminated CPC (Clutch Pressure Control) or Linear solenoids. Symptoms may be present only when cold. Normal flushing and cleaning of contaminated solenoids is usually not successful.



BAXA, MAXA, B7XA *(continued)*

Poor Shift Quality After Overhaul

The following can have a major effect on shift quality:

Fluid type, steel plate finish, and clutch material

Engine performance Adaptive learn: Make sure there are no DTC's , including engine codes.

Relearn Procedure

1. Start the engine and bring the transmission fluid temperature up to normal operating temperature of at least 104F°.
2. Turn the engine off and clear the codes.
3. Disconnect the battery. With both battery cables disconnected, touch them together, then turn on the headlights and press the brake pedal. Turn off lights, release the brake pedal, and reconnect battery.
4. Start the vehicle and let it idle until the cooling fan comes on.
5. As soon as the fan turns off let it idle in Park for one minute with the brake applied and all electrical accessories off.
6. Move the gear selector to the Drive position and let it idle for one minute with the brake applied and all electrical accessories off.
7. Road test the vehicle (do not drive with the wheels off of the ground). Accelerate lightly to 37 mph without exceeding 2400 rpm, then let it coast for five seconds (lift throttle).
8. Drive the vehicle at light throttle, automatically upshifting 1-2, 2-3, 3-4 and let it coast to a stop. Repeat this procedure four times.
9. Drive above 37 mph for five minutes.
10. Check for codes.

BAXA, MAXA, B7XA

Bindups, Erratic Shifting, Lugs Engine

A Bindup, Erratic shift and/or engine lugging may be caused by SSB and SSC harness connectors switched with CPC solenoid A and B harness connectors. Use wire colors to identify the correct harness connectors.

These wires may not be so easy to cross on a V6 unit, however you can cross the SSB and SSC solenoid wires; these connectors are the same.



4 cyl. model shown here

BAXA, MAXA, B7XA

Long or Delayed 1-2 Upshift

A Long/Delayed 1-2 upshift may be caused by a 2nd clutch pressure switch failure. This Switch is sensitive to moisture contamination, especially when it is unplugged. During disassembly of the transmission, do not expose this switches to water or moisture. Meaning, don't put it in the parts washer!

When testing the pressure switches, connect a digital volt/ohm meter to the switch leads. The readings will be either 0 ohms or open (infinite ohms). 0 ohms equals pressure below 36 psi, when the pressure rises above 36-40 psi the switch will open. It is very important that the switch opens and closes every time at the same pressure, if it does not, replace the switch.

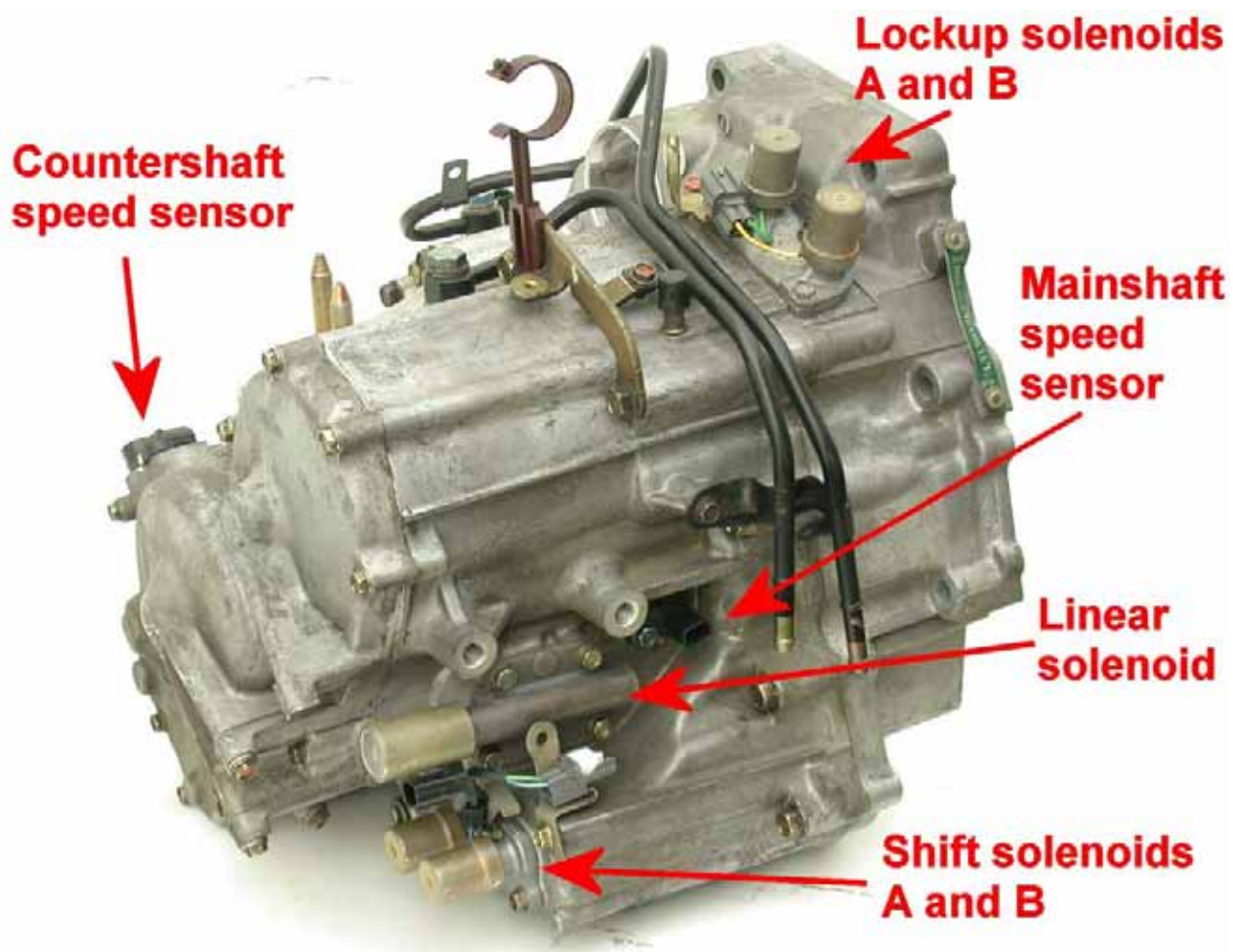
0 ohms = closed
Infinite ohms = open



A4RA, B4RA, M4RA

Identification

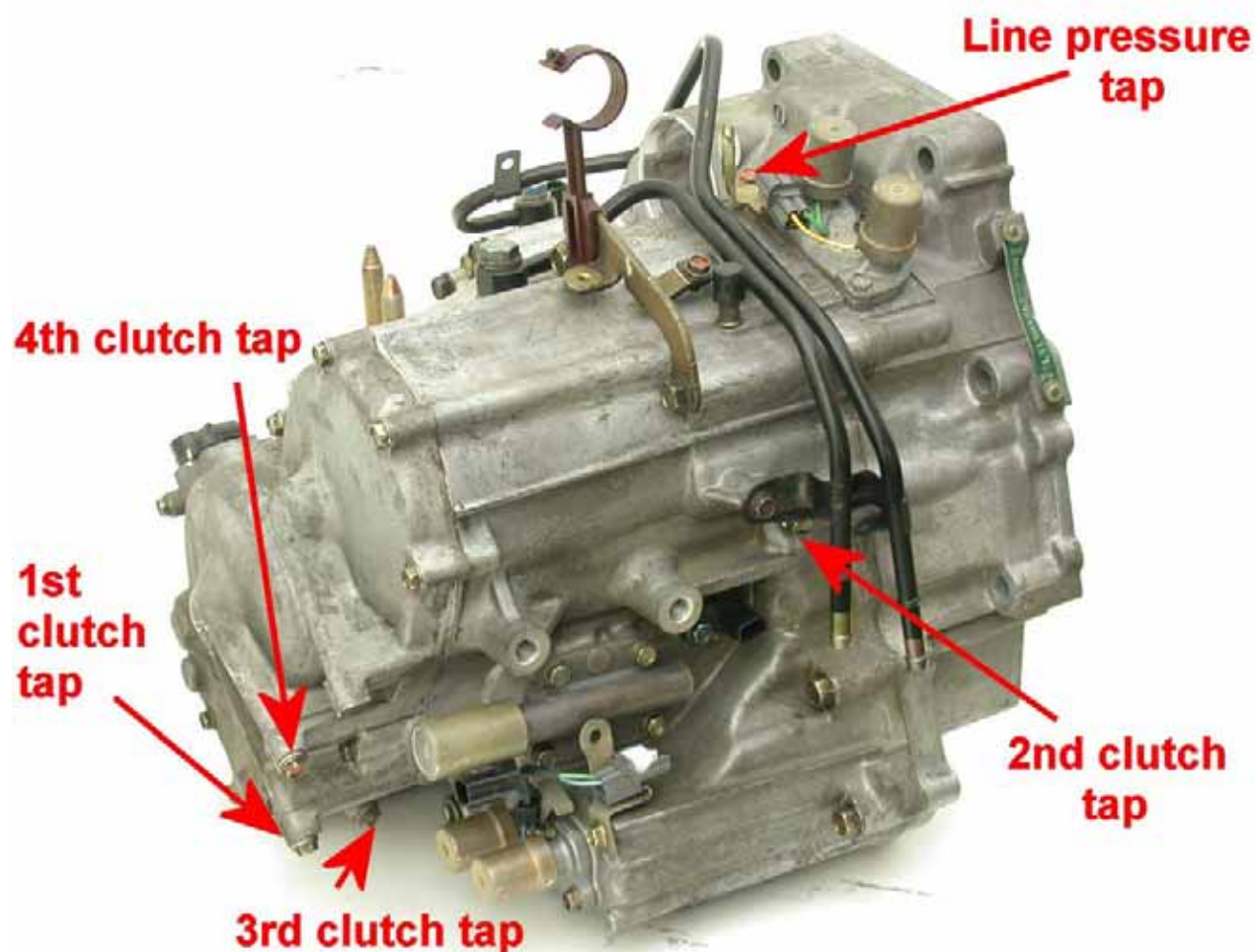
Identifying Honda transmission solenoids and switches can be difficult. Use the following pages to correctly identify them.



A4RA, B4RA, M4RA

Pressure Taps

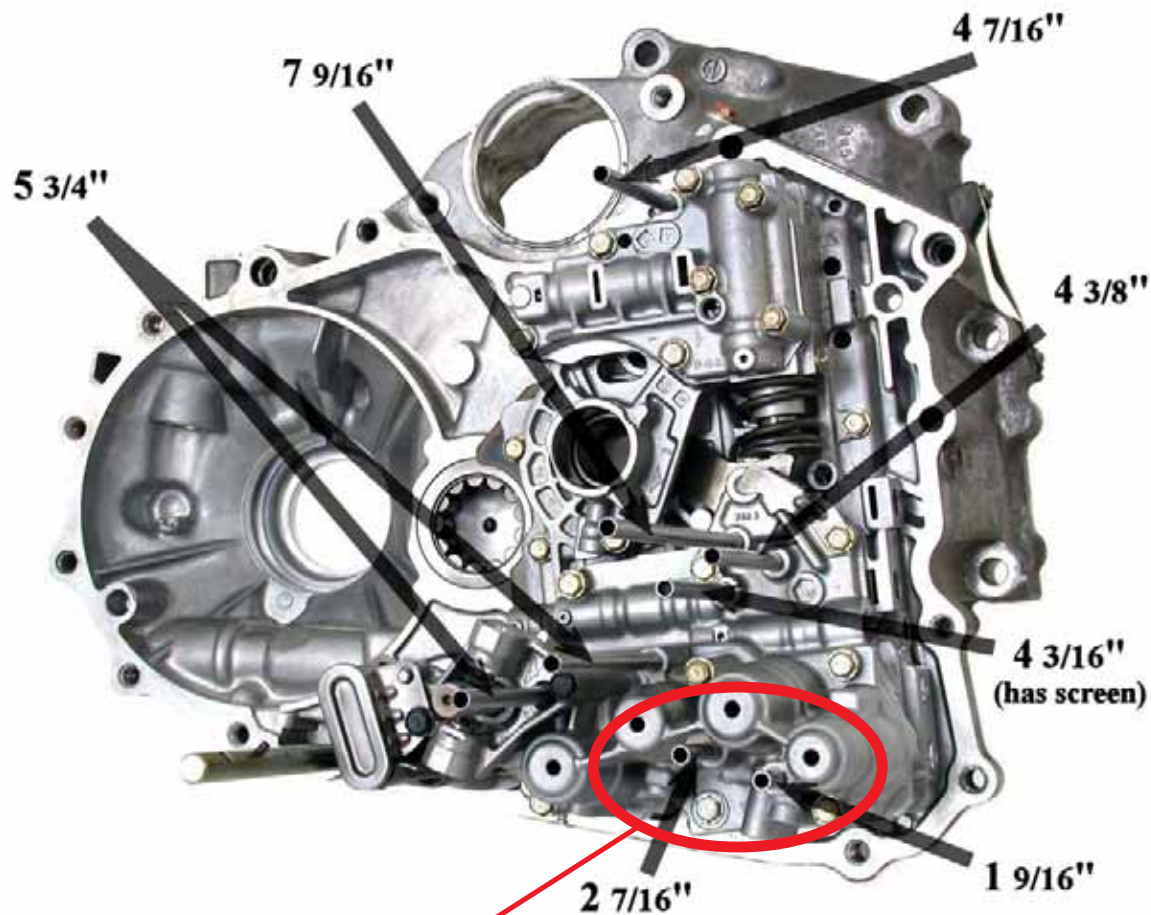
Pressure specifications are 120-130 psi. Line pressure will boost to approximately 300 psi at full throttle.



A4RA, B4RA, M4RA

Wrong Gear Starts with 2nd and 3rd Gear Only, Mainshaft Speed Sensor Code (P0715)

Shift solenoid feed pipes incorrectly installed may cause a number of shift concerns including; wrong gear starts or no first no fourth. Use the diagram below for correct length and location of the feed pipes.



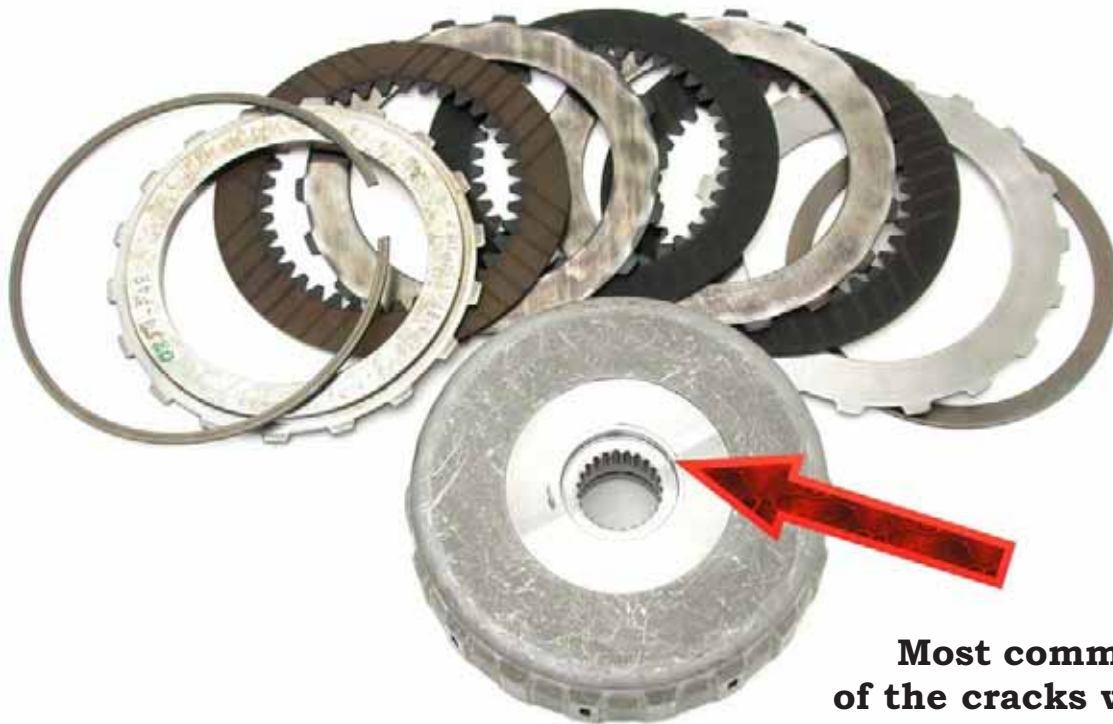
Shift solenoid feed pipes

A4RA, B4RA, M4RA

Cracked 1st Clutch Drum

A cracked 1st clutch drum can cause a number of different concerns. These concerns may be: Slipping in D on takeoff, OK after 1-2 shift, falls out of gear at a stop, no forward engagement, 1st clutch failure. These symptoms usually get worse as the transmission warms up.

Carefully inspect the drum on every one of these units. Many times a crack can be difficult to see.



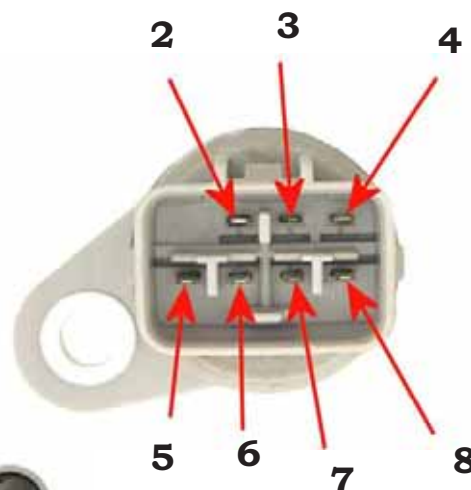
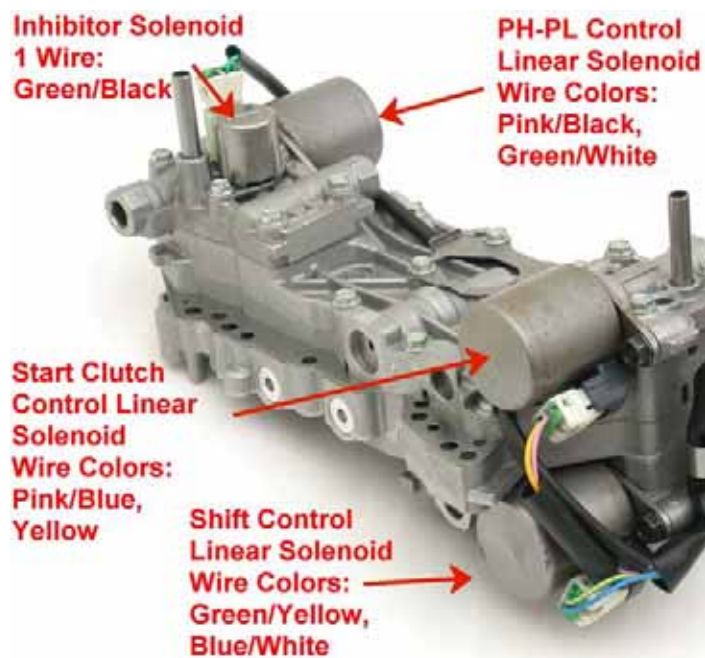
**Most common area
of the cracks will be
seen here.**

Civic CVT

Valve Body and Solenoids

Solenoid identification and wire colors.

Solenoid:	Measure between:	Resistance spec:
Shift Control Linear Solenoid	Terminals 3 and 7	3.8 to 6.8 ohms
PH-PL Linear Solenoid	Terminals 2 and 6	3.8 to 6.8 ohms
Start Clutch Control Linear Solenoid	Terminals 4 and 8	3.8 to 6.8 ohms
Inhibitor Solenoid	Terminal 5 and the valve body	11.7 to 21.0 ohms



NOTES:

ZF5HP19FL

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ZF5HP19FL

Transmission Identification

Identifying the ZF transmission tag is easy. The tag refers directly to the model of the transmission. It will also give you a part number to references.



This transmission is from an Audi

ZF5HP19FL

Application and General Information

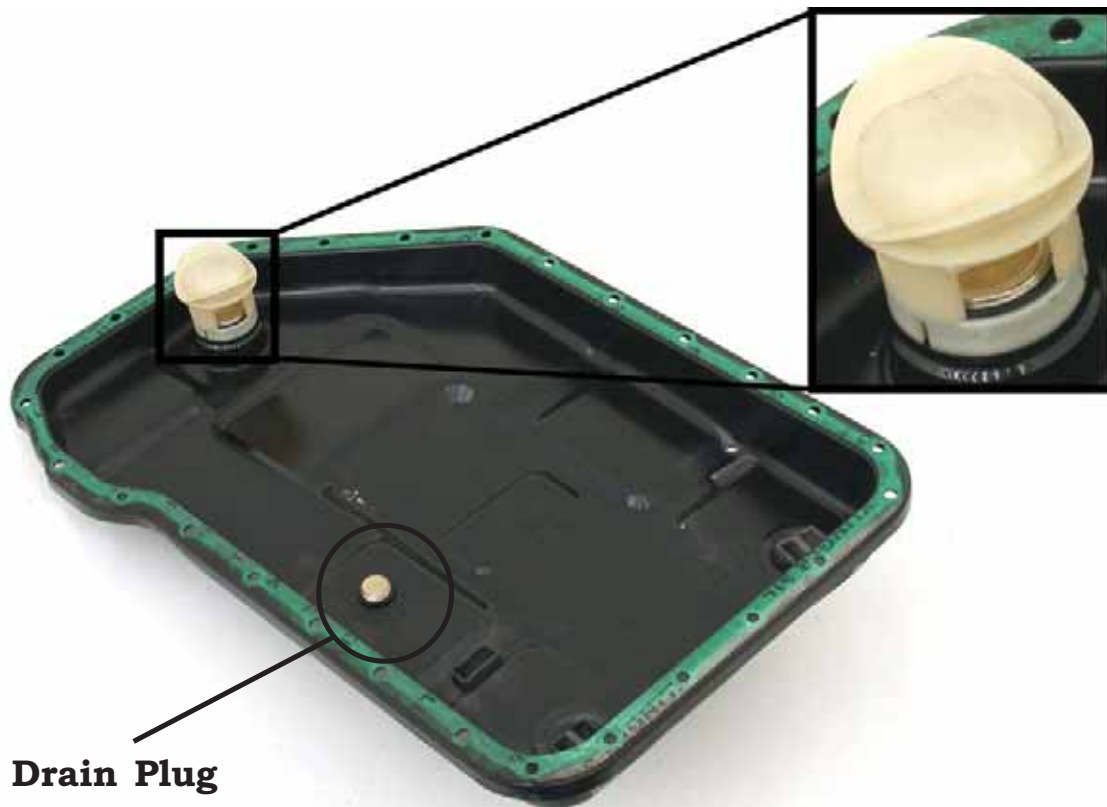
01V Transmissions				
Trans Code Letters		DRD	DSS	EBD
Date Manufactured		Apr-97	May-97	01/99-08/00
Vehicle		98-up Passat		
Engine		2.8L	2.8L	1.8L
Converter codes		F31	F31	M28
Transmission Ratios	1 st	3.665:1		
	2 nd	1.999:1		
	3 rd	1.407:1		
	4 th	1.000:1		
	5 th	0.742:1		
	Reverse	4.096:1		
Intermediate Drive Teeth & Ratios	Input	29	29	29
	Output	35	29	35
	Ratio	1.207:1	1.000:1	1.207:1
Final Drive Teeth & Ratios	Pinion	11	11	11
	Ring	30	34	30
	Ratio	2.727:1	3.091:1	2.727:1
Bus Data		Yes	Yes	No
Hydraulic Control		E17	E17	E18/2

*** VW models only**

ZF5HP19FL

Oil Pan and Fill Hole

The ZF5HP19FL unit is a Fill for Life fluid. The pan holds 2.7-3.2 quarts of oil and a complete refill will hold 9.5 quarts of oil. Fill the transmission with the engine idling and the transmission in park. The oil temperature must be between 95 °F and 115 °F.



ZF5HP19FL

Clutch and Band Application Chart

E17 Models

Position/Gear	Solenoid Valves							Clutches				Brakes			Freewheel
	N88	N89	N90	N91	N92	N93	N94	A	B	E	F	C	D	G	1 ST Gear
Reverse	X			X		X			X				X	X	
Neutral	X	X		X		X					X			X	
D/1 st	X	X		X		X		X						X	X
D/2 nd	X	X		X	X	X		X				X		X	
D/3 rd		X	X	X	X			X			X	X			
D/4 th			X	X				X		X	X				
D/5 th	X		X	X	X					X	X	X			
2/1 st	X			X		X		X					X	X	X
D/5 th -4 th	X		X	X	X		X	(X)		X	X	(X)			

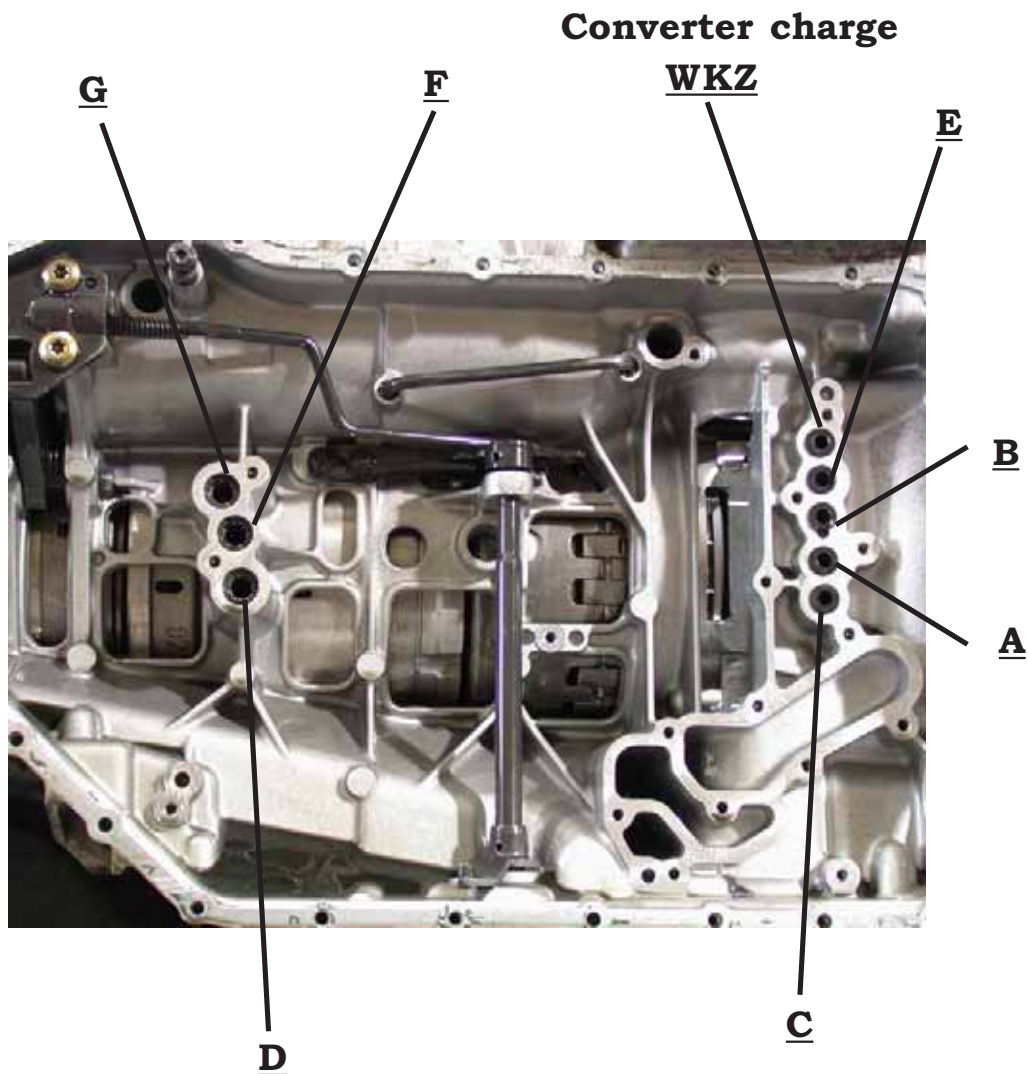
E18 Models

Position/Gear	Solenoids							Clutches							
	Solenoid Valves				Pressure Regulating			Clutches				Brakes			Freewheel
	N88	N89	N90	N215	N216	N217	N218	A	B	E	F	C	D	G	1 ST Gear
Reverse	X			X		X			X				X	X	
	X	X		X		X					X			X	
D/1 st	X	X		X		X		X						X	X
D/2 nd	X	X		X	X	X		X				X		X	
D/3 rd		X	X	X	X			X			X	X			
D/4 th			X	X				X		X	X				
D/5 th	X		X	X	X					X	X	X			
2/1 st	X			X		X		X					X	X	X
D/5 th -4 th	X		X	X	X		X	(X)		X	X	(X)			

ZF5HP19FL

Air Checking the Case

When air checking a case to clutch application, use regulated air pressure at approximately 30 psi.



ZF5HP19FL

Front Seal and Oil Deflector

When dissassembling the pump assembly, you can choose to remove the oil deflector or simply stake it in to place. In some cases the oil deflector becomes loose and can cause the pump bushing to jar loose and spin in the housing. This can cause severe damage to the hub and seal.

**Remove oil deflector or
stake it in place**

Front Bushing Wear



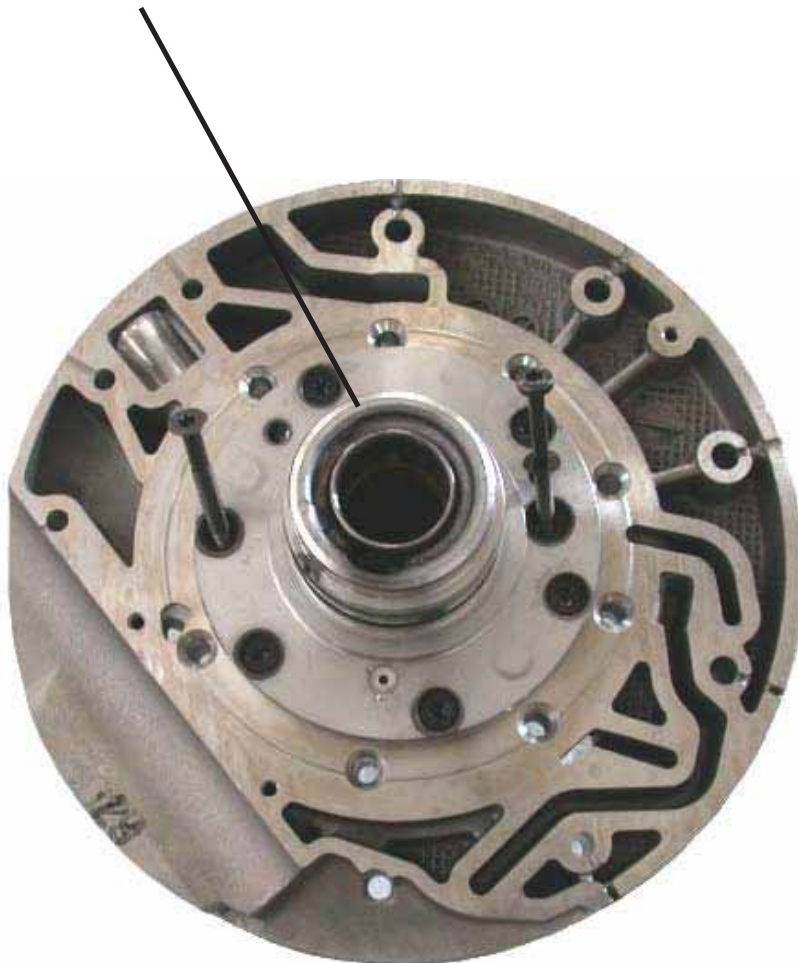
**Possible front seal leak due
to the oil deflector becoming
loose and damaging the seal**



ZF5HP19FL

Pump Disassembly

Look here for bushing wear.



This alignment dowel is used to align the pump halves. VERY IMPORTANT not to lose it.

ZF5HP19FL

Pump Disassembly (continued)

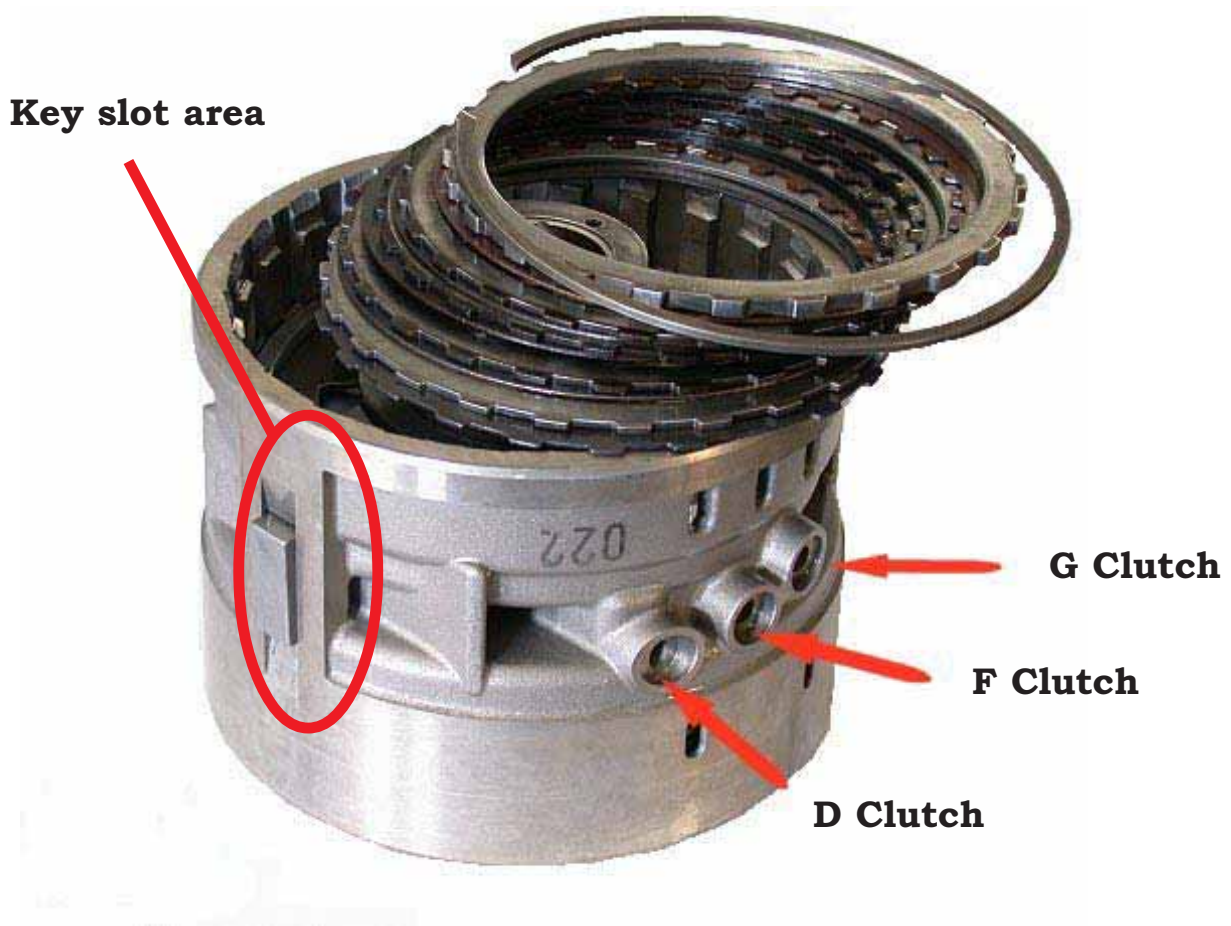


ZF5HP19FL

D Clutch Failure, No Reverse

The rear clutch support housing can become damaged at the key slot area. During disassembly pay close attention to the key slot area. It may be necessary to replace the drum assembly.

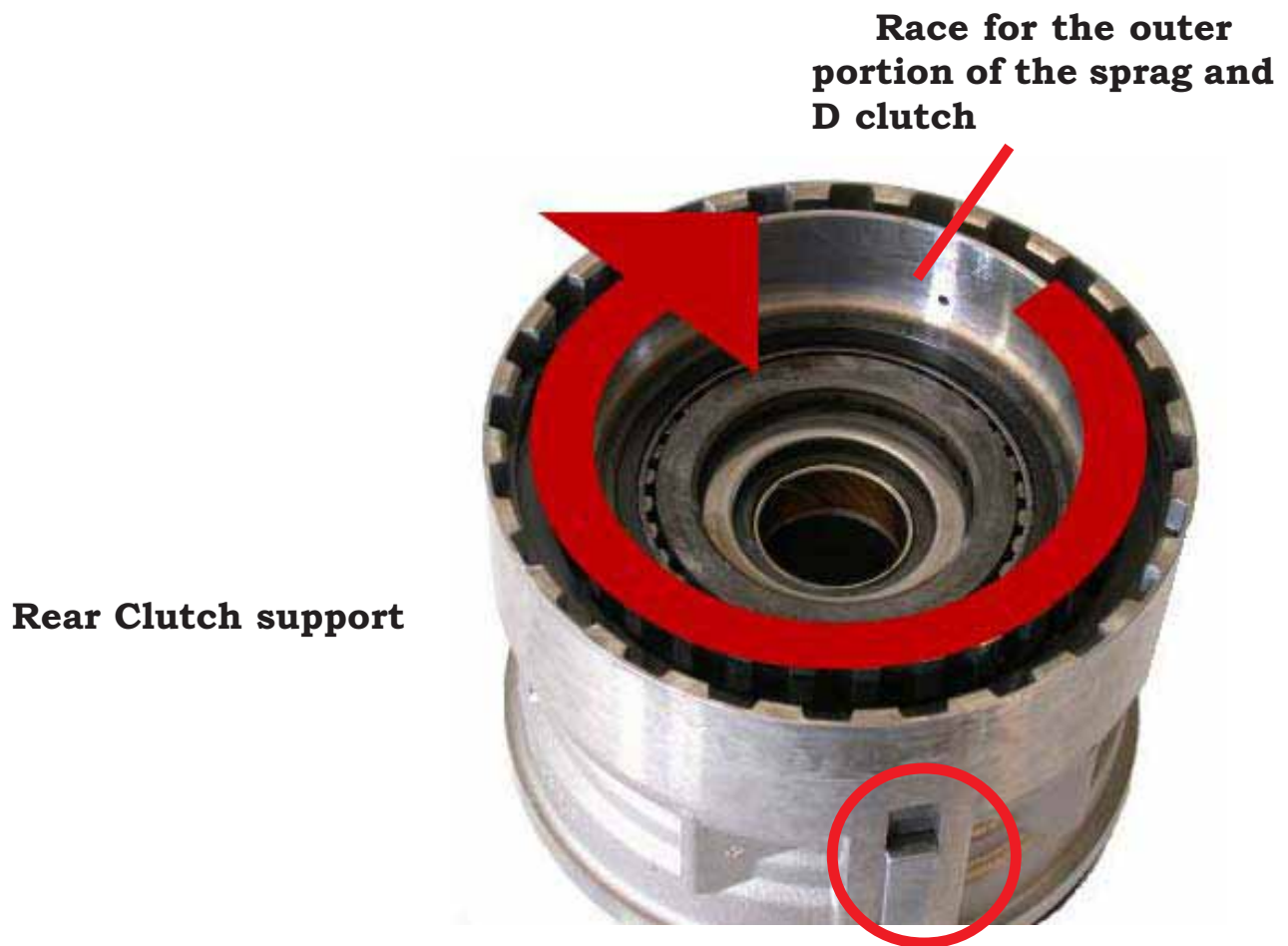
Note: Also check the case for slot wear.



ZF5HP19FL

Sprag Rotation

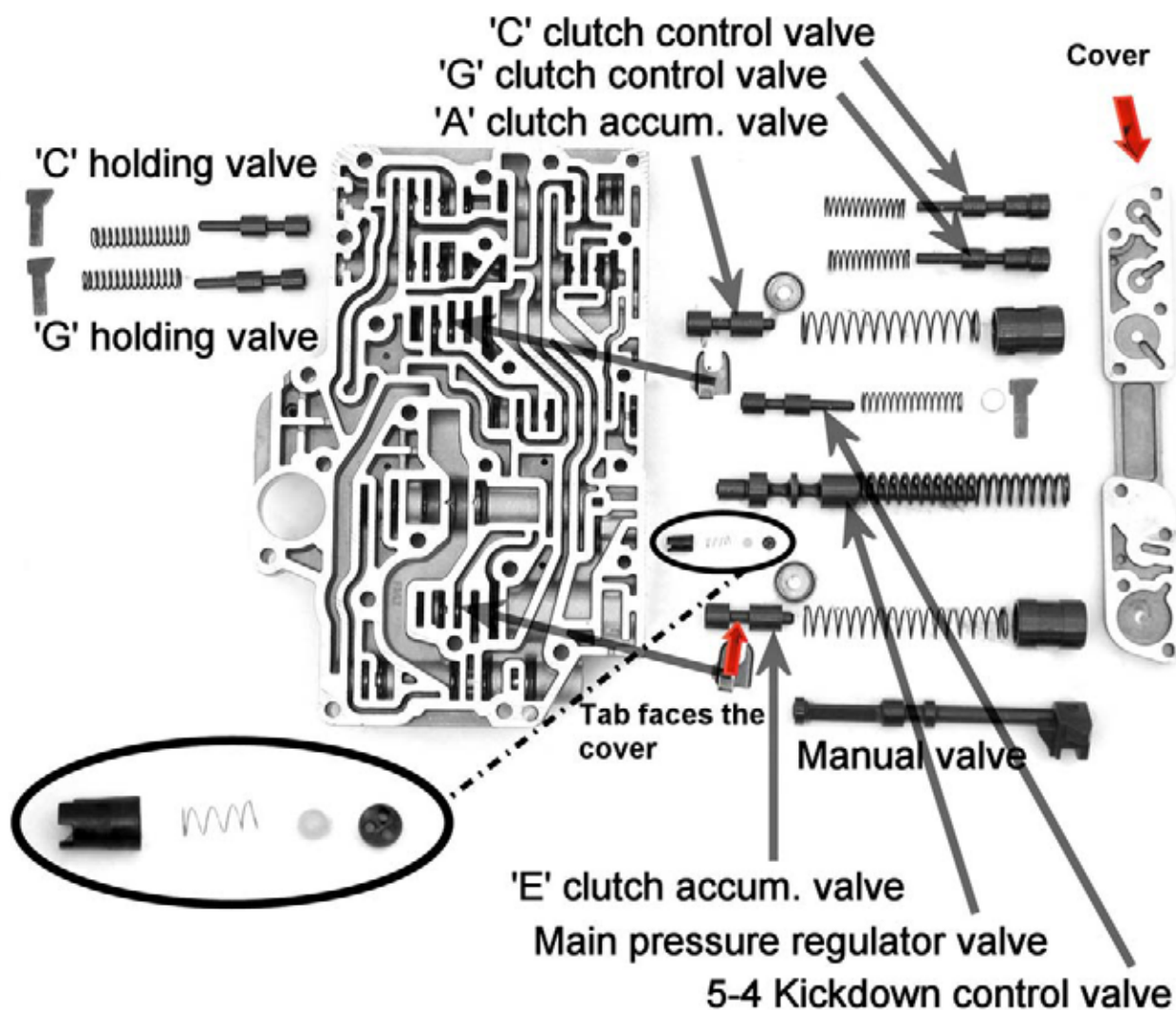
The sprag is viewed from the front of the case.



The support locks into the case using the outer key of the drum.

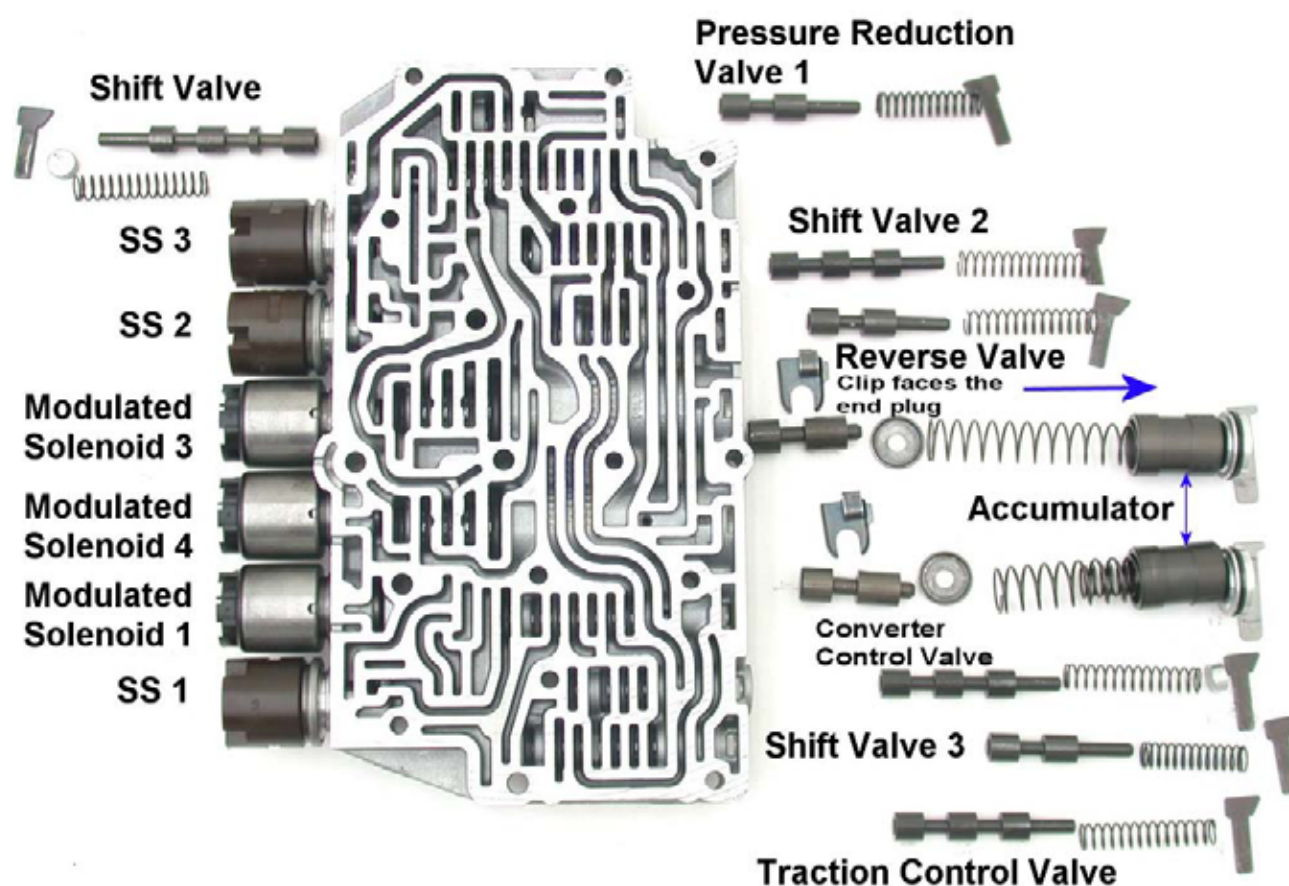
ZF5HP19FL

Main Valve Body Housing



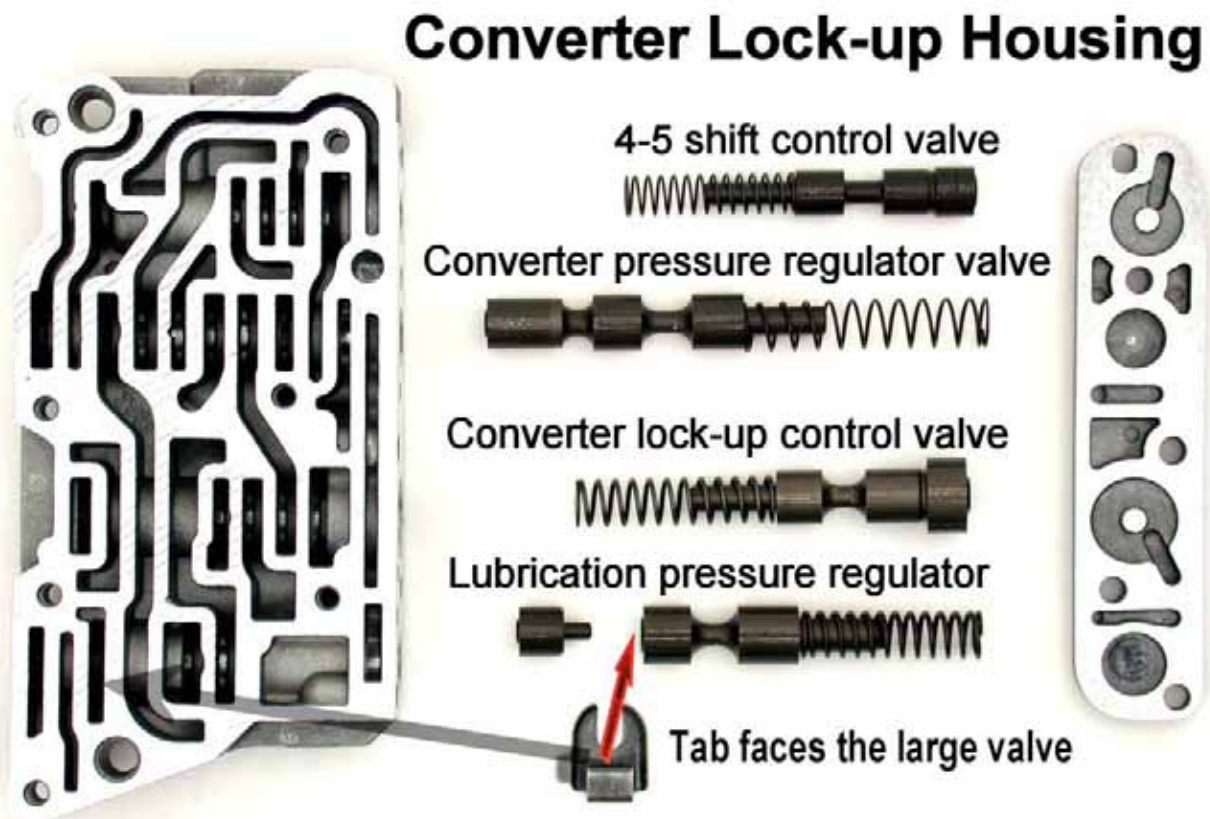
ZF5HP19FL

Main Valve Body Housing (continued)



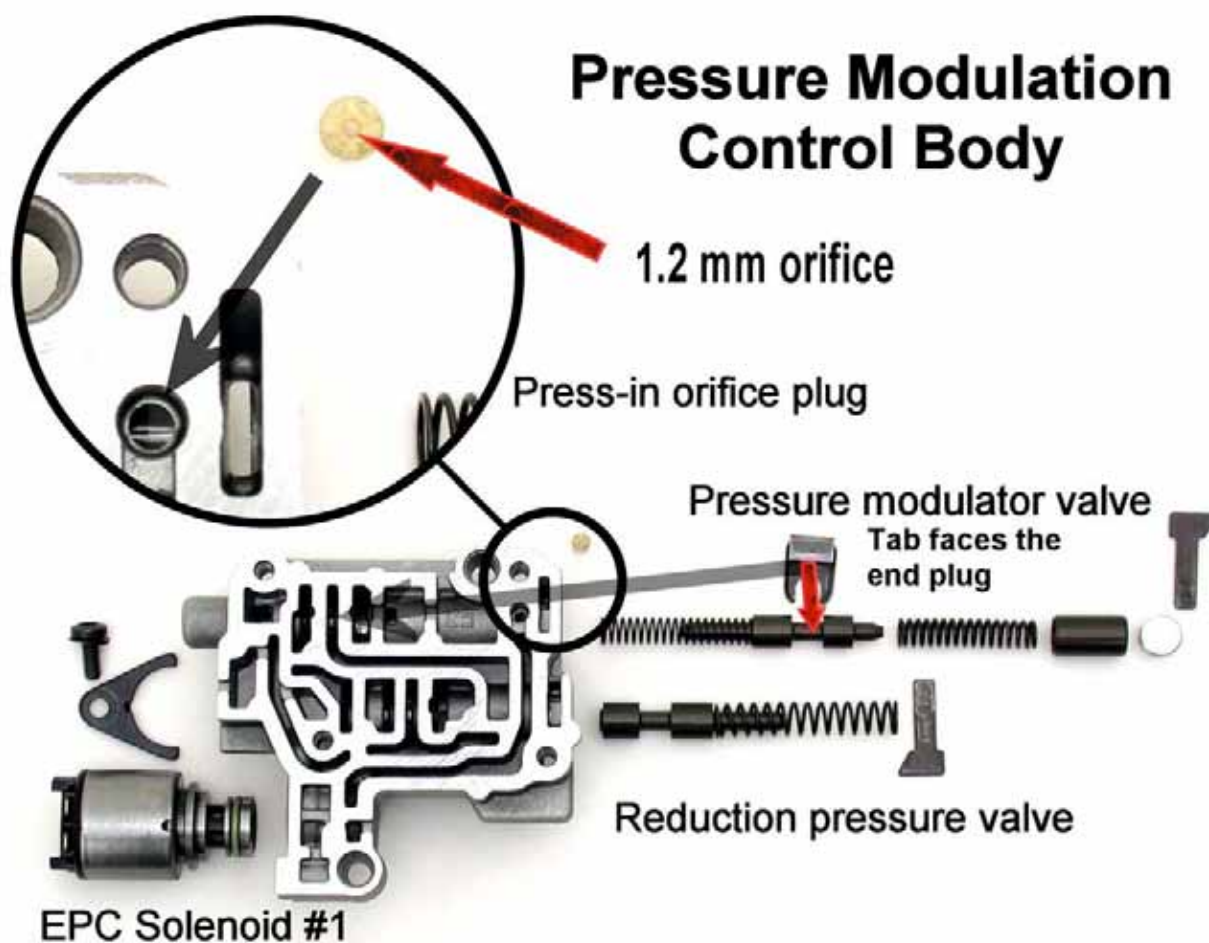
ZF5HP19FL

Converter Lock-up Housing



ZF5HP19FL

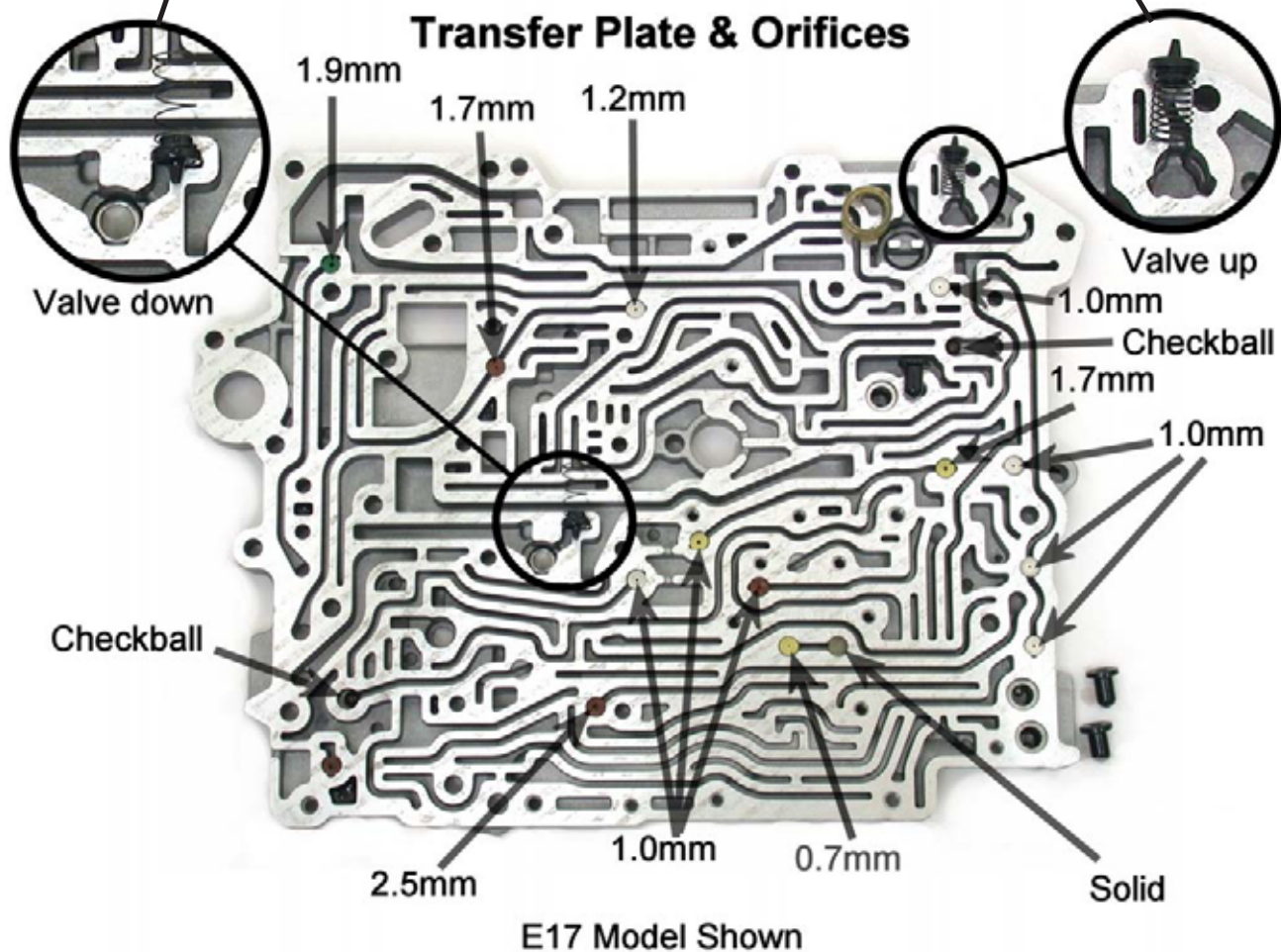
Pressure Modulation Control Body



ZF5HP19FL

Transfer Plate and Orifices

NOTE: Later units and service updates use a flat disc



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Conversion Tables

Area		
Multiply	By	To Obtain
in ²	645.2	mm ²
in ²	6.452	cm ²
in ²	0.0069	Ft ²
Ft ²	0.0929	m ²
Ft ²	144.0	in ²
m ²	10.764	Ft ²
cm ²	0.155	in ²
mm ²	0.00155	in ²
area of a circle = πr^2 area of a cylinder = $\pi r^2 h$		
$\pi = 3.14$ $r = \text{Radius}$ $h = \text{Height}$		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Continued...

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

* The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

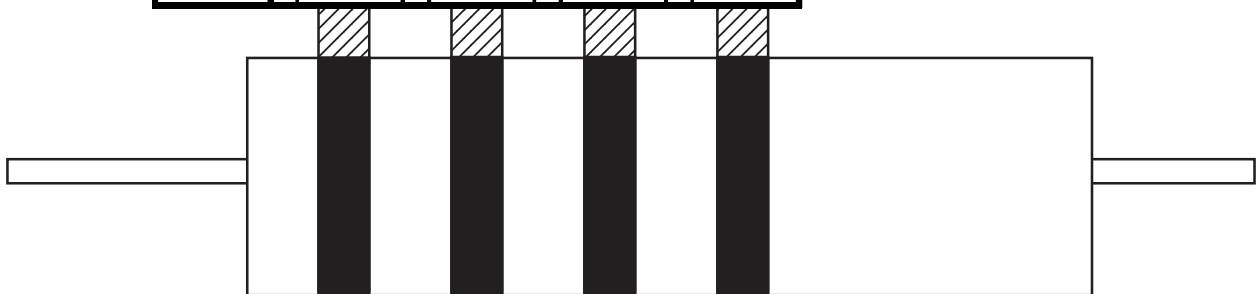
Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	0	—
Brown	1	1	1	—
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Brown	—	—	—	1%
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%

**Brown
1%**



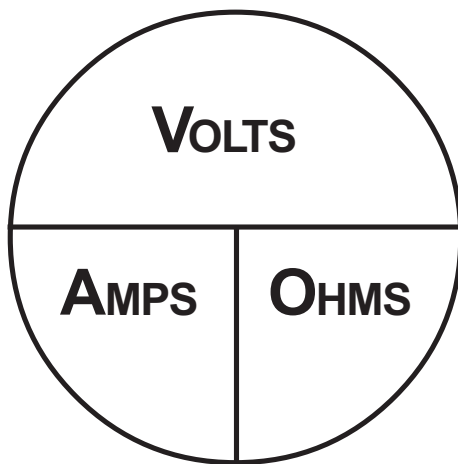
So if the bands are:

Blue 6 Green 5 Yellow 0,000 Silver $\pm 10\%$ = 650 k Ω , $\pm 10\%$

Red 2 Violet 7 Brown 0 Gold $\pm 5\%$ = 270 Ω , $\pm 5\%$

White 9 Orange 3 Violet 0,000,000 Plain $\pm 20\%$ = 930 M Ω , $\pm 20\%$

Ohm's Law



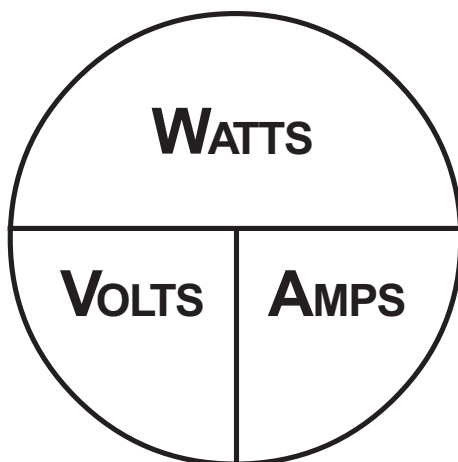
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

Multiple Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

Schematic Symbols

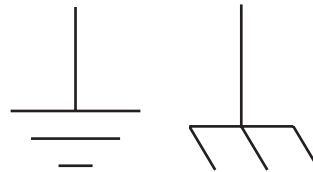


Battery

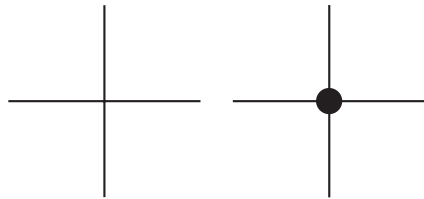
+V



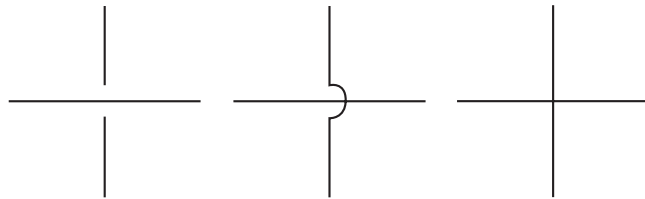
Power



Ground



Connected Wires



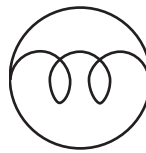
Unconnected Wires



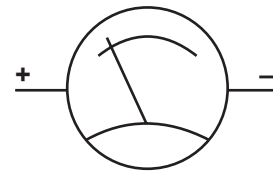
Fuse



Circuit Breaker



Bulb

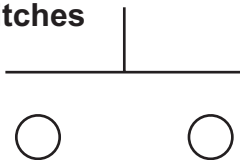


Meter

Pushbutton Switches



NC Switch

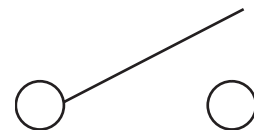


NO Switch

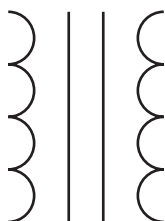
On/Off Switches



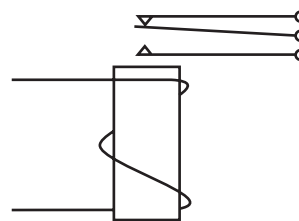
NC Switch



NO Switch



Transformer (Coil)



Relay

Schematic Symbols (continued)



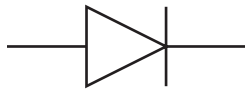
Fixed Resistor



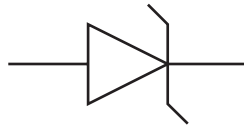
Variable Resistor



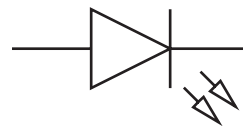
Potentiometer



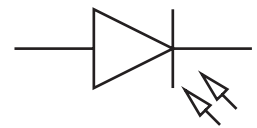
Diode



Zener Diode



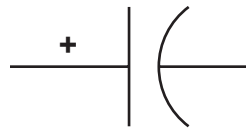
LED



Photodiode



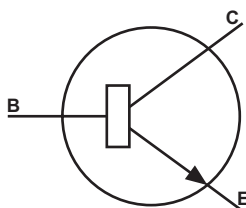
Fixed Capacitor



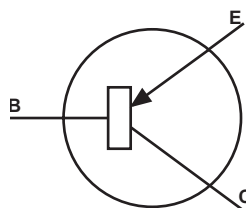
Fixed Capacitor (Polarized)



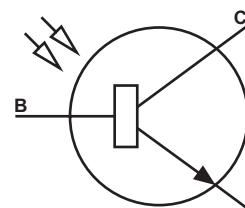
Variable Capacitor



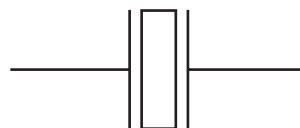
NPN Transistor



PNP Transistor



Phototransistor



Crystal

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates

that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition systems.

Continued...

Glossary of Electrical Terms (cont)

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical

circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific

Continued...

Glossary of Electrical Terms (cont)

direction, or the LED won't light.

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm's Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). Ohms x Amps = Volts; Volts ÷ Ohms = Amps; Volts ÷ Amps = Ohms.

Open Circuit — An incomplete electrical path that won't provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won't operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component's operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won't prevent the other legs from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the

voltage signal, based on its position along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device control-

Continued...

Glossary of Electrical Terms (cont)

ling the circuit.

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kHz	Kilohertz
AC	Alternating current	kV	Kilovolt
B, b	Base electrode, units with single	kW	Kilowatt
base		kWH	Kilowatt hour
°C	Degrees Celsius or centigrade	lb	Pound
C	Capacitance, capacitor	M	Mega; x1,000,000
C, c	Collector electrode	m	Milli; one-one thousandth; 1/1000;
cm	Centimeter	0.001	
cu	Cubic	mf, mfd	Microfarad
db	Decibels	MHz	Megahertz
DC	Direct current	mm	Millimeter
dm	Decimeter	NC	Normally closed
DPDT	Double-pole, double-throw switch	Nm	Newton-meter
DPST	Double-pole, single-throw switch	NO	Normally open
E, e	Emitter electrode	R	Resistance; resistor
E, e	Voltage	SPDT	Single-pole, double-throw switch
mf	Microfarad	SPST	Single-pole, single-throw switch
°F	Degrees Fahrenheit	t	Time
F, f	Frequency	T	Temperature
flu	Fluid	V, v	Volt; voltmeter
FM	Frequency modulation	V _{BB}	Base supply voltage (DC)
g	Gram	V _{BC}	Base-to-collector voltage (DC)
gnd, grd	Ground	V _{BE}	Base-to-emitter voltage (DC)
Hg	Mercury	V _{CB}	Collector-to-base voltage (DC)
Hz	Hertz	V _{CC}	Collector supply voltage (DC)
I	Current	V _{CE}	Collector-to-emitter voltage (DC)
I _B	Base current (DC)	V _{EB}	Emitter-to-base voltage (DC)
I _C	Collector current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _E	Emitter current (DC)	v _{ee}	Emitter supply voltage (DC)
k	x1000	v _F	Forward voltage (DC)
kg	Kilograms	W	Watt; work
		w	Watt
		wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	$\frac{1}{128}$	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	$\frac{15}{128}$	2.9769		
0.0156	$\frac{1}{16}$	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	$\frac{1}{8}$	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	$\frac{17}{128}$	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	$\frac{3}{128}$	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	$\frac{9}{64}$	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	$\frac{3}{16}$ -24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	$\frac{1}{32}$	0.7925			0.1484	$\frac{19}{128}$	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	$\frac{5}{32}$	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	$\frac{3}{16}$ -32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	$\frac{5}{128}$	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	$\frac{21}{128}$	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	$\frac{3}{64}$	1.1913		0-80 NF	0.1719	$\frac{11}{64}$	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	$\frac{7}{128}$	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	$\frac{23}{128}$	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1653		4.2000		5.5mm - 0.80
0.0625	$\frac{1}{16}$	1.5875			0.1820		4.6228	14	12-28 NF
0.0635		1.6129	52		0.1850		4.6990	13	12-32 NEF
0.0670		1.7018	51		0.1875	$\frac{3}{16}$	4.7625		
0.0700	$\frac{9}{128}$	1.7780	50	2-56 NC 2-64 NF	0.1890		4.8006	12	
					0.1910		4.8514	11	
0.0730		1.8542	49		0.1935		4.9149	10	14-20 NS
0.0760		1.9304	48		0.1953	$\frac{25}{128}$	4.9606		
0.0781	$\frac{5}{64}$	1.9837			0.1960		4.9784	9	
0.0785		1.9939	47	3-48 NC	0.1990		5.0546	8	
0.0810		2.0574	46		0.2010		5.1054	7	$\frac{1}{4}$ -20 NC
0.0820		2.0828	45	3-56 NF					14-24 NS
0.0860	$\frac{11}{128}$	2.1844	44	4-36 NS	0.2031	$\frac{13}{64}$	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	$\frac{3}{32}$	2.3825		$\frac{1}{8}$ -32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	$\frac{1}{4}$ -24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	$\frac{27}{128}$	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	$\frac{1}{4}$ -28 NF
0.1015		2.5781	38	$\frac{1}{8}$ -40NF 5-40NC	0.2188	$\frac{7}{32}$	5.5575		$\frac{1}{4}$ -32 NEF
					0.2210		5.6134	2	
0.1016	$\frac{13}{128}$	2.5806			0.2266	$\frac{29}{128}$	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	$\frac{1}{4}$ -40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	$\frac{7}{64}$	2.7788			0.2344	$\frac{15}{64}$	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	²⁹ / ₆₄	11.5087		¹ / ₂ -20 NF
0.2422	³¹ / ₁₂₈	6.1519							¹ / ₂ -24 NS
0.2460		6.2484	D		0.4609	⁵⁹ / ₁₂₈	11.7069		
0.2500	¹ / ₄	6.3500	E		0.4688	¹⁵ / ₃₂	11.9075		
0.2570		6.5278	F	⁵ / ₁₆ -18 NC	0.4766	⁶¹ / ₁₂₈	12.1056		
0.2578	³³ / ₁₂₈	6.5481			0.4800		12.1920		14mm - 2.00
0.2610		6.6294	G		0.4844	³¹ / ₆₄	12.3038		⁹ / ₁₆ -12 NC
0.2656	¹⁷ / ₆₄	6.7462			0.4922	⁶³ / ₁₂₈	12.5019		
0.2660		6.7564	H		0.5000	¹ / ₂	12.7000		14mm - 1.50
0.2720		6.9088	I	8mm - 1.25	0.5039		12.8000		14mm - 1.25
				⁵ / ₁₆ -24 NF	0.5156	³³ / ₆₄	13.0962		⁹ / ₁₆ -18 NF
0.2734	³⁵ / ₁₂₈	6.9444			0.5312	¹⁷ / ₃₂	13.0962		⁵ / ₈ -11 NC
0.2770		7.0358	J		0.5469	³⁵ / ₆₄	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	⁹ / ₁₆	14.2875		
0.2813	⁹ / ₃₂	7.1450		⁵ / ₁₆ -32 NEF	0.5781	³⁷ / ₆₄	14.6837		⁵ / ₈ -18NF
0.2891	³⁷ / ₁₂₈	7.3431							³/₈-18NPT
0.2900		7.3660	L		0.5787		14.7000		16mm - 1.50
0.2950		7.4930	M		0.5938	¹⁹ / ₃₂	15.0825		¹¹ / ₁₆ -11 NS
0.2969	¹⁹ / ₆₄	7.5413			0.6094	³⁹ / ₆₄	15.4788		
0.3020		7.6708	N		0.6220		15.8000		18mm - 2.50
0.3047	³⁹ / ₁₂₈	7.7394			0.6250	⁵ / ₈	15.8750		¹¹ / ₁₆ -16 NS
0.3110		7.8994		9mm - 1.25	0.6406	⁴¹ / ₆₄	16.2712		
0.3125	⁵ / ₁₆	7.9375		³ / ₈ -16 NC	0.6562	²¹ / ₃₂	16.6675		³ / ₄ -10 NC
0.3160		8.0264	O		0.6614		16.8000		18mm - 1.50
0.3190		8.1026		9mm - 1.00	0.6719	⁴³ / ₆₄	17.0663		
0.3203	⁴¹ / ₁₂₈	8.1356			0.6875	¹¹ / ₁₆	17.4625		³ / ₄ -16NF
0.3230		8.2042	P		0.7008		17.8000		20mm - 2.50
0.3270		8.3058		9mm - 0.75	0.7031	⁴⁵ / ₆₄			¹/₂-14 NPT
0.3281	²¹ / ₆₄	8.3337			0.7187	²³ / ₃₂			
0.3320		8.4328	Q	³ / ₈ -24 NF	0.7344	⁴⁷ / ₆₄			
0.3359	⁴³ / ₁₂₈	8.5319			0.7500	³ / ₄			
0.3390		8.6106	R	¹/₈-27 NPT	0.7656	⁴⁹ / ₆₄			⁷ / ₈ -9 NC
0.3430		8.7122		10mm - 1.50	0.7812	²⁵ / ₃₂			
0.3438	¹¹ / ₃₂	8.7325			0.7969	⁵¹ / ₆₄			
0.3480		8.8392	S		0.8125	¹³ / ₁₆			⁷ / ₈ -14 NF
0.3500		8.8900		10mm - 1.25	0.8228		20.9000		22mm - 1.50
0.3516	⁴⁵ / ₁₂₈	8.9306			0.8281	⁵³ / ₆₄			⁷ / ₈ -18 NS
0.3580		9.0932	T	10mm - 1.0	0.8425		21.4000		24mm - 3.00
0.3594	²³ / ₆₄	9.1288			0.8437	²⁷ / ₃₂			
0.3672	⁴⁷ / ₁₂₈	9.3269			0.8594	⁵⁵ / ₆₄			
0.3680		9.3472	U	⁷ / ₁₆ -14 NC	0.8750	⁷ / ₈			1-8 NC
0.3750	³ / ₈	9.5250			0.8779		22.3000		24mm - 2.00
0.3770		9.5758	V		0.8906	⁵⁷ / ₆₄			
0.3820		9.7028		11mm - 1.50	0.9062	²⁹ / ₃₂			
0.3828	⁴⁹ / ₁₂₈	9.7231			0.9219	⁵⁹ / ₆₄			1-12 NF
0.3860		9.8044	W						³/₄-14 NPT
0.3906	²⁵ / ₆₄	9.9212		⁷ / ₁₆ -20 NF	0.9375	¹⁵ / ₁₆			1-14 NS
0.3970		10.0838	X		0.9531	⁶¹ / ₆₄			
0.3984	⁵¹ / ₁₂₈	10.1194			0.9687	³¹ / ₃₂			
0.4040		10.2616	Y		0.9844	⁶³ / ₆₄			
0.4063	¹³ / ₃₂	10.3200			1.0000	1			
0.4130		10.4902	Z	12mm - 1.75					
0.4141	⁵³ / ₁₂₈	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	²⁷ / ₆₄	10.7163		¹ / ₂ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	⁵⁵ / ₁₂₈	10.9144							
0.4375	⁷ / ₁₆	11.1125		¹/₄-18NPT					
0.4453	⁵⁷ / ₁₂₈	11.3106							

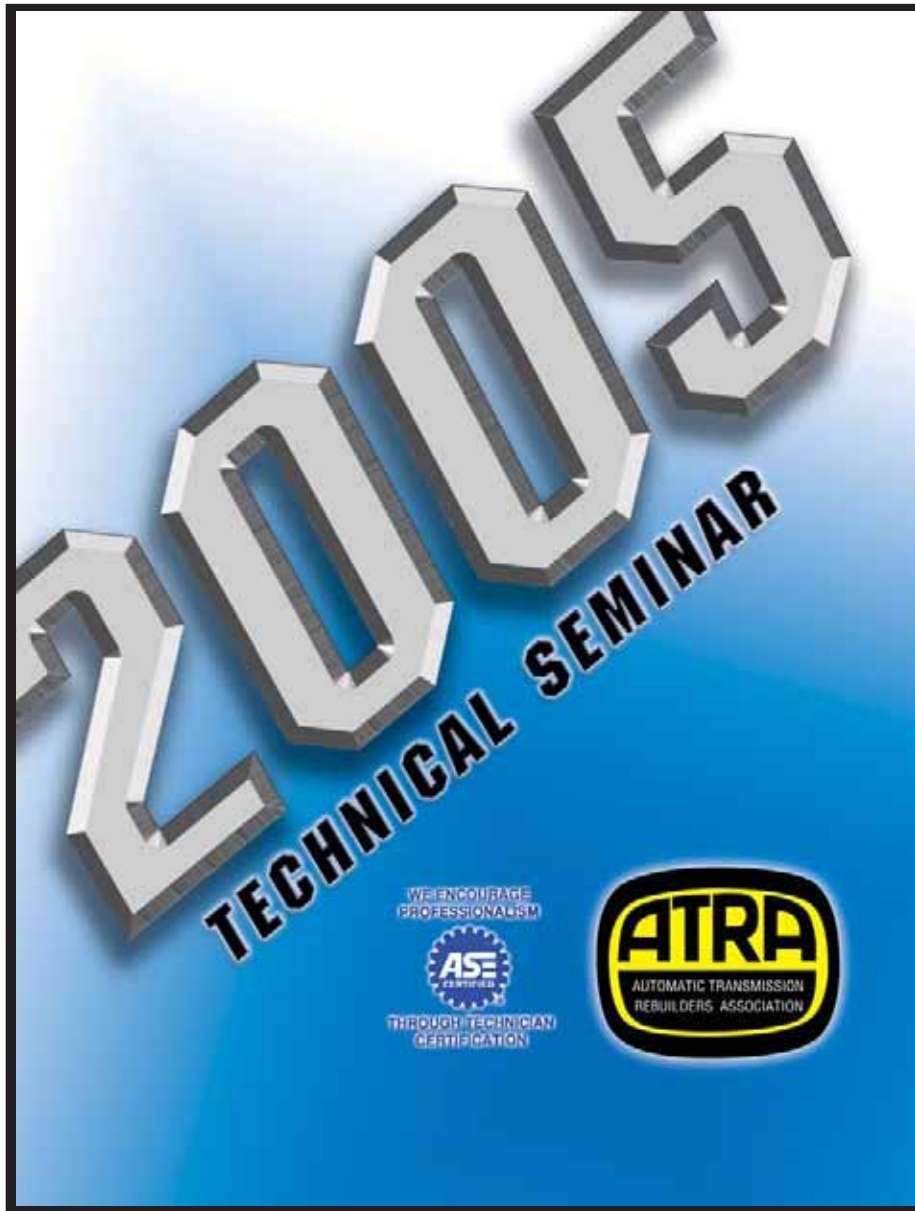
2005 TECHNICAL SEMINAR

WE ENCOURAGE
PROFESSIONALISM



THROUGH TECHNICIAN
CERTIFICATION







The

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Dennis Madden
Chief Executive Officer

Welcome to the 2005 ATRA Technical Seminar!

This year marks another milestone in the evolution of the ATRA technical seminar. Because again the ATRA seminar manual has been developed and printed in full color!

Having worked on several seminar manuals myself I know what it takes to produce a seminar. Lance Wiggins and the ATRA Technical staff have really pulled out all the stops again; another sign of the new things coming out of the "New" ATRA.

This seminar, along with everything else at ATRA is a group effort, with a lot of effort in the background that nobody ever sees. I could not be more delighted with the staff here at ATRA.

ATRA is changing all the time: with the new items like the 3-year Golden Rule warranty, to give your customer that added peace of mind; point-of-sale items to make your shop look even more professional; Nation-wide advertising and referral services, getting more consumers into ATRA Members' shops. These are just a few of the changes you've seen in the past year, and it's only the beginning.

On behalf of the ATRA staff, and the ATRA Chapters that work so hard to bring you this seminar, welcome.

Sincerely,

A handwritten signature in black ink that reads "Dennis Madden".

Dennis Madden,
ATRA, CEO



Lance Wiggins
Technical Director

ATRA is proud to be celebrating another year serving the automatic transmission repair industry. A lot of changes have taken place over the last year and it's because of those changes that technical training has become an integral part of today's transmission repair industry. It's just not possible anymore to get by with a measure of common sense and a decent technical aptitude. To remain profitable, today's technicians need up-to-date training on an ongoing basis.

To that end, ATRA is pleased to present its 2005 Technical Seminar. Packed with countless hours of research and development, writing, editing, photography and layout, this year's seminar will stand out as one of the most demanding and useful technical training programs ever developed for this industry.

Once again, this year's technical manual has been produced in *full color*. With over 300 pages of up-to-the-minute technical information, the 2005 Technical Seminar Manual will remain a valuable resource long after the seminar is just a memory.

We're confident that you'll find this year's seminar presentation and technical manual both informative and profitable. In fact, we're so sure you'll be satisfied with what you learn in this program, we guarantee it!

So, on behalf of the entire ATRA staff, the international board of directors, and all of the ATRA members worldwide, we'd like to thank you for helping to make our over 50 years memorable.

A handwritten signature in cursive script that reads "Lance Wiggins".

Lance Wiggins
Technical Director

ATRA Technical Team (continued)



Kelly Hilmer
Director of Online



Steve Garrett
Technical Advisor, Seminar
Speaker, Service Engineer



Randall Schroeder
Senior Technician
and Seminar Speaker



Weldon Barnett
Technical Advisor



David Skora
Senior Technician,
Seminar Speaker



Mike VanDyke
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Speaker



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Section



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Displacement On Demand (DOD)

A new engine control system was introduced for the 2005 model year that is responsible for fuel economy gains of around 8%. Known as DOD (displacement on demand), the upgraded control system is available on the “new” generation IV small block 5.3L application. The new engine is available in T-truck applications such as the Chevrolet Trailblazer EXT, GMC Envoy XL, and Envoy XUV. The engine is also available in the Buick Rainer for the 2005 model year but the DOD system has been disabled. The Gen IV 5.3L engine with DOD hardware is sold under RPO code LH6 and it will carry a VIN “M” engine designation. Several features have been added to allow DOD operation such as:

- A new engine block, with relocated knock sensors, cam sensor and engine oiling system
- An addition of a VOLM (Valve Lifter Oil Manifold) which contains a series of 4 ground side controlled On/OFF normally closed solenoids. The VOLM is located under the intake manifold
- Updated DOD valve lifters on cylinders 1,4,6 and 7. The updated lifters are used for both the intake and exhaust valves for the effected cylinders.
- An updated camshaft
- Updated E40 PCM and a stand alone TCM
- A brake booster vacuum sensor was added to prevent DOD operation if vacuum is too low
- Updated TCM and PCM calibrations to enable and enhance DOD operation
- New DTC's for the DOD solenoids

DOD Operation:

DOD operation is designed to improve fuel economy by disabling up to 4 cylinders during constant highway speed driving. To enable DOD operation the following must occur:

- Transmission in 3rd or 4th gear
- Engine oil pressure between 25 and 75 PSI
- Steady throttle and load
- Engine speed 900-3000 RPM
- Engine oil temperature 68-302°F (20-150°C)
- System voltage 11-18 volts

Displacement On Demand (DOD)

DOD will be disabled if:

- Manifold/brake booster vacuum to low
- APP position too high or rate of throttle rate of change is too high
- System voltage out of range
- VSS, MAP, BBV, ECT, EOP, CPS, DOD, Trans, Misfire DTC's are set
- DOD has been active for 10 minutes (It will be disabled for 1 minute)

The firing order of the LH6 engine is 18726543. The DOD system can disable every other cylinder in the firing order, 1-7-6-4. During operation, the PCM will ground the DOD solenoids. This action will allow hydraulic pressure into the special DOD lifter disabling the hydraulic lifter operation. The valves and pushrods will maintain contact with the lifters but the valves will not open. In addition the PCM will shut off the fuel injectors for those cylinders. The ignition system will remain active to keep the spark plugs conductive and prevent fouling once the DOD system is disabled. The DOD system can operate up to 10 minutes at a time. The system will then be disabled for 1 minute and then reactivated as long as the enable criteria are met. Since there is no indicator lamp telling the customer DOD is active, DOD operation "should" be transparent.



New Fluid

Updated Dexron III Fluid

New fluid is now available from GM for use in all years and models of Hydramatic transmissions. Dexron III Type H contains several enhancements including changes in the oxidation inhibitor package that is added to the fluid. The upgrades improve the fluids ability to withstand today's more demanding environment. All GM Dexron fluid and fluids that carry the GM Dexron license will be required to meet the new specification by January 2005.

K/T Truck NV246/NV263/ NV126/NV226 Applications

4WD Inoperative, 4WD Indicator Lights Flashing, Possible DTC's Set

4WD inoperative, 4WD switch indicator lamps flashing, possible DTC's include P0700, P0836, P0500, C0327, C0500 C0550 in the different modules. Any or all of the above DTC's may be set in any combination. A grinding noise from the front axle area may also be heard or felt.

Several different areas may cause the above condition, they include:

- Code C0550, if this code is present the Transfer Case Control Module will need to be replaced
- Chafed TCCM wiring harness at the park brake cable release spring area
- Pin tension, connector crimp concerns at the encoder motor (pins A, B, C, D, E, F and G, TCCM (Connector C1 pins B2, A7 (common problem), Connector C2 pins A8, Connector C3 pins A, B, C, D Connector C151 Pins A, F, G, E, Connector C154 pins A, B and C and the under hood relay center.
- TCCM (G110), Engine (G103) (G104 and G107 on the back of the engine, it is common for these to be loose) and Body grounds. Check ground G201 (part of splice pack SP201) and ground G102.
- If the condition has persisted for any length of time always check the front axle wiring as well as the condition of the shift sleeve teeth in the front axle assembly.
- If DTC C0327 sets only when a shift to 4HI is commanded inspect the fluid for contamination. If the fluid has metal in it remove the T-Case, disassemble and inspect the unit for damage

If none of the above items seem to be addressing the problem the cause is likely an encoder sensor. Prior to removing the encoder motor assembly, make sure the transfer case is in Neutral (NV246) or 2WD HI (NV263). If the unit will not shift, remove the transfer case fuse (generally marked TREC 30 Amp) located in the under hood fuse block (UBEC). After reinstalling the fuse, the T-case will generally shift allowing you to attain the desired position. If the unit is a 2003 or later, update the TCCM software prior to returning it to the customer.

NV246/NV263

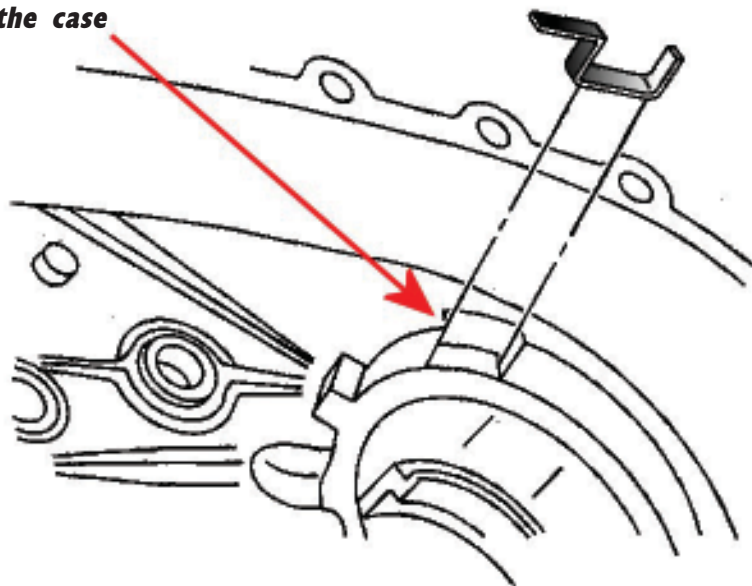
Transfer Case Fluid Leak

One of the most common concerns regarding the New Venture NV246 and NV263 applications is fluid leakage. In many cases the customer fails to notice the fluid leakage until the unit has been run low on fluid, and is extensively damaged.

Two basic concerns may cause the customer complaint, they are:

- The clip that holds the oil pump in the case is missing or broken. If the clip is missing or broken, the flanges of the pump will rub on the slots in the case until a hole has opened up in the case allowing the leak to occur. Many times you will find parts of the clip stuck to the magnet. Inspect the case closely where the oil pump flanges ride, if a hole is present replace the case half. The clip can now be purchased as part number 12470059.
- Rear case porosity is the other main issue. If porosity is found, replace the case half.

***A hole from the Oil Pump
Clip is visible from the
outside of the case***



Inside view of the case

NV233

Low Fluid Level

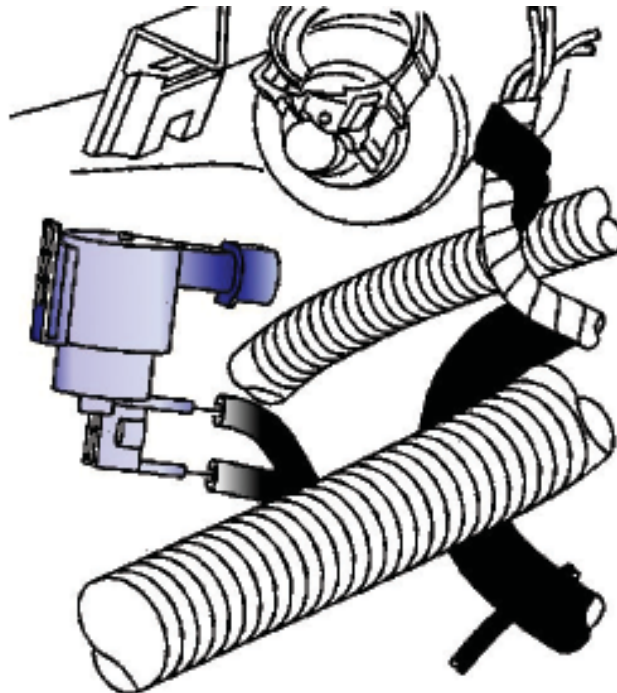
2001-2004 T-Truck 4L60E

2001-2004 Blazer, Sonoma, S-10, Envoy, Trailblazer, Jimmy applications equipped with the NV 233 (RPO NP1) 2 speed electric shift transfer case may exhibit the following concern:

1. Transfer case appears to loose fluid but no external leaks are present
2. A/C operation has declined over time
3. Fluid is found when you remove some vacuum lines

Fluid from the transfer case may be entering the vehicles vacuum system through the transfer case switch. This will lead to HVAC mode switch failure (RPO C60 A/C system), which may cause the customer to believe that the A/C system is faulty. In most cases when the HVAC mode switch finally fails the HVAC system may stick in one mode. This means the customer will not be able to change modes as they change control settings on the HVAC control panel (HVAC mode switch)

Clean or replace all of the effected vacuum lines. Replace the HVAC control head and install the updated transfer case vacuum switch. The updated switch was released for production and service as of 8-4-04 under part #89059420



LCT 1000

PRNDL Flashes or Goes Blank

There are several items that will cause the PRNDL to flash, with some indicating a problem is present while others indicate that no problems are present. The TCM has inhibited a transmission function because the customer may have commanded the transmission to do something that could lead to damage.

Flashing PRNDL indicates a problem present:

1. PRNDL (park/neutral) switch or its circuits may be faulty
2. Trim A/B solenoid or their circuits faulty
3. Input/Output speed sensor or their circuits faulty
4. Lack of line pressure at start up (possible low fluid level)
5. A clutch is slipping or a clutch has failed to apply
6. Sticking shift valves

Flashing PRNDL normal condition customer generated:

1. High engine RPM garage shift engagements into a forward range or reverse (TCM will also command the transmission to neutral)
2. Reverse to drive or drive to reverse gear change (like a parking lot maneuver) with the throttle at greater than 25% (TCM will also command the transmission to neutral)
3. Transfer case was shifted to Neutral while the transmission was in drive or reverse. The TCM will keep the transmission engaged until the vehicle comes to a stop. Once stopped the TCM will command neutral. If the driver moves the shift lever in/out of drive or reverse at this point the PRNDL will flash.
4. Output RPM is greater than 300. If the customer moves the shift lever from a forward range to reverse or from reverse to a forward range the PRNDL will flash.
5. Operating the unit at low ambient temperatures (-49°F -45°C) (TCM will also command the transmission to neutral)

LCT 1000

PRNDL Flashes or Goes Blank (continued)

Blank PRNDL may be caused by:

1. Fault in PRNDL switch (Park Neutral switch) or its circuits
2. PRNDL switch out of adjustment
3. Lack of communication between the PCM and TCM at power up. If the display is blank the TCM will command the appropriate forward or reverse range based on PSM/PSA values



LCT 1000

No Forward Movement, Possible DTC's

A no forward or a slipping in all/some forward gears condition also the PRNDL may flash and ratio or speed sensor DTC's such as P0721, P0731, P0732, P0733, P0734, P0746, P0776, P1720, P1721, P1723 or P1724 may be set in any combination or there may not be any DTC's set at all (depending on the severity of the condition.)

The C1 clutch piston may have started to delaminate. Remove the piston and inspect it to see if chunks of the seal are loose or missing. Replace the C1 piston.



LCT 1000

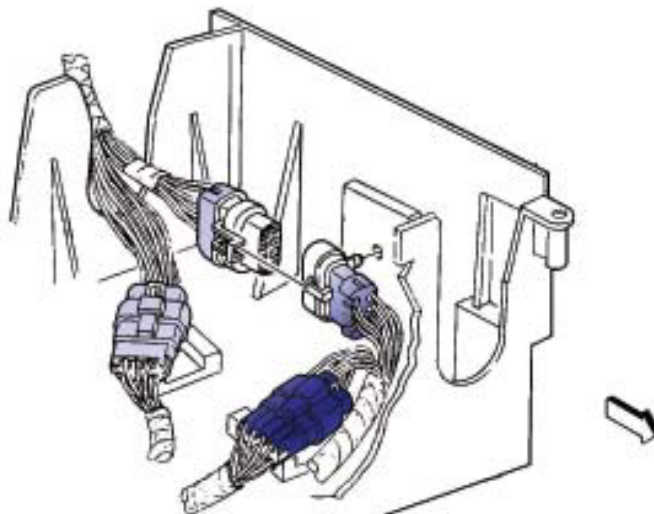
Erratic or No Shift Condition, Possible DTC P0700, P0500 and TCCM Codes

LCT 1000 applications may experience any or all of the following conditions:

1. P0700 Set
2. SES light on
3. Transmission performance issues
4. TCCM DTC's set
5. Premature ABS operation
6. Problems communicating with the TCM

Several items can cause the above concerns including:

1. Circuit 2470 (yellow wire) class 2 data line is open. This circuit is connected through connector C-100 and can cause different symptoms depending whether the fault is present prior to cycling the key to the on position or if the problem is only present after the engine is running. In either case you may experience difficulty communicating with the TCM and you may find a P0700 DTC stored in the PCM. Inspect the terminal at connector C-100, terminal R for damage as well as being backed out of the connector. Connector C-100 is located in the IP to engine harness under the UBEC (Underhood fuse box). If the pin is backed out reposition the harness to reduce harness stress (Fig C100)
2. Grounds: Check/clean and secure G110 (located on the left frame rail front cab mounting bracket) Clean/check and secure G102. (located on the lower right side of the engine) Clean/Check and secure G103 on the gas applications. (Located at the left front of the engine)



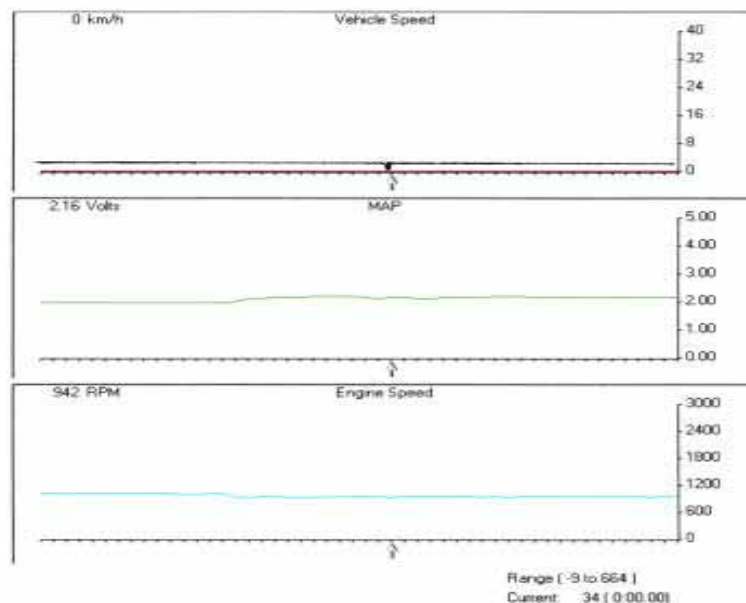
LCT 1000

Intermittent Neutral Condition, Won't Move Forward or Backward, No DTC's

Some Allison LCT 1000 applications may experience a condition where the vehicle tends to drop into neutral at low road speeds intermittently. At normal road speeds the condition typically does not occur. This condition likely occurs when the customer has placed the transmission into gear while the vehicle is stopped and then attempts to move the vehicle forward or backward. Typically the transmission will engage into the selected gear and as the vehicle moves a few feet it will drop out of gear and into neutral. Reselecting forward or reverse will have no effect until the ignition is cycled at which time the vehicle may function properly or it may again act as described above. Typically NO DTC's are set

To isolate the cause of this concern the technician will generally need to take a snapshot/movie when the concern is present. Graph the snapshot/movie so you can monitor the parameters closely. Pay very close attention to the VSS/ISS signals. Note if the VSS signal dropped out at the time the condition occurred. Even the slightest dropout of the VSS signal may cause the concern. On some LCT 1000 software applications the VSS DTC's have been "Masked" but the default action for the condition may still be present. This means the if the VSS signal drops out, even for a split second, the transmission will be commanded to neutral but no DTC's will be recorded. The cause of this condition is generally the VSS sensor, although wiring and pin connections may also cause the concern. If in doubt replace the sensor.

***Actual
snapshot of the
condition***



LCT 1000

Running Changes for 2003-2004

Solenoid Harness up to 2003

A new harness was introduced for the 2003 model years. The harness was lengthened 15mm for trim solenoid B. In addition, the trim solenoid connectors were redesigned to improve retention. The updated harness can be identified by the red connectors for the trim solenoids. The updated harness will back service previous models/years. The harness is available under GM and Allison part number 29541371.

New Solenoid Harness 2004-On

New internal wiring harness to accommodate the introduction of Solenoid G. GM and Allison part number 2953972

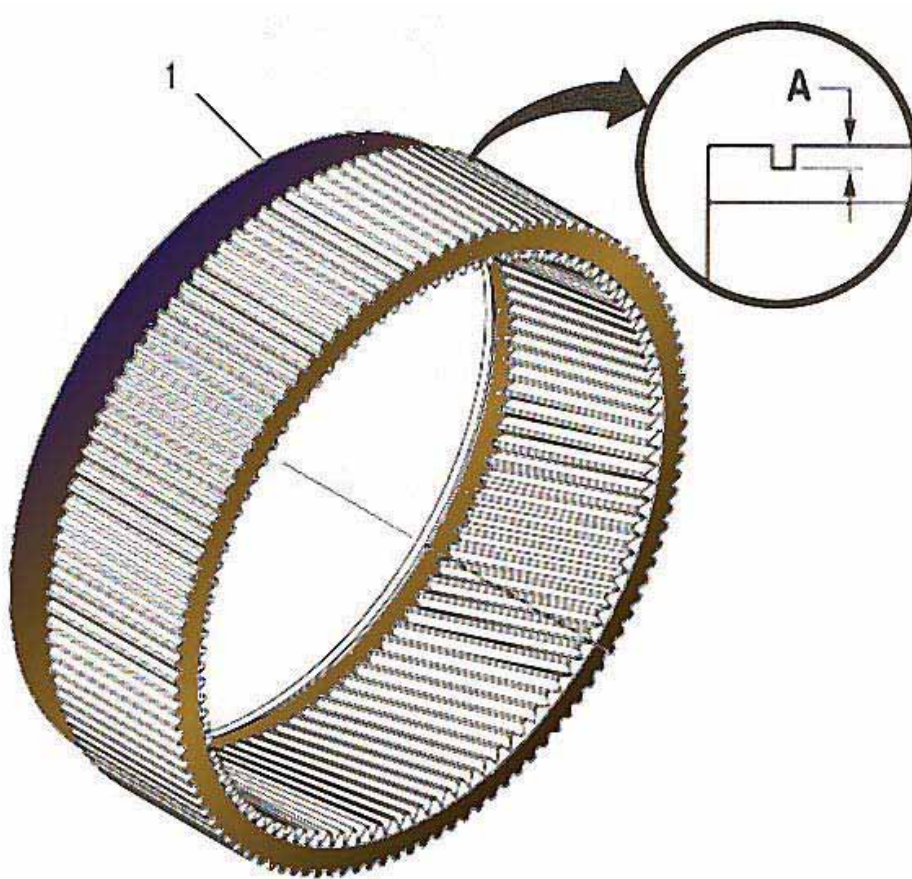


LCT 1000

Running Changes for 2003-2004 (continued)

P-3 Ring Gears

Some P-3 ring gears had a chamfer in the snap ring retaining groove area. Under load the snap ring can break or wear. If the condition is found, update the ring gear and snap ring with Allison part number 29537311.



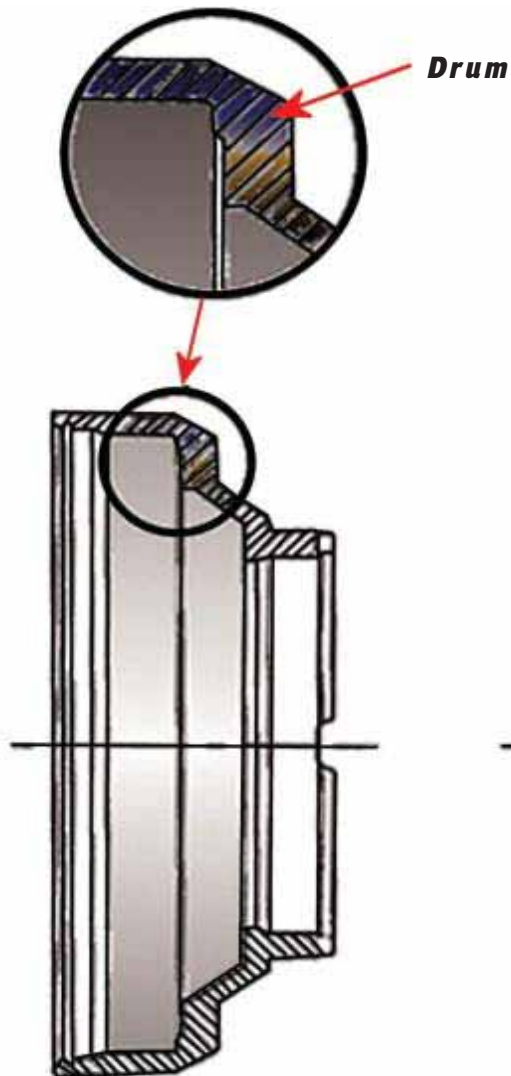
LCT 1000

Running Changes for 2003-2004 (continued)

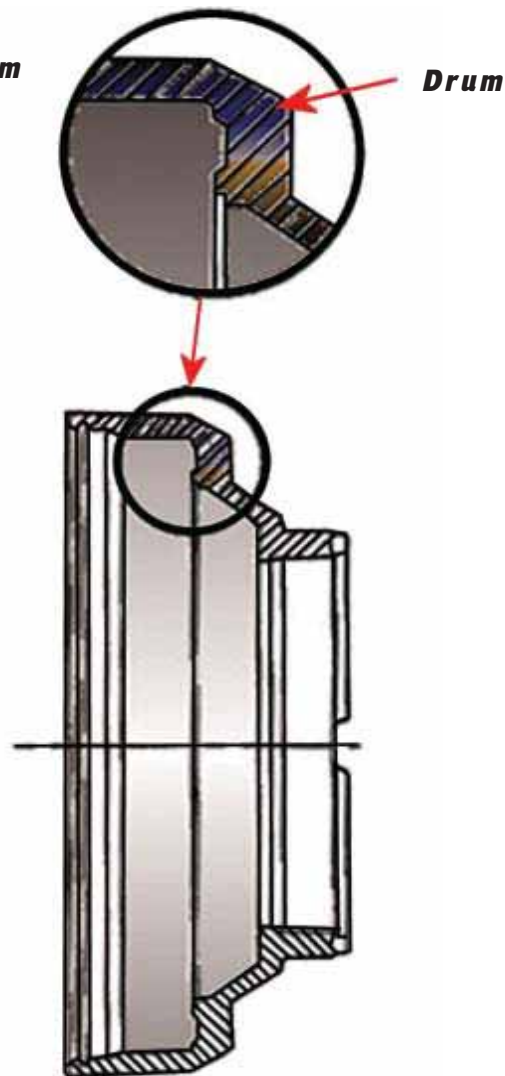
C-1 Drum and Piston Assembly

A new C-1 Drum and Piston Assembly has been released to improve fill times. The updated assembly can be identified by the dam and the part number that is stamped into the casting. The updated GM/Allison part number is 29537993. This assembly will back service previous applications. This update took effect with build date S/N 6310089106 (Indianapolis) S/N 6320006057 (Baltimore).

Previous Design



Updated Design



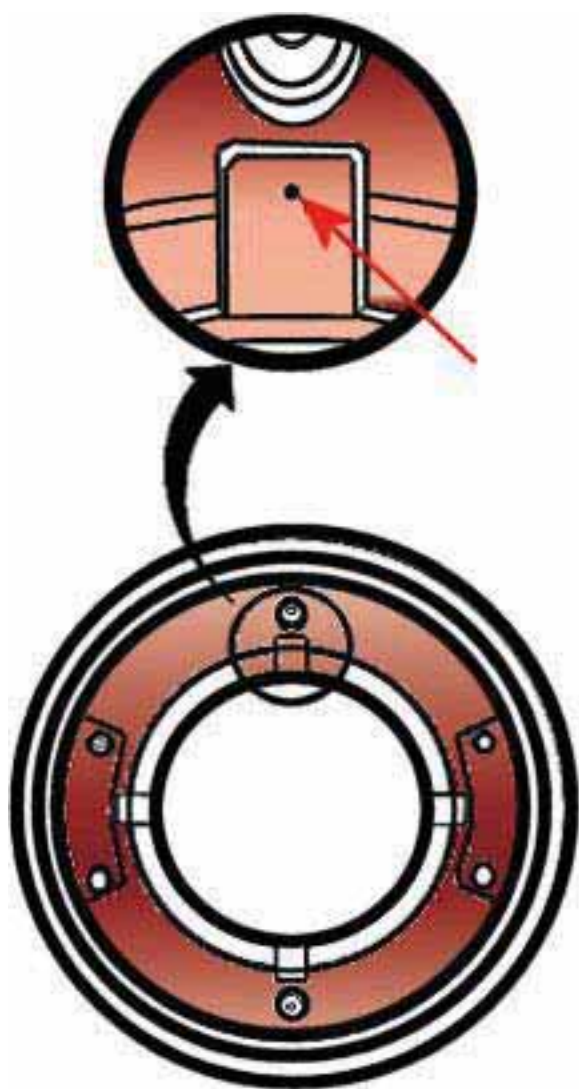
LCT 1000

Running Changes for 2003-2004 (continued)

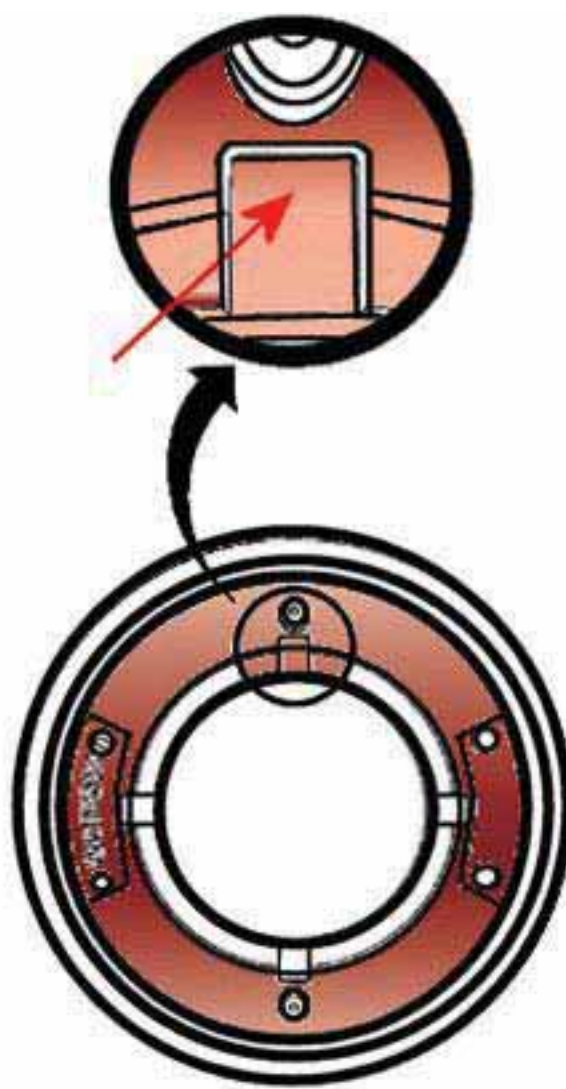
C-2 Piston

A new C-2 piston is available and is sold under Allison and GM part number 29539653. The updated piston design does not have a bleed hole in it to improved clutch fill times. The updated piston will not currently back service the previous applications (01-02). At the present time an updated calibration is not available to allow this interchange.

2002 and Earlier



2003-On

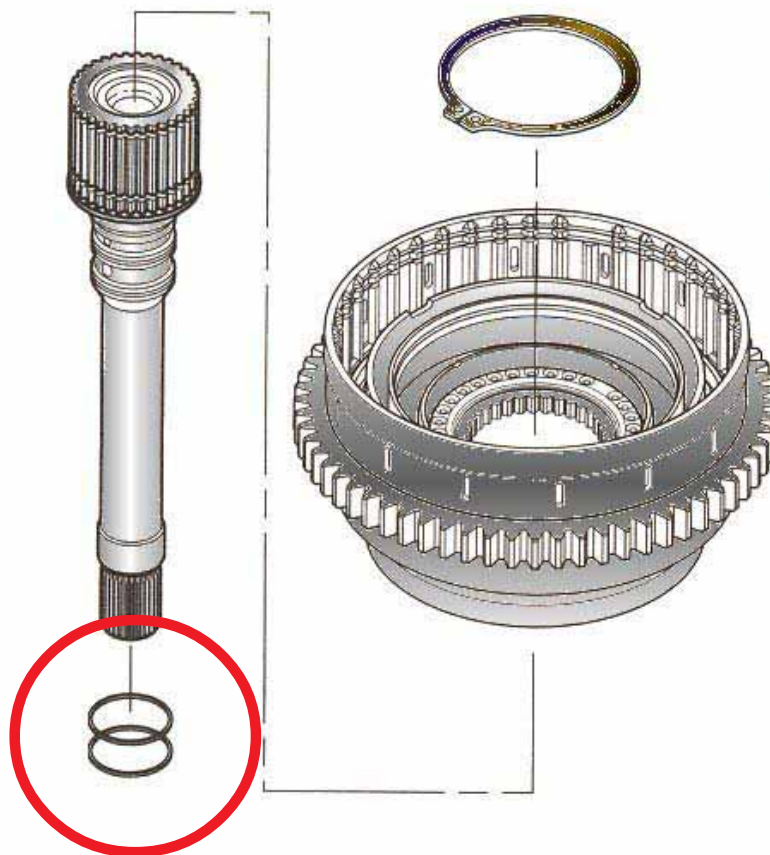


LCT 1000

Running Changes for 2003-2004 (continued)

C-2 Clutch Shaft Seal Rings

The C-2 clutch shaft seal rings have been changed from a butt cut design to a lap design to improve shift quality (especially in cold temperatures). This change corresponds with the C-2 piston change. The lap design seals are sold under Allison part number 29538940. A basic seal/gasket kit with the lap seals included is available from Allison and GM under part number 29541532.



Sealing Rings

LCT 1000

Running Changes for 2003-2004 (continued)

Valve Body

An updated Valve Body (complete assembly) was implemented to improve fuel economy by reducing pump load, reduce pump noise at idle and to improve cooler flow. The Valve Body will back service if it is installed as an assembly although line pressure solenoid (G) will not function on 01-03 applications. **DO NOT attempt to interchange body/spacer plate parts from former to late design applications.** The old valve body part number has been superceded by the updated design. The updated harness is designed to fit the new valve body.

This new Valve Body includes a line pressure solenoid (Solenoid G) Allison and GM part number 29541572 (Complete assembly) Solenoid G Modulated main valve body only, includes solenoid G (Auxiliary valve body), Allison part number 29539797. Solenoid G only, GM and Allison part number 29536833.

The Control Main Valve and its 2 springs will back service previous model/year applications. The valve land configuration was updated to help stabilize the valve position. The largest land is now 4.5mm in length rather than 3.5mm as was used on the previous design. The updated valve and its springs will back service previous model/year applications. Do not interchange early and late spring/valve combinations.

The main regulator valve will also interchange with previous year/model applications. Allison and GM part number 29531323 was not changed for the C/K pickup applications. The part number 295 31323 valve can be identified by a single groove machined on the valve, at the end with the large land. Other commercial applications did update the main regulator valve and it can be identified by the 3 grooves machined around the valve on the large land end.

NOTE: The 2004 valve body upgrades apply to the 8.1L (RPO L18) gas and 6.6L (RPO LLY) Dura Max Diesel applications but not to the 6.6L (RPO LB7) Dura Max Diesel application.

LCT 1000

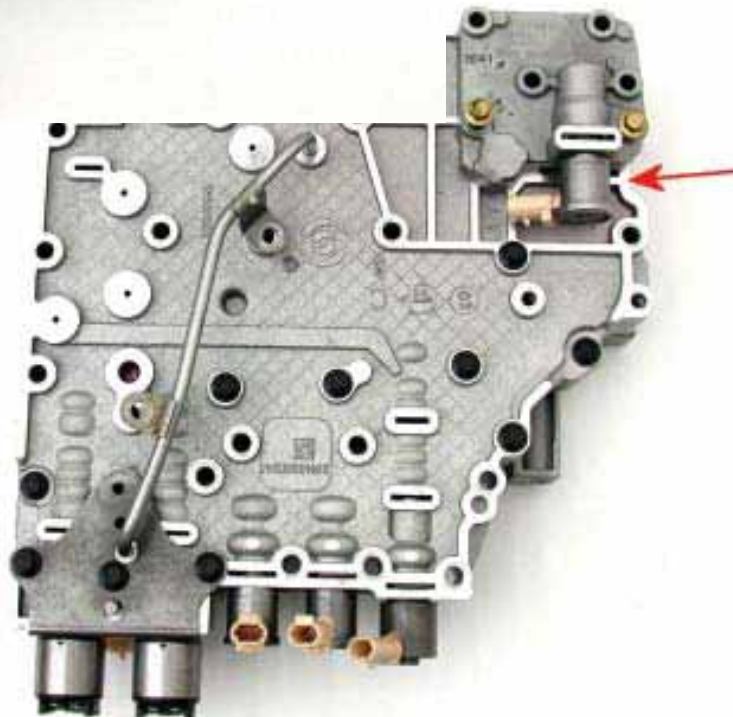
Running Changes for 2003-2004 (continued)

Valve Body

2001-2003 Valve Body



2004-On Valve Body



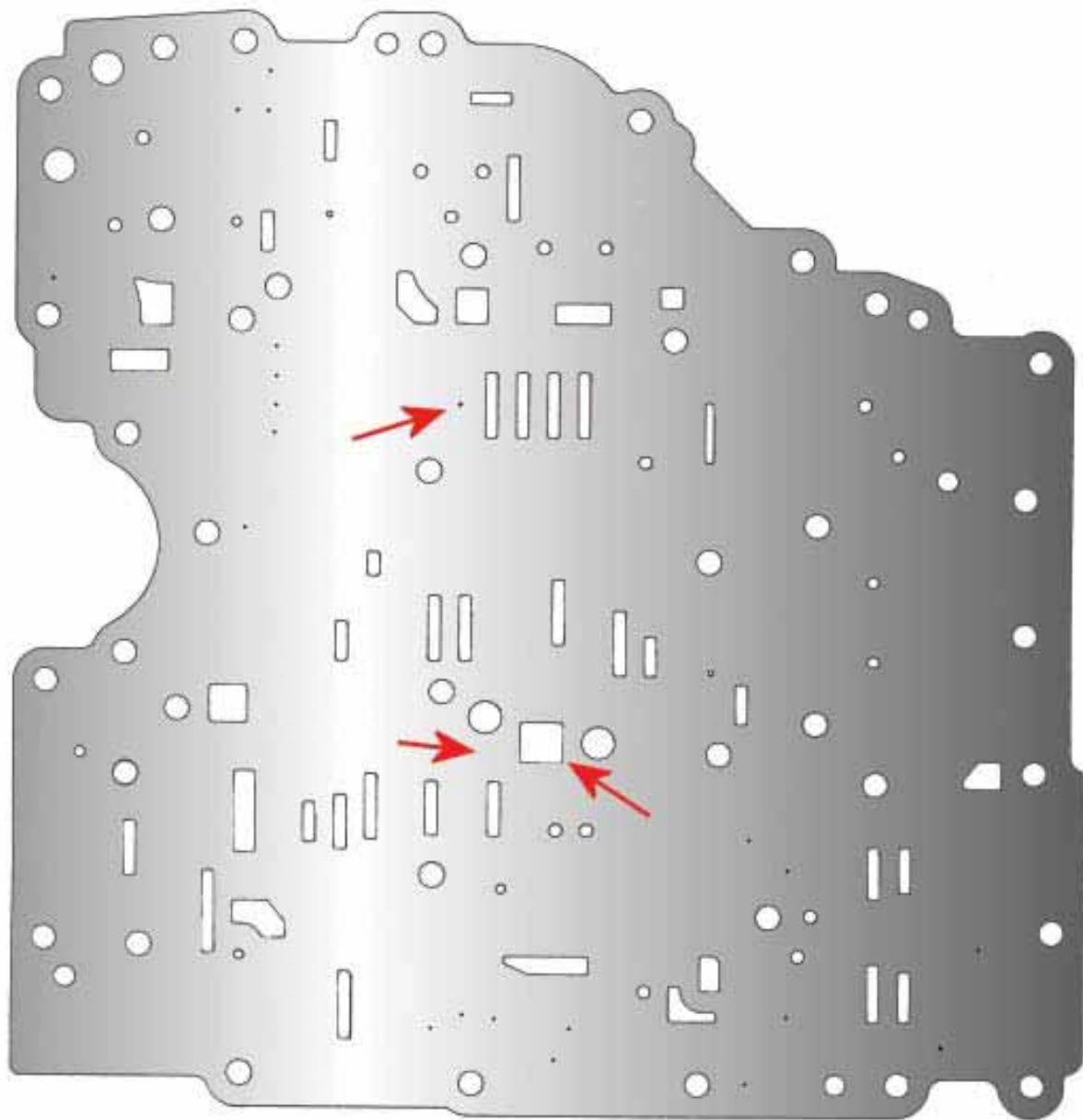
Solenoid "G"

LCT 1000

Running Changes for 2003-2004 (continued)

Original Seperator Plate 2001-2003

This is the original separator plate identification for 2001-2003.

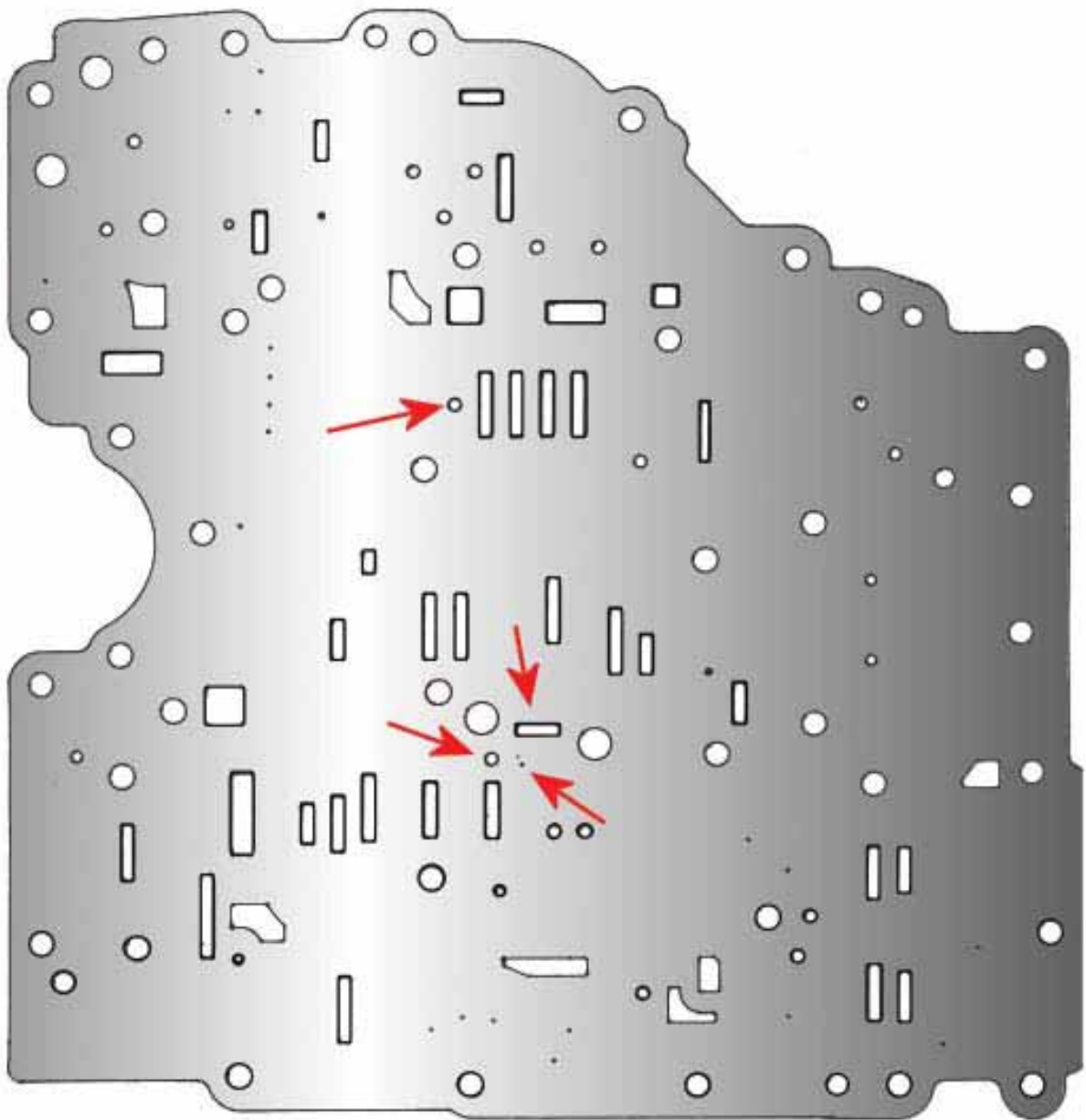


LCT 1000

Running Changes for 2003-2004 (continued)

New Seperator Plate 2004-On

A new separator plate designed to be used with solenoid G, Allison part number 29539793.



LCT 1000

Running Changes for 2003-2004 (continued)

NSBU

An updated NSBU switched has been released for all 2004 LCT 1000 applications. The updated switch uses only one 12 pin connector and will be common with many other GM rear drive applications. The new switch has eliminated the metal alignment strap. The new switch will NOT back service previous applications. The updated switch is available under Allison part number 29541852 and GM part number 24221125.



LCT 1000

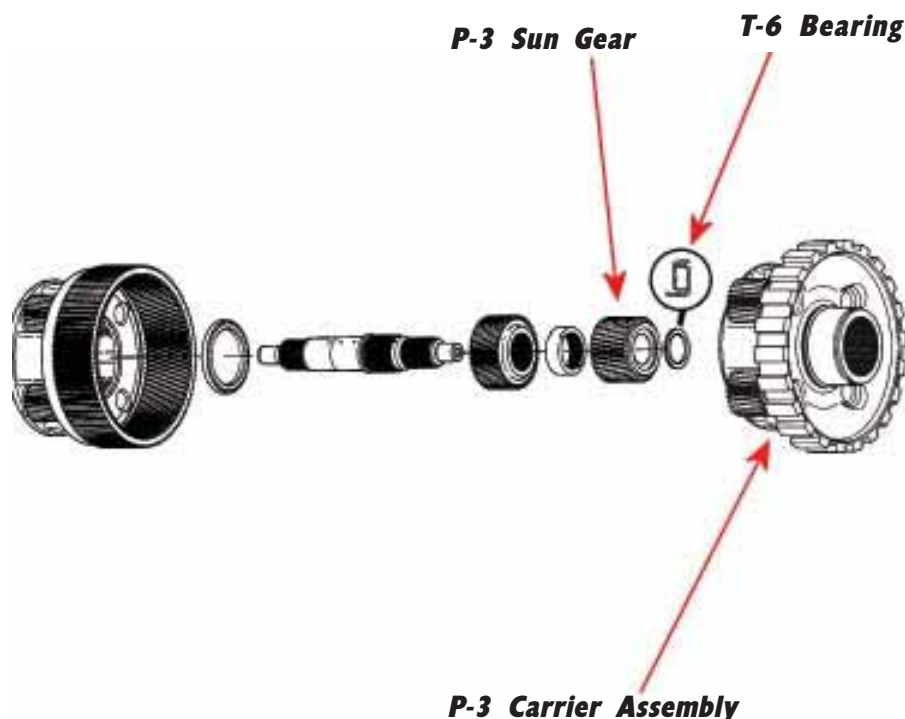
Running Changes for 2003-2004 (continued)

T-6 Bearing, P-3 Sun Gear, and P-3 Carrier Assembly

The T-6 bearing, P-3 sun gear and P-3 carrier assembly was updated as a late 2003 early 2004 product change. The load carrying capacity of the bearing was increased due to durability concerns. When the bearing was updated, the location of the pilot groove for the bearing in the P-3 sun gear also changed. In addition the machining for the undercut on the P-3 carrier changed. The update was included in units built after build dates 6310220802 (Indianapolis) and 6320127996 (Baltimore).

The P-3 carrier, P-3 sun gear, and the T-6 bearing will interchange if they are installed as a package. The former T-6 bearing will still be available under the old part number 29531089. If the sun or carrier requires replacement on an older model unit all the updated parts must be installed as a package. The update Allison parts numbers are as follows: P-3 sun gear 29540499, P-3 carrier assembly 29540500, T-6 bearing 29539501.

NOTE: Always double check the part numbers before ordering. Numerous updates have occurred with many of the part numbers. GM is adding Allison part numbers as a common practice, so check the Allison part number with your local GM suppliers, you may find the part now available from your local GM source.



LCT 1000

Fluid Leaking from the Extension Housing

2001-2004 LCT 1000

Some LCT 1000 applications may exhibit fluid leakage from the extension housing 4wd adapter area.

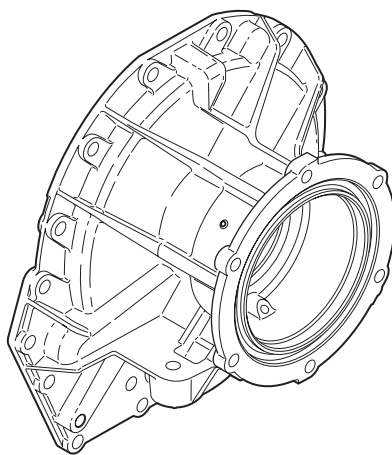
Typically the cause of the leakage is a “crack” in the extension housing adapter. Several areas may cause the extension housing to leak. They include:

1. A faulty U-joint
2. Excessive drive shaft U-joint working angle
3. Drive shaft balance
4. Excessive drive shaft runout
5. A bent or damaged drive shaft
6. Carrier bearing damaged or faulty

It should be noted that most of the above will apply to not only the rear prop shaft but also the front prop shaft.

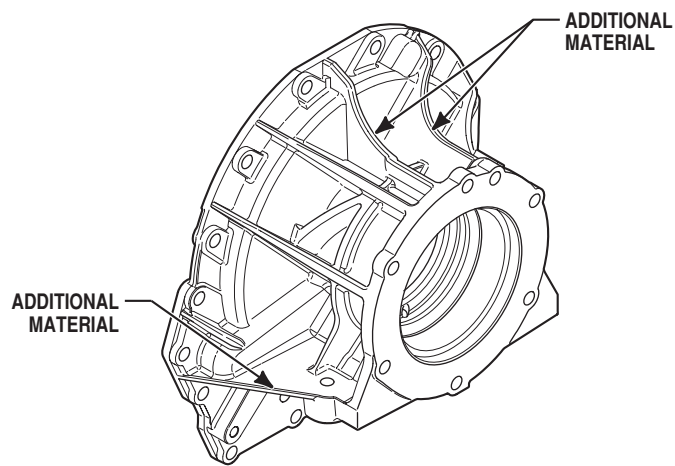
Inspect both drive shafts for the items listed above. Repair the root cause of the concern prior to installing another 4wd adapter housing. The 4wd adapter housing has been updated to a more robust design that is more resistant to vibration. The updated design was released in August 2004 for the 2005 model applications. The updated design will back service all 2001 and later LCT 1000 applications. The updated GM part number is 29542109.

Previous design



FORMER
P/N 29536409

Updated design 29542109



CURRENT
P/N 29542109

LCT 1000

Fluid Leaking from the Extention Housing (continued)

2001-2004 LCT 1000

Use the service procedure outlined in a factory service manual to replace the rear extension housing, torque converter relief spring and the lube regulator spring in the front support assembly.

Notice: *Do not attempt to replace the transmission extension housing with the transmission in the vehicle. Several internal components are held in place by the housing and they will come out of alignment during reassembly. Attempting to do so will result in the following conditions:*

- Displacement of eighteen (18) clutch springs
- Damage to C5 clutch plates
- Damage to P-2 & P-3 thrust bearings
- Improper transmission end play

Notice: *Failure to diagnose and repair the cause of the driveline imbalance may result in a repeat cracked extension housing.*

LCT 1000

Fluid Leaking from the Extention Housing (continued)

2001-2004 LCT 1000

Important: After completing this modification, the transmission control module (TCM) shift adapts must be relearned for proper transmission operation. For model year 2001 using the Tech 2™, select Special Functions (F2), Transmission Output Controls (F1), Preset All Tap Cells, Disconnect the Tech 2™. This action will reset all clutch adaptives and required the vehicle to be driven. For model years 2002 and 2003, follow the procedure outlined in Corporate Bulletin Number 02-07-30-032 to quickly relearn the transmission shift adapts.

Use caution when removing, installing, servicing or moving the transmission in order to prevent personal injury.

Use the service procedures provided in your manual before attempting to install the updated extension housing.

Selective Spacer Identifier Table

If Dimension C Equals	Use spacer with this # of Identifier Holes	Spacers Thickness
1.0081–1.1844 mm (0.0397–0.0466 in)	0	0.245-0.295 mm (0.0096-0.0116 in)
1.0185–1.414 mm (0.0467–0.0557 in)	1	0.475-0.525 mm (0.0187-0.0207 in)
1.415–1.644 mm (0.0557–0.0647 in)	2	0.705-0.755 mm (0.0278-0.0297 in)
1.645–1.874 mm (0.0648–0.0738 in)	3	0.935-0.985 mm (0.0368-0.0388 in)
1.875–2.104 mm (0.0738–0.0828 in)	4	1.165-1.215 mm (0.0459-0.0478 in)
2.105–2.334 mm (0.0829–0.0919 in)	5	1.395-1.445 mm (0.0549-0.0569 in)
2.335–2.5015 mm (0.0919–0.0988 in)	6	1.625-1.675 mm (0.0640-0.0659 in)

Part Number	Description	Qty
29541378	Sub Assy, Extension Housing	1
23047970	Output Bearing	1
29531231	Output Nut	1
29536941	Gasket	1
29536981	Snap ring	1
29536407	Kit: Shim Selective	1
29531147	Spring, Pawl Return	1
29531325	Gasket, PTO cover	1
15704050	Gasket, Transmission to Transfer Case.	1
88996718	Kit, Torque Converter Drain-back Modification	1
12378470 (1 quart) (in Canada, 1 L, P/N 10952622)	DEXRON® III Automatic Transmission Fluid	12 L (13 quarts)

Parts are currently available from GMSPO.

Caution: The Allison™ 1000 Series (M74) transmission has a dry weight of approximately 150 kg (330 lbs). The torque converter has a dry weight of approximately 29 kg (63 lbs).

LCT 1000, 4L60E/65E, 4L80E/85E

OD OFF Light Inoperative

OD disable/off light no longer functions. The transmission may appear to function correctly with no other symptoms present. This condition may have occurred after the Instrument Panel Cluster (IPC) was replaced.

The lamp is controlled by the IPC through input on most applications from the BCM via serial data. In some applications the BCM monitors input from the TOW/HAUL momentary contact switch to signal not only tow/haul programming activation/deactivation but also to disable OD operation when in tow/haul mode. Some applications will disable OD without alerting the driver as the vehicle was not equipped with an OD disable/off light. If your vehicle is equipped with an OD disable lamp several items may cause the concern including:

- A faulty tow/haul switch
- Circuit 553 Lt Blue BCM pin B11 open
- Wrong instrument cluster was installed
- The new instrument cluster was not programmed after installation for the specific application

Prior to performing repair work, make sure the IPC was not replaced. If the IPC had been replaced, reprogram the cluster. If the IPC had not been replaced use the service manual information to isolate the cause of the inoperative lamp.



LCT 1000, 4L60E/65E, 4L80E/85E

Shudder, Miss , Surge, No TCC, Cruise may be Inoperative, Possible DTC's

4.3L, 4.8L, 5.0L, 5.3L, 5.7L, 6.0L, 7.4L, 8.1L

Several areas can cause transmission/engine related concerns on truck applications. In most instances you will note misfire on the appropriate cylinder by monitoring the misfire counters with your scan tool. If a misfire DTC is set, TCC will not function and in many cases the cruise control will also be disabled. If a DTC is not set, the customer may comment regarding a TCC related shudder or a surge complaint that they feel is related to the transmission. If all basic procedures have been followed to isolate the cause of the concern and you are unable to isolate the cause, refer to the following information. Areas of common concern include:

- ***HVS Driven Gear***
- ***HVS (Distributor)***
- ***Fuel Pressure Regulator***
- ***Poppet Nozzle***
- ***Intake Manifold Gasket***
- ***Valve Springs and Valve Guides***
- ***Module/Coil Assembly***

LCT 1000, 4L60E/65E, 4L80E/85E

***Shudder, Miss , Surge, No TCC, Cruise may be Inoperative,
Possible DTC's (continued)***

4.3L, 5.0L, 5.7L, 7.4L

HVS Driven Gear

With the throttle in the float position you will typically feel the surge/miss starting to occur. As long as you hold the throttle steady, the condition will continue. As soon as you step on the throttle or release and reapply the throttle, the condition may be gone. The condition will not occur again unless you accelerate and then decel to the float position. This means this condition cannot be duplicated in the stall for diagnosis. Typically you will note the misfire counters increasing on different cylinders each time the condition occurs. You may note that the "cam retard" value is out of spec or it appears to change on its own as the vehicle is operated. (Generally cam retard on V-8 engines should be 0+-2 degrees and V-6 less than 10 degrees)

The cause of this condition is generally the gear on the bottom of the High Voltage Switch (HVS) Distributor. The gear teeth will start to wear sharp which leads to slack between the cam gear and the HVS gear.

To repair the condition, replace the HVS driven gear.



LCT 1000, 4L60E/65E, 4L80E/85E

***Shudder, Miss , Surge, No TCC, Cruise may be Inoperative,
Possible DTC's (continued)***

4.3L, 5.0L, 5.7L, 7.4L

HVS (Distributor)

This condition is not related to engine load and may or may not be able to be duplicated in the stall for diagnosis. Typically the miss/surge will be picked up by the misfire counters on your scan tool. The misfire will be predominate on one cylinder with the cylinders before and after the problem cylinder (in the firing order) also showing some misfire. In addition you will typically note that the “cam retard” value is out of spec or it appears to change on its own as the vehicle is operated. (Generally cam retard on V-8 engines should be 0+-2 degrees and V-6 should be 0 but must be less than 10 degrees) In rare cases you may also find a P1345 or a P0340 set.

If you have a vehicle with the above concern, remove the HVS cap and grab a hold of the rotor. Apply firm pressure to the rotor in “ALL” directions. If excessive movement is found the HVS bushings are worn and the HVS (distributor) will need to be replaced. Replace the HVS and adjust the Cam Retard (if adjustable on your application) to the specs listed above.



LCT 1000, 4L60E/65E, 4L80E/85E

***Shudder, Miss , Surge, No TCC, Cruise may be Inoperative,
Possible DTC's (continued)***

4.3L, 5.0L, 5.7L, 7.4L

Check for wear in this area



LCT 1000, 4L60E/65E, 4L80E/85E

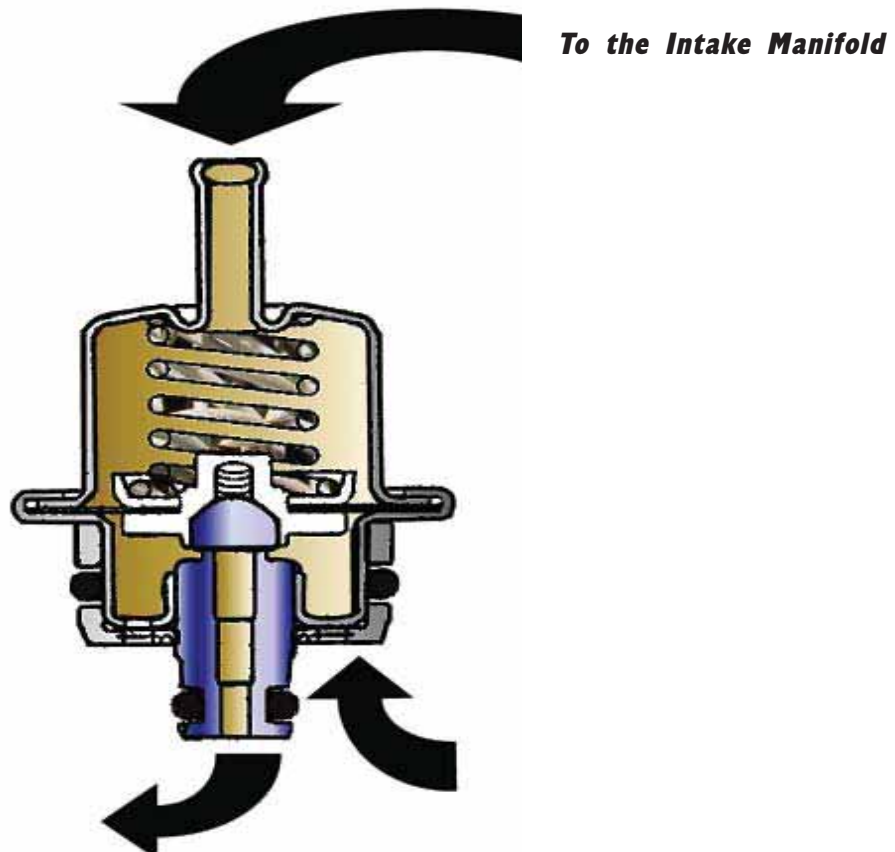
***Shudder, Miss , Surge, No TCC, Cruise may be Inoperative,
Possible DTC's (continued)***

5.0L 5.7L, 7.4L

Fuel Pressure Regulator

5.0L, 5.7L, 7.4L SFI CPI applications, 4L60/65E 4L80/85E Miss, surge on #4 cylinder with a possible P0300 and/or P0304 being set. This concern is many times intermittent and may not be related to engine load.

On this application, the fuel pressure regulator vacuum port points toward #4 intake runner. If the fuel pressure regulator fails, a miss may result on #4 cylinder. Inspect the fuel pressure regulator and replace as necessary.



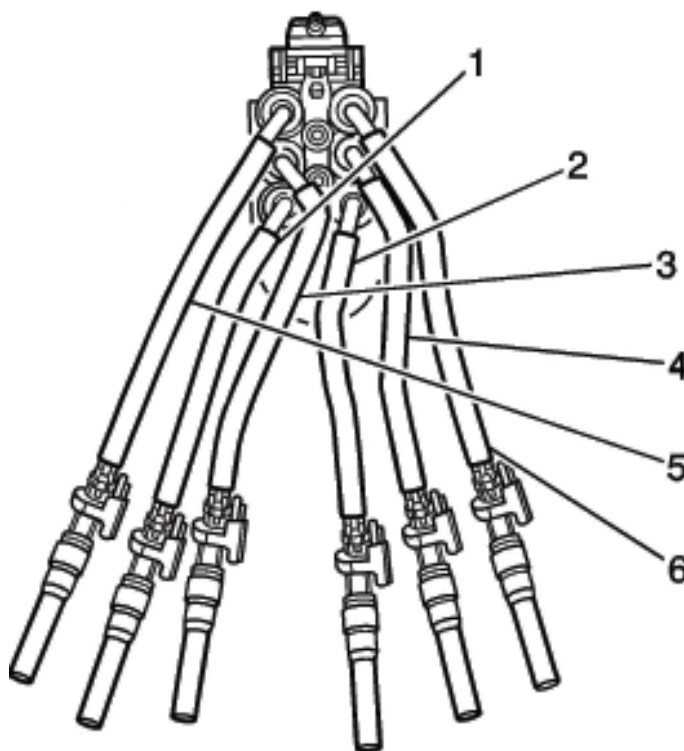
LCT 1000, 4L60E/65E, 4L80E/85E

Shudder, Miss , Surge, No TCC, Cruise may be Inoperative, Possible DTC's (continued)

4.3L, 5.0L, 5.7L

Poppet Nozzle

Miss/Surge at light to moderate throttle with the problem more noticeable when TCC is applied. Misfire DTC's are generally not present although you may see some random misfire on your misfire counters. This condition feels exactly like the TCC regulator valve train concerns that have been so prevalent for so many years. In most cases you will find that the customer has had work performed on the engine, fuel system or the engine electrical system. If you are experiencing the concern remove the intake manifold and inspect the poppet nozzle position in the intake manifold. In most cases you will find that someone has mixed up a pair of poppet nozzles as they are positioned in the intake/cylinder head. If the nozzles are delivering fuel at the wrong time the affected cylinders will be lean resulting in the concern. To repair simply reinstall the poppet nozzles, into their correct cylinder position.



Typical Poppet Nozzles

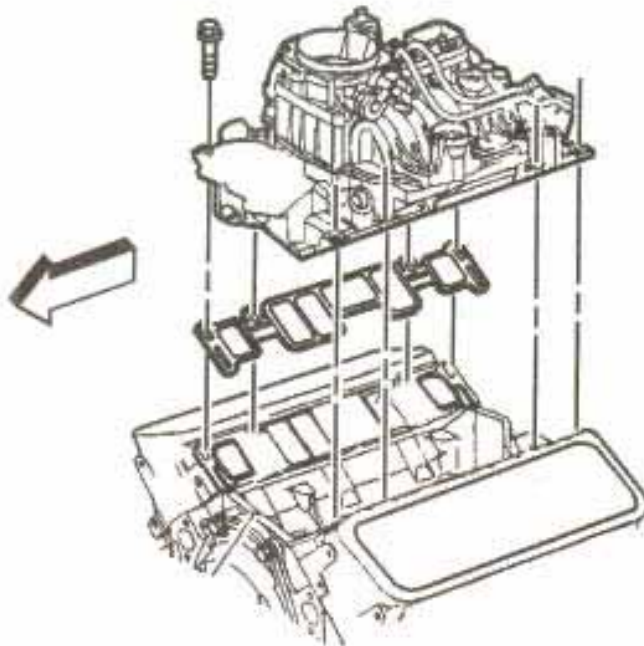
LCT 1000, 4L60E/65E, 4L80E/85E

Shudder, Miss , Surge, No TCC, Cruise may be Inoperative, Possible DTC's (continued)

4.3L, 4.8L, 5.0L, 5.3L, 5.7L, 6.0L, 7.4L, 8.1L

Intake Manifold Gasket

Miss/surge worse typically during engine warm up. On these applications the miss/surge may/may not cause misfire DTC's. The concern is generally worse at low engine rpm such as when TCC is applied or even when TCC is not applied during in town driving. The cause of the concern is generally the intake manifold gasket. Do not use carb or brake cleaner to help isolate this specific concern. Brake and carb cleaners can swell the gasket on this engine family enough to make the problem go away for some time, but it will return which will lead to increased diagnosis time. Use soapy water to isolate the outside of the intake and propane to isolate gasket problems inside the engine. Generally the gasket will leak at one of two locations, the right front corner or the center of the manifold on the left side. Remove the manifold and inspect the gasket if it has been leaking you will typically see the gasket is "dry and clean" in the area of the leak. Replace the gasket and torque to specifications.



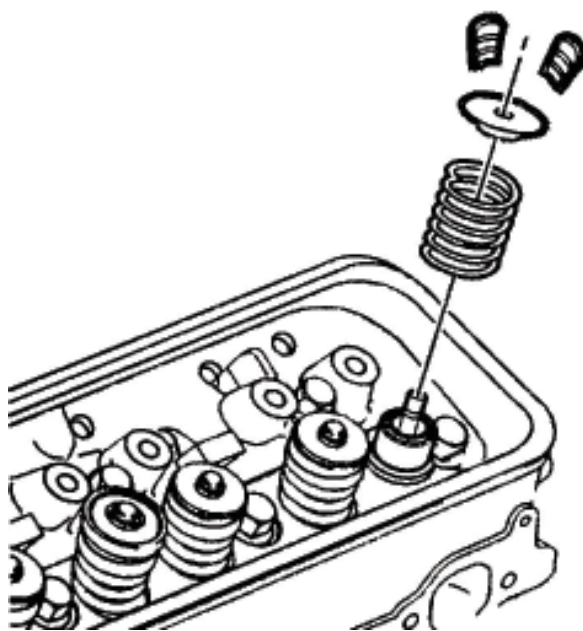
LCT 1000, 4L60E/65E, 4L80E/85E

Shudder, Miss , Surge, No TCC, Cruise may be Inoperative, Possible DTC's (continued)

4.3L, 4.8L, 5.0L, 5.3L, 5.7L, 6.0L, 7.4L, 8.1L

Valve Springs and Valve Guides

Miss/surge at high road speeds or at higher engine RPM's. This concern is generally at engine rpms above 3000 (road speed generally above 60 MPH) with or without TCC applied. Although several things can cause this concern, 2 areas are common causes when conventional diagnostic strategies are not helpful. Both concerns can be isolated by performing a "RUNNING" compression test at the suspect engine speed. Normal running compression is generally 50 psi or greater. If in doubt compare the running compression on the cylinder in question to other the cylinders. If the running compression is low, inspect for broken or weak valve springs and for valves sticking in their guides. Neither of these concerns can be isolated with a vacuum gauge as vacuum gauge diagnostics are only accurate at normal high engine vacuum scenarios. Replace the damaged springs or resize the valve guide to attain proper clearance.



LCT 1000, 4L60E/65E, 4L80E/85E

***Shudder, Miss , Surge, No TCC, Cruise may be Inoperative,
Possible DTC's (continued)***

4.8L, 5.3L, 6.0L, 8.1L

Module/Coil Assembly

This concern typically goes away as the vehicle reaches full operating temperature. All of these engine families use the “coil on plug” design ignition system. During diagnosis you may note that you are intermittently missing spark on one of the cylinders. Replace module/coil assembly.



LCT 1000, 4L60E/65E, 4L80E/85E

Noise when Stopping or when Accelerating from a Stop

Some 1996-2004 truck and SUV 4WD/AWD applications equipped with the 4L60E, 4L65E, LCT 1000, 4L80E, 4L80EHD or the 4L85E transmission may exhibit a clunk, pop, thud or squawk noise as the vehicle is coming to a stop or the noise may occur as the vehicle is pulling away from a stop. The noise is generally pronounced and is intermittent in some cases. In some instances this condition may have been corrected for a short period by installing GM slip yoke lubricant.

The drive shaft yoke may be sticking or binding on the transfer case output shaft. The yoke is slipping then grabbing on the output shaft causing a noise that can be heard and in many cases felt by the operator.

Prior to attempting to permanently repair the condition make sure your vehicle is actually displaying the condition listed above and not one of the conditions listed below:

- Launch shudder or vibration (99-2003 X Cab short box) correct with updated prop shaft # 15071486 and pinion yoke #15071485
- Downshift clunk on a coast down below 15mph (2003 K/N Trucks with 6.0L Vin U or N and 4L65E (M32) and a NR3 or NR4 transfer case. This condition is typically corrected with a PCM software update. The updated program commands the transmission to make a 3-1 downshift at low speeds rather than a 3-2, 2-1 downshift pattern as it was originally calibrated to do. Check the GM calibration web site to see if it is available for your application. : <http://calid.gm.com>

To correct the condition install a “Nickel Plated” slip yoke. Refer to the information below to determine which part number is required for you application.

YEAR	SERIES	BODY STYLE	2 WHEEL/4WHEEL	PART NUMBER
1996-2004	1500 Series	(New and Old body style)	4WD/AWD X Cab Short Box	# 12477702(Includes u-joint)
1999-2004	2500 Series	(New body style)	4WD/AWD X Cab Short Box	# 12477704 (Includes u-joint)
1999-2004	1500 Series	(New and Old body style)	4WD/AWD Reg cab and SUV 4WD/AWD 1996 and later Reg cab and Suburban/Escalade EXT/ Yukon XL and Escalade ESV	# 12479383 (With out U-joint)
1999-2004	1500 Series	(New body style)	AWD/4WD Tahoe/Yukon/Escalade	# 12479384 (With out U-joint)
1999-2004	2500 HD/3500 Series	(New body style)	AWD/4WD	# 12479385 (With out U-joint)
2001-2004	2500 HD/3500 Series	(New body style)	4WD 6.6L/8.1L LCT 1000	#89058876 (With out U-joint)
1999-2004	2500/3500 Series	(New body style)	AWD/4WD (New body style) 6.0L X cab/Crew cab short box	#89058878 (Includes U-joint)
2004-2005	2500 HD/3500 Series		Build date after 2-2004 6.6L/8.1L LCT 1000 Reg cab, X cab, long box, short box	# 89058880 (Includes u-joint)

LCT 1000, 4L60E/65E, 4L80E/85E

Tow/Haul Mode Intermittent, Does not Function

C/K/G/M/L/S/T Trucks

The tow/haul mode feature was introduced during the 1999 model year with other applications coming during later years. The feature is standard equipment on many 4L60E/65E/80E/85E and LCT applications. The tow/haul feature is most effective when the vehicle's actual gross combined weight (GCWR) is at least 75% of the vehicles rated GCWR. Operating in tow/haul mode when the vehicle is not loaded can result in a slight reduction in fuel economy but it will not lead to transmission related failures. The tow/haul system will provide the following features:

- Reduce shift frequency at a given engine and vehicle load (Shift cycling/hunting)
- Eliminate closed throttle upshifts to reduce shift cycling/hunting as the throttle is reapplied
- Increase the shift points for the transmission allowing the engine to operate within its power band when the vehicle is loaded or towing
- Command TCC ON during lower gear operation (some as low as 2nd gear under certain load and temperature conditions)

On most applications, the system is controlled by a switch mounted in the end of the shift lever. Other applications will use a switch mounted in the dash of the vehicle. The BCM feeds signal voltage to the switch. The switch is normally open (normally open momentary contact) so if the customer is not activating the switch the BCM will see voltage on circuit 553. If the customer presses the switch the voltage on circuit 553 will be pulled low. This signals the BCM to command the PCM via serial data that tow/haul is desired or if tow/haul was active, the BCM will command the PCM to disable the tow/haul feature. In addition the BCM via serial data commands the IPC to illuminate the tow/haul light in the dash of the truck. Tow/Haul will cycle off when the ignition is cycled.

Tow/haul mode will affect the upshift as well as the transmission's downshift points. Typically the MPH effect on shifts will vary with which gear is being commanded. As an example an unloaded 2001 K-truck 6.0L 4L80E application on level ground will perform as follows:

LCT 1000, 4L60E/65E, 4L80E/85E

Tow/Haul Mode Intermittent, Does not Function

C/K/G/M/L/S/T Trucks

TOW/HAUL DISABLED 20%
THROTTLE OPENING
1-2 SHIFT 13 MPH
2-3 SHIFT 24 MPH
3-4 SHIFT 32 MPH
TCC APPLIED 4th GEAR

TOW/HAUL ENABLED 20%
THROTTLE OPENING
1-2 SHIFT 21 MPH
2-3 SHIFT 36 MPH
3-4 SHIFT 55 MPH
TCC APPLIED 3rd GEAR

TOW/HAUL DISABLED 40%
THROTTLE OPENING
1-2 SHIFT 26 MPH
2-3 SHIFT 40 MPH
3-4 SHIFT 70 MPH
TCC 3rd GEAR

TOW/HAUL ENABLED 40%
THROTTLE OPENING
1-2 SHIFT 25 MPH
2-3 SHIFT 42 MPH
3-4 SHIFT 72 MPH
TCC 3rd GEAR



LCT 1000, 4L60E/65E, 4L80E/85E

Tow/Haul Mode Intermittent, Does not Function (continued) ***C/K/G/M/L/S/T Trucks***

Some customers may comment that the tow haul feature is not working or that it works only intermittently on their vehicle. This concern is quite common on fleet vehicle applications.

Two common causes for the above concern are:

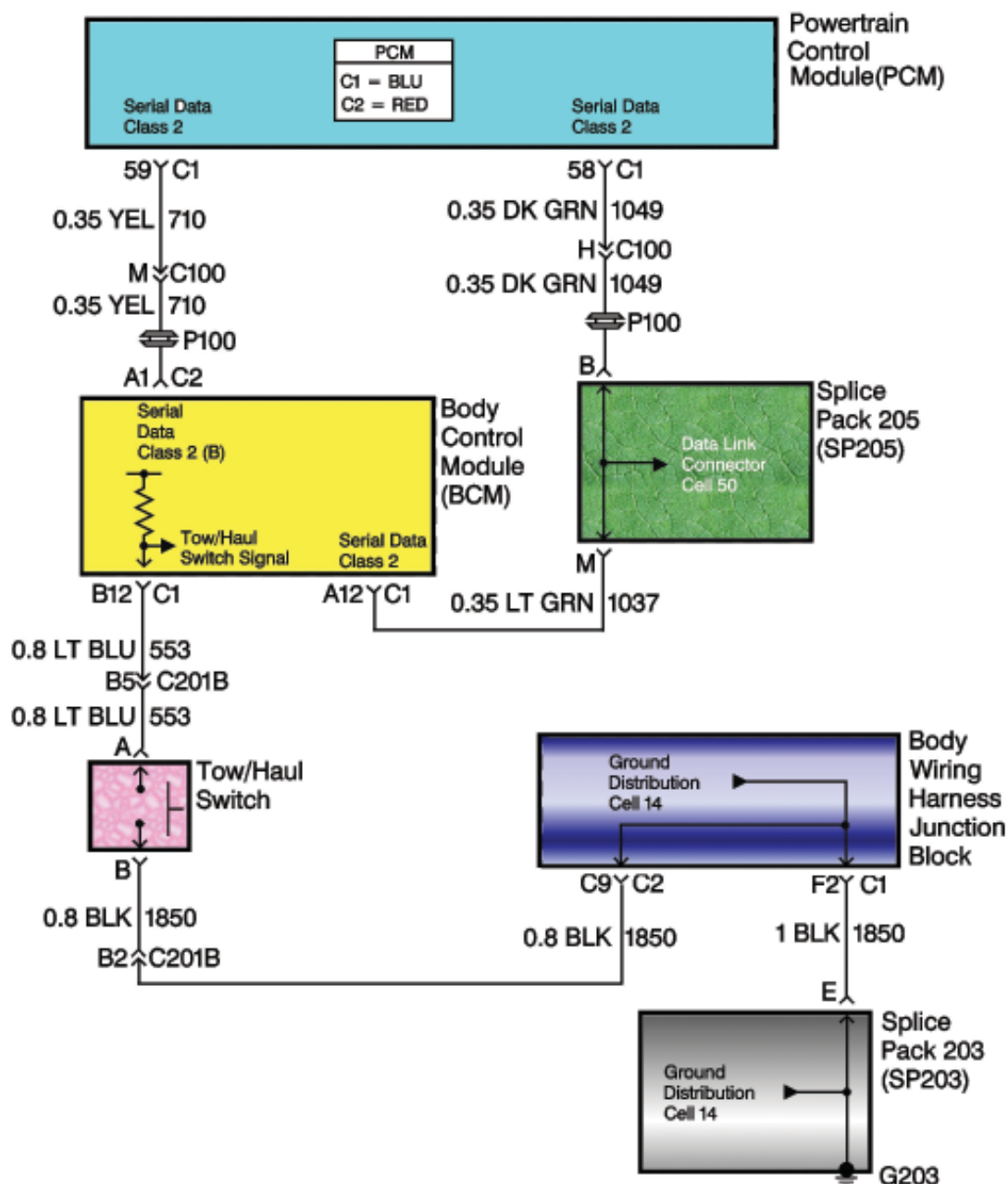
- A faulty tow/haul switch
- A open in circuit 553 (LT BLUE) or circuit 1850 (black) (Fig Tow/haul) The open is generally located in the steering column just behind the gear shift lever boot but above connector C201. In some instances the wires are actually torn in half by the retainer on the column which may have come loose, while others are simple wiring fatigue failures due to the constant movement of the shifter in and out of gear or the tilting of the steering column.

Test the tow/haul switch. If the tow/haul switch is good, inspect and repair circuit 553 or circuit 1850



LCT 1000, 4L60E/65E, 4L80E/85E

Tow/Haul Mode Intermittent, Does not Function (continued)
C/K/G/M/L/S/T Trucks



LCT 1000, 4L60E/65E/ 4L80E/85E

APP Sensor Circuit Concerns with 4.8L, 5.3L, 6.0L, 8.1L Engines

Truck applications equipped with “drive by wire” (TAC) throttle systems may experience one or more of the following symptoms:

- SES light on, Reduced power light on, lack of engine power
- Any combination of the following APP/TP sensor DTC's set P1514, P1515, P1516, P1518, P0120, P0220 or P2135
- APP/TP sensor DTC's P1285, P1286 or P2133 set after repairs have been performed

If the vehicle is setting any combination of the following DTC's P1514, P1515, P1516, P1518, P0120, P0220 or P2135 and you are unable to correct the concern, inspect the TAC control motor circuit #581 (Yellow wire) and circuit 582 (brown wire) for damage. Inspect circuit 581/582 pin tension, connector crimps, and for damage to wiring. Generally damage occurs to the wiring within 1 foot of the throttle body. Wiring that is broken inside the insulation has also been found as a cause for this concern.

If the vehicle is setting any combination of the following DTC's P1285, P1286 or P2133 after repairs have been performed, the wrong part number APP sensor assembly may have been installed. As was covered in the 2003 ATRA seminar, the part number for the APP assembly changed because the number of potentiometers within the sensor changed from 3 sensors (part number 15177923) to 2 sensors (part number 15120405) on later applications. The update to the APP sensor occurred during the 2003 model year on some applications with other applications coming on line during 2004 and 2005. In addition you may find that the shop manual schematics and diagnostics for your application may not show the updated sensor design. If your vehicle is equipped with the 2 sensor APP design you must use the correct schematics and diagnostic procedures to properly diagnose your application.

4L60E/4L65E/4L70E

2005 Updates

A major update is planned for the 4L60E/65E applications for the 2006 model year. The introduction of an input speed sensor (ISS) on “some models” will be fully implemented for the 2006 model year. As with other changes in the past, some of the changes will be pulled forward into the mid 2005 model year applications in preparation for the roll out of the completed ISS system. In addition a new model transmission will be introduced in 2006 using the same technology, the 4L70E. The addition of the ISS system will make input speed calculations a much simpler process while leading to more accurate diagnosis of transmission related concerns.

Several hardware changes will need to occur in order to implement the ISS system. Many of the changes will occur in stages. Some of the changes are required to make room for the new input speed sensor while others are required to make the ISS function. The updates include:

- Shortening of the Reverse Boost PR valve line-up
- Casting changes within the pump assemble to relocate the S3 bore boss
- Casting changes relocating the TCC release bore
- Update/change Stator support sleeve passages
- Update/change the turbine shaft. The shaft will receive reluctor teeth for sensor operation. In addition the location of the seal rings on the turbine shaft will be repositioned
- Adding an Input speed sensor and updating/changing the vehicle and transmission wiring harness (On applications not using an ISS the sensor hole will be filled with a plug)
- Enable shift control features in the software that were not fully utilized in previous applications
- 2 DTC's were added for the ISS system P0716 and P0717

4L60E/4L65E/4L70E

2005 Updates (continued)

Shortening of the Reverse Boost PR valve line-up

Casting changes within the pump assemble to relocate the S-3 bore boss

**Revised S-3 bore
with updated PR boost,
reverse boost valves to make
room for ISS**

**Note: PR valve train can no
longer be serviced without
Removing the pump**



Updated valve and
single spring

Spring pocket to
reduce build issues



4L60E/4L65E/4L70E

2005 Updates (continued)

Update/change Stator Support Sleeve Passages



4L60E/4L65E/4L70E

2005 Updates (continued)

Input Speed Sensor

The addition of an Input Speed Sensor created the updated/changes in the transmission wiring harness. In applications not using an ISS, the sensor hole will be filled with a plug.



ISS connector

4L60E/4L65E/4L70E

2005 Updates (continued)

Turbine Shaft

Update/change to the turbine shaft. The shaft will receive reluctor teeth for sensor operation. In addition the location of the seal rings on the turbine shaft will be repositioned

***15 teeth added, seal
rings relocated
2.5mm***



4L60E

P0741 Set, Hard Shifts, Cruise Control Inoperative

T-Truck Applications

Bravada, Envoy, Trailblazer and Rainier applications with the 4.2L engine and a 4L60E transmission may set an intermittent P0741 DTC.

CAUSE/REPAIR:

P0741 will set if:

- TP value between 20-90%
- Gear ratio is between .89 and 1.02 (3rd gear)
- TCC duty cycle is greater than 75%
- No TP, VSS, Shift solenoid DTC's are set
- No TCC P0742 DTC set
- TCC slip exceeds 130 RPM for more than 20 seconds

If a P0741 is set the PCM will:

- Illuminate the MIL
- Command maximum line pressure
- Command TCC off
- Inhibit 4th gear if in hot mode
- Inhibit cruise control operation
- Freeze adapts

Several items can cause this DTC to set including:

- A sticking/damaged TCC converter clutch valve
- A faulty/damaged TCC apply solenoid
- A faulty/damaged TCC PWM solenoid
- Worn/sticking/damaged regulator apply isolator valve train
- Leakage within the TCC circuit
- A faulty Torque converter
- Calibration Level

If you are working on a T-truck application, check the calibration level of your vehicle with your scan tool before inspecting for valve, solenoid or leakage issues.

An updated calibration is available for some model years that corrects false P0741, P0335 and P0606 in one calibration download. The calibration numbers for this update are Trans; 12597046 Operating; 12597031. Refer to the GM calibration web site to see if and updated calibration is available for your application.

<http://calid.gm.com>

4L60E

P0741 Set, Hard Shifts, Cruise Control Inoperative (continued)

T-Truck 4.2L

2004/05 Trailblazer, Bravada, Envoy and Rainier applications may exhibit any or all of the following symptoms:

- P0741 set
- SES light on
- Hard shifts
- Cruise inoperative

An updated transmission calibration is available to address the above concerns. Use the GM web site to determine if your vehicle applies to the calibration change. Install the updated calibration. The updated calibration was installed at the plant, in all 4.2L T-truck applications starting September 23rd 2004.

4L60E/65E

Intermittent Neutral in the Over Drive Range

4L60E/65E applications may exhibit a neutral condition when attempting to accelerate from a stop with the vehicle in OD range. In some instances the concern may also be associated with an engine flare and then an engagement bump complaint as the vehicle tries to accelerate from a stop. In most instances the condition is intermittent and generally very hard to duplicate.

Several items may cause the above concern such as:

- Shifter cable condition and adjustment (Common)
- A loss of pressure in the forward clutch circuit
- Debris in the valve body (Common)
- A faulty forward sprag clutch (Not common)
- Broken/missing pump priming spring
- Low roller clutch faulty (Not common)

If the concern can be duplicated note the following:

- Is line pressure normal while the condition is present? If it is low, inspect the pump for missing priming springs.
- Are the PSM/PSA values indicating the unit is in OD range while the condition is present (A= High, B=Low, C=Low)? Does moving the shifter in and out of gear correct the condition? What is the physical condition of the shifter cable? Look for corrosion especially in the areas where the cable halves come together. If the PSM values are not correct, inspect the condition of the rooster comb detents, manual valve linkage and shifter cable adjustment.

If no problems are found or if the problem cannot be duplicated, inspect the valve body for debris and adjust the shifter cable. Upon installation of the valve body, be sure the valve body is moved as close to the front of the transmission as possible before torquing the valve body bolts.



4L60E/4L65E

Poor Acceleration

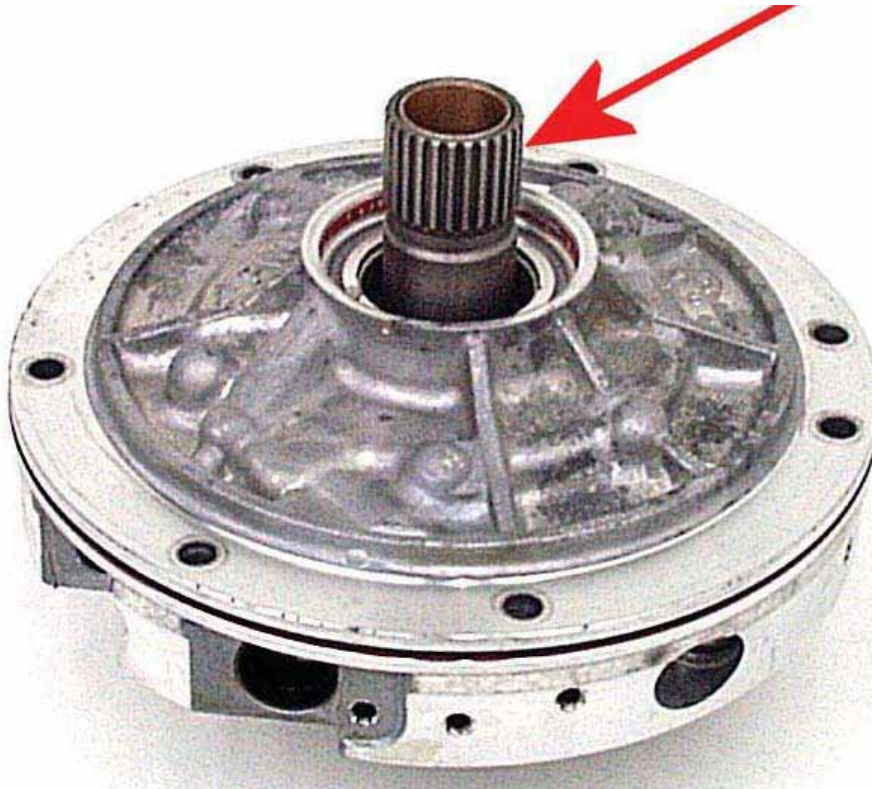
1994-2005 4L60E/65E

1994-2005 4L60E/65E applications may exhibit any or all of the following concerns:

- Poor acceleration at lower speeds, such as when accelerating from a stop
- Surge during acceleration
- Ping/Detonation at idle with the transmission in gear
- Higher than normal transmission temperatures during in town driving
- Possible P0101(MAF), P0106 (MAP) or P0121(TP) set
- Stall speed lower than would be expected for the appropriate engine and transmission package

Depending on the extent of damage, the concerns may be intermittent

Check for driveability issues that could lead to the above concern. If none are found, inspect the stator support splines on the front of the pump for damage. Improper hardening of the splines can lead to damage which can result in the above symptoms. If the splines are found to be damaged replace the pump or the pump half containing the support, torque converter and fully flush and flow check the cooler.



4L60E/4L65E

Code P0756 Set, Erratic Shifting

C/K/N Truck and Y car

P0756 is one of the DTC's that is used to determine if a mechanical/hydraulic problem is present in the transmission. To set a P0756 the following must occur: P0756 Will set if:

- The PCM commands the transmission into 1st gear
- The gear ratio indicates the transmission is not in 1st gear with a measured ratio indicating the unit is in 3rd or 4th gear
- The above conditions are met for more than 1 second
(Creating a 4-3-3-4 shift pattern)
OR
- The PCM commands the transmission into 2nd gear
- The gear ratio indicates the transmission is not in 2nd gear with a measured ratio indicating the unit is in 3rd or 4th gear
- The above conditions are met for more than 2 seconds
(Creating a 4-3-3-4 shift pattern)
OR
- The PCM commands the transmission into 3rd gear
- The gear ratio indicates the transmission is not in 3rd gear with a measured ratio indicating the unit is in 1st or 2nd gear
- The above conditions are met for more than 2 seconds
(Creating a 1-2-2-1 shift pattern)
OR
- The PCM commands the transmission into 4th gear
- The gear ratio indicates the transmission is not in 4th gear with a measured ratio indicating the unit is in 1st or 2nd gear
- The above conditions are met for more than 1 second
(Creating a 1-2-2-1 shift pattern)

If a P0756 is set the PCM will:

- Command 3rd gear
- Command Maximum line pressure
- Inhibit TCC
- Freeze adapts
- Illuminate the MIL

4L60E/4L65E

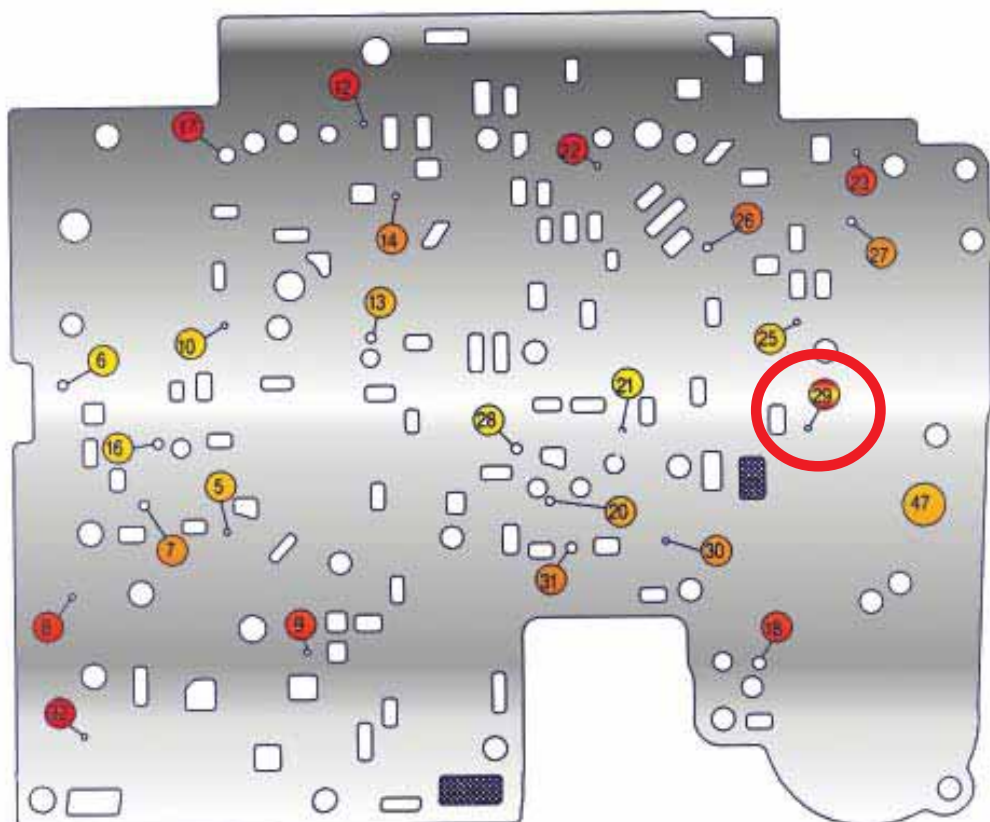
Code P0756 Set, Erratic Shifting (continued)

C/K/N Truck and Y car

Several items can cause a P0756 including:

- A faulty/damaged/stuck/cracked 2-3 shift solenoid
- A damaged 2-3 shift solenoid O-ring
- Debris plugging or restricting AFL feed oil at orifice # 29 in the spacer plate
- Damaged/stuck 2-3 shift valve
- Damaged/stuck 2-3 shuttle valve
- Damaged/stuck 4-3 sequence 3-4 relay valves
- Damaged 3-4 clutch
- Calibration update needed for a false P0756 DTC

Check for a calibration update for this concern (new calibration available for T Truck GMC Canyon and Chevrolet Colorado) Check the GM calibration web site to see if an updated is available for your application. <http://calid.gm.com> If none are found inspect and repair the valves, spacer plate and solenoids as listed above.



5L40E

Speedometer Fluctuation, Shifting Concerns

Cadillac Applications

Some Cadillac applications equipped with the 5L40E may exhibit any or all of the following symptoms:

- Transmission fails to upshift
- Transmission shift points erratic
- Transmission downshifts without customer commanding the shift
- Speedometer drops out/fluctuates
- VSS DTC's Set

Inspect the output VSS wiring for damage. Typically the damage will result from the VSS harness coming in contact with the exhaust around the catalytic converter area. Repair and reposition the harness

Sensor resistance should measure between 325 and 485 ohms at 20°C (68°F). Output voltage will vary from a minimum of 0.5 V peak to peak at 100 RPM, to 600 V peak to peak at 8500 RPM.

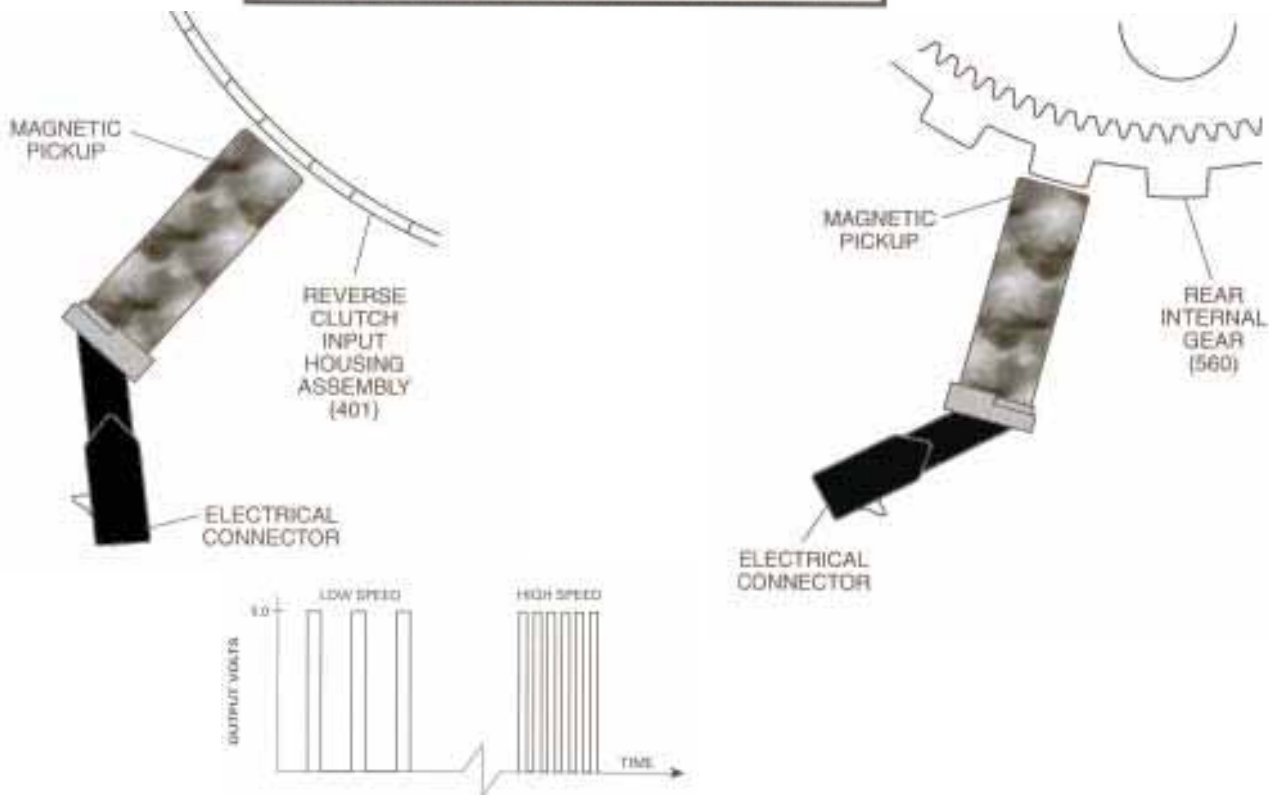
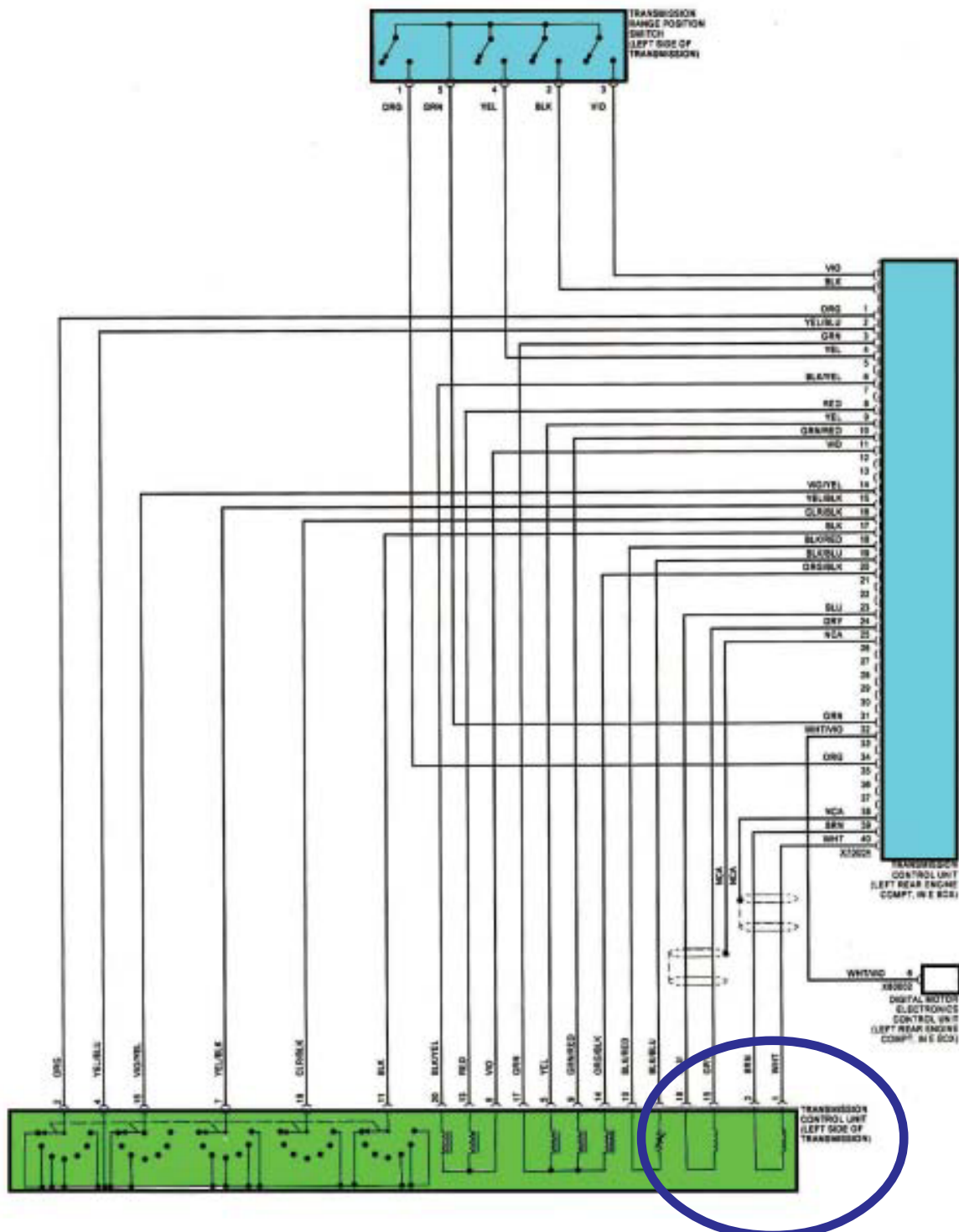


FIGURE A: CONDITIONED SIGNAL

5L40E

Speedometer Fluctuation, Shifting Concerns (continued)

Cadillac Applications



5L40E/50E

Transmission Overheats

Some 5L40E or 5L50E applications may experience a transmission over heat condition. The IPC or DIC may display a message to the customer indicating that the transmission is overheating and instructing the customer to bring the engine to an idle. In addition a P0218 may be set.

The transmission fluid bypass valve may be stuck in the closed position. To determine if the valve is malfunctioning, remove the return line and check the flow rate. The fluid bypass valve starts to open at 152°F (67°C) and should be fully open at 168°F (76°C). If flow is low or zero remove the bypass valve and inspect it for the presence of a black rubber sleeve. If the sleeve is not present or if the valve appears to be malfunctioning replace the transmission bypass valve. If the valve is operating properly, inspect the transmission oil cooler for restrictions.

TransmissionFluid By-Pass Valve

The Transmission Fluid Bypass Valve is part of the heavy duty cooling system for the 5L40E/5L50E transmission.

The Transmission Fluid Bypass Valve starts to open at 152°F (67°C) and should be fully open at
168°F (76°C)



5L40E/50E

Adaptive Learning

The 5L40E and 5L50E applications use a Bosch controller that utilizes an adaptive strategy to assure proper shift feel and clutch durability over the life of the transmission. Like other Hydramatic applications, the 5L40E/50E controllers store adaptive information which must be cleared if the transmission has been replaced or if repair work has been performed on the unit. Clearing adapts can be performed using one of two methods:

- Using a scan tool (recommended)
- Disconnecting the battery (not recommended)

Several different types of adaptive memories are used on the 5L40E/50E including:

- Power on upshift
- Coast down shift
- Quick fill pulse pressure adapt
- Ec³ coast adapt
- Garage shift adapt
- Steady state adapt

(Note: Power on upshift, Coast down shift, Quick fill pulse and Ec³ coast adapt strategies are not functional if transmission temperatures are below 122°F/50°C)

Unlike most GM transmissions, the Bosch controller applications like the 5L40E and 5L50E utilize software that allows for a “Quick learn” process to reduce the amount of time it takes for the adapts to learn their proper values. Three of the adaptive strategies can be learned by operating the vehicle in a specific driving sequence they are:

Garage Shifts

During the warm up transition (initial transmission temp below 165°F/75°C) perform 3 garage shifts at 68°F/20°C intervals from Neutral to Reverse and then Neutral to Drive. Pause after each engagement for at least 5 seconds. To clarify, the technician will perform 3 N-D and 3 N-R engagements for every 68°F/20°C temperature change as the transmission temperature increases toward normal operating temperature.

5L40E/50E

Adaptive Learning (continued)

Power on Upshifts

The transmission temperature must be at least 158°F/70°C to learn power on upshift adapt values. Once the transmission has reached the proper temperature repeat the following upshifts 1-2, 2-3, 3-4, 4-5 at least 3 times at each of the following throttle openings, 15%, 30%, 45%, 60%, 80% and 100% (NOTE: Some upshifts at higher throttle settings may not be feasible due to speed limit laws)

Coast Downshifts

Select manual shift mode to command the shift while meeting the following criteria:

- With the throttle at 0%
- In Manual 5th gear, repeat a 5th gear to 4th gear coasting downshift every 30kph/18mph to cover all the speed range
- In Manual 4th gear, repeat a 4th gear to 3rd gear coasting downshift every 20kph/12mph to cover all the speed range
- In Manual 3rd gear, repeat a 3rd gear to 2nd coasting downshift every 15kph/9mph to cover all the speed range
- In Manual 2nd gear, repeat a 2nd gear to 1st gear coasting downshift every 10kph/6mph to cover all the speed range

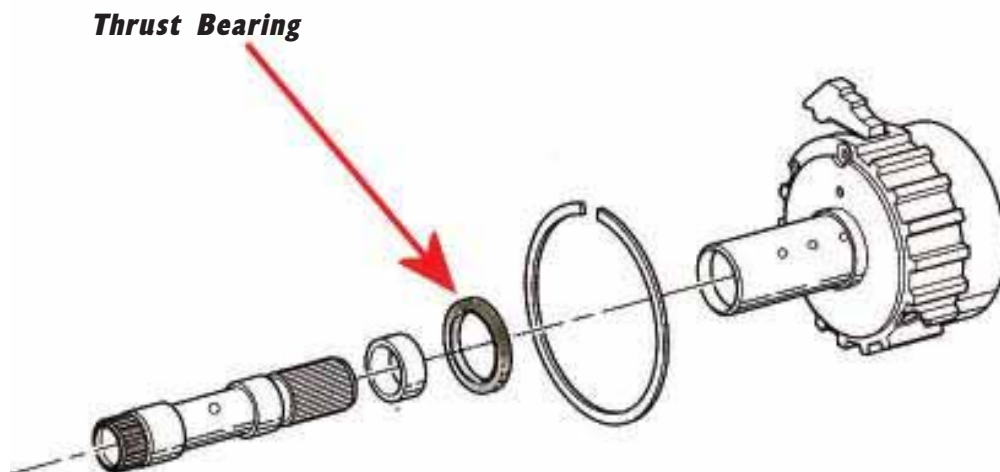
Once all the above maneuvers have been completed, move the selector into the standard position and increase your speed to achieve 5th gear. Remove your foot from the accelerator and apply the brake while bringing the vehicle to a stop (repeat this braking phase 2 times). Evaluate the shifts and if needed repeat the above steps.

4T65E

2005 Updates

Several changes have been implemented for the 4T65E application, they include:

- Thrust washer #691 Part #24200584 that was changed to a thrust bearing, part number 24214159. This change was designed to improve high mileage durability and reduce metal contamination. The updated part will back service previous years and models
- Park gear, bearing and sun gear shaft were updated. This updated design will enhance in car service of the final drive by making it harder for the park gear bearing to become mispositioned. The park gear now has a deeper pocket, while the sun shaft had a collar added to it. In addition, the bearing is now thicker. The parts will back service only if they are used as a complete package. Do not inter-mix/interchange the updated and the previous design components. Two kits are planned to allow back service of the update. AWD applications will use one of the kits while all FWD applications will use a different kit part number.
- During the 2005 model year, the Pontiac Grand Prix GXP will be fitted with the Gen III 5.3L V8. To upgrade the 4T65E to a GM V-8 application several items were changed including; The bottom pan, the case, the filter, a modified channel plate and sleeve, Redesigned drive and driven sprocket support bearings Upgraded single sided 4th clutches and 4th clutch shaft, Upgraded forward band with new material and anchor location, HD ceramic shot peened carriers, planetaries and bearings, HD ceramic shot peened final drive and updated calibrations for the V-8 application.
- As a mid 2005 change all 4T65E applications will use phenolic 1-2,2-3 accumulator pistons. The updated pistons will back service previous applications.



4T65E

Noise, Won't Move, Possible DTC and Hard Shifts

1999-2003 4T65E applications

A grinding/growling type noise, which may change in intensity as the unit shifts through the gears, depending on the extent of damage. In addition, the unit may even exhibit hard shifts and a P1811 (max adapt) DTC may be set. In some cases the unit will not move if the failure is extreme enough.

As the unit is disassembled for inspection, the amount of damage found can vary greatly. If you find a lot of metal particulate in the pan the damage will likely be greater. The root cause of the problem is input sun/carrier bearing #671. A thickness variation concern with the bearing races lead to cracks in the bearing races and ultimately bearing failure. In many cases the bearing needles and the race materials migrate into the planetaries which leads to extensive damage.

PART NUMBERS

- # 668 Input sun gear 24204098
- # 672 Input carrier 24204430
- # 675 Reaction sun and shell 24205127
- # 674 Thrust bearing 8646504
- # 676 Thrust bearing 8649353



4T65E

Burnt 2nd Clutches, Burnt 4TH Clutches

4T65E applications may have burned 2nd and/or 4th clutches as well as the symptoms that result from damaged clutches.

The accumulator bore “taper” may be too deep (Improper machining) resulting in over travel of the 1-2 or 3-4 accumulator piston into the tapered area. When the piston seal contacts the tapered area, the seal may become damaged leading to pressure loss in the affected circuit. Pressure loss in the circuit will result in damage to the appropriate clutch.

Inspect the accumulator housing bores for damage and equal bore taper depth. If the taper is excessive in one of the suspect bores or if the bore is damaged replace the accumulator housing.



4T65E

Fluid Leaking from the Reverse Servo Area

2002-2004 4T65E applications may exhibit leakage from the reverse servo area when the transmission is exposed to cold temperatures (Lower than 20°F -7°C). As the transmission temperature increases, the leak will typically decrease or be eliminated completely.

An updated seal and cover is available under GM part number 24207376. Currently the updated seal is not available separately from GM. Install the updated parts.



4T65E

Fluid Leak at the Left Axle Area

Many technicians have been misled into believing that the leak is being caused by the axle seal or by the valve body side cover seal. In many instances the leak is actually being caused by seal #59 which seals the side cover to the channel plate. Remove the seal and inspect it closely as you roll it with your fingers and you will generally notice a small cut or nick in the seal.



4T80E

Manual Valve Clip

Some technicians have expressed concerns with finding the clip that connects the manual valve without buying the complete assembly. The valve clip is available under GM part number 24209439



4T80E

P0741

Some 4T80E applications may set a DTC P0741. In this instance, this concern may/may not be intermittent.

P0741 will set if:

- No TP, VSS, ISS, IMS, TCC PWM, DTC's are set
- P0742 is not set
- The transmission is in 3rd or 4th gear
- TFT 20-133°C (68-271°F)
- TP between 10-50%
- Engine calculated torque is between 43-215 N-m (32-159 lb ft)
- TCC is commanded full on
- TCC Slip speed is excessive. Slip thresholds (rationality checks) are as follows:

<u>SLIP RPM</u>	<u>TORQUE lb ft</u>
48	0
80	48
200	95
252	143
271	191
280	239

- The above conditions are present for more than 5 seconds

If a P0741 is set the PCM will:

- Illuminate the MIL on the 2nd consecutive failure/trip (TYPE B DTC)
- Inhibit 4th gear if in hot mode
- Disable TCC

4T80E

P0741 (continued)

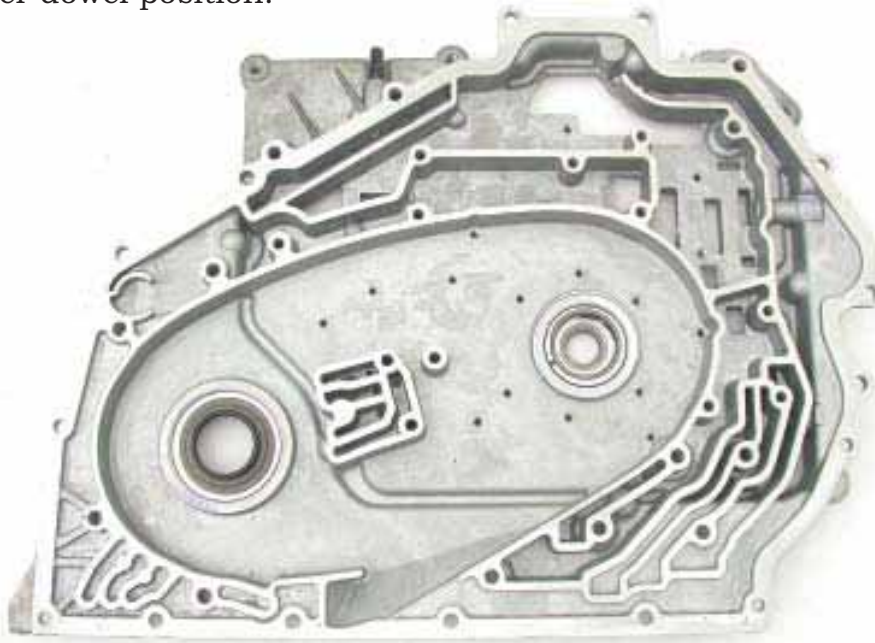
Several items can cause a P0741 to set including:

- TCC Control valve stuck or damaged
- TCC regulator valve worn or sticking
- TCC feed limit valve worn or sticking
- TCC enable valve stuck or damaged
- Lack of 3rd gear oil feed to the TCC PWM solenoid
- Drive sprocket support bushing damaged/worn
- Faulty TCC PWM solenoid (Refer to previous ATRA seminar manuals regarding quality spill issues with these solenoids) (COMMON)
- Improper/outdated calibration (Refer to previous ATRA seminar manuals or the GM web site <http://calid.gm.com>. Calibration updates have been made to some applications to address this issue. As discussed and demonstrated in previous ATRA seminars, always check your calibration level before attempting other repairs for this concern. (COMMON)
- Worn/damaged drive sprocket support seal rings (# 34, 35, 409, 412). In addition inspect the 2 case cover seals (34, 35) for uneven wear. (Unit may have some axle seal seepage in addition to the P0741 DTC) Inspect the drive sprocket support (#400) for wear in the bearing race area. (Drive sprocket support part number 8681071) Inspect the case cover (33) for damage due to the sprocket support bearing failure. If any of the above are found replace the case cover. (Case cover part number 24229131) The case covers on some 98-04 application may have machining issues allowing the case cover bore to be improperly positioned when compared to the case cover dowel position. (COMMON)
- A faulty Torque converter (COMMON ON VCC APPLICATIONS) See Previous ATRA seminar books to see if your model code uses a VCC converter)

4T80E

P0741 (continued)

Worn/damaged drive sprocket support seal rings (# 34, 35, 409, 412). In addition inspect the two case cover seals for uneven wear. (Unit may have some axle seal seepage in addition to the P0741 DTC) Inspect the drive sprocket support (#400) for wear in the bearing race area. (Drive sprocket support part number 8681071) Inspect the case cover (33) for damage due to the sprocket support bearing failure. If any of the above are found replace the case cover. (Case cover part number 24229131) The case covers on some 98-04 application may have machining issues allowing the case cover bore to be improperly positioned when compared to the case cover dowel position.



4T80E

Harsh Shifts

P0748 (Formerly DTC 76) DTC Set

Some 4T80E applications may experience a hard shift condition which may/may not be followed by various driver information messages. Upon inspection, the technician may find that a P0748 (DTC 76) DTC is set in the PCM memory. PCM DTC P0748 (DTC 76) will set if:

- Command PCS amperage varies from actual PCS amperage by more than 0.05A
- The condition is present for longer than 1 second
- P0730 and/or P1811 DTC's are not set

If a P0748 (DTC 76) sets the PCM will:

- Command maximum line pressure
- Freeze adapts
- Display a service vehicle soon, service transmission message on the DIC

Several items may cause the a P0748 (DTC 76) including:

- An open, short to ground or short to voltage in circuit 1229 (Blue/White)
- An open or short to ground in circuit 1228 (Red/Black)
- A faulty PCS- Replace the PCS
- Oil intrusion into the transmission pass thru connector. Remove the connector and inspect for fluid contamination. If fluid is present, install the updated harness. NOTE: This concern may also lead to other DTC's as well as other symptoms
- On some PCM applications the PCS driver circuit (QDM) also is used to operate the fuel injectors. On some of those applications engine oil has been getting into the injector harness causing the DTC to set. Inspect the injector harness and connectors then measure the injector resistances to be certain a shorted injector or damaged/contaminated harness is not responsible for your concern. Replace and repair as necessary
- Some PCM applications have experienced circuit board solder joint issues. This issue was addressed on 9-6-04 for both production as well as remanufactured PCM applications. If you are unable to find the root cause for your concern and your PCM was manufactured prior to the above date replace the PCM

4T80E

Updates 2005

The major change for the 4T80E application for the mid 2005 model year is the elimination of the VCC (Viscous Converter Clutch) for all models. The upgrade is scheduled for the 1st quarter 2005. Replacing the VCC converter is a new Ec³ Torque converter. (TCC converters will still be available on some applications as in previous years) It should be noted that the update to an Ec³ system is designed for VCC as well as some of the TCC applications. In addition it is imperative that the updated parts/gaskets not be intermixed with parts/gaskets for the other designs. To facilitate such a change several changes were required including:

- New Ec³ converters for all VCC applications
- Updated calibrations to enable Ec³ operation. In addition the new calibration will change parameters required for setting 4 DTC's (P0741, P0742, P2763 and P2764)
- An updated Case Cover Spacer Plate. Four Orifice dimensions were changed and an Id hole was added to the NEW plate in the Left corner to act as a quick identification marker when compared to the prior VCC application spacer plate. Three Orifice dimensions were changed and an Id hole was added to the NEW plate in the Left corner to act as a quick identification marker when compared to the prior TCC application spacer plate. The new spacer plate will service VCC and TCC applications. The updated spacer plate will be available in a kit to allow the technician to update prior VCC applications to an Ec³ application.
- An updated Case Cover Spacer Plate Gasket. One passage change was required for the Ec³ application gasket. The updated gasket is included in the service kit to update prior VCC applications
- An updated Valve Body Gasket. One passage change was required for the Ec³ application gasket. The updated gasket is included in the service kit to update prior VCC applications
- An updated converter clutch control valve spring and TCC enable spring are used on all Ec³ applications. Both the TCC control spring and the TCC enable spring are now the same spring tension and dimensions.

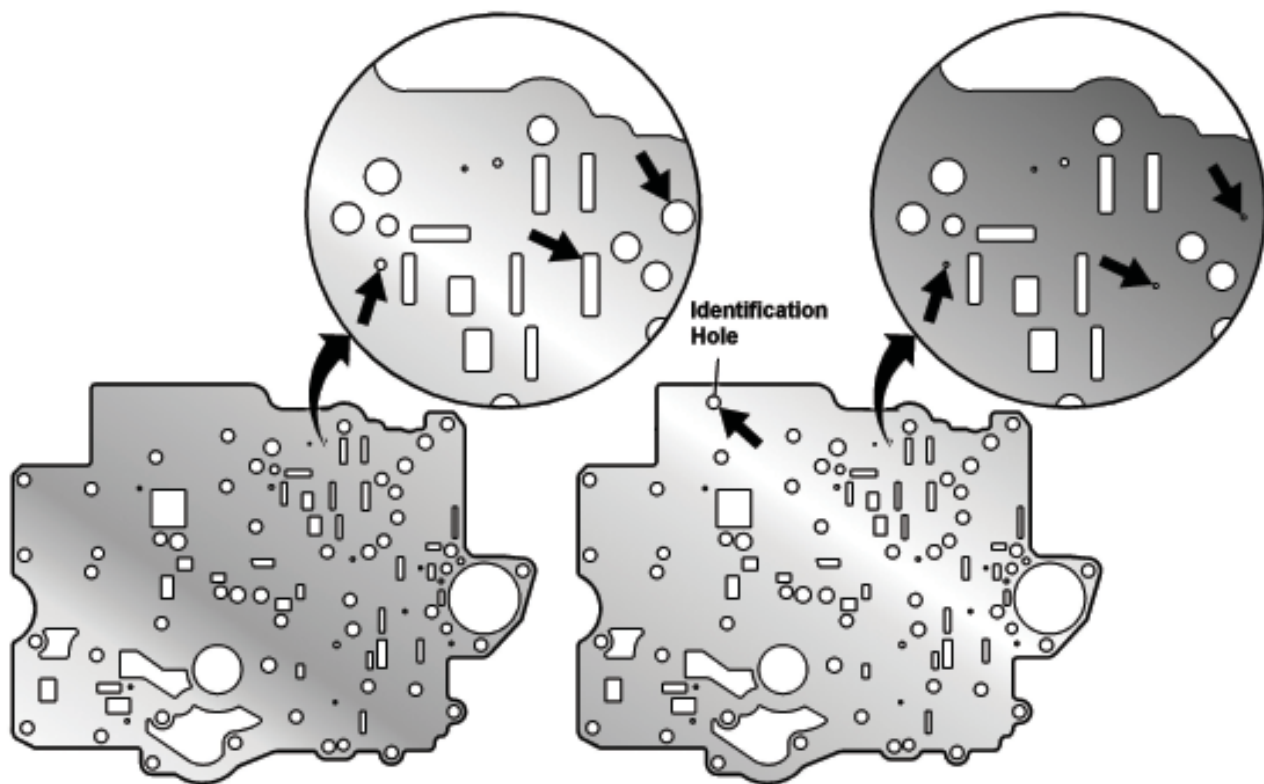
The update kit is available under part number 24233678 (Some TCC applications such as export models) 24233679 (VCC applications)

4T80E

Updates 2005 (continued)

Case Cover Spacer Plate

An updated Case Cover Spacer Plate. Four Orifice dimensions were changed and an Id hole was added to the NEW plate in the Left corner to act as a quick identification marker when compared to the prior VCC application spacer plate. Three Orifice dimensions were changed and an Id hole was added to the NEW plate in the left corner to act as a quick identification marker when compared to the prior TCC application spacer plate. The new spacer plate will service VCC and TCC applications. The updated spacer plate will be available in a kit to allow the technician to update prior VCC applications to an Ec³ application.



**Case Cover Assembly Spacer Plate
(TCC) Current Design**

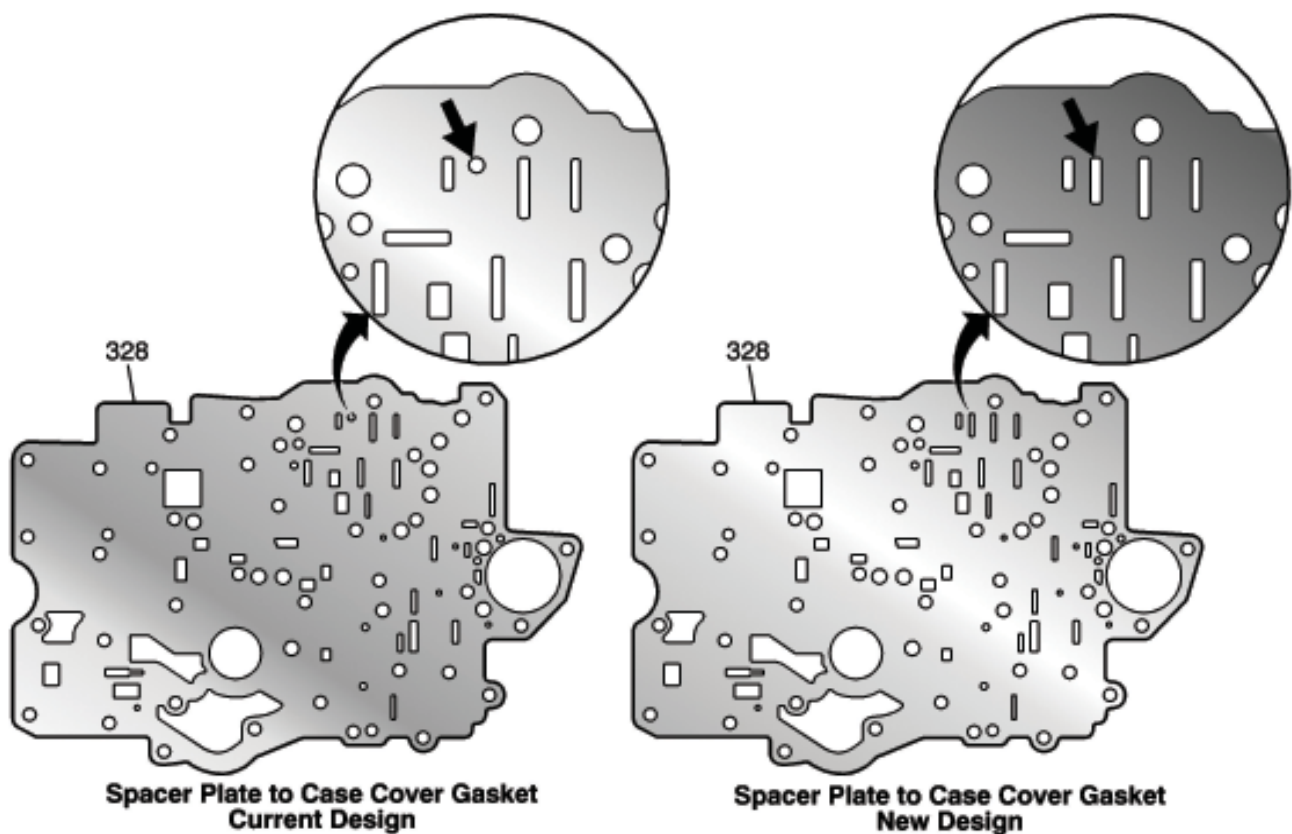
**Case Cover Assembly Spacer Plate
(TCC) New Design**

4T80E

Updates 2005 (continued)

Case Cover Spacer Plate Gasket

An updated Case Cover Spacer Plate Gasket. One passage change was required for the Ec³ application gasket. The updated gasket is included in the service kit to update prior VCC applications

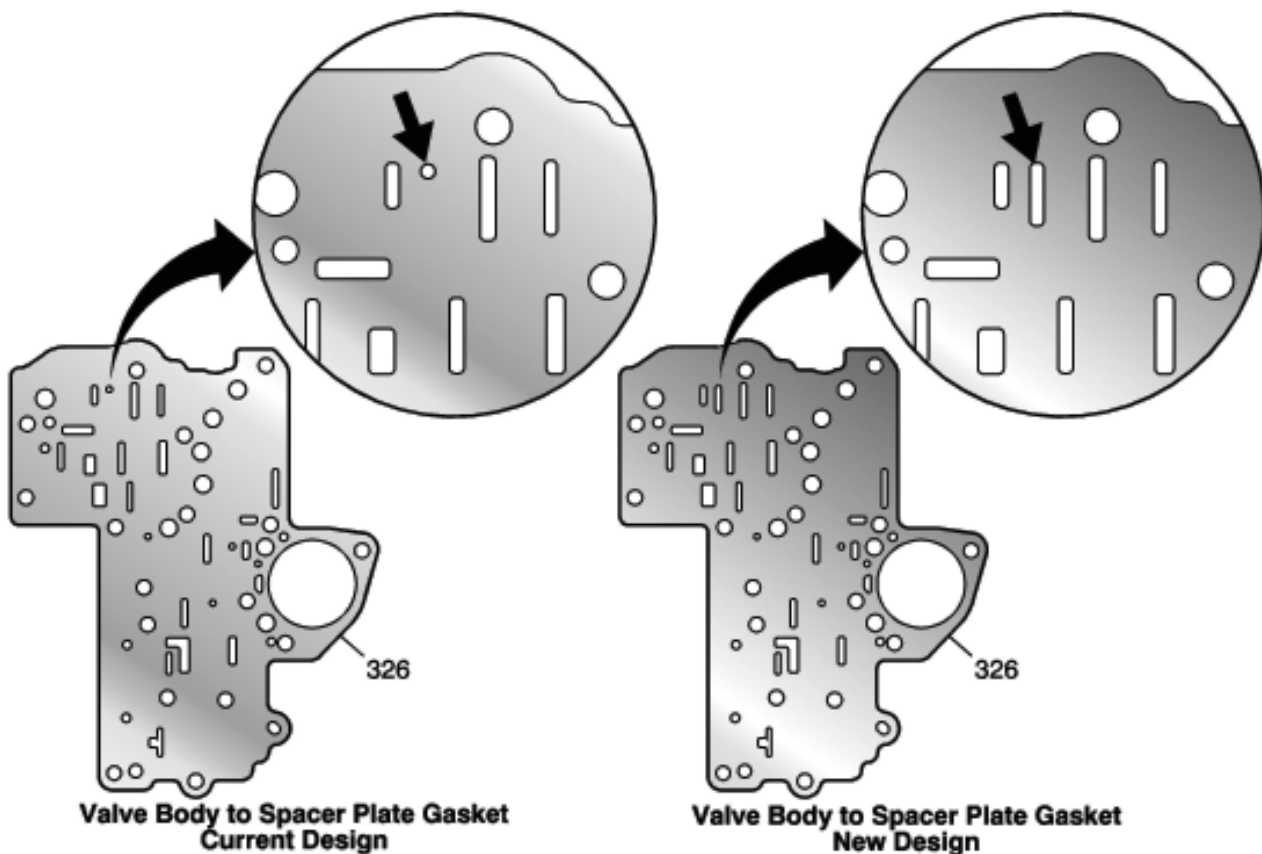


4T80E

Updates 2005 (continued)

Valve Body to Spacer Plate Gasket

An updated Valve Body Gasket. One passage change was required for the Ec³ application gasket. The updated gasket is included in the service kit to update prior VCC applications



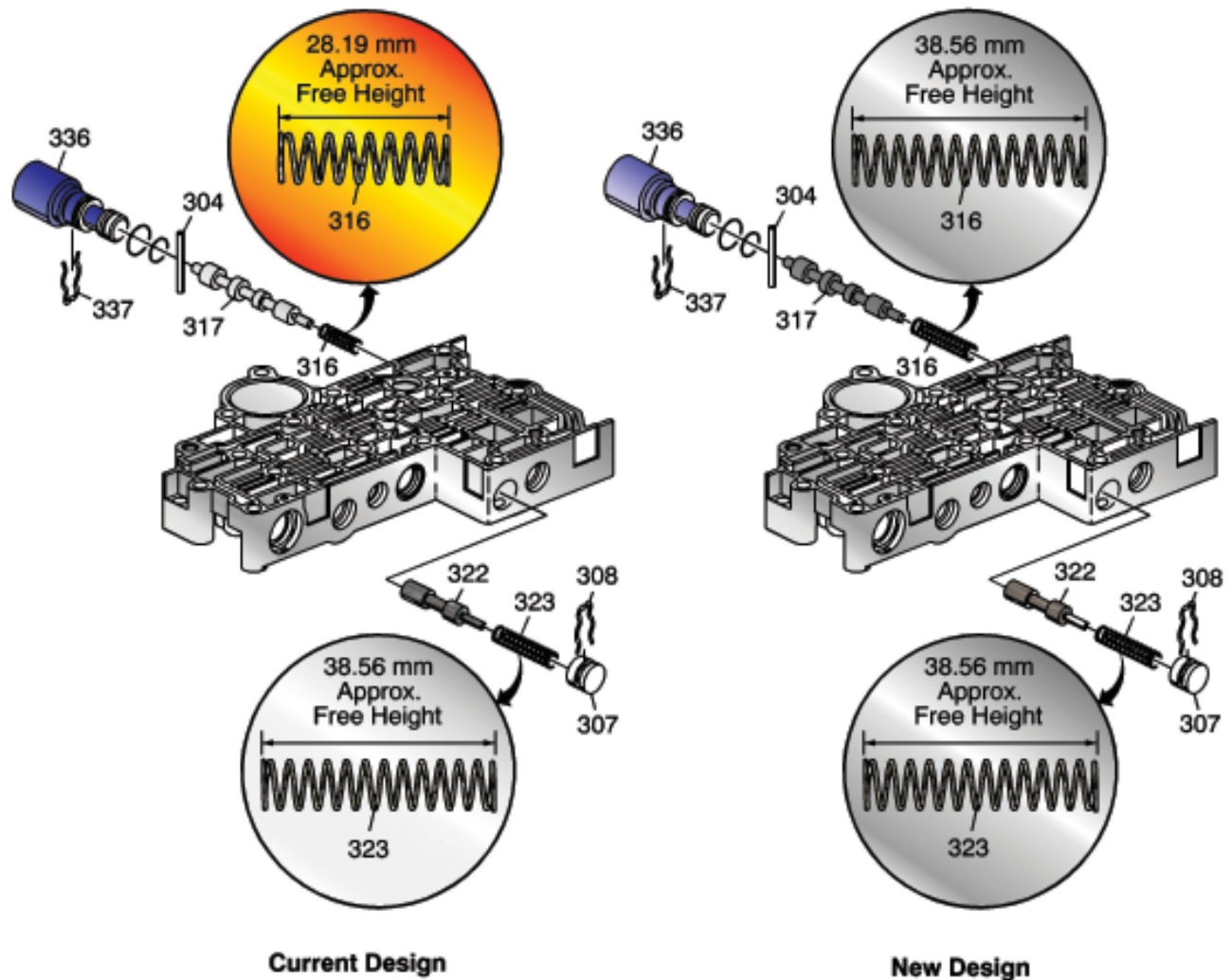
4T80E

Updates 2005 (continued)

Valves and Springs

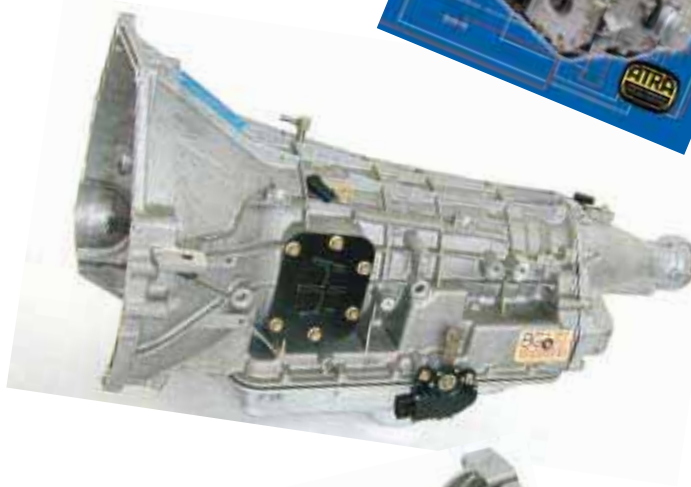
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FORD

Section



Ford

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TorqShift

6.0L Diesel No Start, Misfire Codes

Vehicles equipped with the 6.0L engine may exhibit a no start or engine misfire codes. Multiple root causes can create these symptoms, including the Fuel Injection Control Module (FICM).

There are a couple of areas to look, at the wiring and the FICM. If the FICM is suspected to be the root cause, refer to the following procedure to verify the FICM is at fault before replacement.

NOTE: Verify the scanner has the latest level and the vehicle is updated to the latest calibration. Calibration issues and related Powertrain components can also cause this problem.

The most common symptoms of a failed FICM are a no start or multiple misfire codes that can not be removed. Diagnostic codes U0105 and/or P0611 may also be present. Symptoms other than these are not likely to be caused by the FICM.

If the FICM is replaced, it will not contain the necessary software. It must be programmed prior to use.

Check for FICM wiring harness for chafing. Perform a wiggle test to verify the integrity of the connections at the FICM and injectors. It's common to see DTC's P2614 and P2617 as a result of wire chafing. It is often necessary to push on the engine/injector harness to duplicate a ground out condition. Ensure the FICM connectors are fully seated. If any wire chafing is noted, repair as necessary and evaluate the vehicle. If the condition is corrected, return the vehicle to customer. If no wiring chafes are located proceed with the following pages.

NOTE: Some common chafing locations are:

1. The upper left valve cover
2. Valve Cover Bolt areas
3. Near the intake bolts
4. Under and near the FICM

TorqShift

6.0L Diesel No Start, Misfire Codes (continued)

Set up your scanner to test the FICM power and grounds by selecting these PIDS:

1. FICM_VPWR
2. FICM_LPWR
3. FICM_MPWR
4. B+

Monitor PIDS for the following values:

FICM_VPWR: FICM vehicle power from ignition switch voltage = battery voltage

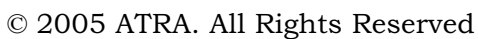
FICM_LPWR: FICM logic power from fuse, FICM relay voltage = battery voltage

FICM_MPWR: Internal FICM power voltage = 47-50 volts

B+: Battery Voltage

If all of the above readings are within range, proceed with the following pages. If any of the above are out of range, disconnect the three FICM connectors and inspect condition of connector, pins, and wiring at the connector, paying close attention for wiring chafes. Repair any issues and evaluate the vehicle, if the condition is corrected return the vehicle to the customer.

6.0L Diesel No Start, Misfire Codes (continued)



TorqShift

6.0L Diesel No Start, Misfire Codes (continued)

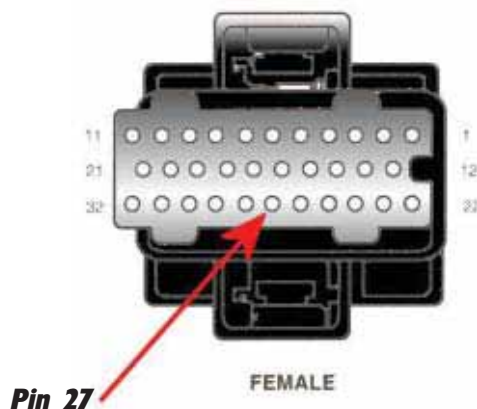
If the condition is still present use your voltmeter to check the following:

Check for B+ voltage at pin 27 of connector 1388c with the KOEO. If there is no voltage present, or low voltage is present, check circuit 3098 for an open. If B+ is present, jumper pin 27 of connector 1388c to a good battery ground.

Check for B+ voltage at pins 4, 7, 8, 23, 24, 25. If no or low voltage is found at any pin, repair as necessary.

If B+ is present at all pins, replace the FICM and return vehicle to customer.

NOTE: If the FICM is replaced it will not contain software, it must be programmed prior to use.



PIN	Circuit	Circuit Function	PIN	Circuit	Circuit Function
1	574 (BK/PK)	Ground	17		Not Used
2	574 (BK/PK)	Ground	18		Not Used
3	574 (BK/PK)	Ground	19		Not Used
4	876 (DG/LG)	Fuel Injector Control Module (FICM) Power Relay, Switched Power	20		Not Used
5	54 (LG/YE)	Fuel Delivery Command	21		Not Used
6		Not Used	22	574 (BK/PK)	Ground
7	1717 (VT/OG)	Voltage Supplied in Start and Run (Overload Protection)	23	876 (DG/LG)	Fuel Injector Control Module (FICM) Power Relay, Switched Power
8	814 (WH/BK)	Fuel Injector Control Module (FICM) Power Relay, Switched Power, Fuse Feed	24	876 (DG/LG)	Fuel Injector Control Module (FICM) Power Relay, Switched Power
9	878 (PK/YE)	Powertrain Control systems, Communications	25	876 (DG/LG)	Fuel Injector Control Module (FICM) Power Relay, Switched Power
10	56 (DB/OG)	Cylinder Identification	26	574 (BK/PK)	Ground
11		Not Used	27	3098 (RD/YE)	Fuel Injector Control Module (FICM) Power Relay, Control
12		Not Used	28		Not Used
13		Not Used	29		Not Used
14		Not Used	30	69 (RD/LG)	CAN Bus 2H
15		Not Used	31	70 (LB/WH)	CAN Bus 2L
16		Not Used	32	57 (BK)	Drain Wire

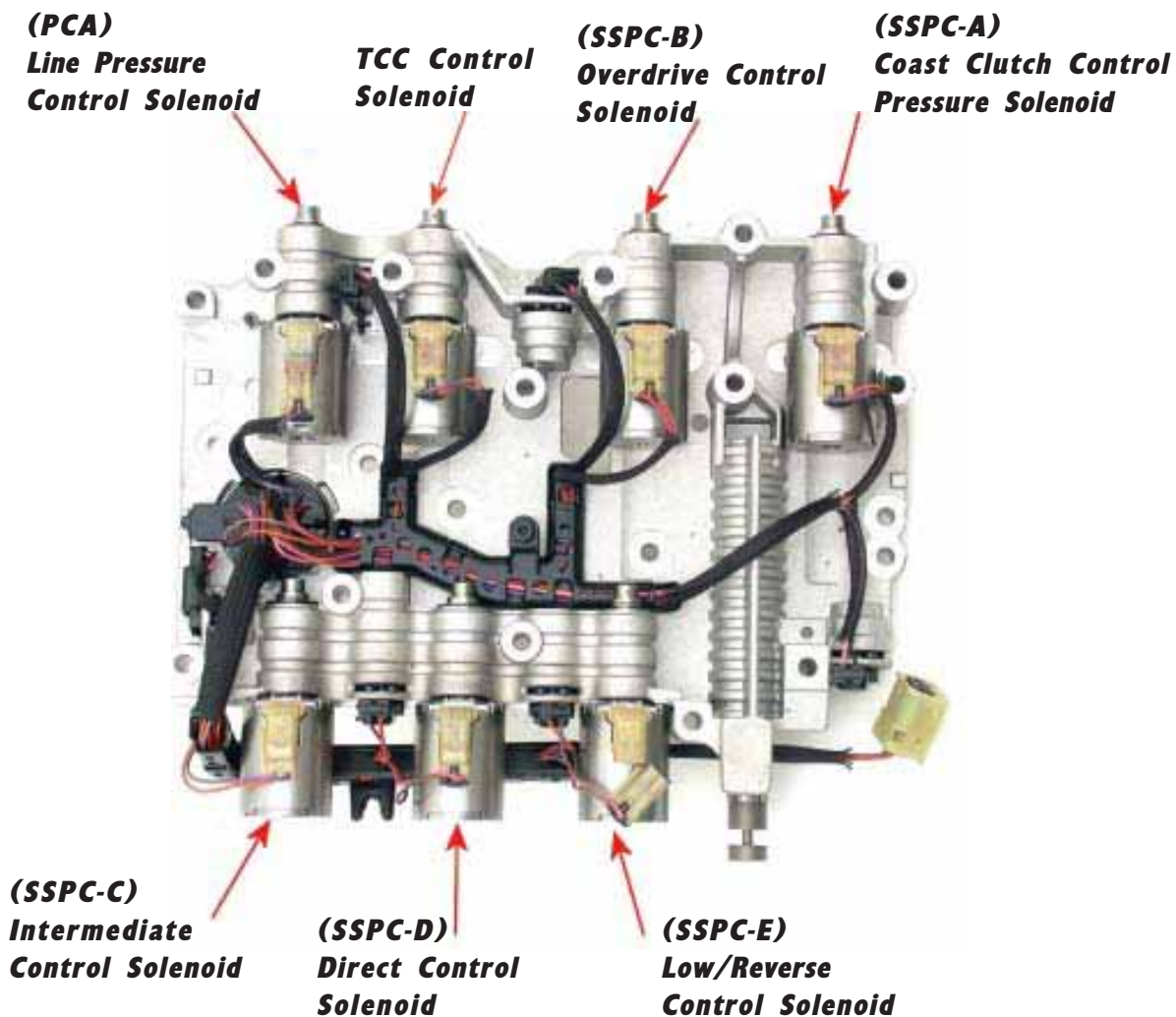
TorqShift

Erratic Line Pressure

Pressure Control Solenoid Failure

A failed solenoid can cause line pressure to bounce from 20 to 200 psi. Symptoms include erratic shift patterns, harsh shifts, soft shifts, flare shifts. The TorqShift transmission has a shift strategy system which allows the PCM to adjust the pressure of the transmission, allowing the transmission to shift the same way every time. To properly diagnose the solenoid, use your scanner and pressure gauge simultaneously. Compare the two readings to determine if the PCM is the cause or if the solenoid has failed.

- (2)Two **3C3Z-7J136-AA (Coast and the Direct Clutch Solenoids)**
- (4)Four **3C3Z-7J136-BA (L/R, Intermediate, O/D, TCC Solenoids)**
- (1)One **4C3Z-7G383-AA (Line Pressure Control Solenoid)**



TorqShift

Harsh Shifts Caused by the Wrong Fluid

Mercon SP ATF

You must use Mercon SP ATF. Using Mercon V may cause harsh shifts, overheating, possible delayed engagements, and erratic shifts. These symptoms can be evident within the first test-drive.

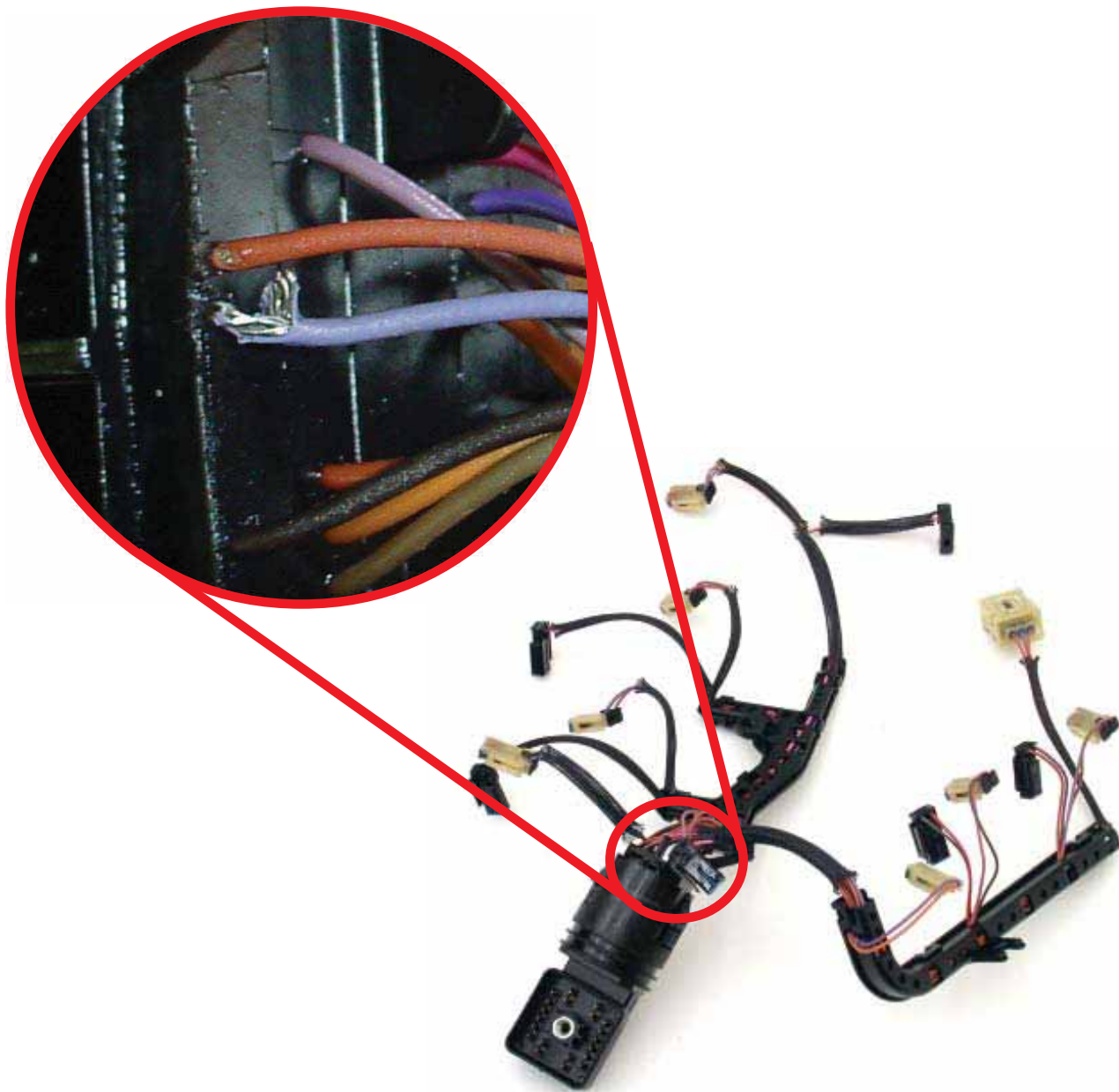


TorqShift

Harsh Shifts

Solenoid Body Harness Damaged

Harsh shifts may be caused by the solenoid body harness being damaged. You may not see codes associated with this concern. Using your scanner, check the command from the PCM to the solenoid, if the PCM command to the solenoid is correct, remove the pan and check the solenoid harness.



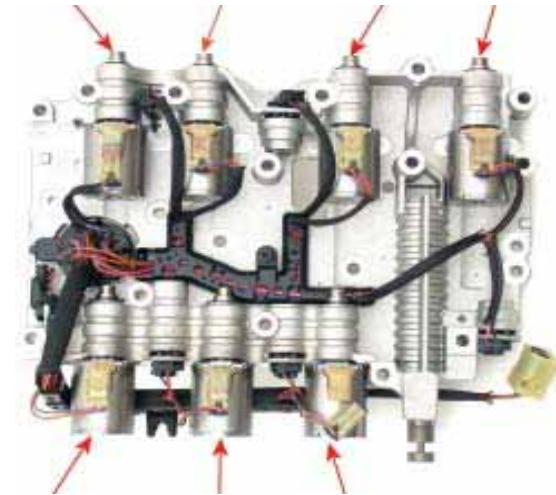
TorqShift

Internal Transmission Wiring Harness or Solenoid Body Replacement – Service Tip

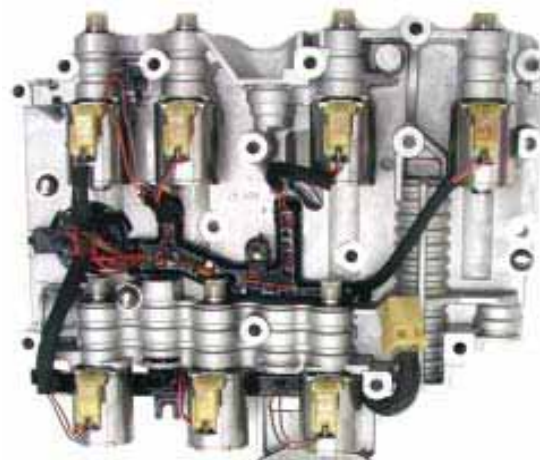
Super Duty F-Series or Excursion

The new solenoid harness does not have pressure switch connectors and is no longer required. The new harness supersedes all harnesses. A PCM reprogram is recommended.

Earlier Solenoid Body and Harness with Switches



Updated Solenoid Body and Harness without Switches



TorqShift

Harsh Disengagement When Shifting From Reverse to Park

2003 Super Duty F-Series or Excursion

Some 2003-2004 Super Duty F-Series or Excursion vehicles built before 11/14/2003 with a 6.0L diesel engine and TorqShift transmission may exhibit a harsh disengagement when shifting from reverse to park. A clunk may also be heard during this disengagement. To correct this condition, replace the original solenoid body manual valve with a redesigned part 4C3Z-7D376-AA. To perform this repair, first remove the solenoid body assembly. Replace the manual valve with the redesigned valve. Use a new solenoid body-to-case gasket (3C3Z-7C155-DA) during reinstallation, clean and reuse the bottom pan gasket, and top off with Mercon SP transmission fluid.

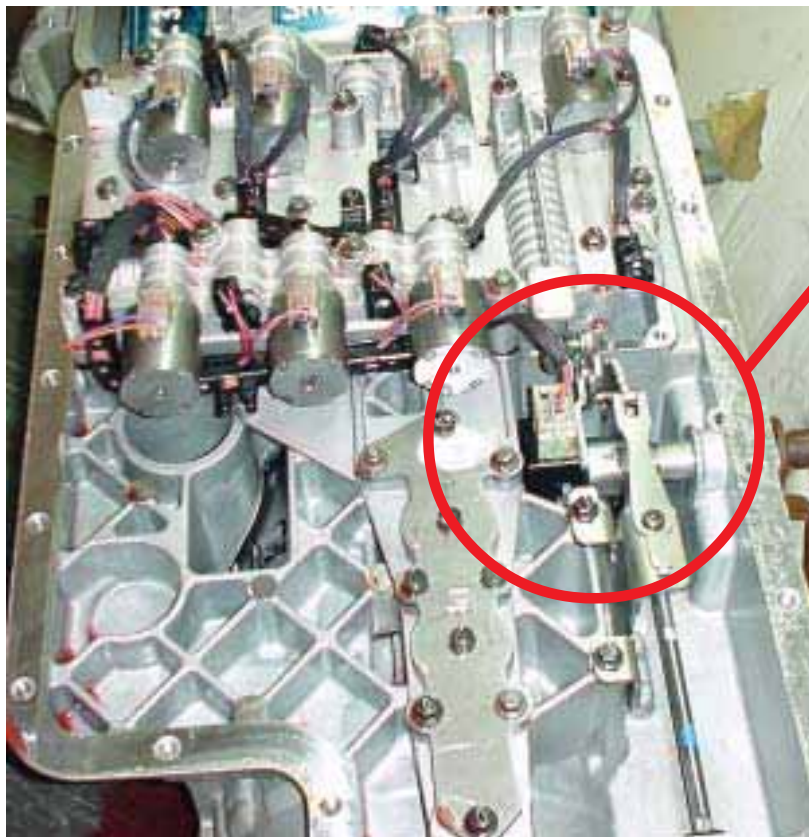


Torqshift

No Crank/No Start with Low TR-P Voltage

2003 Super Duty F-Series or Excursion Equipped with 6.0L DIT

Some 2003-2004 Super Duty F-Series or Excursion vehicles equipped with a 6.0L DIT and Torqshift transmission may exhibit a no crank/no start. DTC's P1705 (TR circuit not indicating park/neutral during self test) P0706 (TR-P sensor frequency fault) and P0707 (TR-P sensor circuit duty cycle low input) may be present. If low voltage is found at the transmission range position sensor (TR-P) Pin 21 (3-4 volts) circuit 371, electrically disconnect the cooling fan clutch and retest the voltage. If the voltage now reads battery voltage and the vehicle cranks and starts, verify with a short test drive that the codes do not return. Do not service the transmission or replace the transmission range position sensor (TR-P) for this condition. Refer to the appropriate wiring diagram and service manual section to diagnose and service the cooling fan.



***The
Transmission
Range Sensor is
internal and
located on the
manual shaft.***

E4OD/4R100

Check Ball Identification and Symptom Chart

Repeated failures are caused by only two types of problems: parts or technique. If a *part* is causing the failure, it should be no surprise that using the same no-good part causes the same failure.

If the problem is *technique*, it means a process you are doing is actually *causing* the failure. An example would be drilling out a separator plate hole, changing the servo size, or leaving a checkball out. Sure, there are valid reasons for making modifications.

Checkballs are one of those *technique* issues: “yeah, leave that checkball out for a better 2-3 shift.” We’ve all heard it, and we’ve all done it at one point or another, sometimes successfully, sometimes we’re not so sure. But what we *can* be sure of is what those little checkballs do, and what effect leaving them out will have.

Early 1989 E4ODs...

The first E4OD had 16 checkballs.

Late 1989 E4ODs...

The second release of the E4OD was during the mid-year production. This change omitted CB3, CB4 and CB5. These are orificing checkballs for the intermediate, overdrive and direct accumulators. When these checkballs were omitted, so were the separator plate holes where they seated.

Leaving these checkballs out on an early 1989 model will cause a slide-bump during the shifts. Leaving the check balls in will cause no problem in late ‘89.

1990 – 1993 E4ODs...

In 1990, Ford omitted CB12 and BS5. BS5 was a shuttle for direct clutch oil and would shuttle between the direct clutch accumulator feed and engagement control valve feed. This ball didn’t do anything in reverse, and wasn’t needed for third because the engagement control valve blocked fluid flowing back through the system.

CB12 worked *with* BS5 in that it was part of the direct clutch feed circuit. It simply forced any oil on one side of BS5 to go through the engagement control valve during the apply, and then allowed for a quick drain of the circuit during release (reverse only).

E40D/4R100

Check Ball Identification and Symptom Chart (continued)

1990 – 1993 E40Ds...(continued)

After the spearator plate hole for CB12 was eliminated, there was no more need for BS5. These two checkballs are a matched set; that is, it either has both or neither. If you install them on models that don't use them it's no big deal; they won't interfere with anything.

If you leave out the BS5 on models that require it, direct clutch oil will leak from the CB12 plate hole in third gear — regardless of whether you install the CB12 ball. When they eliminated CB12 they got rid of the hole in the plate for it. If your plate doesn't have a hole for CB12, leave both balls out (CB12 and BS5).

If you leave out CB12 on models that use it, it'll bypass the engagement control valve during reverse engagements, resulting in a *more aggressive engagement* in reverse.

1994 – 1995 E40Ds...

Some '94-'95 repair manuals labeled CB13 as CB12 in the hydraulics and in the check ball ID section. The function of this ball has always been the same. It's still the same ol' checkball in the lower valve body section that's been around since the beginning.

1996 – On E40Ds...

The changes in 1996 include two checkballs that were added (CB15 and CB16) and BS6 was moved from the case to the lower valve body. This change was to prime the low/reverse circuit in 1st gear, park and neutral.

Moving BS6 to the lower valve body put it near the SS2 (shift solenoid 2) circuit, so low/reverse clutch oil would dump when SS2 came on for the shift to 2nd. In addition, the 1-2 manual transition valve prevents SS2 oil from reaching the 1-2 shift valve until the low/reverse clutch is fully drained. CB16 is part of that circuit.

If you forget to install CB16, you may not realize it for a while. That's because it'll only leak low/reverse oil in manual low; reverse will be fine. BS6 was eliminated on some models and the reverse circuit to it was eliminated. But if you leave it out on models that use it, the transmission will shift 1-4, or in some cases (depending on condition of SS2) you'll get a 1-3-4 shift. Some models don't use BS6, but it won't cause any problem if you accidentally install it, because the hole in the separator is oblong, so the ball won't seal the hole. If the plate has two holes over the bath tub you must use a check ball in that location. If the plate has one hole, do not install a check ball.

E40D/4R100

Check Ball Identification and Symptom Chart

1996 – On E40Ds...

The CB15 is used in the exhaust circuit of the L/R modulator valve. The idea is that anytime you block off a regulator valve exhaust circuit it'll open fully to line (or whatever is feeding the circuit). So in park or neutral the L/R modulator valve primes the L/R clutch circuit, and CB15 allows the L/R modulator valve exhaust circuit to drain.

When you go to reverse, reverse oil begins to flow through the circuits, pushing CB15 into the L/R modulator valve exhaust, and BAM! — the low/reverse clutch applies. Applying the L/R clutch before the direct clutch in reverse makes for a much smoother apply. The L/R clutch will still apply if you leave out CB15, but not as quickly, so you may get a bang going from park to reverse.

The Rest of the Checkballs...

So far we've only talked about the checkballs that have changed over the years. Let's do a quick rundown on the ones that *haven't* changed:

CB1: Blocks manual 2 and L oil going to the 4-3-2 manual timing valve from leaking through the reverse circuit. Leave it out and it'll dump line oil out of the manual control valve.

CB6: Orificing checkball for the direct clutch exhaust. During a 3-2 kickdown it forces direct clutch oil to drain through an orifice, slowing the release. If you leave it out, you'll get a clunk on a 3-2 kickdown.

CB7: Orificing checkball for the overdrive clutch exhaust. During a 4-3 kickdown it forces overdrive clutch oil to drain through an orifice, slowing the release. If you leave it out, you'll get a clunk on a 4-3 kickdown.

CB8: Orificing checkball for the coast clutch apply. If you leave it out, you'll get a clunk when the coast clutch applies for engine braking.

CB9: Orificing checkball for intermediate servo apply. If you leave it out, the intermediate band will apply more aggressively during a manual 3-2 downshift.

CB14: Orificing checkball for intermediate clutch release. If you leave it out you'll get a clunk on the 2-1 kickdown.

E4OD/4R100

Check Ball Identification and Symptom Chart

The Rest of the Checkballs...

BS1: Shuttles between reverse oil and manual 2/low oil to stroke the coast clutch shift valve. If you leave it out, line oil dumps through the manual control valve in all of these ranges... not to mention the coast clutch won't apply for engine braking, *except* in drive when you cancel OD.

BS2: Shuttles between SS2 oil and manual 2 oil to stroke the 1-2 shift valve and L/R modulator valve. If you leave it out, the transmission will shift from 1st to 4th. That is, when the computer commands 2nd it stays in 1st. When it commands 3rd, it goes to 4th (just like BS6 on 1996-98 model E4ODs). The problem is, if the SS2 is stuck off it'll cause the same thing, so be careful. One more thing, depending on the condition of SS2, and well it flows, you may get a 1-3-4 shift.

BS3: Shuttles between reverse/manual 2 oil and the coast clutch solenoid to stroke the coast clutch shift valve. If you leave it out, you won't have any engine braking when you cancel overdrive. You'll also lose engine braking in reverse, manual 2 and manual low, just like leaving out BS1.

E4OD/4R100

Check Ball Identification and Symptom Chart (continued)

All Checkball Locations For E4OD and 4R100						
Ball Location	Early 1989	Late 1989	1990-93	1994-95	1996-on	4R100
CB1	X	X	X	X	X	X
CB3	X	{1}				
CB4	X	{1}				
CB5	X	{1}				
CB6	X	X	X	X	X	X
CB7	X	X	X	X	X	X
CB8	X	X	X	X	X	X
CB9	X	X	X	X	X	X
CB12	X	X				
CB13	X	X	X {2}	X	X	X
CB14	X	X	X	X	X	X
CB15					X	X
CB16					X	X
BS1	X	X	X	X	X	X
BS2	X	X	X	X	X	X
BS3	X	X	X	X	X	X
BS5	X	X {3}				
BS6 {4}	X	X	X	X	X {5}	X {5}

{1} CB3, CB4, CB5 (See early '89 check ball location page) If the plate has seats for these check balls, a ball must be installed.

{2} Some '94-'95 manuals labeled CB13 as CB12 in the hydraulics and in the check ball ID section. The function of this ball has always been the same.

{3} 5/16 steel ball in late '89

{4} '89-'95-BS6 Check ball was located in the case. '96-on BS6 was moved to the upper Valve body. (Also see note #5)

{5} The BS6 check ball was deleted in some models. If the plate has two holes over the bath tub you must use a check ball in that location. If the plate has one hole, do not install a check ball.

E40D/4R100

Check Ball Identification and Symptom Chart (continued)

Common Complaint Associated to Missing or Damaged Check Balls		
Ball Location	Comments	Complaint
CB1		Low line in Manual 2 and L
CB3		1-2 Slide Bump
CB4		3-4 Slide Bump
CB5		2-3 Slide Bump
CB6		Harsh 3-2 kickdown
CB7		Harsh 4-3 Kickdown
CB8		Clunk when applying the coast clutch
CB9		Harsh manual 3-2 coastdown shift
CB12	1994-95	Aggressive forward engagement
CB13	Except '94-95	Aggressive forward engagement
CB14		Harsh 2-1 Kickdown
CB15	96-on	Bump into Reverse
CB16	96-on	Repeat Low/Reverse Clutch Failure
BS1		
		No Coast clutch apply. Low line in Reverse, Manual 2 & L. The coast clutch will work in Drive when you cancel OD
BS2		Shifts 1-4*
BS3		No coast clutch apply
BS5	89 only	Slips in third and fourth, Burnt Direct Clutch
BS6	1989-95	Low line in Reverse and Manual 2
BS6	1996-on some models	Low line in Reverse and Manual 2, Shifts 1-4*

*Can shift 1-3-4 depending on the condition of SS2

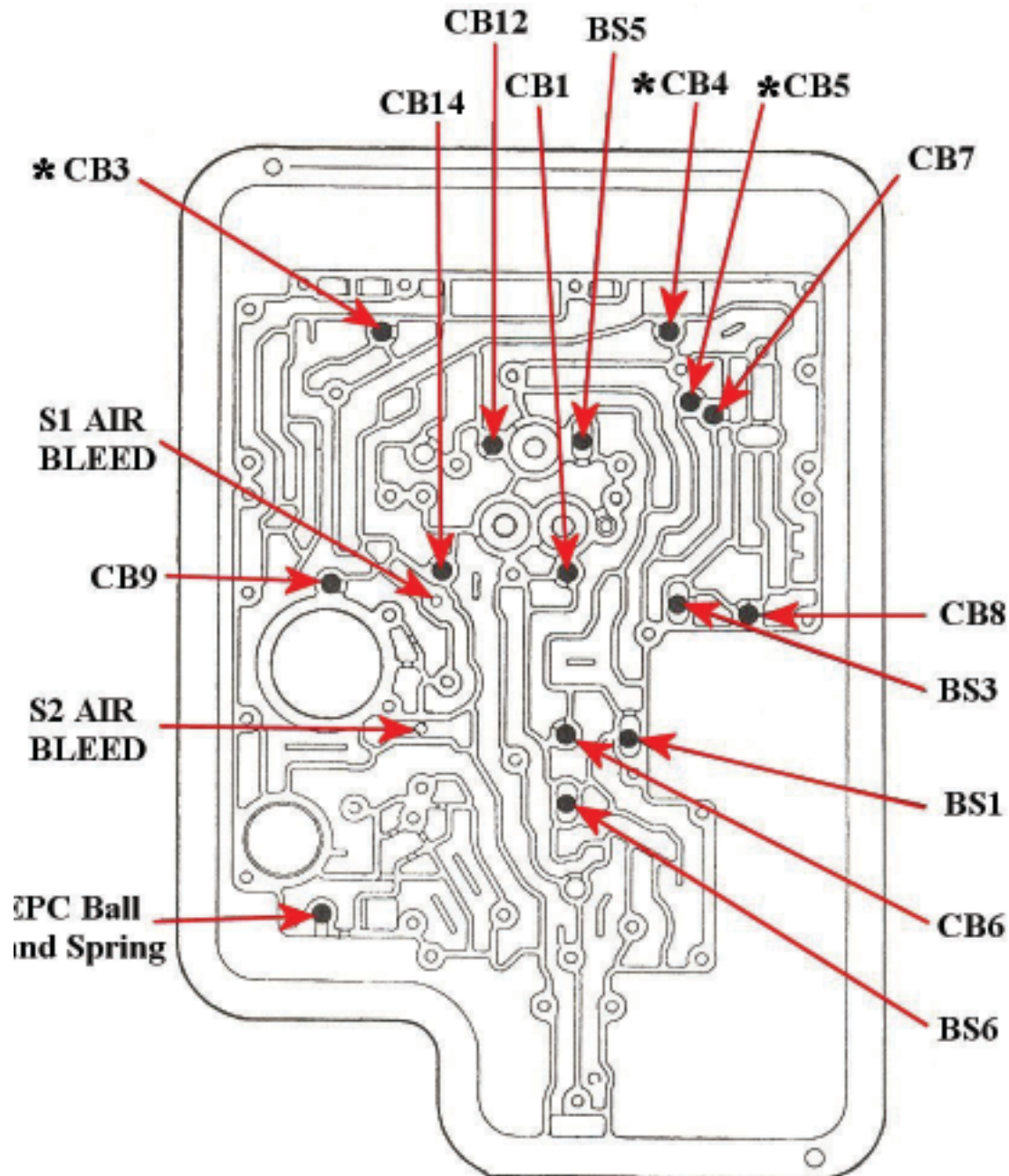
E40D/4R100

Check Ball Identification and Symptom Chart (continued)

Early 1989

*CB3, CB4, CB5

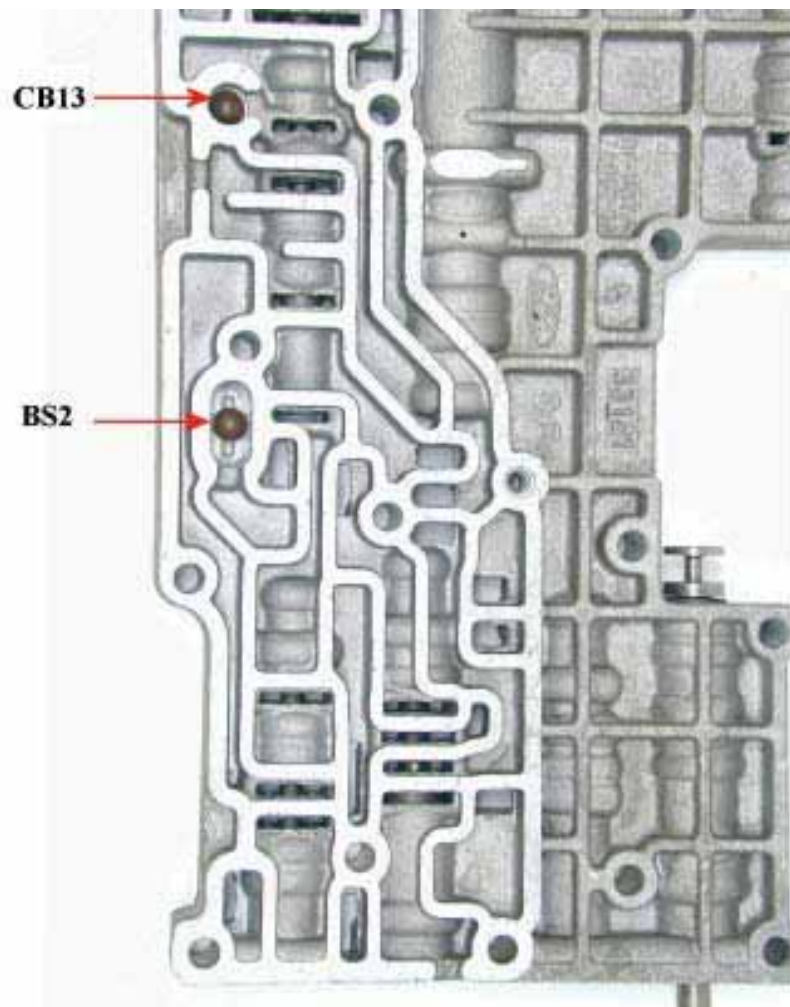
If the plate has seats for these check balls, a ball must be installed.



E40D/4R100

Check Ball Identification and Symptom Chart (continued)

Early 1989



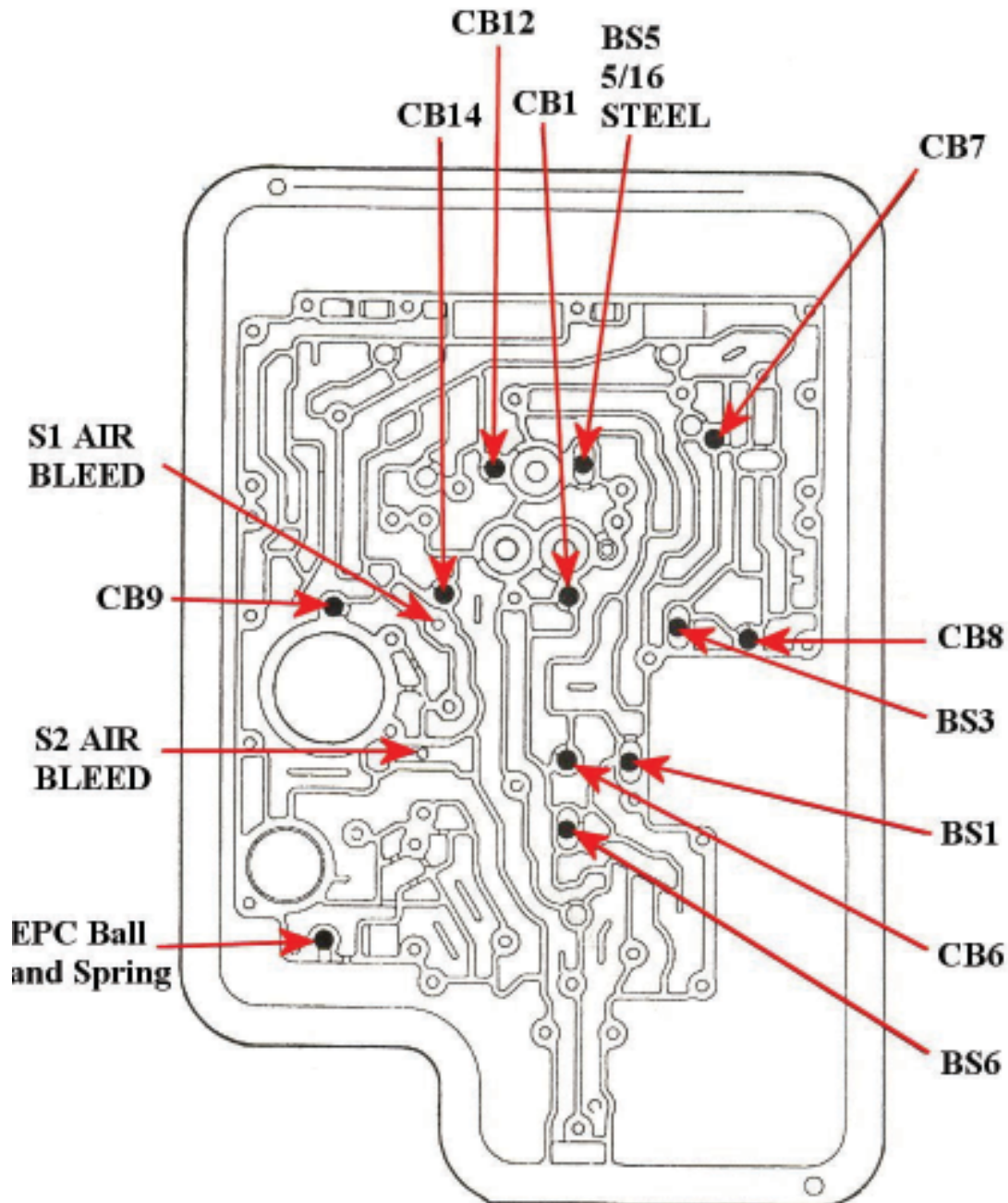
E40D/4R100

Check Ball Identification and Symptom Chart (continued)

Late 1989

*CB3, CB4, CB5 (See early '89 check ball location page)

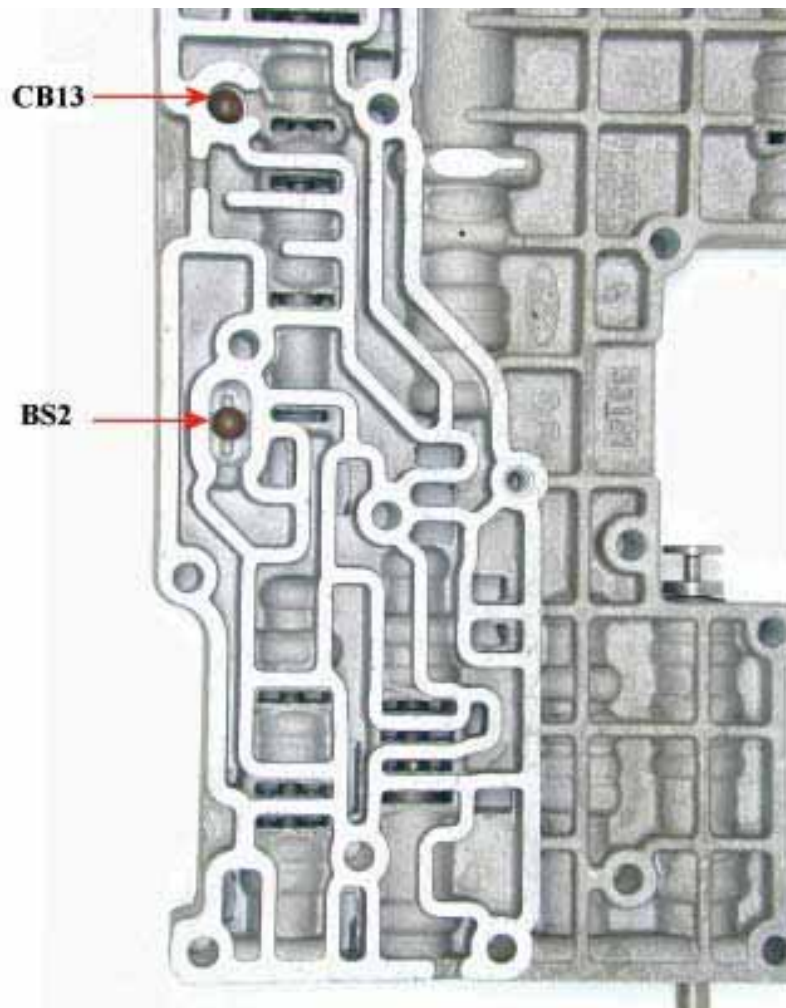
If the plate has seats for these check balls, a ball must be installed.



E40D/4R 100

Check Ball Identification and Symptom Chart (continued)

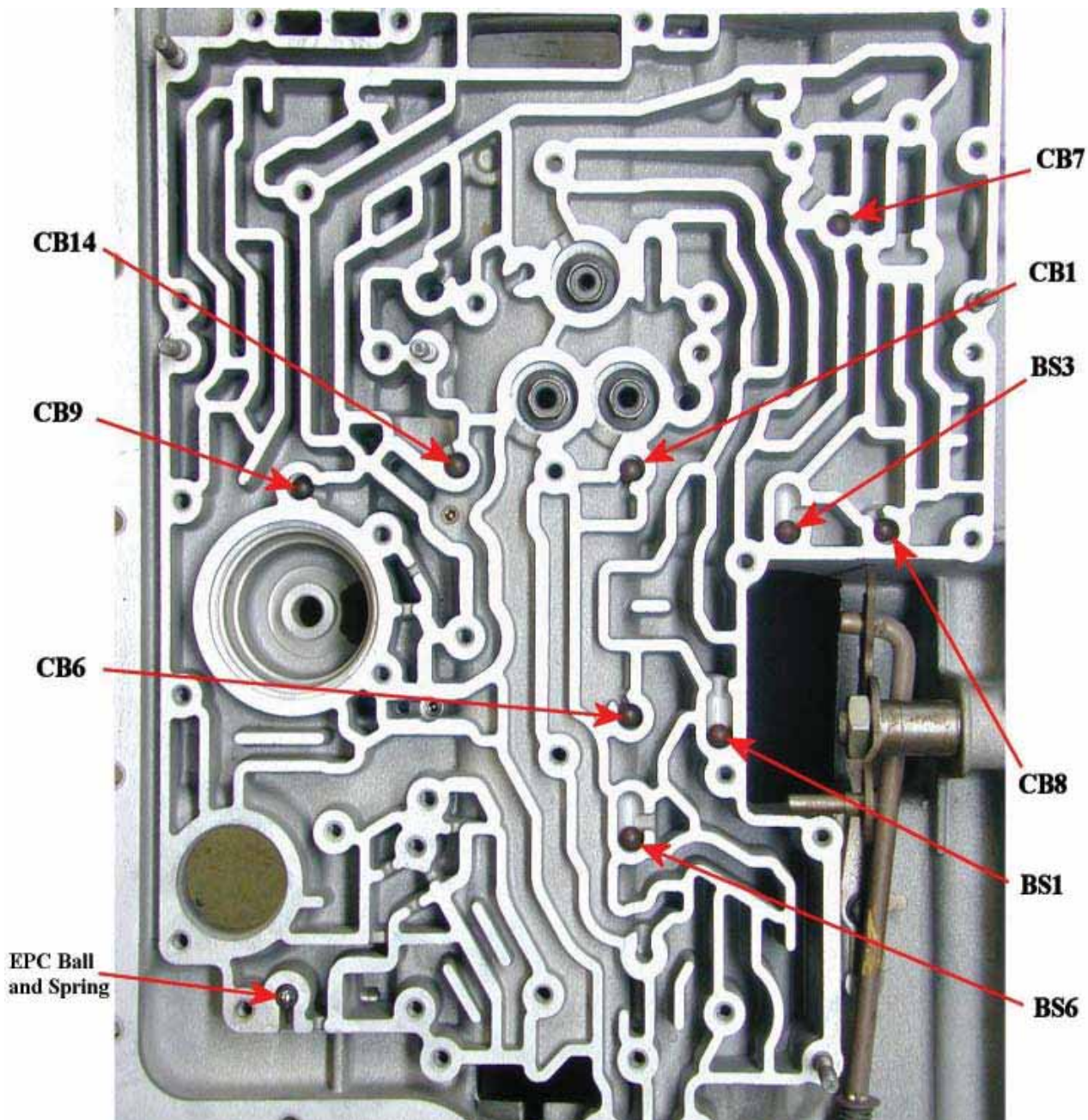
Late 1989



E40D/4R100

Check Ball Identification and Symptom Chart (continued)

1990-1995

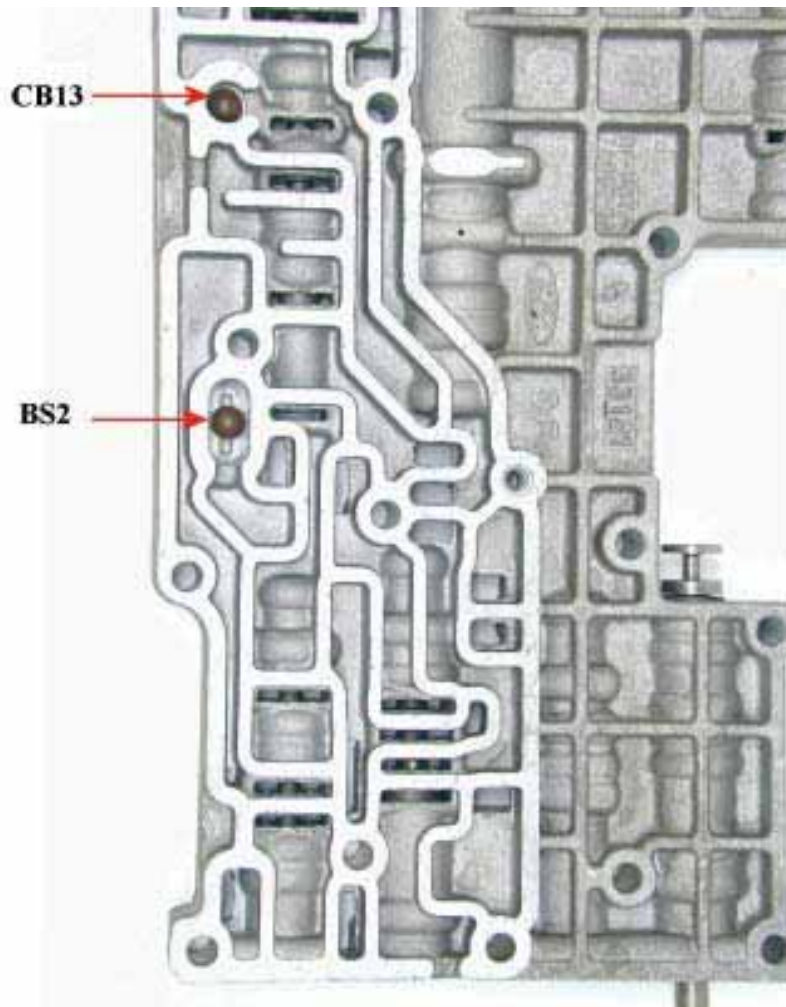


E40D/4R100

Check Ball Identification and Symptom Chart (continued)

1990-1995

Some '94-'95 manuals labeled CB13 as CB12 in the hydraulics and in the check ball ID section. The function of this ball has always been the same.

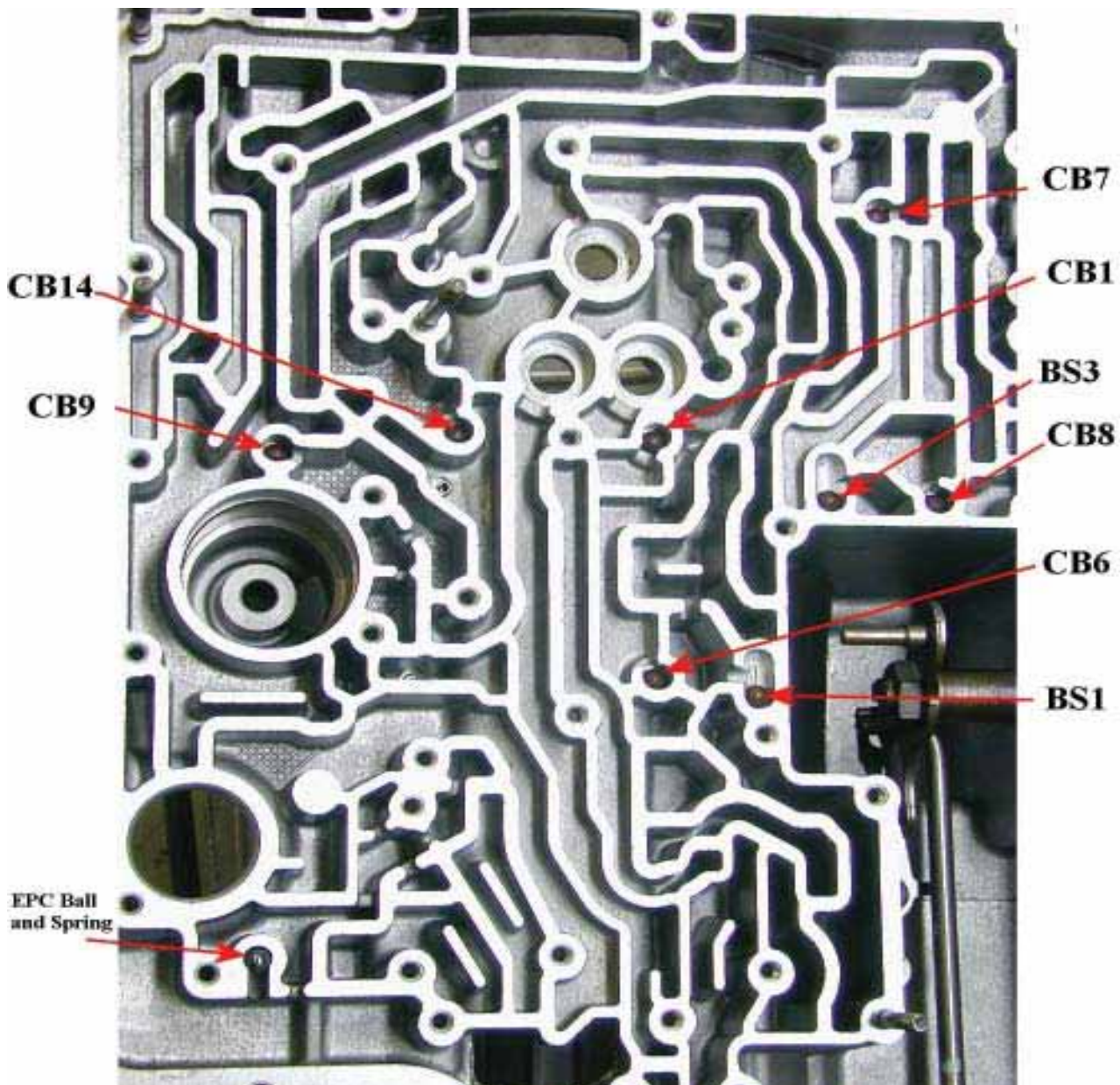


E40D/4R100

Check Ball Identification and Symptom Chart (continued)

1996-On

Some manuals labeled CB 14 and CB 9 incorrectly.

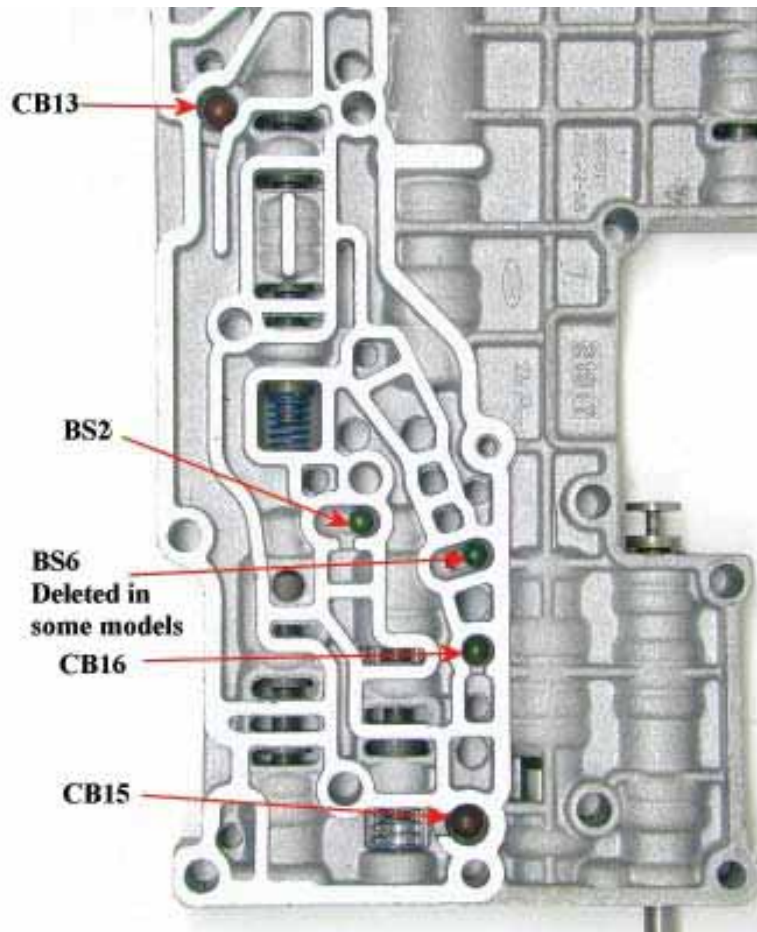


E40D/4R100

Check Ball Identification and Symptom Chart (continued)

1996-On

The BS6 check ball was deleted in some models. If the plate has two holes over the bath tub you must use a check ball in that location. If the plate has one hole, do not install a check ball.

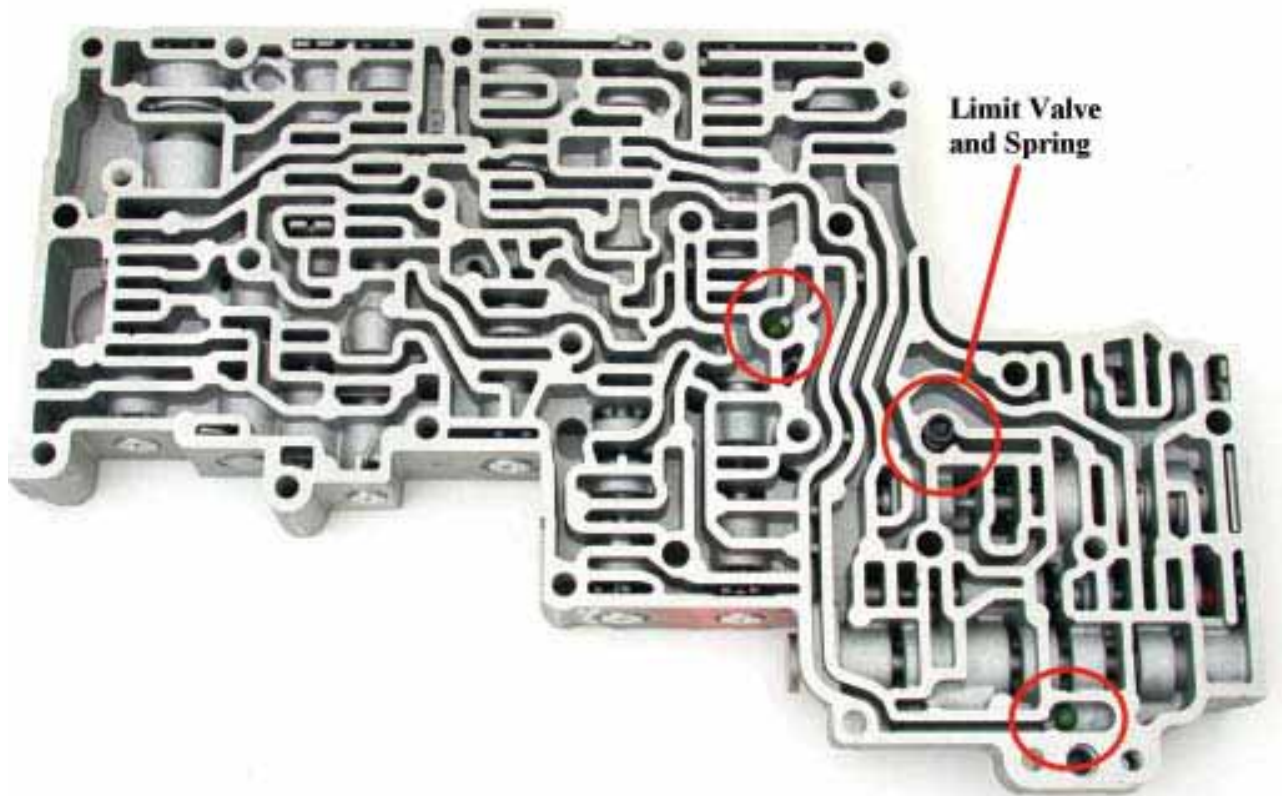


5R55N/W/S

Checkball Locations

5R55N

Check ball locations are important. The 5R55N transmission only uses two check balls and one limit valve. Take note of the locations and always replace the check balls during reassembly.



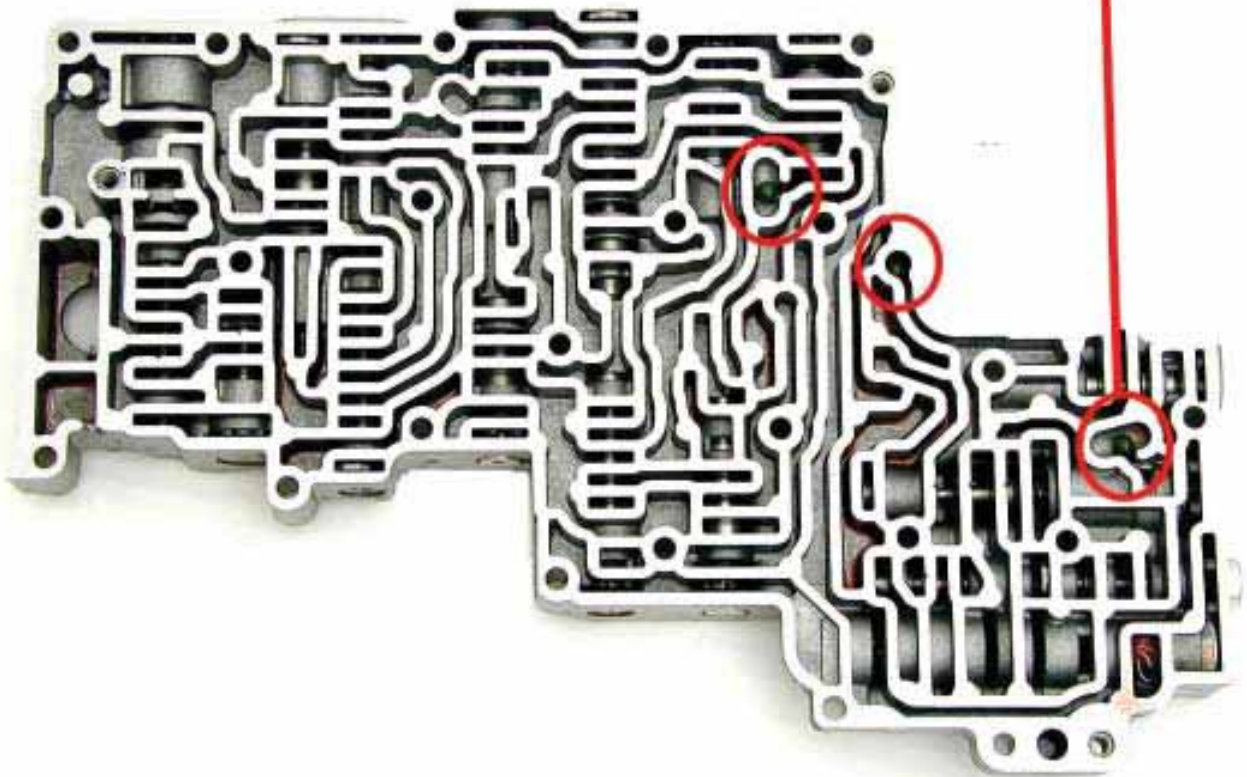
5R55N/W/S

Checkball Locations (continued)

5R55W/S

Not every 5R55W/S transmission has a third check ball. If you mismatch the separator plate you can cause serious failure to the transmission.

If you have two holes in the plate over the bath tub area, it will require a check ball. If your separator plate has only one hole then, no check ball should be installed.



5R55N/W/S

Solenoid Applications

Not every solenoid body is the same. When replacing the solenoid body, be sure to reference the part numbers with the correct model.

5R55N ONLY:

(2000-2002)

XW4Z-7G391-AC (Engineering Part Number XW4P-7G391-AE)

5R55W/S:

(2002-2003 ONLY)

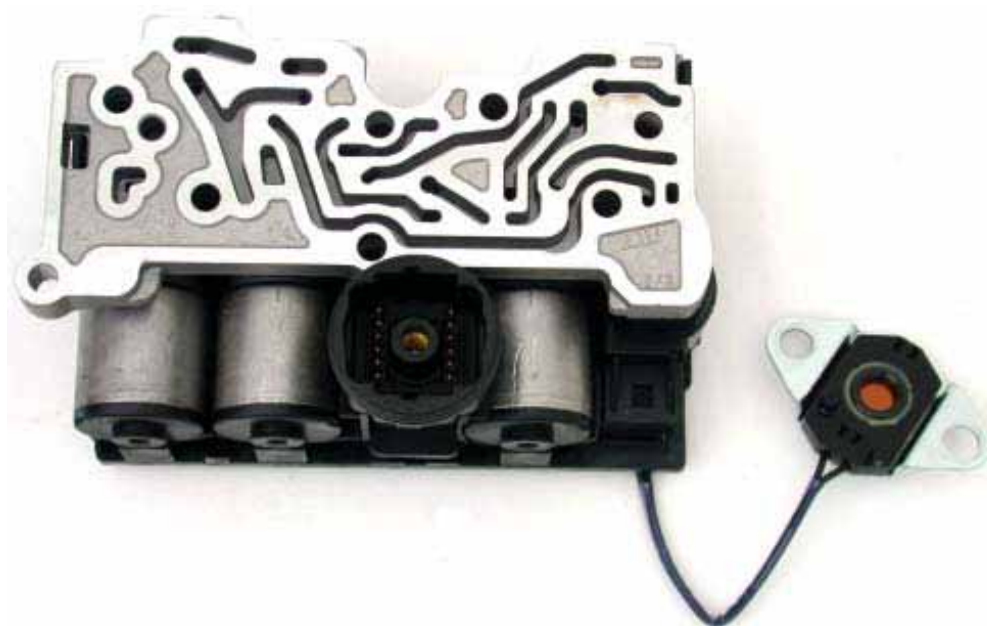
1L2Z-7G391-AE (Engineering Part Number 1L2P-7G391-AF)

5R55S:

(2004)

4L2Z-7G391-AA (Engineering Part Number 4L2P-7G391-AA)

NOTE: Due to the different solenoid transfer functions and calibrations do not use this solenoid body for 2002-2003 5R55W/S models .



5R55N/W/S

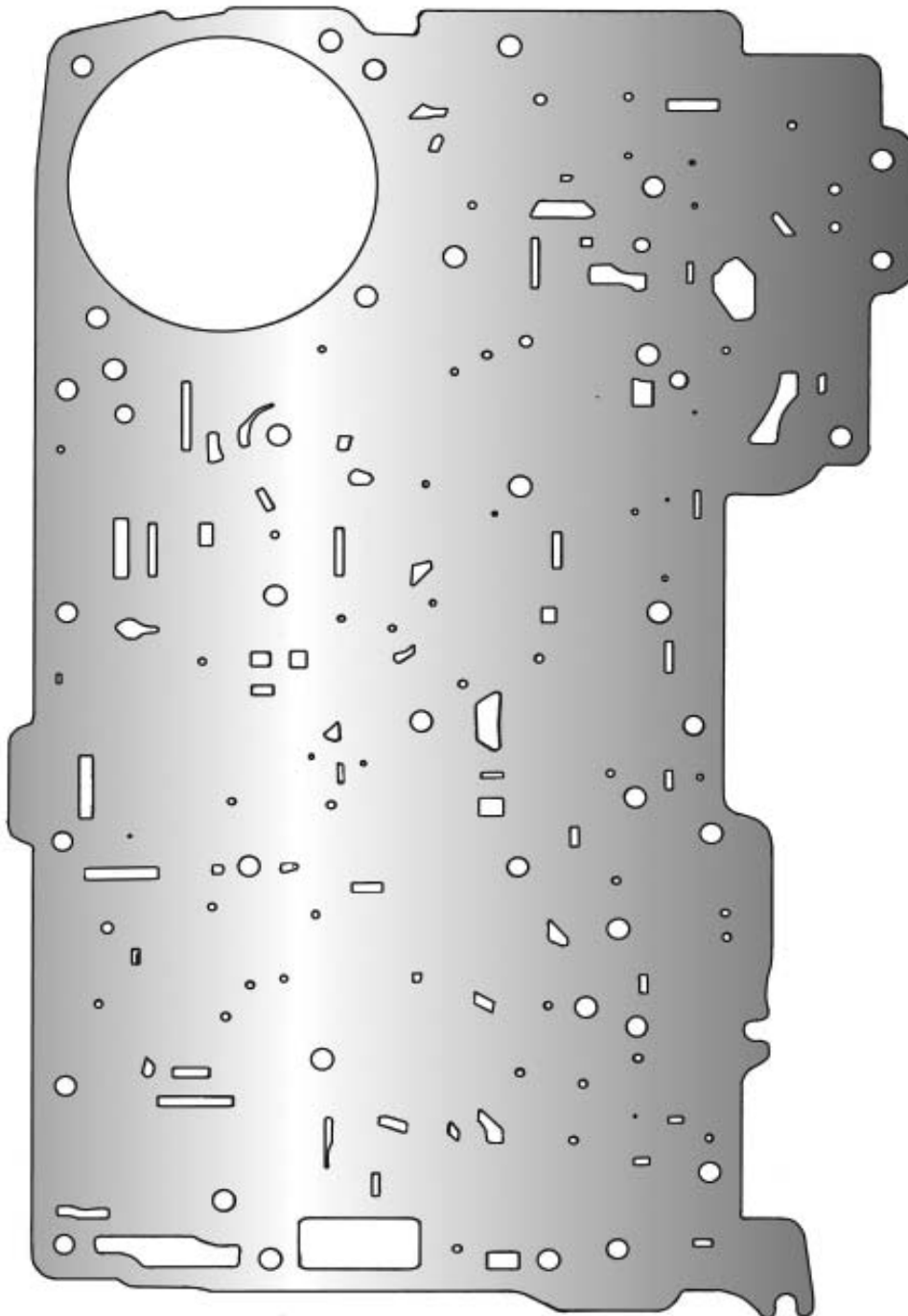
ValveBody Separator Plate Identification

Vehicle Application Chart				
Year	Model	Transmission	Engine	Separator Plate Part Number
2002	T-BIRD	5R55N	V8-3.9L	XW4Z-7Z490-AA
2003-2004	T-BIRD	5R55S	V8-3.9L	3W4Z-7Z490-AA (11/18/02-07/14/03)
2004-2005	T-BIRD	5R55S	V8-3.9L	4W4Z-7Z490-AA (AFTER 07/14/03)
2005	MUSTANG	5R55S	V6-4.0L V8-4.6L	4W4Z-7Z490-AA (AFTER 07/14/03)
1999-2001	S-TYPE JAGUAR	5R55N	V6-3.0L V8-4.0L	
2002-2003	EXPLORER/MOUNTAINEER	5R55W/S	V6-4.0L V8-4.6L	1L2Z-7Z490-AB
2004-2005	EXPLORER/MOUNTAINEER	5R55S	V6-4.0L V8-4.6L	4L2Z-7Z490-AA
2003-2005	AVIATOR	5R55S	TRANS ID(3L2P-E, 3L2P-F)	1L2Z-7Z490-AB
2004-2005	AVIATOR	5R55S	TRANS ID(4L2P-E, 4L2P-F)	4L2Z-7Z490-AA
2003-2005	LINCOLN LS	5R55S	V6-3.0L V8-3.9L	3W4Z-7Z490-AA
2000-2002	LINCOLN LS	5R55N	V6-3.0L V8-3.9L	XW4Z-7Z490-AB
2000	LINCOLN LS	5R55N	TRANS ID (XW4P-A, XW4P-B)	XW4Z-7Z490-AA (REPLACED BY A NEW VALVE BODY PER FORD PART# 2W4Z-7A100-AA)

5R55N/W/S

Valve Body Separator Plate Identification

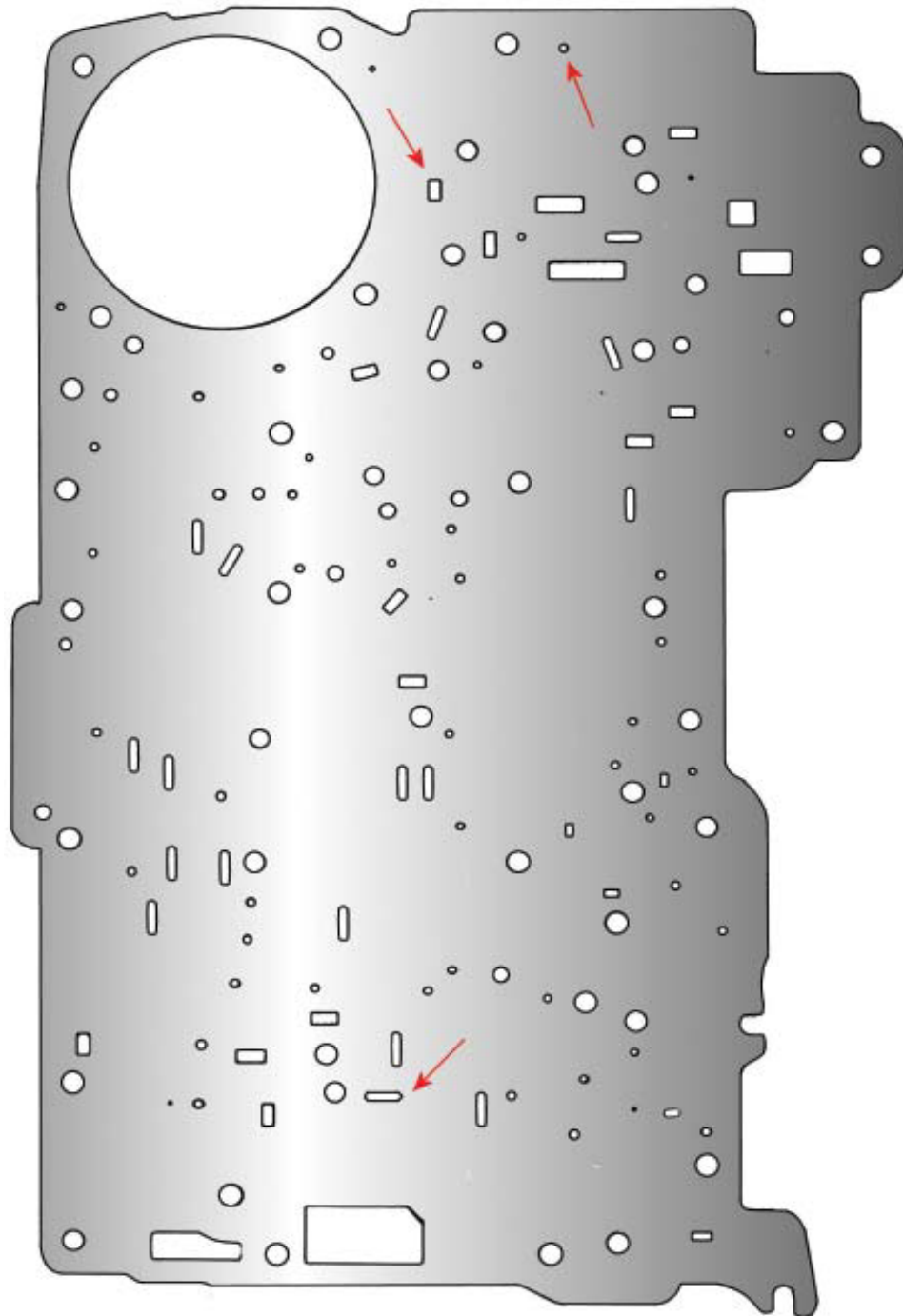
***2002 T-Bird, 2000-2002 Lincoln LS Only
XW4Z-7Z490-AB***



5R55N/W/S

Valve Body Separator Plate Identification

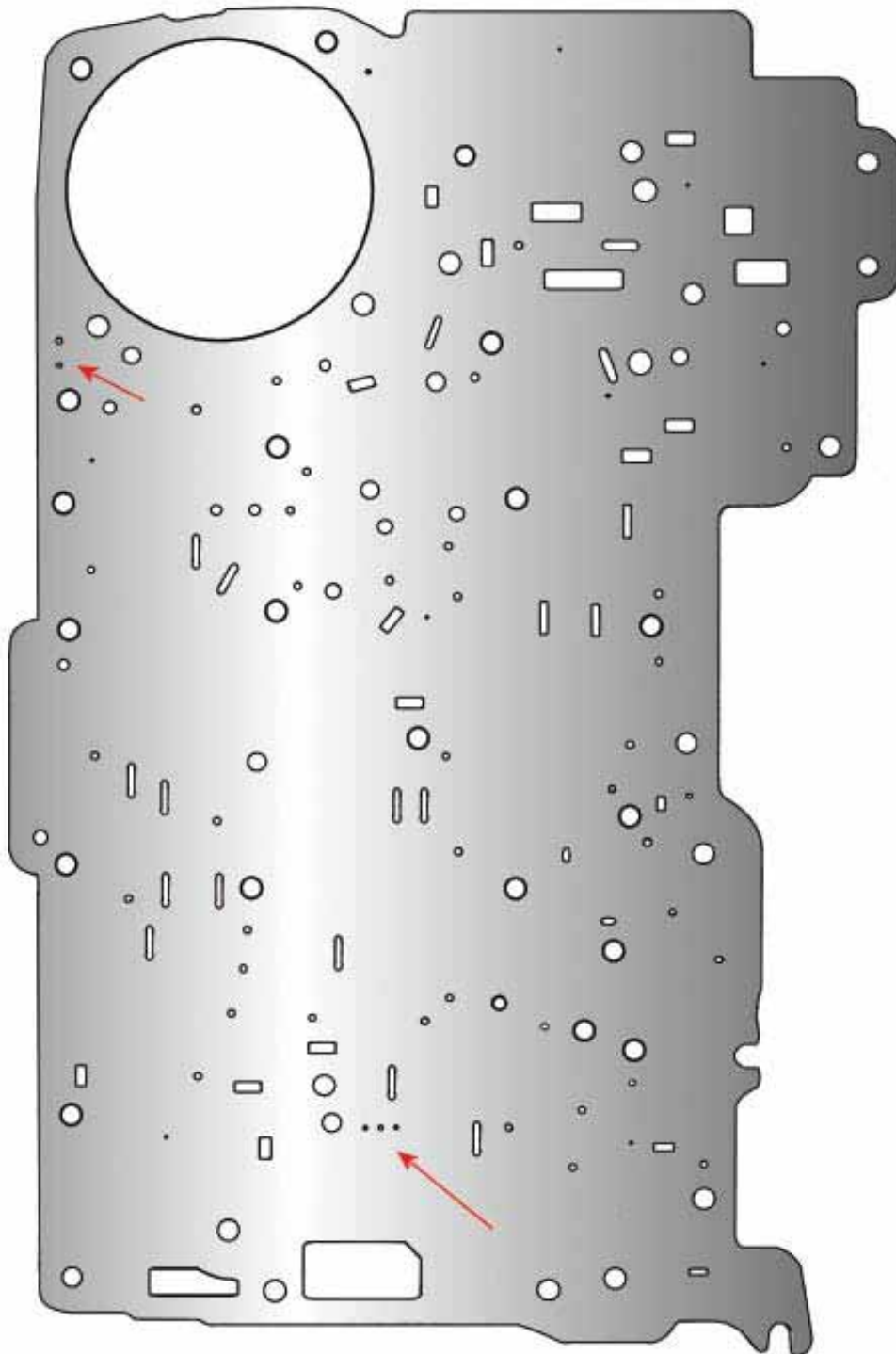
2002-2003 Explorer/Mountaineer, 2003-2005 Aviator
1L2Z-7G490-AB



5R55N/W/S

Valve Body Separator Plate Identification

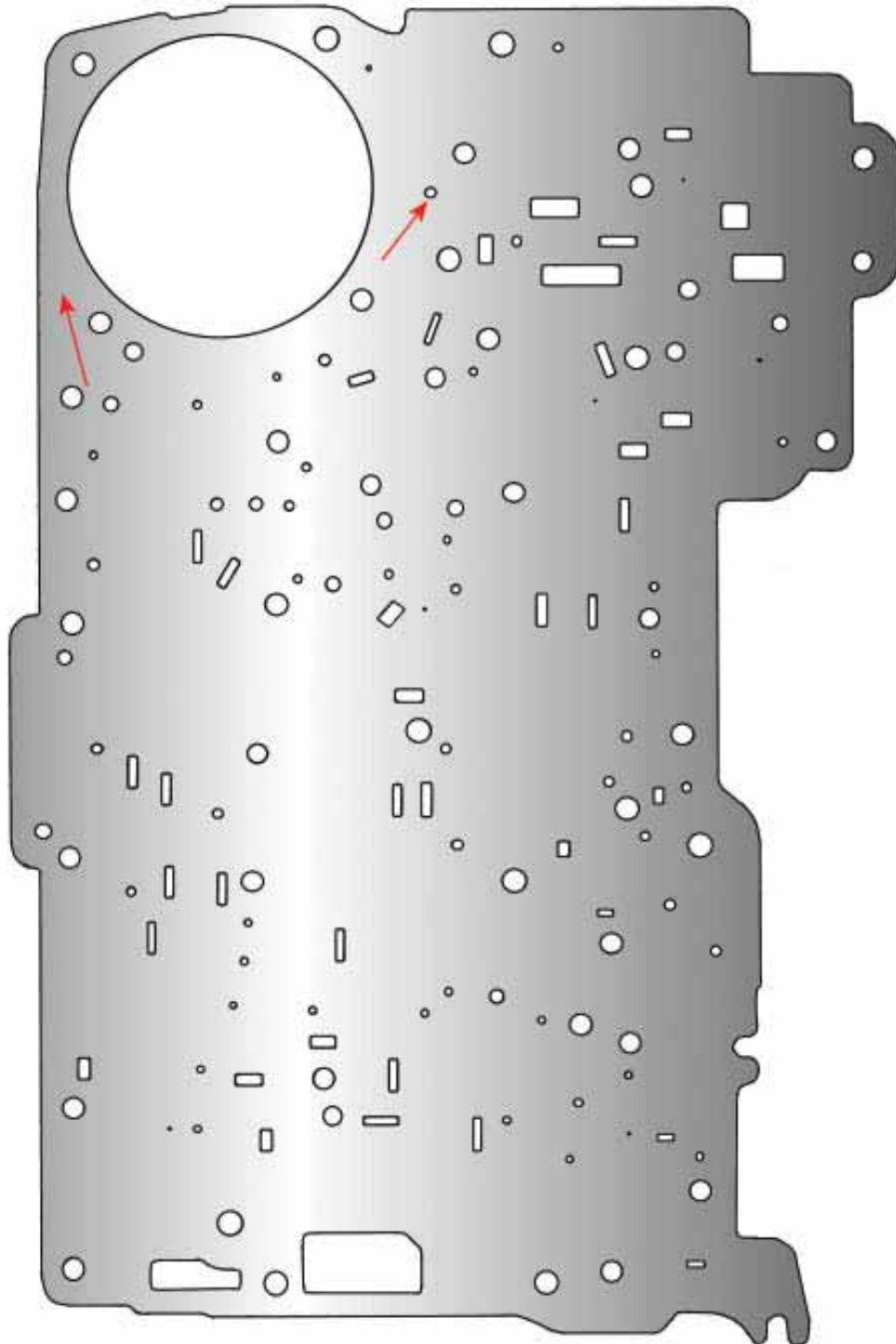
2004-2005 Explorer/Mountianeer, 2004-2005 Aviator
4L2Z-7Z490-AA



5R55N/W/S

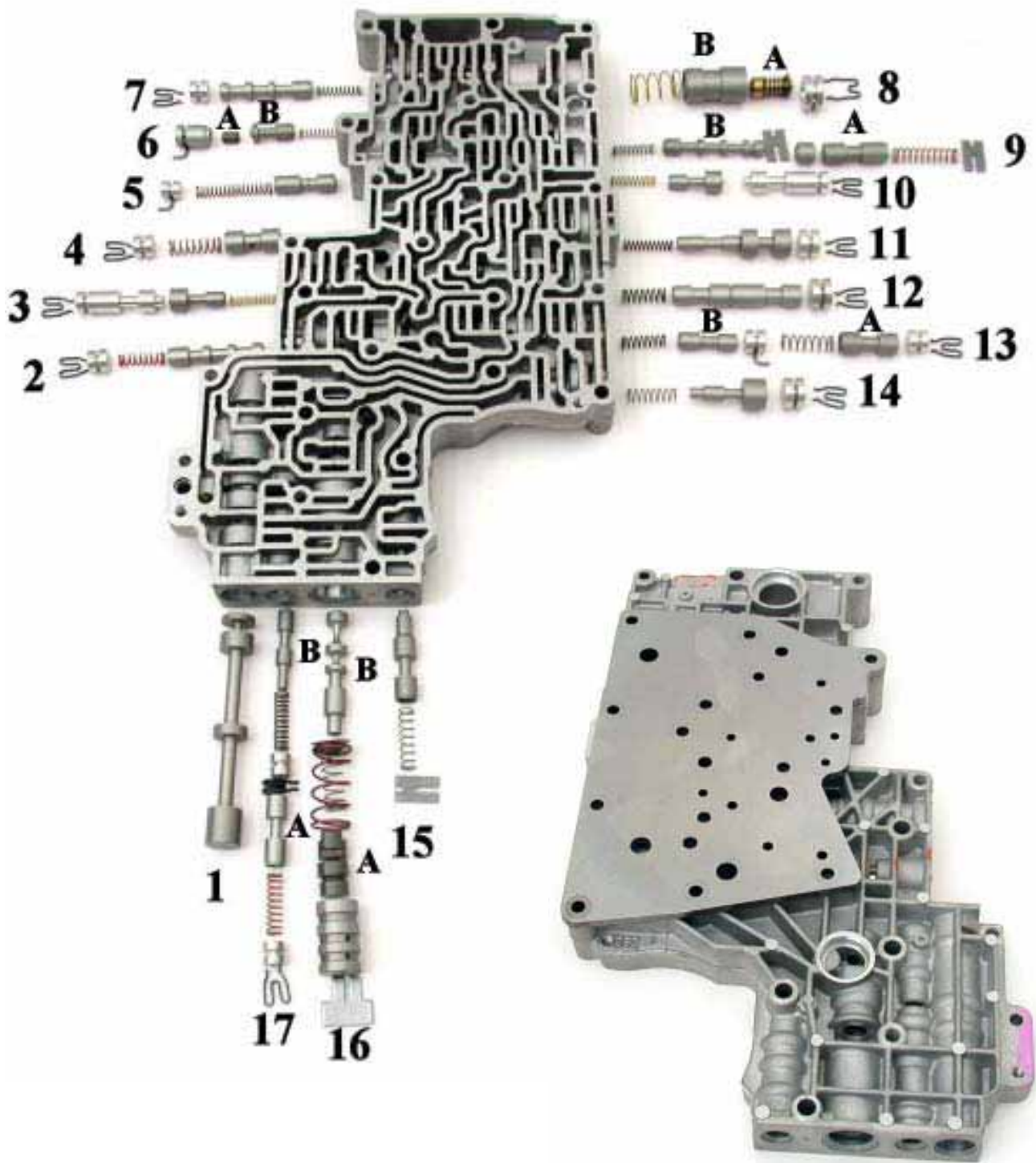
Valve Body Separator Plate Identification

**2003-2004 T-Bird, 2003-2005 Lincoln LS
3W4Z-7Z490-AA**



5R55N

Valve Body Exploded View



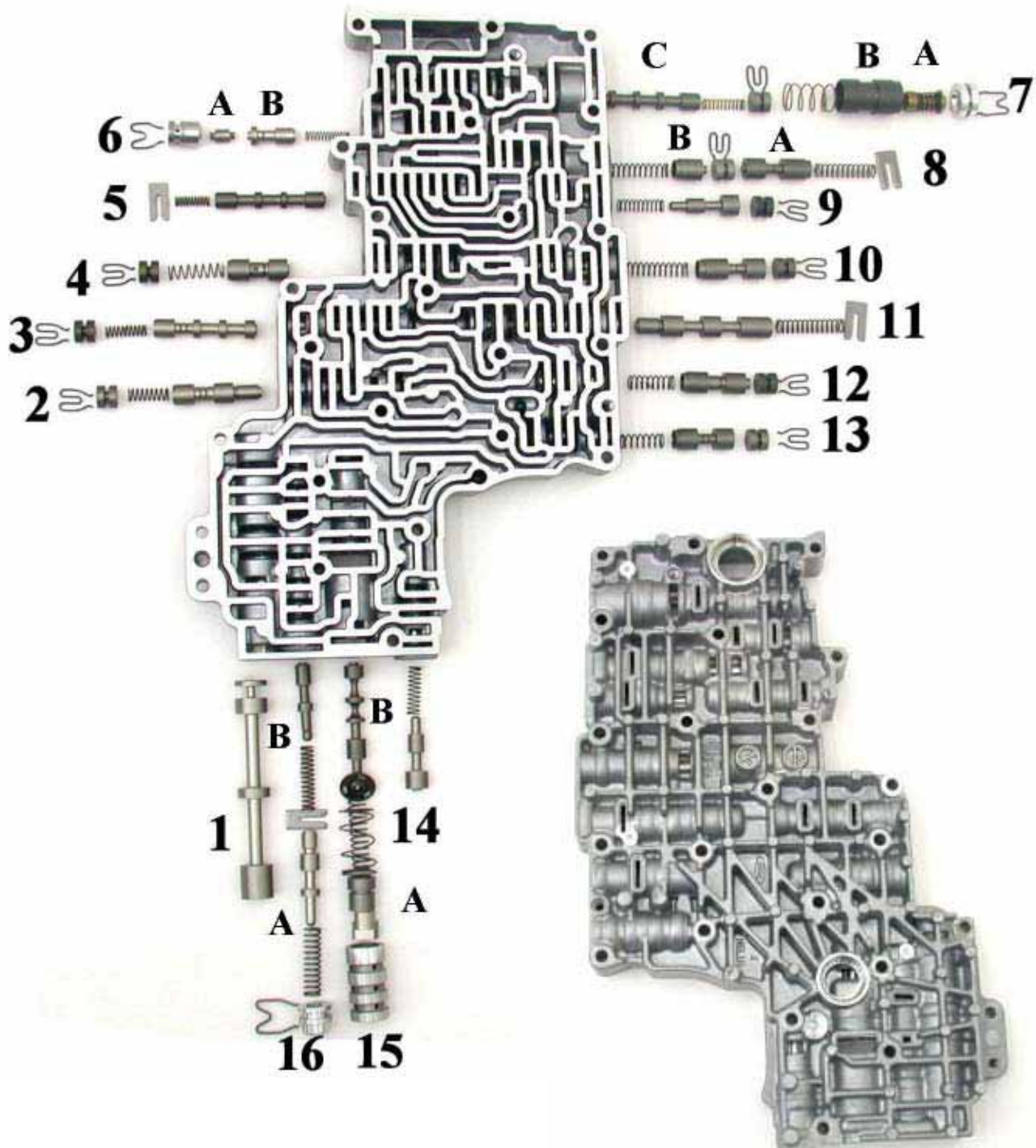
5R55N

Valve Body Exploded View

Valve ID	Valve Description
1	Manual Valve
2	Select Valve
3	Modulator Valve
4	Forward Engagement Control Valve
5	TCC Back Pressure Valve
6	(A) TCC Modulator Control Valve (B) TCC Modulator
7	TCC Control Valve
8	(A) Thermo Valve Assembly (B) Fluid Cooler Bypass Valve
9	(A) Coast Clutch Control Valve (B) Overdrive Servo Control Valve
10	Modulator Valve
11	4-3 ISR Downshift Control Valve
12	4-3 Prestroke Intermediate Band Control Valve
13	(A) Reverse Engagement Valve (B) High Clutch Control Valve
14	Reverse Modulator Valve
15	Rear Servo Control
16	(A) Booster Valves (B) Main Regulator Valve
17	(A) Reverse Inhibition Valve (B) Solenoid Regulator Valve

5R55S/W

Valve Body Exploded View



5R55S/W

Valve Body Exploded View

Valve ID	Valve Description
1	Manual Valve
2	Rear Servo Control Valve
3	RS ISA Select Valve
4	Forward Engagement Control Valve
5	Overdrive Servo Control Valve
6	(A) TCC Modulator Control Valve (B) TCC Modulator
7	(A) Thermo Valve Assembly (B) Fluid Cooler Bypass Valve (C) TCC Control Valve
8	(A) Coast Clutch Valve (B) TCC Back Pressure Valve
9	VFS2 Modulator Valve
10	Intermediate Servo Release Valve
11	Direct Clutch Control Valve
12	Reverse Modulator Valve
13	Reverse Engagement Valve
14	VFS1 Modulator Valve
15	(A) Booster Valve (B) Main Regulator Valve
16	(A) Converter Relief Valve (B) Solenoid Regulator Valve

5R55N

Component Application Chart

Band and Clutch Application Chart A							
	Overdrive Band	Intermediate Band	Reverse Band	Forward Clutch	Intermediate Clutch	Direct Clutch	Coast Clutch
REVERSE			A ³			A ³	Ac ²
1st				A ³			
2nd	A ³			A ³			
3rd				A ³	A ³		
4th				A ³	A ³	A ³	
5th	A ³			A ³	A ³	A ³	
1st ^a			Ac ²	A ³			Ac ²
2nd ^a	A ³		Ac ²	A ³			
3rd ^a				A ³	A ³		Ac ²
4th ^a				A ³	A ³	A ³	Ac ²
MAN. 3rd		Ac ²		A ³	A ³		Ac ²
MAN. 2nd	A ³		Ac ²	A ³			
MAN. 1st			Ac ²	A ³			Ac ²

3 A= Applied

a (overdrive canceled)

2 Ac= Applied to carry coast torque

5R55N

Component Application Chart

Band and Clutch Application Chart B							
	O/D One-Way Clutch		Low One-Way Clutch		Intermediate One-way Clutch		Engine Braking
	Drive	Coast	Drive	Coast	Drive	Coast	
REVERSE	H ⁵	OR ⁶	NE ⁷		NE ⁷		YES
1st	H ⁵	OR ⁶	H ⁵	OR ⁶	NE ⁷		NO
2nd	OR ⁶	OR ⁶	H ⁵	OR ⁶	NE ⁷		NO
3rd	H ⁵	OR ⁶	OR ⁶	OR ⁶	H ⁵	OR ⁶	NO
4th	H ⁵	OR ⁶	OR ⁶	OR ⁶	OR ⁶		NO
5th	OR ⁶	OR ⁶	OR ⁶	OR ⁶	OR ⁶		YES
1st ^a	H ⁵	OR ⁶	H ⁵	OR ⁶	NE ⁷		YES
2nd ^a	OR ⁶	OR ⁶	H ⁵	OR ⁶	NE ⁷		YES
3rd ^a	H ⁵	OR ⁶	OR ⁶	OR ⁶	H ⁵	NE ⁷	YES
4th ^a	H ⁵	OR ⁶	OR ⁶	OR ⁶	OR ⁶		Yes
MAN. 3rd	H ⁵	OR ⁶	OR ⁶	OR ⁶	H ⁵	NE ⁷	YES
MAN. 2nd	OR ⁶	OR ⁶	H ⁵	OR ⁶	NE ⁷		YES
MAN. 1st	H ⁵	OR ⁶	H ⁵	OR ⁶	NE ⁷		YES

H⁵ =Hold

OR⁶ =Overrunning

NE⁷ =No Effect

5R55N/W/S

Vehicle Application Chart

Vehicle Application Chart			
Year	Model	Transmission	Engine
2000-2002	T-BIRD	5R55N	V8-3.9L
2002-2005	T-BIRD	5R55S	V8-3.9L
1999-2001	S-TYPE JAGUAR	5R55N	V6-3.0L V8-4.0L
2002	EXPLORER/MOUNTAINEER	5R55W/S	V6-4.0L V8-4.6L
2003-2005	EXPLORER/MOUNTAINEER	5R55S	V6-4.0L V8-4.6L
2002-2005	LINCOLN LS	5R55S	V6-3.0L V8-3.9L
2000-2001	LINCOLN LS	5R55N	V6-3.0L V8-3.9L
2005	MUSTANG	5R55S	V6-4.0L V8-4.6L



5R55W/S



5R55N

5R55W/S

Component Application Chart

Band and Clutch Application Chart A						
	Overdrive Band	Intermediate Band	Reverse Band	Forward Clutch	Direct Clutch	Coast Clutch
REVERSE			A ^a		A ^a	Ac ^b
1st				A ^a		
2nd	A ^a			A ^a		
3rd		A ^a		A ^a		
4th				A ^a	A ^a	
5th	A ^a			A ^a	A ^a	
1st ^c				A ^a		
2nd ^c	A ^a			A ^a		
3rd ^c		A ^a		A ^a		
4th ^c				A ^a	A ^a	Ac ^b
MAN. 3rd		Ac ^b		A ^a		Ac ^b
MAN. 2nd	A ^a		Ac ^b	A ^a		
MAN. 1st			Ac ^b	A ^a		Ac ^b

A_a = Applied

Ac_b = Applied to carry coast torque

(D)_c = Position (overdrive canceled)

5R55W/S

Component Application Chart

Band and Clutch Application Chart B					
	Direct One-Way Clutch		Low One-Way Clutch		Engine Braking
	Drive	Coast	Drive	Coast	
REVERSE	H ^a	OR ^b	NE ^c		NO
1st	H ^a	OR ^b	H ^a	OR ^b	NO
2nd	OR ^b	OR ^b	H ^a	OR ^b	NO
3rd	H ^a	OR ^b	OR ^b	OR ^b	NO
4th	H ^a	OR ^b	OR ^b	OR ^b	NO
5th	OR ^b	OR ^b	OR ^b	OR ^b	YES
1st ^d	H ^a	OR ^b	H ^a	OR ^b	YES
2nd ^d	OR ^b	OR ^b	H ^a	OR ^b	YES
3rd ^d	H ^a	OR ^b	OR ^b	OR ^b	YES
4th ^d	H ^a	OR ^b	OR ^b	OR ^b	Yes
MAN. 3rd	H ^a	OR ^b	OR ^b	OR ^b	YES
MAN. 2ND	OR ^b	OR ^b	H ^a	OR ^b	YES
MAN. 1ST	H ^a	OR ^b	H ^a	OR ^b	YES

H^a = Hold

OR^b = Overrunning

NE^c = No Effect

(D)^d = Position (overdrive canceled)

5R55W/S

2002 Computer Pin Charts for Explorer/Mountaineer

4.6L Explorer/Mountaineer

Sensors/Inputs	PCM Pin/PID only	Measured/PID Values				Units Measured/PID
		KOEO	Hot Idle	30 MPH	55 MPH	
FPM	A02	.1/OFF	VBAT/ON	VBAT/ON	VBAT/ON	DCV/OFF-ON
ILC	A08	0	9	9	9	DCV
FEPS	A13	0.1	0.1	0.1	0.1	DCV
PATSIN	A14	VBAT	VBAT	VBAT	VBAT	DCV
4X4(L)	A23	VBAT/OFF	VBAT/OFF	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
BPS	A28	VBAT/OFF	.1/ON (E)	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
SCMA	A29	VBAT	VBAT	VBAT	VBAT	DCV
ACP V/ACP	A30	.1/OPEN	.1/OPEN	.1/OPEN	.1/OPEN	DCV/ OPEN-CLOSED
MAF V	A31	0	.7-9	1.2-1.4	1.5-2	DCV
SCMB	A36	VBAT	VBAT	VBAT	VBAT	DCV
BPP	A40	.1/OFF	VBAT/ON (E)	.1/OFF	.1/OFF	DCV/OFF-ON
TCS	A41	.1/OFF	VBAT/ON (G)	.1/OFF	.1/OFF	DCV/OFF-ON
SCMC	A46	VBAT	VBAT	VBAT	VBAT	DCV
ACDS	A47	0.1	0.1	0.1	0.1	DCV
ACCS	A50	.1/OFF	VBAT/ON (A)	.1/OFF	.1/OFF	DCV/OFF-ON
IAT	A51	1.7-3.5/120-50 (K)	1.7-3.5/120-50 (K)	1.7-3.5/120-50 (K)	1.7-3.5/120-50 (K)	DCV/DEG
FTP V/FTP	A52	2.6/0	2.6/0	2.6/0	2.6/0	DCV/IN-H2O
SCCS	A57	5	5	5	5	DCV
TR V/TR	B09	0/PARK	0/PARK	2/OD	2/OD	DCV/MODE
TR 4	B10	0	0	VBAT	VBAT	DCV
TR 2	B18	0	0	VBAT	VBAT	DCV
HCDS	B21	0	200	620	1185	Hz
TR 1	B22	0	0	VBAT	VBAT	DCV
TFT	B23	.5-2.4/210-110	.5-2.4/210-110	.5-2.4/210-110	.5-2.4/210-110	DCV/DEG
OSS	B26	0	0	460/1250	885-1000/ 2100-2400	Hz/RPM

5R55W/S

2002 Computer Pin Charts for Explorer/Mountaineer

4.6L Explorer/Mountaineer

Actuators/ Outputs	PCM Pin/PID only	Measured/PID Values				Units Measured/PID
		KOEO	Hot Idle	30 MPH	55 MPH	
O2S12	B28	0.1	(D)	(D)	(D)	DCV
O2S22	B29	0.1	(D)	(D)	(D)	DCV
CHT	C40	.6 or 3.7/194	.6 or 3.7/194	.6 or 3.7/194	.6 or 3.7/194	DCV/DEG
DPFEGR	C41	.95-1.10	.95-1.10	.95-4.65	.95-4.65	DCV
O2S21	C44	0	switching (C)	switching (C)	switching (C)	DCV
O2S11	C45	0	switching (C)	switching (C)	switching (C)	DCV
KS1	C51	0	0	0	0	DCV
KS2	C52	0	0	0	0	DCV
CID	C53	0	6	12-Nov	16	Hz
CKP	C55	0	400	800	970-1050	Hz
TPV	C57	.53-1.27	.53-1.27	1.3-1.5	1.5-1.8	DCV
CPP/PNP	PID	ON	ON	OFF	OFF	OFF/ON
FLI	PID	50	50	50	50	%
GEAR	PID	1	1	4	5	GEAR
LOAD	PID	(L)	16-23	20	25	%
MISF	PID	OFF	OFF	OFF	OFF	OFF-ON
OCTADJS	PID	NO RETARD	NO RETARD	NO RETARD	NO RETARD	NO RETARD/ RETARD
RPM	PID	0	890	1350	1650	RPM
VSS	PID	0	0	30	55	MPH
EVAPCV	A06	0	0-10/0-100	0-10/0-100	0-10/0-100	Hz/%
VSO	A07	0	0	65	125	Hz
WAC	A09	VBAT/OFF	.1/ON (A)	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
TPO	A10	15-Jan	15-Jan	1.4/18	1.8/20	DCV/%
PATSOUT	A11	11.3	11.8	11.8	11.8	DCV
EVAPPDC	A12	0	0-10/0-100	0-10/0-100	0-10/0-100	Hz/%
ACF	A19	0.1	0.1	0.1	0.1	DCV
PATSIL	A22	11.3	11.8	11.8	11.8	DCV
PATSTRT	A39	0.1	0.1	0.1	0.1	DCV
SCC	A45	VBAT	VBAT	VBAT	VBAT	DCV
FP	A58	VBAT/0	.1/100	.1/100	.1/100	DCV/%
SS1	B01	.1/ON	.1/ON	VBAT/OFF	VBAT/OFF	DCV/OFF-ON

5R55W/S

2002 Computer Pin Charts for Explorer/Mountaineer

4.6L Explorer/Mountaineer

Actuators/ Outputs	PCM Pin/PID only	Measured/PID Values				Units Measured/PID
		KOEO	Hot Idle	30 MPH	55 MPH	
SS2	B02	VBAT/OFF	VBAT/OFF	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
SS3	B03	VBAT/OFF	VBAT/OFF	VBAT/OFF	.1/ON	DCV/OFF-ON
SS4	B04	.1/ON	.1/ON	.1/ON	.1/ON	DCV/OFF-ON
TCC	B05	VBAT/0	VBAT/0	VBAT/0	.2/100	DCV/%
EPC	B07	5.8	7.6	10.3	10.6	DCV
EPC3	B12	5.9	7.7	12.3	VBAT	DCV
EPC2	B13	8.2	10	8.2	10.8	DCV
HTR12	B15	.2/ON (P)	.2/ON (P)	.2/ON (P)	.2/ON (P)	DCV/OFF-ON
HTR22	B16	.2/ON (P)	.2/ON (P)	.2/ON (P)	.2/ON (P)	DCV/OFF-ON
CDD	C01	VBAT	VBAT	VBAT	VBAT	DCV
INJ1	C02	0	3.3-3.8	5.1	7-Jun	mS
HTR11	C07	.1/ON (P)	.1/ON (P)	.1/ON (P)	.1/ON (P)	DCV/OFF-ON
HTR21	C08	.1/ON (P)	.1/ON (P)	.1/ON (P)	.1/ON (P)	DCV/OFF-ON
IAC	C09	VBAT/0	9.8/28	8.4/45	7.7/65	DCV/%
INJ5	C11	0	3.3-3.8	5.1	7-Jun	mS
CDE	C12	VBAT	VBAT	VBAT	VBAT	DCV
CDC	C13	VBAT	VBAT	VBAT	VBAT	DCV
INJ2	C14	0	3.3-3.8	5.1	7-Jun	mS
EGRVR	C16	VBAT/0	VBAT/0	VBAT/0	10.8/40	DCV/%
INJ6	C21	0	3.3-3.8	5.1	7-Jun	mS
CDF	C22	VBAT	VBAT	VBAT	VBAT	DCV
CDB	C23	VBAT	VBAT	VBAT	VBAT	DCV
INJ3	C24	0	3.3-3.8	5.1	7-Jun	mS
INJ7	C29	0	3.3-3.8	5.1	7-Jun	mS
CDG	C30	VBAT	VBAT	VBAT	VBAT	DCV
CDA	C31	VBAT	VBAT	VBAT	VBAT	DCV
INJ4	C32	0	3.3-3.8	5.1	7-Jun	mS
INJ8	C37	0	3.3-3.8	5.1	7-Jun	mS
CDH	C38	VBAT	VBAT	VBAT	VBAT	DCV
CHTIL	PID	OFF	OFF	OFF	OFF	OFF-ON
FUELPW1	PID	0	3.3-3.8	5.1	7-Jun	mS
FUELPW2	PID	0	3.3-3.8	5.1	7-Jun	mS
LONGFT1	PID	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	%
LONGFT2	PID	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	%
MIL	PID	OFF	OFF	OFF	OFF	OFF-ON
SHRTFT1	PID	0	(-)10-(+)10	(-)10-(+)10	(-)10-(+)10	%
SHRTFT2	PID	0	(-)10-(+)10	(-)10-(+)10	(-)10-(+)10	%
SPARKADV	PID	0	16-Dec	30	28-33	DEG
TCIL	PID	OFF	OFF	OFF	OFF	OFF-ON
KAPWR	A44	VBAT	VBAT	VBAT	VBAT	DCV
VPWR	A32	VBAT	VBAT	VBAT	VBAT	DCV
VREF	A20	5	5	5	5	DCV

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2003-2004 Computer Pin Charts for Explorer/Mountaineer

4.6L Explorer/Mountaineer

Sensors/Inputs	PCM Pin/PID only	Measured/PID Values				Units Measured/PID
		KOEO	Hot Idle	30 MPH	55 MPH	
ACDS	B3	0.1	0.1	0.1	0.1	DCV
APP1	B5	4	4	3.4-4.0	2.9-4.0	DCV
BPS	B7	VBAT/OFF	.1/ON (E)	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
BPP	B8	.1/OFF	VBAT/ON (E)	.1/OFF	.1/OFF	DCV/OFF-ON
FTP V/FTP	B9	2.6/0	2.6/0	2.6/0	2.6/0	DCV/IN-H2O
IAT	B16	1.7-3.5/120-50 (K)	1.7-3.5/120-50 (K)	1.7-3.5/120-50 (K)	1.7-3.5/120-50 (K)	DCV/DEG
APP2	B17	1.5	1.5	1.4-1.9	1.4-2.4	DCV
FPM	B21	0.1	0 - VBAT	0 - VBAT	0 - VBAT	DCV
4WD MC SW	B22	VBAT	VBAT	VBAT	VBAT	DCV
ILC	B24	0.7	9	9	9	DCV
ACP V	B26	VBAT	VBAT	VBAT	VBAT	DCV
TCS	B27	.1/OFF	VBAT/ON (G)	.1/OFF	.1/OFF	DCV/OFF-ON
APP3	B28	0.9	0.9	.9-1.3	.9-1.8	DCV
4WDSW RTN	B29	0	0	0	0	DCV
MAF V	B32	0	.7-9	1.2-1.7	1.5-2.4	DCV
PATSIN	B42	VBAT	VBAT	VBAT	VBAT	DCV
FEPS	B44	0.1	0.1	0.1	0.1	DCV
OSS	T3	0	0	460/ 1250	885-1000/ 2100-2400	Hz/RPM
HCDS	T4	0	0	713	1315	Hz
4WD_POS1	T7	VBAT	VBAT	VBAT	VBAT	DCV
4WD_POS2	T8	VBAT	VBAT	VBAT	VBAT	DCV
TSS	T15	0	360/670	713/1300	985/1800	Hz/RPM
TR 1	T16	0	0	VBAT	VBAT	DCV
TR 2	T17	0	0	VBAT	VBAT	DCV
4WD_POS3	T19	VBAT	VBAT	VBAT	VBAT	DCV
4WD_POS4	T20	VBAT	VBAT	VBAT	VBAT	DCV
O2S22	T22	0.1	(D)	(D)	(D)	DCV
O2S12	T24	0.1	(D)	(D)	(D)	DCV
TR3 V/TR3	T27	0/PARK	0/PARK	1.6/OD	1.6/OD	DCV/MODE
TR 4	T28	0	0	VBAT	VBAT	DCV
TFT	T29	.5-2.4/210-110	.5-2.4/210-110	.5-2.4/210-110	.5-2.4/210-110	DCV/DEG
TP1	E19	4.1	4.4	4.1	4	DCV
KS2	E21	0	0	0	0	DCV
CID	E25	0	6	12-Nov	16	Hz
TP2	E29	1.2	0.8	1.1	1.2	DCV

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2003-2004 Computer Pin Charts for Explorer/Mountaineer

4.6L Explorer/Mountaineer

Sensors/Inputs	PCM Pin/PID only	Measured/PID Values				Units Measured/PID
		KOEO	Hot Idle	30 MPH	55 MPH	
O2S11	E30	0	switching (C)	switching (C)	switching (C)	DCV
O2S21	E31	0	switching (C)	switching (C)	switching (C)	DCV
KS1	E32	0	0	0	0	DCV
CHT	E33	.6 or 3.7/194	.6 or 3.7/194	.6 or 3.7/194	.6 or 3.7/194	DCV/DEG
CKP	E34	0	400	800	970-1050	Hz
FRP V/FRP	E37	3.0/40	2.8/40	2.8/40	2.8/40	DCV/PSI
DPFEGR	E44	.25-1.30	.25-1.30	.25-4.65	.25-4.65	DCV
FLI (H)	PID	50	50	50	50	%
GEAR	PID	1	1	4	5	GEAR
LOAD	PID	(L)	16-23	20	25-37	%
RPM	PID	0	630-750	1465	1726	RPM
VSS	PID	0	0	30	55	MPH
VSO	B1	0	0	67	125	Hz
PATSTRT	B2	0.1	0.5	0.5	0.5	DCV
FP	B12	8.4	2.5	2.8	2.8	DCV
EVAPCV	B13	VBAT/0	VBAT/0	VBAT/0 (S)	VBAT/0 (S)	DCV/ %
WAC (ACCR)	B25	VBAT/OFF	.1/ON (A)	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
PATSOUT	B31	VBAT	VBAT	VBAT	VBAT	DCV
4WDT_IL	B33	0.1	0.1	0.1	0.1	DCV
4WDL_IL	B46	VBAT	VBAT	VBAT	VBAT	DCV
EVMV	B34	0	0	500-900 (F)	500-900 (F)	mA
PATSIL	B37	11	13	13	13	DCV
EPC	T11	6	8	10	10	DCV
EPC2	T23	8	10	10	10	DCV
EPC3	T34	6	8	VBAT	VBAT	DCV
SS1	T42	.1/ON	.1/ON	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
SS2	T43	VBAT/OFF	VBAT/OFF	VBAT/OFF	VBAT/OFF	DCV/OFF-ON
SS3	T44	VBAT/OFF	VBAT/OFF	VBAT/OFF	.1/ON	DCV/OFF-ON
SS4	T45	.1/ON	.1/ON	VBAT/OFF	.1/ON	DCV/OFF-ON
TCC	T46	VBAT/0	VBAT/0	VBAT/0	.2/100	DCV/%
HTR12	T47	12.0/OFF (P)	.2/ON (P)	.2/ON (P)	.2/ON (P)	DCV/OFF-ON
HTR22	T48	12.0/OFF (P)	.2/ON (P)	.2/ON (P)	.2/ON (P)	DCV/OFF-ON
4WD_CLUTCH	T49	0.5	0.2	0.2	0.2	DCV
CDA (CYL1)	E1	VBAT	VBAT	VBAT	VBAT	DCV
INJ1	E2	0	3.3-3.8	5.1	7-Jun	mS
INJ2	E3	0	3.3-3.8	5.1	7-Jun	mS
INJ3	E4	0	3.3-3.8	5.1	7-Jun	mS
INJ4	E5	0	3.3-3.8	5.1	7-Jun	mS
EGRVR	E6	VBAT/0	VBAT/0	(V)	(V)	DCV/%

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2003-2004 Computer Pin Charts for Explorer/Mountaineer

4.6L Explorer/Mountaineer

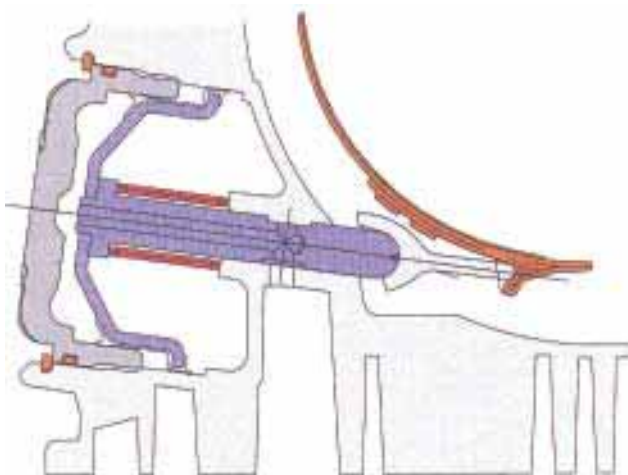
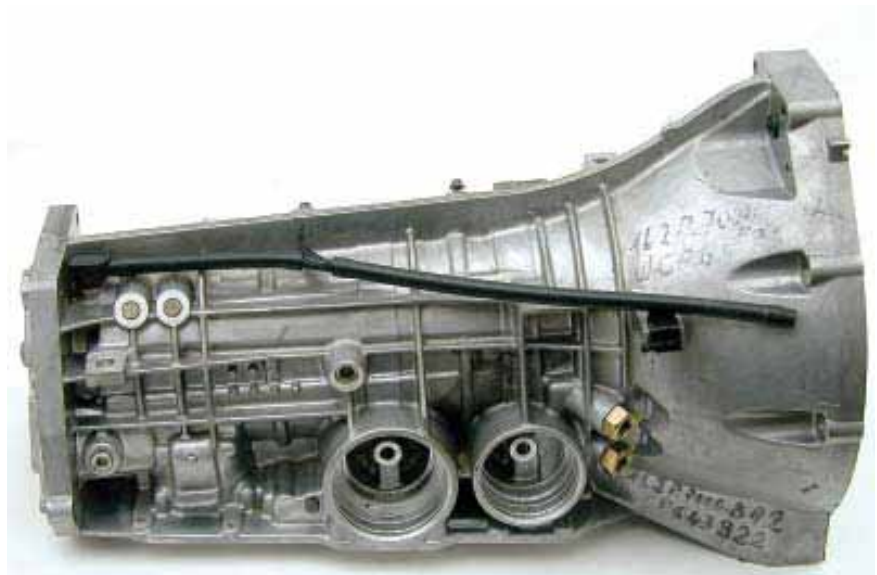
Actuators/ Outputs	PCM Pin/PID only	Measured/PID Values				Units Measured/PID
		KOEO	Hot Idle	30 MPH	55 MPH	
INJ5	E8	0	3.3-3.8	5.1	7-Jun	mS
INJ6	E9	0	3.3-3.8	5.1	7-Jun	mS
INJ7	E10	0	3.3-3.8	5.1	7-Jun	mS
INJ8	E11	0	3.3-3.8	5.1	7-Jun	mS
CDD (CYL2)	E12	VBAT	VBAT	VBAT	VBAT	DCV
CDB (CYL3)	E24	VBAT	VBAT	VBAT	VBAT	DCV
CDG (CYL4)	E35	VBAT	VBAT	VBAT	VBAT	DCV
CDF (CYL5)	E38	VBAT	VBAT	VBAT	VBAT	DCV
CDE (CYL6)	E39	VBAT	VBAT	VBAT	VBAT	DCV
CDC (CYL7)	E42	VBAT	VBAT	VBAT	VBAT	DCV
CDH (CYL8)	E43	VBAT	VBAT	VBAT	VBAT	DCV
TACMP	E47	3.8	VBAT	VBAT	VBAT	DCV
TACMN	E48	3.8	VBAT	VBAT	VBAT	DCV
HTR11	E49	12.0/OFF (P)	.1/ON (P)	.1/ON (P)	.1/ON (P)	DCV/OFF-ON
HTR21	E50	12.0/OFF (P)	.1/ON (P)	.1/ON (P)	.1/ON (P)	DCV/OFF-ON
CHTIL	PID	OFF	OFF	OFF	OFF	OFF-ON
FUELPW1	PID	0	3.3-3.8	5.1	7-Jun	mS
FUELPW2	PID	0	3.3-3.8	5.1	7-Jun	mS
LONGFT1	PID	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	%
LONGFT2	PID	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	(-)20-(+)20	%
MIL	PID	OFF	OFF	OFF	OFF	OFF-ON
SHRTFT1	PID	0	(-)10-(+)10	(-)10-(+)10	(-)10-(+)10	%
SHRTFT2	PID	0	(-)10-(+)10	(-)10-(+)10	(-)10-(+)10	%
SPARKADV	PID	0	16-Dec	30-35	28-35	DEG
TCIL	PID	OFF	OFF	OFF	OFF	OFF-ON
KAPWR	B45	VBAT	VBAT	VBAT	VBAT	DCV
VPWR	B35,36	VBAT	VBAT	VBAT	VBAT	DCV
VREF	B40, T40	5	5	5	5	DCV
ETCVREF	B4, E18	5	5	5	5	DCV

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Slipping 2nd/5th Gears, Binds on the 2-3 Shift

Overdrive Servo Bore Wear

The symptom may be erratic. Before removing the transmission, always check the pressures to determine the cause of the problem. If the pressures are normal, check the O/D servo bore for premature wear. Side loading causes the Servo to wear the bore excessively.



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Erratic Shifts

Drive Cycle Procedure

Erratic shifts after an overhaul may be caused by a relearn strategy. DO NOT remove the transmission and attempt to make any repairs until you thoroughly drive the vehicle. Don't be alarmed if you have to drive the vehicle for up to 4 hours.

Many concerns will be associated with the transmission:

- No upshift without lifting the throttle
- 2-3 flare 3-4 and 4-5 OK
- 1-2 shift late and harsh
- 2-3 flare and on time

Drive Cycle Recommendations:

1. Most OBDII monitors will complete more readily using a "steady foot" driving style during cruise or acceleration modes. Operating the throttle in a "smooth" fashion will minimize the time required for monitor completion.
2. Fuel tank level should be between 1/2 and 3/4 fill with 3/4 fill being the most desirable.
3. The Evaporative Monitor can only operate during the first 30 minutes of engine operation. When executing the procedure for this monitor, stay in part throttle mode and drive in a smooth fashion to minimize "fuel slosh".

An adaptive learning strategy in the PCM controls the shift feel and timing on the transmission. This feature is designed to increase durability and provide consistent shift feel over the life of the vehicle. As a result of the battery being disconnected, the transmission may have firm and/or soft shifts. This operation is considered normal and will not affect the function or durability of the transmission. Once the vehicle is at operating temperature it may take several shifts at that same operating condition before the transmission will operate properly. Over time, the adaptive learning process will fully update the operation of the transmission. The more varied the driving habits the longer it may take.

Disconnected Battery

When the battery has been disconnected, or a new battery installed certain transmission operating parameters may be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

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Erratic Shifts (continued)

Drive Cycle Procedure

OBDII Monitor Exercised	Drive Cycle Procedure	Purpose of Drive Cycle Procedure
Drive Cycle Preparation	1. Install scan tool. Turn key on with the engine off. Cycle key off, then on. Select appropriate Vehicle & Engine qualifier. Clear the continuous diagnostic trouble codes (DTCs) and reset the emission monitors information in the powertrain control module (PCM). 2. Begin to monitor the following PIDs: ECT, EVAPDC, FLI (if available) and TP MODE. Start vehicle WITHOUT returning to Key Off. 3. Idle vehicle for 15 seconds. Drive at 64 Km/h (40 MPH) until ECT is at least 76.7°C (170°F).	Bypass engine soak timer. Resets OBDII Monitor status.
Prep for Monitor Entry	4. Is IAT within 4.4 to 37.8°C (40 to 100°F)? If not, complete the following steps, but note that step 14 will be required to "bypass" the EVAP monitor and clear the P1000.	Engine warm-up and provide IAT input to the PCM.
HEGO	5. Cruise at 64 Km/h (40 MPH) for at least 5 minutes.	Executes the HEGO monitor.
EVAP	6. Cruise at 64 to 128 Km/h (45 to 65 MPH) for 10 minutes (avoid sharp turns and hills). NOTE: To initiate the monitor TP MODE should = PT, EVAPDC must be > 75%, and FLI must be between 15 and 85%.	Executes the EVAP monitor (If IAT is within 4.4 to 40°C (40 to 120°F).
Catalyst	7. Drive in stop-and-go traffic conditions. Include five different constant cruise speeds, ranging from 32 to 112 Km/h (20 to 70 MPH) over a 10 minute period.	Executes the Catalyst Monitor.
EGR	8. From a stop, accelerate to 72 Km/h (45 MPH) at 1/2 to 3/4 throttle. Repeat 3 times.	Executes the EGR Monitor.
SEC AIR/CCM (Engine)	9. Bring the vehicle to a stop. Idle with transmission in drive (neutral for M/T) for 2 minutes.	Executes the ISC portion of the CCM.

5R55W

Erratic Shifts (continued)

Drive Cycle Procedure

OBDII Monitor Exercised	Drive Cycle Procedure	Purpose of Drive Cycle Procedure
CCM (Trans)	10. For M/T, accelerate from 0 to 80 Km/h (0 to 50 MPH), continue to step 11. For A/T, from a stop and in overdrive, moderately accelerate to 80 Km/h (50 MPH) and cruise for at least 15 seconds. Stop vehicle and repeat without overdrive to 64 Km/h (40 MPH) cruising for at least 30 seconds. While at 64 Km/h (40 MPH), activate overdrive and accelerate to 80 Km/h (50 MPH) and cruise for at least 15 seconds. Stop for at least 20 seconds and repeat step 10 five times.	Executes the transmission portion of the CCM.
Misfire & Fuel Monitors	11. From a stop, accelerate to 104 Km/h (65 MPH). Decelerate at closed throttle until 64 Km/h (40 MPH) (no brakes). Repeat this 3 times.	Allows learning for the misfire monitor.
Readiness Check	12. Access the On-Board System Readiness (OBDII monitor status) function on the scan tool. Determine whether all non-continuous monitors have completed. If not, go to step 13.	Determines if any monitor has not completed.
Pending Code Check and EVAP Monitor "Bypass" Check	13. With the scan tool, check for pending codes. Conduct normal repair procedures for any pending code concern. Otherwise, rerun any incomplete monitor. If the EVAP monitor is not complete AND IAT was out of the 4.4 to 37.8 °C (40 to 100 °F) temperature range in step #4, or the altitude is over 2438 m. (8000 ft.), the EVAP "bypass" procedure must be followed. Proceed to Step 14.	Determines if a pending code is preventing the clearing of P1000.
EVAP Monitor "Bypass"	14. Park vehicle for a minimum of 8 hours. Repeat steps 2 through 12. DO NOT REPEAT STEP 1.	Allow the "bypass" counter to increment to two.

5R55W

TCIL Illuminated, Code P0713, Multiple Codes

2002 Explorer/Mountaineer

Vehicles equipped with a 5R55W transmission and DTC P0713 may have water intrusion in the transmission solenoid body connector.

Check the transmission solenoid body connector for signs of water intrusion. If water intrusion is present, replace the Transmission Wiring Harness with part number 1L2Z-7C078-AB. A new harness has been released to prevent this condition.

<i>Part Number</i>	<i>Part Name</i>
---------------------------	-------------------------

<i>1L2Z-7C078-AB</i>	<i>Transmission Wiring Harness</i>
-----------------------------	---



NOTE: An adaptive learning strategy in the PCM controls the shift feel and timing on the transmission. This feature is designed to increase durability and provide consistent shift feel over the life of the vehicle. As a result of the battery being disconnected, the transmission may have firm and/or soft shifts. This operation is considered normal and will not affect the function or durability of the transmission. Once the vehicle is at operating temperature it may take several shifts at that same operating condition before the transmission will operate properly. Over time, the adaptive learning process will fully update the operation of the transmission. The more varied the driving habits the longer it may take.

5R55W

TCIL Illuminated, Code P0713, Multiple Codes (continued)

Harness Replacement Procedure

To replace the harness:

1. Disconnect the battery.
2. Remove the transmission connector from the Powertrain Electronic Controller (PTEC), center pocket.
3. Remove the transmission harness from the retainers along the dash panel.
4. Ensure the transmission wiring harness is loosened at the rear of the engine.
5. Attach a length of wire or string to the PTEC connector to assist in pulling/routing of the new transmission wiring harness back up from below the vehicle.
6. Raise the vehicle on the hoist.
7. Pull the transmission harness down from above leaving the wire/string in place.
8. Remove the old transmission harness from the rest of the transmission.
9. Carefully clean around the solenoid body connector prior to disconnecting to prevent contamination from getting into the connector.
10. Blow out the solenoid body connector to ensure it is dry.
11. Lubricate the O-rings in the solenoid body connector with dielectric grease to ease assembly.
12. Torque the solenoid body connector screw to 5 N-m (44 lb-in). DO NOT OVERTIGHTEN.
13. Reroute the new harness onto the transmission.
14. Attach to the PTEC connector.
15. Lower the vehicle off of the hoist.
16. Pull the transmission harness back up from below.
17. Reroute the wiring along the dash panel and attach in the retainers.
18. Reconnect the transmission connector to PTEC, center pocket. Torque the PTEC connector screw at 6 N-m (53 lb-in).
19. Raise the vehicle on the hoist to install one pushpin for the harness at the back of the engine that is not accessible at Step 17.
20. Lower the vehicle off of the hoist.
21. Reconnect the battery.
22. Verify the repair.

5R55N/W/S

Broken Flexplate, Vibration at Idle, Vibration while Driving

A special tool must be used when installing the adapter plate to the torque converter. In order to correctly install the special service tool, use one round hole and one oblong hole. Rotunda Part #307-403



Using two oblong holes will cause damage to the transmission



4R44/55E, 5R44/55E

TCC Slip Codes

Always verify you have the correct EPC and TCC solenoid. The conception that the updated solenoid will work for all years is wrong. Only use the correct solenoid for the correct year, refer to the list below.

TCC Solenoids

1995-1996 Explorer, Ranger, Aerostar
F5TZ-7F037-AA

1997-Only Aerostar
1997-2001 4DR Explorer
1997-2003 Explorer Sport
1997-2005 Explorer Sport Trac, Ranger
XL2Z-7G136-AA



EPC Solenoids

1995-1996 Explorer, Ranger, Aerostar
F5TZ-7H144-A

1997-Only Aerostar
1997-2001 4DR Explorer
1997-2003 Explorer Sport
1997-2005 Explorer Sport Trac, Ranger
XL2Z-7G383-AA



5R55E

Gear Noise, Whine in 1st, 2nd and Third Gear

Some 2001-2003 Rangers, 2001-2003 Explorer Sport/Sport Trac

Vehicles equipped with a 5R55E automatic transmission and 4.0L engine, may exhibit a gear whine type of noise in 1st, 2nd and 3rd gear ONLY. This may be caused by the Reverse and Forward Planetary assemblies and/or the driveshaft.

Verify that only these conditions exist and no DTCs are present. If other conditions are present and DTCs exist they must be diagnosed and serviced first. Once all other conditions are serviced and only the 1st, 2nd and 3rd gear whine are still present, refer to the following Service Procedure. Using the chart provided, select the parts that need to be replaced.

Replace the Forward and Reverse Planetary assemblies.

Application and Component Replacement Chart	
2001-2003 Ranger	Forward and Reverse Planetaries
2001-2002 Explorer Sport built prior to 8/12/02	Forward and Reverse Planetaries Only and NO Driveshaft
2001-2002 Explorer Sport Trac 4x4 built prior to 8/12/02	Forward and Reverse Planetaries Only and NO Driveshaft
2001-2002 Explorer Sport Trac 4x2 built prior to 8/12/02	Forward and Reverse Planetaries and Driveshaft
2002 -2003 Explorer Sport Trac 4x2, built 8/12/02 thru 10/18/02	Driveshaft Only

PART NUMBER	PART NAME
XL2Z-7D006-AA	Reverse Planetary Assembly
XL2Z-7A398-AA	Forward Planetary Assembly
2L2Z-4602-AA	Driveshaft

4F27E

TCC Engagement Concerns

The turbine shaft bushing clearance is critical, the bushings are used to separate the T/C F (TCC release) and T/C R (TCC apply) oil circuits. Worn bushings allow TCC apply oil pressure to leak into the TCC release circuit, causing partial TCC release and TCC slip codes.



4F27E

End Cover Failure

Mazda and Ford use two different types of End Covers. Mazda End Covers have Hard Coat Anodized Aluminum Ring Lands. Ford End Covers have Steel Ring Lands. Mazda End Covers tend to fail in the Ring Land area because of the thin Anodized surface.

***Hard Coat Anodized
Aluminum Ring Lands
wear in this area***



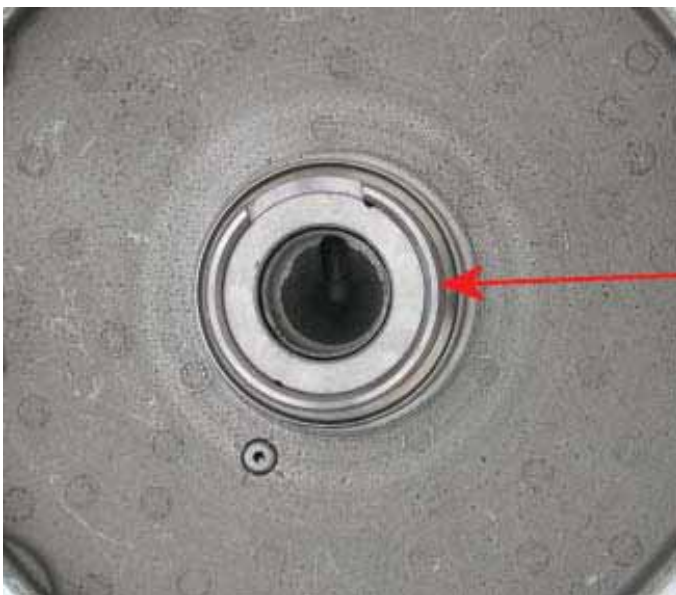
4F27E

End Cover Failure (continued)

Normal rebuilding procedure should include upgrading the Mazda type End Cover to the Ford type End Cover. This can be done with minor modifications.



***Hard Coat Anodized
Aluminum Cover
(Mazda Applications)***

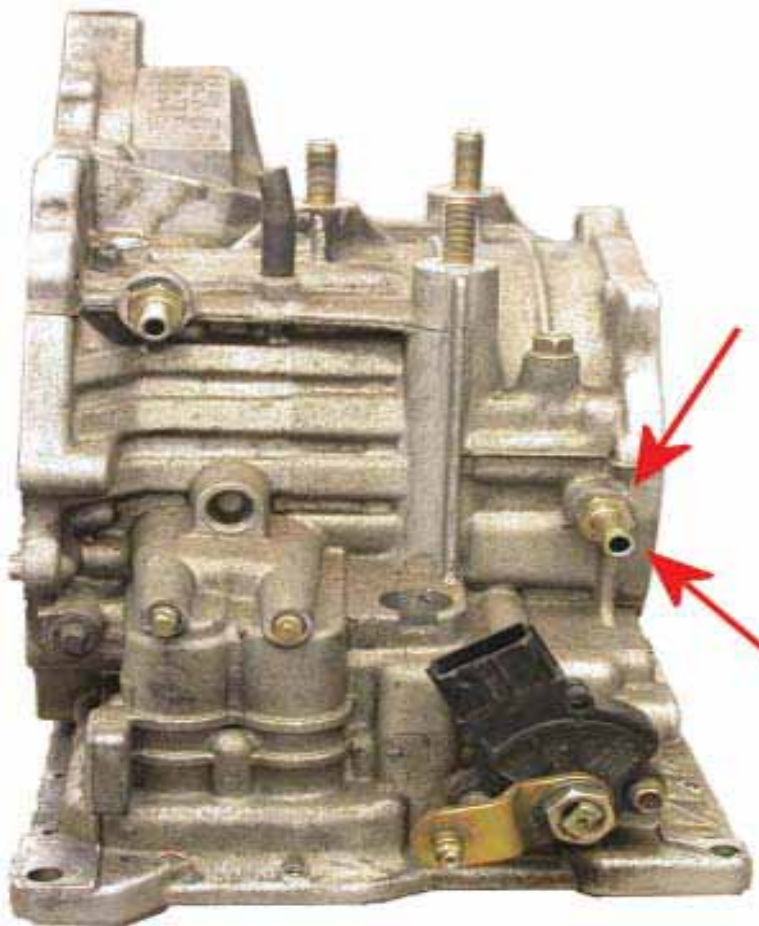


***Pressed on Steel Sleeve
(Ford Applications)***

4F27E

End Cover Failure (continued)

When using a Ford cover on a Mazda application, the cooler return line must be relocated from the case to the end cover.



***Mazda cases
have the cooler
return line
located in the
case***

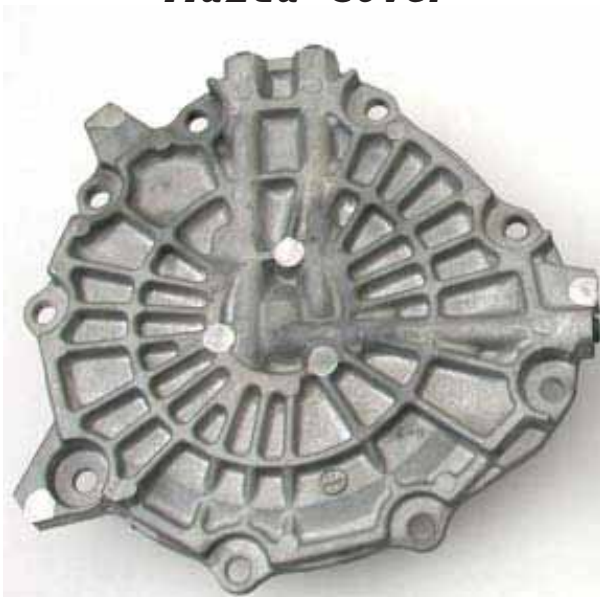
***This Mazda
fitting will **NOT**
thread into the
Ford cover***

4F27E

End Cover Interchange

The first step is to install a 3/8" fitting adapter to the Ford cover.

Mazda Cover



**Ford Cover
XS4Z-7222-BA**



**YS4Z-7D273-AA
3/8" Fitting Adapter
(sold separately)**

4F27E

End Cover Interchange

Using a piece of 3/8" cooler line, cut and *bubble flare* the tubing to match the length of the original Mazda case fitting.



4F27E

End Cover Interchange (continued)

Mazda cover

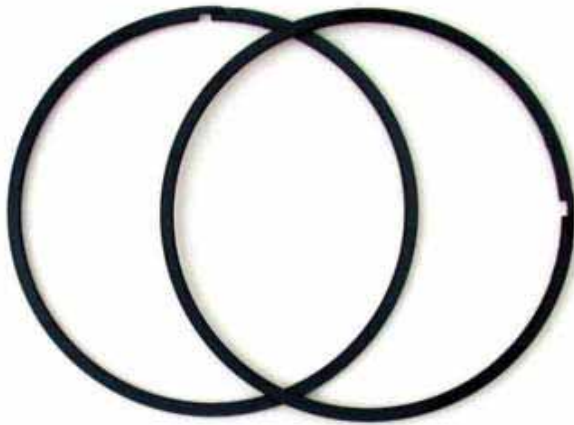
Ford cover



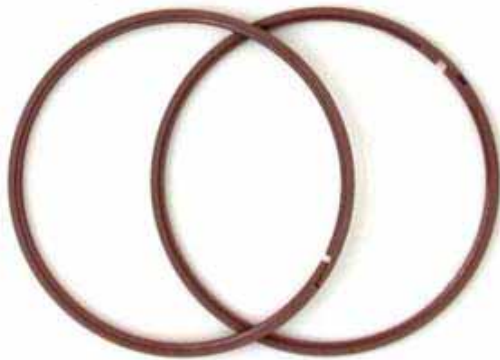
4F27E

End Cover Interchange (continued)

When useing the Ford cover always use the Ford Rings.



Reverse Clutch Rings
YS4Z-7D020-AA



Direct Clutch Rings
YA4Z-7D019-AA

4F27E

End Cover Interchange (continued)

When replacing hard parts, always check the end play. End play can be adjusted by replacing the selective washer.

End Play -0.010"-0.019"



0.062"	 XS4Z-7G262-FB
0.068"	 XS4Z-7G262-FC
0.075"	 XS4Z-7G262-FD
0.083"	 XS4Z-7G262-FE
0.091"	 XS4Z-7G262-FF
0.098"	 XS4Z-7G262-FG

AX4S/AX4N

TCC Does Not Engage

NOTE: If the “TCCRAT” PID data is incorrect, the incorrect transaxle or drive and driven sprockets may have been installed in the vehicle

For DTC P0741 and P1744, check the resistance at the TCC solenoid. Make sure you have the right solenoid in place.

If the PCM commands the TCC “ON” and the TCC does not engage and you see a major slip on the PID’s through your scanner, try to kill the engine in the stall. With the transmission commanded third gear and the parking brake applied, command the TCC ON.

****If the Transmission kills the engine check the command from the PCM.***

****If the Transmission does not kill the engine there are other areas you will need to check***

AX4S/AX4N

TCC Does Not Engage (continued)

If the Torque converter clutch does not engage when being commanded and/or Diagnostic Trouble Codes (DTC) P0741 or P1744 stored in memory, there may be many different problems associated with this. One of the more common problems is the bypass clutch control valve stuck in the bore.

When you start your diagnosis, use a scan tool to monitor PID's to help determine the proper steps to take for service.

The torque converter clutch may not engage if one or more of the following conditions exist:

1. Low Pressure
2. Stuck Converter Regulator Valve
3. Stuck Solenoid Regulator Valve
4. Stuck Bypass Clutch Control Valve
5. Stuck Pressure Failsafe Valve
6. Poor Pump Performance
7. Worn Pump Shaft or Damaged Pump Shaft Seals
8. Pump Shaft Internal Sleeve Loose (rattles)
9. Turbine Shaft Seals Damaged or Missing
10. Incorrect Torque Converter Clutch (TCC) solenoid
11. TCC Solenoid Mechanically Stuck or Electrically Inop
12. Damaged Internal Wiring Harness
13. Incorrect Gear Ratio (Wrong Sprockets)
14. Damaged or Worn Stator Support
15. Worn Torque Converter Hub Bushing
16. Torque Converter Clutch Worn or Damaged
17. Worn Bypass Clutch Control Valve Bore
18. Worn TCC Regulator Valve Bore

Use a scan tool to monitor the following PID's:

1. TCC = Commanded Duty Cycle for the TCC Solenoid
2. TCCMACT = Actual slip across the TCC, measured in RPM
3. RPM = Actual engine speed
4. TSS_SRC = Actual turbine shaft speed
5. TCCRAT = Speed/Gear ratio of torque converter/transaxle

AX4S/AX4N

TCC Does Not Engage (continued)

Check for pump shaft wear or damaged seals

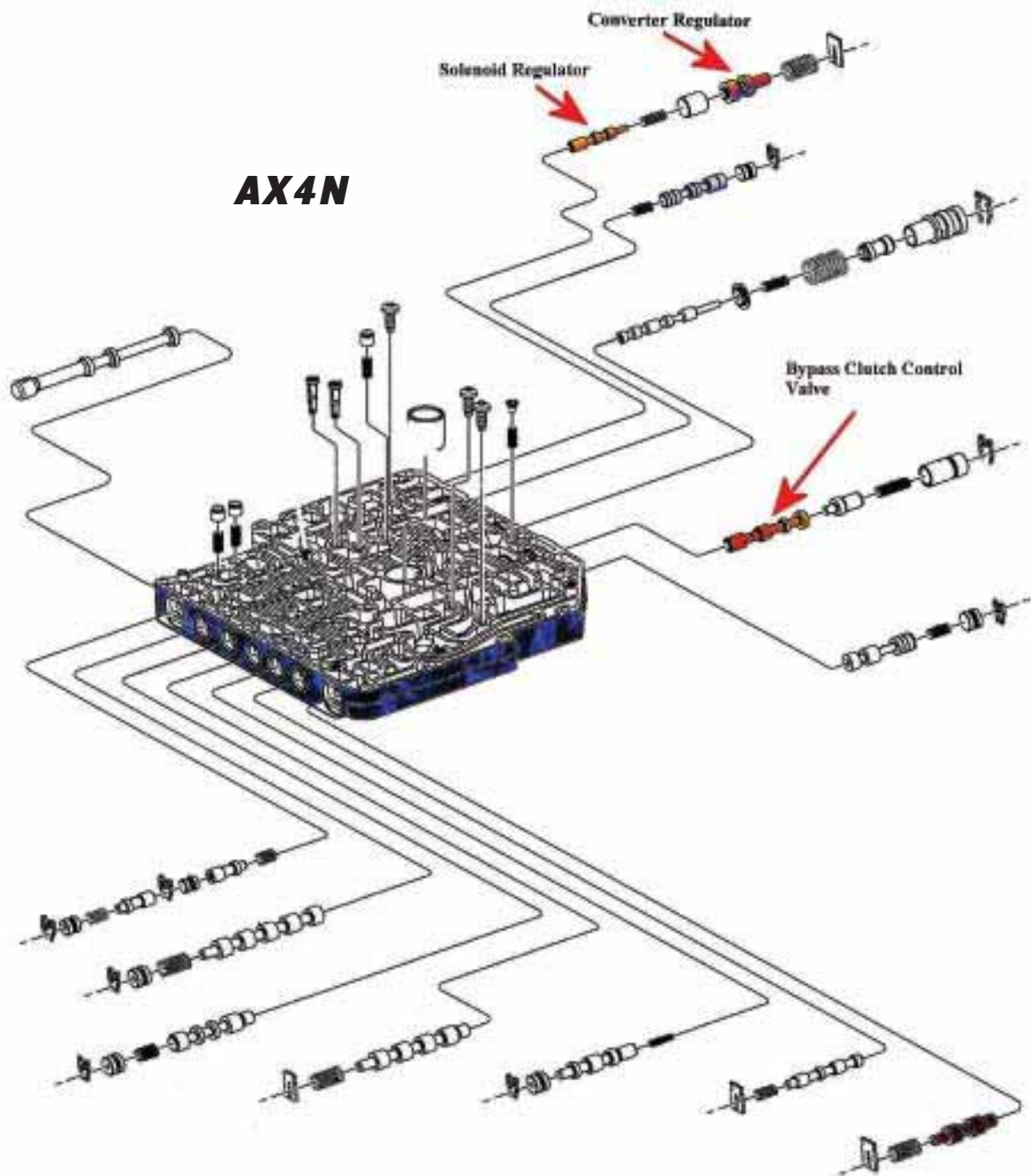
Always inspect the pump shaft ring area, also look inside the shaft and make sure it has a inner tube and plug.



AX4S/AX4N

TCC Does Not Engage (continued)

Inspect the converter regulator valve, solenoid regulator valve, bypass clutch control valve and pressure failsafe valve

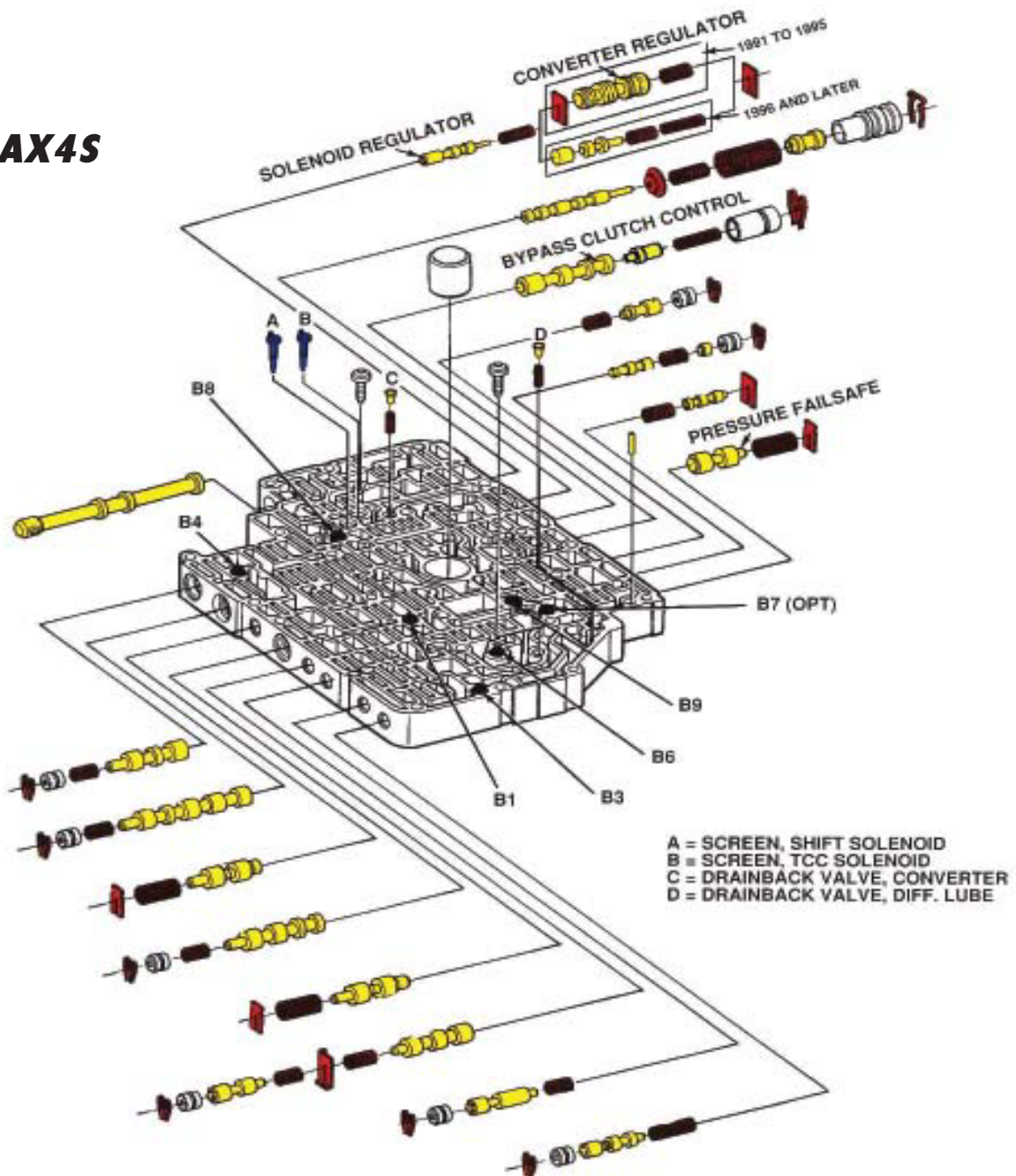


AX4S/AX4N

TCC Does Not Engage (continued)

Inspect the converter regulator valve, solenoid regulator valve, bypass clutch control valve and pressure failsafe valve

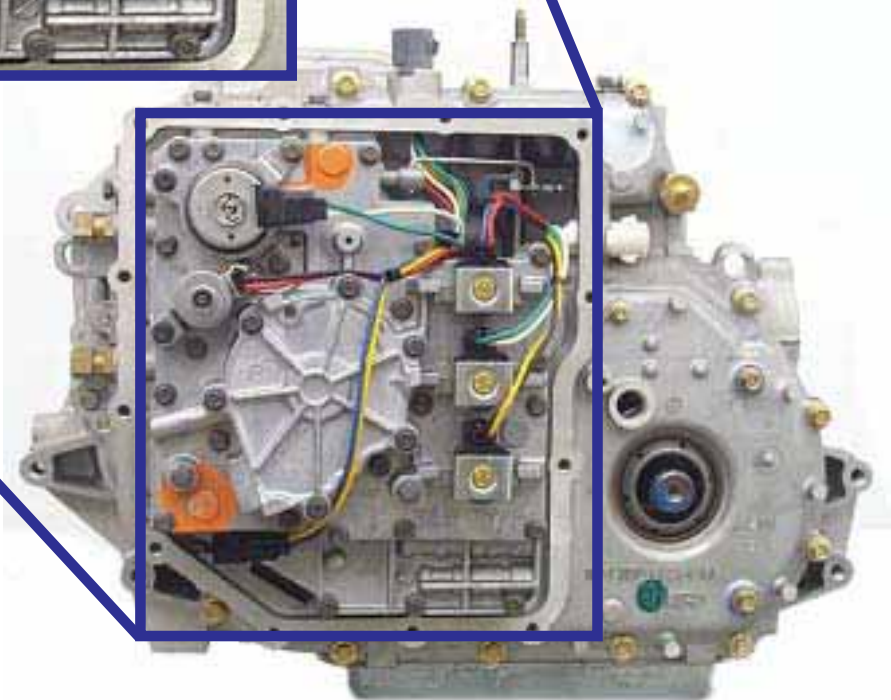
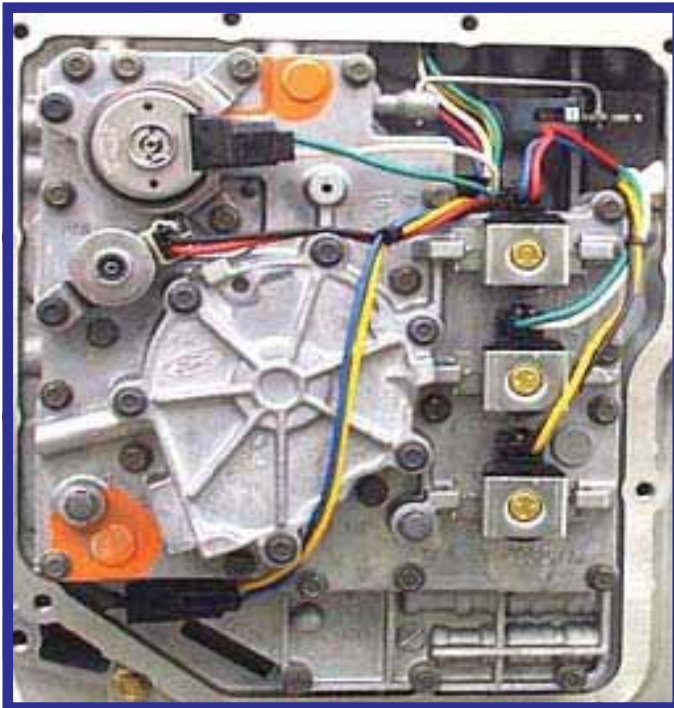
AX4S



AX4S/AX4N

TCC Does Not Engage (continued)

Inspect the internal wiring harness for damage

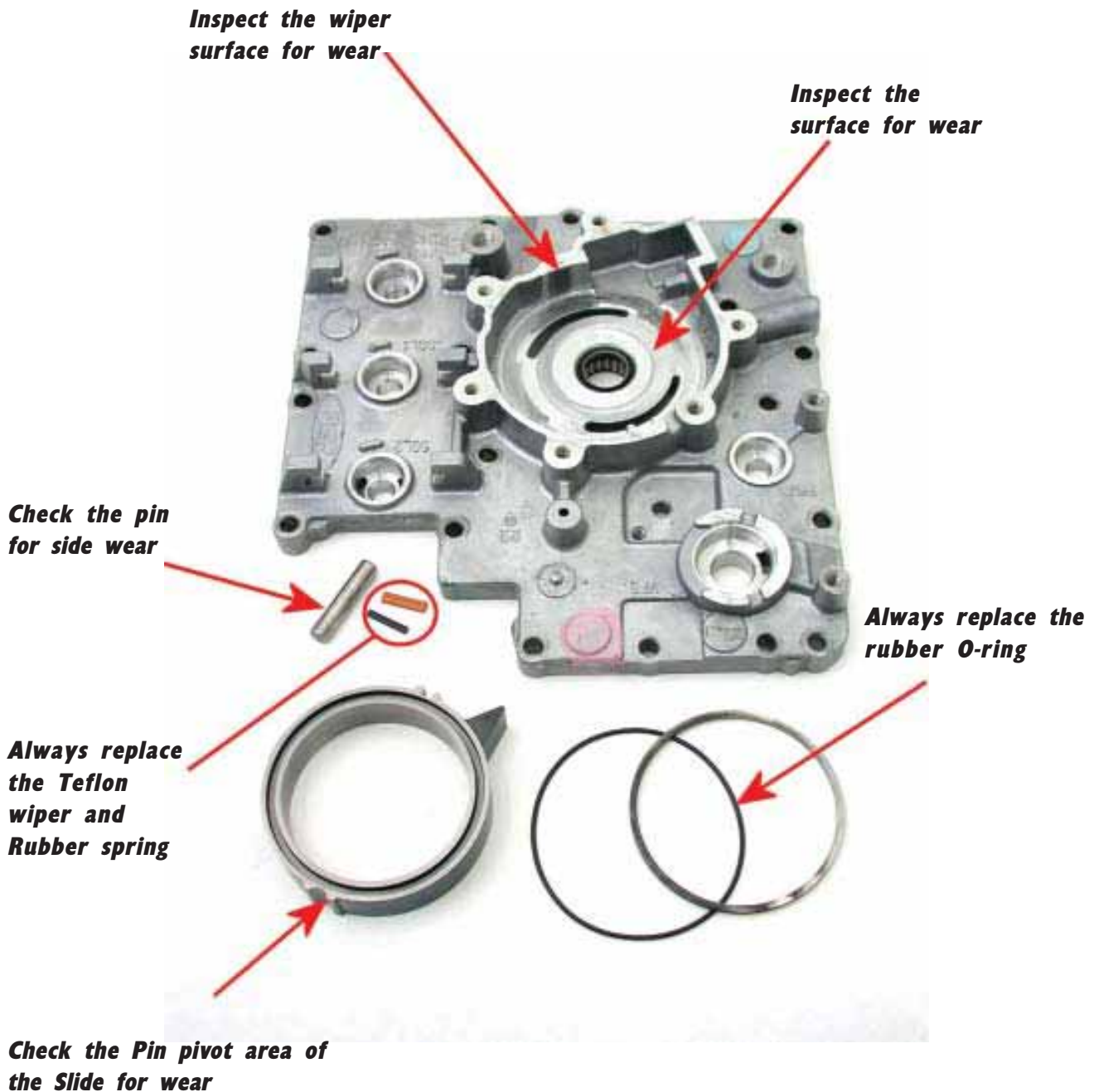


AX4S/AX4N

TCC Does Not Engage (continued)

Poor Pump Performance

Poor Pump Performance can be caused by wear or by not replacing the Teflon wiper, rubber spring, and rubber O-ring.



AX4S/AX4N

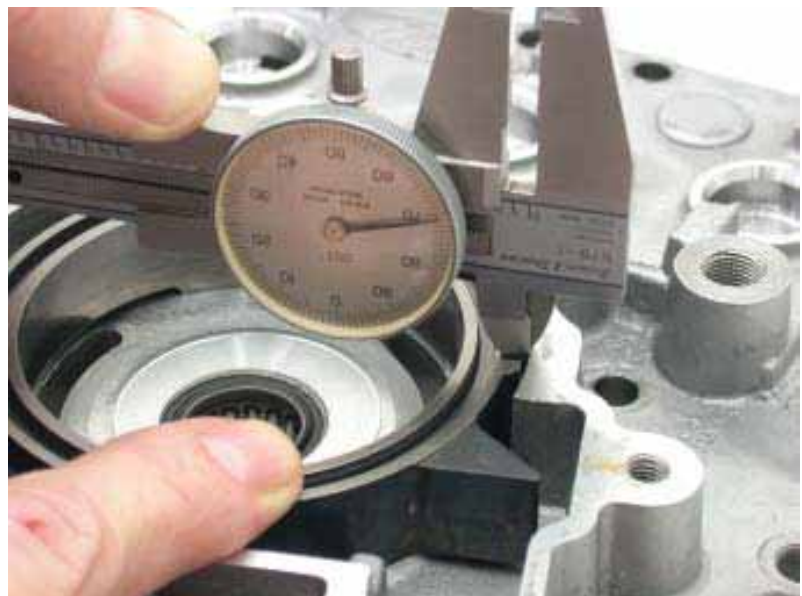
TCC Does Not Engage (continued)

Poor Pump Performance

The distance between the wiper groove in the slide and the wiper surface of the pump body changes depending on the position of the slide. Always replace the rubber spring and Teflon wiper during rebuild.



***Measurement of
the slide in the
max position of
its travel***



***Measurement of
the slide in the
center position of
its travel***

AX4S/AX4N

TCC Does Not Engage (continued)

Poor Pump Performance

As the slide moves, the angle of the wiper surface changes. This causes the Teflon wiper to flex the rubber spring. Over time this becomes loose.



***Slide in the max
position of its
travel***



***Slide in the
center position
of its travel***

AX4S/AX4N

TCC Does Not Engage (continued)

Poor Pump Performance

There are no factory specifications for pump clearances from Ford.



Rotor clearances should be 0.0015"-0.003"



Slide clearance should be 0.002"-0.004"

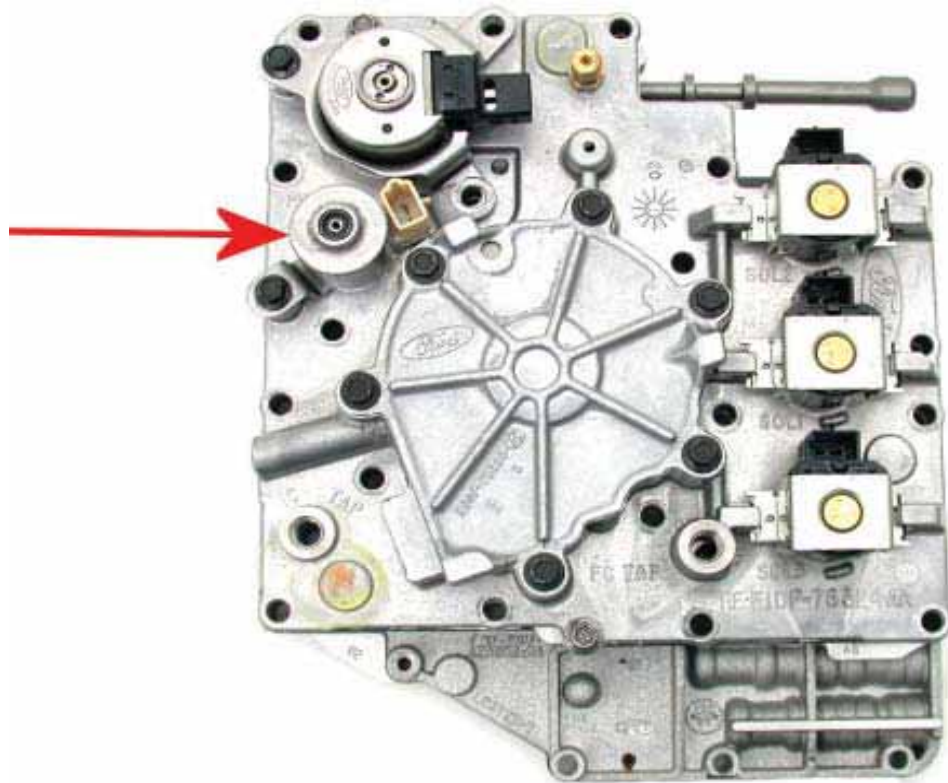
AX4S/AX4N

TCC Does Not Engage

Check the TCC Solenoid

The new TCC solenoid has a blue connector, the old solenoid is white. Do not interchange these solenoids, some calibrations have problems with the different solenoids and TCC ratio error codes will be present.

Always check the resistance of the TCC Solenoid to make sure you have the correct one.



Vehicle	Year	Date	Resistance
Taurus/Sable	1986-1990		20-40 ohms
Continental	1988-1990		20-40 ohms
Taurus/Sable	1991		21-36 ohms
Continental	1991-1996		0.98-1.6 ohms
Taurus/Sable	1992-1997		0.98-1.6 ohms
Windstar	1995-1998	Thru (9-8-97)	0.98-1.6 ohms
Continental	1997-2002		13-24 ohms
Taurus/Sable	1998-2003		13-24 ohms
Windstar	1998-2003	From (9-9-97) until the End of Production	13-24 ohms

AX4S/AX4N

TCC Does Not Engage

Inspect the Torque Converter Hub Bushing and Stator Support for wear

Inspect the Torque Converter Hub Bushing and the Stator Support for abnormal and excessive wear. If the Stator Support is worn and/or broken, check the torque converter splines in the bottom of the converter and the Stator Support splines. Both of the splines should have equal amount of teeth.



Torque Converter:

Hub outside diameter: 1.991" (surface for the lip seal contact)

Bushing inside diameter: 1.657" (surface for the Stator Support)

Stator Support:

Shaft outside diameter: 1.652" (surface to TC bushing contact)

Bushing inside diameter: 1.079" (surface for the Turbine Shaft contact)

Turbine Shaft:

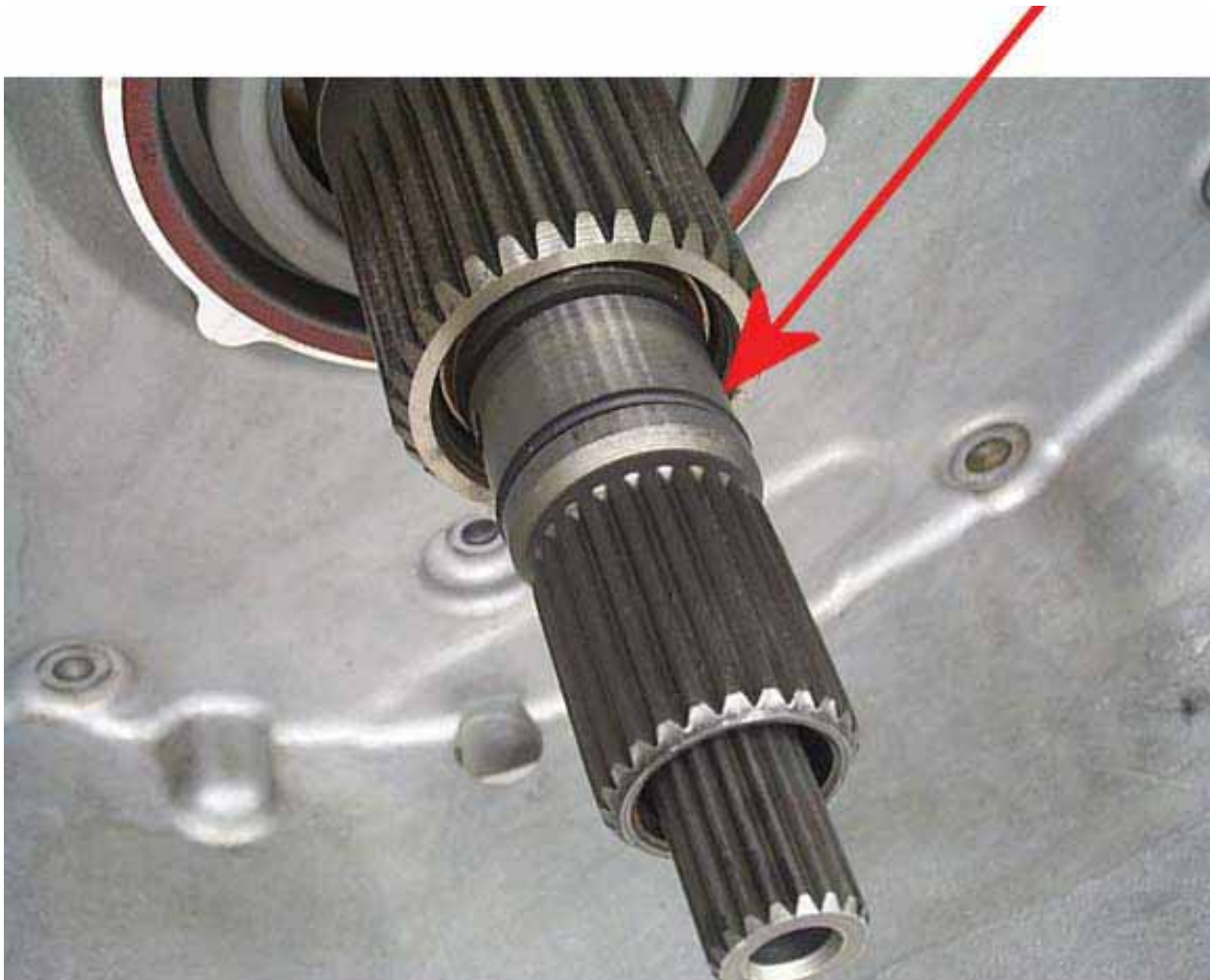
Outside diameter: 1.076"-1.077" (surface for the Stator Support contact)

AX4S/AX4N

TCC Does Not Engage

Inspect Turbine Shaft seals

The Turbine Shaft Seal is used to seal the apply side of the TCC. A worn, damaged, or missing seal will cause a slipping TCC application or a no TCC apply.



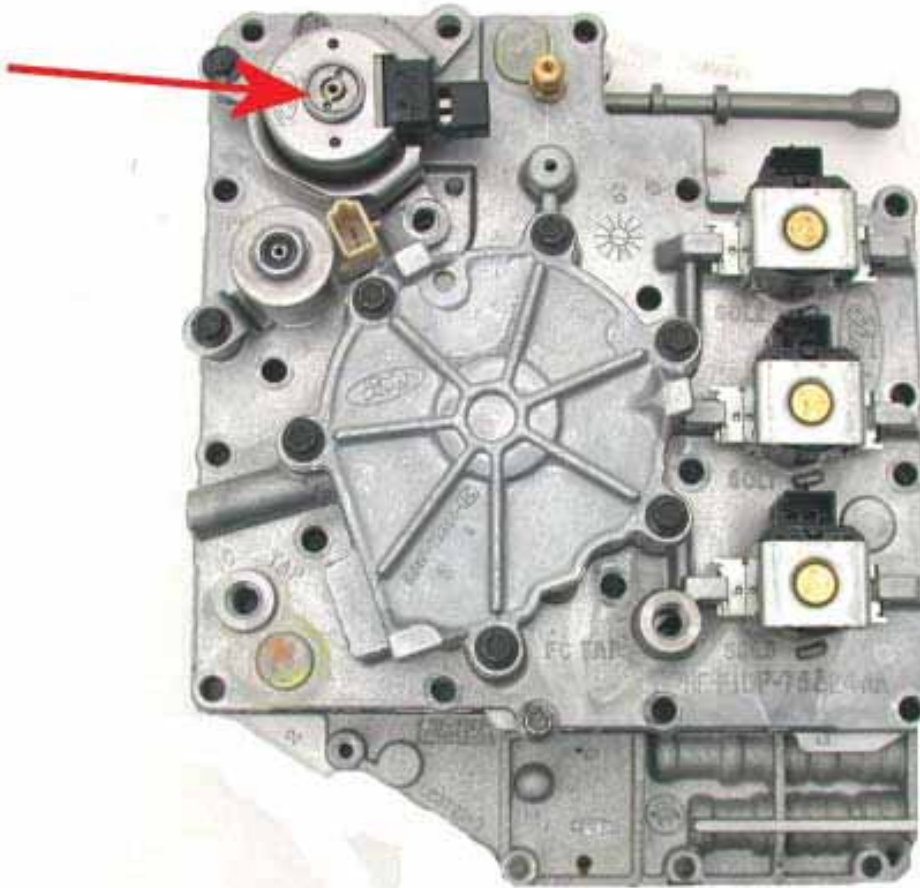
AX4S/AX4N

Erratic Mainline Pressure Rise

1996 Taurus/Sable, 3.0L 2V

Erratic line pressure can be caused by many things, reprogramming the PCM or replacing the EPC Solenoid may not fix this problem. However, some 1996 model years with 3.0L 2V Taurus/Sable PCM's may not be able to be reprogrammed using the factory scan tool (NGS). PCM part numbers F6DF-12A650-BF, F6DF-12A650-JD, F6DF-12A650-DF, & F6DF-12A650-KD were released with the same HEX file name programmed into the PCM. The F6DF-12A650-BF PCM can be reprogrammed with the factory scan tool. PCM with part numbers F6DF-12A650-JD/DF/KD may not be able to be reprogrammed with the factory scan tool. All four of these PCM's can be reprogrammed using the July 98' or later program. If the factory scan tool is unable to reprogram the PCM it is necessary to replace the PCM assembly.

EPC Solenoid



ZF6HP26

Expedition/Navigator

This transmission uses planetary gears with hydraulic electronic controls. The transmission control module (TCM) and the main control valve body units form a composite element that is installed as a single unit inside the automatic transmission.

This transmission has the following features:

- Six forward speeds
- Torque converter with an integral converter clutch
- Electronic shift and pressure controls
- Single planetary gear set
- Double planetary gear set
- Two fixed multi-disc clutches
- Three multi-plate clutches

All hydraulic functions are directed by electronic solenoids to control:

- Engagement feel.
- Shift feel.
- Shift scheduling.
- Modulated torque converter clutch (TCC) applications.

This transmission has a mechatronic unit also referred to as a transmission control module (TCM) which contains:

- Turbine shaft speed (TSS) sensor
- Output shaft speed (OSS) sensor
- An internal P, R, N, D selector shaft position sensor
- Transmission fluid temperature (TFT) sensor

ZF6HP26

Expedition/Navigator

Engine power reaches the transmission by a torque converter with an integral converter clutch. The six forward gears and one reverse gear are obtained from single planetary sets.

This automatic transmission is a six-speed electronically controlled transmission comprising the basic elements of a TCM, main control valve body unit, torque converter, one solenoid valve and six pressure regulators. Gear selection is achieved by the control of automatic transmission fluid flow to operate various internal clutches. The TCM operates the electrical components and provides for the control of gear selection shift pressure which increases refinement and torque converter slip.

In the event of a system fault, the TCM also provides for failure mode effect management (FMEM) to maintain maximum functional operation of the transmission with a minimum reduction in driver, passenger or vehicle safety. In the event of a total loss of control or electrical power, the basic transmission functions PARK, REVERSE, NEUTRAL and DRIVE are retained. Also third or fifth gear is retained by the hydraulic system. The gear retained is dependent upon the gear selected at the time of the failure.

ZF6HP26

Expedition/Navigator

Solenoid Application Chart								
Gear	SS A (EDS1)	SS B (EDS2)	SS C (EDS3)	SS D (EDS4)	PC A (EDS5)	TCC (EDS6)	SS E (MV1)	REV (MV3) ^a
PARK				X	a			
REVERSE		X		X	a			b
NEUTRAL				X	a			
First gear manual	X			X	a	a		
Second gear manual	X		X		a	a		
Third gear manual	X	X			a	a		
First gear D6/D4	X			X	a	a		
Second gear D6/D4	X		X		a	a		
Third gear D6/D4	X	X			a	a		
Fourth gear D6/D4	X			X	a	a	X	
Fifth gear D6/D4		X		X	a	a	X	
Sixth gear D6/D4 (Overdrive)			X	X	a	a	X	

ZF6HP26

Expedition/Navigator

Clutch Application Chart					
Gear	Forward (A)	Direct (B)	Intermediate (C)	Low/Reverse (D)	Overdrive (E)
PARK				X	
REVERSE		X		X	
NEUTRAL				X	
First gear (M) manual	X			X	
Second gear manual	X		X		
Third gear manual	X	X			
First gear D6/D4	X			X	
Second gear D6/D4	X		X		
Third gear D6/D4	X	X			
Fourth gear D6/D4	X				X
Fifth gear D6/D4		X			X
Sixth gear D6/D4			X		X

Chrysler

Section



Chrysler

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41TE/42LE

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45RFE

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Transfer Case Issues - Recall

2001 Durango and 2001 Dakota

4X4 Trucks Unexpectedly Rolling When in Park

Light duty trucks and sport utility vehicles equipped with Electric Shift 4-wheel drive. The electric shift transfer case may not fully engage into gear when the operator moves the transfer case selector switch. This could cause the transfer case to end up in the neutral position unexpectedly and allow the vehicle to roll if the parking brake is not fully applied. Vehicles built between manufacture dates: JUL 1999 through JAN 2001. Chrysler has a recalibration for the transfer case control module that is for this specific concern Campaign No: 01V077000. This is a recall campaign so there should be no dealer charge for the module relearn.

Control Modules

Module Diagnostics

Module Calibration Fault Example

The flowing fault is very common and easily fixed. Although it is technically an HVAC concern, the wide variety of symptoms may lead technicians into hours of frustrating diagnosis in other systems.

Symptoms

The following symptom combinations in the following list occur primarily through the late 1990's Minivans (NS Body) after a module replacement or extended power loss. If you replace the HVAC control head or the battery is removed/dead for an extended period of time, the wiper and A/C status indicator LEDs will be flashing. There will be no trouble codes stored, and normal diagnostics will not lead to a solution.

- **Rear Wiper and Intermittent Wiper LEDs flash simultaneously:** This condition indicates that the A/C control head calibration diagnostics have failed. Repeat the calibration procedure in this article.
- **A/C and RECIRC LEDs flash simultaneously:** This condition indicates that the A/C control head calibration diagnostics have failed the 'cooldown' test. Repeat the cooldown test in this article.
- **A/C, RECIRC, Rear Wiper and Intermittent Wiper LEDs flash simultaneously:** This condition indicates that the A/C control head calibration diagnostics have failed. Repeat the calibration procedure in this article.
- **Rear Wiper and Intermittent Wiper LEDs flash simultaneously:** This condition indicates that the A/C control head calibration diagnostics and the cooldown test have failed.

The primary reason this fault is difficult to diagnose is that it isn't really a fault. It is usually just an indication that the HVAC control head had lost calibration information or requires initial calibration.

Control Modules

Module Diagnostics

Recalibration Procedure

To enter the recalibration procedure, perform the following steps:

- With the engine running, set the blower motor to HIGH
- Set the mode position to PANEL
- Open all A/C outlets
- Set the temperature to COLD (both sliders if equipped)
- Depress WASH and REAR WIPER buttons simultaneously for 5 seconds

The module has entered calibration and diagnostic mode when all LEDs illuminate. The following will occur during test:

- All LEDs will illuminate for 5 seconds
- REAR WIPER and INTERMITTENT LEDs will flash alternately while the test is running
- A/C and RECIRC LEDs will flash alternately if the test then enters to cooldown test
- When the REAR WIPER LED alone is flashing, the test has completed and passed
- Press the WIPER button to exit this mode

This test is actually running the actuators in the system back and forth to calibrate the actuator and feedback relationships.

Control Modules

Module Diagnostics

Cool Down Test Entry

The cool down test should automatically run with the calibration test, but can also be run separately by completing the following steps:

- With the engine running, set the blower motor to HIGH
- Set the mode position to PANEL
- Open all A/C outlets
- Set the temperature to COLD (both sliders if equipped)
- Depress WASH and A/C buttons simultaneously for 5 seconds

The test is running if the A/C and RECIRC LEDs are alternately flashing. If the LEDs are flashing simultaneously, the test has failed.

Once both tests have been run, the LEDs should no longer be flashing. In other words, this procedure clears the flashing LEDs, since the LEDs are only flashing as an alert that the control head is not properly calibrated. If the LEDs continue to flash in any order, then the module has stored trouble codes.

Note: If the cooldown test is initiated with a cold evaporator, the test will fail. First run the engine with the blower on HIGH and the A/C off for 3 minutes prior to the test.

HVAC Flash Codes

If the calibration or cooldown tests fail, the LEDs will flash out codes. The REAR WIPER LED flashing indicates the level of the code, and the INTERMITTENT LED indicates the code. After the test is complete, the level 1 codes will automatically be displayed. Pressing the WASH button advances to the next level.

Note: While this is useful information, this procedure is almost always used just to calibrate the module to clear the blinking LEDs. It is not common for codes to result from this procedure. In any case, it is nice to know that the self diagnostics are so thorough, and can help you in the event of a real fault.

Control Modules

Module Diagnostics

Level Number – Rear Wiper LED

The following list shows the mode indicated by the number of Rear Wiper LED flashes:

- 1: Fail Codes
- 2: Mode Potentiometer Test
- 3: Blend/Passenger Potentiometer Test
- 4: Evaporator Probe
- 5: Driver Potentiometer

In level 1, the number of INTERMITTENT WIPER LED flashes indicates the following:

- 0: (Not flashing) Passed all test
- 1: Mode Actuator did not reach defrost position
- 2: Mode Actuator did not reach panel position
- 3: Blend/Pass Actuator did not reach cold stop
- 4: Blend/Pass Actuator did not reach hot stop
- 5: Evaporator Probe open
- 6: Evaporator Probe shorted
- 7: Driver Actuator did not reach cold stop
- 8: Zone/Driver Actuator did not reach heat stop
- 9: Control Head internal failure

41TE/42LE

Solenoid Electrical Code Diagnostics

Code 41 (P0750) L-R Solenoid

Code 42 (P0755) 2-4 Solenoid

Code 43 (P0760) OD Solenoid

Code 44 (P0765) UD Solenoid

Solenoid codes are electrical specific codes.
Hydraulic influences will not set these codes.

Diagnosing solenoid codes can be simplified by isolating the parts of the wiring circuit that are involved as well as the components (transmission relay, solenoid body, battery, wiring, and control module) and harness connectors that affect these conditions. Battery condition as well as battery cables and clamp ends must be good at all times (engine off and engine running).

Check procedures:

- Clean the battery posts or pads (even if they look clean). Recheck for codes. If codes do not reappear you are done.
- Check for battery voltage (engine not running 12.6 minimum) directly on the posts, then the clamps
- Check for charging voltage (engine running with as many loads on as possible ie; head lights on high beam, dome light on, fan motor running on high fan, radio on) voltage should be 13.0 to 14.8.
- Locate the transmission control module and transmission relay (disconnect transmission control module and jump the relay coil power wire energizing the relay and check for switched voltage to match keep alive memory voltage at the computer connector). If there is a voltage drop through the transmission relay, change the relay with a NEW relay and retest.

41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

- Unplug the transmission relay
- Install a jumper wire in system voltage terminal and switched voltage terminals of the transmission relay receiver
- Check for voltages as they originate at battery, through relay, to switched battery voltage terminals and down through the solenoid pack, as they work there way to the ground pins plugging into the computer connector (un plugged)
- Check amperage draw on solenoid ground locations of the computer connector locations using the DVOM on amperage scale to energize each of the solenoids (important: only check the solenoid ground wires in this fashion)

If the originating battery voltage is confirmed at all test points and all 4 solenoids check out with exact same amperages than you must check powers and grounds at the transmission control module (cranking ignition voltage, running ignition voltage, and computer grounds). If all circuits check out, suspect a faulty control module.

NOTE: Refer to the reference pages located in the back of this 2005 Seminar Manual.

41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

Check the battery voltage (engine not running) directly on the posts. Also check the battery voltage at the clamps, minimum voltage should read 12.45V (70% to capacity charged battery)



Acceptable Battery Voltage

Unacceptable and needs to be charged and retested or replaced



41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

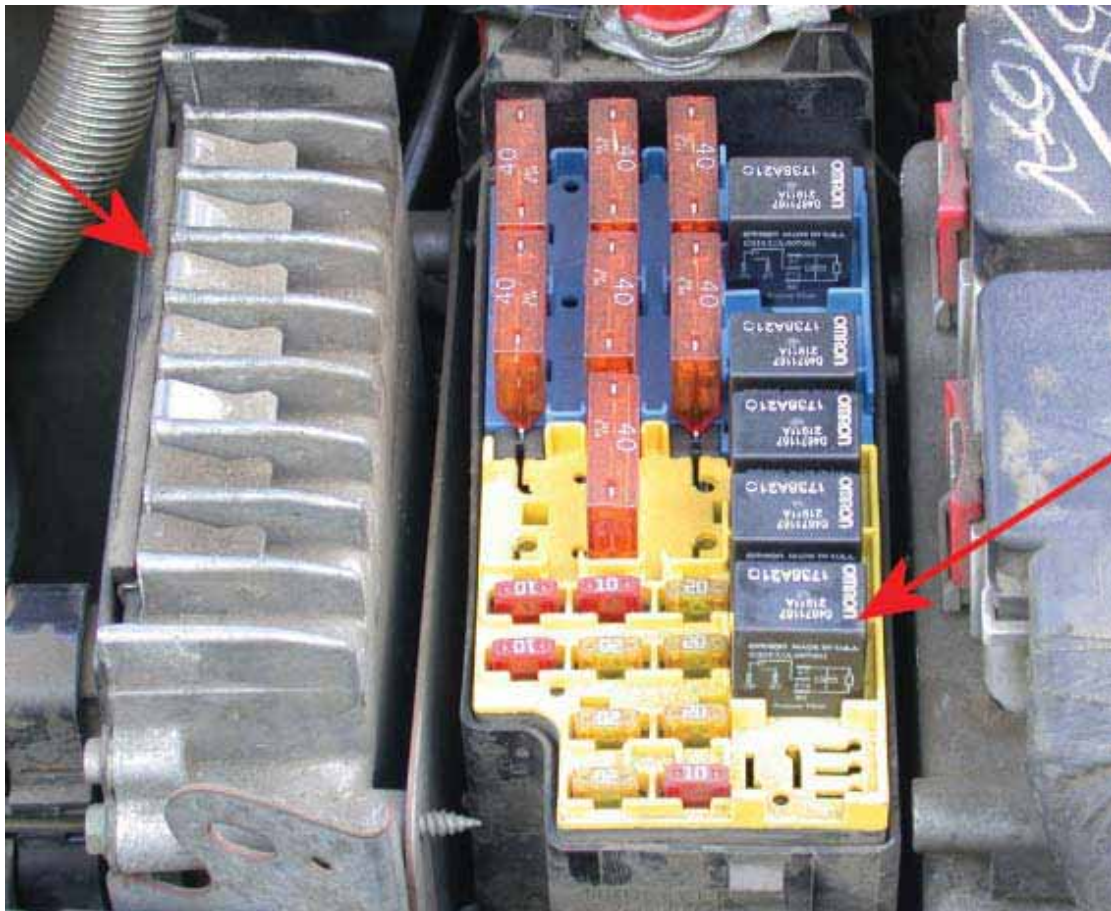
Check the charging voltage (engine running with as many loads on as possible ie; head lights on high beam, dome light on, fan motor running on high fan, radio on), voltages should read between 13.0V and 14.8V. A system overcharging/undercharging can cause codes to set.



41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

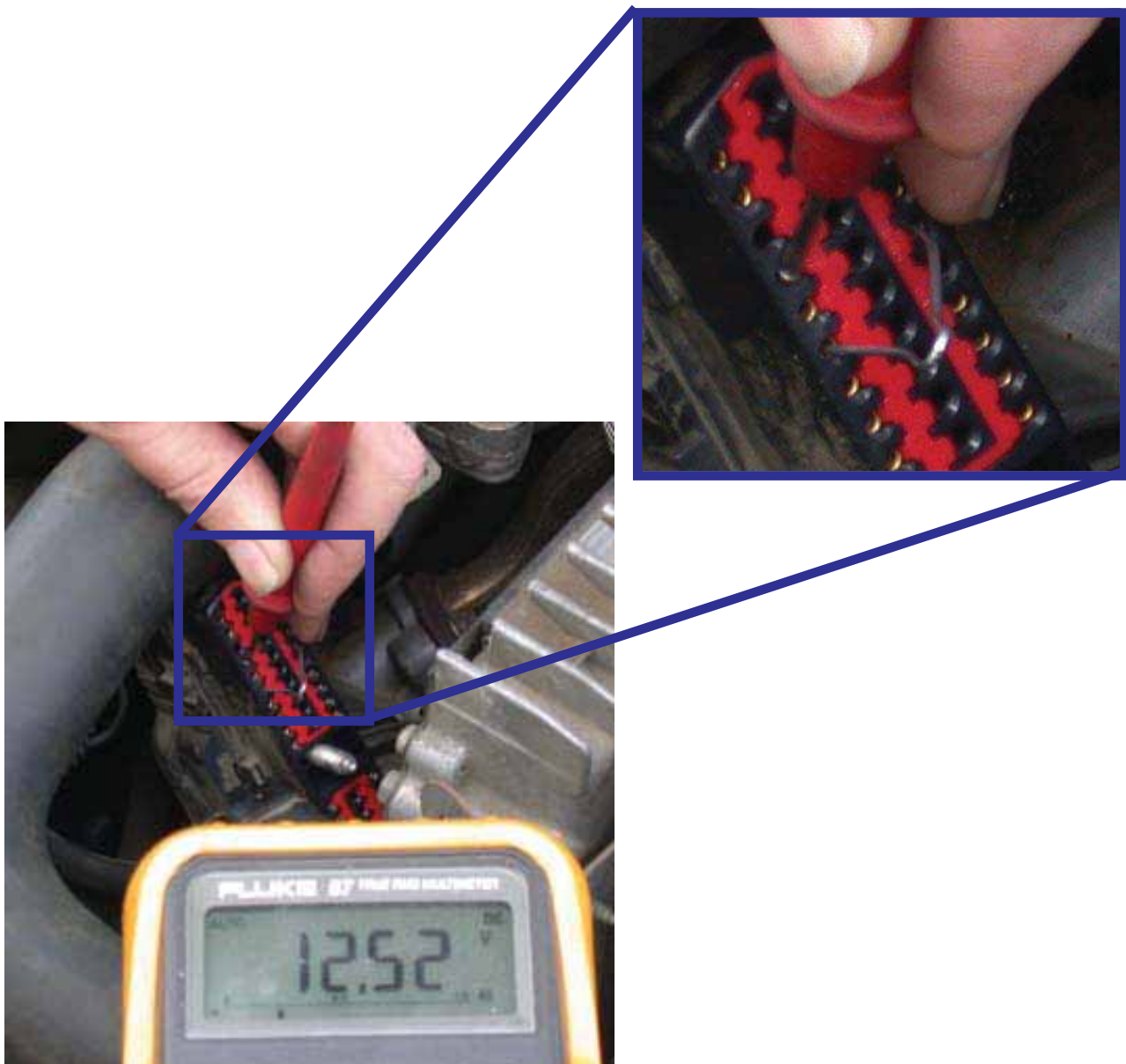
Locate the transmission control module and the transmission relay.



41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

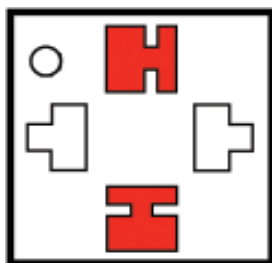
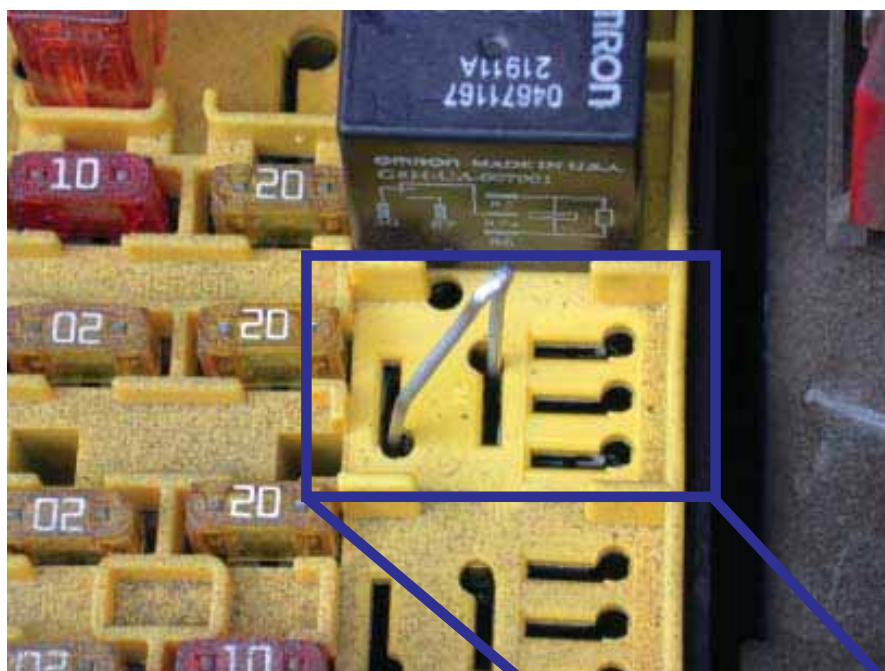
Disconnect the transmission control module connector and jump the relay coil power wire energizing the relay (note: use pin 56 has a battery voltage source). Check for switched voltage to match the keep alive memory voltage at the computer connector. If there is a voltage drop through the transmission relay, change the relay with a NEW relay and retest.



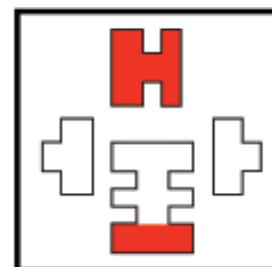
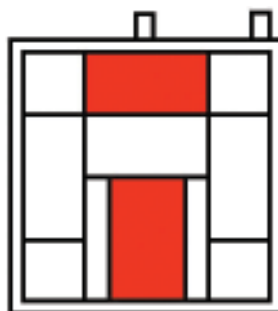
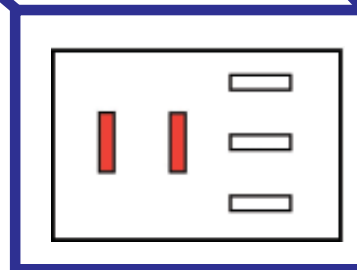
41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

Unplug the transmission relay. Install a jumper wire/lead in system voltage terminal and switched voltage terminals of the transmission relay receiver.



**5 Common
Relay Receivers**



41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

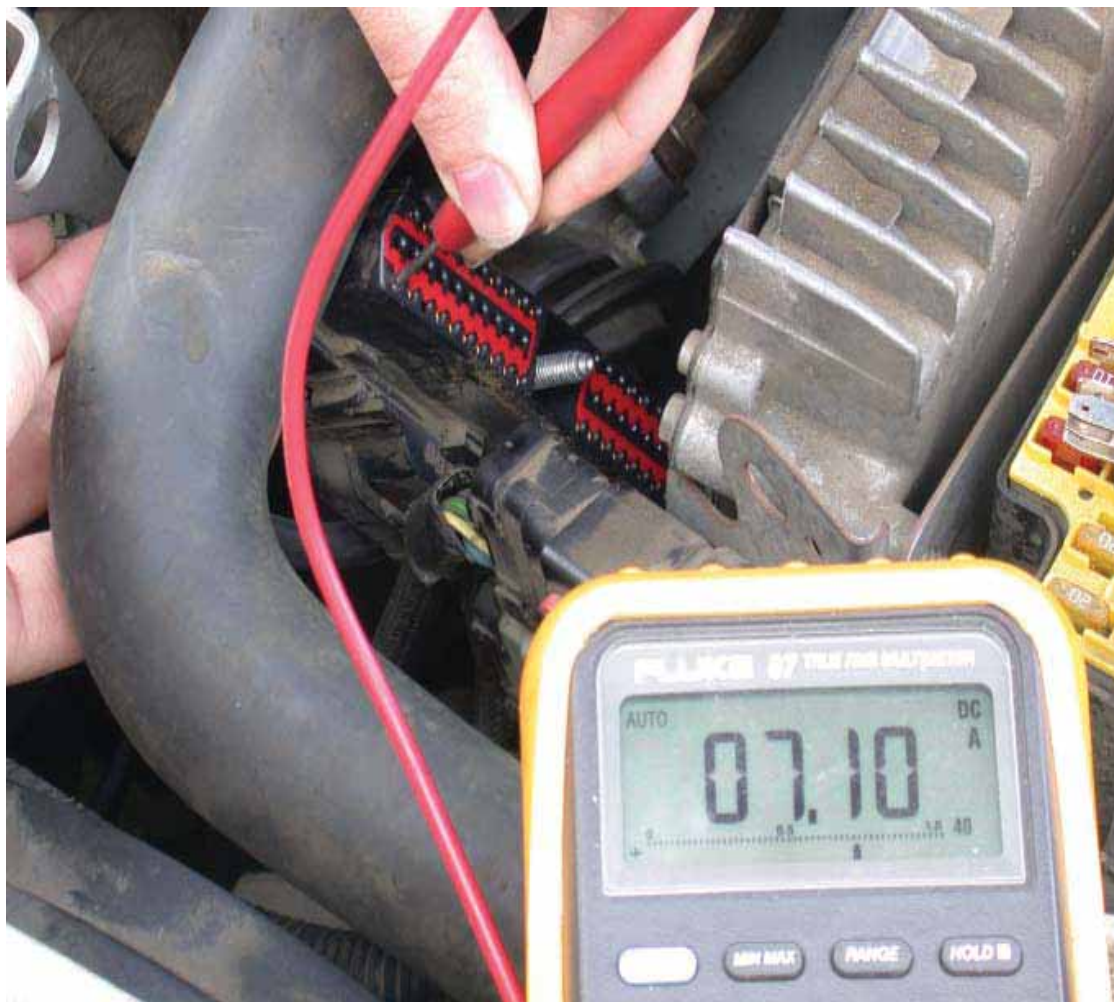
Check the solenoid ground pin voltages to confirm battery voltages as they originate at the battery. Solenoid ground control pins are 19, 20, 59, and 60.



41TE/42LE

Solenoid Electrical Code Diagnostics (continued)

Check amperage at the solenoid ground supply locations of the computer connector locations using the DVOM on amperage scale to energize each of the solenoids (Important: only check the solenoid ground supply wires in this fashion)



4ITE, 42RLE, 45RFE

Solenoid Codes

2004 Dakota, Ram Truck, Pacifica, Stratus/Sebring, Neon, PT Cruiser Caravan/Voyager/Town&Country, and Voyager (International Markets)

DTC's P0755, P0750, P0760, P0765, P0770, and P2706 indicating solenoid electrical faults that can be PCM related caused in manufacturing. Check the manufacturing date on the module serial number attached to the front of the module. An example of this number is MODULE S/N T65EH2353D55N6. The manufacture date code is shown in the 6th through 9th digits in this numbers. The plant that the module is built in will be the 5th digit. If the date code is between H(2313) and H(2393), the fault is likely to be the module. These modules were built at the (H) Huntsville plant. This only pertains to these modules. Always confirm electrical checks discussed earlier in this handout.



1996–1999 RE Transmissions

Governor Pressure Sensor Voltage too High DTC P1763

Some vehicles may exhibit an MIL illumination with a DTC P1763 (Governor Pressure Sensor Volts to High). Symptom may be slower than normal vehicle accelerations because the transmission may have temporarily entered its third gear “LIMP IN” mode as a result of the DTC. The limp mode may clear when the driver cycles the key on/off. This problem may not be detected after the code is cleared and car is road tested. This is caused by an increase in line pressure. Valve body machining process changed at the beginning of production date JAN 1, 1998. This condition occurred most often with vehicles that were built between JAN 1, 1998 through DEC 18, 1998. If earlier units have a valve body change, this condition can occur depending on the year of the valve body production. If this concern is experienced, there are calibration updates for the PCM to help compensate for the higher pressures (stock valve body only). New software changes are (96Call8, 97Call8, 98Call2, and 99Call4).

Note: This code can occur if valve body recalibrations are made by aftermarket products that increase driving line pressures over 100 psi. Calibration updates will not compensate when this has been done.

42RE

No Up Shift From 2nd Gear On Grades

2002 – 2003 Dakota

A no upshift from second gear on grade acceleration may be caused by computer calibration issues. This is caused by the module not allowing governor pressure to rise properly with road speed. Verify that the PCM/TCM has the latest version of software loaded.

42RE/46RE

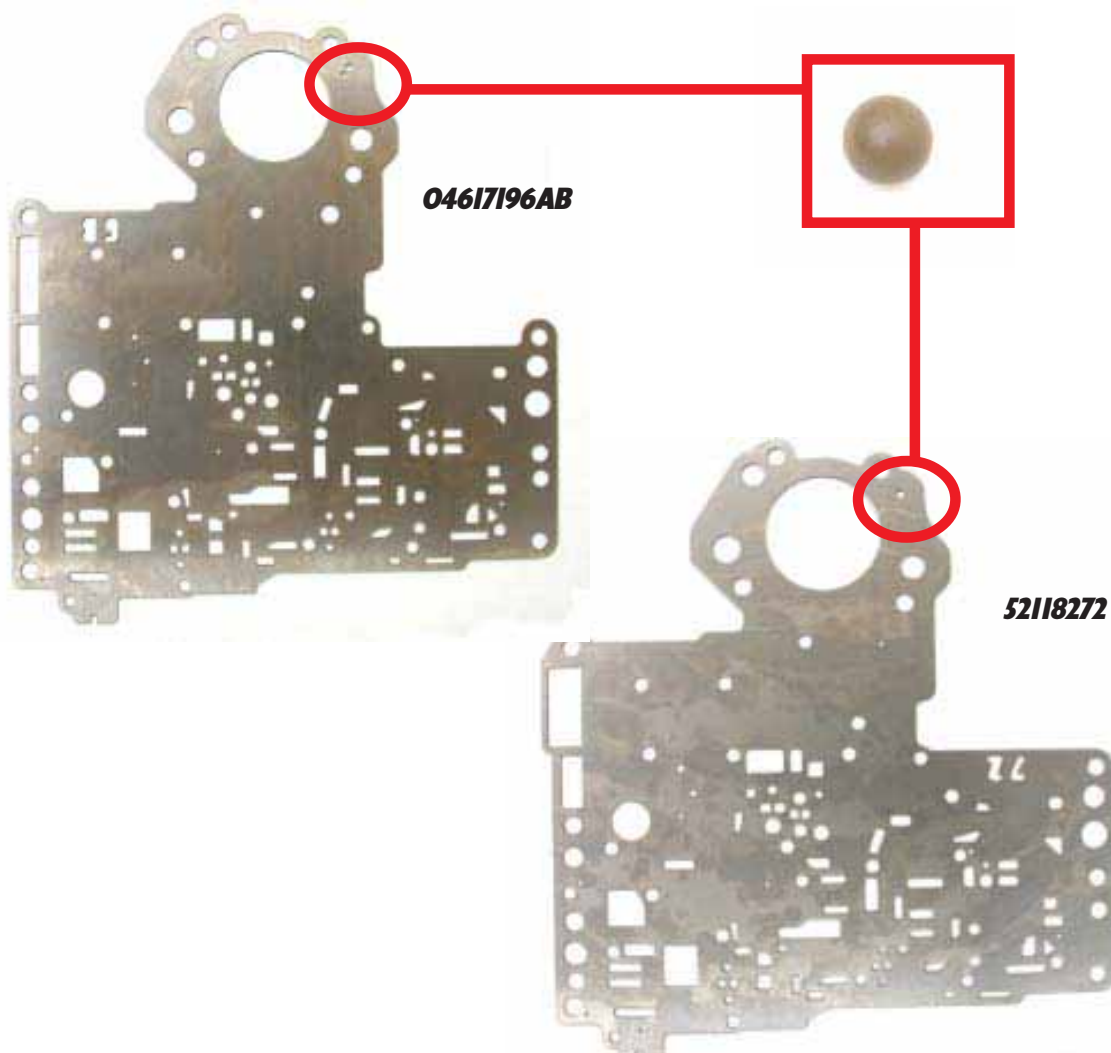
Intermittent Harsh Reverse

1999 – 2000 Ram Van, Dakota, Ram Truck, Durango, and Grand Cherokee may experience an intermittent harsh engagement into reverse (more sensitive as oil temperature reaches operating temperature). The reverse check ball has been changed from a steel ball to a torlion® plastic ball to seal orifice oil feeding the reverse servo. The new plastic ball and plate part numbers are as follows:

Rear Servo Check Ball 52118261

Valve Body Separator Plate (42RE) 52118272

Valve Body Separator Plate (46RE) 4617196AB



45RFE

Soft Shifts / Erratic Shifts

Erratic soft shift concerns with possible slip codes. Shift feel changes on each upshift pattern. Possible cause: Line pressure transducer. The line pressure transducer can be checked for accuracy using special Miller Tool #8259. This tool and any other Miller tool can be ordered by calling SPXMILLER Tools at 1(800)801-5420. Failure of the pressure transducer mounted on the side of the transmission case (externally) can cause erratic pressures in the transmission. Pressure is set at a base line value of 100 psi to 120 psi. Inspect for possible cracks and leaking sealing rings on transducer. Replace when damaged.

**Part Number
4799758**



45RFE

No Converter Charge After Rebuild

A no converter charge after rebuild can be caused by missing or improperly torqued retaining screws (2 torx screws) holding the wear plate to oil pump. These screws are covered up when bolting the pump and stator assembly together.

Proper oil pump torque is:

- 2 (two) plate retaining screws 40 in lbs.
- 29 (twenty nine) pump body screws 40 in lbs.
- 6 (six) pump body to case bolts 250 in lbs.

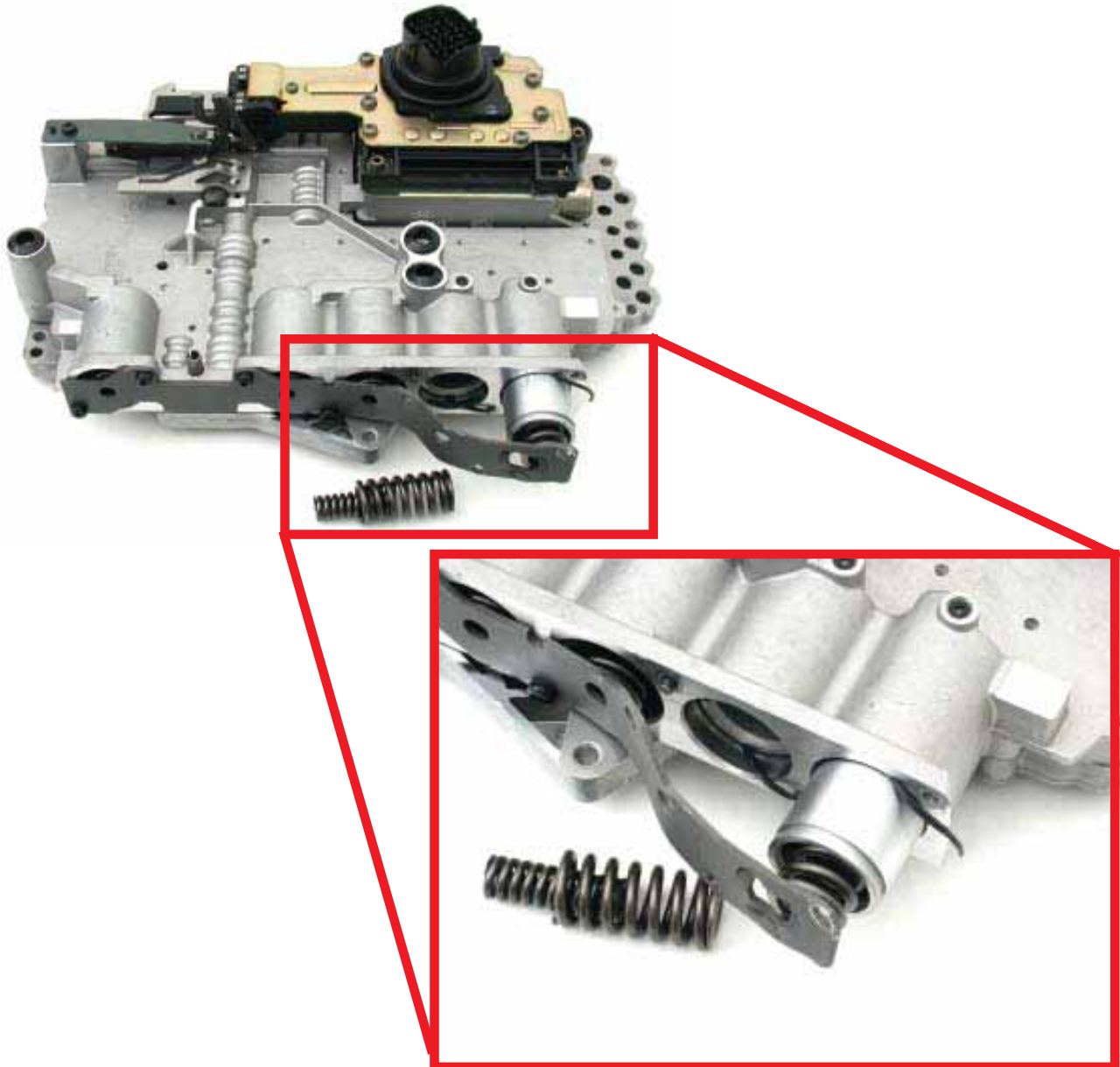


**(2) Torx Screws Pan Head M5X0.8"X12.60
Part Number 6503 232**

45RFE

Slip Shifts / Failsafe

The accumulator retaining plate on the valve body is commonly breaking loose and blowing the accumulators out of the valve body. The cause (answer from Chrysler Tech) is improper torque on the retaining screws allowing them to back out. When repairing the valve body and accumulator plate, it is important to use lock tight (blue) on the retaining screws to prevent them from backing out causing failure again. Plate screw retaining torque is 40 in lbs.



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Import

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4L30E

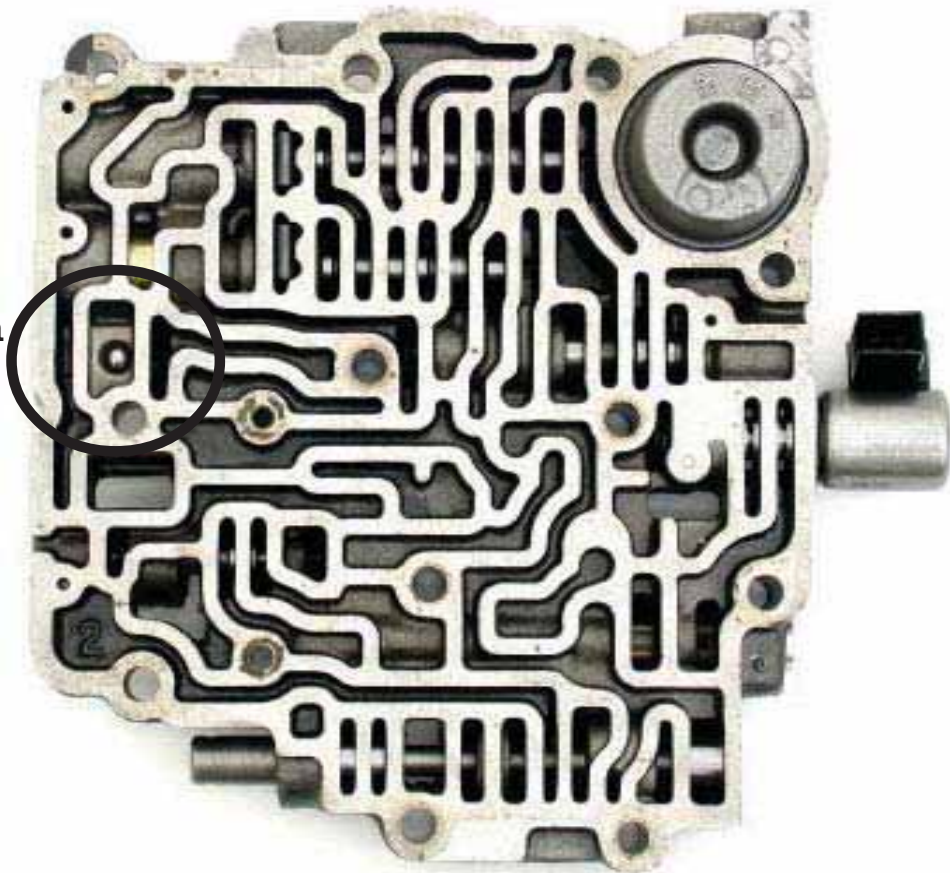


Checkball Location

3rd Clutch Checkball Missing

A bindup or slip condition in 4th gear may be caused by a missing or leaking 3rd Clutch Checkball. When this Checkball is missing, 1-2 Servo release pressure can leak in 4th gear causing the 1-2 band to apply.

**3rd clutch
checkball**



Checkball Location *(continued)*

D 3 2 Shuttle Ball Missing:

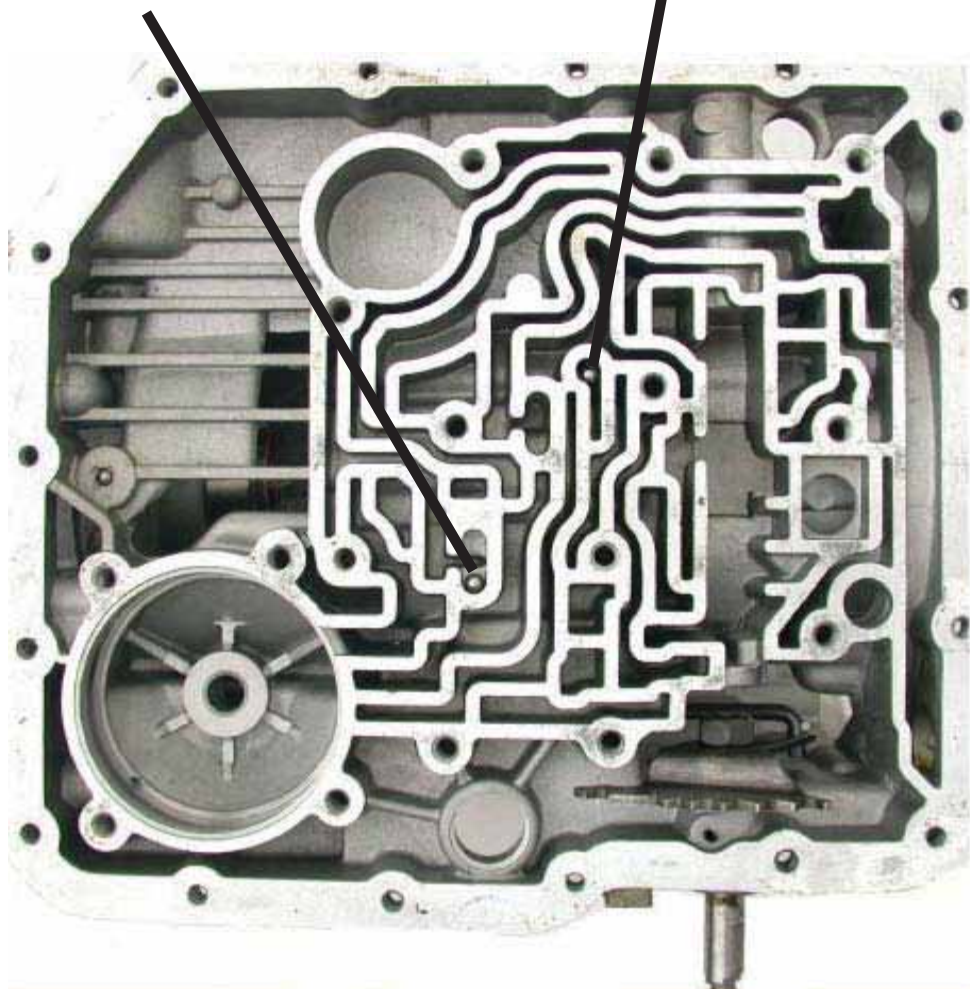
A missing D 3 2 Shuttle Ball will cause low mainline pressure in D4 and Manual Low and have normal pressure in D3 and Manual 2.

3rd Clutch Quick Dump Ball Missing:

A missing 3rd Clutch Quick Dump Ball will cause a 3-2 down shift clunk or bind on the 3-2 down shift.

D 3 2 Shuttle Ball

3rd Clutch Quick Dump Ball

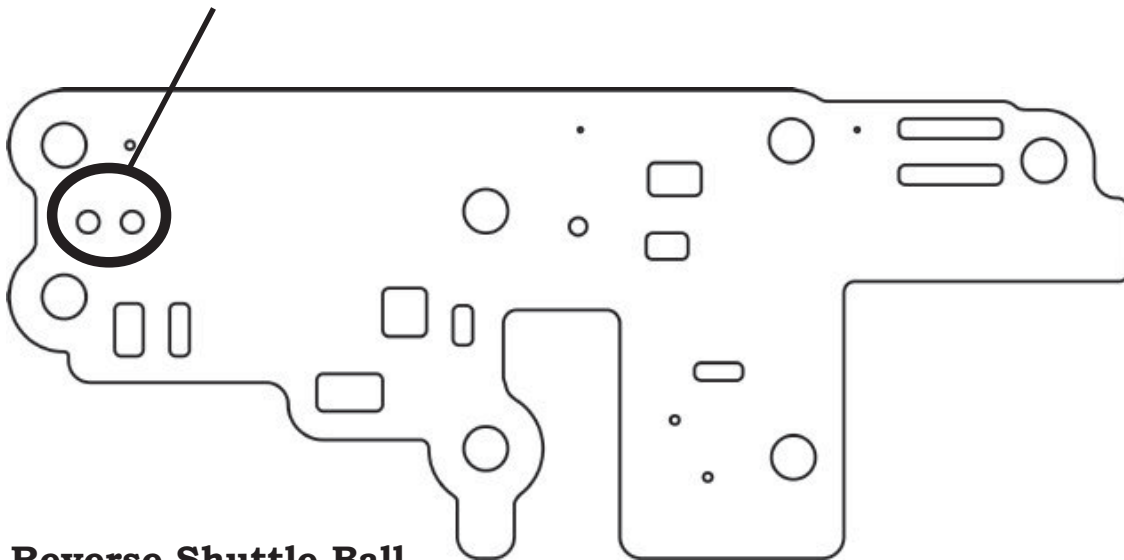


Checkball Location *(continued)*

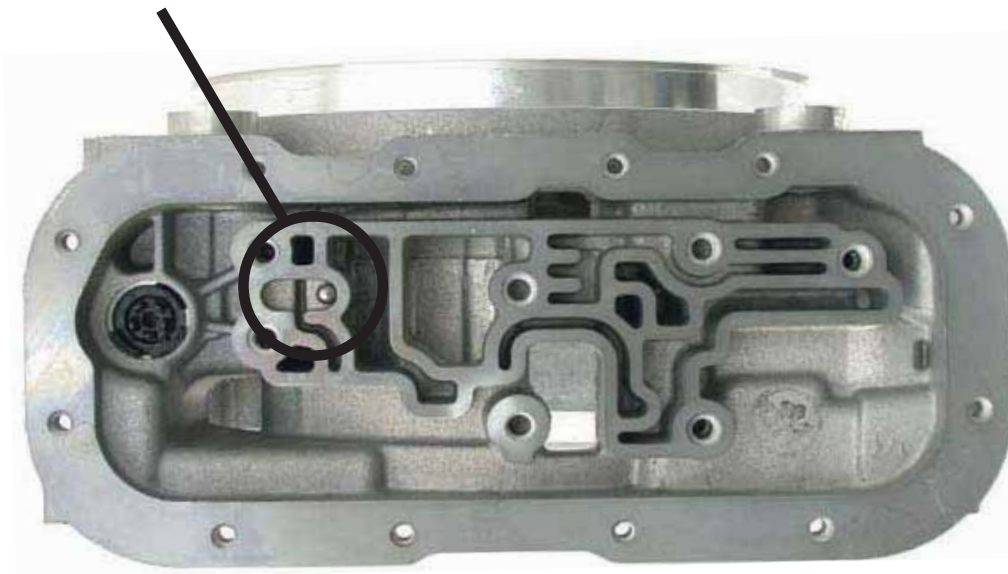
Reverse Shuttle Ball Missing:

A missing Reverse Shuttle Ball will cause a no lockup condition in all forward ranges. In Reverse, a missing Reverse Shuttle Ball can cause the 2nd Clutch to partially apply, burning the 2nd Clutch and possibly causing a bind in Reverse.

2 Holes = Ball
1 Hole = No Ball

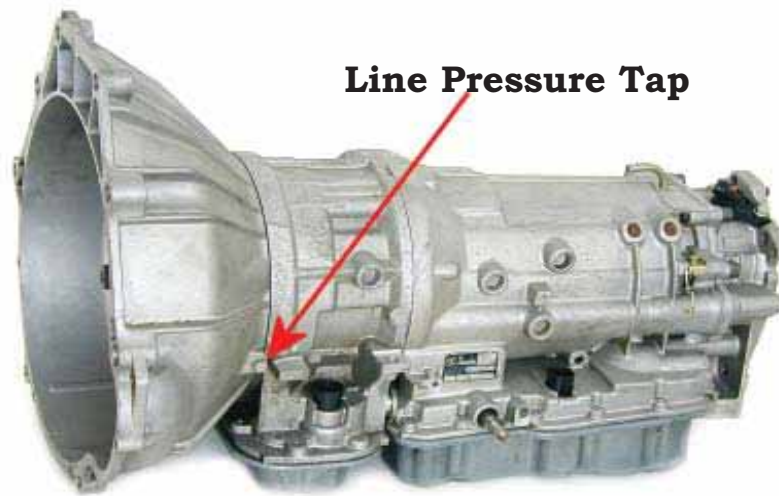


Reverse Shuttle Ball



Pressure Taps

Pressures:		
	Idle	Stall
Drive	45-55	150-160
Reverse	65-75	210-225



The Servo Release Pressure should be equal to mainline pressure in 3rd and 4th gears and zero in all other gears including Park and Neutral.

Servo Release Pressure

Pilot Drill: 1/8"
Tap Drill: "Q" or 21/64"
Tap: 1/8" NPT



Line Pressure Taps

2nd Clutch Pressure:

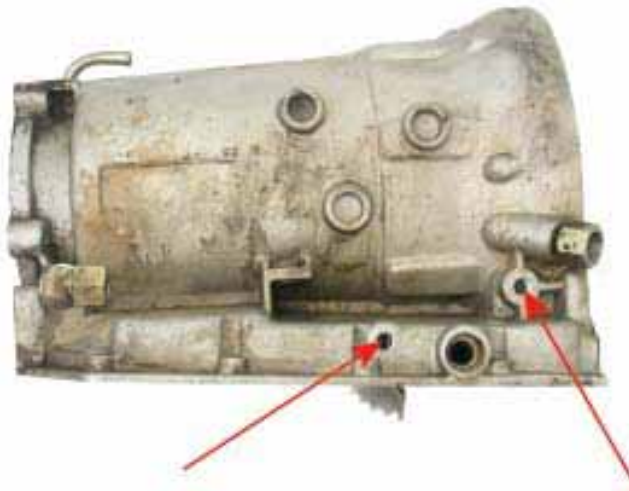
The 2nd Clutch pressure should be equal to mainline pressure in 2nd, 3rd and 4th gear and zero in all other gears including Park and Neutral.

4th Clutch Pressure:

The 4th Clutch pressure should be equal to mainline pressure in 4th gear and zero in all other gears including Park and Neutral.

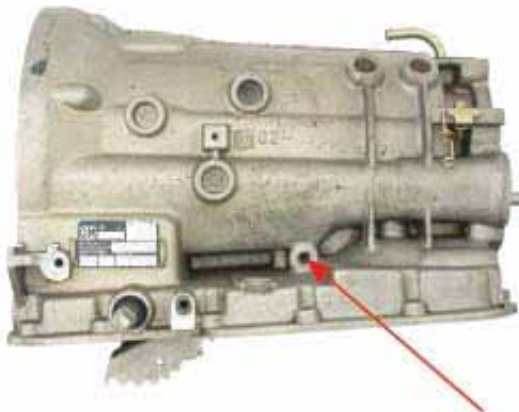
Servo Apply Pressure:

The Servo Apply pressure should be equal to mainline pressure in all forward ranges and zero in Park, Reverse and Neutral.



2nd Clutch Apply Pressure

4th Clutch Apply Pressure

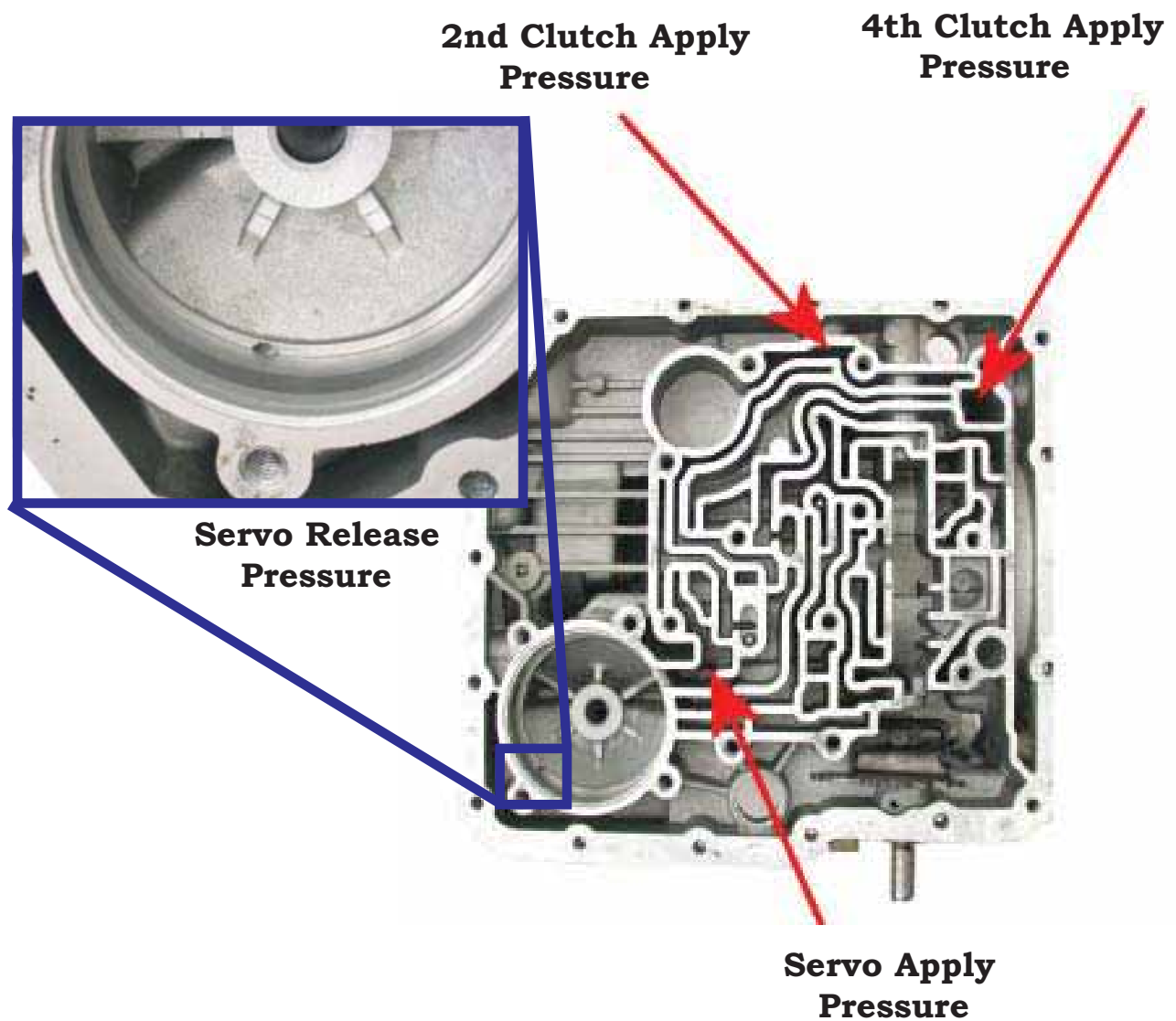


Servo Apply Pressure

Pilot Drill: 1/8"
Tap Drill: "Q" or 21/64"
Tap: 1/8" NPT

Pressure Tap Circuits

When you are drilling the pressure taps, take notice of the correct circuit locations prior to drilling.



Input Sprag Rotation

No Reverse, No Drive Engagement, Bind in 2nd Gear

If you install the Input Sprag incorrectly or if the sprag has failed; the symptoms that will follow are no reverse, no drive engagement and a bind in 2nd gear. Check the transmission in all ranges, if you have Manual Low, look for the Sprag as the root of the problem.

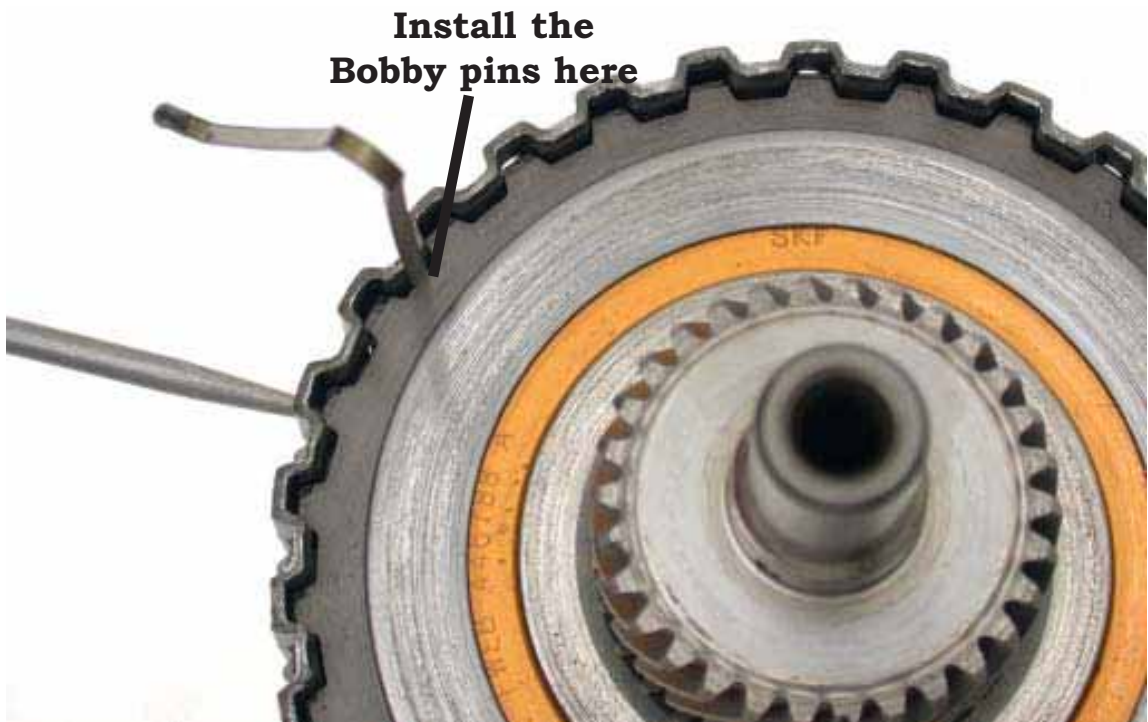
**Sun Gear Freewheels
Counter Clockwise**



3rd Clutch Drum Disassembly

Tools and Procedures

The correct tool for disassembling the 3rd Clutch Drum assembly is expensive and most technicians do not have this tool. Unfortunately the only other method is using a pick and putting your finger tips and thumbs in jeopardy. The following procedure is an easy inexpensive way around harming yourself.



3rd Clutch Drum Disassembly

Tools and Procedures (continued)

In order to remove the sprag assembly to gain access to the clutches you must first remove the internal snap ring holding the sprag race assembly to the drum. To do this, start with one end of the snap ring, push in on the snap ring with a scribe and slide a bobby pin between the drum and the snap ring, keeping that portion of the snap ring out of the groove. Work your way around the drum installing several bobby pins until the snap ring is completely out of the groove.

Install several Bobby pins around the 3rd Clutch Drum.



3rd Clutch Drum Disassembly

Tools and Procedures (continued)

Once you have all of the Bobby pins in place, simply use two screw drivers to pop the race out of the drum.



Pry the Sprag Race out with two screw drivers.

3rd Clutch Drum Assembly

Pressure Plate Installation

The 3rd Clutch Cushion Plate should be installed as shown for proper operation. If the 3rd Clutch Cushion Plate is installed incorrectly a harsh 3rd gear will occur. There is no factory specifications for clutch clearance.

Try to maintain 0.008"-0.010" per disc.



**3rd Clutch Cushion
Plate is beveled as
shown**

Binds in 2nd Gear

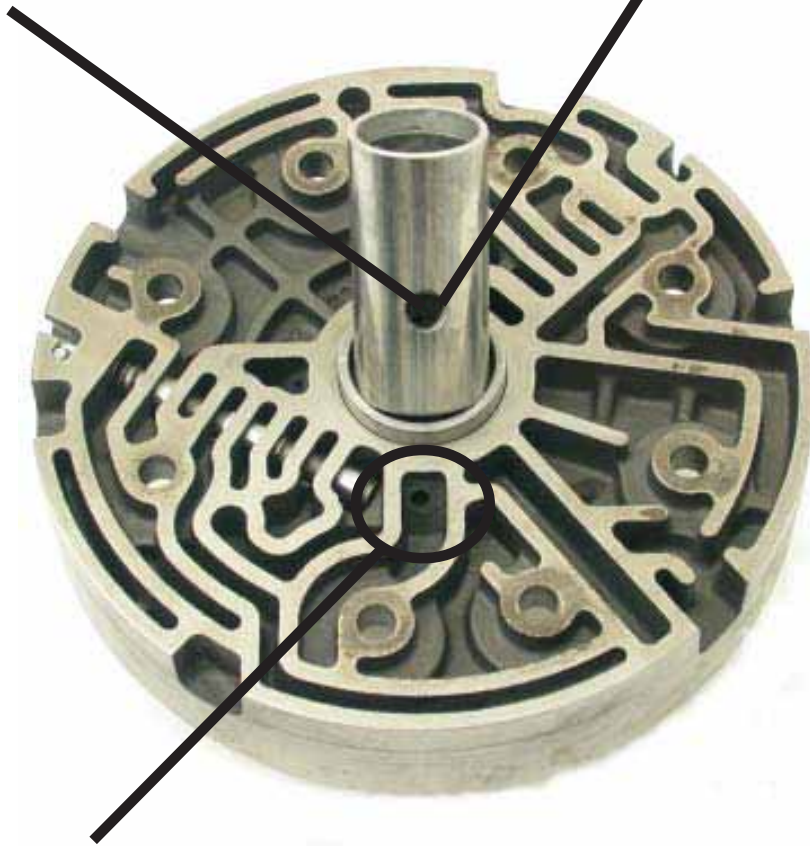
Bushing Installation

Installation of the 3rd Clutch Bushing is very important. If the feed hole is not aligned properly, 3rd clutch failure will occur. It will also cause a bind in 2nd due to the 3rd clutch staying on.

NOTE:
The offset hole MUST
face down

**This hole must line up
with the 3rd Clutch
Feed Circuit**

3rd Clutch Feed

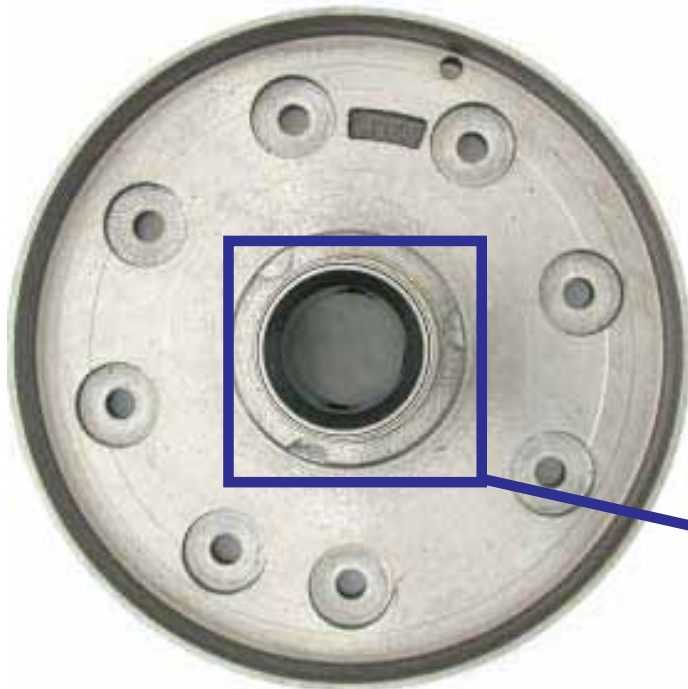


Center Support Washer

Isuzu Washers

Center Supports that use a “no-tab” style thrust washer tend to fail because the plastic washer is allowed to spin on the support. If you choose to machine the “no-tab” style Center Support you can use the 3 tab washers and they are more adjustable for endplay. These washers are also used for the Pump to adjust Over-drive housing endplay.

0.064”	Yellow	8-96013-761-0
0.070”	Red	8-96013-762-0
0.077”	Black	8-96013-763-0
0.084”	White	8-96013-764-0
0.094”	Green	8-96013-765-0
0.100”	Blue	8-96013-766-0



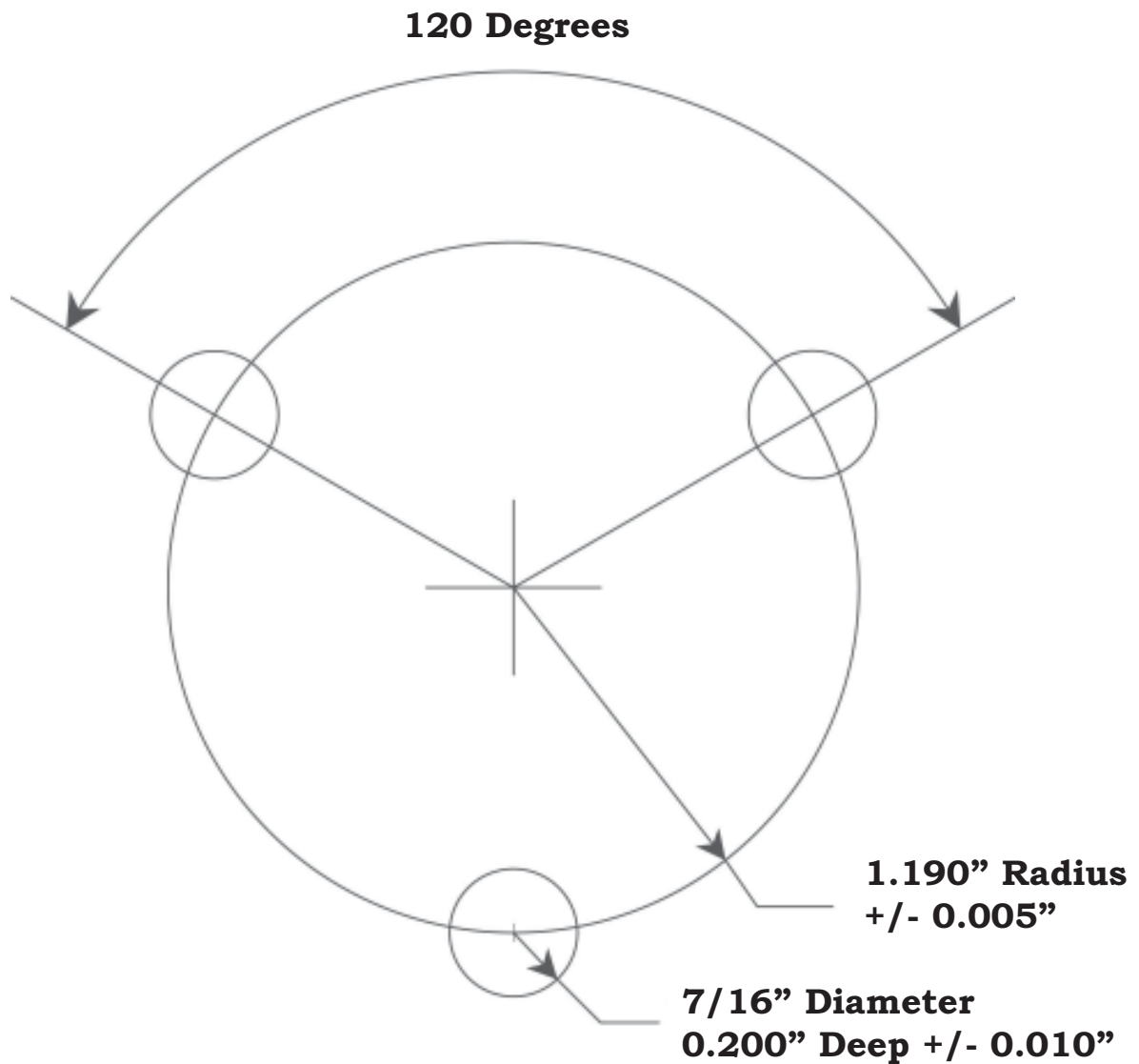
Main Case Endplay
0.014”-0.031”
O/D Case Enplay
0.004”-0.030”

Refer to the Blue
Print on the
following page

Center Support Washer

Isuzu Washers (continued)

Do not use a drill press to machine the Center Support. It should only be machined on a milling machine. Use this schematic as a reference to machine the Center support area for the three tab washer.



Computer Types

Type 1

1990-1993 Isuzu Rodeo and Trooper

Type 1b

1992-1995 BMW w/4L30E

Type 2

1994-1995 Isuzu Rodeo, Trooper, Amigo and Honda Passport

Type 3

1996-1999 Isuzu Rodeo, Trooper, Amigo, Vehicross, Honda Passport and Acura SLX

Type 4

2000-up Isuzu Rodeo, Trooper, Amigo, Vehicross, Honda Passport and Acura SLX

Type 5

1997-1998 Cadillac Catera

Type 6

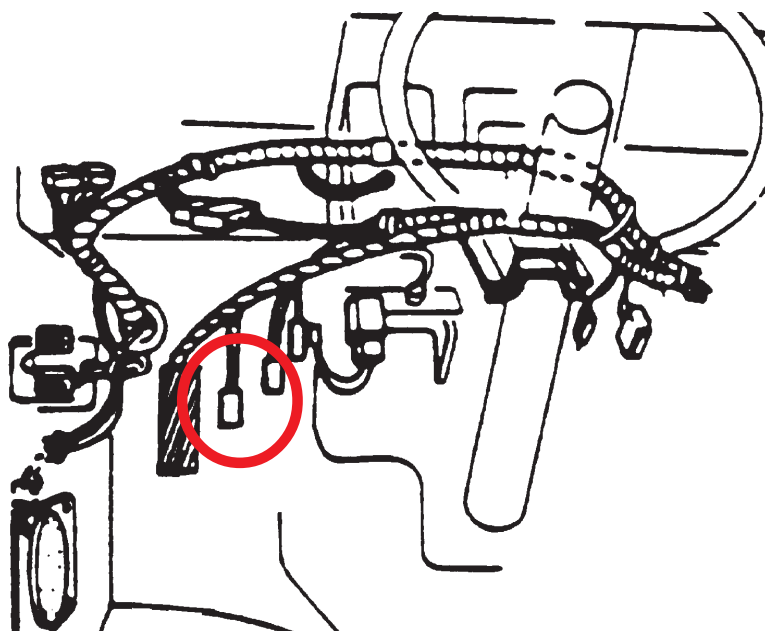
1996-2001 BMW w/4L30E

1999-2001 Cadillac Catera

Computer Type 1 & 2

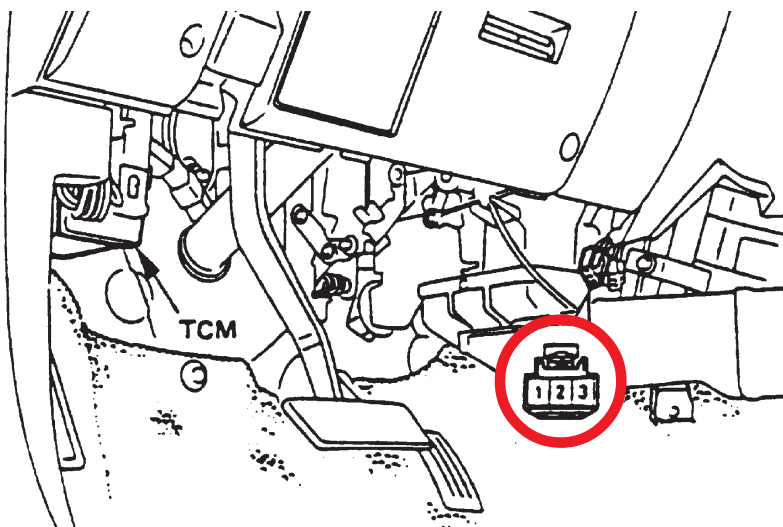
Manual Code Retrieval

1990-1991 Isuzu Troopers used a two-terminal diagnostic connector. To display codes, simply jump the two terminals together.



Ground the Yellow w/Black stripe wire on the 2 or 3 pin connector

1992-1995 Isuzu Troopers have a three-terminal diagnostic connector. To display codes, jump the two outer terminals together.



Type I

Codes

- 17 1-2/3-4 Solenoid shorted to ground
- 21 TPS Voltage too high
- 22 TPS Voltage too low
- 23 Engine coolant switch voltage high
- 25 1-2/3-4 Solenoid open or shorted to B+
- 26 2-3 Solenoid shorted to ground
- 28 2-3 Solenoid open or shorted to B+
- 29 TCC Solenoid shorted to ground
- 31 No engine RPM signal
- 32 Force Motor circuit amperage too low (Less than 0.095A)
- 33 Force Motor circuit amperage too high (Higher than 1.5A)
- 34 Band Apply Solenoid open or shorted to B+
- 35 Band Apply Solenoid open or shorted to ground
- 36 TCC Solenoid open or shorted to B+
- 39 No VSS
- 41 Gear ratio error
- 43 Solenoid ground supply circuit open, shorted to ground or shorted to B+
- 46 Down shift error
- 48 Low battery voltage (Below 9.0V)
- 49 High battery voltage (Above 16V)
- 55 EPROM failure
- 56 Transmission range switch input incorrect
- 65 Trans Temp sensor shorted to ground
- 66 Trans Temp sensor open or shorted to B+
- 77 Kickdown switch stuck closed (shorted to ground)
- 82 Transmission range switch input incorrect

Type 2

Codes

- 11 No VSS
- 13 No engine RPM signal
- 15 Trans Temp Sensor open or shorted to B+
- 16 Trans Temp Sensor shorted to ground
- 21 TPS Voltage too high
- 22 TPS Voltage too low
- 23 TPS connector disconnected
- 25 Low battery voltage (Below 9.0V)
- 26 High battery voltage (Above 16V)
- 31 1-2/3-4 Solenoid open or shorted to ground
- 32 2-3 Solenoid open or shorted to ground
- 33 TCC Solenoid open or shorted to B+
- 34 Band Apply Solenoid open or shorted to ground
- 35 Force Motor open or shorted
- 36 Solenoid B+ supply circuit open or shorted to ground
- 37 Torque management serial line fault
- 41 1-2/3-4 Solenoid shorted to B+
- 42 2-3 Solenoid shorted to B+
- 43 TCC Solenoid shorted to ground
- 44 Band Apply Solenoid shorted to B+
- 46 Solenoid B+ supply circuit shorted to B+
- 51 Engine Coolant Switch open, shorted to ground or shorted to B+
- 52 Kickdown Switch stuck closed (shorted to ground)
- 53 Transmission range switch input incorrect in P, N or R position
- 54 Transmission range switch input incorrect
- 55 Brake Switch open or shorted to ground
- 56 Brake Switch shorted to B+
- 61 Gear ratio error
- 62 Downshift protection
- 63 EPROM failure
- 64 TCC valve stuck on
- 65 TCC valve stuck off
- 82 Shift or Band Apply Solenoids faulty during driving

Type 3

Codes

P0218	Transmission fluid over temp
P0560	System voltage malfunction
P0705	Transmission range switch illegal position
P0706	Transmission range switch performance
P0711	TFT sensor performance
P0712	TFT sensor circuit low
P0713	TFT sensor circuit high
P0719	Brake switch stuck on
P0722	Output speed sensor
P0723	Output speed sensor intermittent
P0724	Brake switch stuck off
P0730	Gear ratio error
P0742	TCC stuck on
P0748	Force motor electrical fault
P0751	SSA (1-2/3-4 solenoid) stuck on or stuck off
P0753	SSA (1-2/3-4 solenoid) electrical fault
P0756	SSB (2-3 solenoid) stuck on or stuck off
P0758	SSB (2-3 solenoid) electrical fault
P1790	ROM check sum error
P1792	EEPROM check sum error
P1835	Kickdown switch stuck on
P1850	Band apply solenoid electrical fault
P1860	TCC solenoid electrical fault
P1870	Transmission component slipping

Type 4

Codes

P0218	Transmission fluid over temp
P0502	No VSS signal
P0562	System voltage low
P0563	System voltage high
P0601	PCM/ECM memory checksum
P0602	PCM/ECM programming error
P0604	PCM/ECM RAM error
P0606	Internal performance
P0705	Transmission range switch illegal position
P0706	Transmission range switch performance
P0711	TFT sensor performance
P0712	TFT sensor circuit low
P0713	TFT sensor circuit high
P0719	Brake switch stuck on
P0722	Output speed sensor
P0723	Output speed sensor intermittent
P0724	Brake switch stuck off
P0730	Gear ratio error
P0742	TCC stuck on
P0748	Force motor electrical fault
P0751	SSA (1-2/3-4 solenoid) stuck off
P0752	SSA (1-2/3-4 solenoid) stuck on
P0753	SSA (1-2/3-4 solenoid) electrical fault
P0756	SSB (2-3 solenoid) stuck off
P0757	SSB (2-3 solenoid) stuck on
P0758	SSB (2-3 solenoid) electrical fault

Type 4

Codes

P1120	TPS1 circuit
P1220	TPS2 circuit
P1221	TPS1-TPS2 correlation (circuit performance)
P1271	APS1-APS2 correlation (circuit performance)
P1272	APS2-APS3 correlation (circuit performance)
P1273	APS1-APS3 correlation (circuit performance)
P1275	APS1 circuit
P1280	APS2 circuit
P1285	APS3 circuit
P1790	ROM check sum error
P1792	EEPROM check sum error
P1835	Kickdown switch stuck on
P1850	Band apply solenoid electrical fault
P1860	TCC solenoid electrical fault
P1870	Transmission component slipping

Type 5 & 6 (Except BMW)

Codes

P0218	Transmission fluid over temp
P0560	System voltage malfunction
P0601	TCM internal error
P0703	Brake switch circuit
P0705	Transmission range switch illegal position
P0706	Transmission range switch performance
P0711	Transmission fluid over temp
P0712	TFT sensor circuit low
P0713	TFT sensor circuit high
P0722	Output speed sensor
P0725	Engine RPM signal
P0727	Engine RPM signal
P0730	Gear ratio error
P0742	TCC stuck on
P0743	TCC solenoid electrical fault
P0748	Force motor electrical fault
P0751	SSA (1-2/3-4 solenoid) stuck off
P0752	SSA (1-2/3-4 solenoid) stuck on
P0753	SSA (1-2/3-4 solenoid) electrical fault
P0756	SSB (2-3 solenoid) stuck off
P0757	SSB (2-3 solenoid) stuck on
P0758	SSB (2-3 solenoid) electrical fault
P1560	TCM voltage interrupted
P1600	Transmission power relay circuit (Solenoid B+ supply)

Type 5 & 6 (Except BMW)

Codes

P1605	TCM internal error
P1621	TCM internal error
P1625	Transmission power relay circuit (Main Case Solenoid B+ supply)
P1705	P/N output circuit from ECM to TCM (not the trans range sensor)
P1740	Torque management circuit
P1743	TPS signal invalid from ECM to TCM
P1760	Keep alive power circuit fault
P1740	Torque management circuit
P1792	Engine coolant circuit
P1800	Transmission power relay circuit (Main Case Solenoid B+ supply)
P1835	Kickdown switch stuck on (info from ECM on some models)
P1844	TCS torque reduction request circuit
P1845	Gear ratio output to ABS
P1850	Band apply solenoid electrical fault
P1870	Transmission component slipping
P1890	ECM to TCM data input circuit (TPS data incorrect on some models)
P1895	Engine torque delivered circuit (TCM to traction control module)
U2100	CAN bus circuit
U2104	CAN bus circuit
U2105	CAN bus circuit
U2108	CAN bus circuit

Aisin Warner Section

Nissan

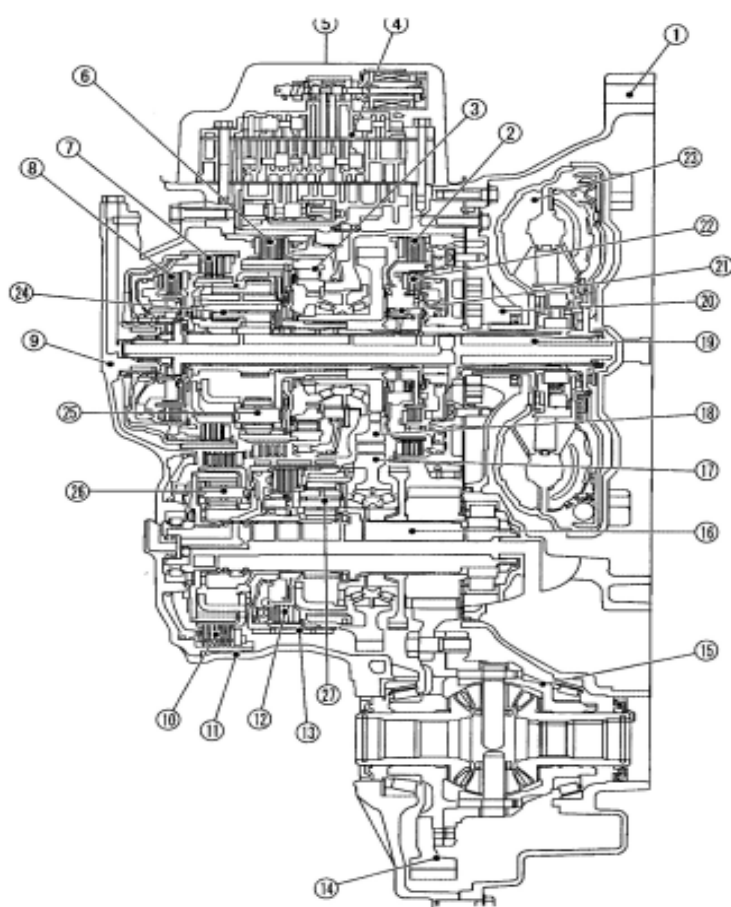
Applications and Internal Component ID

Aisin Warner:

RE5F22A:

2004 and newer Maxima V6

2005 and newer Altima



1	Converter Housing	10	B5 Brake	19	Input Shaft
2	2nd Brake	11	Transaxle Case	20	Oil Pump
3	One-Way Clutch No.2	12	U/D Clutch	21	One-Way Clutch No.1
4	Control Valve Assembly	13	U/D Brake	22	2nd Coast Brake
5	Side Cover	14	Final Gear	23	Torque Converter
6	1st and Reverse Brake	15	Differential Case	24	Main Rear Planetary Gear
7	Forward Clutch	16	Output Shaft	25	Main Front Planetary Gear
8	Direct Clutch	17	Counter Driven Gear	26	U/D Rear Planetary Gear
9	Transaxle Case Cover	18	Counter Drive Gear	27	U/D Front Planetary Gear

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Component Application Chart

Shift position		Clutch			Brake					One-way clutch		Remarks
		F/C 1	D/C 2	U/D.C 3	2nd C/ B 4	2nd/B 5	1st & R/B 6	U/D.B 7	B5/B 8	O.C1 9	O.C2 10	
P									●			PARK POSITION
R			●				●		●			REVERSE POSITION
N									●			NEUTRAL POSITION
	1st	●							●		●	
D	1 ⇌ 2	●			■	■			●	■	■	Automatic shift 1 ⇌ 2 ⇌ 3 ⇌ 4 ⇌ 5
	2nd	●			●	●			●	●		
	2 ⇌ 3	●			●	●		■	■	●		
	3rd	●			●	●		●		●		
	3 ⇌ 4	●		■	●	●		■		●		
	4th	●		●	●	●				●		
	4 ⇌ 5	●	■	●	■	●				■		
	5th	●	●	●		●						
M5	5th	●	●	●		●						Locks in 5th gear*
M4	4th	●		●	●	●				●		Locks in 4th gear*
M3	3rd	●			●	●		●		●		Locks in 3rd gear*
M2	2nd	●			●	●			●	●		Locks in 2nd gear*
M1	1st	●					●		●		●	Locks in 1st gear*

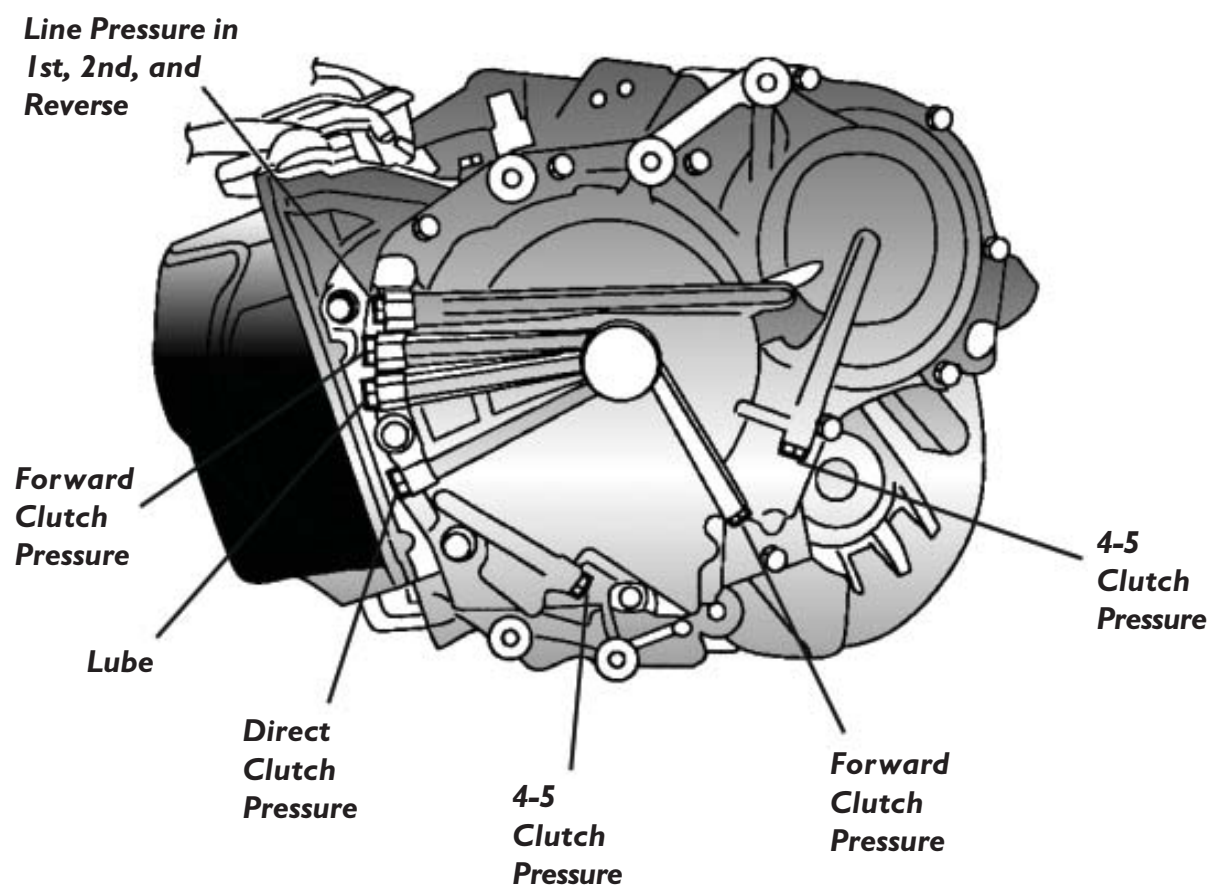
●: Operates

■: In transition between applied and released.

*: Except when automated up/down shift control and up/down shift permission control are activated.

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Pressure Tap Locations



Engine Speed:	D, M positions	Reverse
Idle	48-57 psi	73-88 psi
WOT Stall	186-202 psi	247-287 psi

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Manual Code Retrieval

Preliminary Test:

1. With the selector lever in Park, start the engine and warm it to operating temperature.
2. Turn the ignition switch to the Off position, then turn the switch in cycles On, Off, On, Off (ending in the Off position).
3. Wait 10 seconds.
4. Turn the ignition switch to the “On” position (do not start engine).
5. The “A/T Check” indicator should come on for about 2 seconds. If the “A/T Check” indicator does not come on, check the CAN bus circuits from the TCM to the instrument cluster, power and ground to A/T control module and the “A/T Check” indicator lamp and circuits.

*** The short blinks indicate codes that are not set and the long blinks indicate codes that are set. Example: If all of the blinks are short except for the 8th, 12th, and 23rd, it means you have codes 8, 12 and 23 set.**

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Manual Code Retrieval (continued)

Code retrieval procedure:

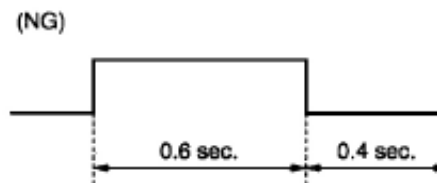
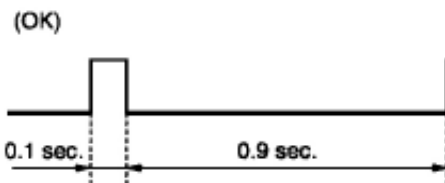
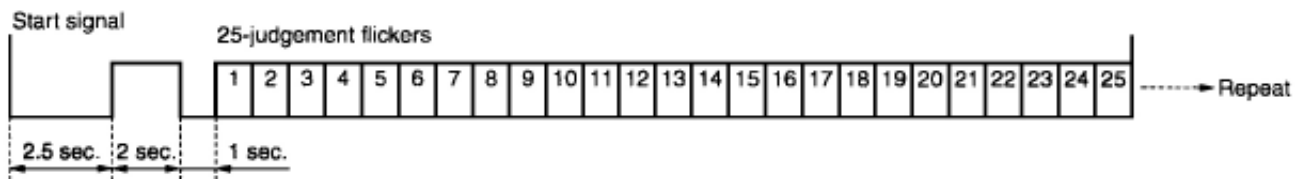
Note: Step 7 must be performed within 2 seconds of completing step 6

(turning ignition switch "On")

1. Set the Parking Brake
2. Turn the ignition switch to the "Off" position
3. Push the shift lock release button
4. Move the selector lever from the "P" to the "D" position.
5. Make sure the accelerator pedal is fully released (closed throttle)
6. Depress the brake pedal
7. Turn the ignition switch to the "On" position
8. Move the selector lever to the "N" position, then release the brake pedal.
9. Move the selector lever to the "D" position, then depress the brake pedal.
10. Release the brake pedal.
11. Depress the accelerator pedal fully, then release it

The A/T Check indicator should now flash, indicating any self-diagnosis codes that are set.

*** The short blinks indicate codes that are not set and the long blinks indicate codes that are set. Example: If all of the blinks are short except for the 8th, 12th, and 23rd, it means you have codes 8, 12 and 23 set.**



Codes are cleared by turning the ignition switch off after the code retrieval procedure has been performed.

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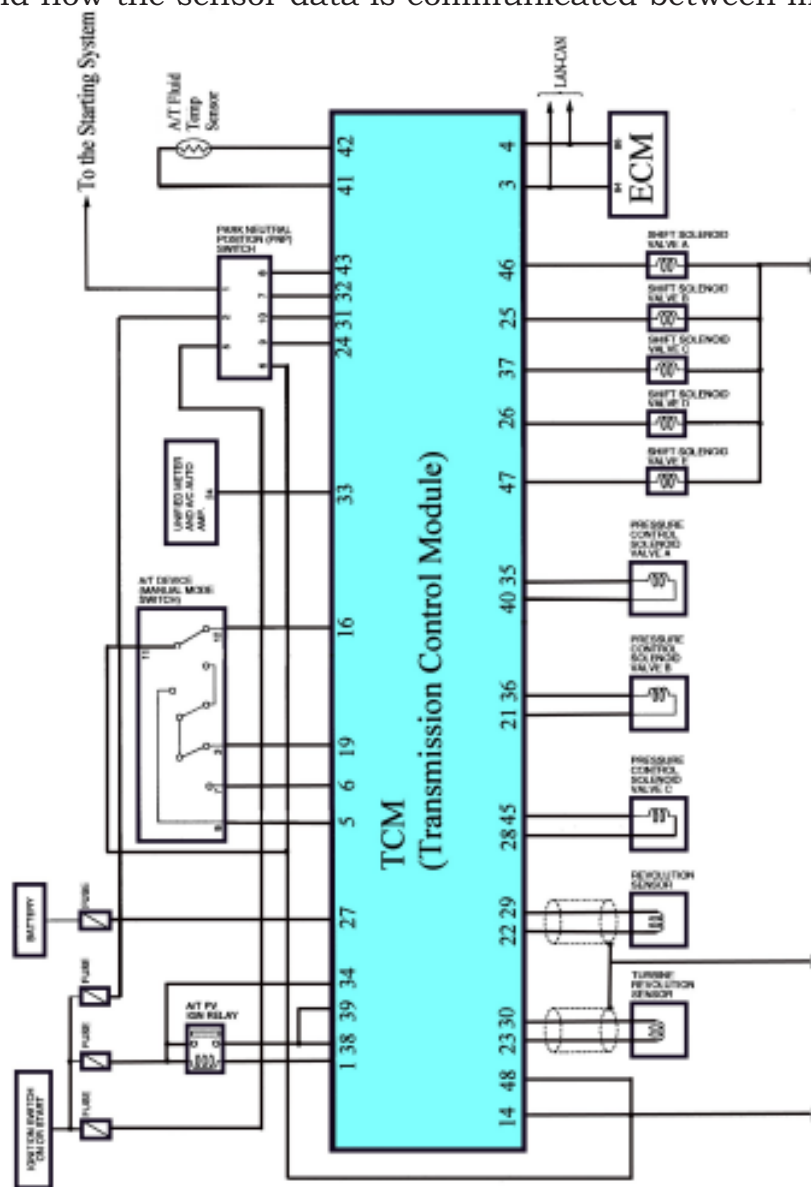
DTC Identification

OBDII DTC	Flash Code	Cause
P0500	15	Vehicle speed signal from instrument cluster
P0613		TCM internal malfunction
P0705	11	PNP switch signal fault
P0710	12	ATF temperature sensor circuit fault
P0711		ATF temperature sensor no signal change (not rational)
P0717	2	Turbine speed sensor signal loss or out of range
P0722	1	Vehicle speed sensor (revolution sensor) signal loss or out of range
P0726	14	Engine speed signal fault (from ECM)
P0731	17	1 st gear ratio error
P0732	18	2 nd gear ratio error
P0733	19	3 rd gear ratio error
P0734	20	4 th gear ratio error
P0735	21	5 th gear ratio error
P0744	24	TCC performance (TCC slip)
P0745	3	PC solenoid A (line pressure) electrical circuit fault
P0750	6	Shift solenoid A electrical circuit fault
P0755	7	Shift solenoid B electrical circuit fault
P0760	8	Shift solenoid C electrical circuit fault
P0762	22	Shift solenoid C stuck on (performance fault)
P0765	9	Shift solenoid D electrical fault
P0770	10	Shift solenoid E electrical fault
P0775	4	PC solenoid B electrical circuit fault
P0780	23	Shift performance fault (incorrect gear, long shift, slipping)
P0795	5	PC solenoid C electrical circuit fault
P0797	25	PC solenoid C stuck on (performance fault)
P0826		Manual mode switch signal fault
P0882		TCM power loss (power/ground fault, battery/charging fault, battery disconnected)
P1726	13	Electronic throttle control system fault
U1000	16	CAN communication line (CAN bus fault)

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Wiring Diagram

The transmission control module wiring diagram below shows some of the same components and circuits that you would find in previous year models. If you look closely, you will notice that some sensors you would find on earlier vehicles, such as the TPS, are not present. The overview of the CAN bus network covered in the next couple of pages will help you understand which modules these sensor signals go to, and how the sensor data is communicated between modules.



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CAN Communication

There are some quick tests you can perform on the Nissan CAN bus network without even using a scan tool or DMM. Using this type of test procedure can help you quickly determine if there is a problem and narrow down where the problem may be located.

For example, looking at the CAN data transfer charts on the following pages, you can determine which modules are transmitting specific data information, and which are receiving (“T” for the transmitting module, “R” for the receiving module).

Example 1:

Verifying the network between the ECM and the Unified Meter and A/C Amp. The “Engine Speed Signal” is transmitted over the CAN bus network by the ECM, and received by the Unified Meter and A/C Amp (instrument cluster module).

Test 1:

So if you start the engine and the tachometer is functioning, then you have verified that the network between the ECM and Unified Meter and A/C Amp is intact and functioning at this time.

Example 2:

Verifying the network between the TCM and the Unified Meter and A/C Amp. The “A/T Position Indicator Lamp” data is transmitted over the CAN bus network by the TCM, and received by the Unified Meter and A/C Amp (instrument cluster module).

Test 2:

If you move the Transmission Selector Lever and the Position Indicator Lamps are functioning properly, you have verified that the network between the TCM and Instrument Cluster is intact and functioning at this time.

Looking at the network wiring diagram, you can see that by performing the tests described above you can verify the integrity of the network from the Unified Meter and A/C Amp to the ECM.

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CAN Communication (continued)

TYPE 14/TYPE 15/TYPE 16									
T: Transmit R: Receive									
Signals	ECM	TCM	Display control unit	Display unit	BCM	Unified meter and A/C amp.	Driver seat control unit	ABS actuator and electric unit (control unit)	IPDM E/R
Engine speed signal	T	R	R			R		R	
Engine status signal	T				R				
Engine coolant temperature signal	T	R				R			
Key switch signal					T		R		
Ignition switch signal					T		R		R
ABS operation signal	R	R						T	
Fuel consumption monitor signal	T					R			
			R	R		T			
A/C switch signal	R				T				
A/C compressor request signal	T								R
Blower fan motor switch signal	R				T				
A/C control signal			T	T		R			
			R	R		T			
Cooling fan speed request signal	T								R
Cooling fan speed signal	R								T
Position light request signal					T	R			R
Low beam request signal					T				R
Low beam status signal	R								T
High beam request signal					T	R			R
High beam status signal	R								T
Front fog light request signal					T				R
Day time running light request signal					T	R			
Vehicle speed signal						R		T	
	R	R	R		R	T	R		
Sleep wake up signal					T	R	R		R
Door switch signal			R	R	T	R	R		R
Turn indicator signal					T	R			
Cornering lamp request signal					T				R
Key fob iD signal					T		R		
Key fob door unlock signal					T		R		
Oil pressure switch signal					R				T
					T	R			
Buzzer output signal					T	R			
Fuel level sensor signal	R					T			
ASCD SET indicator signal	T					R			
ASCD CRUISE indicator signal	T					R			
Malfunction indicator lamp signal	T					R			

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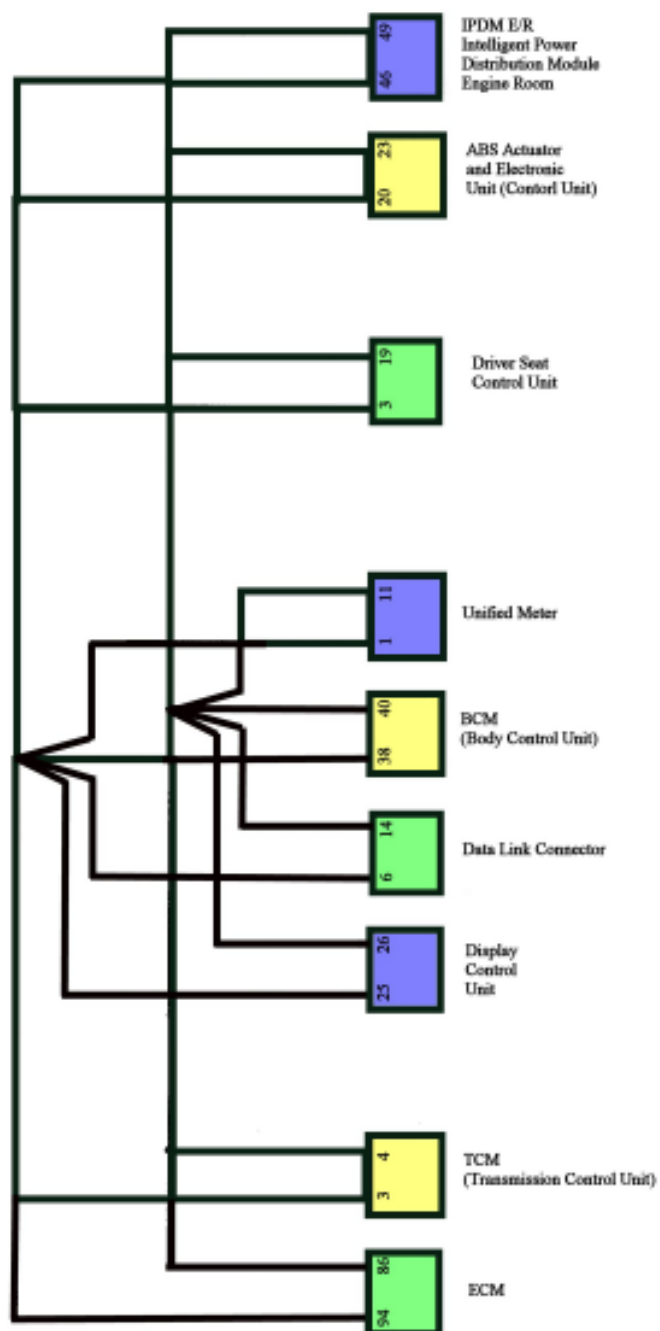
CAN Communication (continued)

Signals	ECM	TCM	Display control unit	Display unit	BCM	Unified meter and A/ C amp.	Driver seat control unit	ABS actuator and electric unit (control unit)	IPDM E/R
Front wiper request signal					T				R
Front wiper stop position signal					R				T
Rear window defogger switch signal					T				R
Rear window defogger control signal	R		R	R					T
Hood switch signal					R				T
Theft warning horn request signal					T				R
Horn chirp signal					T				R
ABS warning lamp signal						R		T	
Brake warning lamp signal						R		T	
System setting signal			T	T	R		R		
			R	R	T		T		
Distance to empty signal			R	R		T			
Seat belt buckle switch signal					R	T			
Parking brake switch signal					R	T			
A/T self-diagnosis signal	R	T							
Electric throttle control signal	T	R							
Engine and A/T integrated control signal	T	R							
	R	T							
Accelerator pedal position signal	T							R	
P range signal		T					R	R	
R range signal		T					R		
Stop lamp switch signal		R				T			
TCS operation signal	R	R						T	
Input shaft revolution signal	R	T							
Output shaft revolution signal	R	T							
ASCD operation signal	T	R							
ASCD OD cancel request	T	R							
SLIP indicator lamp signal						R		T	
A/T CHECK indicator lamp signal		T				R			
A/T position indicator lamp signal		T				R			
A/T shift schedule change demand signal		R						T	
Manual mode indicator signal		T				R			

Nissan

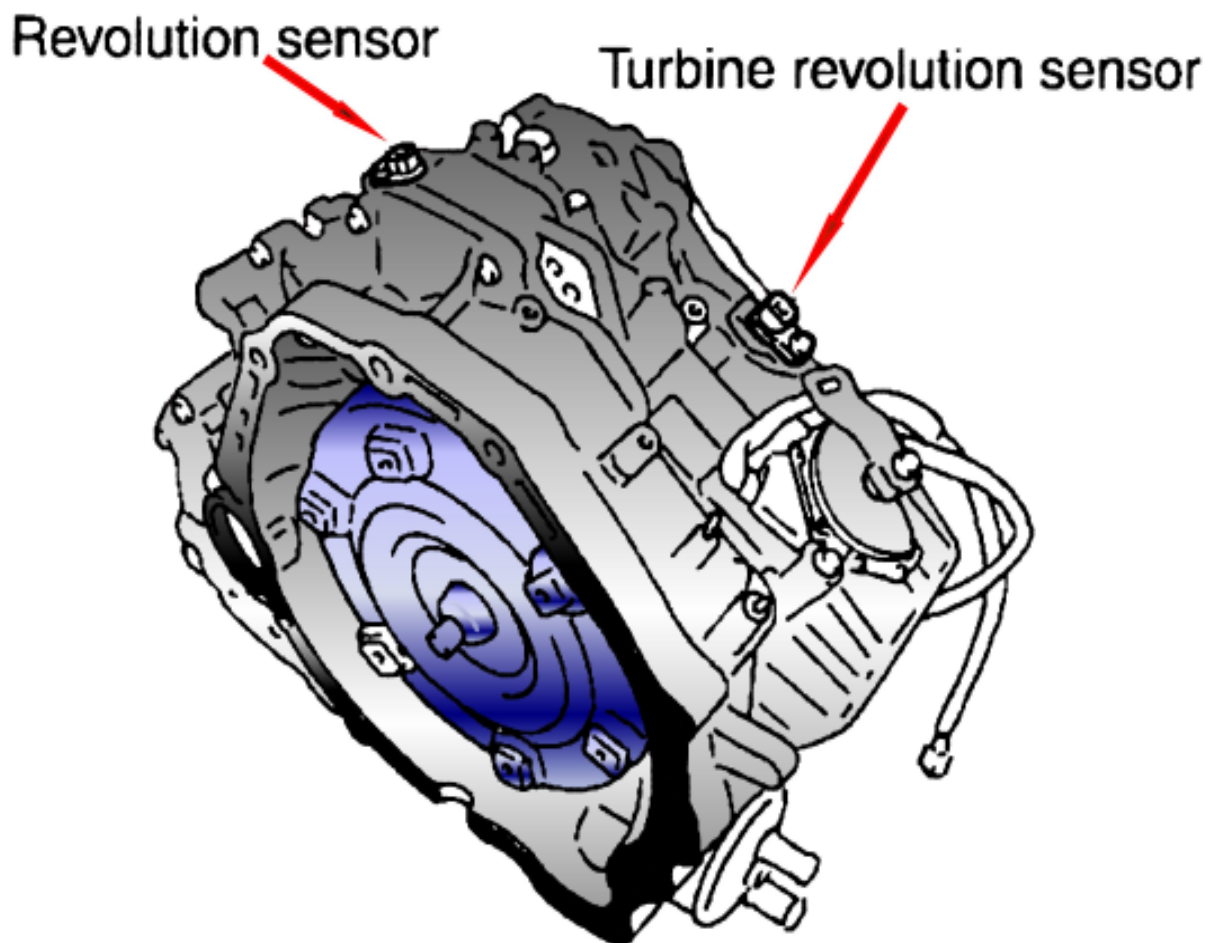
CAN Communication (continued)

CAN System (TYPE 16)



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Revolution and Turbine Speed Sensor ID and Testing



Nissan

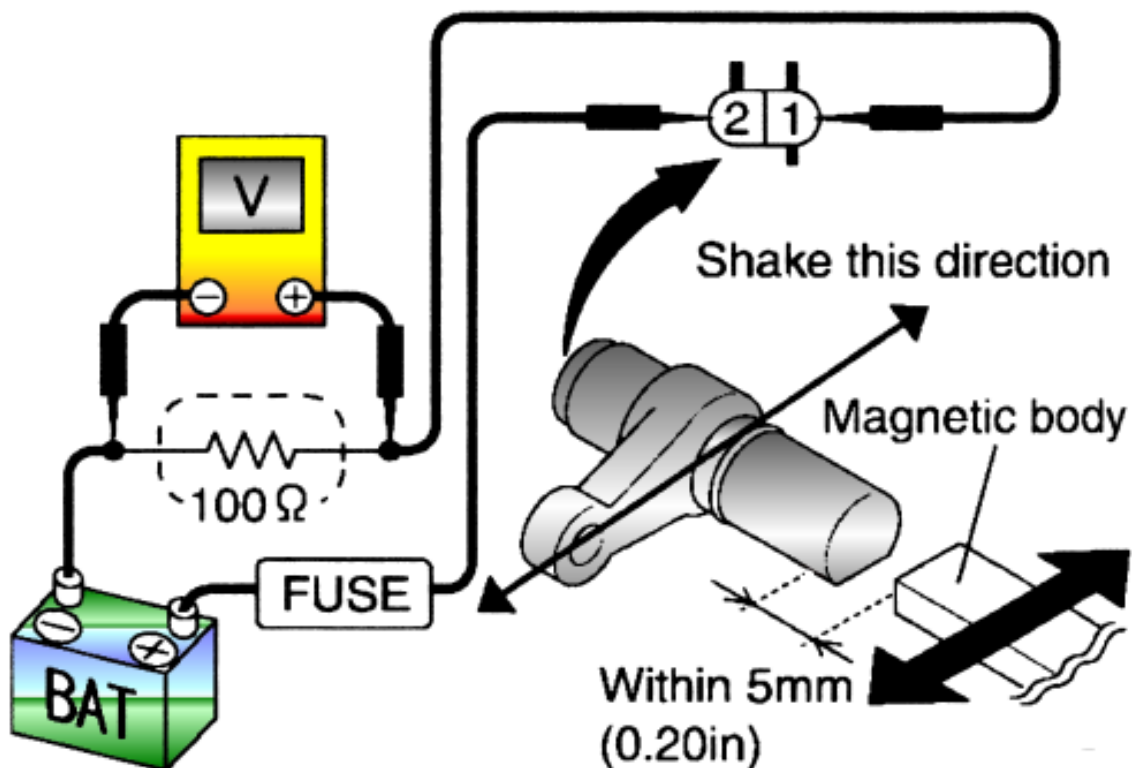
Revolution and Turbine Speed Sensor ID and Testing

When a piece of magnetic metal (iron) is waved back and forth as illustrated, measured voltage should toggle between a high reading of 1.2 – 1.6 volts, and a low reading of 0.4- 0.8 volts. These sensors are not pulse generators, they must have voltage to operate properly.

100 ohm Resistor

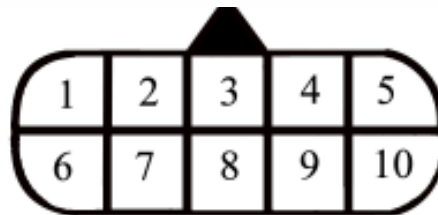
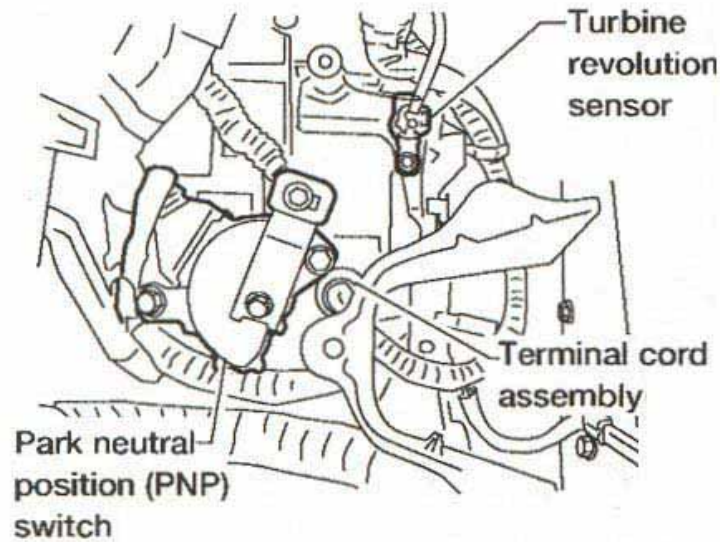
Radio Shack Part Number

271-1311



Nissan

Park/Neutral Position Switch Testing

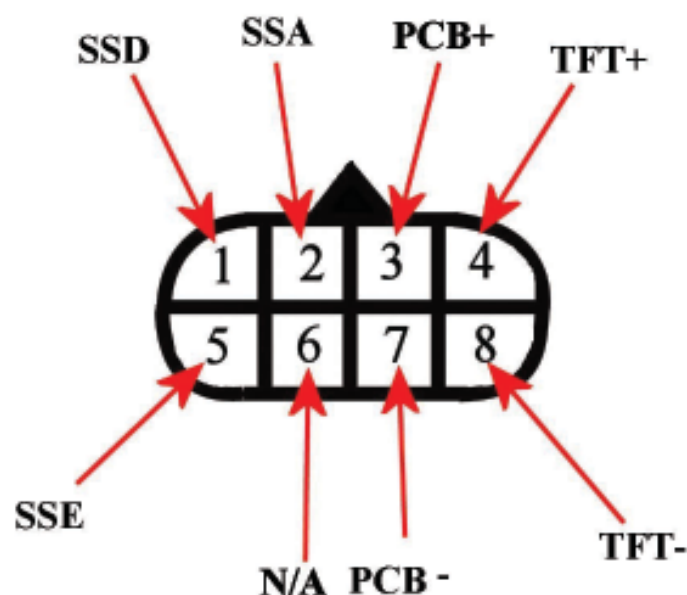


Circuit	Starter		Reverse		Position				
	+	-	+	-	-	A	B	C	PA
Terminal No.	5	1	2	4	6	9	10	7	8
Lever position									
P	○—○				○—○				○
R			○—○		○—○	○			
N	○—○				○		○		○
D					○		○—○		

○—○ : Continuity

Nissan

Solenoid and A/T Temperature Sensor Testing



Solenoid Resistances

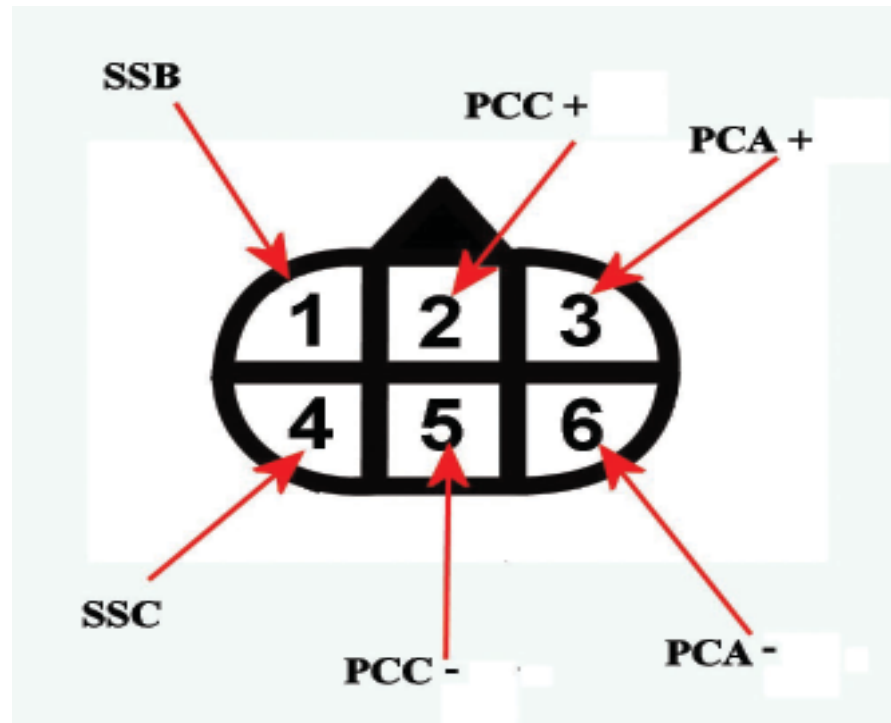
Solenoid	Resistance	Measure between:
SSA	11-16 ohms	2 and ground
SSD	11-16 ohms	1 and ground
SSE	11-16 ohms	5 and ground
PCB	5.0 – 5.6 ohms	3 and 7

A/T Fluid Temperature Sensor Readings

Temperature	Resistance (unplugged)	Voltage (plugged in)
0°C (32°F)	9.8 k	4.0 volts
20°C (68°F)	4.2 k	3.0 volts
80°C (176°F)	0.54 k	0.8 volts
100°C (212°F)	0.31 k	0.5 volts

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Solenoid and A/T Temperature Sensor Testing (continued)



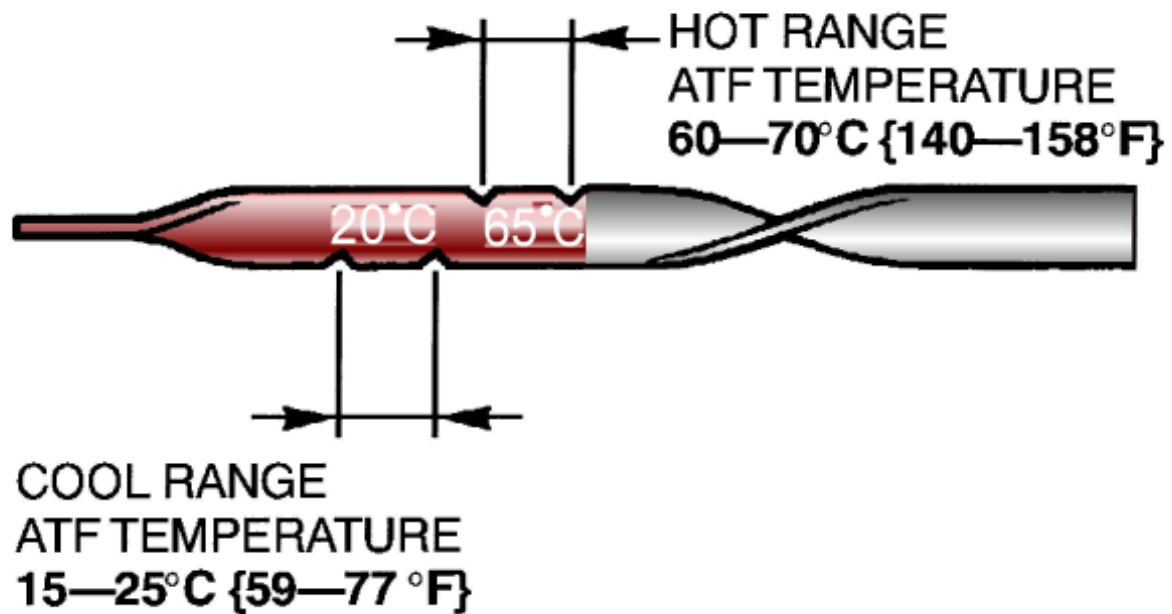
Solenoid Resistance

Solenoid	Resistance	Measure between:
SSB	11-16 ohms	1 and ground
SSC	11-16 ohms	4 and ground
PCA	5.0-5.6 ohms	3 and 6
PCC	5.0-5.6 ohms	2 and 5

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Fluid Fill/Check Procedure

Nissan: Nissan Matic-K (P/N 999MP-MTK00P)



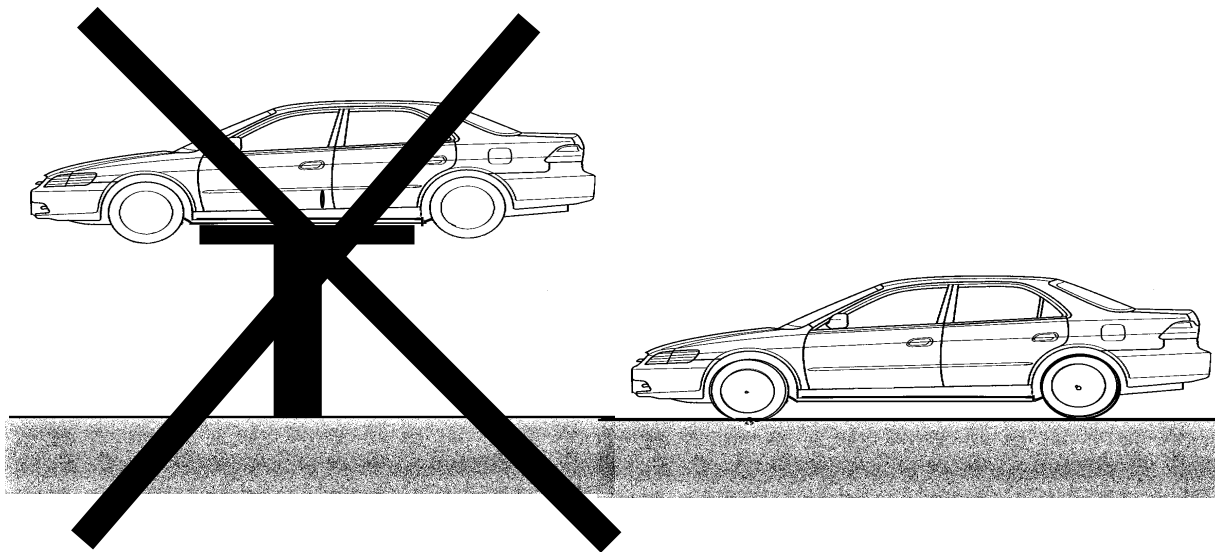
Honda Section

BAXA, MAXA and B7XA

ATRA Bulletin #634

No 2-3 Shift On the Rack After Rebuild

Many times after rebuild a no 2-3 shift is discovered. The computer strategy does not allow a successful 2-3 shift with the wheels off of the ground. It may be possible to shift the transmission manually to get the 2-3 shift. The transmission may shift erratic during the initial road test.



INCORRECT

CORRECT

Acura

1995-2004 Vehicle Applications

Transaxle Model	Vehicle Model
A6VA	1997 2.2CL
B6VA	1998 – 1999 2.3CL
B7ZA / M7ZA	1997 – 1999 3.0CL
BGFA / MGFA	2001 – 2003 3.2CL
M5DA	1996 – 3.5RL
M1WA	1995 – 1998 2.5 TL
M5HA	1996 – 1998 3.2TL
B7VA (4 speed)	1999 3.2TL
B7VA (5 speed)	2000 3.2TL
B7WA	2001 -3.2TL
MGHA	2001 -MDX
S4XA	1996 – 1999 Integra
SKWA	2000 – 2001 Integra
MRMA	2002 - RSX
MR9A	1991 – 2002 NSX

Honda

1995-2004 Applications

Transaxle Model	Vehicle Model
A4RA / B4RA / M4RA	1996 – 2000 Civic
BMXA	2001 – 2004 Civic
M4VA (CVT)	1996 – 2000 Civic HX
MLYA (CVT)	2001 Civic
SZCA (CVT)	Civic Hybrid
BAXA / MAXA	1998 – 2002 Accord 4
MCLA	2003 – Accord 4
B7XA	1998 – 2002 Accord V6
BAYA / MAYA	2003 – Accord V6
M6HA	1997 – 2001 Prelude
MPJA	1995 – 1997 Odyssey
MDWA	1998 Odyssey
B7TA / B7VA	1999 – 2001 Odyssey
BYBA	2002 Odyssey
MDMA / SDMA /	1997 – 2001 CRV
MCVA / MRVA	2002 – CRV
MHTA	2001 - Insight

Honda/Acura

General Information

The following pages are procedures that need to be performed during every repair. Diagnosing Honda/Acura transmissions can be difficult and time consuming especially when a problem was never found and/or was created during the overhaul. These procedures were developed and tested to help reduce comebacks.

Pressure Testing

All Applications

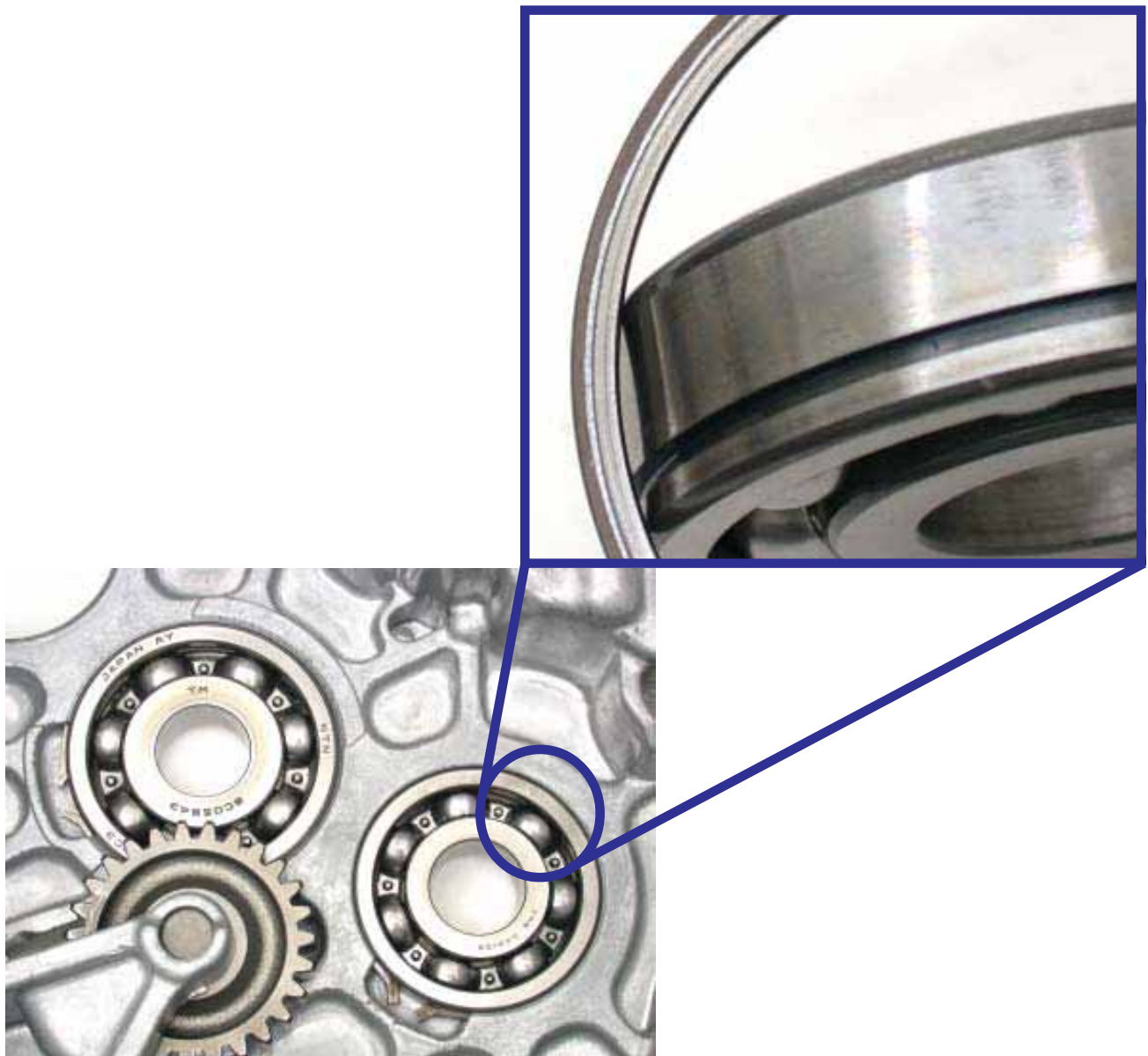
Standard mechanical gauges will work for checking line pressure, however if you use a mechanical gauge, the accumulation effect of the gauge and rubber hose can cause flares or mask harsh shifts when connected to a clutch pressure port. It is best to use transducer type electronic gauges for clutch pressures.



Shaft Bearing Snaprings

General Information

Always remove the bearings from the case and carefully inspect snaprings for wear. Excessive wear allows shaft movement which can cause noise problems and shaft tube retainer/end cover damage.



Clutch Packs

General Information (continued)

Check for wear on the bottom steel plate of each clutch pack

The cushion plate will often wear into the bottom steel plate. This will increase clutch pack clearance, and decrease the cushioning effect on clutch apply. If the groove is more than 0.005" deep, replace the steel plate.

Steel plate finish:

Improper Steel plate finish can cause shift quality problems. The factory finish on an unused steel plate is NOT a mirror finish. It looks more like a scratchy surface.

Shift Concerns:

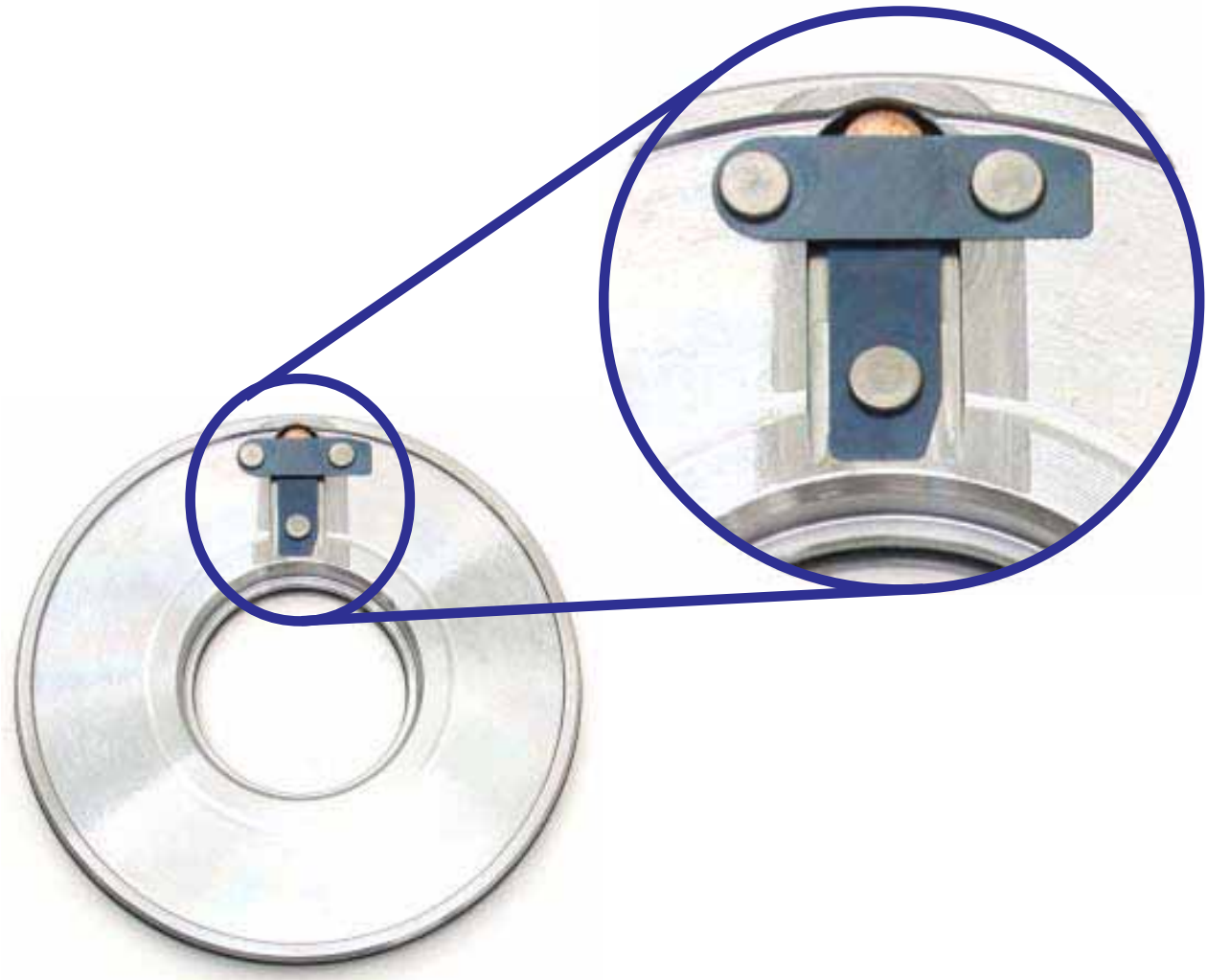
1. Slide Bump
2. Shudder
3. Groan
4. Grunt
5. Squawk



Piston Flapper Valves

Clean and Inspect

Carefully clean the piston flapper valve with solvent and compressed air. Closely inspect the flapper valve for contamination, such as clutch fibers or metal debris stuck behind the “flapper”.



All Drums

Drum cracks are a common failure on many units and are most common on Civic units. Inspect the Drums for cracks and Steel Plate lug wear.



Seals

Torque Converter and Axle Seals are Directional

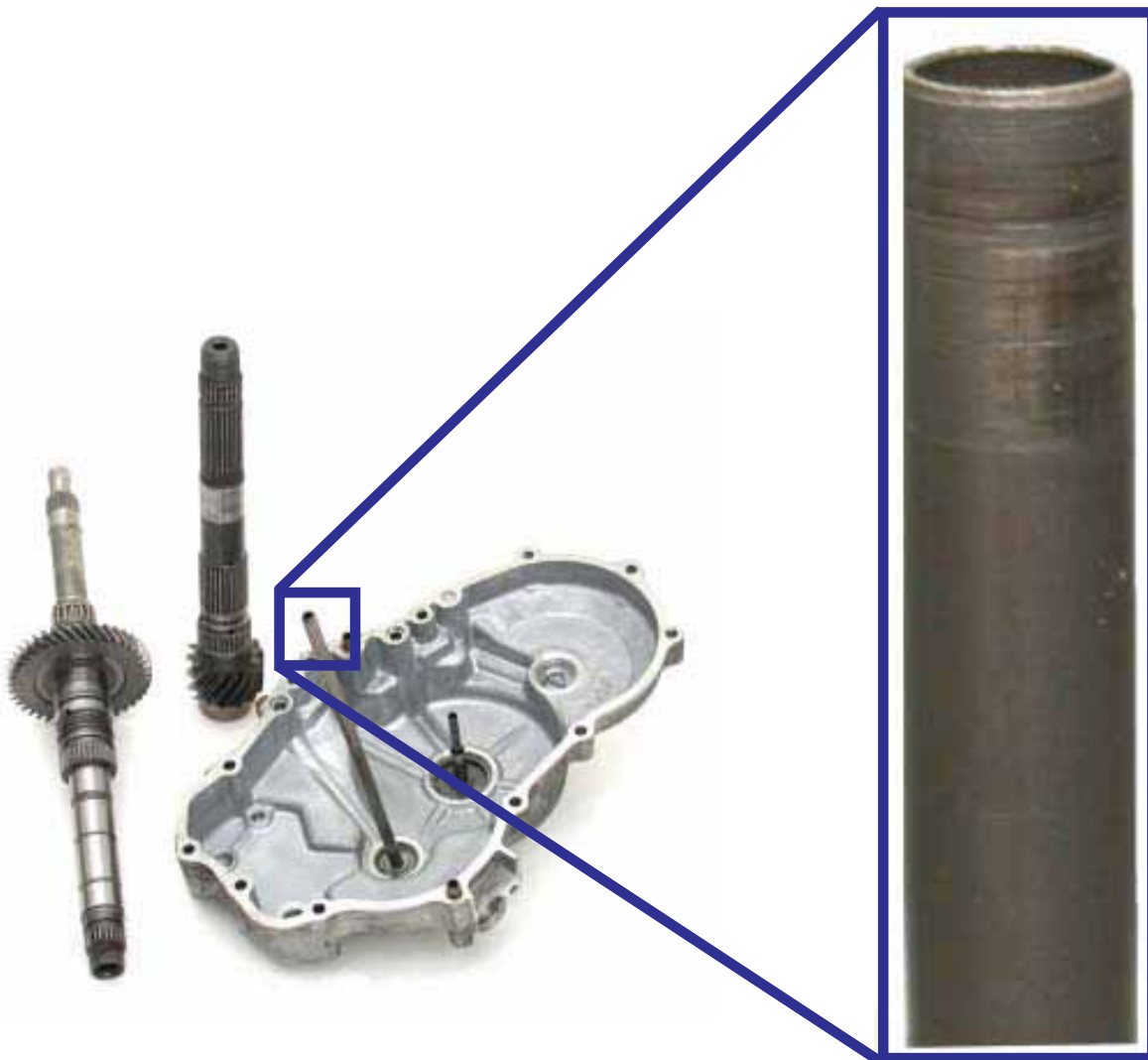
Most Honda seals have an arrow showing the correct rotation. On 4-cylinder applications the torque converter seal has an arrow pointing counter clockwise, on V6 applications the arrow points clockwise.



Shaft Bushings and Tubes

Closely Inspect the Tube Ends for any Signs of Wear or Scoring

A slight polishing or marking on the end of the tube where the shaft bushing rides is acceptable. If any scoring, grooves or wear is present, replace both the tube and the bushing.



Shaft Bushings and Tubes

Check the Tube to Bushing Clearance with “Scotch” Type Tape

1. With a pair of scissors, cut a narrow (1/16") strip of “Scotch” or similar type plastic tape (about 0.002" thick).
2. Lay the piece of tape lengthwise at the end of the tube, leaving some of the tape hanging off of the end of the tube.
3. Fold the loose end of the tape in slightly so it will lead itself into the shaft bushing.
4. Insert the tube into the shaft, taped end first.

The tube should not fit into the bushing with the piece of tape on it. If it will fit into the bushing (without excessive force), the bushing or tube are worn and need to be replaced.



Valve Body

Correct End Plug Installation

Be very careful during disassembly and reassembly of the valve body. If these plugs are installed incorrectly many different shift concerns will occur depending on what plug is installed incorrectly.

This end faces out (away from the valve)



This end faces in (towards valve/spring)



Manual Code Retrieval

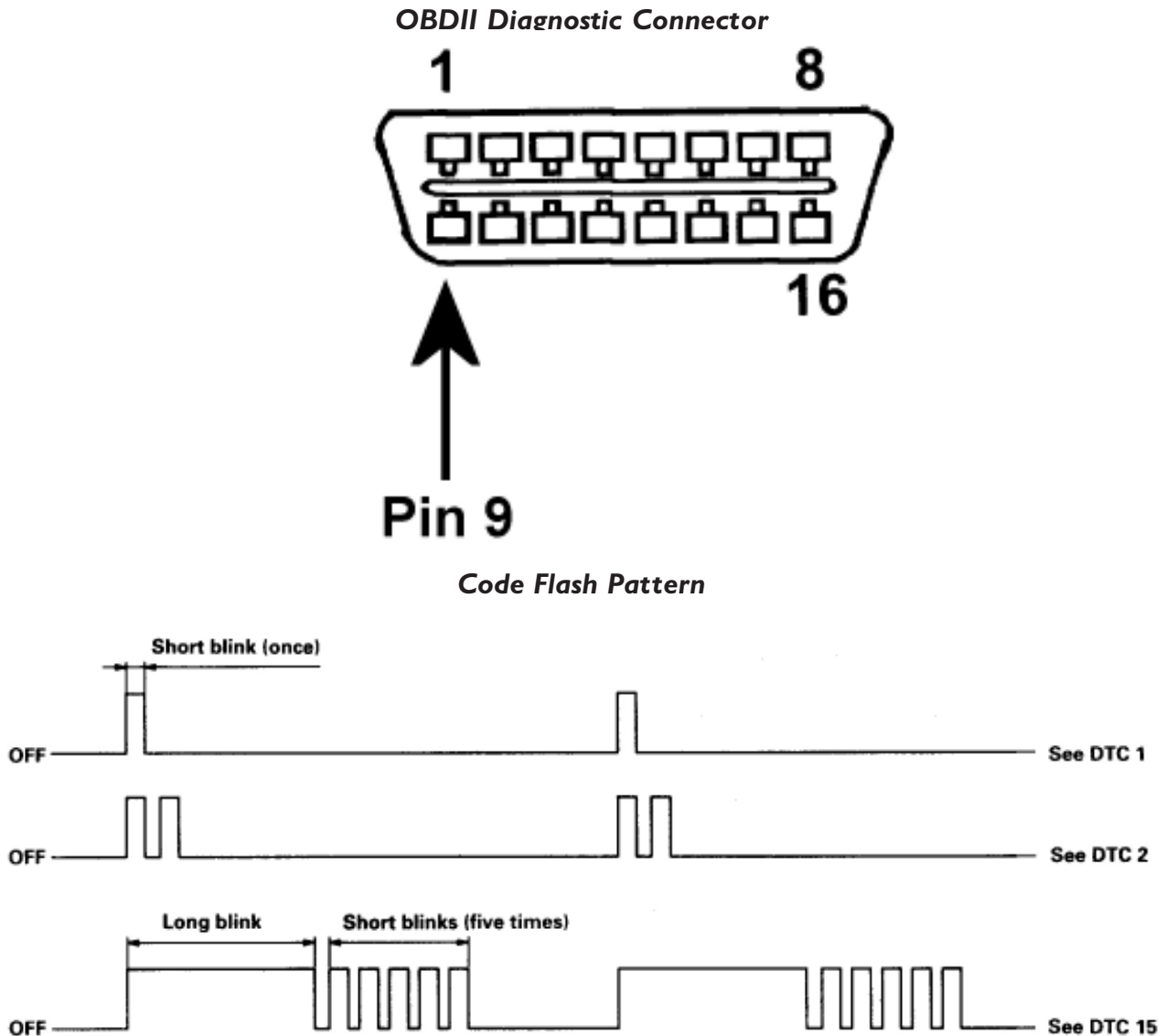
OBDII Diagnostics

Code Retrieval:

On later OBDII vehicles, the two pin service check connector was deleted. If the vehicle does not have a service check connector, ground pin 9 (brown wire) at the OBDII connector to flash transmission codes out of the D, D4, or D5 light.

Clear Codes:

Remove BACK-UP fuse (7.5Amp) from under dash or underhood fuse/relay box for 10 seconds, or use scan tool to clear codes.



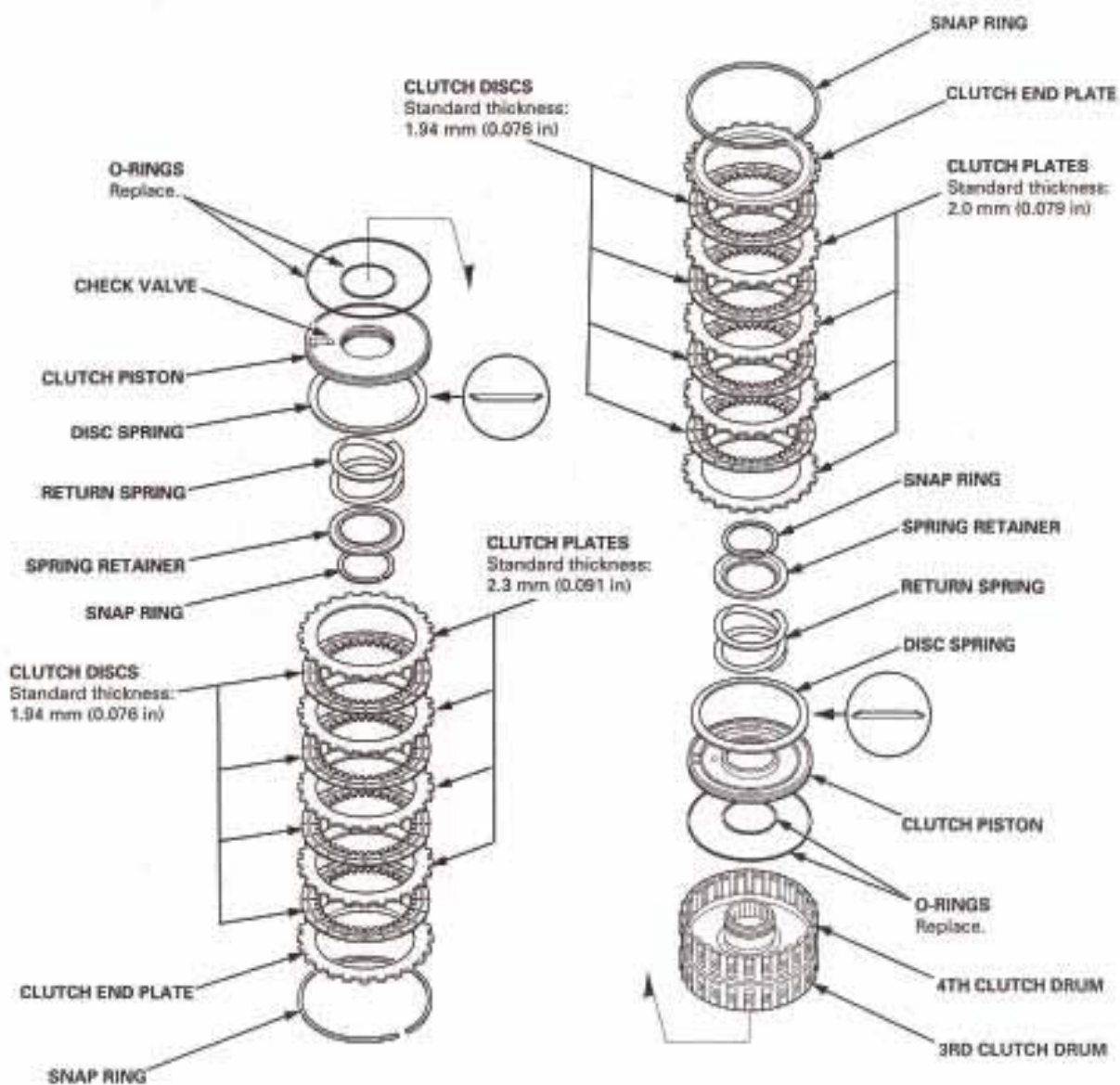
DTC Definitions

Flash	OBDII DTC	Indicator light	Definition
1	P1753	Yes	Lock-up Solenoid Valve A circuit fault
2	P1758	Yes	Lock-up Solenoid Valve B circuit fault
3	P1790	Yes	Throttle Position Sensor fault
4	P1791	Yes	VSS signal fault
5	P1705	Yes	A/T Gear Position Switch fault (short)
6	P1706	No	A/T Gear Position Switch fault (open)
7	P0753	Yes	Shift Control Solenoid A circuit fault
8	P0758	Yes	Shift Control Solenoid B circuit fault
9	P0720	Yes	Countershaft Speed Sensor (NC) signal fault
10	P1792	Yes	Engine Coolant Temperature Sensor signal fault
11	P0725	Yes	Engine Speed Signal fault
12	P1793	Yes	MAP sensor signal fault
13	P1794	Yes	Barometric Sensor signal fault
14	P1786	Yes	FAS signal fault (ECM to TCM)
15	P0715	Some models before 1998 will not flash indicator light	Mainshaft Speed Sensor (NM) signal fault Note: this code can be caused by a transaxle performance problem (slipping, incorrect gear, etc.)
16	P1768	Yes	Linear Solenoid circuit fault A/T Clutch Pressure Control Solenoid A circuit fault
18	P1787	No	FFS signal fault (ECM to TCM)
22	P0763	Yes	Shift Control Solenoid C circuit fault
23	P1773	Yes	A/T Clutch Pressure Control Solenoid B circuit fault
24	P1709	Yes	A/T Shift Switch circuit fault (manual upshift/downshift switch)
25	P1738	No	2nd Clutch Pressure Switch signal fault
26	P1739	No	3rd Clutch Pressure Switch signal fault
27	P1740	No	4th Clutch Pressure Switch signal fault
28	P0710	Yes	ATF Temperature Sensor signal fault
29	P1778	Yes	A/T Lock-up Pressure Control Solenoid circuit fault
30	P1870	Yes	Shift Control Linear Solenoid circuit fault
31	P1873	Yes	PH – PL Control Linear Solenoid circuit fault
32	P1879	Yes	Start Clutch Control Linear Solenoid circuit fault
33	P1882	Yes	Reverse Inhibitor Solenoid circuit fault
34	P1885	Yes	Drive Pulley Speed Sensor signal fault
35	P1886	Yes	Driven Pulley Speed Sensor signal fault
36	P1888	Yes	Secondary Gear Shaft Speed Sensor signal fault
37	P1655	Yes	TMA or TMB signal fault (Civic CVT) SEAF or SEFA signal fault (Prelude) Note: Prelude will not flash code 37 from indicator light
40	P0740	No	Lock-up control system fault
41	P0730	No	Shift control system fault
42	P1890	Yes	Shift control system fault
43	P1891	Yes	Start clutch control system fault
45	P0780	Yes	Mechanical problem in hydraulic system
46	P1750	Yes	Mechanical problem in hydraulic system
47	P1751	Yes	Mechanical problem in hydraulic system
63	P1710	No	1st Hold Switch signal fault

BAXA/MAXA/B7XA Family

Poor Shift Quality After Overhaul

Cushion Plate Direction



3rd and 4th Clutch Drums

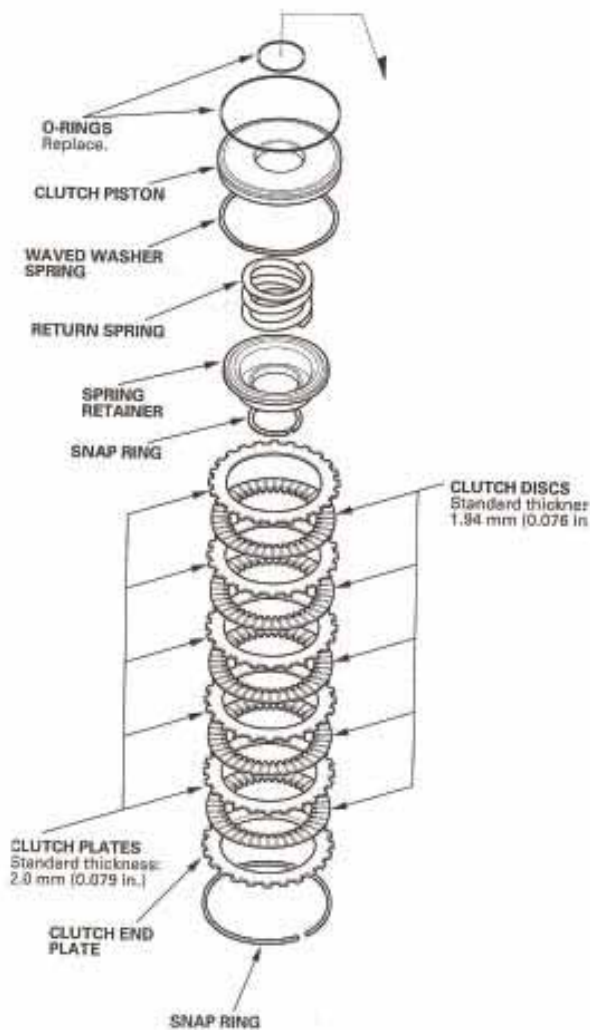
BAXA/MAXA/B7XA Family

Poor Shift Quality After Overhaul

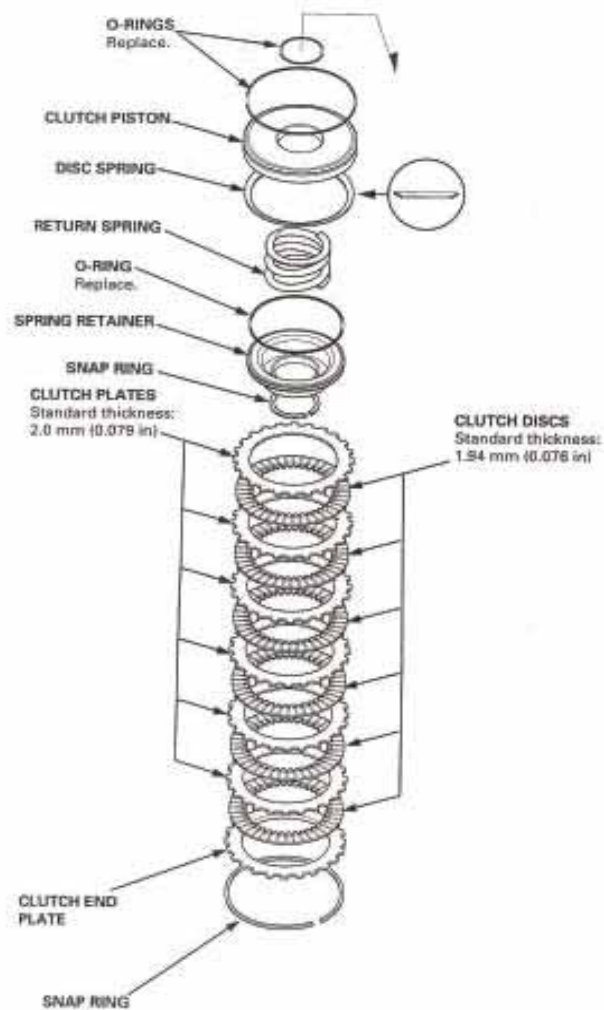
Cushion Plate Direction

Some units use a wave type cushion plate and others use a dish type cushion plate

Wave Plate Design



Dish Plate Design

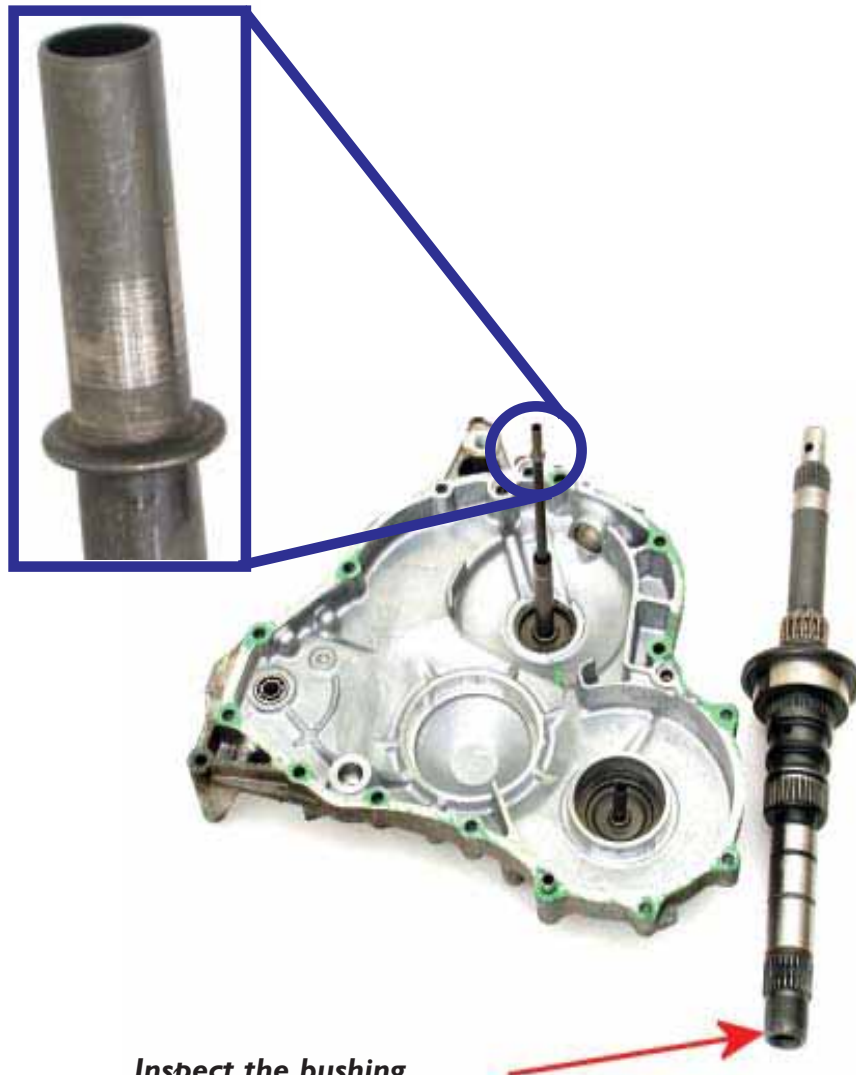


1st Clutch Drum

Bindup in Reverse

Worn Feed Tube and Bushing

A worn mainshaft bushing or pipe may cause crossleaks between the 3rd clutch and 4th clutch assemblies. Install a pressure gauge on the 3rd clutch pressure port. Stall test the transmission in Reverse, there should be NO pressure in the 3rd clutch pressure tap.



*Inspect the bushing
with tape as previously
discussed*

Gear Noise/Whine

Noise in 1st and 2nd Gear

MAXA, BAXA, B7XA, B7VA, B7TA 4 Cylinder and V6 Applications

Be careful when pulling the retainer assembly. If the puller bolts are installed too deep they can damage the thrust bearing surface below the ball bearing.



WARNING: Bolts should not be impacted into the retainer assembly. Impacting your puller bolts into the retainer will cause the lip of the retainer to rise at the arrow points shown. This will cause bearing damage.

Gear Noise/Whine

Noise in 1st and 2nd Gear (continued)

MAXA, BAXA, B7XA, B7VA, B7TA 4 Cylinder and V6 Applications

Make sure the transfer gear is installed correctly. The step on the gear needs to be installed towards the threaded end of the shaft.

*The step must face
the threaded end of the
shaft*



Gear Noise/Whine

Noise in 1st and 2nd Gear (continued)

4 cylinder models

Make sure the Reverse Idler Gear is installed correctly. The ridge on the gear must face up during installation as shown in the picture below.

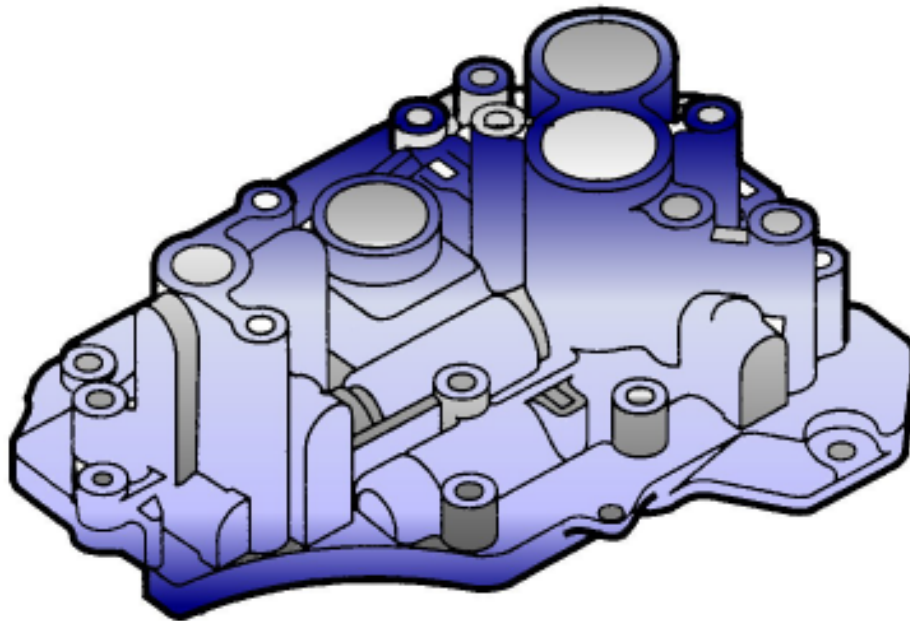


B7TA/B7XA

Popping / Snapping / Grinding in Reverse

Some B7TA and B7XA transaxles in 1998 – 2000 Honda Accords and 1999 – 2000 Honda Odysseys may make a snapping, popping, or grinding noise in reverse, especially under acceleration. This is caused by the Servo Bore depth being machined incorrectly by the factory.

The Factory has an updated design servo valve body: Honda part number 27400-P7X-A50



CPC Solenoid Feed Pipes

V6 Units

During the rebuild make sure you install all of the pipes in there proper locations. Often times during the rebuild the CPC Solenoid feed pipe is not installed correctly or not installed at all.

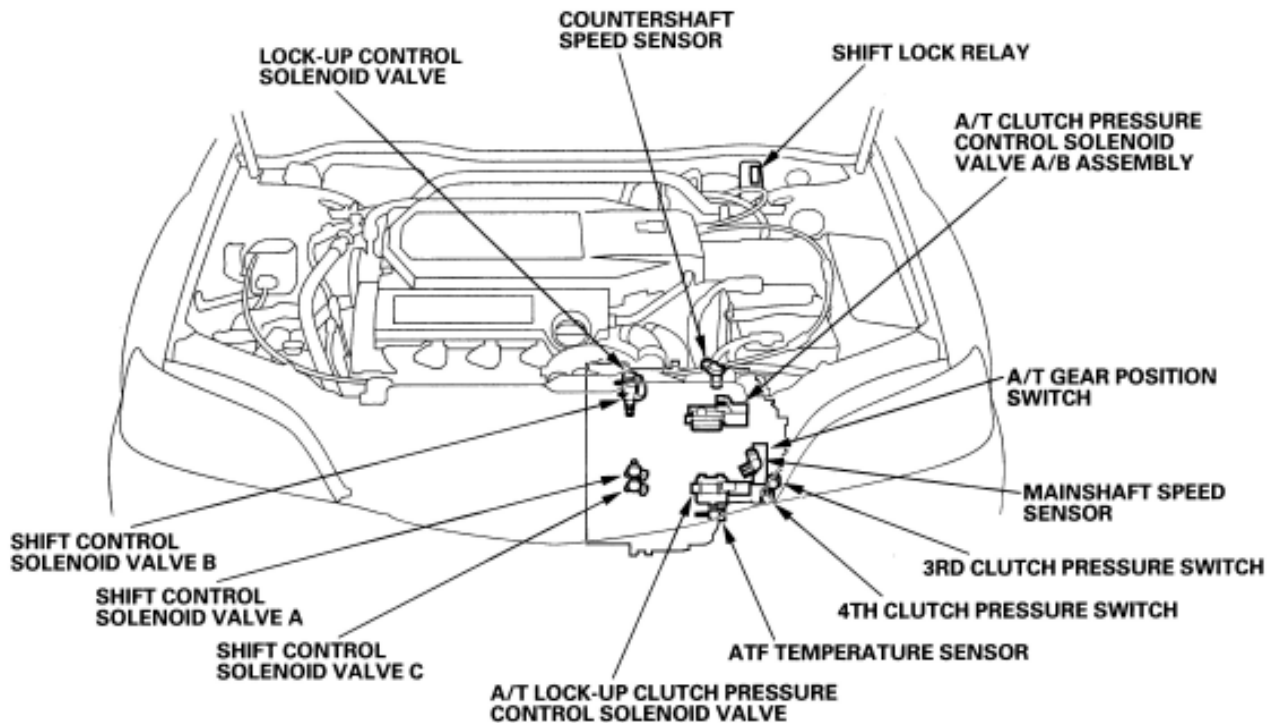
CPC Feed Pipes



External Components

5 Speed V6 Electrical Component ID

Use this chart to identify the components you are working on. Make sure the components are connected to the correct harness plugs.



Solenoid	V6 Wire Colors
Torque Converter Clutch Solenoid Valve	Yellow and Black
Shift Control Solenoid Valve A	Blue/Yellow and Black
Shift Control Solenoid Valve B	Green/White and Black
Shift Control Solenoid Valve C	Green and Black

MCLA

No Reverse Condition

2003 Accord 4 Cylinder

2003 Accord 4 cylinder can develop a no reverse condition if the transmission is shifted between forward and reverse several times, and wheel speeds exceeding 12 mph (such as when the vehicle is stuck in snow). This is due to a programming problem causing the PCM to get stuck in reverse inhibit mode.

Have a dealer reprogram the PCM according to Honda TSB 03-042

2003 Accord 4 cylinder 2 door	From VIN 1HGCM7...3A000001 Thru VIN 1HGCM7...3A023877
2003 Accord 4 cylinder 4 door	From VIN 1HGCM5...3A000001 Thru VIN 1HGCM5...3A080789
2003 Accord 4 cylinder 4 door	From VIN 3HGCM5...3G700001 Thru VIN 3HGCM5...3G705659
2003 Accord 4 cylinder 4 door	From VIN JHMCM5...3C000001 Thru VIN JHMCM5...3C077295

Updated vehicles will have a punch mark above the 9th character of the engine compartment VIN.

Note: The PCM inhibits reverse by turning off Shift Solenoid Valve E. A quick test is to check the Shift Solenoid Valve E circuit for voltage with a DMM.

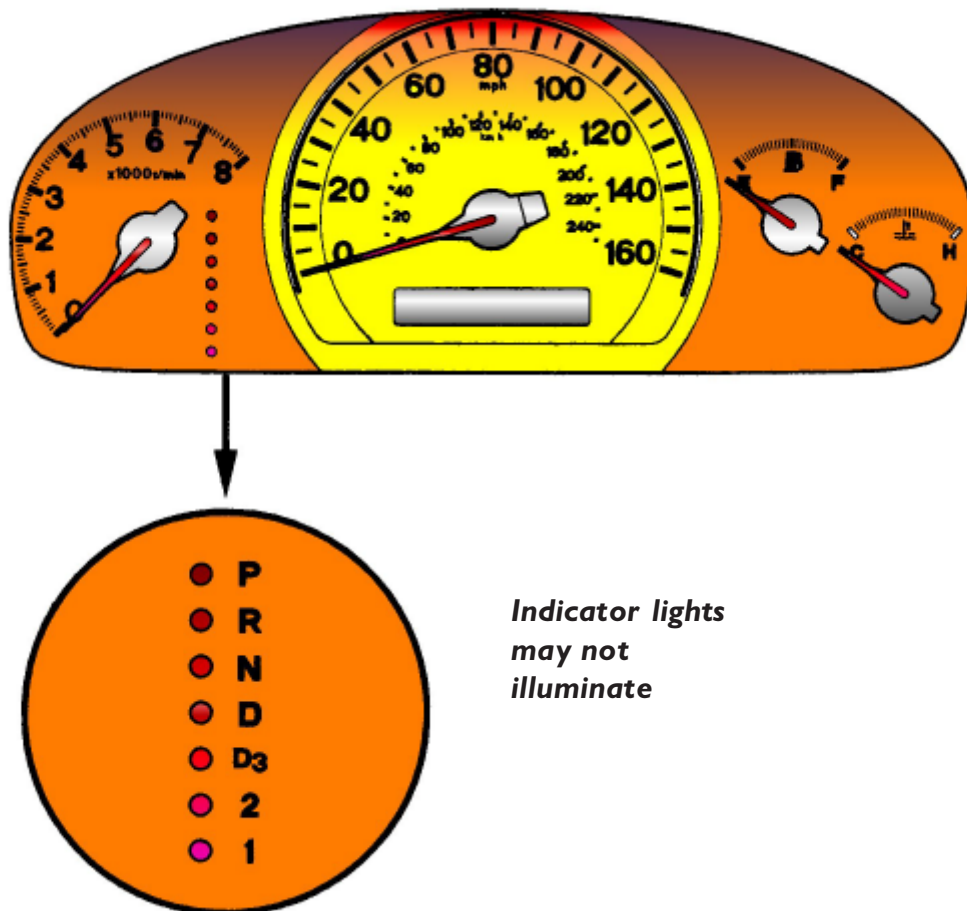
*** No voltage = reverse inhibit command.**

2003 Accord V6

DTC U1055, Shift Position Indicator Inoperative

2003 model year Accord V6's with DTC U1055, along with shift position indicator, cruise control, and A/C not working, may have a problem with PCM communication on the F-CAN network. There is a software update for this concern.

Have a dealer reprogram the PCM according to Honda TSB 03-072



BGFA, B7WA, B7VA 5 Speed

Replace the PCM when Installing an Overhauled or Replacement Transaxle

2000 – 2003 Acura 3.2TL and 2001 – 2003 3.2CL have an updated PCM available to improve transaxle performance and durability.

2000 – 2002 3.2TL	All
2003 3.2TL (except Type S)	From VIN 19UUA5...3A000001 Thru VIN 19UUA5...3A019556
2003 3.2TL Type S	From VIN 19UUA5...3A000001 Thru VIN 19UUA5...3A019061
2001 – 2002 3.2CL	All
2003 3.2CL	From VIN 19UYA42...3A000001 Thru VIN 19UYA42...3A005203

* To order the correct PCM, you need to know the vehicle's emission type. The dealer can scan the vehicle to retrieve the emission type.

PCM P/N	Year/Model	Emission Type*
37820-P8E-305RM	2000-01 3.2TL	KA
37820-P8E-305RM	2001 3.2CL	KA
37820-PGE-305RM	2001 3.2CL Type-S	KA, KL
37820-P8E-306RM	2000-01 3.2TL	KL
37820-P8E-306RM	2001 3.2CL	KL
37820-PJE-A62RM	2002-03 3.2TL	KA
37820-PJE-A62RM	2002-03 3.2CL	KA
37820-PGE-A58RM	2002-03 3.2TL Type-S	KA, KL
37820-PGE-A58RM	2002-03 3.2CL Type-S	KA, KL
37820-PJE-L62RM	2002-03 3.2TL	KL
37820-PJE-L62RM	2002-03 3.2CL	KL

KA = Federal

KL = California

BAYA/MAYA

2003 Accord V6 Update PCM Software

Update PCM Software when the Transaxle is Overhauled or Replaced

Updated PCM software has been developed to improve driveability and durability under certain driving conditions.

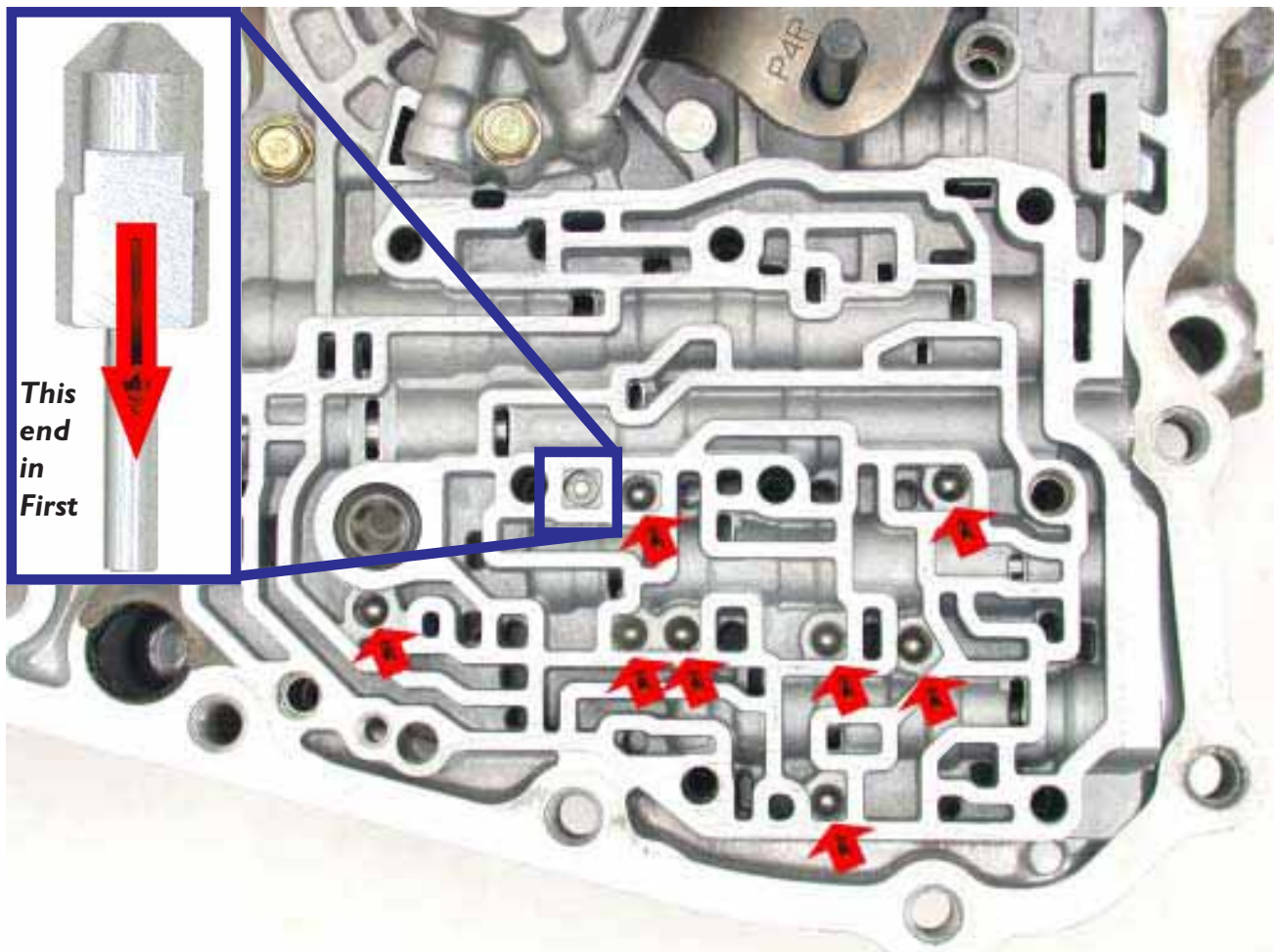
Have a dealer reprogram PCM according to Honda TSB 03-070

2003 Accord V6 4-door	From VIN 1HGCM6...3A000001 Thru VIN 1HGCM6...3A091630
2003 Accord V6 2-door	From VIN 1HGCM8...3A000001 Thru VIN 1HGCM8...3A035060

A4RA/B4RA/M4RA

1996-2000 Civic Valve Body Checkball and Relief Valve Locations

The 1st gear Accumulator Choke Valve installation is very important. If the valve is installed incorrectly, forward engagement problems may occur.



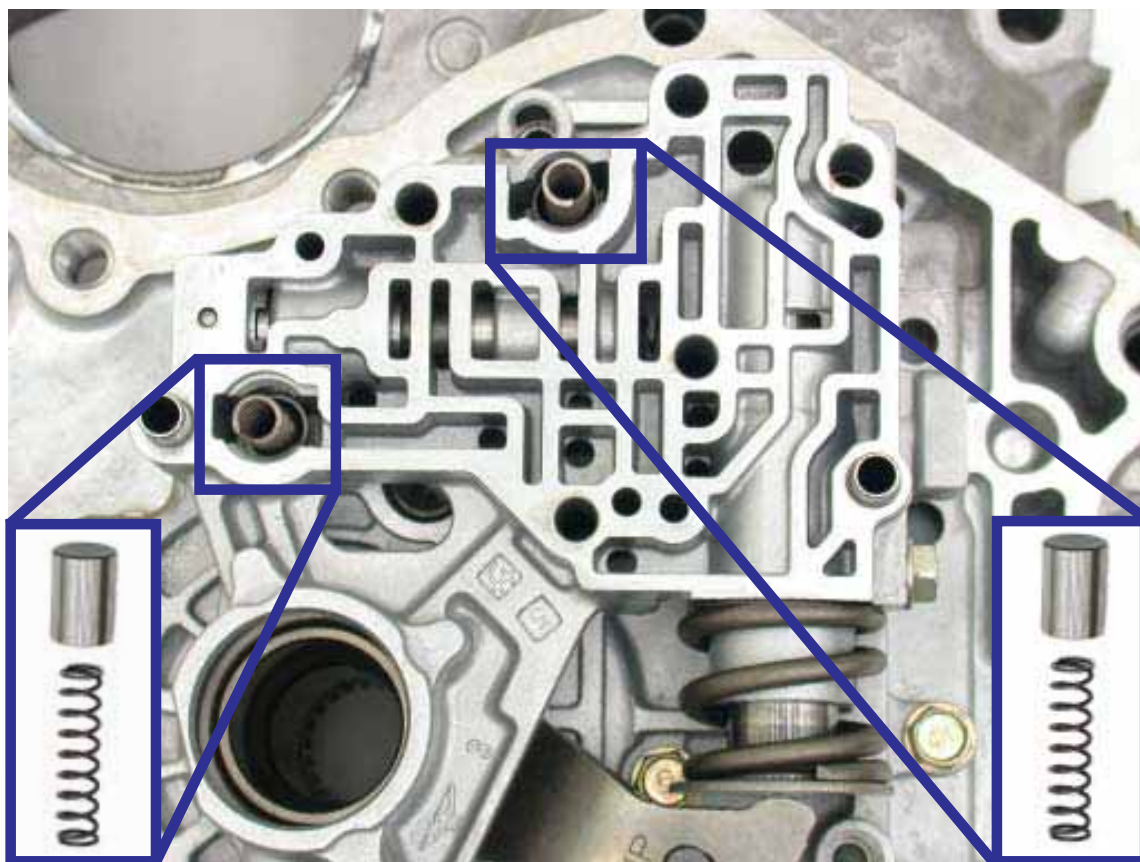
A4RA/B4RA/M4RA

1996-2000 Civic Valve Body Checkball and Relief Valve

Locations

Regulator Body

Incorrect installation of the Cooler Relief Valve and the torque converter relief valve can cause multiple problems. Always install the valve first and then the spring.



M4VA

Civic CVT External Components

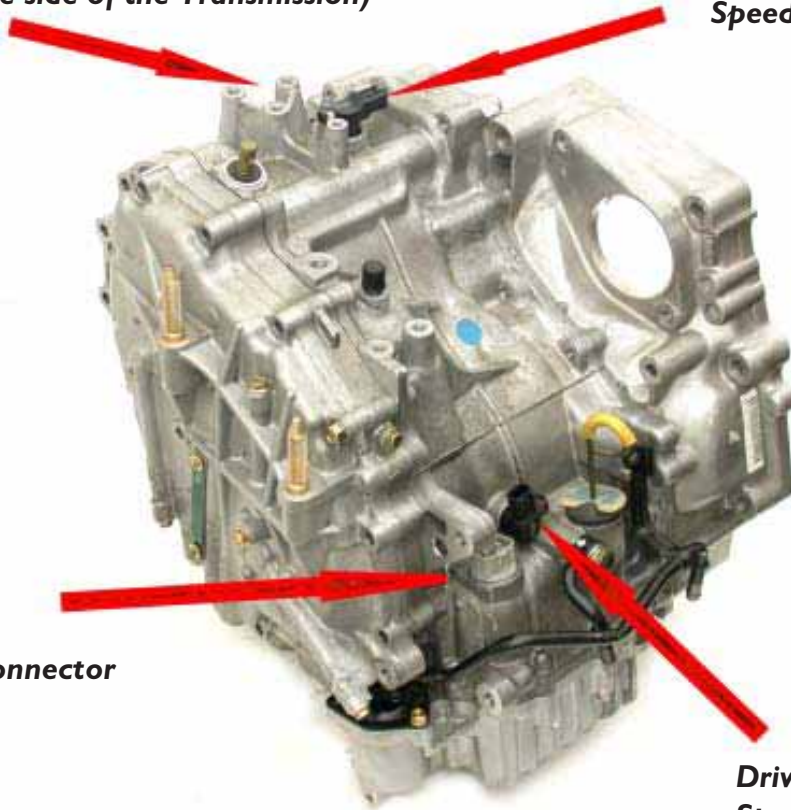
General Identification

Secondary Shaft Speed Sensor
(Located on the side of the Transmission)

Driven Pulley Speed Sensor

Case Connector

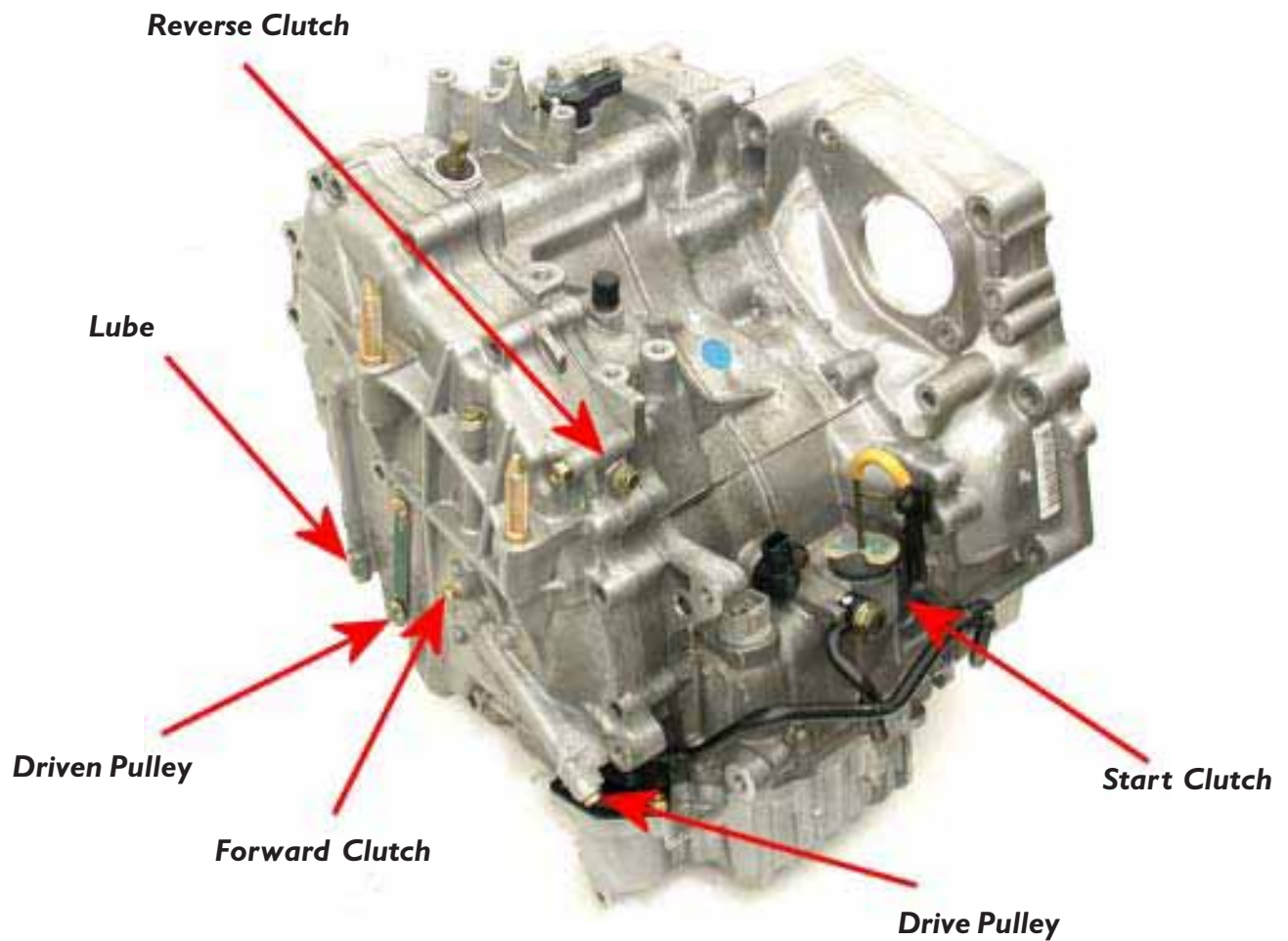
Drive Pulley Speed Sensor



M4VA

Civic CVT Pressure Taps

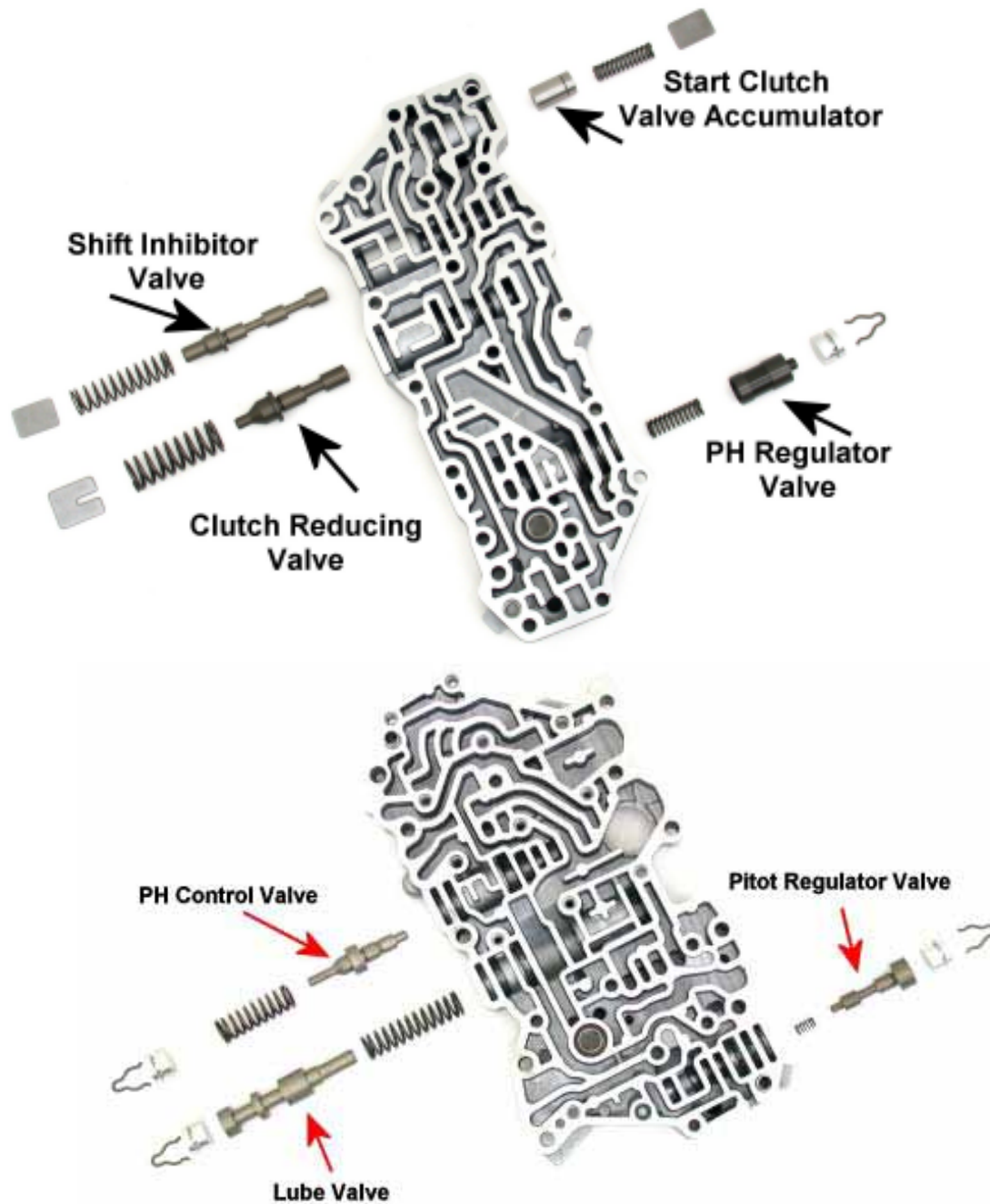
General Identification



M4VA

Valve Body Assembly

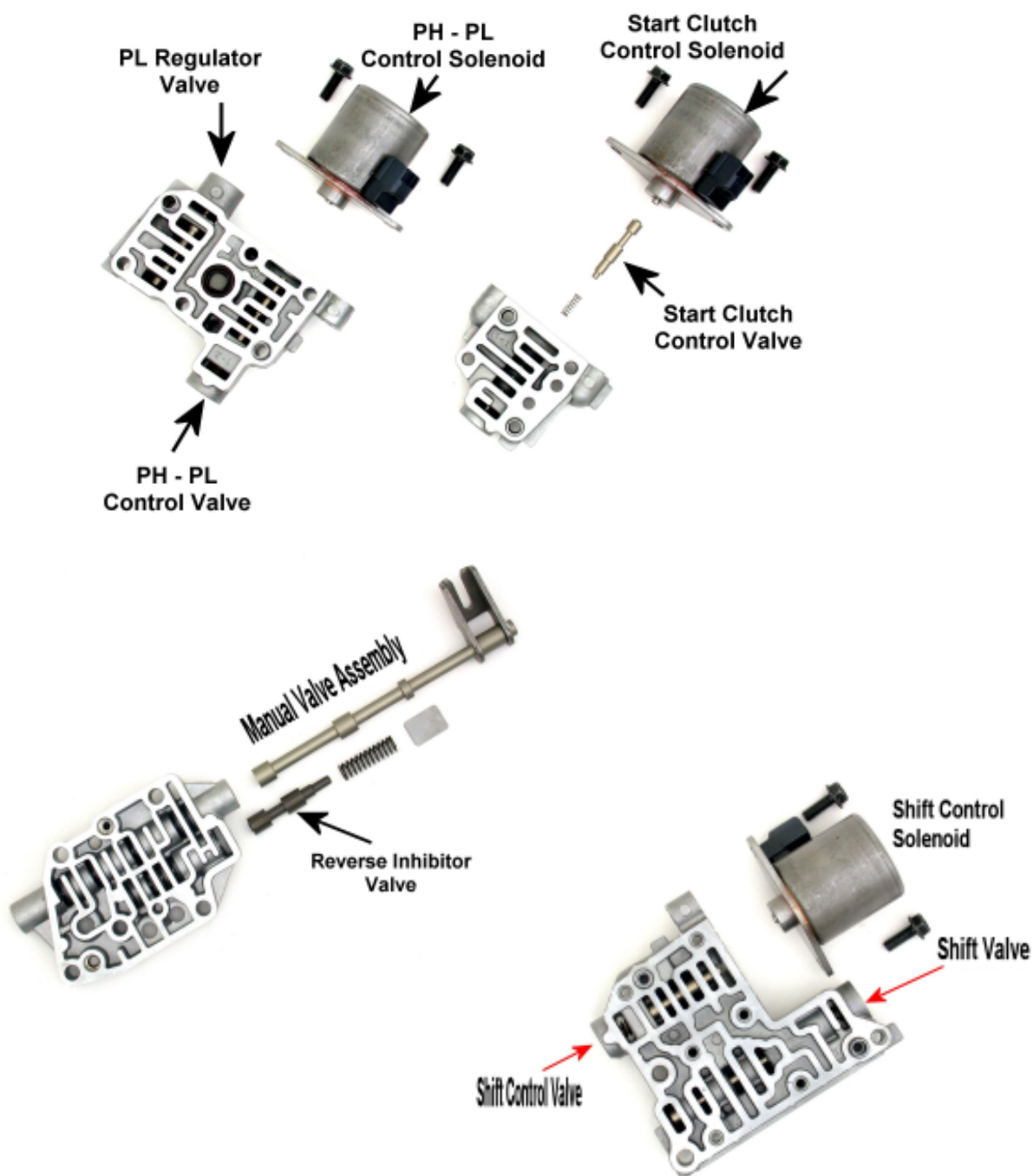
An exploded view of the Valve Body break down not available in any shop manuals at this time.



M4VA

Valve Body Assembly (continued)

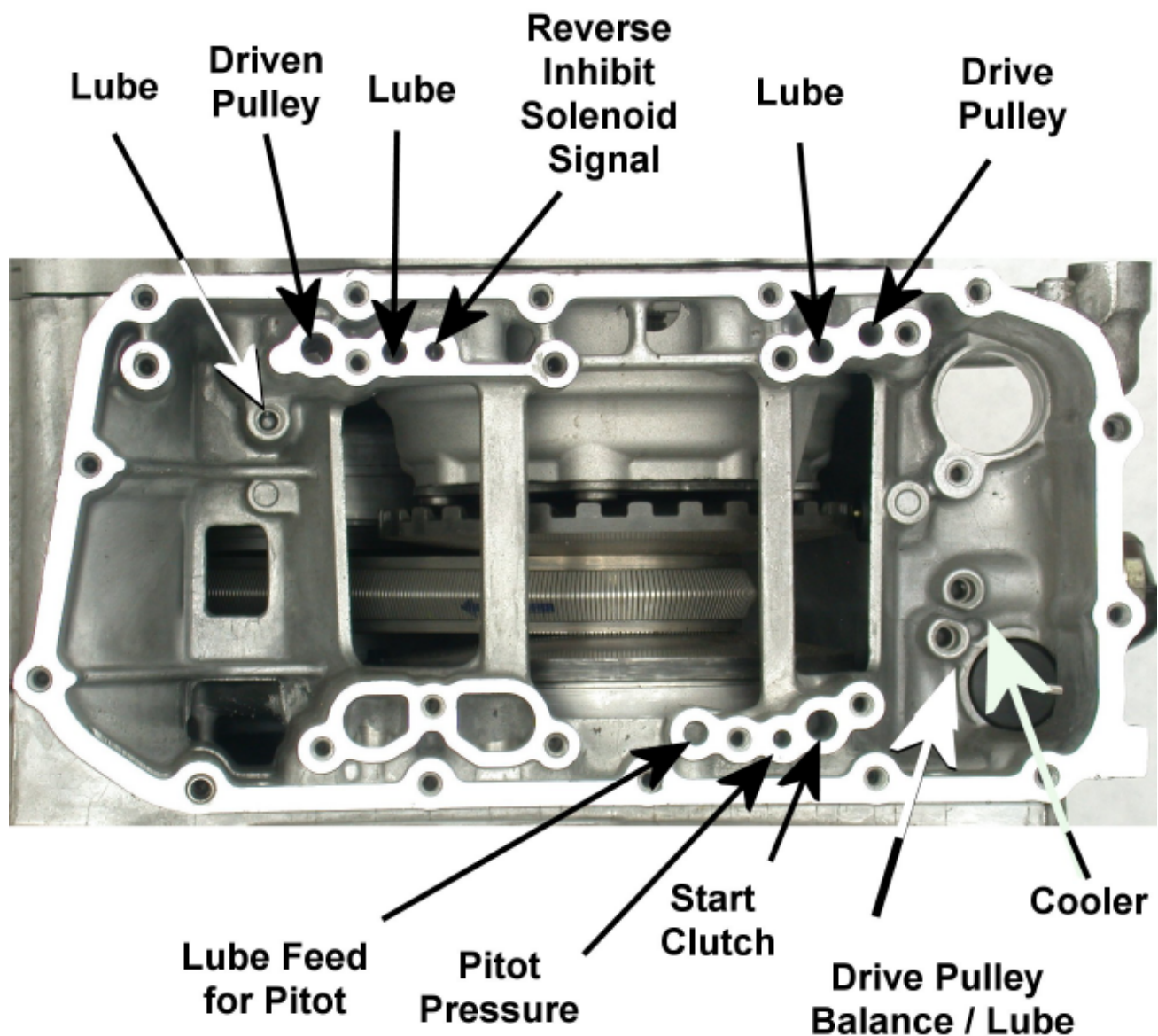
An exploded view of the Valve Body break down not available in any shop manuals at this time.



M4VA

Case Passage Air Test ID

It's always a good idea to air test the unit before disassembly and after rebuild. You can easily check the pulley assembly by pressurizing the driven pulley and turning the pulley with a screw driver. The pulley will squeeze down and close, then perform the same procedure with the Drive pulley.



M4VA

Pulleys and Belt

The belt and pulleys are only available as an assembly and are VERY EXPENSIVE!!

Air test the pulleys before disassembling the unit, check the sheave finish. Make sure there is no polishing, dishing, or scoring. All of these concerns will cause multiple problems.

The finish you're looking for is an even ground finish similar to a brand new roller bearing outer race.



*Inspect the pulley
Sheave for rough
surfaces*

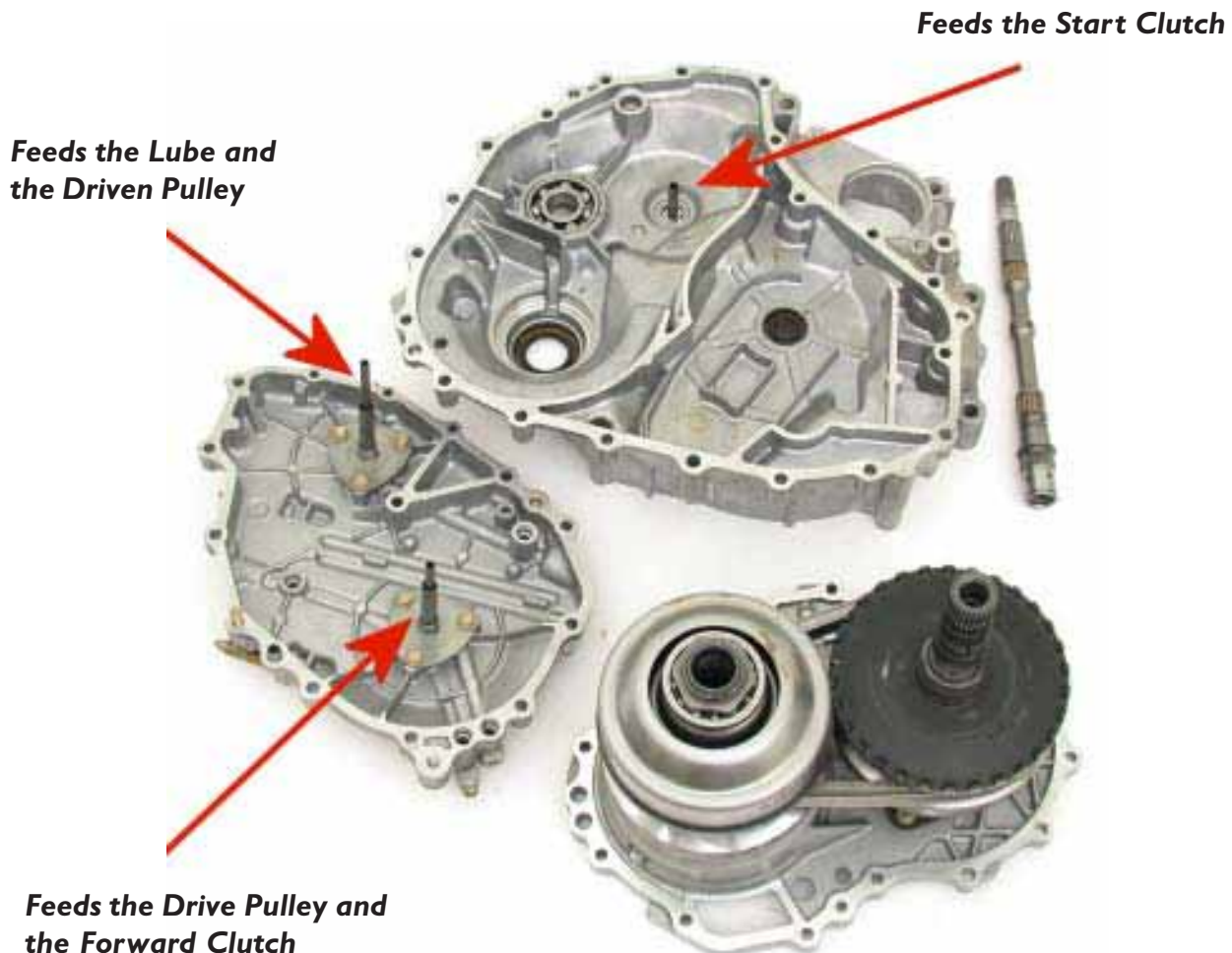


M4VA

General Overhaul Procedures

Shaft Tubes and Shaft Bushings

Inspect the shaft and bushings for wear with “scotch” type tape. Do not overlook basic Honda transxale overhaul procedures. Check all feed pipes and shaft bushings



M4VA

Start Clutch Drum Assembly

The Start Clutch components are only available as a complete assembly from Honda. The Start Clutch components have been upgraded by Honda.

Possible symptoms when the Start Clutch is failed:

- 1. Shudder on take-off**
- 2. Falls out of gear at a stop**
- 3. Falls out of gear during decel**
- 4. Neutral bang engagement**

Clearance Specifications are: **0.020"-0.028"**

NOTE: Always inspect the clutch plates for glazing or worn off nitride finish.



M4VA

Start Clutch Drum Assembly (continued)

After removing the spring and retainer, there is another snapping that must be removed before the piston will come out of drum.



M4VA

Start Clutch Control Problems

General Engagement Concerns:

1. Engine stalling in gear
2. Delayed engagements
3. Harsh engagements
4. No engagement until engine speed is increased

Critical inputs to the TCM/ECM for start clutch control:

1. Brake switch signal
2. Range switch signal
3. MAP sensor signal
4. TPS signal

Fix engine codes and engine performance problems first

Perform start clutch calibration procedure

Check the TCM/ECM for good grounds

M4VA

Start Clutch Control Problems (continued)

Surging in gear at a stop

1. Fix any engine codes or engine performance/drivability problems first.
2. Contaminated/sticking solenoids and valves
3. Bad TCM/PCM grounds
4. Updated TCM for 1996-1998 year models **P/N 28100-P2M-306**

Service kit: P/N 27010-P4V-305

Contains:

1. Pan gasket
2. Harness connector oring
3. Pickup filter oring
4. Start clutch control linear solenoid
5. Shift control linear solenoid
6. Drain bolt washer

Shudder/Chatter on Takeoff

Start clutch shudder caused by:

1. Deteriorated fluid
2. Wrong fluid type
3. Glazed or damaged start clutch

Low Pressure:

1. Forward Clutches
2. Slip/Shudder
3. Check the pump for damage

M4VA

Start Clutch Control Problems (continued)

Surging in gear at a stop, shudder, idle fluctuation
1999 – 2000 Civic HX

Symptoms:

1. Idle fluctuates between 500 and 1500 RPM (more pronounced when cold)
2. Shudder when accelerating from a stop, or when coming to a stop
3. Surging at highway speeds between 2000 and 3000 RPM
4. Excessive shock when the engine is cold, and you start to accelerate
5. A “coo” sound, lasting about 5 to 10 seconds, after coming to a stop

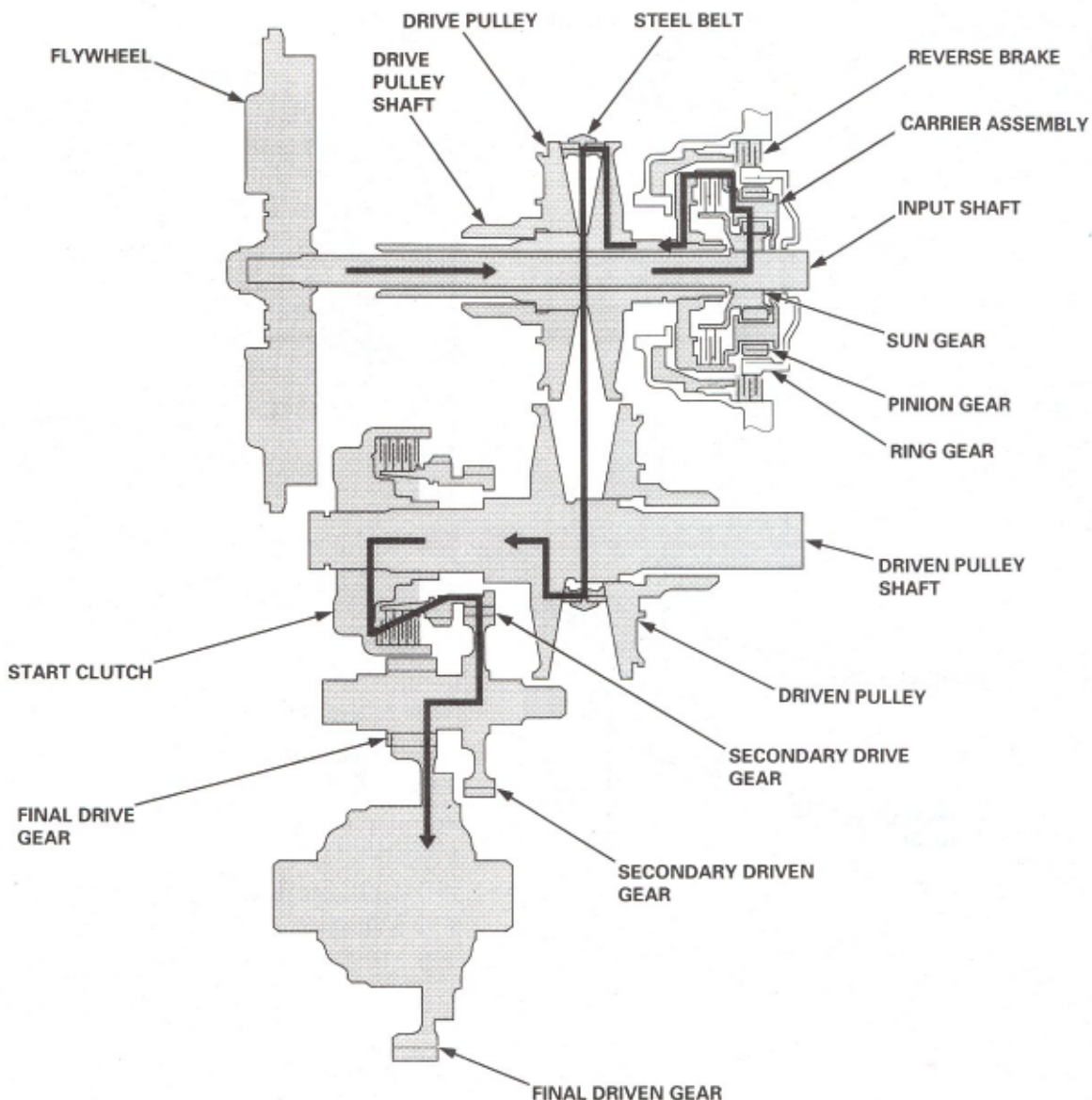
Replace the start clutch assembly, start clutch control valve, and the PCM

Start Clutch Kit (49 State – JF1)	P/N 06220-P2M-309
Start Clutch Kit (California – JL2)	P/N 06220-P2M-405

M4VA

Whining/Gear Noise in Reverse

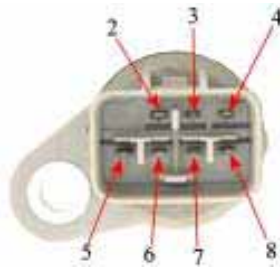
In Reverse everything is rotating simultaneously from the input shaft to the Start Clutch Assembly. When the vehicle is at a stop there is a distinct whine noise associated with the transmission. This is normal and no service should be performed.



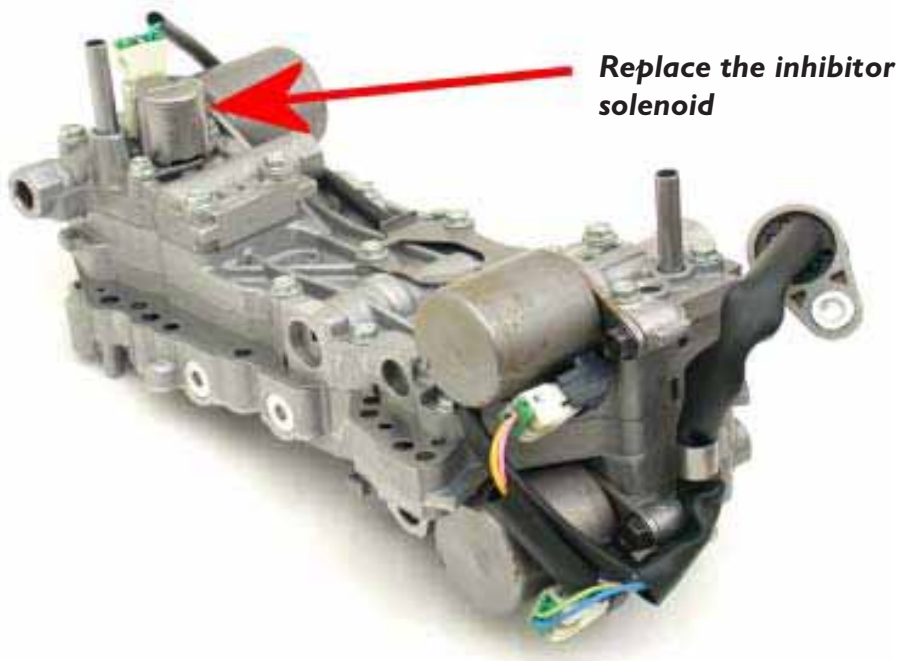
M4VA

No Reverse

Problems may be intermittent and may occur only when cold or hot. Back probe the harness connector and check for voltage to the inhibitor solenoid.



Solenoid:	Measure between:	Resistance spec:
Shift Control Linear Solenoid	Terminals 3 and 7	3.8 to 6.8 ohms
PH-PL Linear Solenoid	Terminals 2 and 6	3.8 to 6.8 ohms
Start Clutch Control Linear Solenoid	Terminals 4 and 8	3.8 to 6.8 ohms
Inhibitor Solenoid	Terminal 5 and valve body	11.7 to 21.0 ohms



M4VA

Start Clutch Relearn Procedure

Procedure for 1996 model only:

Caution: *Do not use this procedure for 1997 and newer vehicles.*

1. Engage the parking brake and block the front wheels securely.
2. Jump the Service Check connector (the Service Check connector is located under the dash on the passenger side of the vehicle).
3. Start the engine and warm it up to normal operating temperature (the radiator fan comes on twice.)
4. Fully depress the brake pedal and accelerator for 20 seconds with the gear selector in D position (full power stall).
5. Shift into N or P. To store the negative pressure in memory, let the engine idle in N or P for one minute under the following conditions:
 - * With the brake pedal depressed
 - * With the A/C switch off
 - * With the combination light switch (headlights/running lights) off
 - * With the heater fan switch off
 - * Turn OFF all other electrical accessories

Note: *Start step 5 within 60 seconds after the radiator fan goes off.*

6. Shift into "D" position and let the engine idle for two minutes to store the feedback signal under the same conditions as in step 5.
7. Connect a scan tool and verify the TCM has completed the start clutch calibration.

Note: *The TCM will not store the feedback signal when the CVT fluid temperature is below 104 degrees F (40 degrees C), even if the engine coolant reaches normal operating temperature.*

- * Repeat these procedures until the start clutch calibration is shown to be completed in scan data.
8. Disconnect the jumper from the Service Check connector.

M4VA

Start Clutch Relearn Procedure (continued)

Procedure for 1997 – 2003 vehicles:

The TCM ('97-'98) and PCM ('99 and newer) memorize the feedback signal when you drive the vehicle as follows:

1. After warming up the engine (the radiator fan comes on)
2. Shift into the "D" position
3. Turn off all electrical accessories
4. Drive the vehicle up to 37 MPH (60 km/h)
5. After your speed reaches 37 MPH (60 km/h), release the accelerator for 5 seconds

M4VA

Road Test Chart

These charts are useful to troubleshoot slipping concerns. New vehicle owners and technicians that are not familiar with CVT type transaxle operation can use this chart to verify normal operating conditions.

“D” Position			
Throttle Position Sensor Voltage	Engine RPM at 25 MPH (40 Km/h)	Engine RPM at 37 MPH (60 Km/h)	Engine RPM at 62 MPH (100 Km/h)
0.75 V	1250-1650 RPM	-----	-----
2.25 V	2500-3100 RPM	2650-3250 RPM	2700-3300 RPM
4.5 V	3950-4550 RPM	4650-5250 RPM	5200-5800 RPM

“S” Position			
Throttle Position Sensor Voltage	Engine RPM at 25 MPH (40 Km/h)	Engine RPM at 37 MPH (60 Km/h)	Engine RPM at 62 MPH (100 Km/h)
0.75 V	1800-2200 RPM	2200-2800 RPM	3550-4150 RPM
2.25 V	2950-3550 RPM	3250-3850 RPM	4050-4650 RPM
4.5 V	4100-4700 RPM	5100-5700 RPM	5900-6500 RPM

“L” Position			
Throttle Position Sensor Voltage	Engine RPM at 25 MPH (40 Km/h)	Engine RPM at 37 MPH (60 Km/h)	Engine RPM at 62 MPH (100 Km/h)
0.75 V	3100-3700 RPM	3650-4250 RPM	4450-5050 RPM
2.25 V	3500-4100 RPM	4050-4650 RPM	4800-5400 RPM
4.5 V	4100-4700 RPM	5100-5700 RPM	5900-6500 RPM

Jatco 5 Speed Section

Applications and Designations

Mazda: JA5A-EL

2002 and newer MPV
2003 and newer Mazda 6 (V6)

Volkswagen: 09A (AG5)

Late 2002 and newer Jetta 1.8T and 2.8
Late 2002 and newer GTI 1.8T and 2.8

Land Rover: Jatco 5 Speed Automatic Transaxle

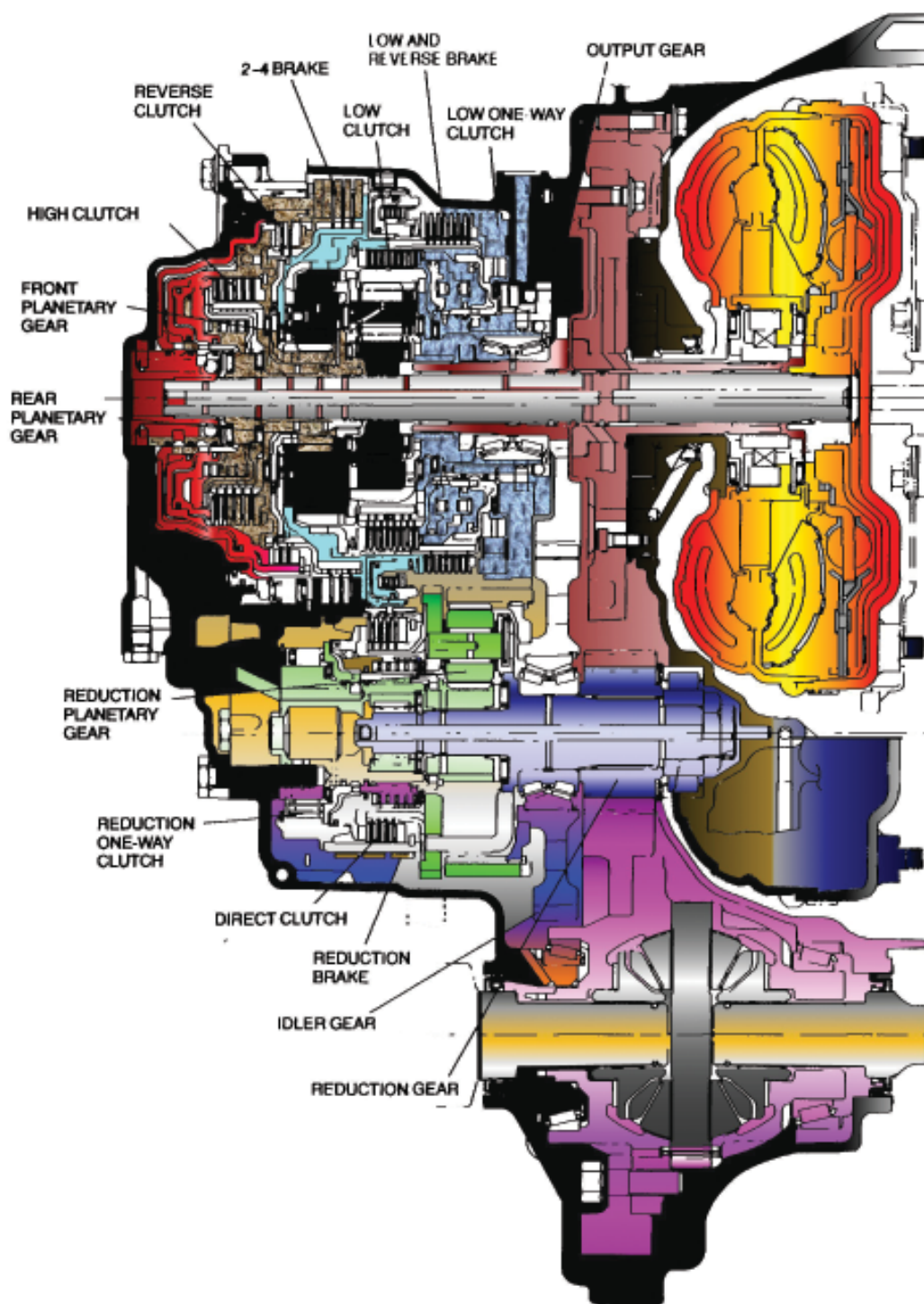
2002 and newer Freelander

Jaguar: JF506E

X Type

Mazda

Component Application Chart



Mazda

Component Application Chart (continued)

Position/Renge	Mode	Mode	Gear position	Engine braking effect	Low clutch	2-4 brake	High clutch	Reverses clutch	Low and reverse brake	Reduction brake	Direct clutch	Low one-way clutch	Reduction one-way clutch	Solenoids		
														Shift solenoid A	Shift solenoid B	Shift solenoid C
P	—		—	—						○				○	○	○
R	—		Reverse	Yes				○	○	○				○	○	○
			Reverse inhibition control	No				○		○				○	○	○
N	—		—	—						○				○	○	○
D	O/D OFF switch OFF	Normal/Slope	1GR	No	○							●	●	○	○	○
			2GR	No	○	○							●	○	○	
			3GR	No	○		○						●		○	
			4GR	No		○	○						●			○
			5GR	Yes		○	○				○			○		○
	O/D OFF switch ON	—	1GR	No	○							●	●	○	○	○
			2GR	No	○	○							●	○	○	
			3GR	No	○		○						●		○	
			4GR	Yes		○	○			○						○
			5GR*	Yes		○	○				○			○		○
3	—	—	2GR	No	○	○							●	○	○	
			3GR	Yes	○		○			○					○	
			4GR*	Yes		○	○			○						○
			5GR*	Yes		○	○				○			○		○
2			2GR	Yes	○	○				○				○	○	
			3GR*	Yes	○		○			○					○	
			4GR*	Yes		○	○			○						○
			5GR*	Yes		○	○				○			○		○

○: Operating

●: Transmits the torque only when driving

*: To prevent engine overspeed, inhibits downshift until the engine speed is reduced to the preset speed

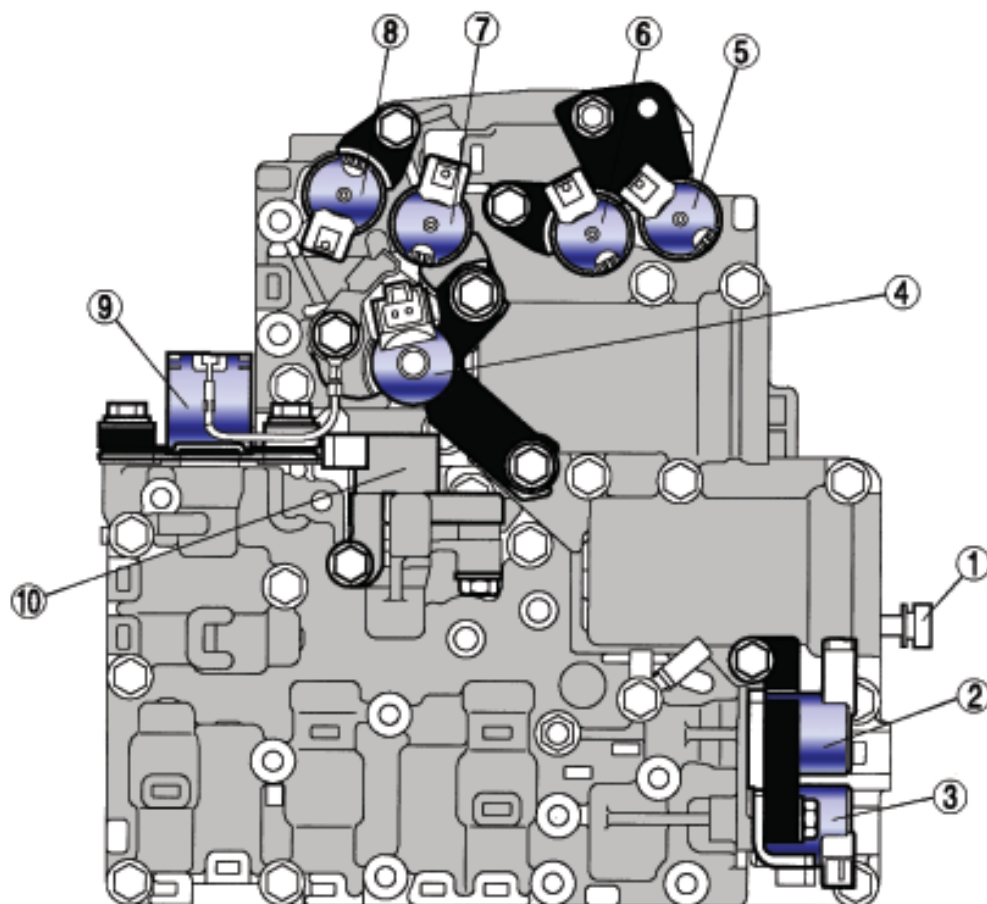
Mazda

DTC Identification

DTC	MIL	OD Light	Cause
P0705	On	Yes	Transaxle Range Switch Circuit Shorted
P0706	On	Yes	Transaxle Range Switch Circuit Open
P0711	On	No	Transaxle Fluid Temperature Sensor Malfunction (Stuck)
P0712	On	Yes	Transaxle Fluid Temperature Sensor Shorted
P0713	On	Yes	Transaxle Fluid Temperature Sensor Open
P0715	On	Yes	Input / Turbine Speed Sensor Circuit Fault
P0720	On	Yes	Vehicle Speed Sensor Circuit Fault
P0740	On	No	Torque Converter Clutch System Fault
P0743	On	Yes	Torque Converter Clutch Solenoid Circuit Fault
P0748	Off	Yes	Pressure Control Solenoid Circuit Fault
P0751	On	No	SSA Fault (Stuck Off)
P0752	On	No	SSA Fault (Stuck On)
P0753	On	Yes	SSA Circuit Fault (Open/Short)
P0756	On	No	SSB Fault (Stuck Off)
P0757	On	No	SSB Fault (Stuck On)
P0758	On	Yes	SSB Circuit Fault (Open/Short)
P0761	On	No	SSC Fault (Stuck Off)
P0762	On	No	SSC Fault (Stuck On)
P0763	On	Yes	SSC Circuit Fault (Open/Short)
P0768	Off	Yes	Reduction Timing Solenoid Circuit Fault (Open/Short)
P0773	On	Yes	Neutral Shift Solenoid Circuit Fault (Open/Short)
P0778	Off	Yes	2-4 Brake Solenoid Circuit Fault (Open/Short)
P0791	On	Yes	Intermediate Speed Sensor Circuit Fault (Open/Short)
P0798	Off	Yes	High Clutch Solenoid Valve Circuit Fault (Open/Short)
P1710	Off	No	Ground Return Circuit Fault
U0073	On	Yes	CAN Bus Off
U0100	On	Yes	TCM Cannot Receive Any Signals From PCM

Mazda

Solenoid Identification



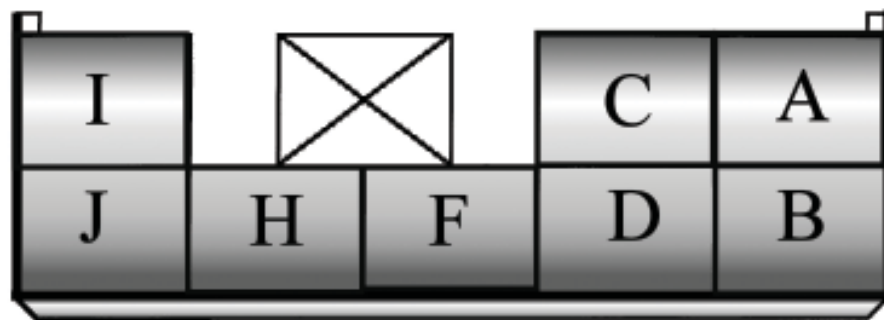
1	Manual Valve
2	2-4 Brake Solenoid Valve
3	Neutral Shift Solenoid Valve
4	TCC Solenoid Valve
5	Shift Solenoid C

6	Shift Solenoid B
7	Reduction Timing Solenoid Valve
8	Shift Solenoid A
9	Pressure Control Solenoid
10	High Clutch Solenoid Valve

Mazda

Solenoids, Sensors, and Case Connectors

Coupler Connector (8-PIN)



Part Side Connector (View From The Harness Side)

Solenoid	Measure between:	Resistance
SSA	K and A	14–18 ohms
Reduction Timing Solenoid	I and A	14–18 ohms
SSB	J and A	14–18 ohms
SSC	H and A	14–18 ohms
Pressure Control Solenoid	L and A	2.6–3.2 ohms
TCC Solenoid	C and A	12.0-13.2 ohms
High Clutch solenoid	F and A	2.6–3.2 ohms
2-4 Brake Solenoid	D and A	2.6–3.2 ohms
Neutral Shift Solenoid	F and A	14–18 ohms

Mazda

Solenoids, Sensors, and Case Connectors (continued)

Coupler Connector (10 PIN)



Part Side Connector (View From The Harness Side)

Sensor	Resistance	Measure Between:
Input Speed	513 – 627 ohms	A and B
Intermediate	513 – 627 ohms	C and D
Vehicle Speed	513 – 627 ohms	F and H

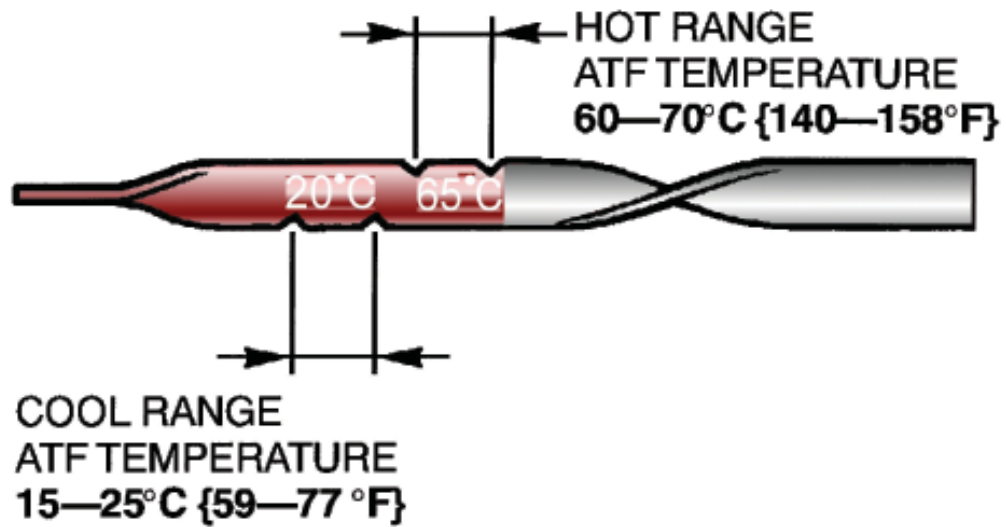
ATF Temperature Sensor:

Measure between pins I and J for specifications

Temperature °C (°F)	Resistance, K ohms
-40 (-40)	54.9
-20 (-4)	16.7
0 (32)	6.02
20 (68)	2.5
40 (104)	1.16
60 (140)	0.59
80 (176)	0.33
100 (212)	0.19
120 (248)	0.12
140 (284)	0.08

Mazda

Fluid Fill and Check



Fluid Type

Mazda: M-III or Dexron III

Mazda

Specifications

Total end play:	0.010" – 0.020" (End Cover section)
Output gear bearing preload:	5.6 – 11.5 inch pounds
Reduction gear bearing preload:	5.3 – 15.5 inch pounds
Differential bearing preload:	6.9 – 16.5 inch pounds

Torque Specifications:

End cover bolts:	14 – 16 foot pounds
Case half bolts:	20 – 22 foot pounds
Valve body bolts:	5.1 – 6.5 foot pounds
Pump to case bolts:	14 – 16 foot pounds
Pan bolts:	5.1 – 6.5 foot pounds

Mazda Clutch Specifications:

Reverse Clutch: 2 drive and 2 driven plates
Clearance: 0.020" – 0.031"
Friction plate minimum thickness: 0.067"

High Clutch: 5 drive and 5 driven plates
Clearance: 0.031" – 0.043"
Friction plate minimum thickness: 0.067"

Low Clutch: 7 drive and 7 driven plates
Clearance: 0.044" – 0.051"
Friction plate minimum thickness: 0.067"

Direct Clutch: 4 drive and 4 driven plates
Clearance: 0.071" – 0.087"
Friction plate minimum thickness: 0.067"

Low and Reverse Brake: 6 drive and 5 driven plates
Clearance: 0.031" – 0.043"
Friction plate minimum thickness: 0.067"

2-4 Brake: 3 drive and 4 driven plates
Clearance: 0.024" – 0.035"
Friction plate minimum thickness: 0.067"

Volkswagen

DTC Identification VAG DTC's

VAG DTC	Cause
00258	Solenoid 1 (N88) circuit fault (open/short)
00260	Solenoid 2 (N89) circuit fault (open/short)
00262	Solenoid 3 (N90) circuit fault (open/short)
00264	Solenoid 4 (N91) circuit fault (open/short)
00266	Solenoid 5 (N92) circuit fault (open/short)
00268	Solenoid 6 (N93) circuit fault (open/short)
00281	Vehicle Speed Sensor (G68) circuit fault
00293	Multi-function switch (F125) signal fault
00296	Kickdown switch signal fault
00300	Transmission fluid temperature sensor (G93) open/short to +
00347	Solenoid 8 (N281) circuit fault (open/short)
00348	Solenoid 9 (N282) circuit fault (open/short)
00349	Solenoid 10 (N283) circuit fault (open/short)
00350	Ground return wire fault (open/short)
00351	Intermediate speed sensor (G265) circuit fault (open/short)
00526	Brake light switch (F) signal fault
00529	Missing speed signal from TCM to ECM (check sensor inputs)
00532	Supply voltage low (power/ground, battery/charging system)
00652	Gear monitoring implausible signal or mechanical malfunction (gear ratio error)
00777	Throttle position sensor (G79) no signal.
001045	Tiptronic switch (F189) circuit fault (open/short)
001166	Engine torque signal fault (engine performance problem or module coding problem)
001192	Torque converter clutch malfunction (TCC slip)
001236	Selector lever lock solenoid (N110) circuit fault (open/short)
001312	Drive train data bus fault or no communication
001314	ECM no communication or incorrect equipment
001316	ABS module no communication
0018108	Brake pressure switch (F270) signal fault (open/short)
0017101	Transmission RPM sensor (G182) no signal. (can be caused by multi-function switch fault, wrong gear, or slipping/no engagement condition)
0065535	TCM (J217) internal failure

Volkswagen

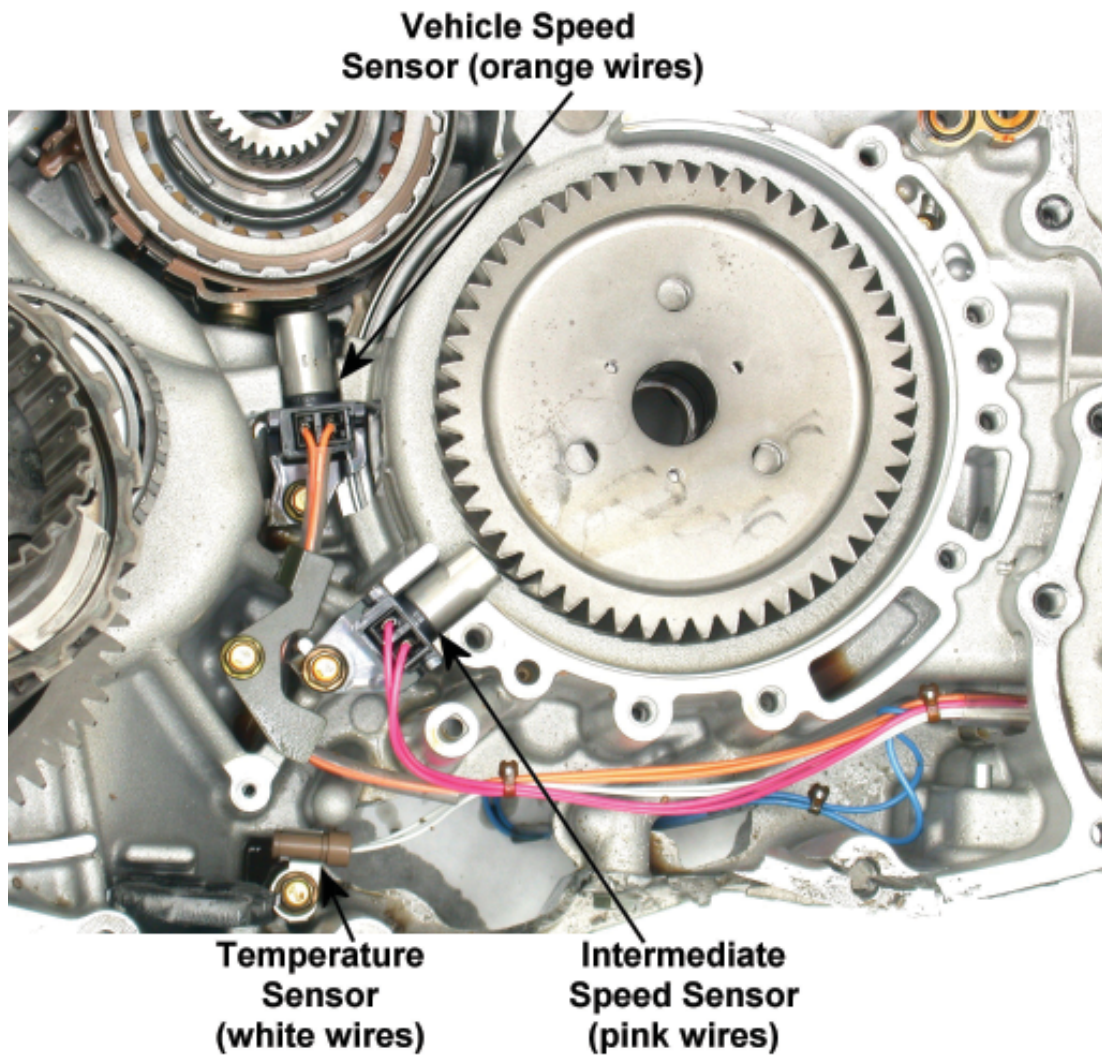
DTC Identification OBD-II SAE DTC's

DTC	Cause
P0614	ECM/TCM incompatible
P0700	TCM MIL request
P0705	Transmission range sensor circuit fault (multi-function switch)
P0710	Transmission fluid temperature sensor fault
P0715	Input/turbine speed sensor (G182) circuit fault
P0717	Input/turbine speed sensor (G182) circuit no signal
P0722	Output speed sensor (G68) no signal
P0725	Engine speed input circuit fault (signal from ECM)
P0730	Incorrect gear ratio
P0731	Gear ratio 1 incorrect
P0732	Gear ratio 2 incorrect
P0733	Gear ratio 3 incorrect
P0734	Gear ratio 4 incorrect
P0735	Gear ratio 5 incorrect
P0740	Torque converter clutch malfunction (TCC slip)
P0743	Torque converter clutch solenoid (N91) circuit failure (open/short)
P0746	Pressure control solenoid A (N93) stuck off
P0748	Solenoid 6 (N93) circuit fault (open/short)
P0753	Solenoid 1 (N88) circuit fault (open/short)
P0758	Solenoid 2 (N89) circuit fault (open/short)
P0763	Solenoid 3 (N90) circuit fault (open/short)
P0768	Solenoid 4 (N91) circuit fault (open/short)
P0773	Solenoid 5 (N92) circuit fault (open/short)
P0778	Solenoid 10 (N283) circuit fault (open/short)
P0785	Shift/Timing solenoid
P0791	Intermediate speed sensor (G265) circuit fault
P0811	Excessive clutch slippage
P0863	TCM communication circuit (CAN bus fault)
P0864	TCM communication circuit range/performance
P0865	TCM communication circuit low
P1626	Missing message from TCM (CAN bus fault)
P1780	Torque retraction malfunction (mechanical fault in transaxle)
P1823	Solenoid 8 (N281) circuit fault (open/short)
P1828	Solenoid 9 (N282) circuit fault (open/short)
P1850	Missing message from ECM (CAN bus fault)

Volkswagen

Electrical Component ID

Some publications show the sensors as being external, they are not. These sensors are located internally. The sensors are identical and can be interchanged.



Volkswagen

Electrical Component ID (continued)

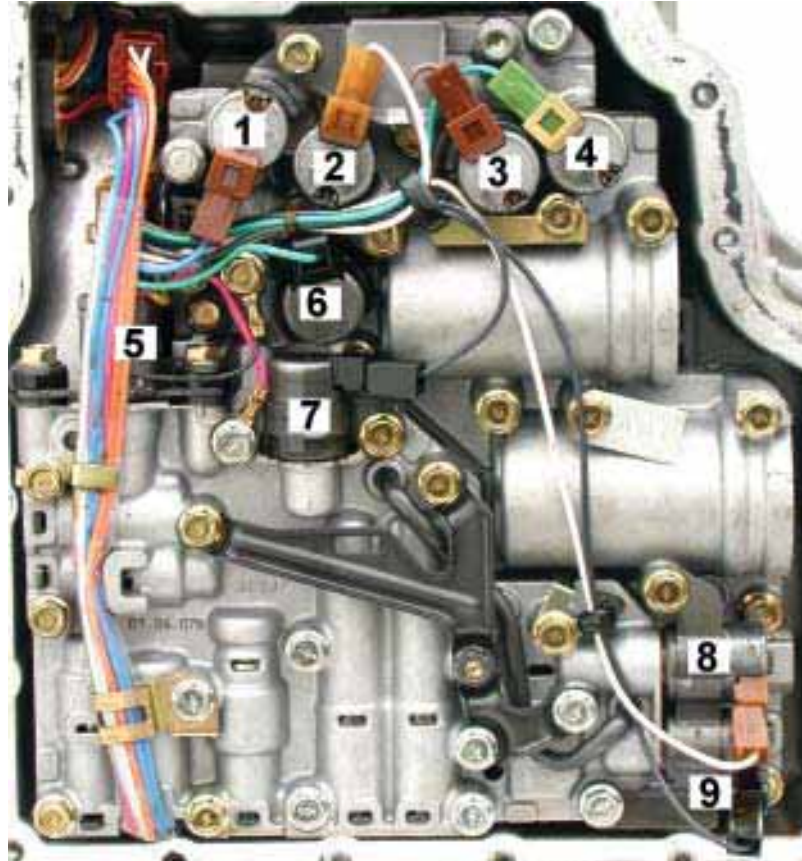
The Input speed sensor can be removed in the vehicle. Remove the End cover and locate the speed sensor for diagnosing.



**Input Speed Sensor
(blue wires)**

Volkswagen

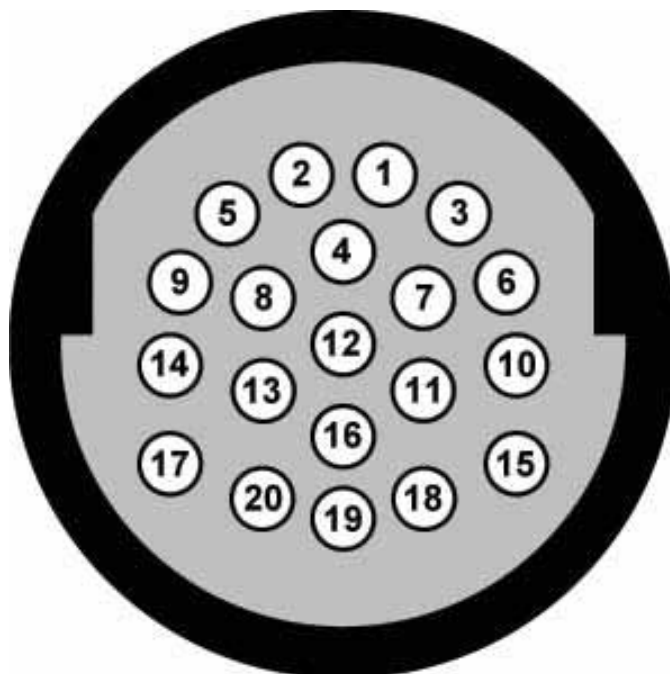
Electrical Component ID (continued)



Solenoid Identification	
1	N88 (Solenoid Valve 1)
2	N281 (Solenoid Valve 8)
3	N89 (Solenoid Valve 2)
4	N92 (Solenoid Valve 5)
5	N93 (Solenoid Valve 6)
6	N91 (Solenoid Valve 4)
7	N90 (Solenoid Valve 3)
8	N283 (Solenoid Valve 10)
9	N282 (Solenoid Valve 9)

Volkswagen

Solenoids, Sensors, and Case Connector



Solenoid / Sensor	Resistance	Measure Between:
Input Speed Sensor	400 – 600 ohms	1 and 2
Intermediate Speed	400 – 600 ohms	3 and 4
Vehicle Speed Sensor	400 – 600 ohms	5 and 6
N93	1.0 – 5.0 ohms	15 and 18
N92	9.0 – 24.0 ohms	11 and 18
N91	9.0 – 24.0 ohms	17 and 18
N282	9.0 – 24.0 ohms	13 and 18
N90	9.0 – 24.0 ohms	12 and 18
N281	9.0 – 24.0 ohms	14 and 18
N88	9.0 – 24.0 ohms	9 and 18
N89	9.0 – 24.0 ohms	10 and 18
N283	1.0 – 5.0 ohms	16 and 18
ATF Temp Sensor	(20°C) 68°F = 2.5k ohms (80°C) 176°F=300 ohms	7 and 8

Volkswagen/Land Rover

Fluid Check/Fill

Fluid check procedure:

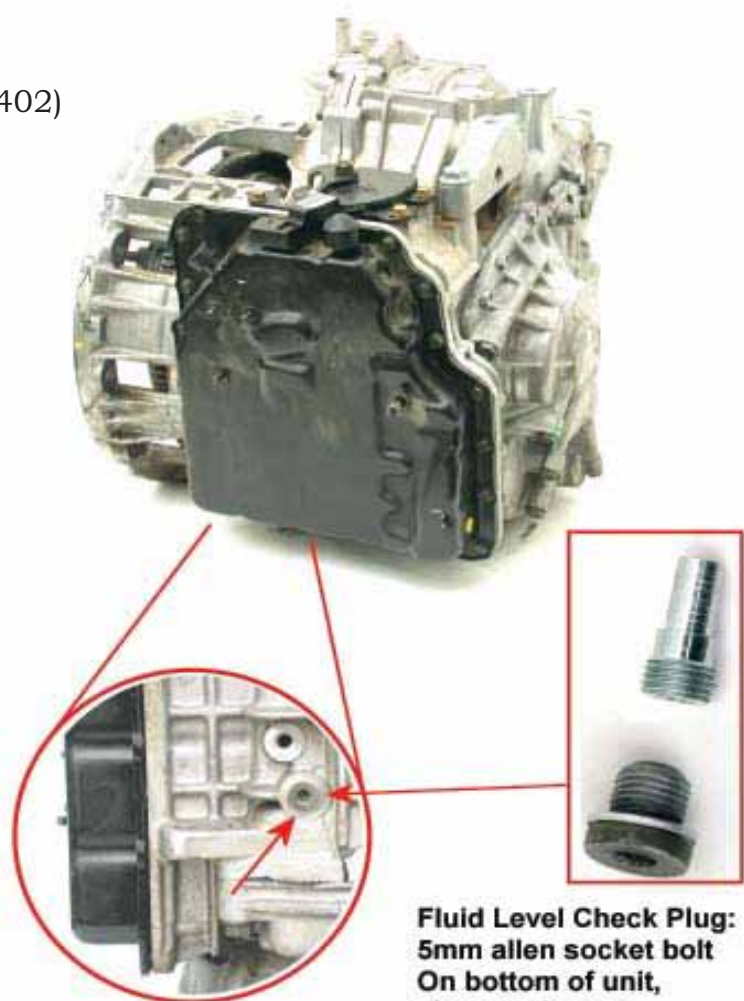
1. Start the engine.
2. Run until transmission fluid temperature is between 95° and 113° F.
3. Move the transmission selector through all ranges, then return to the Park position.
4. Remove the check plug (5mm allen, on bottom of unit).
5. Fluid should just dribble out of check plug hole.
6. If the fluid does not dribble out of check plug hole, carefully add fluid to transmission until it begins to run out.
7. Replace the check plug.

Fluid Type

Volkswagen: G 052 990 A2

Land Rover: LRN402 (Texaco N402)

Jaguar: WSS-M2C92-A1

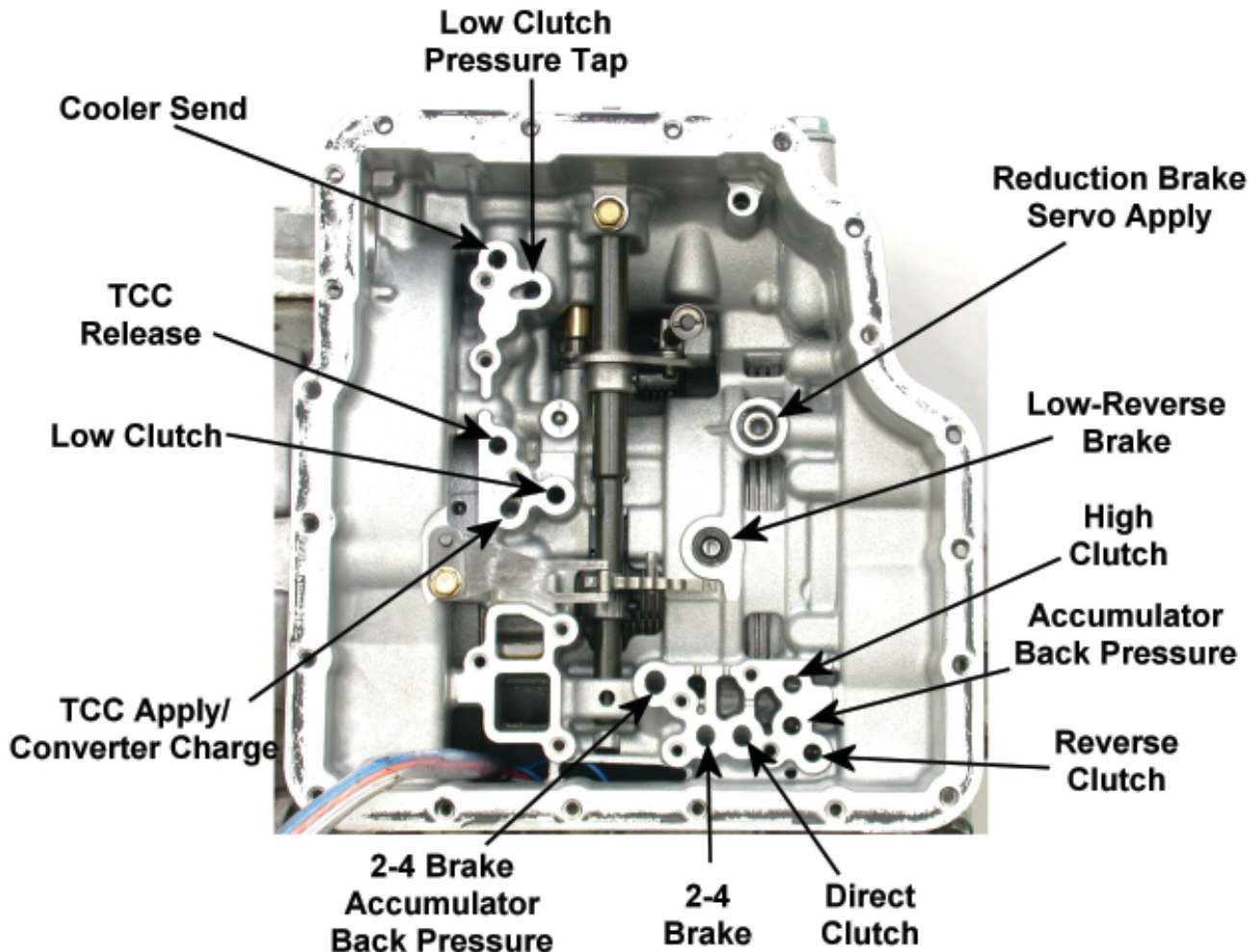


Fluid Level Check Plug:
5mm allen socket bolt
On bottom of unit,
close to the pan

Volkswagen

Case Passage Air Test Identification

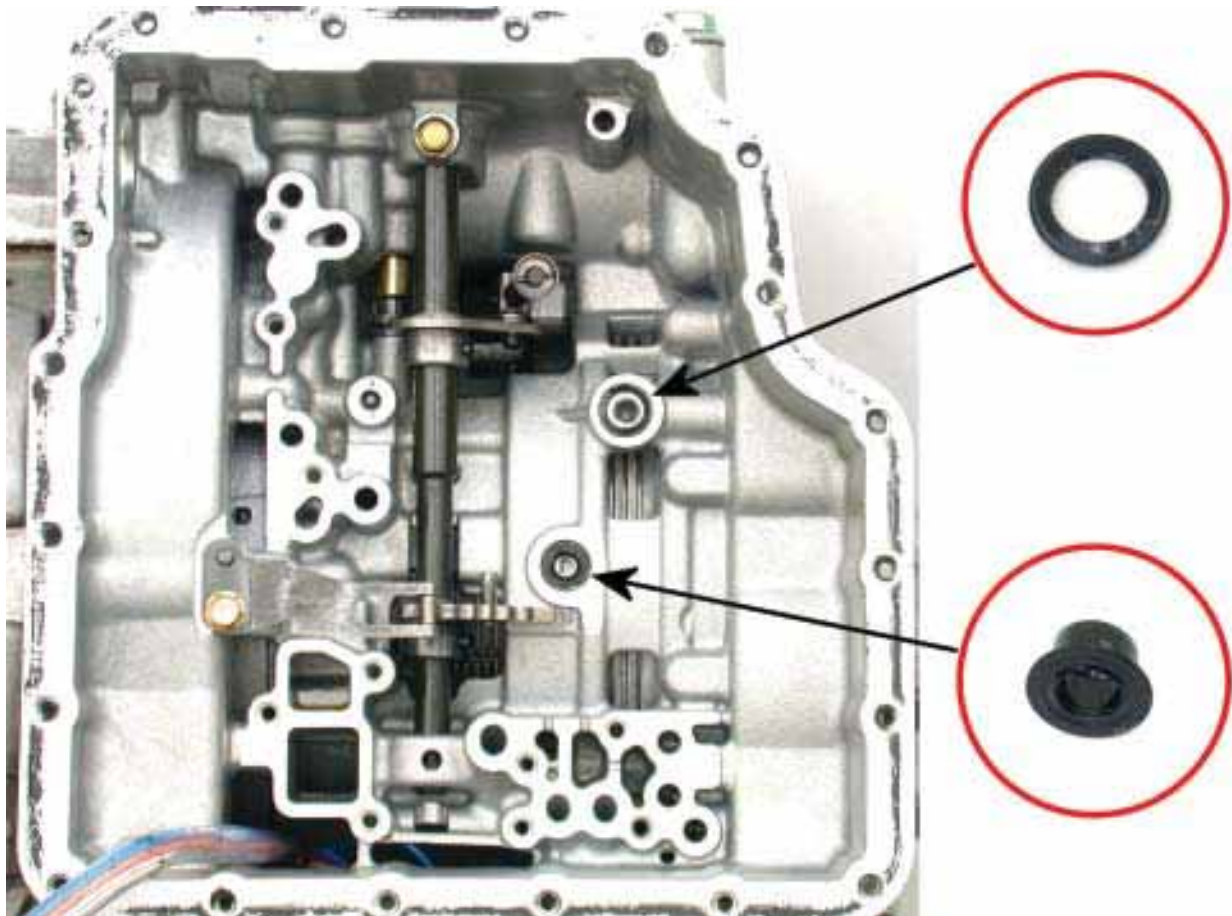
Always air check the clutches before disassembly and after reassembly before the Valve Body is installed



Volkswagen

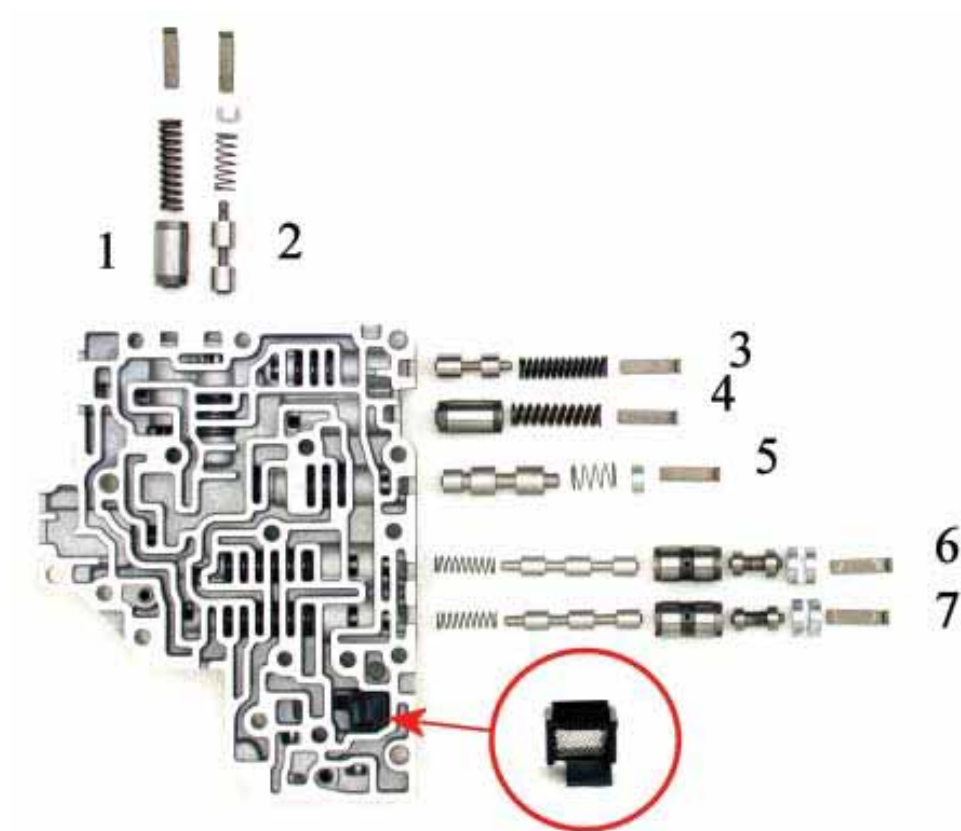
Valve Body to Case Seals

These seals are located behind the Valve Body. The Valve Body needs to be removed before the L/R piston assembly can be removed. If you attempt to remove the L/R piston without removing the Valve Body you will destroy the seal.



Volkswagen

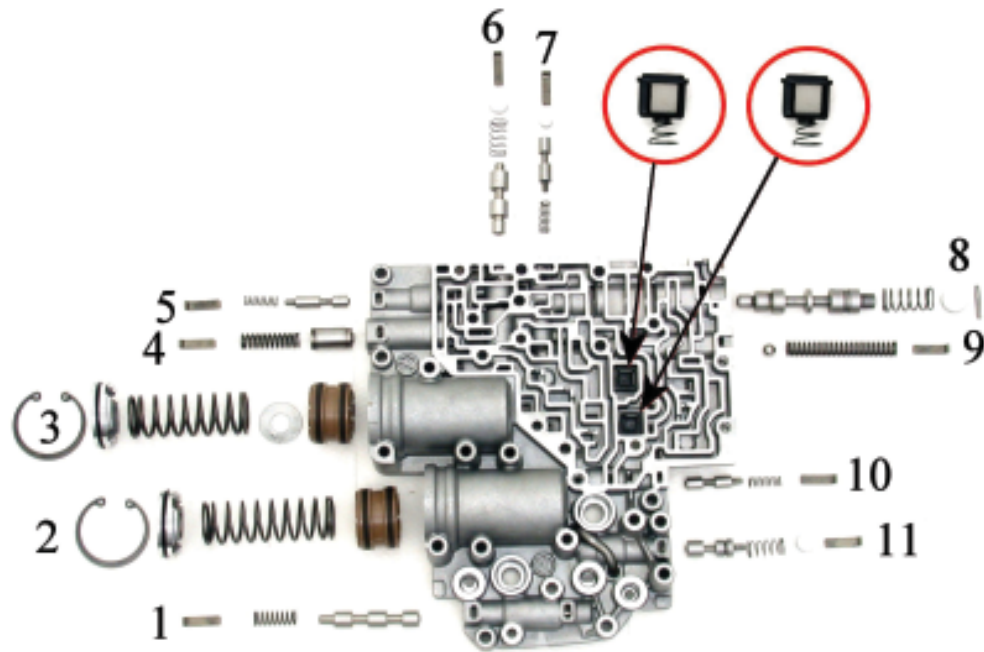
Valve Body Assembly



ID	Description
1	Modifier Accumulator
2	Pressure Modifier Valve
3	Torque Converter Regulator Valve
4	Throttle Accumulator Valve A
5	Accumulator Control Valve A
6	Unknown
7	Unknown

Volkswagen

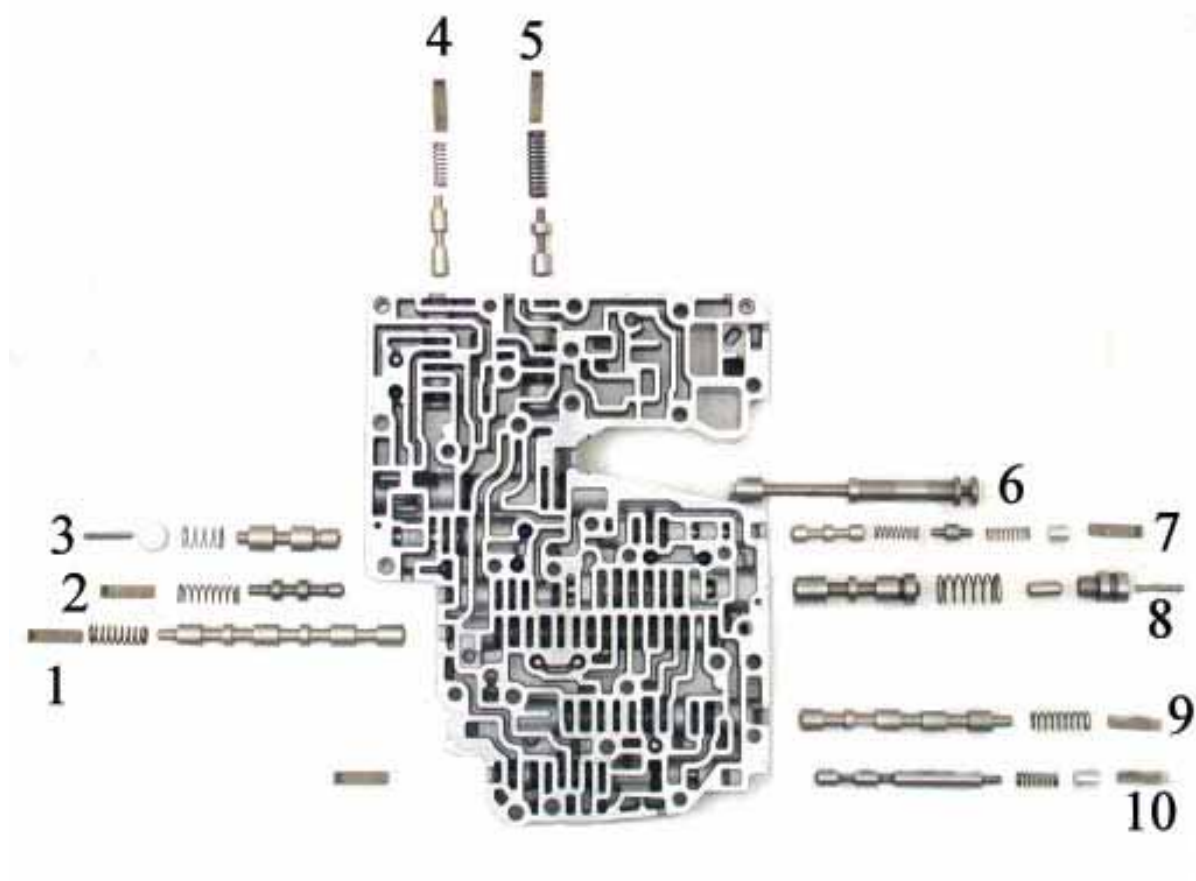
Valve Body Assembly (continued)



ID	Description
1	Shift Valve C
2	Low Clutch Accumulator
3	High Clutch Accumulator
4	Throttle Accumulator
5	Unknown
6	Accumulator Control Valve B
7	Unknown
8	Pressure Regulator Valve
9	Line Pressure Relief Valve
10	Reduction Timing Valve
11	Reduction Reducing Valve

Volkswagen

Valve Body Assembly (continued)

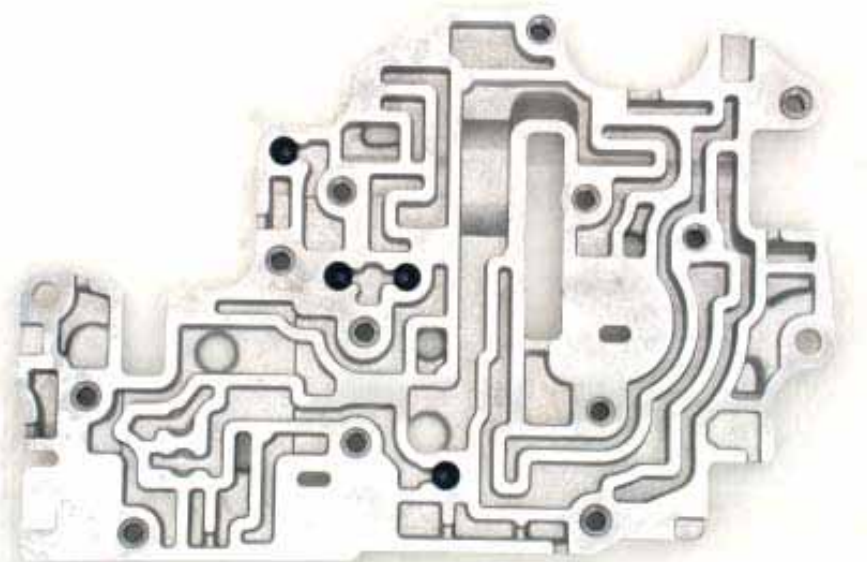
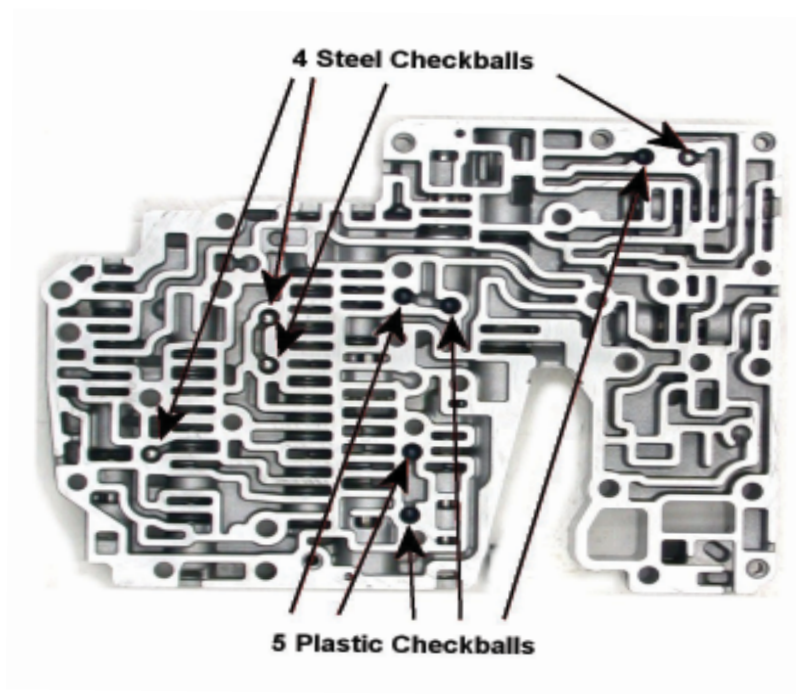


ID	Description
1	Shift Valve A
2	Reverse Inhibit Valve
3	Neutral Control Valve
4	Accumulator Switch Valve
5	Pilot Valve
6	Manual Valve
7	Neutral Shift Valve
8	TCC Control Valve
9	Shift Valve
10	Failsafe Valve

Volkswagen

Valve Body Assembly (continued)

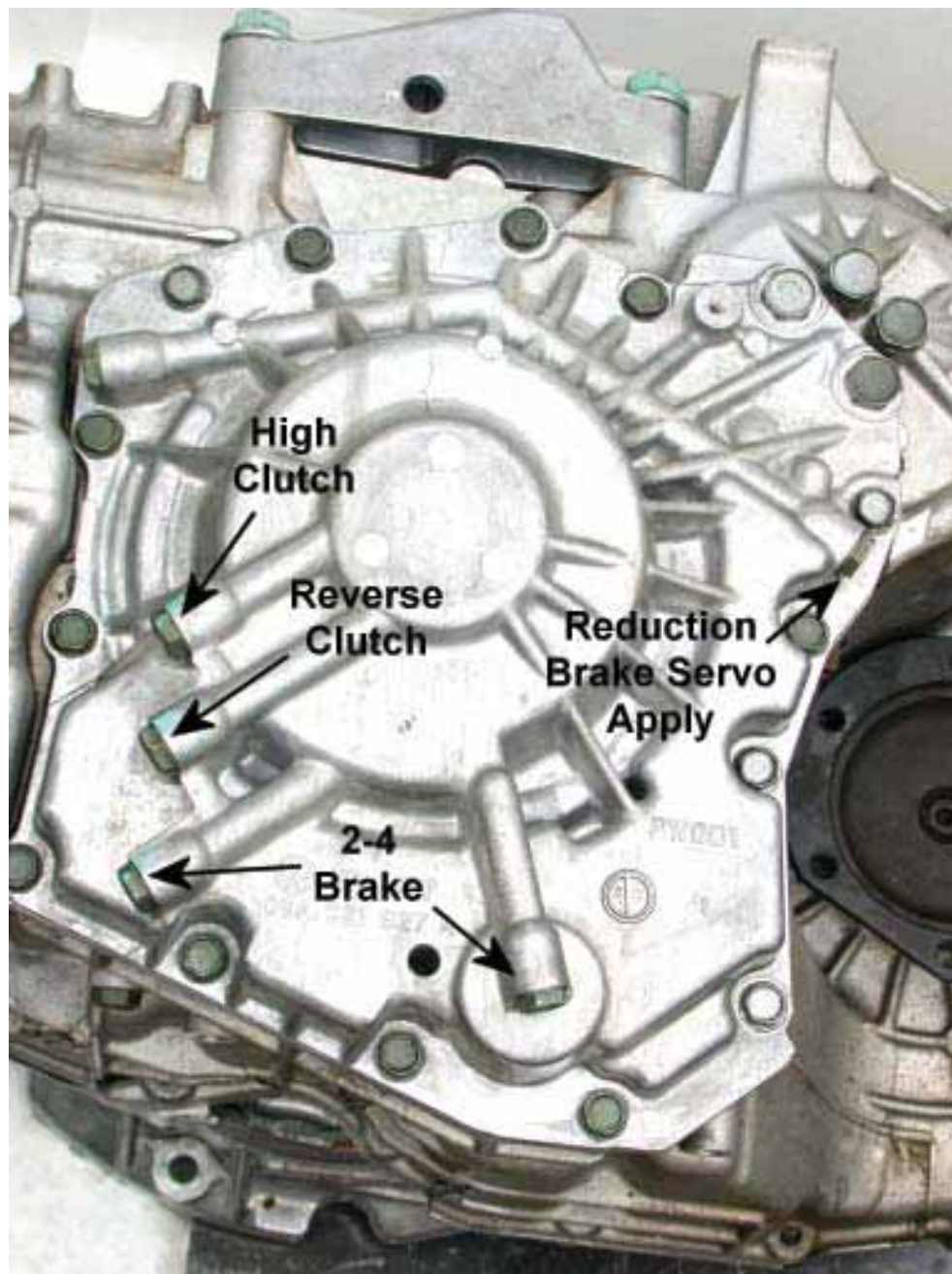
All check balls are .218" (5.5mm)



Volkswagen

Pressure Taps

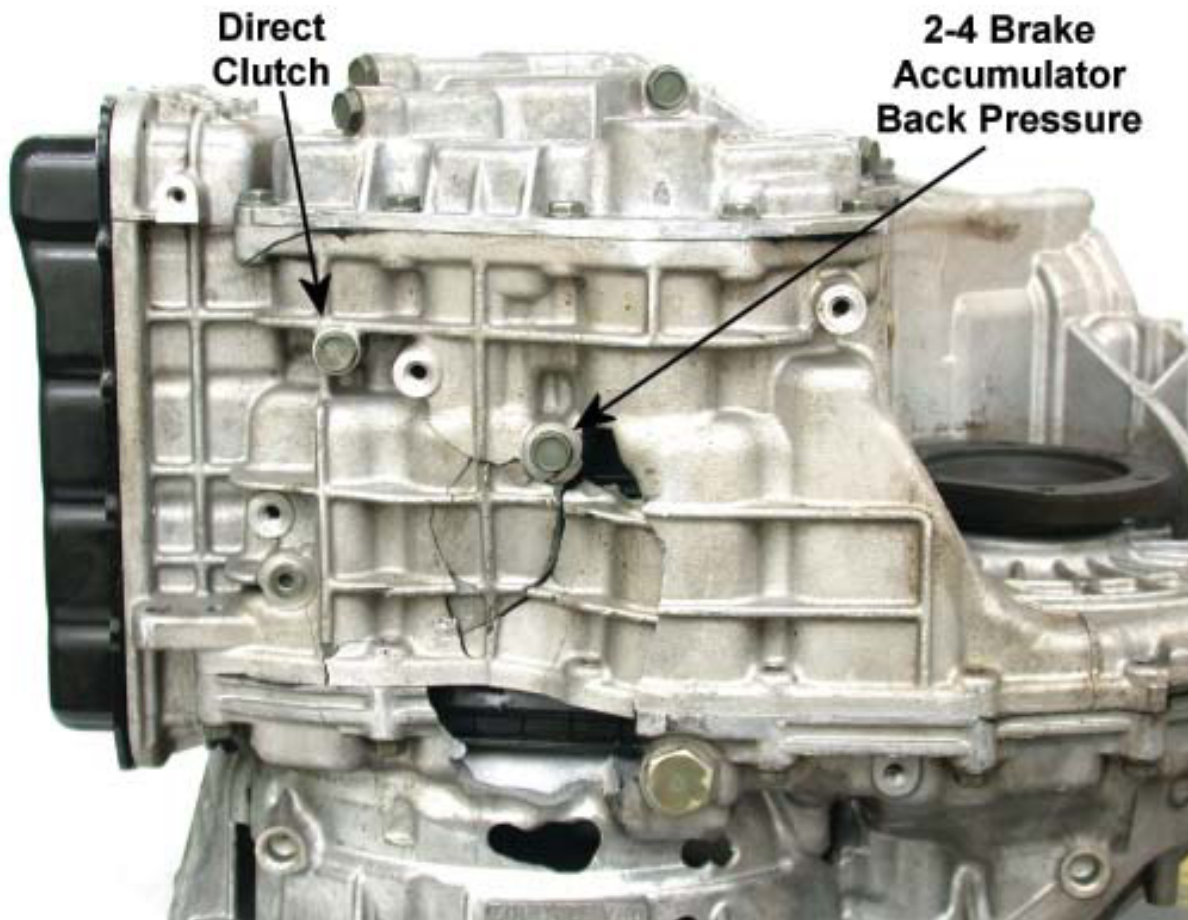
The End Cover pressure taps are M10x1.0 straight thread



Volkswagen

Pressure Taps (continued)

Pressure taps located at the bottom of the transmission case.

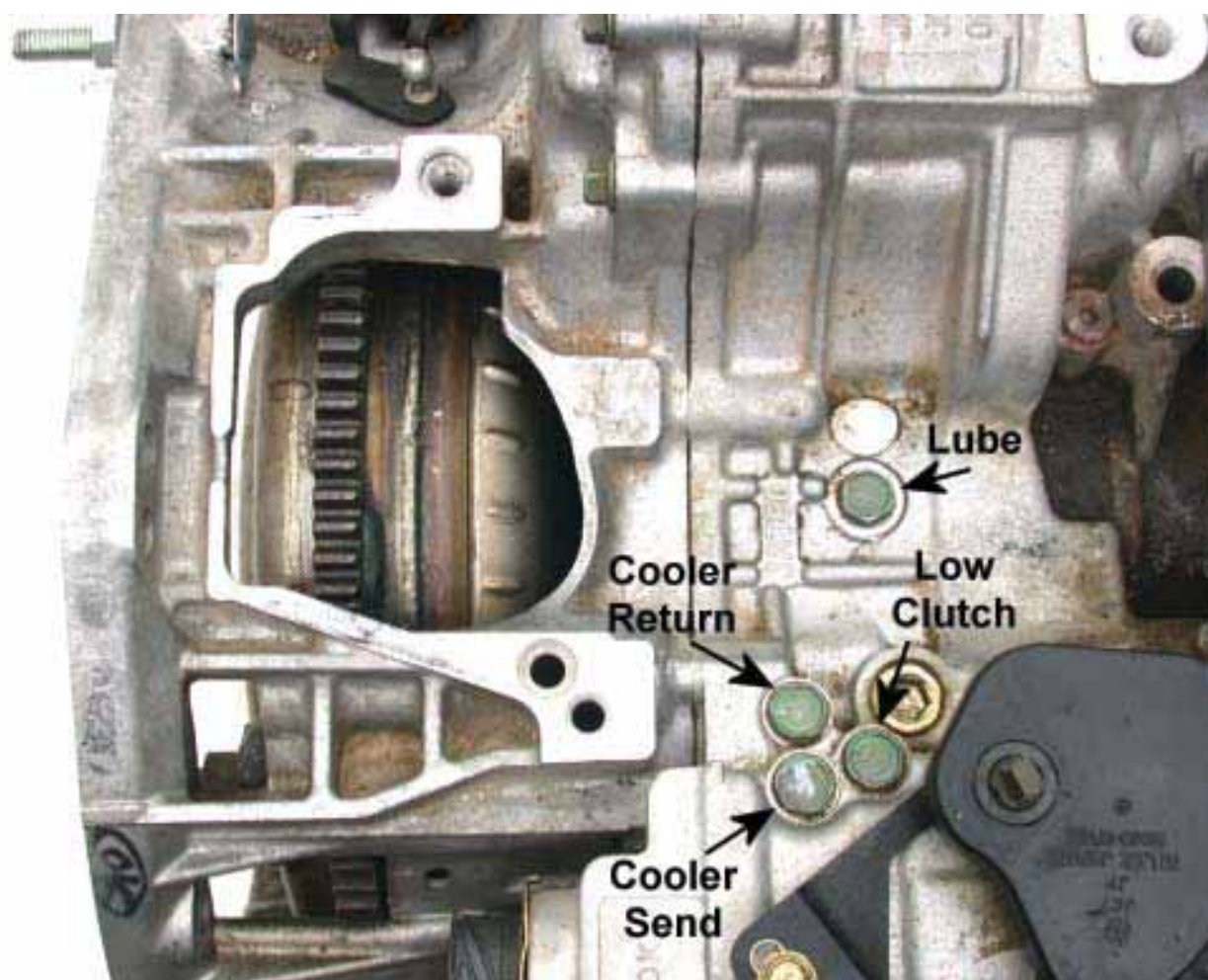


Broken cases are common due to the position of the transmission in the vehicle. The location of the transmission is low to the ground and surface street dips and other types of road hazards can cause the transmission to bottom out on the street surface.

Volkswagen

Pressure Taps (continued)

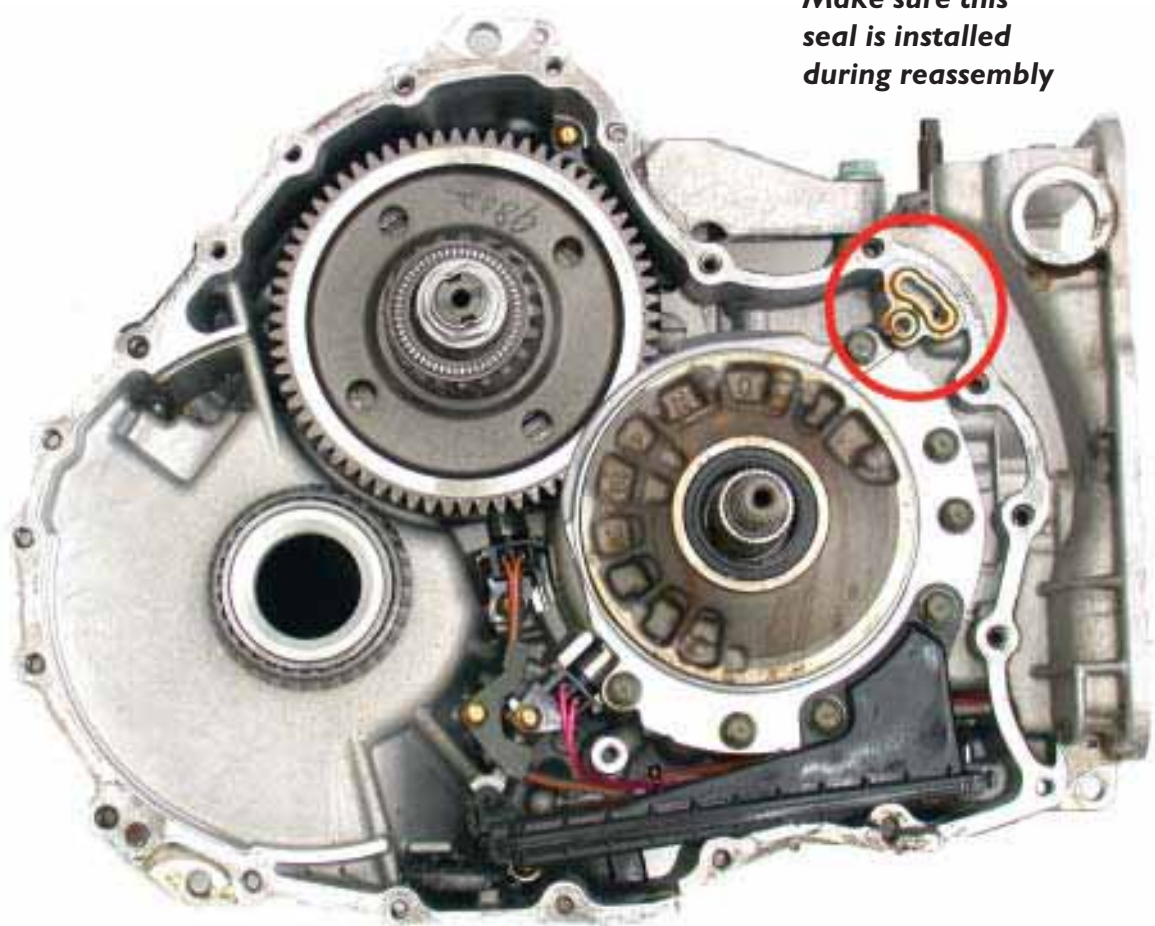
Pressure taps located at the top of case.



Volkswagen

Lube Failure

Make sure the Lube Seal is installed during your reassembly.

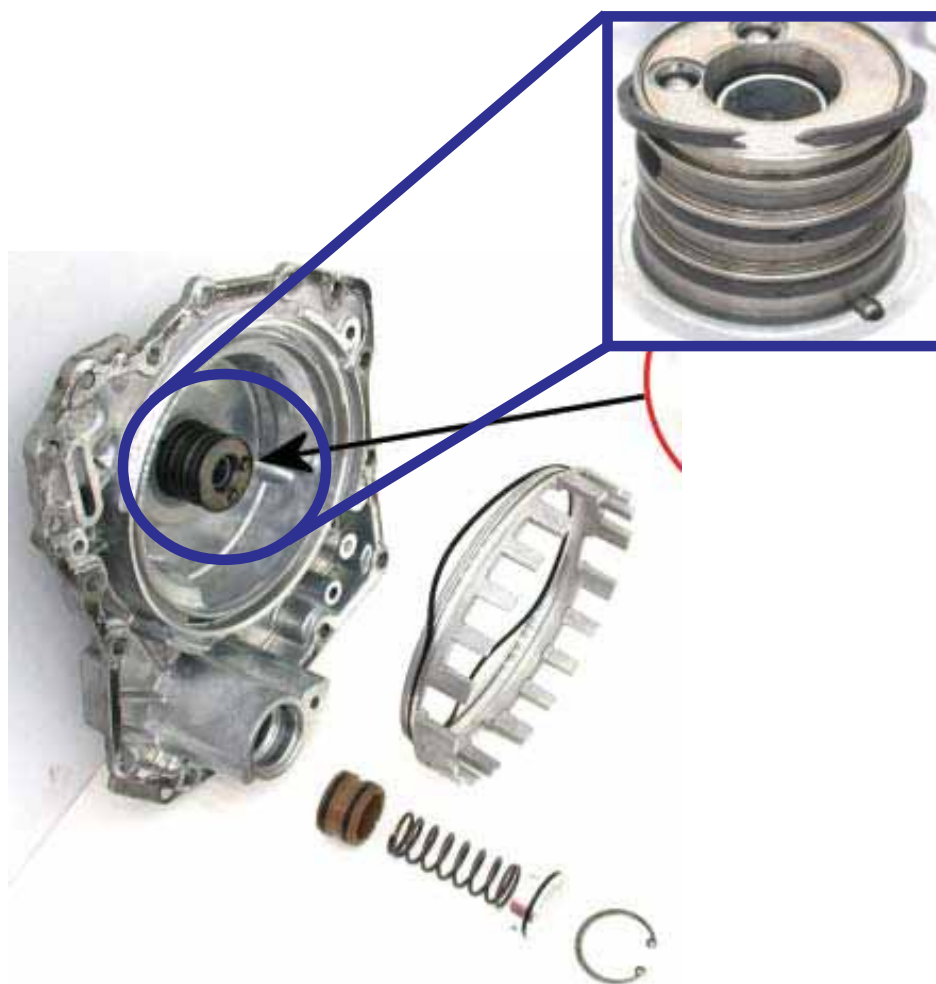


*Make sure this
seal is installed
during reassembly*

Volkswagen

Disassembly: End Cover Section

The V-Cut seals can be improperly installed. Be careful when installing the seals in the End-Cover section. Install seals with V-Cut as shown.



Volkswagen

Disassembly: End Cover Section (continued)

L/R piston housing, return spring, and spring seat.



**Correct return spring
seat installation**



Volkswagen

Reverse and High Clutch Drums

Piston cracks can be caused by crossleaks between the forward and reverse clutches. Inspect closely when there is a burnt/welded clutch failure. To check for crossleaks while in the vehicle, install a pressure gauge in the reverse clutch pressure tap. There should be 0 psi when in all of the forward ranges.

Check for cracks in this area



Volkswagen

Pump Specifications

The pump specifications are as follows:

Pump Clearances	Specifications
Outer Gear to Body	0.006"
Inner Lobe Tip Clearance	0.0008" - 0.0059"
Inner Gear Clearance	0.0008" - 0.0015"
Outer Gear Clearance	0.0008" - 0.0019"
Converter Hub Diameter	1.652" (41.97mm)
Converter Hub to Bushing Clearance	0.002" *
*Measured on a known good hub and bushing (There is no factory Specification)	

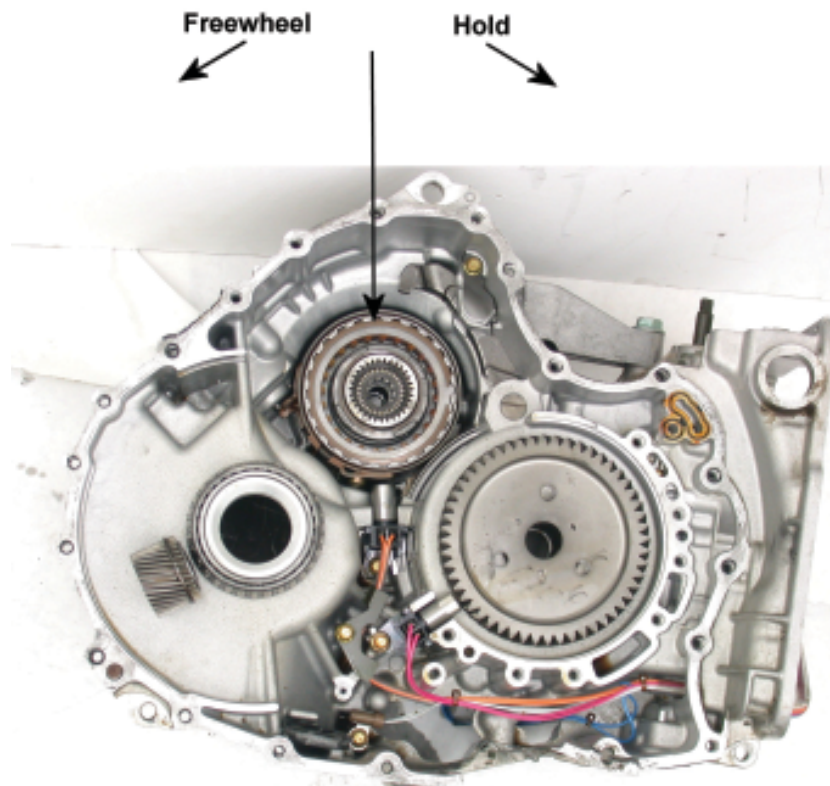


Bushing Installation:
Step is installed towards
the gear



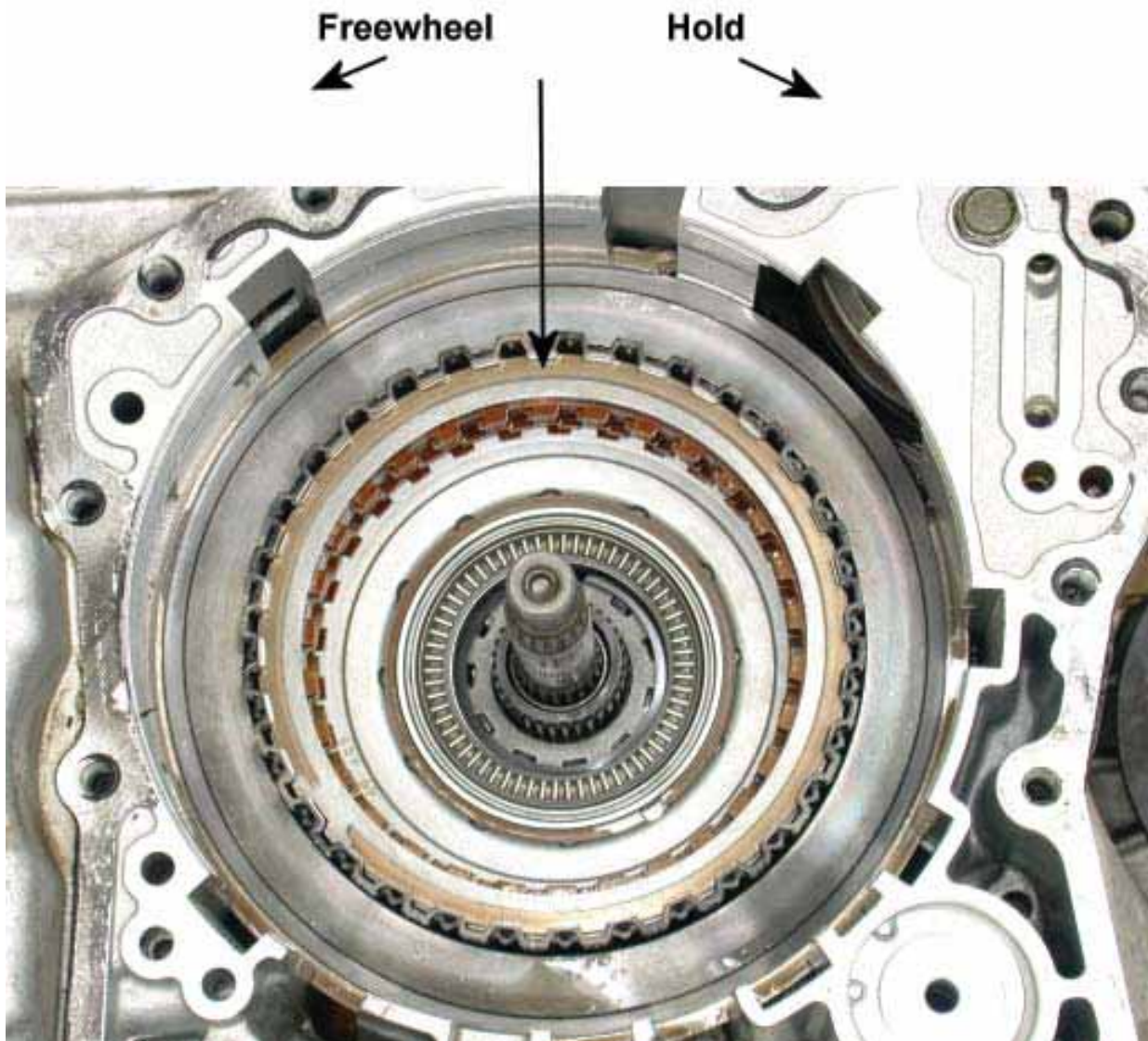
Volkswagen

Sprag Rotation



Volkswagen

Sprag Rotation (continued)



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Conversion Tables

Area		
Multiply	By	To Obtain
in ²	645.2	mm ²
in ²	6.452	cm ²
in ²	0.0069	Ft ²
Ft ²	0.0929	m ²
Ft ²	144.0	in ²
m ²	10.764	Ft ²
cm ²	0.155	in ²
mm ²	0.00155	in ²
area of a circle = πr^2 area of a cylinder = $\pi r^2 h$		
$\pi = 3.14$ r = Radius h = Height		

Temperature
$(F^{\circ} - 32) \times 5 \div 9 = C^{\circ}$
$(C^{\circ} \times 9 \div 5) + 32 = F^{\circ}$

Distance		
Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Pressure		
Multiply	By	To Obtain
PSI	0.0703	kg/cm ²
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm ²	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Continued...

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	By	To Obtain
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in ³)	0.01639	Liters
Cubic in. (in ³)	16.387	Cubic cm (cm ³)
Cubic in. (in ³)	16387.0	Cubic mm (mm ³)
Liters	61.025	Cubic in. (in ³)
Cubic cm (cm ³)	0.06103	Cubic in. (in ³)
Cubic mm (mm ³)	0.000061	Cubic in. (in ³)

Volume (Liquid Measure)		
Multiply	By	To Obtain
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
Liters	1.05672	Quarts
Liters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			Voltage*
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

* The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.

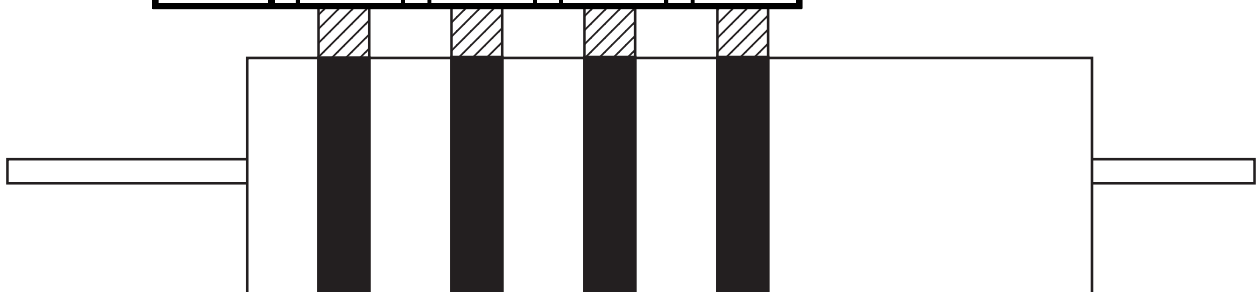
Resistor Values

If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values				
Color	1 st Band	2 nd Band	3 rd Band	4 th Band
Black	0	0	0	—
Brown	1	1	1	—
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Brown	—	—	—	1%
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%

**Brown
1%**



So if the bands are:

Blue Green Yellow Silver

6 5 0,000 ±10% = 650 kΩ, ±10%

Red Violet Brown Gold

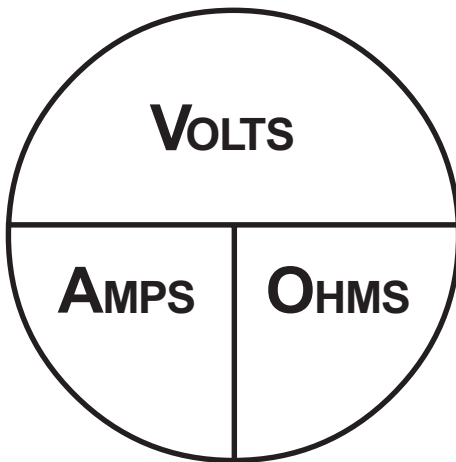
2 7 0 ±5% = 270 Ω, ±5%

White Orange Violet Plain

9 3 0,000,000 ±20% = 930 MΩ, ±20%

The resistor value is:

Ohm's Law



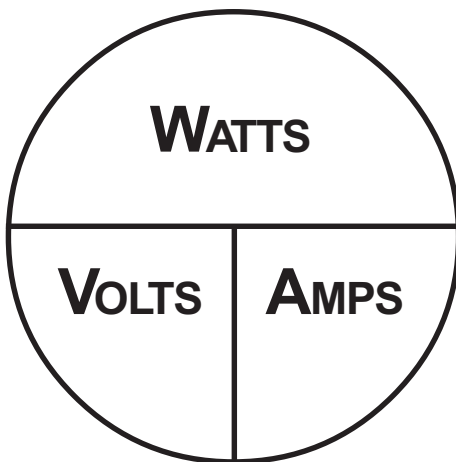
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

$$\text{Volts} \div \text{Amps} = \text{Ohms}$$

$$\text{Volts} \div \text{Ohms} = \text{Amps}$$

$$\text{Amps} \times \text{Ohms} = \text{Volts}$$

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

$$\text{Watts} \div \text{Volts} = \text{Amps}$$

$$\text{Watts} \div \text{Amps} = \text{Volts}$$

$$\text{Volts} \times \text{Amps} = \text{Watts}$$

Electrical Formulas

Resistors in a Series Circuit

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \dots$$

Two Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{\text{TOTAL}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots}$$

Two Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{C_1 \times C_2}{C_1 + C_2}$$

Multiple Capacitors in a Series Circuit

$$C_{\text{TOTAL}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots}$$

Capacitors in a Parallel Circuit

$$C_{\text{TOTAL}} = C_1 + C_2 + C_3 \dots$$

Schematic Symbols

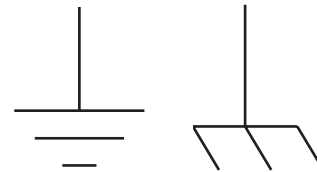


Battery

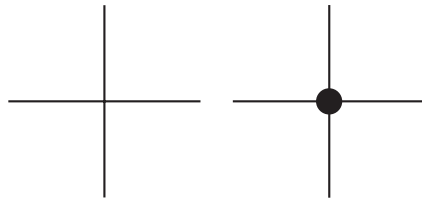
+V



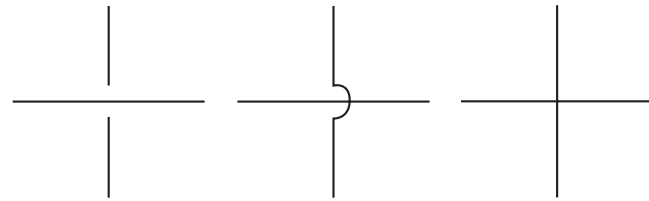
Power



Ground



Connected Wires



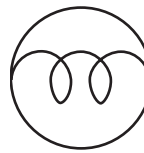
Unconnected Wires



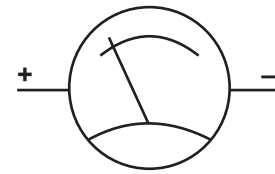
Fuse



Circuit Breaker



Bulb

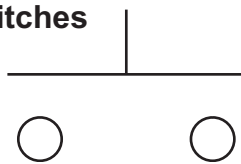


Meter

Pushbutton Switches



NC Switch

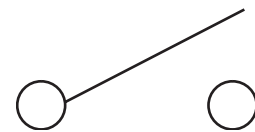


NO Switch

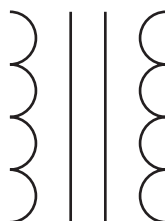
On/Off Switches



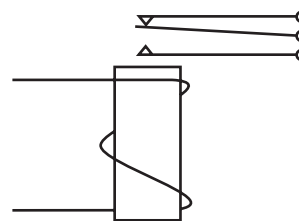
NC Switch



NO Switch



Transformer (Coil)



Relay

Schematic Symbols (continued)



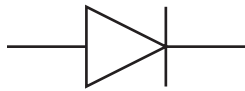
Fixed Resistor



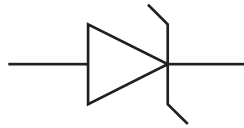
Variable Resistor



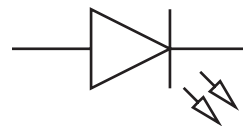
Potentiometer



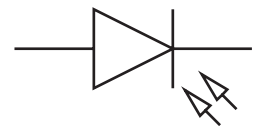
Diode



Zener Diode



LED



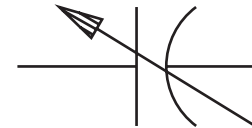
Photodiode



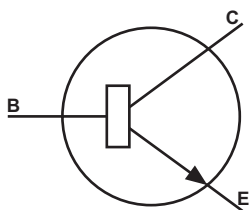
Fixed Capacitor



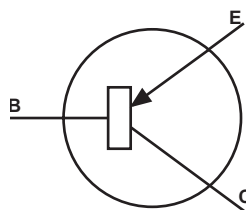
Fixed Capacitor (Polarized)



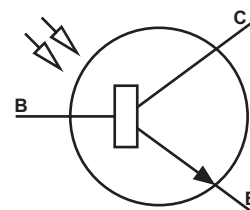
Variable Capacitor



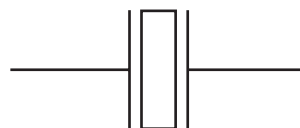
NPN Transistor



PNP Transistor



Phototransistor



Crystal

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates

that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition systems.

Continued...

Glossary of Electrical Terms (cont)

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical

circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific

Continued...

Glossary of Electrical Terms (cont)

direction, or the LED won't light.

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm's Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). Ohms x Amps = Volts; Volts ÷ Ohms = Amps; Volts ÷ Amps = Ohms.

Open Circuit — An incomplete electrical path that won't provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won't operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component's operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won't prevent the other legs from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the

voltage signal, based on its position along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device controlling the circuit.

Continued...

Glossary of Electrical Terms (cont)

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely be dealing with open and close to control hydraulic flow, to allow the transmission to shift gears, control lockup, and control line pressure.

Thermistor — A semiconductor that varies resistance based on temperature. There are two types of thermistor: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). The NTC thermistor is more common — as the temperature goes up, its resistance goes down.

Transistor — A semiconductor that operates as an electronic "relay." Transistors allow a low current circuit to control power or ground to a high current circuit.

Variable Resistor — A one- or two-wire sensor that modifies a voltage signal based on stress or temperature. Thermistors are the most common type of variable resistor in today's cars and trucks.

Voltage — The pressure in an electrical system, that pushes current through the circuit. One volt of pressure is necessary to push one amp of current through one ohm of resistance. Sometimes called the circuit's potential.

Voltmeter — Electrical test device that measures the voltage potential in a circuit. Displays its reading in volts.

Abbreviations

Abbr.	Description	Abbr.	Description
A	Ammeter	kHz	Kilohertz
AC	Alternating current	kV	Kilovolt
B, b	Base electrode, units with single	kW	Kilowatt
base		kWH	Kilowatt hour
°C	Degrees Celsius or centigrade	lb	Pound
C	Capacitance, capacitor	M	Mega; x1,000,000
C, c	Collector electrode	m	Milli; one-one thousandth; 1/1000;
cm	Centimeter	0.001	
cu	Cubic	mf, mfd	Microfarad
db	Decibels	MHz	Megahertz
DC	Direct current	mm	Millimeter
dm	Decimeter	NC	Normally closed
DPDT	Double-pole, double-throw switch	Nm	Newton-meter
DPST	Double-pole, single-throw switch	NO	Normally open
E, e	Emitter electrode	R	Resistance; resistor
E, e	Voltage	SPDT	Single-pole, double-throw switch
mf	Microfarad	SPST	Single-pole, single-throw switch
°F	Degrees Fahrenheit	t	Time
F, f	Frequency	T	Temperature
flu	Fluid	V, v	Volt; voltmeter
FM	Frequency modulation	V _{BB}	Base supply voltage (DC)
g	Gram	V _{BC}	Base-to-collector voltage (DC)
gnd, grd	Ground	V _{BE}	Base-to-emitter voltage (DC)
Hg	Mercury	V _{CB}	Collector-to-base voltage (DC)
Hz	Hertz	V _{CC}	Collector supply voltage (DC)
I	Current	V _{CE}	Collector-to-emitter voltage (DC)
I _B	Base current (DC)	V _{EB}	Emitter-to-base voltage (DC)
I _C	Collector current (DC)	V _{EC}	Emitter-to-collector voltage (DC)
I _E	Emitter current (DC)	v _{ee}	Emitter supply voltage (DC)
k	x1000	v _F	Forward voltage (DC)
kg	Kilograms	W	Watt; work
		w	Watt
		wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	$\frac{1}{128}$	0.1981			0.1130		2.8702	33	6-40 NF
0.0135		0.3429	80		0.1160		2.9464	32	
0.0145		0.3683	79		0.1172	$\frac{15}{128}$	2.9769		
0.0156	$\frac{1}{16}$	0.3962			0.1200		3.0480	31	6-48 NS
0.0160		0.4064	78		0.1250	$\frac{1}{8}$	3.1750		
0.0180		0.4572	77		0.1285		3.2639	30	
0.0200		0.5080	76		0.1328	$\frac{17}{128}$	3.3731		
0.0210		0.5334	75		0.1340		3.4036		4mm - 0.70
0.0225		0.5715	74						4mm - 0.75
0.0234	$\frac{3}{128}$	0.5944			0.1360		3.4544	29	8-32 NC
0.0240		0.6096	73						8-36 NF
0.0250		0.6350	72		0.1405		3.5687	28	8-40 NS
0.0260		0.6604	71		0.1406	$\frac{9}{64}$	3.5712		
0.0280		0.7112	70		0.1440		3.6576	27	
0.0292		0.7417	69		0.1470		3.7338	26	$\frac{3}{16}$ -24 NC
0.0310		0.7874	68		0.1476		3.7500		4.5mm - 0.75
0.0312	$\frac{1}{32}$	0.7925			0.1484	$\frac{19}{128}$	3.7694		
0.0320		0.8128	67		0.1495		3.7973	25	10-24 NC
0.0330		0.8382	66		0.1520		3.8608	24	
0.0350		0.8890	65		0.1540		3.9116	23	
0.0360		0.9144	64		0.1563	$\frac{5}{32}$	3.9700		
0.0370		0.9398	63		0.1570		3.9878	22	$\frac{3}{16}$ -32 NF
0.0380		0.9652	62		0.1590		4.0386	21	10-32 NF
0.0390	$\frac{5}{128}$	0.9906	61		0.1610		4.0894	20	
0.0400		1.0160	60		0.1641	$\frac{21}{128}$	4.1681		
0.0410		1.0414	59		0.1650		4.1910		5mm - 0.90
0.0420		1.0668	58		0.1660		4.2164	19	
0.0430		1.0922	57		0.1690		4.2926		5mm - 0.80
0.0465		1.1811	56		0.1695		4.3053	18	
0.0469	$\frac{3}{64}$	1.1913		0-80 NF	0.1719	$\frac{11}{64}$	4.3663		
0.0520		1.3208	55		0.1730		4.3942	17	
0.0547	$\frac{7}{128}$	1.3894			0.1770		4.4958	16	12-24 NC
0.0550		1.3970	54		0.1797	$\frac{23}{128}$	4.5644		
0.0595		1.5113	53	1-64 NC 1-72NF	0.1800		4.5720	15	
					0.1653		4.2000		5.5mm - 0.80
0.0625	$\frac{1}{16}$	1.5875			0.1820		4.6228	14	12-28 NF
0.0635		1.6129	52		0.1850		4.6990	13	12-32 NEF
0.0670		1.7018	51		0.1875	$\frac{3}{16}$	4.7625		
0.0700	$\frac{9}{128}$	1.7780	50	2-56 NC 2-64 NF	0.1890		4.8006	12	
					0.1910		4.8514	11	
0.0730		1.8542	49		0.1935		4.9149	10	14-20 NS
0.0760		1.9304	48		0.1953	$\frac{25}{128}$	4.9606		
0.0781	$\frac{5}{64}$	1.9837			0.1960		4.9784	9	
0.0785		1.9939	47	3-48 NC	0.1990		5.0546	8	
0.0810		2.0574	46		0.2010		5.1054	7	$\frac{1}{4}$ -20 NC
0.0820		2.0828	45	3-56 NF					14-24 NS
0.0860	$\frac{11}{128}$	2.1844	44	4-36 NS	0.2031	$\frac{13}{64}$	5.1587		
0.0890		2.2606	43	4-40 NC	0.2040		5.1816	6	
0.0935		2.3749	42	4-48 NF	0.2050		5.2070		6mm - 1.00
0.0938	$\frac{3}{32}$	2.3825		$\frac{1}{8}$ -32 NC	0.2055		5.2197	5	
0.0960		2.4384	41		0.2090		5.3086	4	$\frac{1}{4}$ -24 NS
0.0980		2.4892	40	3mm - 0.50	0.2109	$\frac{27}{128}$	5.3569		
0.0995		2.5273	39		0.2130		5.4102	3	$\frac{1}{4}$ -28 NF
0.1015		2.5781	38	$\frac{1}{8}$ -40NF 5-40NC	0.2188	$\frac{7}{32}$	5.5575		$\frac{1}{4}$ -32 NEF
					0.2210		5.6134	2	
0.1016	$\frac{13}{128}$	2.5806			0.2266	$\frac{29}{128}$	5.7556		
0.1040		2.6416	37	5-44 NF	0.2280		5.7912	1	$\frac{1}{4}$ -40 NS
0.1065		2.7051	36	6-32 NC	0.2340		5.9436	A	
0.1094	$\frac{7}{64}$	2.7788			0.2344	$\frac{15}{64}$	5.9538		
0.1100		2.7940	35		0.2380		6.0452	B	
0.1110		2.8194	34	6-36 NS	0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size	Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C		0.4531	$\frac{29}{64}$	11.5087		$\frac{1}{2}$ -20 NF
0.2422	$\frac{31}{128}$	6.1519							$\frac{1}{2}$ -24 NS
0.2460		6.2484	D		0.4609	$\frac{59}{128}$	11.7069		
0.2500	$\frac{1}{4}$	6.3500	E		0.4688	$\frac{15}{32}$	11.9075		
0.2570		6.5278	F	$\frac{5}{16}$ -18 NC	0.4766	$\frac{61}{128}$	12.1056		
0.2578	$\frac{33}{128}$	6.5481			0.4800		12.1920		14mm - 2.00
0.2610		6.6294	G		0.4844	$\frac{31}{64}$	12.3038		$\frac{9}{16}$ -12 NC
0.2656	$\frac{17}{64}$	6.7462			0.4922	$\frac{63}{128}$	12.5019		
0.2660		6.7564	H		0.5000	$\frac{1}{2}$	12.7000		14mm - 1.50
0.2720		6.9088	I	8mm - 1.25	0.5039		12.8000		14mm - 1.25
				$\frac{5}{16}$ -24 NF	0.5156	$\frac{33}{64}$	13.0962		$\frac{9}{16}$ -18 NF
0.2734	$\frac{35}{128}$	6.9444			0.5312	$\frac{17}{32}$	13.0962		$\frac{5}{8}$ -11 NC
0.2770		7.0358	J		0.5469	$\frac{35}{64}$	13.8913		
0.2800		7.1120		8mm - 1.00	0.5590		14.2000		16mm - 2.00
0.2810		7.1374	K		0.5625	$\frac{9}{16}$	14.2875		
0.2813	$\frac{9}{32}$	7.1450		$\frac{5}{16}$ -32 NEF	0.5781	$\frac{37}{64}$	14.6837		$\frac{5}{8}$ -18NF
0.2891	$\frac{37}{128}$	7.3431							$\frac{3}{8}$-18NPT
0.2900		7.3660	L		0.5787		14.7000		16mm - 1.50
0.2950		7.4930	M		0.5938	$\frac{19}{32}$	15.0825		$\frac{11}{16}$ -11 NS
0.2969	$\frac{19}{64}$	7.5413			0.6094	$\frac{39}{64}$	15.4788		
0.3020		7.6708	N		0.6220		15.8000		18mm - 2.50
0.3047	$\frac{39}{128}$	7.7394			0.6250	$\frac{5}{8}$	15.8750		$\frac{11}{16}$ -16 NS
0.3110		7.8994		9mm - 1.25	0.6406	$\frac{41}{64}$	16.2712		
0.3125	$\frac{5}{16}$	7.9375		$\frac{3}{8}$ -16 NC	0.6562	$\frac{21}{32}$	16.6675		$\frac{3}{4}$ -10 NC
0.3160		8.0264	O		0.6614		16.8000		18mm - 1.50
0.3190		8.1026		9mm - 1.00	0.6719	$\frac{43}{64}$	17.0663		
0.3203	$\frac{41}{128}$	8.1356			0.6875	$\frac{11}{16}$	17.4625		$\frac{3}{4}$ -16NF
0.3230		8.2042	P		0.7008		17.8000		20mm - 2.50
0.3270		8.3058		9mm - 0.75	0.7031	$\frac{45}{64}$			$\frac{1}{2}$-14 NPT
0.3281	$\frac{21}{64}$	8.3337			0.7187	$\frac{23}{32}$			
0.3320		8.4328	Q	$\frac{3}{8}$ -24 NF	0.7344	$\frac{47}{64}$			
0.3359	$\frac{43}{128}$	8.5319			0.7500	$\frac{3}{4}$			
0.3390		8.6106	R	$\frac{1}{8}$-27 NPT	0.7656	$\frac{49}{64}$			$\frac{7}{8}$ -9 NC
0.3430		8.7122		10mm - 1.50	0.7812	$\frac{25}{32}$			
0.3438	$\frac{11}{32}$	8.7325			0.7969	$\frac{51}{64}$			
0.3480		8.8392	S		0.8125	$\frac{13}{16}$			$\frac{7}{8}$ -14 NF
0.3500		8.8900		10mm - 1.25	0.8228		20.9000		22mm - 1.50
0.3516	$\frac{45}{128}$	8.9306			0.8281	$\frac{53}{64}$			$\frac{7}{8}$ -18 NS
0.3580		9.0932	T	10mm - 1.0	0.8425		21.4000		24mm - 3.00
0.3594	$\frac{23}{64}$	9.1288			0.8437	$\frac{27}{32}$			
0.3672	$\frac{47}{128}$	9.3269			0.8594	$\frac{55}{64}$			
0.3680		9.3472	U	$\frac{7}{16}$ -14 NC	0.8750	$\frac{7}{8}$			1-8 NC
0.3750	$\frac{3}{8}$	9.5250			0.8779		22.3000		24mm - 2.00
0.3770		9.5758	V		0.8906	$\frac{57}{64}$			
0.3820		9.7028		11mm - 1.50	0.9062	$\frac{29}{32}$			
0.3828	$\frac{49}{128}$	9.7231			0.9219	$\frac{59}{64}$			1-12 NF
0.3860		9.8044	W						$\frac{3}{4}$-14 NPT
0.3906	$\frac{25}{64}$	9.9212		$\frac{7}{16}$ -20 NF	0.9375	$\frac{15}{16}$			1-14 NS
0.3970		10.0838	X		0.9531	$\frac{61}{64}$			
0.3984	$\frac{51}{128}$	10.1194			0.9687	$\frac{31}{32}$			
0.4040		10.2616	Y		0.9844	$\frac{63}{64}$			
0.4063	$\frac{13}{32}$	10.3200			1.0000	1			
0.4130		10.4902	Z	12mm - 1.75					
0.4141	$\frac{53}{128}$	10.5181							
0.4210		10.6934		12mm - 1.50					
0.4219	$\frac{27}{64}$	10.7163		$\frac{1}{2}$ -13 NC					
0.4290		10.8966		12mm - 1.25					
0.4297	$\frac{55}{128}$	10.9144							
0.4375	$\frac{7}{16}$	11.1125		$\frac{1}{4}$-18NPT					
0.4453	$\frac{57}{128}$	11.3106							



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The

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Dennis Madden
Chief Executive Officer

Welcome to the 2006 ATRA Technical Seminar!

Lance Wiggins and the ATRA Technical staff have really worked hard to get you the most up-to-date and relevant technical information that you can put to work right away... and again, in full color!

For those of you who have attended past ATRA seminars you'll be delighted to know this seminar material is just what you expected from ATRA, or even more. If you've never attended an ATRA seminar before you're in for a treat.

This seminar, along with everything else at ATRA is a group effort, with a lot of people working in the background to make this seminar a success. I am honored to be part of such a worthy organization and to work with such great people.

ATRA is changing all the time. Not only with the way we distribute technical material, but in almost every area where we serve our members, and the industry at large.

On behalf of the ATRA staff, and the ATRA Chapters that work so hard to bring you this seminar, welcome.

Sincerely,

A handwritten signature in black ink, appearing to read "Dennis Madden". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Dennis Madden,
ATRA, CEO



Lance Wiggins
Technical Director

ATRA is proud to be celebrating another year serving the automatic transmission repair industry. Many changes have taken place over the last year and it's because of those changes that technical training has become an integral part of today's transmission repair industry.

To that end, ATRA is pleased to present its 2006 Technical Seminar. Packed with countless hours of research and development, writing, editing, photography and layout, this year's seminar will stand out as one of the most demanding and useful technical training programs ever developed for this industry.

Once again, this year's technical manual has been produced in full color. With over 325 pages of up-to-the-minute technical information, the 2006 Technical Seminar Manual will remain a valuable resource long after the seminar is just a memory.

We're confident that you'll find this year's seminar presentation and technical manual both informative and profitable. In fact, we're so sure you'll be satisfied with what you learn in this program, we guarantee it!

This past year ATRA lost one of our own, Jim Lambos passed away in December of 2005 from a vehicle accident. As a reminder of his countless hours spent helping our members, we have dedicated this 2006 Technical Seminar Manual to him and his family.

On behalf of the entire ATRA staff, the international board of directors, and all of the ATRA members worldwide, we'd like to thank you for helping to make every day memorable.

A handwritten signature in black ink that reads "Lance Wiggins". The signature is written in a cursive, flowing style.

Lance Wiggins
ATRA Technical Director

ATRA Technical Team (continued)



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Technical Advisor



Steve Garrett
Technical Advisor, Seminar
Speaker, Service Engineer



Randall Schroeder
Senior Technician
and Seminar Speaker



Weldon Barnett
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Spanish Technical
Advisor



Bill Brayton
Technical Advisor

In Memory Of Jim Lambos



Jim Lambos had been promoted to the rank of Master Sergeant, and he had received several awards and decorations for meritorious service.

IN MEMORY OF JIM LAMBOS

by Paul Morton

James J. "Jim" Lambos joined the technical staff of ATRA in April of this year, following a distinguished 25-year career with the U.S. Air Force. While in the Air Force, Jim held a number of increasingly responsible positions related to the repair and maintenance of vehicles. Not surprisingly, one of his specialties was the repair and rebuilding of transmissions. In fact, this skill was put to good use while he was stationed at the remote outpost of Shemya, Alaska, where Jim's ability to rebuild transmissions saved the Air Force thousands of dollars in unneeded shipping costs. At the time of his retirement, Jim had been promoted to the rank of Master Sergeant, and he had received several awards and decorations for meritorious service.

In 1985, Jim married the former Ronda McIntire, and together they had two sons; Jimmy, 14, and Zane, 10.

Following his retirement, Jim walked into the ATRA IBO and spoke with ATRA's Technical Director, Lance Wiggins. Though Lance will recall his relationship with Jim in his own words, he realized that Jim was someone he wanted on the ATRA Technical team. From the beginning, Jim began to make a contribution. In fact, his first technical article appears in this issue, with a forward written by Technical Editor Larry Frash.

On the evening of December 7, 2005, Jim was driving his GTO in nearby Ventura, when he was involved in an accident and killed. His contribution and his loss may best be described by Lance Wiggins, in his own words:

I try to learn from my mistakes, and the knowledge and opinions of others. It helps me grow into the person I want to become. Jim Lambos is one person who helped me in many different ways, in a short period of time. Jim came to the office about eight months ago, looking for a job after many years in the Air Force. His traits and qualities were clear and obvious; you don't find many people like that, just walking in off the street for an interview.

Jim's military background definitely influenced my decision to hire him, and what a good decision that was. He was a complete team player; always asking for more work and never complaining about a thing. For those of you who talked to Jim on the Technical Help line, you know how he always went out of his way to fix your problems.



I can tell you two things about Jim's character that sums it up for me. One, he was a Chicago Bears fan, and two, he was a Cubs fan. And if you support those two teams, you have to be special as well as brave! If I could, I would thank Jim for the time he spent with us, for his loyalty and sense of team play, and for being the person he was. I know I speak for the entire ATRA family, of which he will always be a part, the Tech Department, and for me as well ... we will miss you. Rest in peace, my friend.



In Memory of Jim Lambos:

Husband

Father

Friend

Airman

ATRA Tech

*Thank you for allowing the ATRA Family to know
you. Rest in Peace my Friend*

ATRA Staff



It's difficult enough getting the seminar book researched, written, pictured, edited, and printed let alone getting it out to the seminar attendees. This is where the ATRA Staff comes in.

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Without the ATRA team, it would be very hard to accomplish the task at hand. Please enjoy the seminar.

Lance Wiggins
ATRA Technical Director

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GM All

Body Style Identification

Several shops have indicated the need for an identification chart for GM body styles. Listed below are the body style codes for the various 2005/2006 GM applications. On passenger cars the body style is indicated by the 4th digit of the VIN. On truck applications the 5th digit indicates the body style.

2006 Models

CARS

A= CHEVROLET COLBALT, PONTIAC PURSUIT, SATURN ION

D= CADILLAC CTS, CADILLAC STS

H= BUICK LUCERNE

J= CHEVROLET OPTRA

M= CHEVROLET MATIZ, PONTIAC SOLTICE

K= CADILLAC DEVILLE

S= PONTIAC VIBE

T= CHEVROLET AVEO, PONTIAC WAVE

U= CHEVROLET U-100

V= CHEVROLET EPICA, PONTIAC GTO

W= CHEVROLET IMPALA, MONTE CARLO, PONTIAC GRAND PRIX, BUICK LACROSSE, BUICK ALLURE

Y= CHEVROLET CORVETTE, CADILLAC XLR

Z= CHEVROLET MALIBU, PONTIAC G6

GM All

Body Style Identification

2006 Models

TRUCKS

A= CHEVROLET HHR, BUICK RENDEZVOUS 2WD

B= BUICK RENDEZVOUS 4WD

C= CHEVROLET SILVERADO 2WD, GMC SIERRA 2WD, CADILLAC ESCALADE, DENALI 2WD,

E= CADILLAC SRX

G= CHEVROLET EXPRESS VAN 2WD, GMC SAVANA VAN 2WD

H= CHEVROLET EXPRESS VAN AWD, GMC SAVANA VAN AWD

K= CHEVROLET SILVERADO 4WD, GMC SIERRA 4WD, CADILLAC ESCALADE, DENALI 4WD

L= CHEVROLET EQUINOX, PONTIAC TORRENT

N= HUMMER H2

S= 2WD CHEVROLET COLORADO, SSR, BLAZER, TRAILBLAZER, 2WD GMC ENVOY, CANYON, SONOMA, BUICK RAINIER, ISUZU ACENDER 2WD

T= 4WD/AWD CHEVROLET COLORADO, SSR, BLAZER, TRAILBLAZER, 4WD/AWD GMC ENVOY, CANYON, SONOMA, BUICK RAINIER, ISUZU ACENDER 4WD, SAAB 9-7, HUMMER H3

U= CHEVROLET UPLANDER 2WD, PONTIAC MONTANA

V= CHEVROLET UPLANDER EXPRESS/APV, PONTIAC AWD/EWB, BUICK TERRAZA, SATURN RELAY

X= SATURN RELAY AWD, BUICK TERRAZA AWD, CHEVROLET UPLANDER AWD

Z= SATURN VUE

GM All

Body Style Identification

2005 Models

CARS

A= CHEVROLET COLBALT, PONTIAC PURSUIT, SATURN ION

C= BUICK PARK AVENUE

D= CADILLAC CTS, CADILLAC STS

H= BUICK LESABRE, PONTIAC BONNEVILLE

J= CHEVROLET CAVALIER, OPTRA, PONTIAC SUNFIRE, SATURN L300

N= CHEVROLET MALIBU CLASSIC, PONTIAC GRAND AM

M= CHEVROLET MATIZ

K= CADILLAC DEVILLE

S= PONTIAC VIBE

T= CHEVROLET AVEO, PONTIAC WAVE

U= CHEVROLET U-100

V= CHEVROLET EPICA, PONTIAC GTO

W= CHEVROLET IMPALLA, MONTE CARLO, PONTIAC GRAND PRIX, BUICK
LACROSSE, BUICK ALLURE, BUICK CENTURY CUSTOM

Y= CHEVROLET CORVETTE, CADILLAC XLR

Z= CHEVROLET MALIBU, PONTIAC G6

GM All

Body Style Identification

2005 Models

TRUCKS

A= BUICK RENDEZVOUS 2WD, PONTIAC AZTEK 2WD

B= BUICK RENDEZVOUS 4WD, PONTIAC AZTEK 4WD

C= CHEVROLET SILVERADO 2WD, GMC SIERRA 2WD, CADILLAC ESCALADE, DENALI 2WD,

E= CADILLAC SRX

G= CHEVROLET EXPRESS VAN 2WD, GMC SAVANA VAN 2WD

H= CHEVROLET EXPRESS VAN AWD, GMC SAVANA VAN AWD

K= CHEVROLET SILVERADO 4WD, GMC SIERRA 4WD, CADILLAC ESCALADE, DENALI 4WD

L= CHEVROLET EQUINOX, PONTIAC TORRENT

M= CHEVROLET ASTRO, GMC SAFARI

N= HUMMER H2

S= 2WD CHEVROLET COLORADO, SSR, BLAZER, TRAILBLAZER, 2WD GMC ENVOY, CANYON, SONOMA, BUICK RAINER, ISUZU ACENDER 2WD

T= 4WD/AWD CHEVROLET COLORADO, SSR, BLAZER, TRAILBLAZER, 4WD/AWD GMC ENVOY, CANYON, SONOMA, BUICK RAINER, ISUZU ACENDER 4WD, SAAB 9-7, HUMMER H3

U= CHEVROLET UPLANDER 2WD, PONTIAC MONTANA

V= CHEVROLET UPLANDER EXPRESS/APV, PONTIAC AWD/EWB, BUICK TERRAZA, SATURN RELAY

X = SATURN RELAY AWD, BUICK TERRAZA AWD, CHEVROLET UPLANDER AWD

Z= SATURN VUE

Dexron® VI

New Fluid Introduced

Beginning in April 2005 a new fluid was introduced into the GM line. Designed for the new 6 speed automatic transmissions, Dexron VI has become the factory fill for GM applications. Dexron VI is designed to replace Dexron III as the service fill for GM applications. Dexron VI was developed by GM in conjunction with Petro Canada and Afton chemical company. Dexron VI is a significant advancement when compared to its counterpart Dexron III.

The following chart represents the improvement over Dexron III.

Extended factory fill	100,000 miles normal
Change interval	50,000 miles severe
Clutch friction stability	Improved 100%
Clutch durability	Improved 120%
Oil film	Increased 20%
Fluid Oxidation	Improved 100%
Shear Stability	Improved 200%
Foam/Aeration	Improved 150%

Dexron® VI

New Fluid Introduced

In addition Dexron VI also offers the following advantages over Dexron III:

- Reduces TCC shudder in PWM applications
- Improved low temperature operation
- Lower viscosity
- More consistent viscosity profile
- 99.9 % pure base stock profile

The following are the standards Dexron VI is designed to meet and maintain in production:

Property/test	Dexron VI
Density kg/l @15C	0.846
Color	Red
Flash Point	206C, 403 F
Viscosity cST@40 C cST@100 C	29.8 6
Viscosity Index	151
Pour point	-54 C, -65F
Brookfield cP @-20C cP @ -30 C cP @ -40C	1053 3164 12030
Sulphated ash %	0.02

88861003	1 Quart container	DEXRON® -VI GM Vehicle Care
88861037	1 Quart container	DEXRON® -VI AC Delco
88861004 In Canada	1 Liter container 1 Gallon container	DEXRON® -VI AC Delco DEXRON® -VI Care
88861045	4 Liter container	DEXRON® -VI AC Delco
88861043 In Canada	55 gallon container	DEXRON® -VI GM Vehicle Care
88861046	205 Liter container	DEXRON® -VI AC Delco
88861044 In Canada		

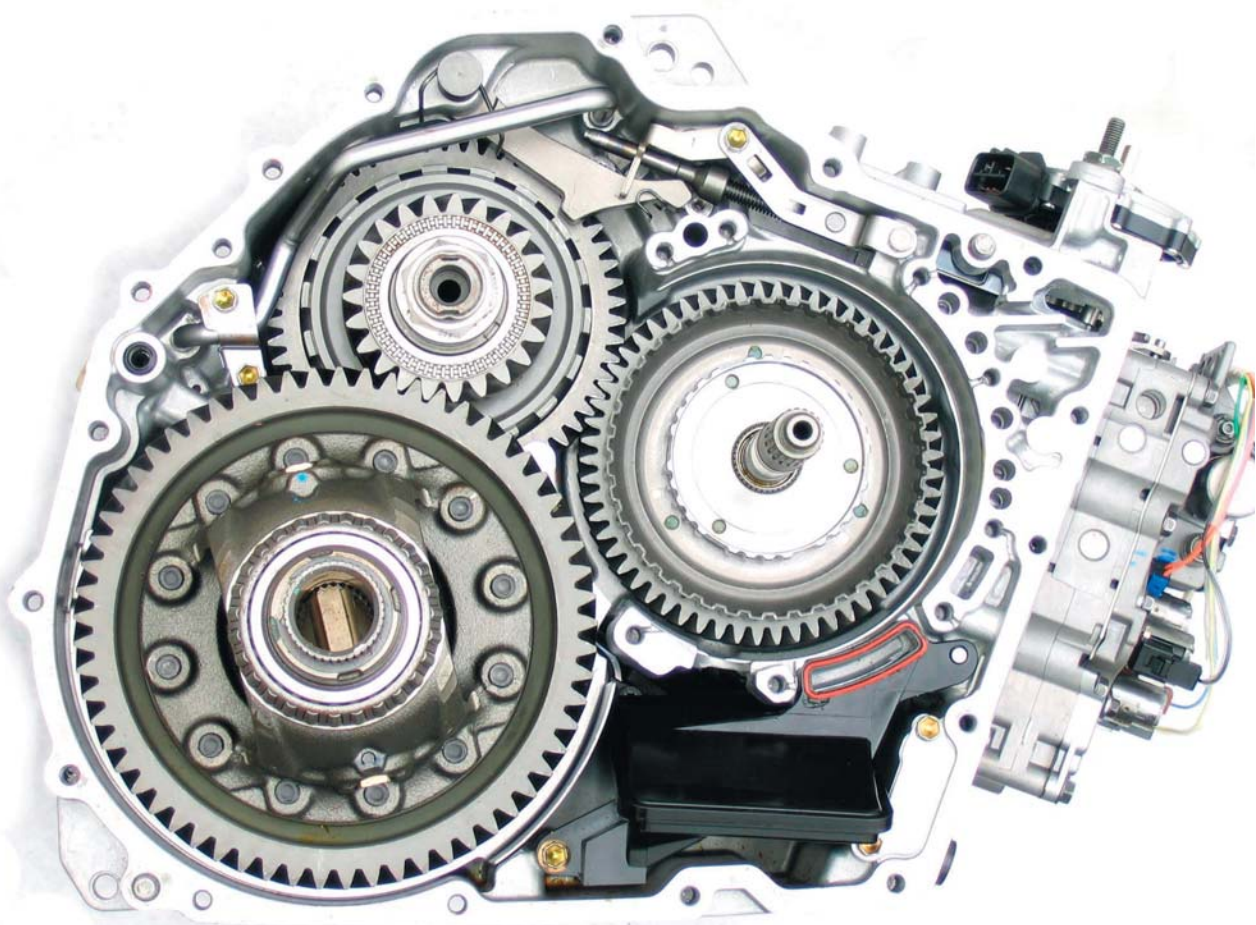
Dexron VI is required for clutch to clutch shift transmissions like the 6 speed applications released for the 2006 model year. Dexron VI is designed to back service all Dexron applications but it is not currently certified to meet the Mercon standard.

AF23-5 Saturn ION

Whine Noise in 4th

A gear noise which is amplified by the drive axle may sound like a whine type noise while in 4th gear under light throttle, light load. This condition is most pronounced when the transaxle is warm.

To repair the concern install a new transfer driven gear, output gear and differential assembly.



4L60E/65E, 4T40E/45E, AF33-5

APP Signals and DTC Applications

Technicians that use a snap shot feature on their meter or use an oscilloscope to aid in diagnosis may misdiagnose the cause of APP DTCs. Your scan tool may register DTCs P0122, P0123, P0220, P0222, P1120, P1220, P1221, P1271, P1275, P1280, P1512, P1514, P1515, P1523, P2101, P2120, P2122 or P2123 on GM “T”, “Z”, “L” trucks and GM “A” and “Z” car applications. This may lead the technician to replace components that are not faulty.

NOTE: The body styles are as follows:

- T= Trailblazer, Envoy, Colorado, Canyon, H3, Bravada
- Z= Vue
- L= Equinox
- A= Cobalt, Pursuit
- Z= Malibu, G6, Ion

These applications utilize a special software algorithm that is used to locate faults in the APP and TP systems. When monitoring some APP or TP sensors the technician may notice that the voltage drops on the circuit. This condition only lasts for about 6.5ms. This test is performed to determine if there is a short in the sensors or the wiring is present. By monitoring the signal for the other sensors at the time the sensor signal is shorted to ground, the PCM can determine if a short to any of the other circuit are present. If APP, TP DTC's are not set, no repairs should be attempted. If a TP or APP DTC is set, refer to the service information to assist with diagnosis for the DTC's that are set.



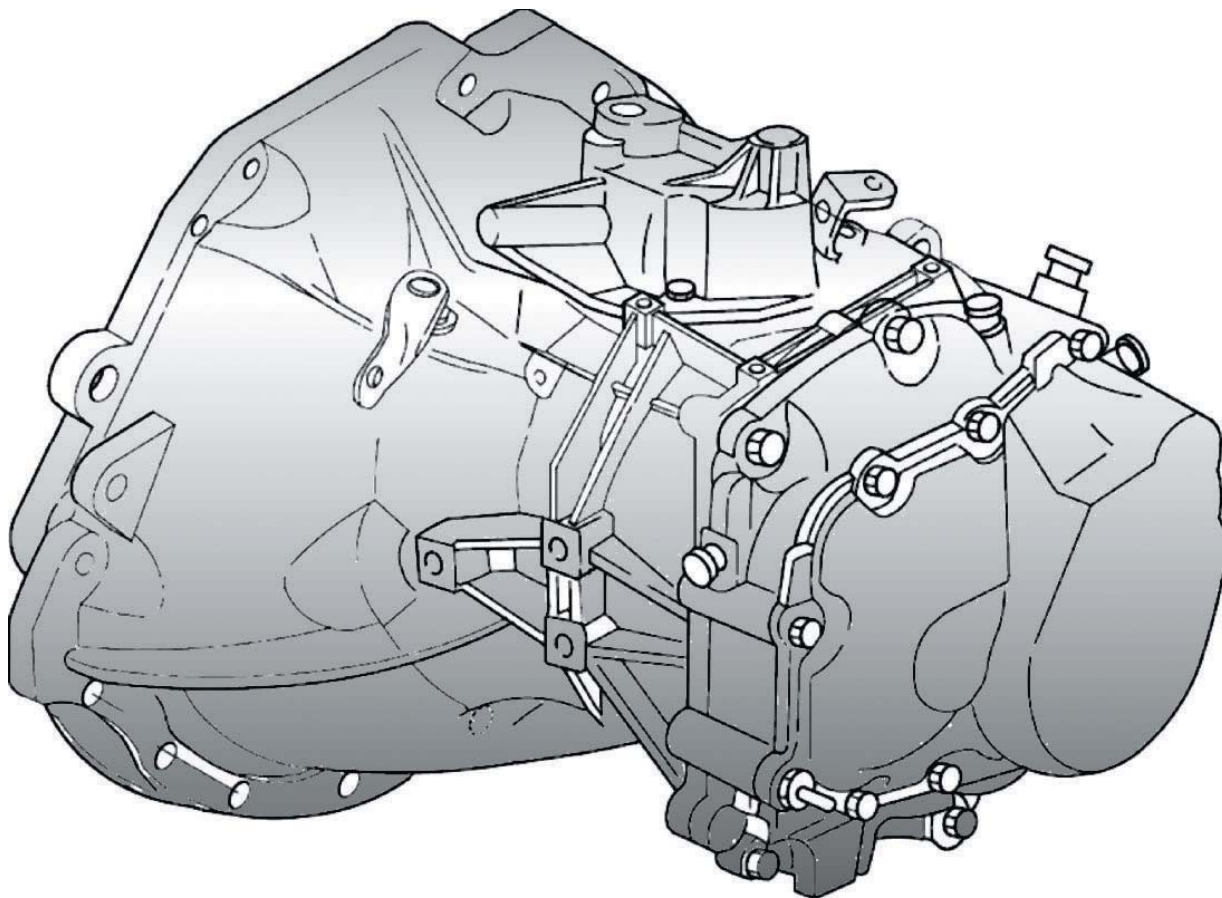
81-40LE

No 4th gear

Chevrolet Aveo, Pontiac Wave

Chevrolet Aveo or a Pontiac Wave equipped with an Aisin Warner 81-40LE (RPO MV6) automatic transmissions may exhibit a no shift into 4th gear at times. The customer may indicate that this is an intermittent condition and generally happens after a cold start.

The 81-40 LE is programmed to inhibit 4th gear anytime transmission temperature is below 59°F (15°C). This feature is designed to lower emissions and enhance heater operation during engine warm up. This should be considered a normal condition.



5L40/50E

Downshift Related Concerns

Intermittent or Unwanted downshifts while operating the vehicle in a coast condition set, may be caused by a weak internal brake booster vacuum spring that prevents the brake booster pedal position sensor from returning to the released position. The pedal position sensor can be monitored using ABS data. The EBCM signals the PCM which then signals the TCM regarding the brake pedal sensor position via the scan data, causing the condition to occur. To repair replace the brake booster. This condition will not set a DTC.



5L40/50E, 4T60E

3.6L (LY7) or 2.8L (LP1)

Shared 5-Volt Reference Circuit

Several GM vehicles equipped with a 3.6L (LY7) or 2.8L (LP1) engine share the PCM 5 volt reference circuit among several different sensors. Some vehicle families include the Cadillac CTS/SRX/STS as well as the Buick Lacrosse and Rendezvous to name a few.

The PCM/ECM is not equipped with a DTC for a 5 volt reference problem on the engine families listed above. Therefore, the computer will not set an individual DTC related to the 5 volt reference circuit if a short to ground or an open occur in the circuit. It is likely a low voltage DTC for one of the shared circuits will set a DTC but the problem may not necessarily be located in that circuit or component. As an example, it is likely a P0102 MAF DTC could set even though there is no problem with the sensor or it's circuit. The P0102 may set simply because it was the 1st diagnostic to run.

As an example lets look at a Cadillac STS, 3.6L

The shared 5 volt reference "A" circuit includes the following circuits:

- MAF sensor
- IAT sensor
- BARO sensor
- Engine oil pressure sensor, EOP
- APP sensors
- A/C pressure sensor
- Fuel tank pressure sensor, FTP

5L40/50E, 4T60E

3.6L (LY7) or 2.8L (LPI)

Shared 5-Volt Reference Circuit

The shared 5 volt reference “B” circuit includes the following circuits:

- Cam sensor bank 1 intake
- Cam sensor bank 1 exhaust
- Cam sensor bank 2 intake
- Cam sensor bank 2 exhaust

The shared 5 volt reference “C” circuit includes the following circuits:

- APP sensor
- TP sensor

To show you how this might vary lets look at a Buick Rendezvous 3.6L

The shared 5 volt reference “A” circuit includes the following circuits:

- Baro sensor
- EOP engine oil pressure sensor
- APP sensor

The shared 5 volt reference “B” circuit includes the following circuits:

- APP sensor
- MAF sensor
- AC pressure sensor
- FTP fuel tank pressure sensor
- Cam sensor bank 1 intake
- Cam sensor bank 1 exhaust
- Cam sensor bank 2 intake
- Cam sensor bank 2 exhaust

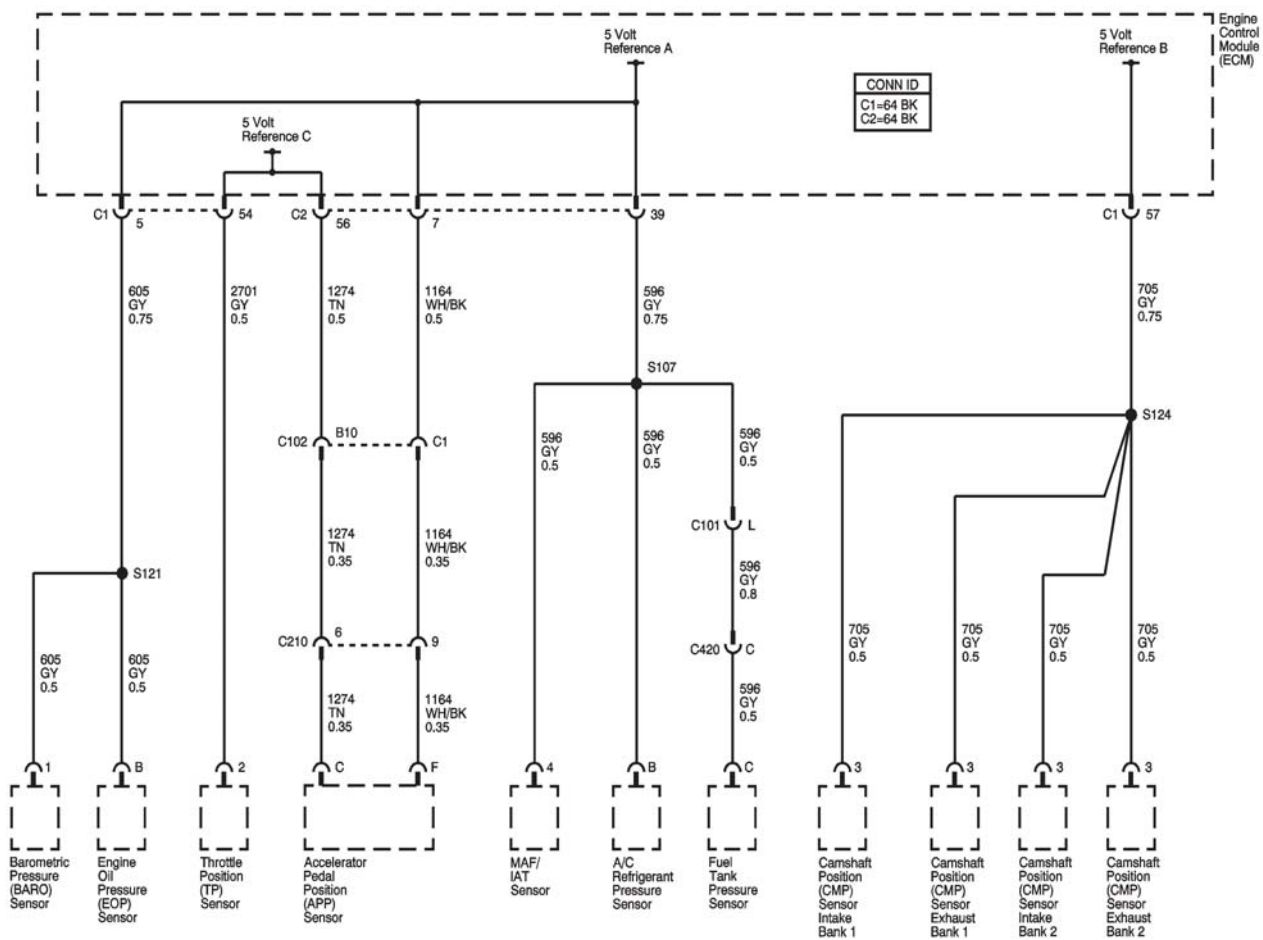
Reference “C” Includes:

- TAC monitor

5L40/50E, 4T60E

3.6L (LY7) or 2.8L (LPI)

Shared 5-Volt Reference Circuit



4T40E/45E

No Upshift

1996-2003

The transmission will not upshift when the shift lever is placed in OD range. If the selector is placed in another gear range the transmission may shift but it may not have all of the shifts desired. As an example, if the shifter is placed in M3 the transmission may only shift as high as 2nd gear.

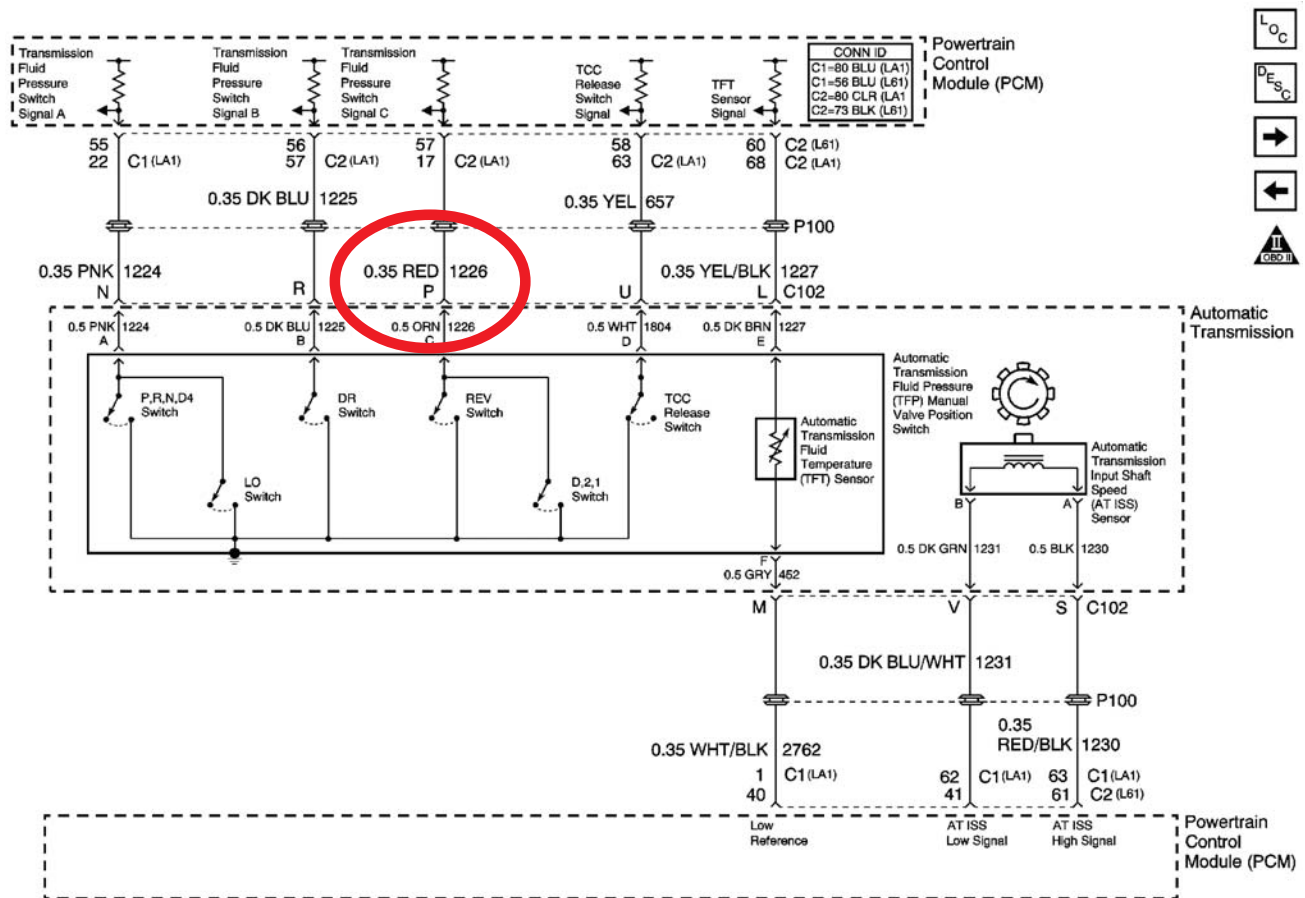
Like other GM transmission applications, the pressure switch assembly is a major input to the PCM regarding shift patterns. If circuit 1226 pin C becomes shorted to ground the voltage on the circuit will remain low all the time. This will be interpreted by the PCM as M1 range even though the range selector is in OD range. When placed in M3 range the PCM will interpret the range as M2. This type of failure will not set a DTC as the sequence is considered a valid PSA sequence. When monitoring the values with a scan tool you will note that the value remains low for all ranges selected. By comparing to the chart below, you will see the voltage should be high when M3 or OD ranges are selected. If you encounter the condition disconnect the transmission electrical connector while monitoring the PSA scan values. If circuit C goes to a HI status, the short to ground is located within the transmission internal harness or the PSA. If circuit 1226 pin C stays LOW, the short to ground is located between the transmission electrical connector and the PCM. Repair as necessary.

PSA OPERATION SEQUENCE								
Range Indicator	Fluid Pressure					Circuit		
	REV	PRND4	DR	D21	LO	A	B	C
PARK/NEUTRAL	0	1	0	0	0	LOW	HI	HI
REVERSE	1	1	0	0	0	LOW	HI	LOW
OVERDRIVE	0	1	1	0	0	LOW	LOW	HI
Manual THIRD	0	0	1	0	0	HI	LOW	HI
Manual SECOND	0	0	1	1	0	HI	LOW	LOW
Manual FIRST	0	0	1	1	1	LOW	LOW	LOW
1 = Pressurized 0 = Exhausted LOW = 0 volts HI = Ignition voltage								

4T40E/45E

No Upshift (continued)

1996-2003



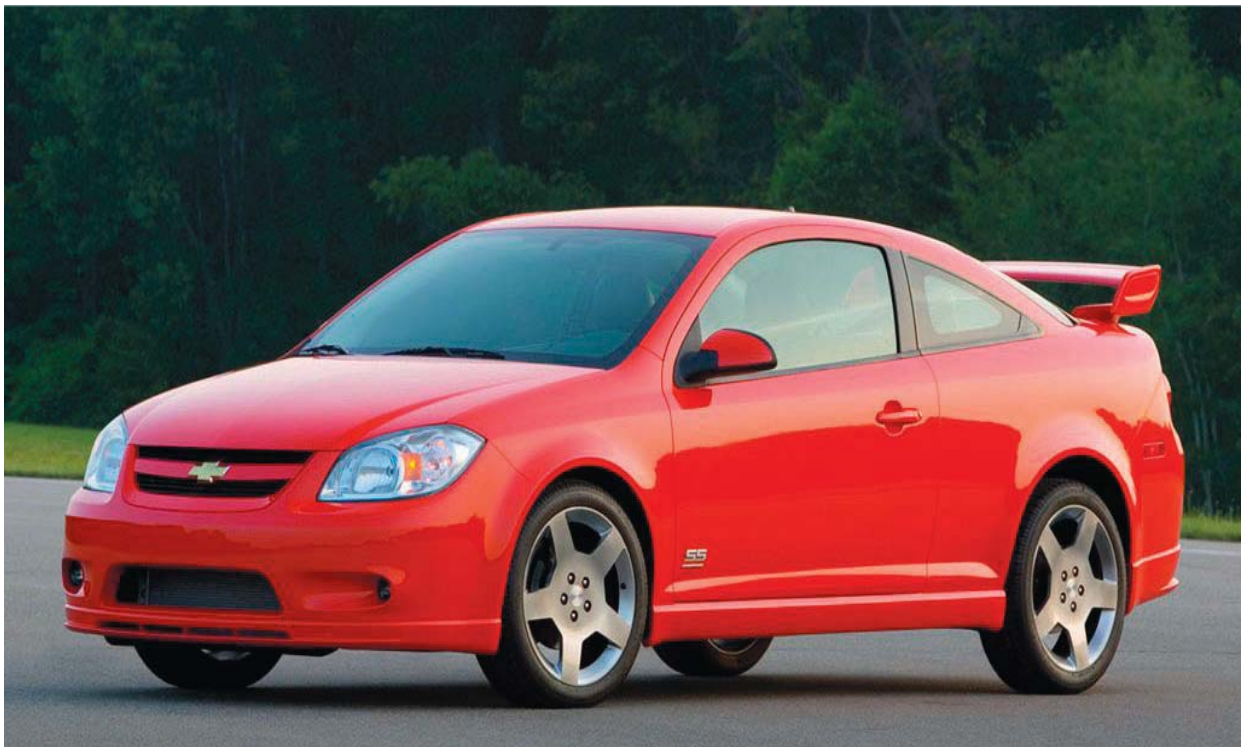
Circuit 1226 is for the reverse pressure switch and is connected to Pin "P"

4T40E

“A” Car Transaxle Characteristics

The “A” body style was introduced in 2005 as the Chevrolet Cobalt, Saturn Ion and Pontiac Pursuit. These applications are equipped with a 4T40E transaxle. The programming for this transmission varies slightly from some of the 4T40E applications. The transaxle is programmed to perform as follows:

- The low traction light will illuminate (if the car is equipped with ABS) anytime the transaxle is placed in M1 position
- The transaxle will upshift out of M2 into third at speeds above 40 MPH
- The transaxle will upshift out of M1



4T40E

“A” Car DTC P2138 Set

Some Chevrolet Cobalt, Pontiac Pursuit applications may experience any or all of the following concerns:

- APP DTC P2138 set
- Possible DTC's P0532 (A/C), P1681 (TP/ECM) may be set
- Low power message
- Poor drivability
- Limp home mode
- Transmission shift timing complaints
- A/C compressor may be inoperative

P2138 will set if:

- DTC's P0641, P0651, P2120, P2125 are not set
- APP is above idle position
- A voltage correlation condition exists between APP 1 and APP 2 for longer than 2 seconds

P0532 will set if:

- ECM detects A/C pressure less than 34 Kpa (4.93 psi) (less than .25 volts)

P1681 will set if:

- A control module throttle position performance issue exists

If the A/C compressor is inoperative the problem is not likely to be repaired by replacing the APP sensor pedal assembly. If the compressor is inoperative the cause is generally the A/C high pressure switch. The ECM shares the 5 volt reference circuit with the APP and A/C system. Therefore a short to ground in the A/C pressure switch or its circuit will also pull the APP 5 volt reference circuit low. Inspect the A/C pressure switch circuit and if no problem is found replace the A/C pressure switch. If an A/C problem does not exist, follow the DTC chart for the P2138 code.

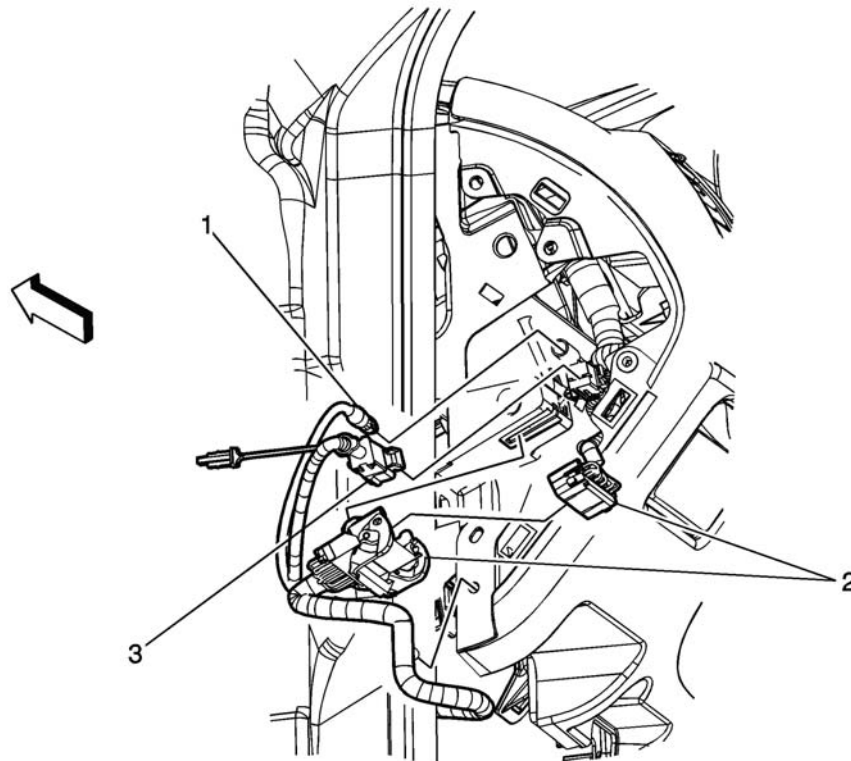
4T40E/45E

APP Sensor DTCs

Some Z car applications (Chevrolet Malibu, Pontiac G6) may exhibit various electrical related concerns including any or all of the following APP DTC's P2119, P2120, P2125, P2135, P2138 as well as possible codes related to the ETC or SVS system. In addition the SES light may be illuminated. Other electrical concerns such as head lamp, data bus, windshield wiper and radio problems may occur if the condition has been present for a long period of time, but generally the APP DTC's will be the first to set.

Inspect connector C206 located on the left side of the instrument panel, "A" pillar area for corrosion or contamination. Inspect the top of the "A" pillar area for signs of water intrusion at the ditch molding or sunroof drain areas. If moisture has penetrated the connector, the terminal pins will need to be removed and cleaned or replaced.

- 1= Radio antenna connector**
- 2= C206**
- 3= C208**



4T65E

W-Car P2138 and/or P1125 Set

Pontiac Grand Prix, Chevrolet Impala, Monte Carlo, Buick Lacrosse applications equipped with the 3.8L may set a P2138 and/or P1125. In addition, the engine may be operating in the reduced power mode which can lead to transmission shift timing complaints. On some applications the DIC (Driver Information Center) may display TCS and/or VSES messages to the driver.

P2138 will set if:

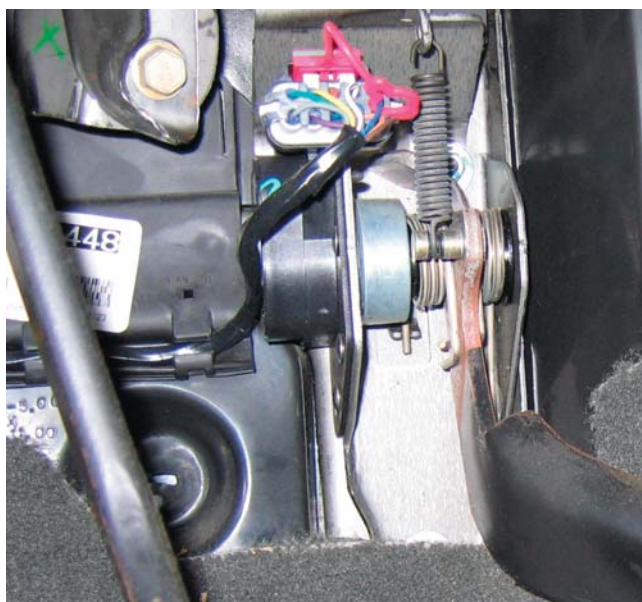
- DTC's P2107 or P2108 are not set
- The PCM determines the difference between APP 1 and APP 2 values are too great. (Greater than .269 volts)

P1125 will set if:

- DTC's P0606, P2108 and U0107 are not set
- APP values are out of range

If both the P1125 and the P2138 are set, replace the APP sensor pedal assembly

If the P1125 or the P2138 are set by themselves or if both are set in conjunction with a P2120 or P2125 inspect the wiring harness for damage. Generally the damage to the wiring harness occurs at the point where the harness is clipped to the ABS/EBCM bracket.



4T65E

P0741 or P2761, TCC Related Concerns

Buick LaCrosse/Allure, LeSabre, Park Avenue Buick Rendezvous, Terraza/Terraza EXT Chevrolet Impala, Monte Carlo, Uplander, Venture Pontiac Aztek, Bonneville, Grand Prix, Montana, Montana SV6 Saturn Relay.

Several items can cause a P0741 DTC to set. In the above scenario either a P0741 or P2761 may be set. If only P0741 is set proceed with the information listed below, if that is not successful refer to the information in the previous 2002 and 2004 ATRA seminar manuals. If a P2761 is set refer to the information described below.

P0741 will set if:

- NO VSS, ISS DTC's are set
- P0742, P1887, P2761 DTC's are not set
- Engine speed greater than 500 RPM , torque greater than 21 lb ft
- TFT 68-266f (20-130c)
- TP 4-99%
- IMS indicates range is D4, D3 or D2
- TCC duty cycle greater than 50%
- Slip speed greater than 180 RPM for longer than 7 seconds, this condition must occur twice during the key cycle

P2761 will set if:

- Engine speed is greater than 500 RPM
- The PCM commands the TCC PWM duty cycle to 70% or greater and feedback voltage remains high
- The PCM commands the TCC PWM duty cycle to 10% or less and the feedback voltage remains low
- The above conditions are present for longer than 5 seconds

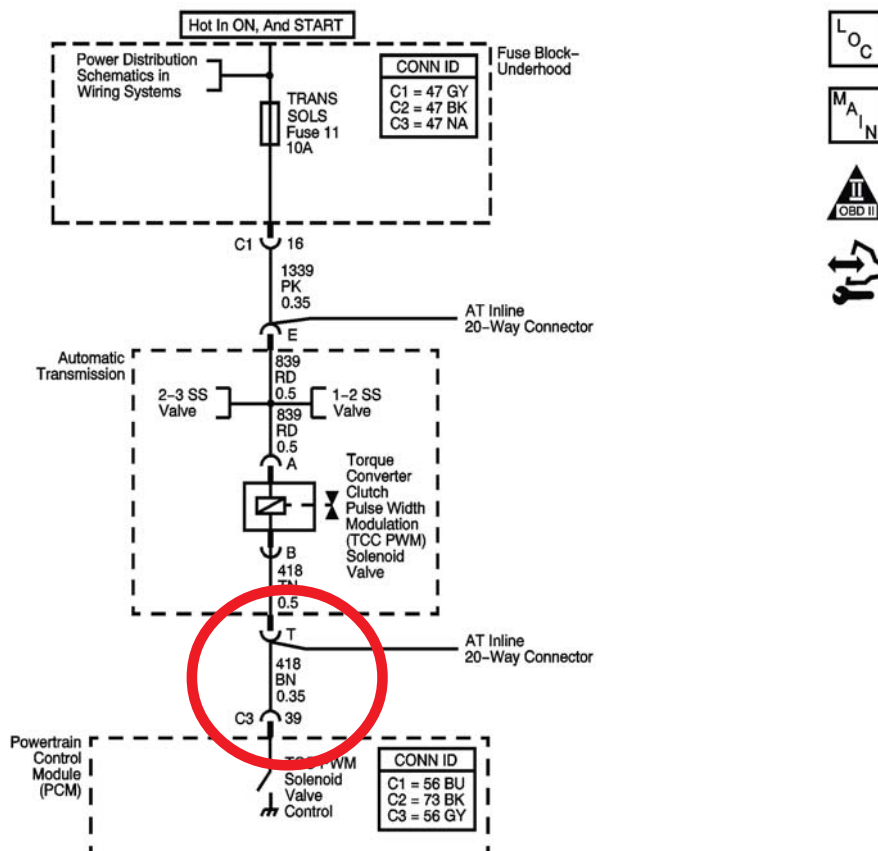
4T65E

P0741 or P2761, TCC Related Concerns (continued)

If the vehicle sets just a P2761 inspect the transmission harness for signs of damage. P2761 is typically set due to an open or short to ground in the TCC PWM circuit or solenoid. One area that has been common for this type of concern is an open in circuit 418 (Brown wire). If you remove the internal wiring harness, TPA (Terminal Position Assurance) clip and tug on circuit 418 you will generally see the terminal is loose and may it even come out of the connector.

On applications that are setting a P0741 it is highly unlikely that an electrical condition will cause the DTC to set, but it is possible if a high resistance condition is present. If you are unable to address the concern by inspecting the items highlighted in previous ATRA seminar manuals inspect circuit 418 for the condition described above.

If circuit 418 is found to be defective replace the terminal or the harness. Harness part number 24229643 is available from GM.



4T65E

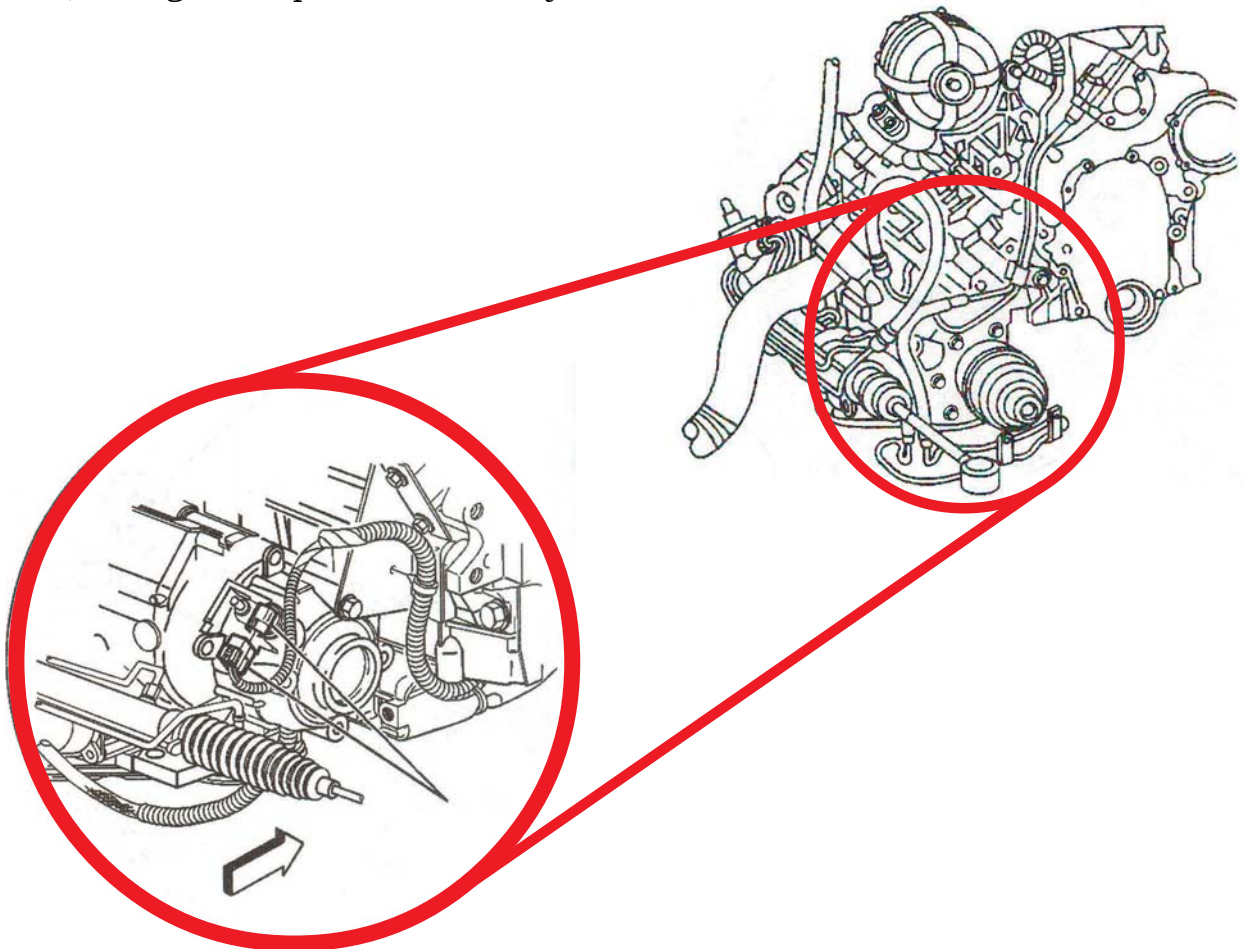
Intermittent Speedometer, Erratic Shifts

W Car Applications

Some W car (Monte Carlo, Impala, Grand Prix) applications may exhibit a condition that causes the speedometer to fluctuate or drop out intermittently. In addition, the transmission may intermittently change gears in response to the change in VSS value. VSS related DTC's may or may not be set

The VSS connector/wiring may come into contact with the power steering hose. As the engine moves in it's mounts the connector may develop an open circuit, resulting in the above condition.

Reposition the power steering hose so it can no longer come into contact with the vehicle speed sensor connector/wiring. Check the condition of the connector, pin tension, wiring and repair as necessary.



4T65E

Intermittent Hard Garage Shift

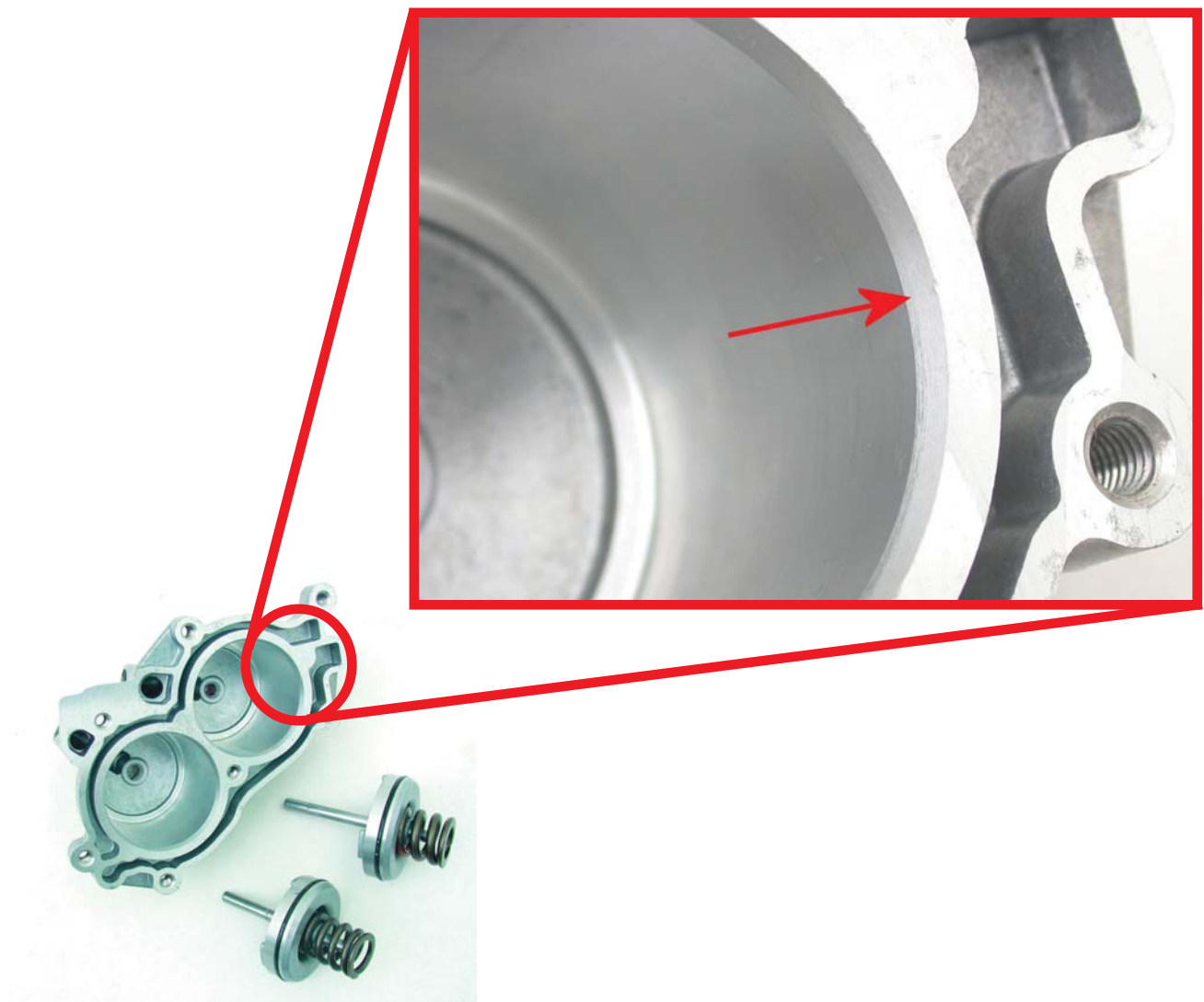
Owners of 1999-2005 GM vehicles equipped with the 4T65E may complain regarding an aggressive garage shift engagement, especially when the engine is cold.

Starting with the 1999 model year the software was changed to increase idle speed for the engine to 1100-1300 rpm for the first 30 seconds of engine run time. After the engine run timer has expired the engine speed will drop to approximately 650 RPM and the garage shift engagement will be much smoother. The update was done to reduce emissions during cold start conditions. This should be considered a normal condition and corrective action should not be attempted.

4T65E

2006 Updates

1-2 and 2-3 accumulator housing bore machining process has been updated. One of the areas that can cause clutches to burn/slip or shudder during apply is the chamfer depth and angle machined into the accumulator housing. The updated accumulator housings have changed the angle of the chamfer from 15 degrees to 10 degrees. In addition, the depth of the chamfer has been changed from 2.7mm deep to 1.8 mm deep. The updated housing will back service previous model year applications.



4T65E

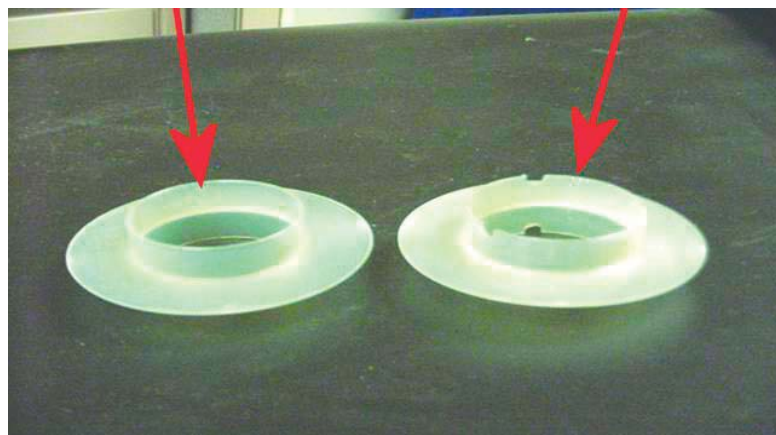
2006 Updates (continued)

A new input sun gear bearing and lube dam will be released in 2006 to enhance lube flow to the planetary and lower the stress on the race from axial load. The updated bearing no longer has 3 lube notches in its inner race. The updated lube dam contains three lube slots and is designed to be used with the updated bearing. The updated lube dam part number is 24225905.



Previous

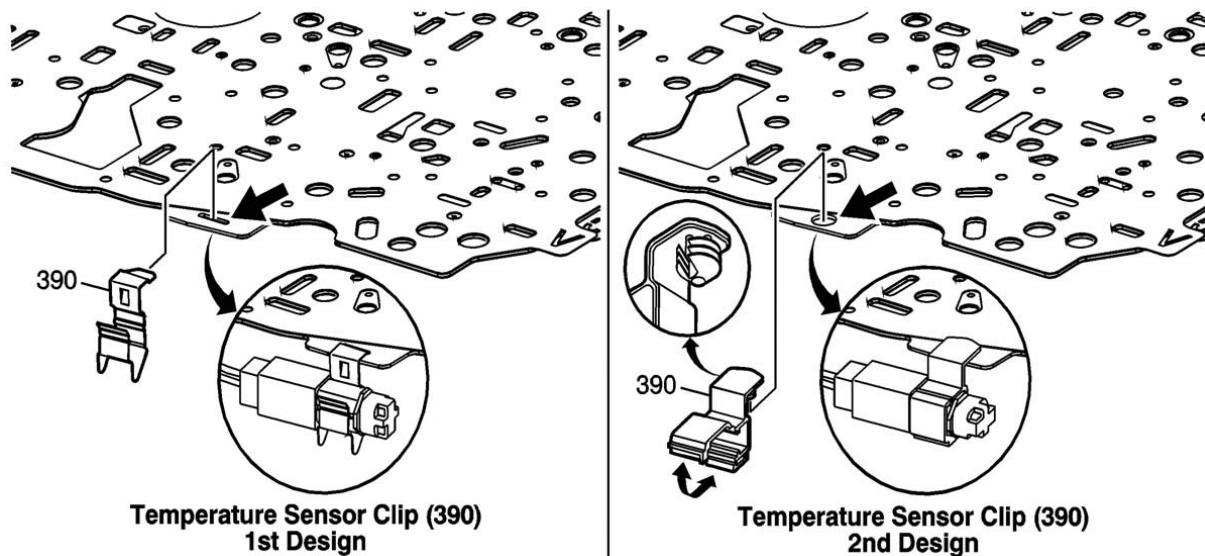
New



4T65E

2006 Updates (continued)

Another running change will be available for the 4T65E. This change includes both an update to the spacer plate as well as an update to the temperature sensor mounting clip. The updated mounting clip is designed to make assembly easier. To install the updated clip an updated spacer plate must also be installed. The updated spacer plate is identical to the previous design except for the area where the clip mounts.



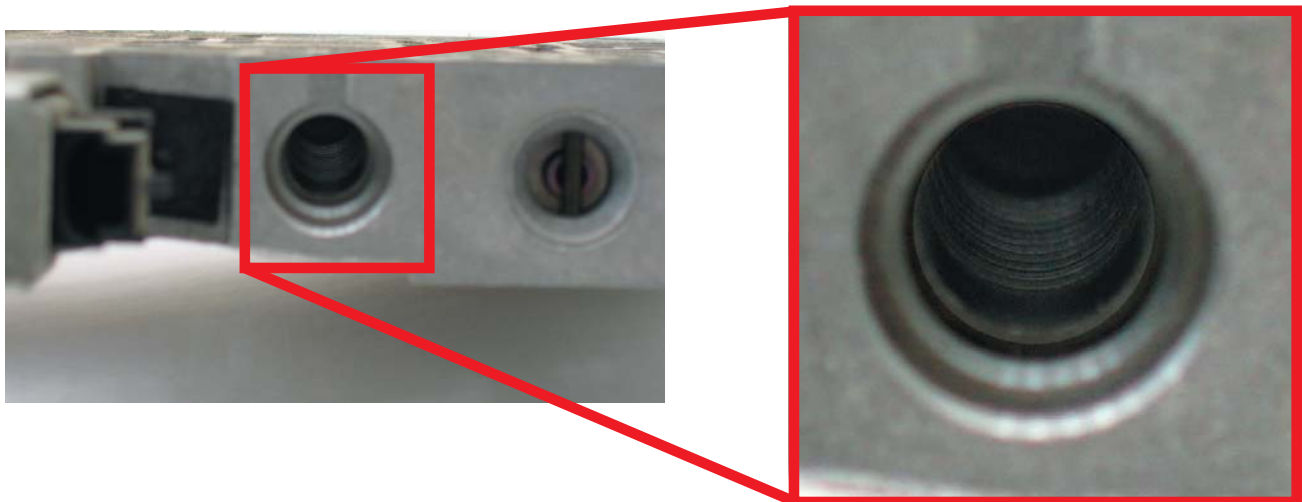
4T80E

3rd Gear Start, No 3rd Gear or Shift Related Concerns

4T80E transmissions may exhibit one or more of the following concerns:

- 3RD gear starts, even though the PCM is commanding the transmission to start in 1st gear
- No 3rd gear, even though the PCM is commanding the transmission to shift to 3rd gear
- No 2nd or 3rd gear even though the PCM is commanding the transmission to those gears
- Incorrect Ratio DTC's set

Remove the 2-3 shift valve and inspect the bore and valve for signs of wear. In most instances the bore starts to score which leads to the shift valve related concerns. To repair the condition, the Lower valve body will require replacement. At this time no one is making service tools to address this issue. Prior to replacement, contact the various companies to be sure service kits are not available to address this concern.



4L60E/65E, 4L80E/85E, NP 236/246

4wd Service Lamp On, DTC C0327 Set

One of the most common problems with the NP126/NP136/NP 236/NP 246/ NP263 transfer case applications is a loss of 4wd and T- case operation. In addition to an inoperative 4wd system the service 4wd lamp may be illuminated. The customer may also comment that the LED's located in the selector switches are blinking and they may hear a grinding noise coming from the front axle area. Any combination of DTC's may/may not be set such as P0452, P0453, P0461, P0462, P0464, P0836, P0500, P1875, U1088, B0790, C0186, C0196, C0300, C0305, C0306, C0321, C0327, C0359, C0374, C0379, C0455, or C0550 which can be stored in various modules such as the PCM, TCM, TCCM or BCM. Typically the DTC that is most common is a C0327 and it can be accessed by communication with the TCCM via a scan tool.

A C0327 will be set if:

The TCCM expects to see a valid voltage sequence from the Transfer case encoder motor sensor based on the input it receives from the range selector buttons. The DTC will set if the value falls outside of the value it expects to see.

If a C0327 sets the TCCM will:

- Lock the T case in the position it was in at the time the problem occurred as the TCCM will no longer command shifts to occur. This condition may lead to a lack of 4wd operation.
- Illuminate the Service 4WD lamp for the remainder of the key cycle

4L60E/65E 4L80E/85E NP

236/246

4wd Service Lamp On, DTC C0327 Set (continued)

Multiple items can cause the above related concerns including any of the following:

AREA OF CONCERN	INSPECT FOR	REPAIR
Software Mode Lockout		Remove the Fuse, generally called out as the TREC located in the engine compartment fuse block Reinstall the fuse after 30 seconds
Software update	Updates	Updates have been released for some applications
Moisture intrusion (C/K truck)	Corrosion on the TCCM connector pins	Replace the damaged pins, Locate the leak, generally the windshield seal and repair
Internal T- case Damage	Metal in the fluid	Repair as necessary Inspect bearings, and shift lever closely. Inspect for shift lever over travel Inspect clutches for wear
TCCM Harness Damaged/pinched	Inspect for damage in the park brake cable release spring area	Repair the harness
Encoder motor Terminals	Inspect the condition and pin tension for the encoder motor connector	Replace the terminal
TCCM, Body and Chassis Grounds	Inspect/measure voltage drop/clean the following: faulty grounds Pay special attention to G110 and G203. Also inspect the following, G101, G102, G103, G105 G106, G107, G108, G109 G201, G302, G303, G304 G305, G306, G401, G402 A ground problem in another circuit can cause TCCM problems as the other circuit may seek ground through the TCCM and it's circuits.	Clean/ Repair/ Replace

4L60E/65E 4L80E/85E NP

236/246

4wd Service Lamp On, DTC C0327 Set

AREA OF CONCERN	INSPECT FOR	REPAIR
TCCM and Under hood Relay center	Check pin tension and terminal condition at the TCCM connectors Pay close attention to Terminal A7 in connector C1. Inspect relay center pins	Repair, replace damaged terminals
C-151 (Some Applications)	Inspect connector C151 for corrosion/damage Located at Left fender well area	Repair/replace terminals
C-101 (Some Applications)	Inspect connector C101 for corrosion/backed out Located in the under hood Fuse block area	Repair/replace terminals. Reroute the harness to remove stress
Encoder Signal voltages	Measure encoder voltages compare to the charts in the service manual. Measure voltage for each range.	Repair the circuit, wiring or replace the Encoder assembly
Encoder/sensor installation	Encoder was not properly timed or sensor was installed incorrectly	Properly time and install sensor or encoder motor correctly
Front axle damage	Inspect the front axle	Repair/replace the Shift fork, shift sleeve

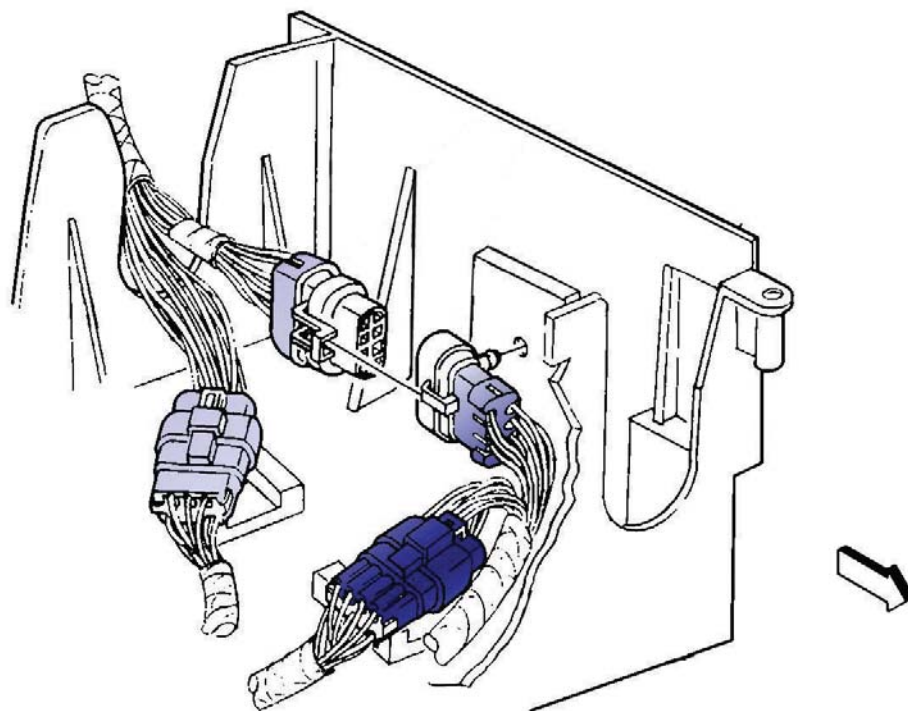
4L60E/65E, 4L80/85E, LCT 1000

PRNDL Inoperative

The PRNDL may be inoperative or it may only operate intermittently. On some applications such as the LCT 1000 you will not be able to communicate with the TCM when using a scan tool.

Circuit 2470 (Yellow wire) may be damaged or the terminal may be backed out of connector C-100. Circuit 2470, terminal "R" may be pulled partially out of the connector.

Locate connector C-100 terminal R (Located in the IP to engine harness under the fuse block) (UBEC). Install the terminal back into the connector and inspect the wiring for damage. Reposition the harness to eliminate the strain on the wiring.



4L60E/65E

Flare On the 2-3 Shift

4L65E/60E applications may exhibit a 2-3 shift flare. This condition may be present prior to you working on the vehicle or it may develop after you have replaced hard parts during a rebuild. Some of the items that can cause a flare will also lead to 3rd clutch damage while others will not cause clutch damage. Some of the items listed will also lead to 2-4 band failure as well as 3-4 clutch distress.

Several items may cause this concern including:

- Leaking clutch piston seals
- Leaking input shaft seal rings
- Incorrect clutch clearance
- Debris in orifice #7
- The sleeve in the pump stator support may have rotated slightly
- Leak in the 2-4 band release circuit
- Incorrectly assembled 3-4 clutch assembly
- Orifice cup plug missing/damage in input housing or the servo bore
- Check ball capsule not sealing in input housing
- Cracks in the input shaft seal ring area
- Damaged/faulty/leaking 3rd accumulator check valve
- Leaking check ball located in the end of the input housing
- Incorrect pump or pump parts
- Damaged/warped case or valve body
- Incorrect spacer plate or gaskets
- Sticking 2-3 shift valve or damaged/cracked 2-3 shift solenoid
- 3-4 clutch feed hole in the input housing may be incorrectly machined. The chamfer for the hole may be too large which exposes it to the area where the seal groove is machined in the housing. This will cause the clutch to leak. This is fairly common on some of the later model applications and you should inspect for this condition as part of your rebuild or prior to installing a new input housing.
- Incorrect Pressure rise

4L60E/65E

Flare On the 2-3 Shift (continued)

3-4 Clutch feed Hole



3-4 clutch feed hole in the input housing may be incorrectly machined. The chamfer for the hole may be too large which exposes it to the area where the seal groove is machined in the housing. This will cause the clutch to leak. This is fairly common on some of the later model applications and you should inspect for this condition as part of your rebuild or prior to installing a new input housing.

4L60E

Lack Of Communication

ECM or TCM, Possible DTC's Set

T- Truck (Rainier, Trailblazer, Envoy, Saab) V-8 applications with the adjustable brake pedal feature, may experience scan tool communication concerns. This may include no or intermittent communication with the PCM and/or TCM. If you are able to scan the vehicle you may find any/all of the following DTC's set:

- P0700
- U0101
- U0073
- U0001
- U2100
- U2105

Inspect the 121 ohm GM LAN terminating resistor located in the harness near the DLC. Locate the terminating resistor and inspect the insulating tape. In many instances the resistor may become damaged from the movement of the adjustable brake pedal. If the resistor is touching ground, or if the resistor appears as though the pedal linkage has been hitting it, relocate the resistor and cover it with fresh tape.

ECM or TCM, Possible DTC's Set



4L60E/65E

2006 Updates

A new design bearing in position #31 (Input sun gear to carrier) will be available as a running change for the 4L65E/60E applications. The new bearing offers a significant reduction in race/retainer stress while improving bearing life. The updated bearing will back service previous applications.



4L60E/65E

2006 Updates (continued)

A new design extension housing seal is planned as a running change for the 2wd applications. This new seal is designed to improve high mileage dependability and will back service the previous applications. The updated seal coating is tan in color.



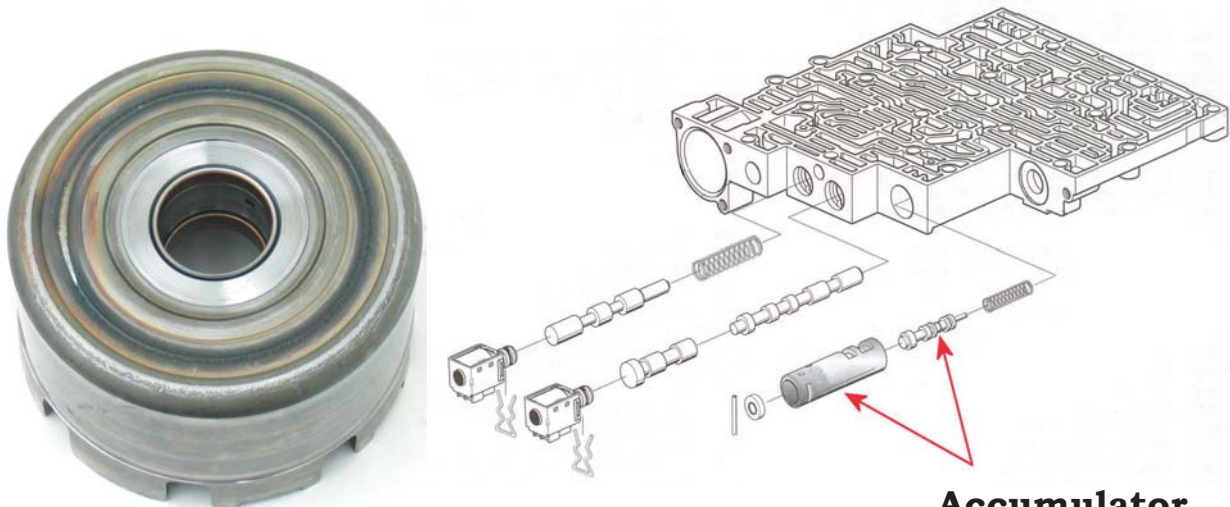
4L60E/65E

I-2 Shift Shudder

4L60E/65E applications may exhibit a shudder on the 1-2 shift. Generally you will not notice this condition during the 3-4 shift and if it does occur it will be less pronounced. This condition may get worse with use and may not have occurred until you replaced hard parts during and overhaul.

Several items may cause the above condition including:

- Valve body face warped
- Defective PCS
- Worn boost valve and sleeve
- Leaking/cracked 1-2 solenoid
- 1-2 shift valve sticking, sediment is a common issue
- Accumulator valve sticking
- Accumulator sleeve rotated in the valve body
- 1-2 accumulator piston cracked, damaged, leaking seal, worn pin hole
- Accumulator housing damaged, Porous
- Servo apply pin length incorrect
- Servo seals damaged leaking
- Servo bore damaged, porous
- 4-3 sequence valve, 3-4 relay valve sticking
- 3-2 downshift valve sticking/leaking
- Gasket or spacer plate mispositioned or incorrect
- Wrong band material
- **Warped/out of round reverse input housing. We have been seeing some with as much as .030" warpage/out of round. Replacing the drum and band will generally fix the concern. Common on 2003-2005 models**



**Accumulator
Valve and Sleeve**

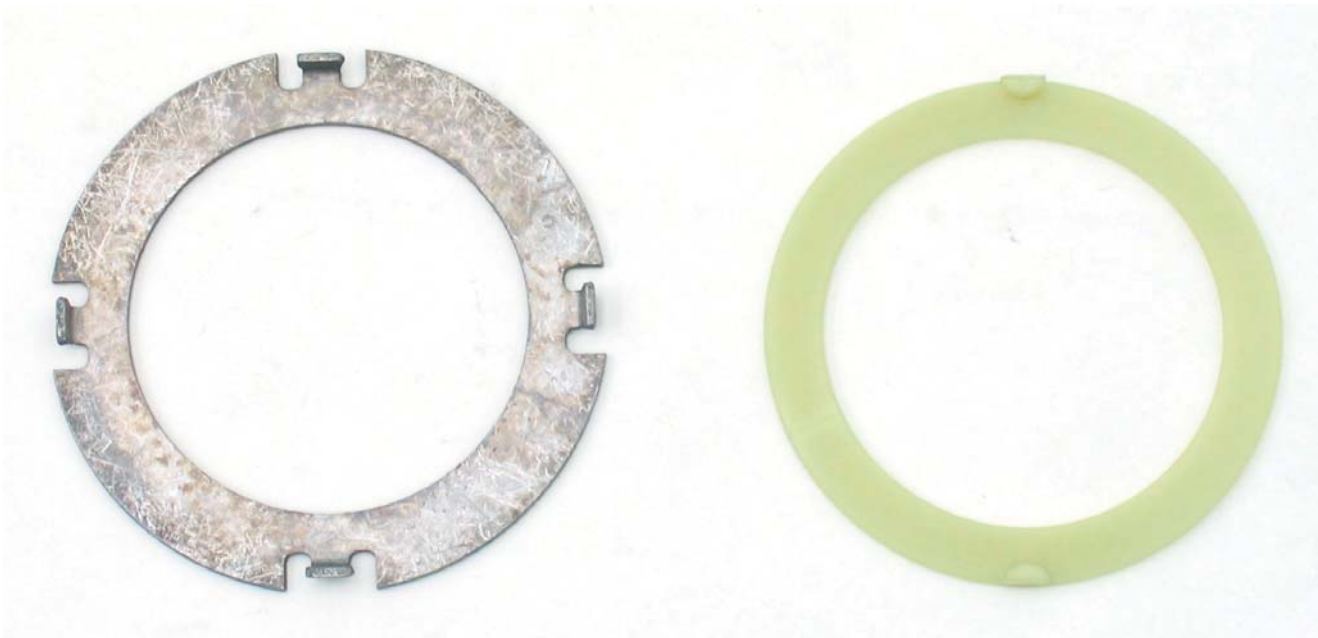
4L80E/80EHD/85E

Planetary Carrier Service

2001 and earlier 4L80E/4L80E HD/4L85E applications utilized an output planetary carrier that may appear different in appearance when compared to later applications or the service replacement part.

Early applications were machined to fit a steel thrust washer that utilized 4 tabs. The later model and service part was manufactured to accept a 2 tab thrust washer. The new thrust washer is plastic rather than steel.

NOTE: Both parts are interchangeable, however you will have to remove 2 of the tabs from the steel washer in order to adapt it to updated carrier. If you install the plastic washer no changes will be required.



Steel Washer: Part # 8626372

Plastic Washer: Part #24214809

4L80E/85E

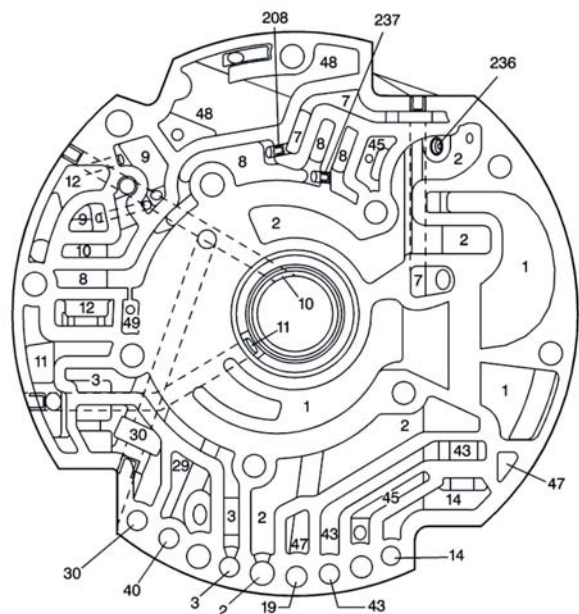
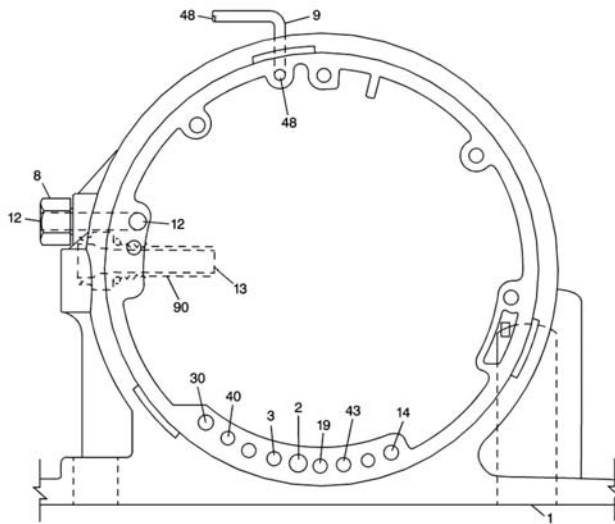
Updated Pump Cover

An update to the pump cover occurred for 2004-06 model years on all 4L80E/85E applications. The pump cover part number was changed to accommodate interim case changes that occurred. The following part numbers for the pump cover based on model year.

These parts are not interchangeable.

1997-2003 24204303

2004-2006 24232405



6L80 (RPO MYC)

Introduction

The first of ten 6 speed automatics has been introduced for the 2006 model year. The 6L80 (RPO MYC) is currently available in the Chevrolet Corvette, Cadillac XLR-V and the Cadillac STS-V applications. The 6L80 will be introduced into several “up level” SUV applications for the 2007 model year. The 6L80 is built in the Willow Run plant in Ypsilanti Michigan. The new plant utilizes several industry first technical innovations and production processes and is unlike any other assembly plant in the world.



6L80 (RPO MYC)

Introduction (continued)

The 6L80 is equipped with the following features:

- RPO MYC
- Input torque capacity 430 lb ft (583 Nm)
- Output torque capacity 664 lb ft (900 Nm)
- Ratios
 - 1st – 4.02-1
 - 2nd – 2.36-1
 - 3rd – 1.53-1
 - 4th – 1.15-1
 - 5th – .85-1
 - 6th – .67-1
- Maximum shift speed 6500 RPM
- Maximum GVW 8600 lb
- Maximum GCVW 14000 lb
- PRNDL positions P, R, N, D, (S or M)
- 2 shift solenoids used (On/Off Design), SS1,SS2
- 6 PWM controlled pressure control solenoids, PCS, PCS1, PCS2, PCS3, PCS4, PCS5, TCC
- 32 bit TCM mounted internal to the transmission on the valve body (Referred to as the “control solenoid valve assembly”) TCM incorporates Solenoids, pressure switches, TFT and it is bolted to the valve body using 6 bolts.
- EC3 Converter 300mm (Corvette) 258mm twin plate (XLR-V and STS-V)
- Fluid required, Dexron VI
- Fluid capacity, 9.5L (10 qts.) model 6CDA, 9.7L (10.2 qts.) model 6CZA, 11.9 L (12.6 qts.) model CYA
- Clutch to clutch shifts, 5 clutches, 1 sprag
- Planetary assemblies, input (Simpson) Output (Dual pinion design)
- Vane style oil pump
- Internally mounted TISS and TOSS hall effect type speed sensors
- Internal Mode Switch (IMS) equipped
- Performance Algorithm Shifting (PAS) programming
- Performance Algorithm Lift foot (PAL) programming
- Sport mode and TAP shift equipped
- Adaptive Strategies with fast learn capabilities
- 75 transmission only DTC’s Learn diagnostic process used

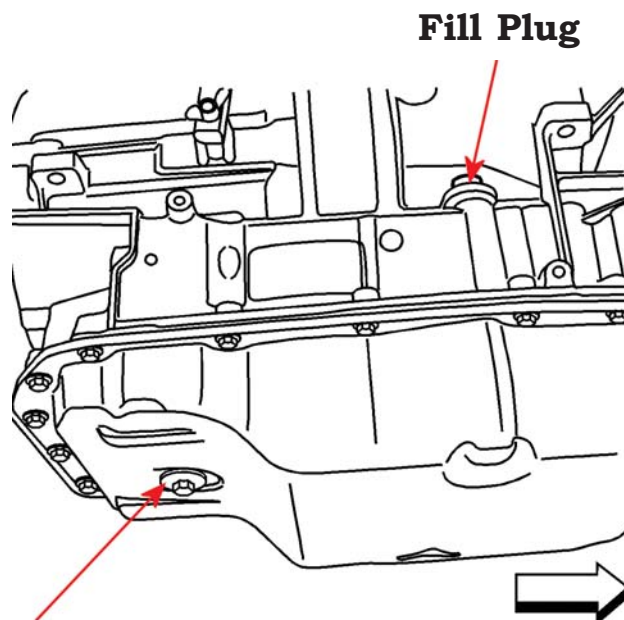
6L80 (RPO MYC)

Checking the Fluid Level

The 6L80 transmission utilizes a very unique process for checking the fluid levels. Most 6L80 applications do not utilize a dipstick. Instead a plug has been placed into the dipstick hole. The plug can be removed and the hole can be used as a fill point for transmission fluid. To check the fluid level the following procedure should be followed:

- The transmission temperature must be between 86-122 °F (30-50°C) a scan tool, the driver information center or the transmission gauge can be used to verify the temperature
- Start the engine and let it idle, Shift the transmission in and out of range pausing in each range for approximately 3 seconds
- Place the transmission in park range
- With the vehicle level, remove the level control plug located in the transmission oil pan.
- If fluid does not drip from the level control hole, add Dexron VI fluid until fluid starts to drip from the hole. If fluid runs from the hole wait until the fluid stops running from the hole. The level is correct when fluid drips slightly from the hole. If a steady stream is present or no flow is present the fluid level is incorrect. Install the fill plug and the level control plug.

NOTE: Fluid may be added through the dipstick hole or through the level control hole.



Level Control Plugs

6L80 (RPO MYC)

Component Application Chart

RANGE	PARK	REV	NEUTRAL	1ST BRAKING	1ST	2ND	3RD	4TH	5TH	6TH
1-2-3-4 Clutch				ON	ON	ON	ON	ON		
3-5 Clutch		ON					ON		ON	
4-5-6 Clutch								ON	ON	ON
2-6 Clutch						ON				ON
L/R Clutch	ON	ON	ON	ON						
Low Sprag				ON	ON					

6L80 (RPO MYC)

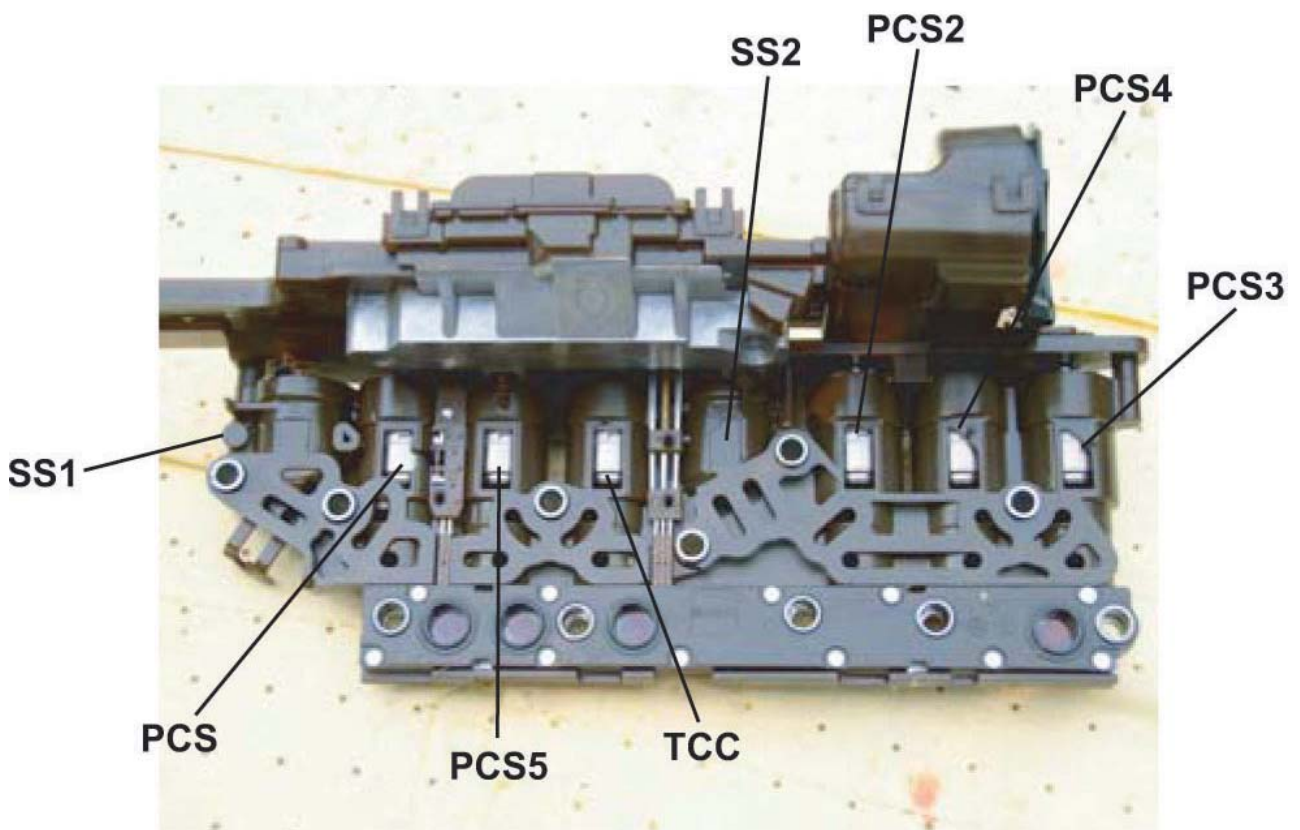
Control Solenoid Operation

GEAR	Shift Sol 1	Shift Sol 2	1-2-3-4 Clutch Pres Control Solenoid Solenoid 5	2-6 Clutch Pres Control Solenoid Solenoid 4	3-5 Clutch Pres Control Solenoid Solenoid 2	Low/Rev 4-5-Clutch Pres Control Solenoid Solenoid 3
PARK	ON	ON	OFF	OFF	OFF	ON
REV	ON	OFF	OFF	OFF	ON	ON
NEU	ON	ON	OFF	OFF	OFF	ON
1 st Braking	ON	ON	ON	OFF	OFF	ON
1st	OFF	ON	ON	OFF	OFF	OFF
2nd	OFF	ON	ON	ON	OFF	OFF
3rd	OFF	ON	ON	OFF	ON	OFF
4th	OFF	ON	ON	OFF	OFF	ON
5th	OFF	ON	OFF	OFF	ON	ON
6th	OFF	ON	OFF	ON	OFF	ON

SHIFT PRESSURE CONTROL SOLENOID ON=PRESSURIZED, OFF= NO PRESSURE
 SHIFT SOLENOIDS, ON= PRESSURIZED, OFF= NO PRESSURE

6L80 (RPO MYC)

Shift and Control Solenoids



6L80 (RPO MYC)

IMS Operation

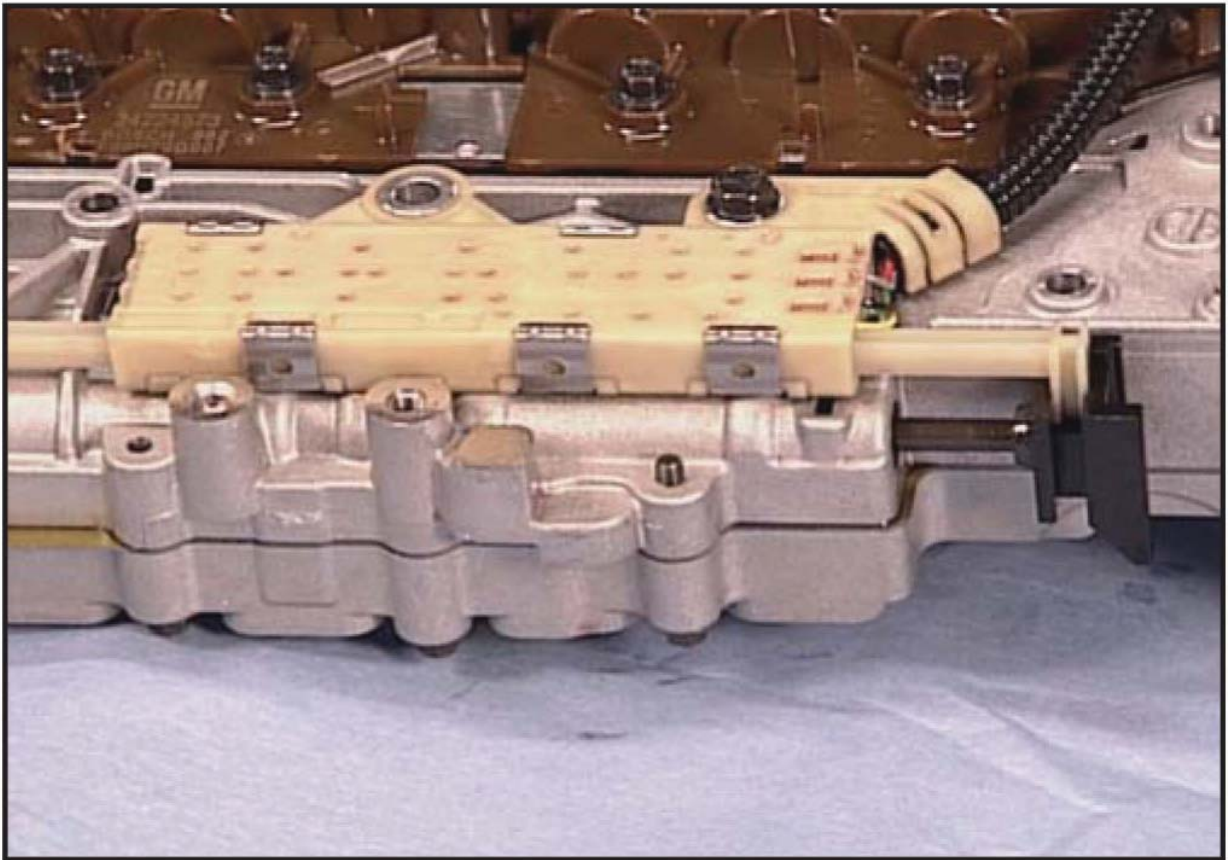
INTERNAL MODE SWITCH LOGIC				
GEAR SELECTOR POSITION	SIGNAL A	SIGNAL B	SIGNAL C	SIGNAL P
PARK	LOW	HIGH	HIGH	LOW
PARK/REV	LOW	LOW	HIGH	LOW
REV	LOW	LOW	HIGH	HIGH
REV/NEU	HIGH	LOW	HIGH	HIGH
NEUTRAL	HIGH	LOW	HIGH	LOW
NEU/D6	HIGH	LOW	LOW	LOW
D6	HIGH	LOW	LOW	HIGH
D6/D4	LOW	LOW	LOW	HIGH
D4-(S)	LOW	LOW	LOW	LOW
D4/D3	LOW	HIGH	LOW	LOW
D3	LOW	HIGH	LOW	HIGH
D3/D2	HIGH	HIGH	LOW	HIGH
D2	HIGH	HIGH	LOW	LOW
OPEN	HIGH	HIGH	HIGH	HIGH
INVALID	HIGH	HIGH	HIGH	LOW
INVALID	LOW	HIGH	HIGH	HIGH

NOTE: High= 12 volts, Low= 0 volts

NOTE: Not all applications utilize all ranges shown

6L80 (RPO MYC)

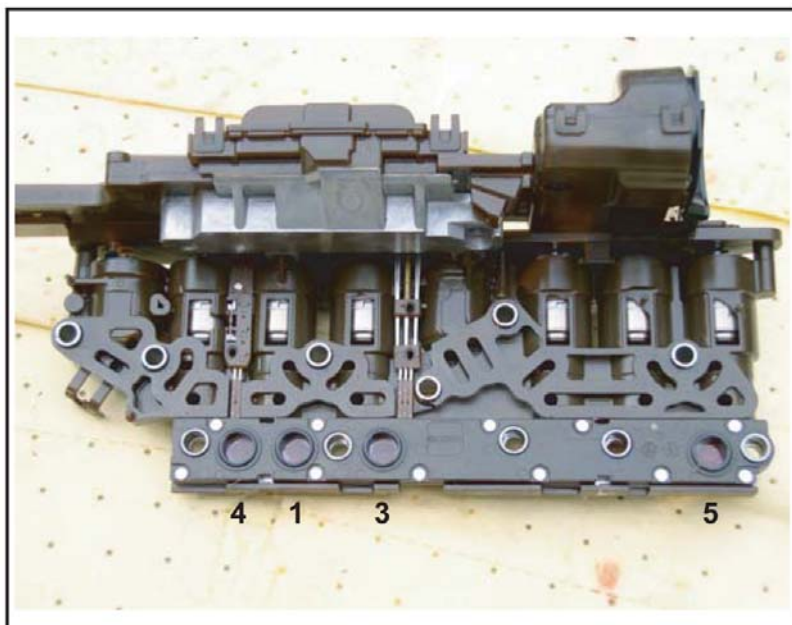
Transmission Manual Shift Shaft Switch



***Transmission Manual Shift Shaft Switch
Assembly***

6L80 (RPO MYC)

Transmission Fluid Pressure Switch



TFP Switches

TFP SWITCH	CLUTCH MONITORED
1	3-5 clutch
3	2-6 clutch
4	1-2-3-4 clutch
5	4-5-6 clutch Low/Rev Clutch

6L80 (RPO MYC)

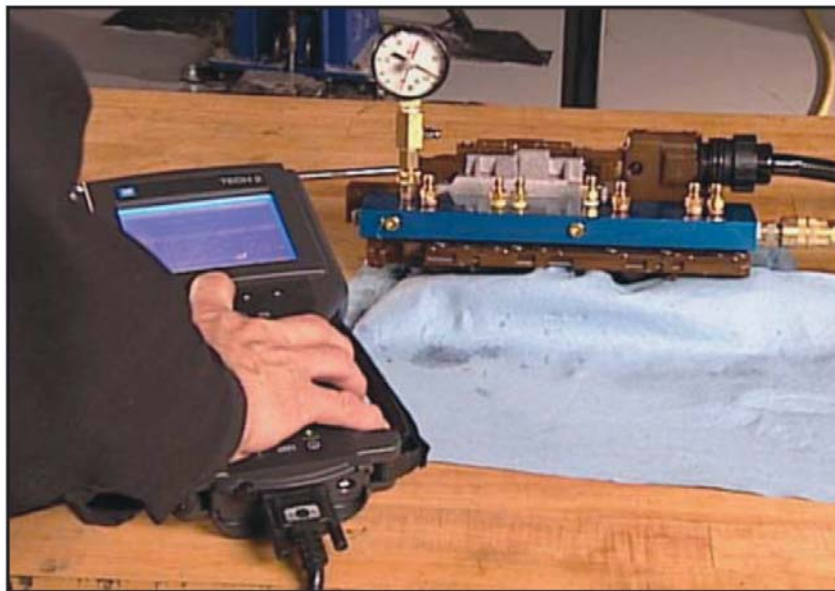
Solenoid and Valve Body Diagnosis

Solenoid and valve body diagnosis requires the following tools:

- A quality scan tool capable of communicating and commanding the TCM and it's solenoids.
- Tool number J 47825-1 Solenoid test plate and jumper harness

Remove the Control Solenoid Valve Assembly from the transmission. Install tool J47821-1 onto the Control Solenoid Valve Assembly (5Nm 44 Lb In). Apply regulated shop air (90-100 psi) to the tool. Connect the scan tool to the Control Solenoid Valve Assembly.

- Command the solenoid ON/OFF air pressure should be present on the gauge and then it should exhaust as the solenoid is cycled. If the solenoid or valve are malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly.
- If the solenoid checked OK, install the gauge on another solenoid port and command that solenoid ON/OFF with the scan to repeat the process.



6L80 (RPO MYC)

Solenoid and Valve Body Diagnosis (continued)

Control Solenoid Valve Assembly Test chart	
COMPONENT	PORT ON TEST
PCS 1	G
PCS 2	C
PCS 3	A
PCS 4	B
PCS 5	F
TCC	E
SS 1	H
SS 2	D

NOTE: The TCM will normally cycle several of the solenoids ON/OFF to help keep the solenoids and the valves free of debris. Therefore this cleaning function (Dither) may cause the gauge to flicker when the TCM is cleaning the solenoid you are testing.

6L80 (RPO MYC)

Adaptive Learning

Adaptive Learning

The 6L80 is fully equipped with several adaptive learning strategies. As with some other GM applications you will need to erase the adaptive values and perform a “Fast Learn” prior to operating the vehicle. Adapts and fast learn procedures should be performed if any of the following occur:

- Internal Transmission repairs have been performed
- The valve body was replaced
- The Control Solenoid valve assembly was replaced
- The TCM was recalibrated
- Internal repairs were performed that could effect shift quality

NOTE: Fast learn is not required if a GM New or Rebuilt 6L80 is used. The transmission is fast learn prior to it being shipped from the plant

To perform a fast learn:

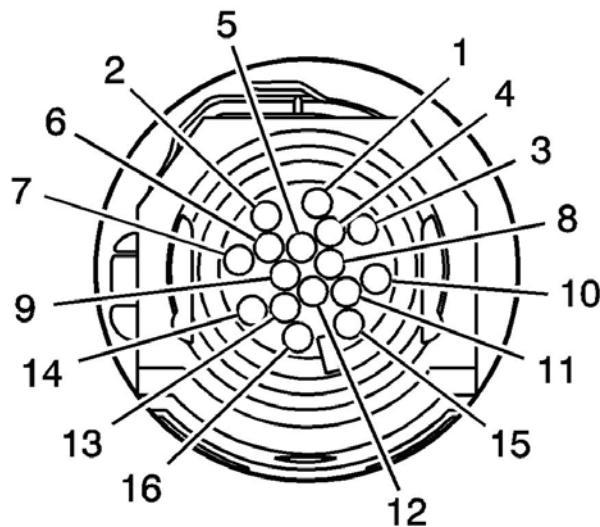
- Use a scan tool capable of performing the fast learn procedure
- TFT 158-230°F (70-110°C)
- Select Fast learn process from the scan tool menu
- Place the transmission in Drive with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume
- Place the transmission in Reverse with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume
- Shut off the engine, power off the scanner
- The process is now complete

The fast learn procedure will not run if:

- DTC's are set
- TFT is not between 158-230 °F (70-110°C)
- The brake switch is not working
- TP is 0% but engine RPM increases during the test
- P/N switch is improperly adjusted or is not functioning correctly
- Line pressure control system is malfunctioning

6L80 (RPO MYC)

Pass-thru Connector ID

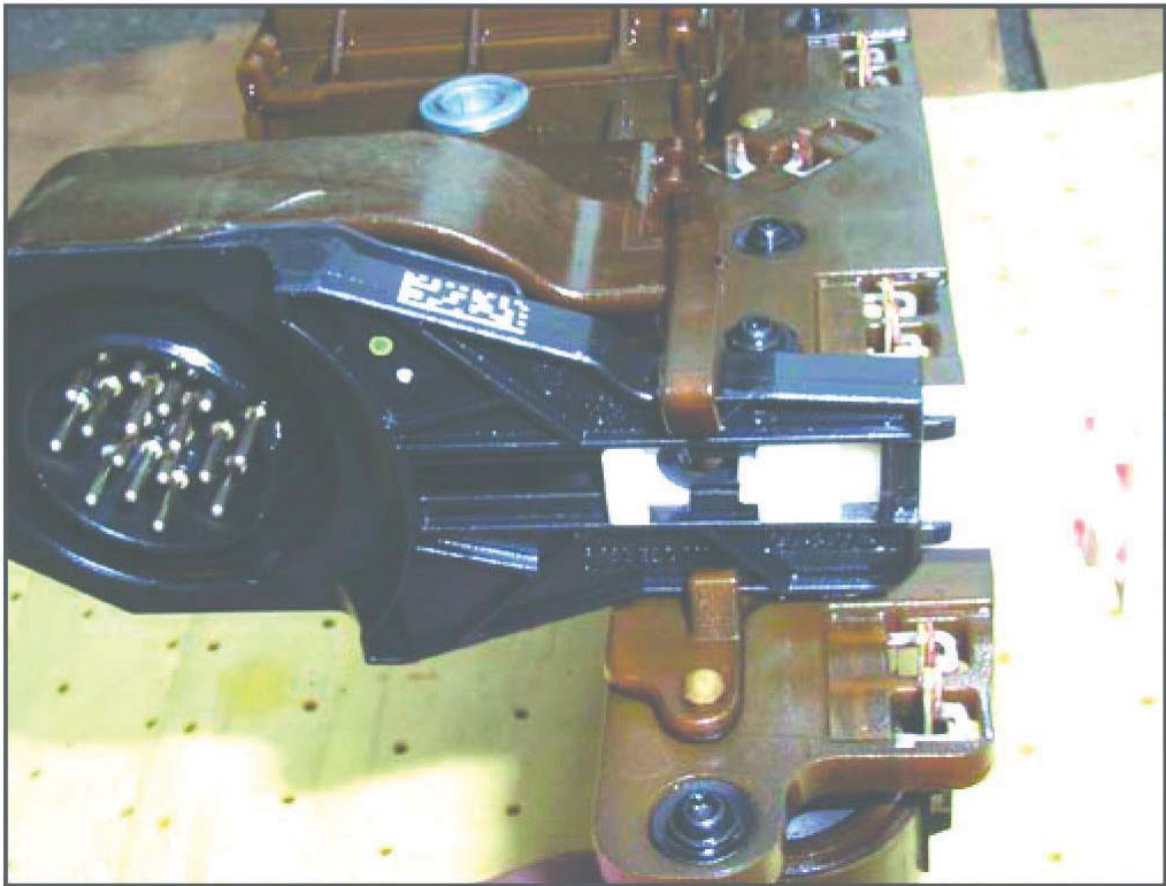


Pin	Wire Color	Circuit No.	Function
1-2	--	--	Not Used
3	OG/BK	1786	Park/Neutral Signal
4	RD/WH	2440	Battery Positive Voltage
5	BK/WH	451	Ground
6	WH	17	Brake Pedal Apply Signal
7	PU	5526	Tap Up/Tap Down Switch
8	--	--	Not Used
9	YE	43	Accessory Voltage Power
10	TN/BK	2500	CAN Hi
11	TN	2501	CAN Lo
12	PK	1339	Run/Crank Voltage
13	TN	2501	CAN Lo 2
14	TN/BK	2500	CAN Hi 2
15-16	--	--	Not Used

6L80 (RPO MYC)

Pass-thru Connector Location

The pass through connector is located on the valve body and is a hard connection to the solenoids. During disassembly of the valve body, use care in the removal of the hard wire harness and connector.



Connector and Pass-thru Sleeve

4L70E

(M70) Introduction

The 4L70E was introduced in the 2006 Chevrolet Trailblazer SS equipped with the 6.0L (LS2). The 4L70E (M70) is a heavy duty version of the 4L65E (M32) that was introduced a few years ago. The 4L70E will be used in some full size pickup applications equipped with the 6.0L (LQ9) engine during the 2006 model year.



4L70E

(M70) Introduction

The 4L70E specifications/features are as follows:

- RPO M70
- Engine horsepower capacity 400 HP
- Input torque capacity 430 Lb ft
- Gear ratios 1st 3.06-1, 2nd 1.63-1, 3rd 1-1, 4th .7-1, Rev 2.29-1
- Converter 300mm, EC3
- SUV application model codes SKD or TKD
- Pickup application model codes CMD, CWD or KMD
- Some applications are equipped with an input speed sensor assembly (Models SKD & TKD use an ISS)
- 5 Pinion planetaries
- 7 plate 3-4 clutch (7 friction, 6 steels) Premium frictions
- 2-4 Band with Premium friction material. .64 ratio servo
- Updated HD rear internal gear assembly
- Shot peened HD output shaft (8620 Steel)
- HD Low roller clutch
- HD input gear and input sprag assembly
- Input shaft equipped for an input speed sensor
- Pump stator support passages updated for input speed sensor design
- Pump casting changes updates, relocation of S3 bore for pressure regulator valve train.
- HD heat treated stator support splines

LCT 1000

Misfire, Surge, Chuggle

6.6L Duramax

Duramax Diesel applications may develop a misfire, surge or chuggle related concern that is difficult to diagnose and repair using current techniques and procedures. The complaint is sometimes misdiagnosed as being transmission related.

6.6L Duramax applications have experienced problems with coolant getting into the ECM and/or the ECM connector. The coolant wicks up the surge tank coolant level sensor and into the wiring. If other attempts to repair the concern have been unsuccessful, remove the ECM connector and inspect the connector and the ECM pins for evidence of corrosion or Dexcool contamination. If contamination is found the ECM may need to be replaced if there is evidence of any corrosion or damage. If only light residue is found you can generally clean the connector and ECM pins with electric circuit board cleaner. If coolant contamination is found, the wire and the coolant switch must be replaced. Make sure to replace the wire and the terminals.



LCT 1000

(RPO M74) PTO Applications

If the PTO option was not ordered when the vehicle was new, you may need to add additional hard parts to the transmission to allow for PTO operation on some applications. On those applications the transmissions may not be equipped with a rotating housing that has the PTO gear installed. Instead they may have a tone ring for the turbine sensor mounted to the housing. Use the chart below to identify your application:

2001-2004	6.6L LB7 (VIN 1)	PTO gear installed
2001-2006	8.1L L18 (VIN G)	PTO gear installed
2004-2006	6.6L LLY (VIN 2) Pickup	No PTO gear
2004-2006	6.6L LLY (VIN 2) Cab/Chassis	PTO gear installed

If a customer wants to install a PTO on an application that is not equipped with a PTO it will be necessary to install a PTO equipped rotating assembly part number 29540518. In addition to the transmission hardware that will need to be added, a PTO, PTO relay, PTO solenoid, a PTO switch, an updated floor pan section as well as updated calibrations for the PCM/ECM may need to be installed to make the PTO system operational.



LCT 1000

2006 Updates

Several areas have been updated for the 2006 model year. The changes were primarily designed to accommodate the higher torque capacity engine applications that were released for 2006. The 2006 part numbers are not designed to be interchangeable with the previous applications. They include the following:

Part Changed	Previous part number	2006 Part number
P1 Carrier Assembly	29531096	29541704
P1 Carrier/Bushing	29531249	29541705
P1 Carrier	29536583	29541708
P2 Ring Gear	29536863	29541707
Snap Ring	29531104	29541011
P2 Carrier Assembly	29536971	29539510
P2 Carrier/Bushing	29536961	29539509
P2 Carrier	29536959	29539502
P2 Pinions	29531113	29541700
P2 Spindle	29537889	29541703
P2 Bearing	29531116	29541706
P3 Ring	29537311	29539499
T-5 Bearing	29531095	29541702
P2 Sun Gear	29536960	29541701
Sun Spacer	29536128	29541728
P3 Sun Gear	29540499	29539498
P3 Carrier and Race Assembly	29540500	29539512
P3 Carrier Assembly	29539575	29539511
P3 Pinion	29531126	29539497
P3 Roller Bearing	29531127	29539500

LCT 1000

2006 Updates

****This Kit allows 2006 pump assembly to be used in prior model year applications. Kit includes Main pump 29542796, Wear plate 29542799, O-Ring 29537620, Instruction Sheet 29543308 (Pump and wear plate must be used together)

Part Changed	Previous part number	2006 Part number
Rotating Clutch/Shaft PTO	29539507	29542801
Housing and PTO Gear Assembly	29540518	29542802
Rotating Clutch/Shaft NO PTO	29539508	29542803
Housing with tone wheel	29536097	29542804
Housing and Bushing	29543232	29542699
Housing	29543233	29542700
C2 Piston	29539653	29542807
Seal C1/C2 Outer	29536101	29542809
Seal C2 Inner	29536103	29542808
C2 return spring	29536104	29542810
C1 Housing	29537993	29542811
Seal ring C1, OD		29542812
C1 Piston	29536109	29543239
C1 Piston with Balance hole	29536203	29542815
Retaining ring	29536204	29541011
C1 Return Spring	29536198	29542814
P1 Ring Gear	29531055	29541008
P2 Ring Gear	29536863	29541818
P3 Ring Gear	29537311	29541010
Detent Spring	29536922	29542698
Detent Lever	29537169	29542692
Front Support Assembly	29541134	29542792
Front Support Assembly Ground Sleeve/Bearing	29541135	29542793
Pump	29541145 (31 Tooth)	29542796 (22 Tooth)
Pump Body/Gear Assembly	29541146	29542797
Pump body	29541147	29542798
Pump Wear Plate	29541149	29542799
Pump Kit ****		29543078

LCT 1000 6 Speed

(RPO MW7) Introduction

New Product Introduction

A new 6 speed LCT 1000 was added to the General Motors lineup for the 2006 model year. Available in the 2500HD and 3500/3600 series trucks equipped with either the 8.1L V8 gas or 6.6L Duramax diesel the MW7 LCT 1000 offers some advancements over the 2005 and earlier applications. The updates for the MW7 LCT 1000 include the following:

- * 6 Speeds, uses the current LCT 1000 clutch design, No new clutches added
- * Tap shifts
- * Increased torque capacity
- * Internal Mode switch replaces the NSBU switch
- * A new transmission control module, 80 pin connector
- * A updated valve body with a revised design TCC solenoid
- * A 20 pin pass through harness
- * An updated pump design for quieter operation



Specifications

The LCT 1000 MW7 applications offers the following ratios:

1st-3.10-1

2nd-1.81-1

3rd-1.41-1

4th- 1-1

5th- .71-1

6th- .61-1

Rev- 4.49-1

Maximum shift speed 4850 RPM

Input Torque capacity 650 lb-ft, 2005 applications 565 lb-ft

Maximum GCWR 23,500 lb

PRNDL positions: PRNDM1

Fluid capacity: 13qt (12 Liter) Dexron VI only

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LCT 1000 6 Speed

(RPO MW7) Features

Features:

- Tap shifts
- Grade Braking
- Cruise control grade braking (Diesel only)
- Tow/Haul Mode
- Shift Stabilization and adaptive shift control algorithm
- Heater Performance mode (Diesel only)
- Low Traction Mode (Diesel only)

Gear Range	1-2/3-4 Clutch	4-5-6 Clutch	3 rd /5 th /Rev Clutch	2/6 Clutch	Low/Rev clutch
P/N					X
REVERSE			X		X
1 ST	X				X
2 ND	X			X	
3 RD	X		X		
4 TH	X	X			
5 TH		X	X		
6 TH		X		X	

LCT 1000 6 Speed

(RPO MW7) Updates

2006 Valve body Updates

On the 2005 applications the valve body utilized the following solenoids:

- Trim A
- Trim B
- Shift solenoid C
- Shift solenoid D
- Shift solenoid E
- TCC-PWM
- Modulated main solenoid

On the 2006 MW7 applications the following solenoids/components are used:

- The trim solenoids were replaced by PCS 1 and PCS 2 solenoids
- The modulated main pressure solenoid
- Modulated detent spring contacts to the internal mode switch
- IMS replaces the NSBU switch
- PWM TCC solenoid was replaced by a PCS variable bleed solenoid
- 20 way connector which includes a different harness design and part number
- 6 Speed feed pipe

2006 TCM updates include:

- * Model A40-1000 TCM
- * Class 2 data communications for gas applications
- * GM LAN communications for diesel applications
- * 80 Pin Connector with a cam lock as part of the connector
- * TCM mounted on the radiator fan shroud

LCT 1000 6 Speed

(RPO MW7) Updates (continued)

Tap Shifts (Range Selection Mode)

Like several other GM applications, the MW7 features tap shifts are standard equipment. Unlike other applications the tap shift function is controlled by a thumb activated switch mounted on the gear shift lever. The range selection feature will hold the vehicle in the gear selected unless the driver commands a gear change or the TCM determines that engine damage may occur and commands a shift to occur. To activate the tap shift feature the shift selector lever must be in the M position.

Tow/Haul/Grade Braking

As with other GM applications, the tow haul feature is activated by a button located in the end of the shift lever. Tow/Haul should be selected anytime the vehicle load exceeds 75% of the GCWR for the application. Tow/Haul mode changes the shift points of the transmission to reduce shift cycling and improve vehicle performance. Tow/Haul mode also changes the TCC apply, which enables TCC in 2nd and 3rd gears as well as commands TCC to stay applied during deceleration. This prevents heat build up due to oil shear within the converter. In addition spark timing is retarded more during the shifts to lower the impact of the shift. The Grade braking feature or the cruise grade braking feature can only be activated if the tow haul feature is active and the shift lever is not in the M position. Grade braking can command downshifts to ranges as low as 2nd gear.

Heater Performance Mode

In the diesel applications the heater performance mode is designed to shorten the length of time it takes for the engine/transmission to reach operating temperature. This algorithm improves heater performance by decreasing the warm up time. The PCM/TCM monitors ambient temperatures and when the vehicle is being operated in cold weather the TCM will raise the 2-3,3-4,4-5 and 5-6 shift points to increase engine speed resulting in quicker warm up.

Low Traction Mode

Diesel power applications are equipped with a Low Traction Algorithm to improve traction during slippery conditions. By selecting a manual range while at a stop the TCM will command the transmission to start and stay in 2nd gear

LCT 1000 6 Speed

(RPO MW7) Updates (continued)

Shift Stabilization

Like other GM applications, the shift stabilization algorithm monitors VSS and load inputs to minimize upshift/downshift cycling. If the current speed cannot be maintained in a higher range, the TCM will command the transmission to hold the gear and the PCM will lower the engine torque output.

Cold Operation

When operating in cold temperatures the TCM will prevent specific operations to prevent damage to the transmission. When the cold mode is active the DIC will display the message "Trans in Warm Up". The modes of operation are as follows:

- -13f or above transmission temp, transmission operates normally
- -13 to -31f transmission temp, 2nd and 3rd gears available only
- -31f or below transmission temp, 2nd gear available only

On diesel powered applications TCC will be inhibited based on both transmission and ambient air temperatures. The modes of operation are as follows:

- IAT below 32f, TCC will not apply until Transmission temperature is above 88F
- IAT 32-50f, TCC will not apply until Transmission temperature is between 50-80f
- IAT above 50f, TCC operates normally

Gas Applications:

- Transmission temperature below 68f, TCC inhibited

MODES OF OPERATION	6.6L Duramax	8.1L Gas
Range Selection Mode	X	X
Grade Braking	X	X
Cruise Grade Braking	X	
Tow/Haul	X	X
Shift Stabilization	X	X
Adaptive shifts	X	X
Heater Performance	X	
Low Traction	X	

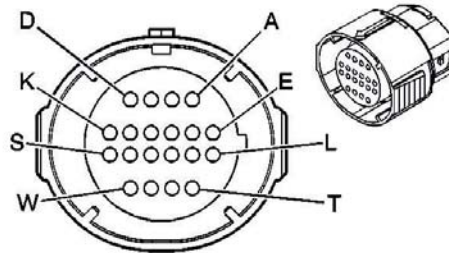
LCT 1000 6 Speed

(RPO MW7) Updates (continued)

Pump

The gear style pump used in the MW7 LCT 1000 is a gear style unit with 22 teeth as opposed to the 31 tooth design used in the previous application. This new design lowers the frequency of the pump noise into a range that can be masked by the engine

LCT 1000 6 speed pass through connector ID Harness

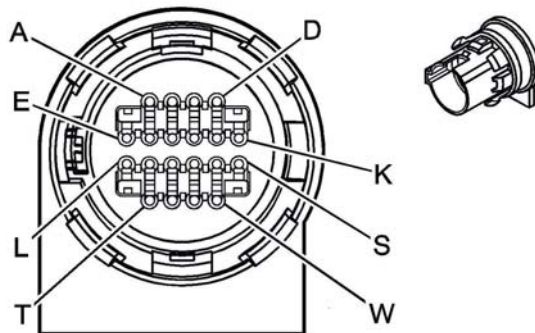


PIN	Wire Color	Circuit #	Function of the Circuit
A	LTGRN	1222	SS1 SHIFT SOL 1
B	YEL/BLK	1223	SS2 SHIFT SOL 2
C	OR/WHT	2557	SS3 SHIFT SOL 3
D	PK	1224	PS1 PRESS SW
E	RED	1226	PS3 PRESS SW
F	DK BLUE	1225	PS2 PRESS SW
G	YEL/BLK	1227	TFT SIGNAL
H	BK	2762	TFT LOW
J	BRN	418	TCC PCS
K	LTGRN/BK	2529	PS4 PRESS SW
L	RED/BLK	1228	HSD1 ACTUATOR SUPPLY
M	LT BLU/WHT	1229	PCS2 PCS LOW
N	BRN	323	HSD2 ACTUATOR SUPPLY
P	BRN/WHT	2469	PCS1 PCS LOW
R	OR/BLK	1786	P/N SIGNAL
S	DK BLUE	1530	MOD MAIN LOW
T	GRAY	773	IMS SIGNAL C
U	YEL	772	IMS SIGNAL B
V	BLK/WHT	771	IMS SIGNAL A
W	WHT	776	IMS SIGNAL P

LCT 1000 6 Speed

(RPO MW7) Updates (continued)

LCT 1000 6 speed pass through connector ID Transmission



PIN	Wire Color	Circuit #	Function of the Circuit
A	DKGRN	1222	SS1 SHIFT SOL 1
B	LT GRN	1223	SS2 SHIFT SOL 2
C	PURPLE	2557	SS3 SHIFT SOL 3
D	OR	1224	PS1 PRESS SW
E	GRAY	1226	PS3 PRESS SW
F	WHT	1225	PS2 PRESS SW
G	TAN	1227	TFT SIGNAL
H	BK	2762	TFT LOW
J	PK	418	TCC PCS
K	BRN	2529	PS4 PRESS SW
L	RED	1228	HSD1 ACTUATOR SUPPLY
M	DK BLU	1229	PCS2 PCS LOW
N	RD/BK	323	HSD2 ACTUATOR SUPPLY
P	LT BLU	2469	PCS1 PCS LOW
R	PURPLE	1786	P/N SIGNAL
S	YEL	1530	MOD MAIN LOW
T	BLK	773	IMS SIGNAL C
U	PK/BLK	772	IMS SIGNAL B
V	YEL/BLK	771	IMS SIGNAL A
W	WHT	776	IMS SIGNAL P

Ford

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AF21-B/Ford 6-Speed

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Torqshift/4R100

4X4 Transfer Case Jumps Out of 4H or 4L

2004-2005 F-Super Duty Manual Shift Transfer Cases Only

2004-2005 F-Super Duty 4x4 vehicles equipped with the Torqshift or 4R100 transmission and manual transfer case, may exhibit the transfer case jumping out of 4H or 4L and into 2H or neutral position.

Use the following Service Procedure to adjust the transfer case shift linkage. It may be necessary to replace the shifter bracket assembly as well.

1. Remove the transfer case control rod at its connection with the shift linkage pivot pin.
2. Loosen the two (2) 9/16 bolts connecting the shift bracket to the transmission.
3. Move the bracket as far rearward as possible, torque the bolts to 85 lb-ft .
4. Move the shifter into the 4H position and hold the linkage against the 4H detent wall of the shift gate.
5. Without applying any further force rearward on the transfer case lever, try to reconnect the transfer case control rod to the shifter pivot pin.
 - a. If the transfer case control rod can be reattached to the shifter pivot pin, return the vehicle to the customer.
 - b. If the control rod cannot be reattached to the shifter pivot pin, remove the shifter bracket assembly and replace with new.

Torqshift/4R100

4X4 Transfer Case Jumps Out of 4H or 4L (continued)

***2004-2005 F-Super Duty
Manual Shift Transfer Cases Only***

**PART NUMBER
4C3Z-7210-BA**

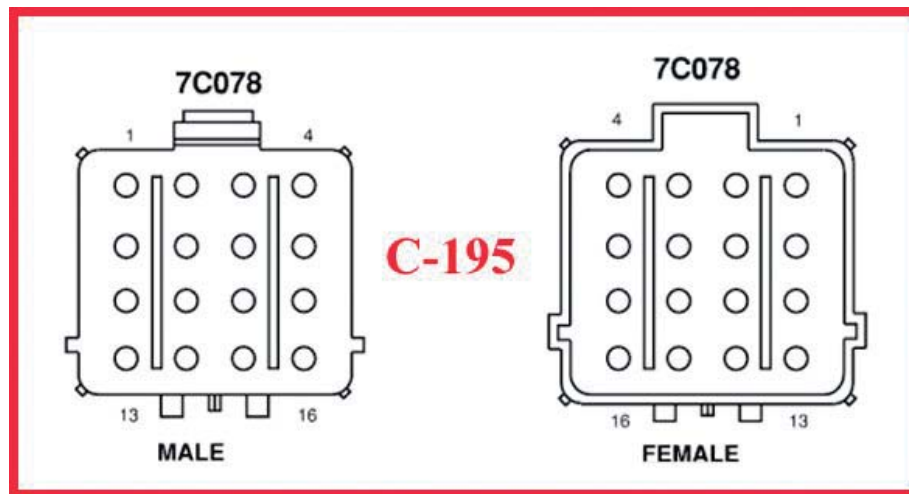


Torqshift

Shift Scheduling, Slipping, Bangs on Downshifts

2004 — 2005 E-450 series and especially the commercial chassis applications like ambulances. The concern begins with intermittent transmission issues like shift scheduling, slipping, bangs on downshifts, etc. As the concern progresses, it flags a DTC P0960 / PCA Open Circuit and illuminates the MIL. The root cause of the concern can be traced to the main connector (C-195) laying across the top of the trans.

If you remove the engine cover (doghouse) which is no easy task, pull apart the connector and look for overheated or burned wires. If this is what you find, look at the inside of the engine cover. You'll see where the connector has been rubbing. Depending on the connector and wiring damage, repair as necessary taking steps to ensure that the connector doesn't rub again. Reset the KAM (Keep alive Memory), perform the Adaptive Learning procedure and test drive.

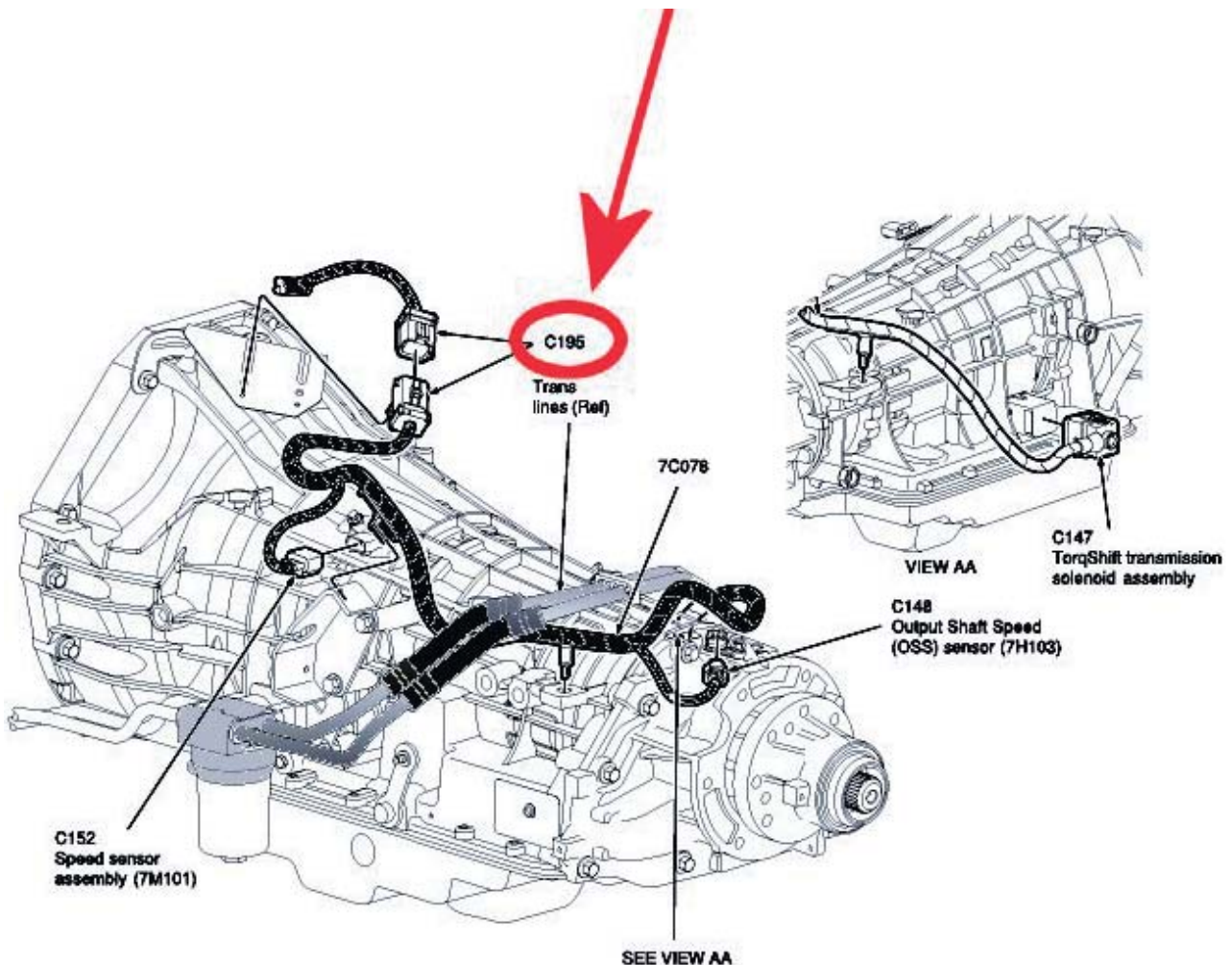


Courtesy of Test Research Center and Stevie Lavallee

Torqshift

Shift Scheduling, Slipping, Bangs on Downshifts (continued)

Pull apart the connector and look for overheated or burned wires.



Torqshift

Introduction

The Torqshift transmission is a 6 speed fully computer-controlled transmission. Externally it looks like it's cousin the E4OD and internally the stack up is much the same, however there are no parts that interchange between the two units. also the TR sensor is internal and the solenoid connector is up front rather than in the rear. There have been several changes made to the planetary gear sets for increased durability in the 2005 version. The PCM has gone through several updates to the programming and it is highly recommended that the computer be reprogrammed with every transmission rebuild.



Torqshift

DTC' P0756, P0761 or P0771

2003-2004 Excursion, F-Super Duty

2004 E-Series

Some vehicles equipped with a 6.0L diesel and the Torqshift transmission, may exhibit the malfunction indicator lamp (MIL) illuminated with diagnostic trouble code (DTC) P0756, P0761 or P0771. This condition will occur if the powertrain control module (PCM) and transmission control module (TCM) are not reprogrammed after installing a 2005-level replacement transmission, installing transmission rebuild kit 5C3Z-7A398-SA, or after overhauling the transmission with 2005-level components.

To repair this problem reprogram the PCM and TCM to the latest calibration using Calibration files may be obtained at www.motorcraft.com.

Torqshift

Calibration Example

EXAMPLE:

Find Vehicle, Model, Engine Size, and Engine Type = Explorer, MY '02, 4.0L, V6 SOHC

Find Catchword = LAE0

Model	Year	Engine	Engine	PartNum	NewPartNum	Catchword	Module	TSB	TSB
		Size	Type				DN	Num	Part Num
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGL	1L2F-AGM	LAE0	PCM		-

Find associated New Part Num = 1L2F-AGM

Model	Year	Engine	Engine	PartNum	NewPartNum	Catchword	Module	TSB	TSB
		Size	Type				DN	Num	Part Num
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGL	1L2F-AGM	LAE0	PCM		-

Find this new part number in the "PartNum" column

Model	Year	Engine	Engine	PartNum	NewPartNum	Catchword	Module	TSB	TSB
		Size	Type				DN	Num	Part Num
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGL	1L2F-AGM	LAE0	PCM		-
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGM	1U7A-BZA	LAE1	PCM		-

Determine if there is a new part number associated with this part number = 1U7A-BZA

Model	Year	Engine	Engine	PartNum	NewPartNum	Catchword	Module	TSB	TSB
		Size	Type				DN	Num	Part Num
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGL	1L2F-AGM	LAE0	PCM		-
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGM	1U7A-BZA	LAE1	PCM		-

Continue the process until there is no new part number listed.

Most recent calibration for this vehicle = 1U7A-GMA

Model	Year	Engine	Engine	PartNum	NewPartNum	Catchword	Module	TSB	TSB
		Size	Type				DN	Num	Part Num
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGL	1L2F-AGM	LAE0	PCM		-
EXPLORER	MY02	4.0L	V6_SOHC	1L2F-AGM	1U7A-BZA	LAE1	PCM		-
EXPLORER	MY02	4.0L	V6_SOHC	1U7A-BZA	1U7A-GMA	ZPZ0	PCM		-
EXPLORER	MY02	4.0L	V6_SOHC	1U7A-GMA	-	MGT0	PCM		-

Torqshift

DTC P0488 and/or P1334

2004 F-Super Duty 2004-2005 Excursion

Vehicles exhibiting no driveability symptoms but have harsh shift and/or transmission engagements. 2004 F-Super Duty vehicles built after 9/29/2003 and 2004-2005 Excursion vehicles built 9/29/2003 through 1/10/2005, all equipped with the 6.0L engine, may exhibit any of the following:

1. Diagnostic trouble code (DTC) P0488 and/or P1334 with no driveability symptoms.
2. Exhaust smoke while operating in elevated idle operation/PTO, charge protect, or cold idle kicker mode.
3. Harsh 3-2 grade load braking downshifts in Tow/Haul mode due to shift initiating on boost pressure.
4. Shift busyness in Tow/Haul mode.
5. Harsh lock-up during the 5-6 shift.
6. Harsh 3-5 upshift during light throttle acceleration.

To repair this problem reprogram the powertrain control module (PCM) to the latest calibration. Calibration files may be obtained at www.motorcraft.com.

Torqshift

Stalling in Reverse or When Coming to a Stop

2005 E-Series, Excursion, F-Super Duty

2005 Super Duty, Excursion, or E-Series vehicles built between 10/1/2004 and 11/30/2004 equipped with the Torqshift transmission, may exhibit an engine stalling or quits upon engagement into drive or reverse, or when coming to a stop.

Diagnostic trouble codes (DTCs) P1744, P0740, P0741, P0743, or P0744 may also be present. This may be due to a stuck torque converter clutch (TCC) solenoid. Verify the condition exists. Replace the TCC solenoid.

This could also be a cooler issue. Make sure you flush the cooler lines, replace the remote filter element and check the cooler flow. Clear codes, if any, and verify repair. Do not replace the torque converter or the pump assembly for this concern.

PART NUMBER
3C3Z-7J136-BA

PART NAME
TCC Solenoid



Torqshift

TR-P Sensor Introduction

The Transmission Range (TR-P) sensor assembly is an internally mounted sensor that includes the detent spring, rooster comb and bracket, located next to the solenoid body. The components of the TR-P sensor are factory adjusted and the sensor must be installed as a calibrated assembly. The TR-P sensor contains electronic circuitry that provides the PCM a fixed frequency at a duty cycle for each of the various positions of the manual lever (PARK, REVERSE, NEUTRAL, DRIVE, M3, M2 and M1) to the PCM. The PCM uses the TR-P sensor signal for engine functions (start, reverse lamps) and for line pressure control, shift scheduling and TCC operation.



Torqshift

TR-P Sensor Diagnosis

There are only two reasons you'd be diagnosing the TR-P sensor:

1. Codes
2. No Start

Codes are caused by the TR-P Frequency being out of range or circuit duty cycle being too low or too high, which can also cause a no start condition, or during the KOEO test the shifter was not in the Park or Neutral position.

Using your scan tool enter the Diagnostic mode function. Enter TR_DC and TR_FREQ. Once this is entered you will be able to see the following information:

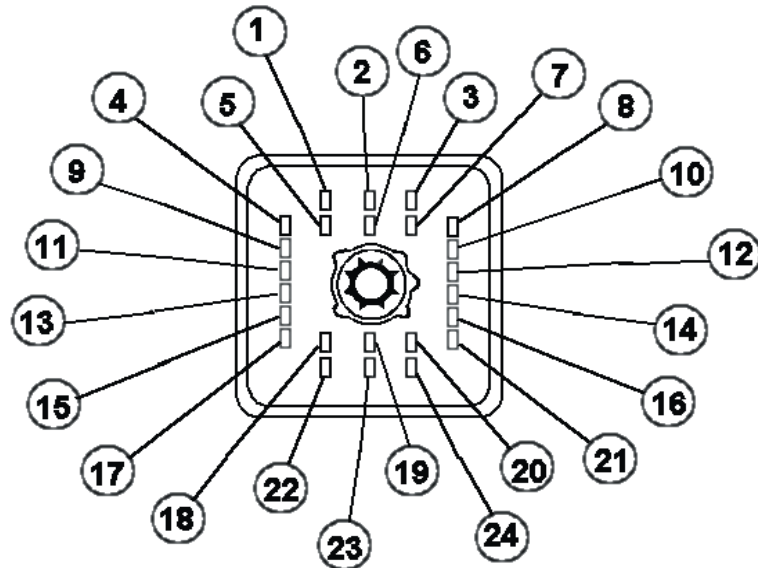
Position	Min % Duty Cycle	Max % Duty Cycle
P	7.13	23.76
R	23.77	38.48
N	38.47	48.55
D	48.56	58.82
3	58.83	68.08
2	68.09	77.96
1	77.97	90.34

If your Duty Cycle is out of range, replace the TR Sensor assembly.

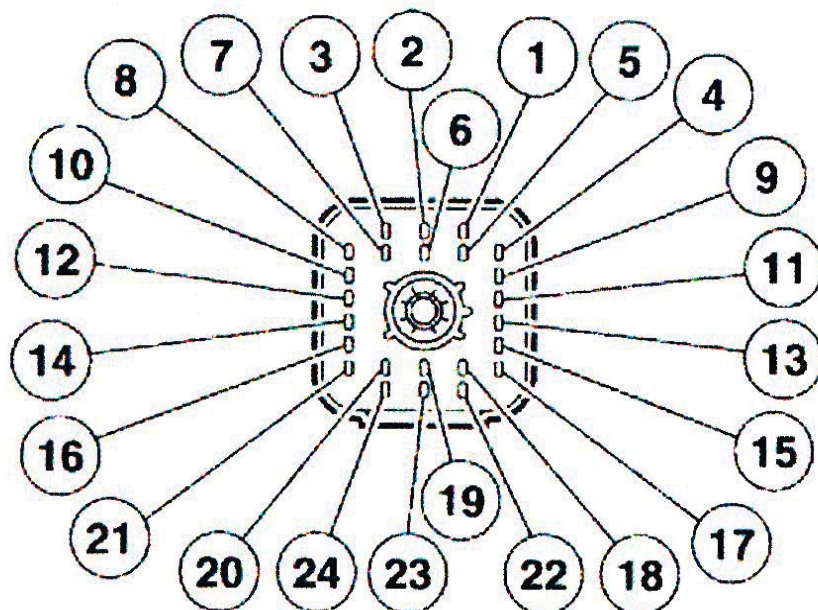
Torqshift

TR-P Diagnosis (continued)

Internal Connector View



External Connector View



Torqshift

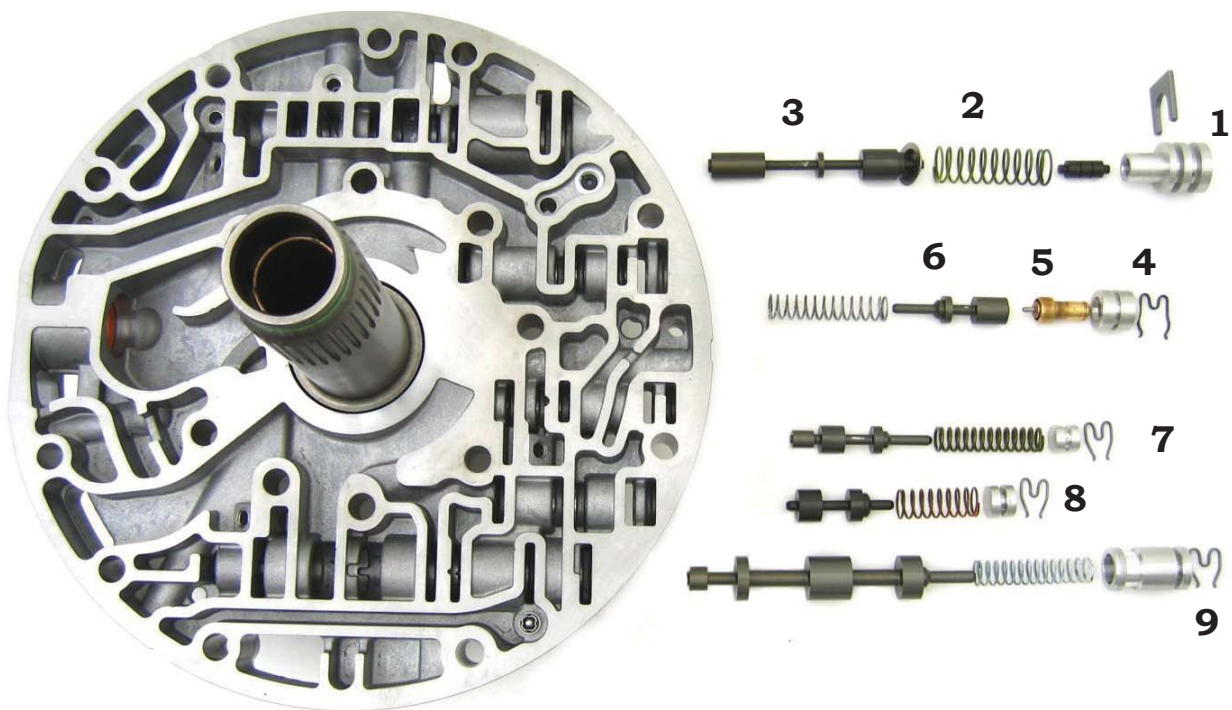
TR-P Diagnosis (continued)

Pin Number	Description	Diesel PCM Connector	Gas PCM Connector	Int. Wire Color Pin No. 1	Int. Wire Color Pin No. 2	Int. Wire Color Pin No. 3
1	SSPC-E	13	12	Light Green	Gray	—
2	Not Used	—	—	—	—	—
3	SSPC-B	10	2	Red	Light green	—
4	SSPC-D	12	11	Brown	Pink	—
5	SSPC-C	11	10	Yellow	Purple	—
6	Not Used	—	—	—	—	—
7	Solenoid VPWRa	7	49	—	—	—
8	TCC	14	13	Dark Blue	Orange	—
9	Not Used	—	—	—	—	—
10	PC-A	2	23	Light Blue	White	—
11	Not Used	—	—	—	—	—
12	SSPC-A	9	1	Purple	Yellow	—
13	Not Used	—	—	—	—	—
14	Not Used	—	—	—	—	—
15	TR-P Signal	25	19	—	Light Blue	—
16	Not Used	—	—	—	—	—
17	TR-P Ground	22	50	—	—	Tan
18	TFT Signal	26	29	Tan	Gray	—
19	Not Used	—	—	—	—	—
20	Solenoid VPWRa	7	49	—	—	—
21	VPWR for TR-P Sensor only	1	39	Orange	—	—
22	SGNRTNa	30	41	—	—	—
23	Not Used	—	—	—	—	—
24	VPWRa	7	49	—	—	—

Torqshift

Pump Valve Identification

Remove and inspect the valves in the stator support. **Note:** Do not use abrasives on the teflon coated valves. This will damage the valves and can cause premature valve wear.



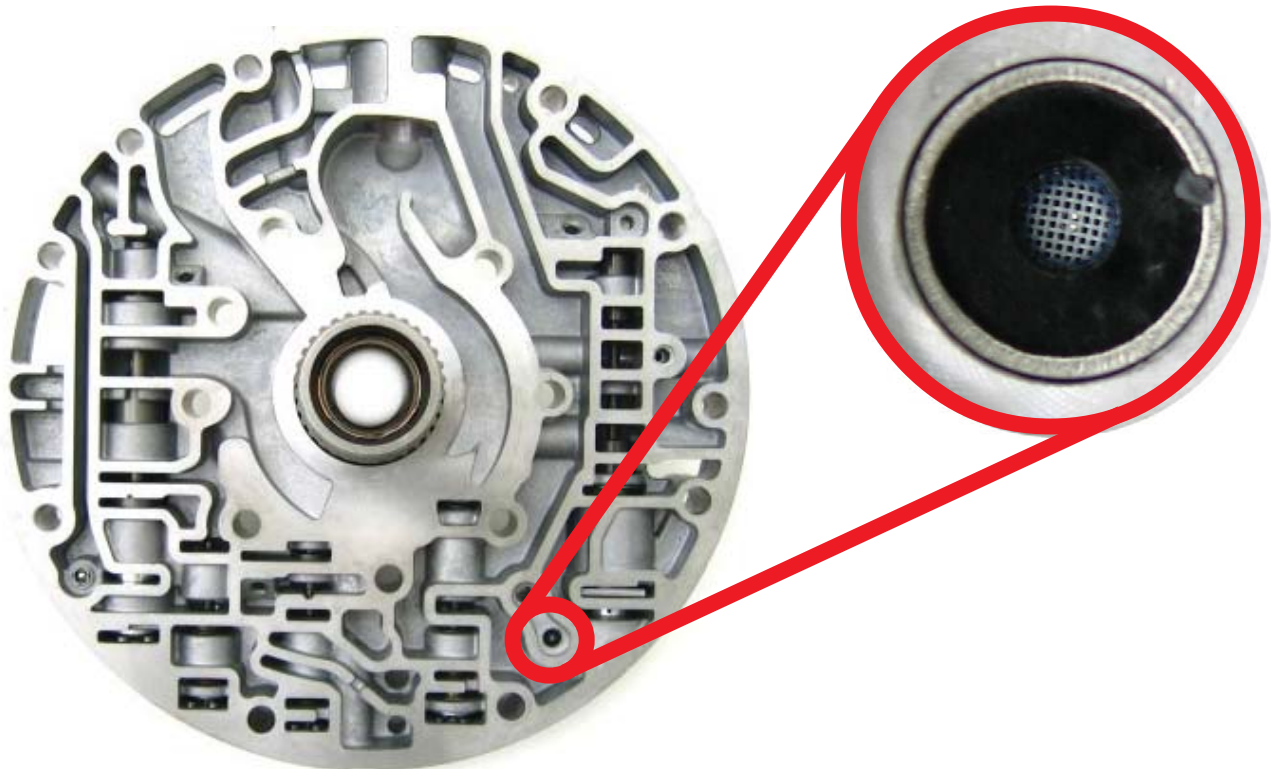
ID	Description
1	TCC Control Valve Sleeve
2	TCC Control Plunger
3	TCC Control Valve
4	Thermostat Control Valve Bore Plug
5	Thermostat Control Valve
6	Cooler Bypass Valve
7	Converter Pressure Limit Valve and Spring
8	Converter Drainback Valve and Spring
9	Mainline Pressure Regulator Valve and Spring

Torqshift

Bleed Screen

The end plugs in the pump can be hard to remove. To make this job easier Ford has threaded the end plugs. Use a 4.0 X 0.7 mm bolt to pull the plugs out of the bore.

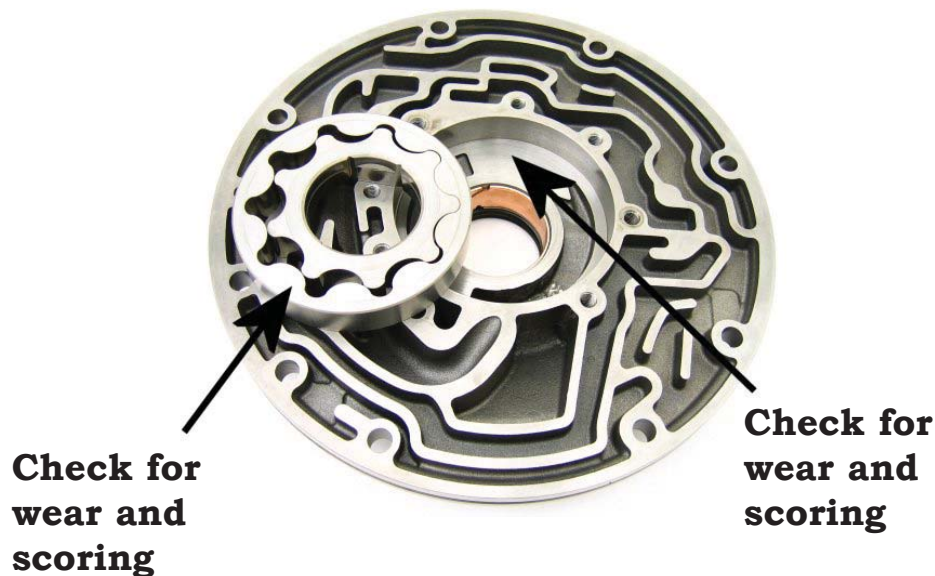
Carefully inspect the bleed screen. The stator support may need to be replaced if this screen is missing.



Torqshift

Pump Failure

Thoroughly Clean and dry the remaining pump components. Check the pump body, pump gears and pump plate for wear and scoring. Check all mating surfaces for burrs or distortion. Inspect the stator bushings and replace as neccassary. In some cases a machine problem from the factory may cause a sliver of metel to lodge into the pump casting. Always disassemble an ordered pump and check the clearances and the machine cut.



Torqshift

Pump Alignment and Assembly

Place the pump plate onto the pump body. Place the stator support half down onto the pump body. Install (5) pump bolts finger tight only.



Torqshift

Pump Alignment and Assembly (continued)

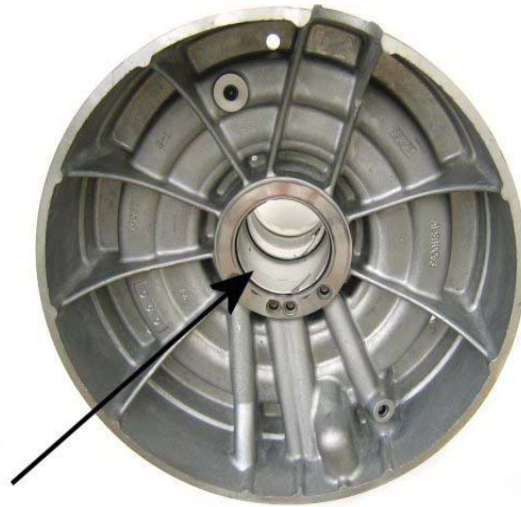
Install a pump alignment band tool onto the pump assembly. Use 2 extension housing bolts to align the pump halve. This is the same procedure as the E4OD and 4R100.



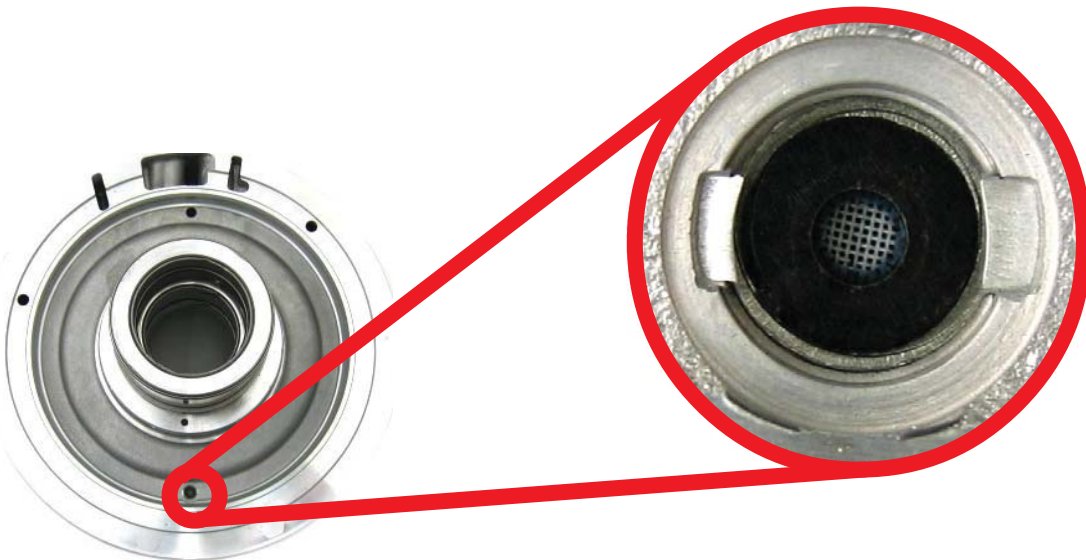
Torqshift

Center Support Assembly

Check the inner bore for sealing ring grooves and bushing wear. Closely inspect the orifice filter.



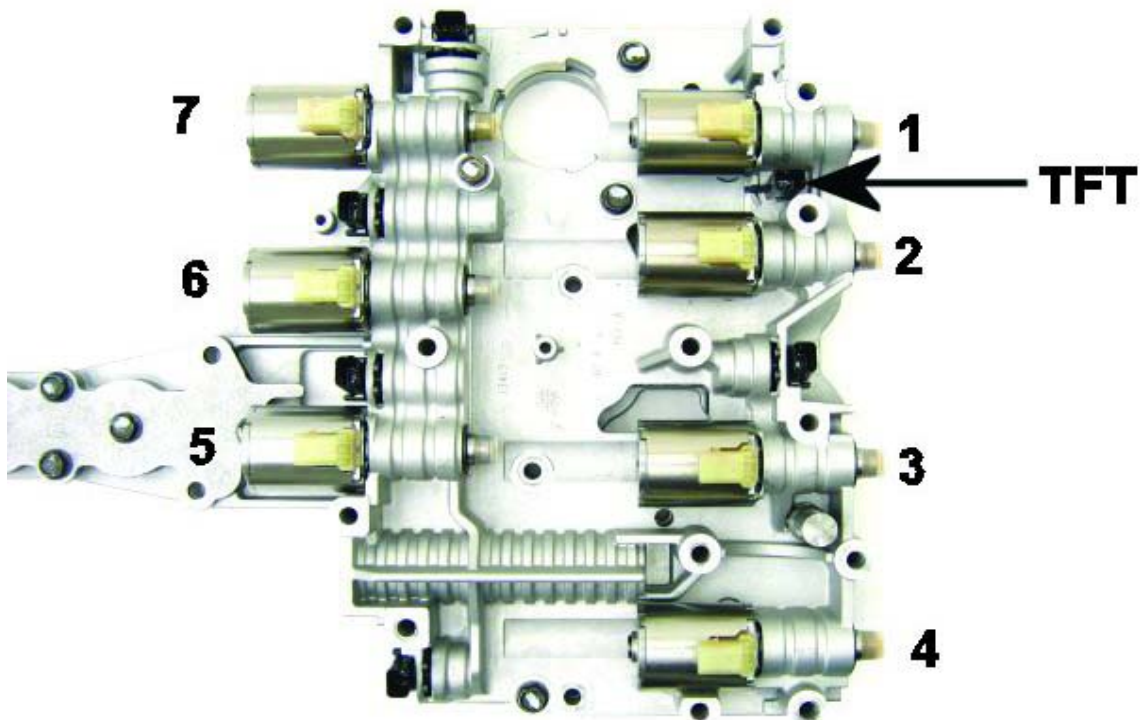
Check for wear



Torqshift

Valve Body Solenoid ID

The solenoids are different so it is very important that they are not mixed up.

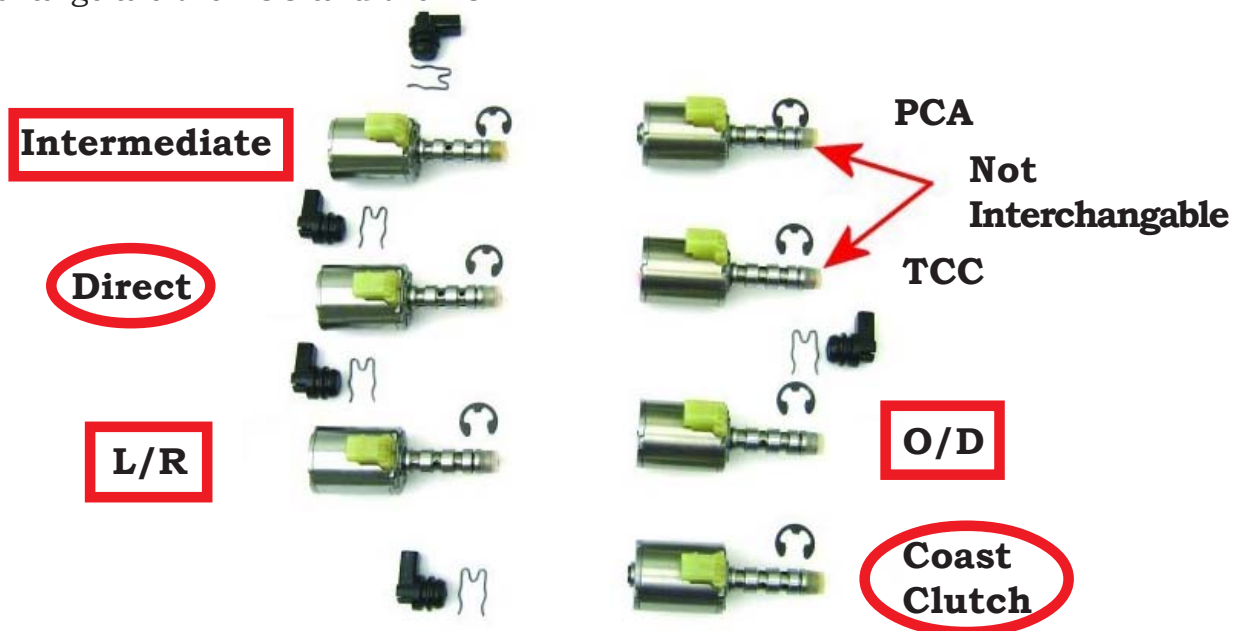


ID	Description
1	PC-A (line pressure control)
2	TCC (torque converter clutch)
3	SSPC-B (overdrive clutch)
4	SSPC-A (coast clutch)
5	SSPC-E (low/reverse clutch)
6	SSPC-D (direct clutch)
7	SSPC-C (intermediate clutch)
8	TFT (transmission fluid temperature)
9	TR position (transmission range sensor)

Torqshift

Valve Body Solenoid Interchange

If you suspect a problem with a particular solenoid you can interchange some of the solenoids to help you with your diagnosis. As an example you can interchange the Intermediate, Low/Reverse and Overdrive solenoids with each other marked with a RED square. You can also interchange the Coast Clutch and Direct Clutch solenoids marked with a RED circle. The only two solenoids you can NOT interchange are the TCC and the PCA



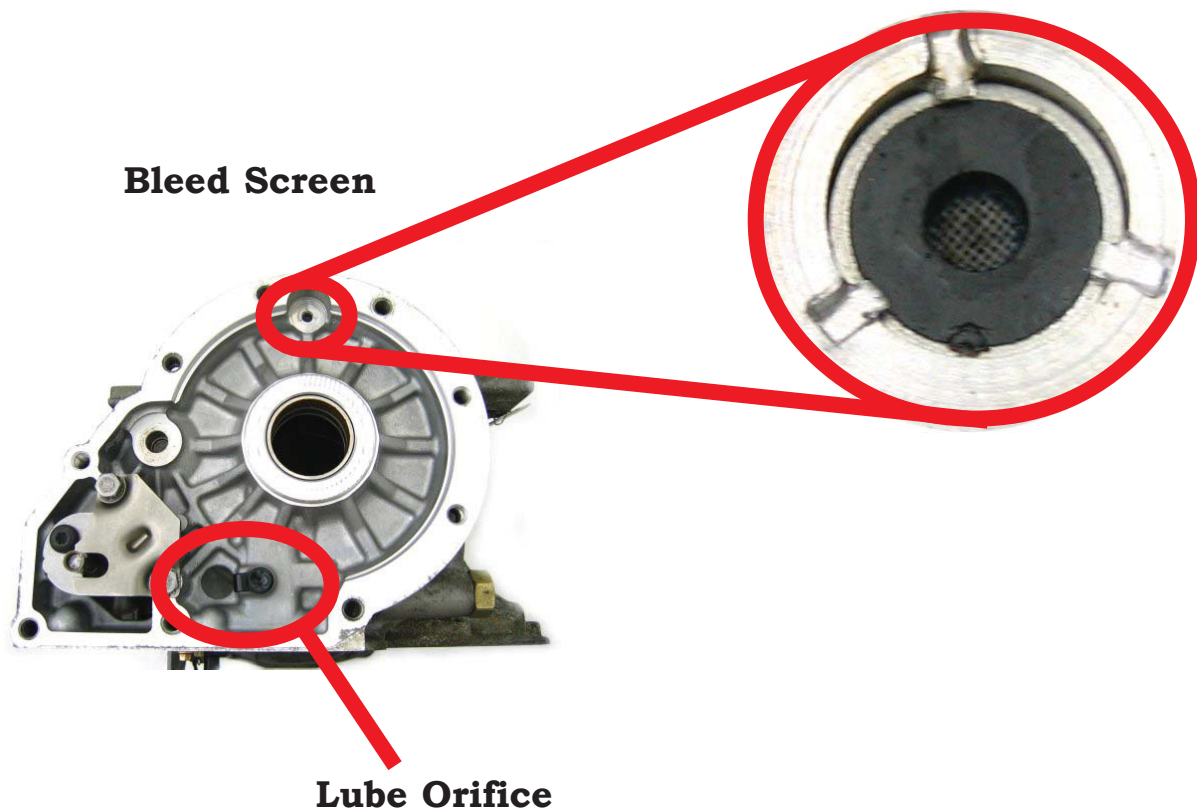
Notice the difference between the Coast/Direct Clutch solenoids and the EPC solenoid.



Torqshift

Lube Orifice and Case

Carefully inspect all mating surfaces for nicks and burrs. There are two things to look for here, the Lube orifice and the Bleed orifice. Make sure that during dissassembly and reassembly that both Bleed orifice and Lube orifice are installed correctly.



Torqshift

Planetary Failure, Lack of Lube

Rear Case Lube Seals

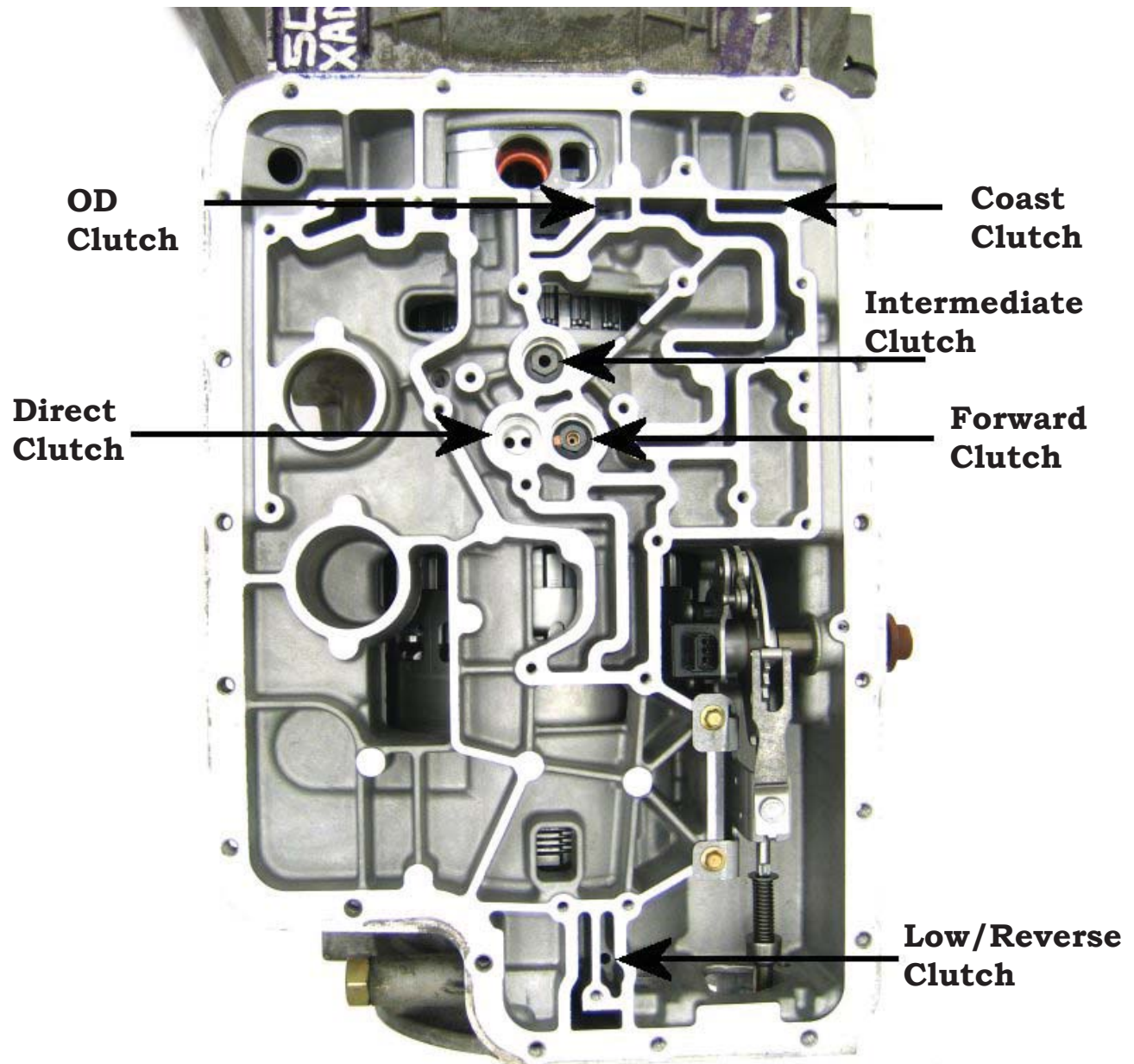
A common cause of planetary failure is a missing or damaged rear case seal. These seals are located behind the rear bushings and may be missed during disassembly.

During disassembly and reassembly pay close attention to the rear bushing area, make sure you replace these seals during every overhaul. Use a small amount of assembly gel to secure the (2) output shaft seals in the grooves.



Torqshift

Air Checking the Case



Torqshift with PTO

Insufficient Line Pressure from the Transmission

2005 F-Super Duty

2005 Super Duty F-Series vehicles equipped with a 6.0L diesel engine, TorqShift transmission and power take off (PTO) option, built before September 22, 2004, will exhibit insufficient transmission line pressure supplied during PTO operation.

Symptoms include lack of torque converter lock up and transmission line pressure below 150 psi while in stationary PTO mode. PTO operation under this condition may result in PTO unit damage, and subsequent TorqShift transmission damage is possible.

Reprogramming the powertrain control module (PCM) and transmission control module (TCM) to the latest calibration using release B33.6 or higher. Calibration files can be obtained at www.motorcraft.com. If transmission damage occurs due to improper PTO function, follow normal procedures to diagnose and repair. Clear diagnostic trouble codes if any, and verify the repair.

4F50N

No 1-2 Upshift and DTC P0732

2004-2005 Taurus, Freestar

2004-2005 Sable, Monterey

2004-2005 Taurus/Sable and Freestar/Monterey vehicles, may exhibit a no 1-2 upshift condition and a diagnostic trouble code (DTC) P0732. This concern may also cause a no 3rd or no 4th condition. This may be due to an intermediate clutch piston seal becoming torn or loose (de-bonded) from the piston.

If the cause is determined to be internal to the transaxle, inspect the intermediate clutch piston seal. The outer clutch seal is bonded to the piston. If the seal is torn or loose replace the piston. Inspect the intermediate clutch plates and replace if necessary.

PART NUMBER

4F1Z-7E005-AA

XF2Z-7B442-AA

XF2Z-7B164-CA

PART NAME

Piston - Intermediate Clutch

Clutch Plate (Steel)

Clutch Plate (Friction)



4F50N

DTCs P0760 and P0763

2005 Taurus, Freestar
2005 Sable, Monterey

2005 Taurus/Sable, Freestar/Monterey vehicles built before 3/15/2005, may exhibit diagnostic trouble codes (DTCs) P0760 and P0763. This may be due to a shorted transaxle internal harness, caused by a sharp edge on the inside of the side cover casting.

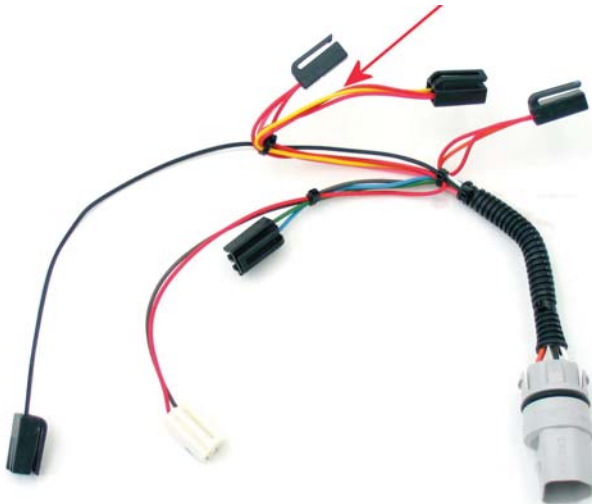
Remove the side cover of the transaxle. Inspect the insulation on the yellow wire of the internal transaxle harness near shift solenoid C (SSC). Replace the internal harness if damaged, also replace the side cover.

PART NUMBER

4F1Z-7G276-AA
1F2Z-7G004-AB

PART NAME

Harness
Side Cover



4F50N, AX4N, AX4S

Erratic Fluid Level, Possible Fluid Leak

**2000-2005 Taurus, 2000-2003 Windstar, 2004-2005 Freestar
2000-2005 Sable, 2004-2005 Monterey**

2000-2005 Taurus/Sable, 2000-2003 Windstar and 2004-2005 Freestar/Monterey vehicles, equipped with a 4F50N, AX4N or AX4S transaxles, may exhibit an erratic fluid level reading on the transaxle dipstick and possible leaks around the filler tube and grommet. The condition may be due to the transaxle vent assembly. The vent has a rubber disk under the metal cap to prevent water from entering the transaxle. This rubber disk may intermittently stick and cause improper venting.

Replace the vent with the previous design vent stem, and rubber vent cap.

NOTE: Leaks may be misdiagnosed as coming from the pan gasket. Always follow the proper procedures to locate the source of the leak.

PART NUMBER

YF1Z-7035-AA

XS4Z-7L282-AA

PART NAME

Vent Stem

Vent Cap



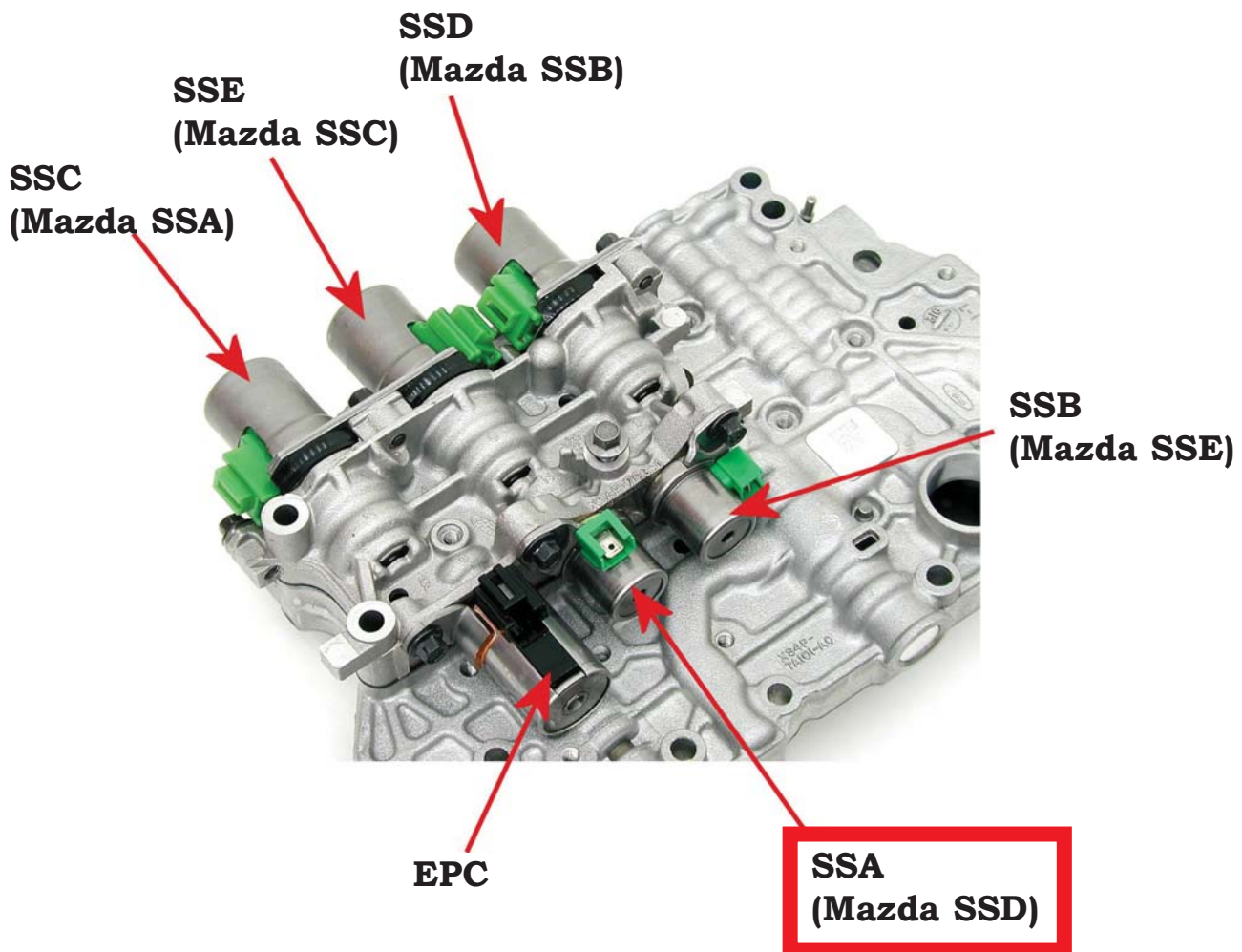
4F27E

Neutrals on the 3-4 Shift, DTC P0750

A neutraling condition on the 3-4 shift maybe caused by Solenoid A not releasing properly. Solenoid B controls the TCC apply and release. Solenoid A controls the 3-4 shift valve which is used to drain the servo release oil to apply the band.

The computer may have DTC P0750 (sol. A electrical fault) that comes back as soon as the key is turned on.

Replace SSA Ford Part # XS4Z-ZH148-AA



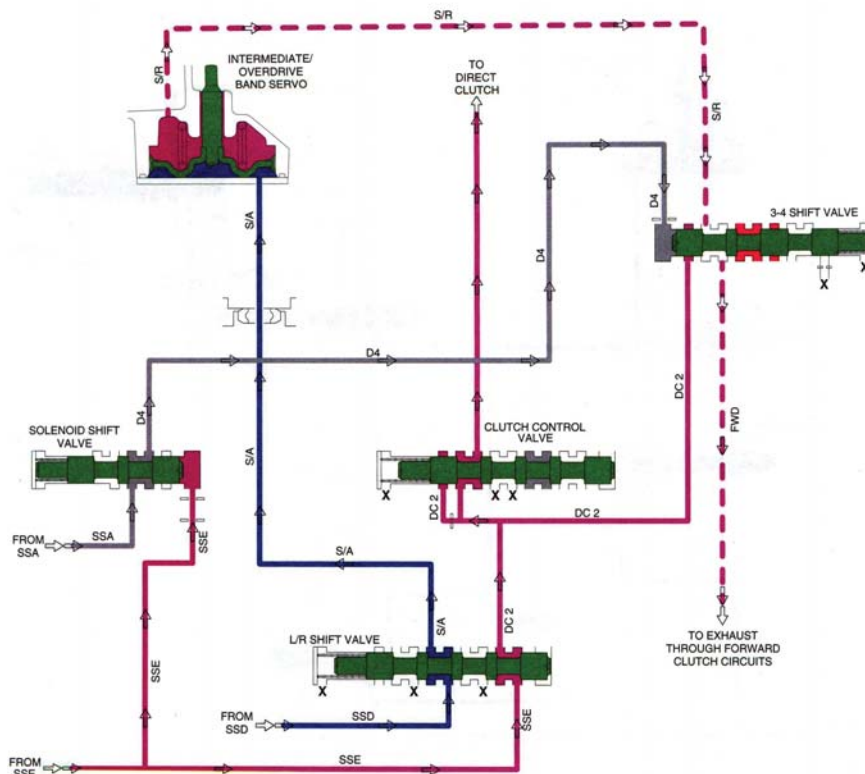
4F27E

Neutrals on the 3-4 Shift, DTC P0750 (continued)

The SSA internal ground strap is the cause of this concern. The internal ground strap breaks and causes the code and the failure.



**4TH GEAR
(INTER./OVERDRIVE BAND SERVO)**

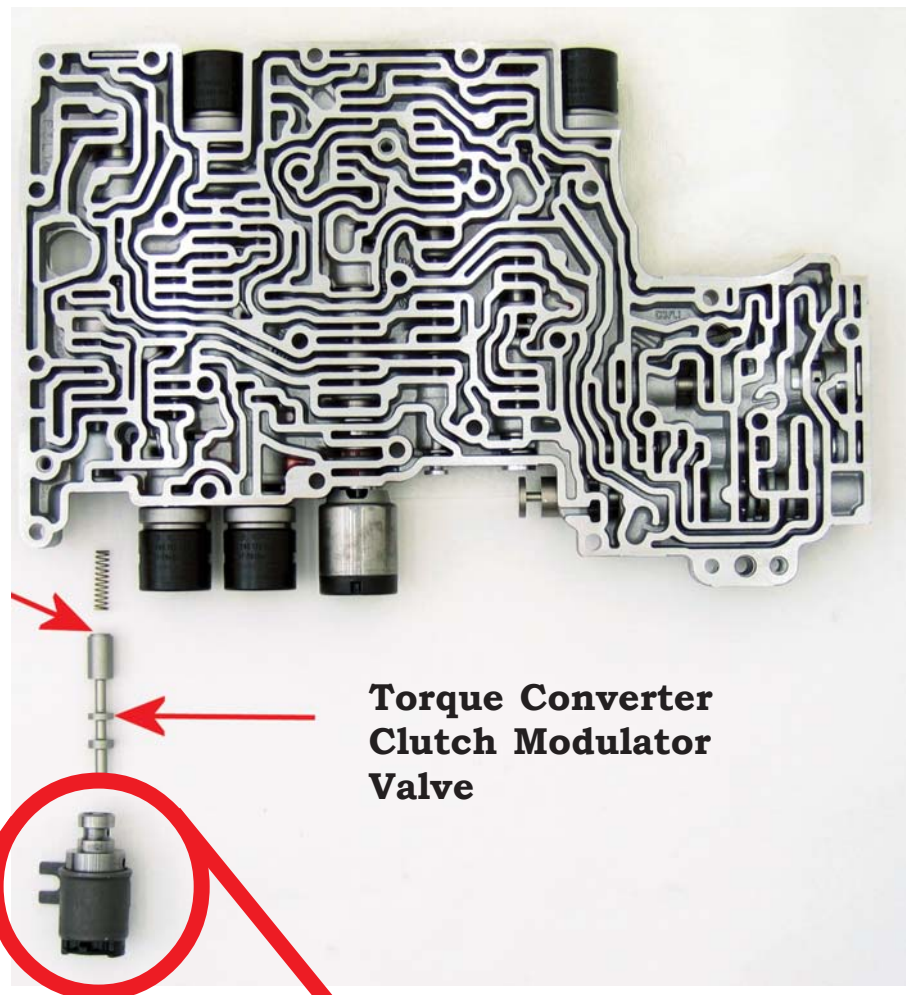


4R/5R55E

TCC Modification

To improve lock-up, use the following modifications. Make sure you use the correct solenoid. Failure to do so may cause TCC, and Ratio ratio codes.

**Always use
assembly grease
in the spring
pocket to prevent
the spring from
popping out
during assembly**



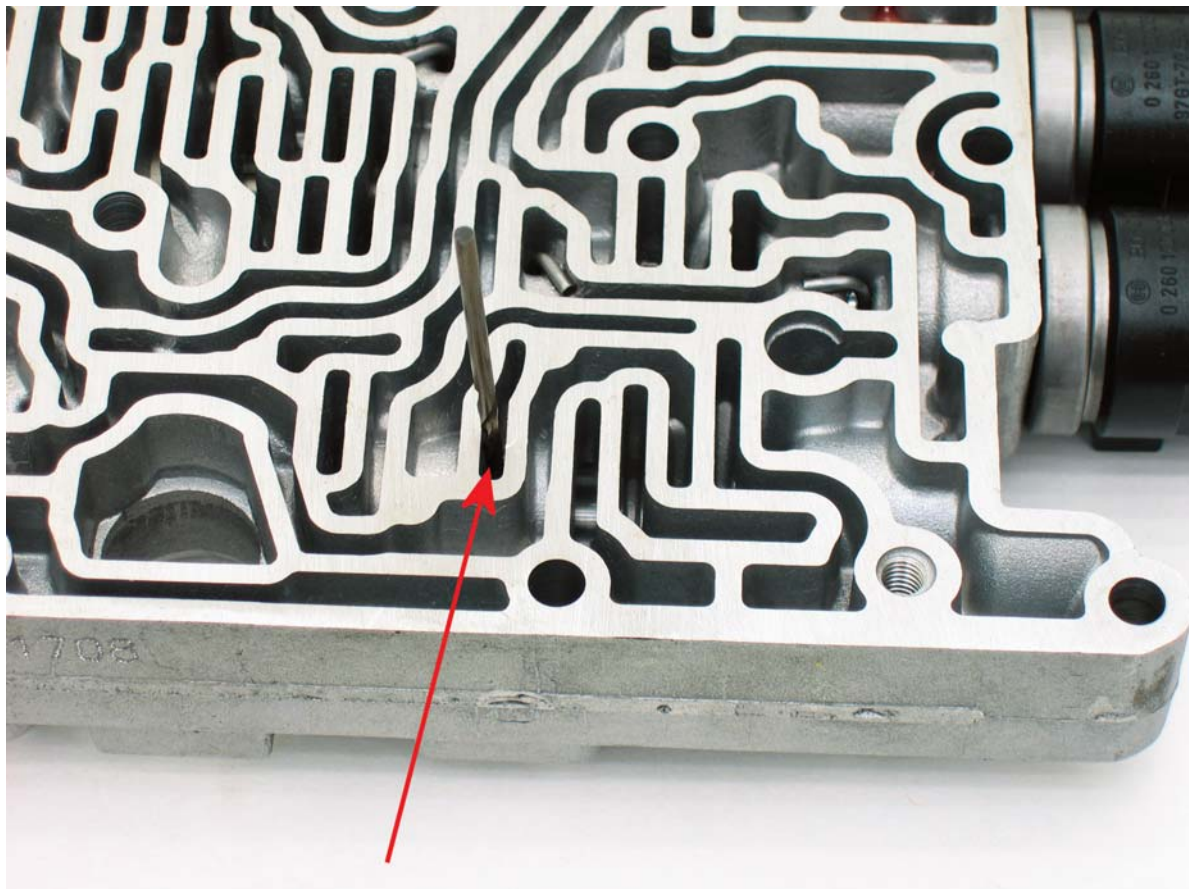
**95-96 Models
Part# F5TZ-7F037-AA**

**97-up Models
Part# ZL2Z-7G136-AA**

4R/5R55E

TCC Modification (continued)

During reassembly as a normal rebuild procedure, always drill the exhaust hole. This should be done with all the modifications listed. This modification is done to create an additional exhaust hole to help prevent unwanted pressure from the converter release circuit.



Drill a 0.062" exhaust hole in this circuit. The hole should protrude through the outside of the casting.

4R/5R55E

TCC Modification (continued)

When you add the exhaust hole by drilling the valve body casting, you must plug the separator plate at the location shown. This is to prevent converter drain back. This should be done with all the modifications listed.



When performing this modification, always plug this hole

PTO

Operation and Diagnosis

Ford Super Duty F-Series Truck Powertrains are designed principally to provide vehicle motivation and short term auxiliary power needs. Power activation of hydraulic or mechanically driven devices such as wrecker lift, snowplow blade lift and movement, power tailgate lift, or dump body lift, are a few examples. The variety of available air circulation, temperature environment, vehicle maintenance level, and other conditions existing with the range of auxiliary horsepower and torque demands that may be placed upon a vehicle in PTO usage, make it difficult to assess the ultimate performance of a vehicle subjected to extended duration usage as an auxiliary power source. The guidelines in this book are intended to assist the PTO equipment installer in avoiding inadvertent vehicle performance and safety concerns. These guidelines should not be considered all inclusive, and it is the responsibility of the PTO equipment installer, to choose and install a PTO system that the vehicle operators will be able to use in a safe manner with the necessary precautions to ensure safe operation and customer satisfaction.

WARNING:

Do not subject the Excursion to any auxiliary power take-off application as this could overheat the fuel tank and increase the risk of personal injury.

Vehicle	Engine	Transmission	PTO Port Location
F250/350/450/550	5.4L Gas / 6.8L Gas	M60D-HD	Manual LH only
F250/350/450/551	7.3L Diesel	M60D-HD	Manual LH only
F250/350/450/552	6.8L Gas / 7.3L	Gas 4R100 Automatic	LH only

Auxiliary Idle Control

The Ford 7.3L diesel engine has two Auxiliary Idle Control kits are available to elevate the engine idle speed. The kit offered as Regular Production Option Code 96P for

F-Series (option Code 961 for E-Series) contains a “full function” Auxiliary Powertrain Control Module or APCM. A “limited function” APCM is included in the kit that is part of the Ambulance Prep Option. For gas engines, the PTO installer will need to obtain high idle throttle control from an aftermarket source.

Elevated Idle Feature

For 7.3L diesel engine and 4R100 with PTO provision only. Activating the “PTO Circuit” will automatically elevate the engine idle to 1200 rpm in “PARK” or “NEUTRAL” regardless of the parking brake being set. This feature does not require use of the Auxiliary Idle Control option or the APCM.

PTO

Operation and Diagnosis (continued)

General Guidelines / Warnings

1. Additional transmission lubricant may be required with addition of the PTO.
2. Follow severe-duty vehicle maintenance schedules, including transmission fluid changes.
3. Route PTO hydraulic lines away from the vehicle exhaust system.
4. Diesel engines are recommended for stationary PTO operation of extended duration.
5. Do not block air flow circulation to the engine coolant radiator, engine and transmission.
6. Monitoring the following powertrain fluid temperatures to avoid excessive heat build up.

NOTE - If any of the above temperatures are exceeded, disengage the PTO operation and return vehicle engine speed to normal idle. Allow the temperature to stabilize at a lower level before re-engaging the PTO.

7. The M60D manual transmission case will require a slight modification to package PTO pumps that are mounted directly to the PTO and facing rearward. Refer to Figure 1 for instructions on removing a small tab on the case to obtain clearance for the pump.

PTO

Operation and Diagnosis (continued)

4R100 Transmission

The 4R100 with a PTO port must be ordered as a separate option. Option Code 62R is available for SD FSeries only. It includes a PTO drive gear and in the case of gas engines, has a unique electronic engine control module (EEC) that the non-PTO 4R100 does not have. The PTO port is a non-standard, 6-bolt hole pattern, threaded for M10 metric fasteners, and comes with a reusable controlled compression gasket to control gear mesh installation. The PTO drive gear is functional in all gear ranges: D1, D2, Drive, Reverse, Park, Neutral (except Overdrive). This accommodates both stationary and mobile PTO operation. However, the PTO drive gear is NOT functional in any drive gear when vehicle speed is zero. The Overdrive-Cancel light is designed to illuminate when operating in PTO mode.

1. The PTO drive gear is rated at 170 lb-ft torque peak, 120 lb-ft torque continuous use.
2. Automatic transmission PTO applications intended for stationary operation must comply with the following engine rpm limitations: – Reference PTO manufacturer's owners manual for recommended PTO pump operating speeds.
(1) High idle throttle control required. (Electronic Throttle Kicker) and not provided by Ford. (2) Automatically controlled by the PCM.

Engine RPM	6.8L Gas Engine	7.3L Diesel Engine
Max RPM	1300	1200
Max RPM	2500	2500

3. The 4R100 line pressure tap thread is 1/8-27 Dryseal N.P.S.F. normal line pressure is approximately 50 to 60 psi at normal engine idle; and approximately 180 psi at 1200 rpm with torque converter clutch applied and PTO circuit activated.

4. If the vehicle battery has been disconnected, the powertrain control strategy may "forget" PTP logic and may not respond to commands for elevated idle. To remedy this, a sensor in the transmission needs to count the teeth on the PTO gear.

PTO

Operation and Diagnosis (continued)

5. Simply drive the vehicle a short distance. Typically, less than a mile will be sufficient to prepare the strategy to respond properly. Driving the automatic transmission in 1st gear may also speed up this memory. Do not rush to drive, but also avoid excessive delay. Once the ignition goes through the ON, CRANK and START cycle the strategy cycle that looks for “PTO” only lasts a relatively short time. Repeat the cycle if the first drive attempt is ineffective.

6. A temperature monitor internal to the 4R100 is designed to disengage the PTO drive gear clutch in an over-temperature condition. High torque demand at low vehicle speed can trigger this safeguard. Spreading fertilizer in farming or snowplowing are typical examples. If this occurs, disengage the PTO operation and rest the vehicle in Park or Neutral at normal engine idle to cool the powertrain.

7. New for 2002 model year Super Duty F-Series, and placed in the instrument cluster, is a Transmission Fluid Temperature Gauge for automatic transmission only. A complete description is located in the Owner Guide.

Here in brief explains what the needle readings mean.
Cold Range: 50° F or colder.

White Area [“Normal”]: Normal operating range,
51 to 248° F.

Yellow Area [“Warning”]: Stop driving the vehicle or remove auxiliary loads at the earliest convenience. Typically, leave the engine running at normal idle will aid cooldown. Allow to cool into the normal range before starting to drive again or operate the PTO. The transmission fluid is not overheating, but operating in the Yellow Range for extended periods of time may cause internal transmission damage.

Red Area [“Over-Temperature”]: The transmission fluid is over-heating. Stop the vehicle, do not drive, and allow to cool into normal range.

PTO

Operation and Diagnosis (continued)

For readings in the Red and Yellow areas make sure that snow or debris is not blocking airflow to the radiator and transmission fluid cooler, that cooler lines are not kinked or restricted, and that vehicle load capacities or duty cycles are not excessive.

Front End Accessory Drive(Fead) – Mounted PTO (“Clutch Pumps”)

1. An auxiliary crankshaft bearing support is required on all modular gas engine applications where the clutch pump is drawing power from the engine crank pulley. This further applies to all tangentially mounted auxiliary equipment in general.

Log on to www.fleet.ford.com/truckbbas/ and select QVM Bulletin List, to obtain bulletin Nos. Q-62 and Q-74 for a complete description.

2. Always maintain the clearance relationship between the Ford OEM fan, radiator and shroud to help maintain optimum engine cooling performance.

3. Always consider engine roll and body/frame torsion when packaging clearances.

4. Restrict application to 5.4L/6.8L gas and 7.3L diesel engines.

5. Temperature monitoring of powertrain fluids as noted in the General Guidelines SPLIT-SHAFT PTO 4R100 automatic transmission is not recommended.

Restrict application to manual transmission only. QVM Bulletin No. Q-14, “Guidelines for Modifying Light Truck Drivelines” is available by calling (877) 840-4338.

NOTE: The 4x4 transfer case does not have a PTO port. The F-Super Duty Motorhome Stripped Chassis does not accommodate a PTO. Temperature monitoring of powertrain fluids as noted in the General Guidelines Warnings in the owners manual.

AF2I-B/Ford 6-Speed

Introduction

This transaxle is a compact, lightweight, next generation electronically controlled, 6-speed automatic transaxle that employs a Ravigneaux-type planetary gear. This transaxle contains a high precision clutch hydraulic control system for a smooth, highly responsive gear shift feel.

All hydraulic functions are directed by electronic solenoids to control:

1. Engagement feel.
2. Shift feel.
3. Shift scheduling.
4. Modulated torque converter clutch (TCC) applications.
5. Engine braking utilizing the coast clutch.

AF2I-B/Ford 6-Speed

Apply Components

C-1 Clutch

The C1 clutch connects the front planetary carrier to the rear sun gear of the rear planetary set. The C1 clutch is applied in 1st (typical operation during engine braking), 2nd, 3rd and 4th gears.

C-2 Clutch

The C2 clutch connects the intermediate shaft to the rear planetary carrier. The C2 clutch is applied in 4th, 5th and 6th gears.

C-3 Clutch

The C3 clutch connects the front planetary carrier to the middle sun gear of the rear planetary set. The C3 clutch is applied in 3rd and 5th gears, and also in reverse when the vehicle speed is 7 km/h (4 mph) or less.

B-1 Brake

The B1 brake locks the middle sun gear of the rear planetary gear set. The B1 brake is applied in 2nd and 6th gears.

B-2 Brake

The B2 brake locks the rear planetary carrier in reverse gear when the vehicle speed is 7 km/h (4 mph) or less.

F-1 One-Way Clutch

The F1 one way clutch locks the counterclockwise rotation of the rear planetary carrier during 1st gear operation (during both normal operation and engine braking).

Hydraulic Systems

Valve Body

The valve body supplies fluid by switching the fluid circuit for the hydraulic pressure that is generated by the fluid pump. Based on the hydraulic pressure generated by the fluid pump the TCM sends control signals to the solenoid valves in accordance with vehicle conditions. Upon activation of the solenoid valve, the control hydraulic pressure to the clutch and brakes is determined (according to the equilibrium with the obtained hydraulic pressure) and gear shift and lockup are accomplished. In addition, an appropriate amount of fluid is supplied to the torque converter, planetary gears and lubricating parts.

AF2I-B/Ford 6-Speed

Operational Strategies

Automatic Gearshift Control

In automatic gearshift control, based on each gearshift pattern, SSA and SSB turn ON or OFF and SSC, SSD, SSE and SSF are operated linearly according to information that includes vehicle speed, the degree to which the accelerator is open and brake signal.

Driver Adaptive Shift Control

This automatic transaxle does not have a driving mode selection switch that allows drivers to select a mode themselves. The vehicle is ordinarily in adaptive mode. However, when specific conditions are met, the transmission control unit (TCU) selects a shifting pattern appropriate to driving conditions from all of the shifting patterns and switches automatically.

Green — Mode 1 — Switched from mode 2 to warm up the transmission fluid. This mode acts to protect the transaxle before the adaptive mode.

Green — Mode 2 — After engine start-up, warm-up speed is increased for a certain period when transmission fluid temperature is low and the vehicle speed is 0.

High Temp — When fluid temperature becomes too high, this mode activates lock-up at an earlier timing to stop the temperature rise and lower the temperature.

Down Slope — When driving down a slope, the transmission control module (TCM) detects a down slope based on the engine control unit signal and output rpm. TCM switches to down slope mode to alleviate the load to the brake by down shifting.

AF2I-B

Operational Strategies (continued)

Gear Shift Control

When the shift lever is moved from N to D or from N to R, after the engine is started, a shift control solenoid assembly (SSC, SSD, SSE) is used for the fluid pressure required by C1 clutch or C3 clutch and appropriately regulated fluid pressure is supplied to the clutch, engaging smoothly without shock.

Reverse Converter Control

If the shift lever is moved from N to R while the vehicle is moving forward and the transaxle shifts into REVERSE, the wheels will be locked, which is extremely dangerous. In order to avoid this, the TCM inhibits the transaxle from shifting into REVERSE while moving forward.

Torque Converter Control

Based on output rpm signals, signals from the engine control unit (engine rpm and throttle opening) and vehicle speed, a smooth engagement is carried out through linear control of the torque converter clutch (TCC) solenoid. Also, the slip rate is detected by adding input rpm signals and slip control is carried out.

Engagement Control

Control is carried out using a TCC solenoid. The TCC solenoid is linearly turned ON and OFF. The clutch inside the torque converter is operated and the pump impeller and turbine runner are connected. Through this the engine and the transaxle are coupled and engine output is connected directly to the transaxle, eliminating transaxle loss and enhancing fuel economy.

Slip Control

Control is carried out using a TCC solenoid. The TCC solenoid is linearly turned ON and OFF and the clutch within the torque converter is operated outside of the engagement range. The clutch slides without being in a completely coupled condition, increasing transaxle efficiency and enhancing fuel economy.

AF2I-B

Electronic System Description

The transmission control module (TCM) and its input/output network controls the following operations:

1. Shift timing
2. Line pressure (shift feel)
3. Torque converter clutch (TCC)

The transaxle control is separate from the engine control strategy in the powertrain control module (PCM), although some of the input signals are shared between the TCM and PCM. When determining the best operating strategy for transaxle operation, the TCM uses input information from certain engine-related and driver-demand related sensors and switches supplied by the PCM.

In addition, the TCM receives input signals from certain transaxle-related sensors and switches. The TCM also uses these signals when determining transaxle operating strategy.

Using all of these input signals, the TCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the best line pressure needed to optimize shift feel. To accomplish this the TCM uses output solenoids to control transaxle operation. The following provides a brief description of each of the sensors and actuators used to control transaxle operation.

Transmission Control Module (TCM) Control Function

In automatic gear shift control, based on each gear shift pattern, SAA and SBB turn ON or OFF and SSC, SSD, SSE and SSF are operated linearly according to information that includes vehicle speed, the degree to which the accelerator is open and brake signals. For the gear and solenoid operation chart, refer to the general specification tables in this section.

The transmission range (TR) sensor is built in the transmission control module (TCM), it detects the automatic transmission range information via the Hall-effect sensor and outputs the information to the TCM. The TCM reads the voltage and adjusts the automatic transmission range.

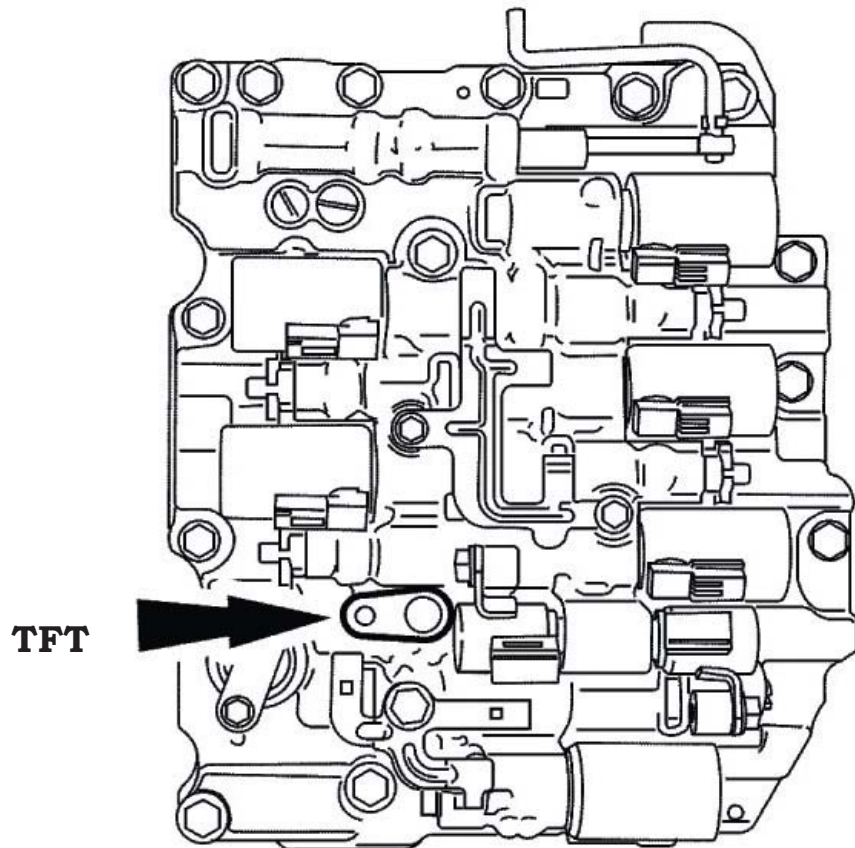
Brake Pedal Position (BPP) Switch

The brake pedal position (BPP) switch tells the powertrain control module when the brakes are applied. The torque converter clutch disengages when the brakes are applied and the BPP switch closes when the brakes are applied and opens when they are released.

AF21-B

TFT

The transmission fluid temperature sensor, which is integrated within the transmission wiring, is installed on the front of the valve body. It directs the fluid temperature within the hydraulic pressure control circuit and transmits a signal based on that temperature to the TCM. Through this it controls gear shift, lockup and slip in response to changes in fluid temperature for smooth shifting across wide fluid temperature zones.

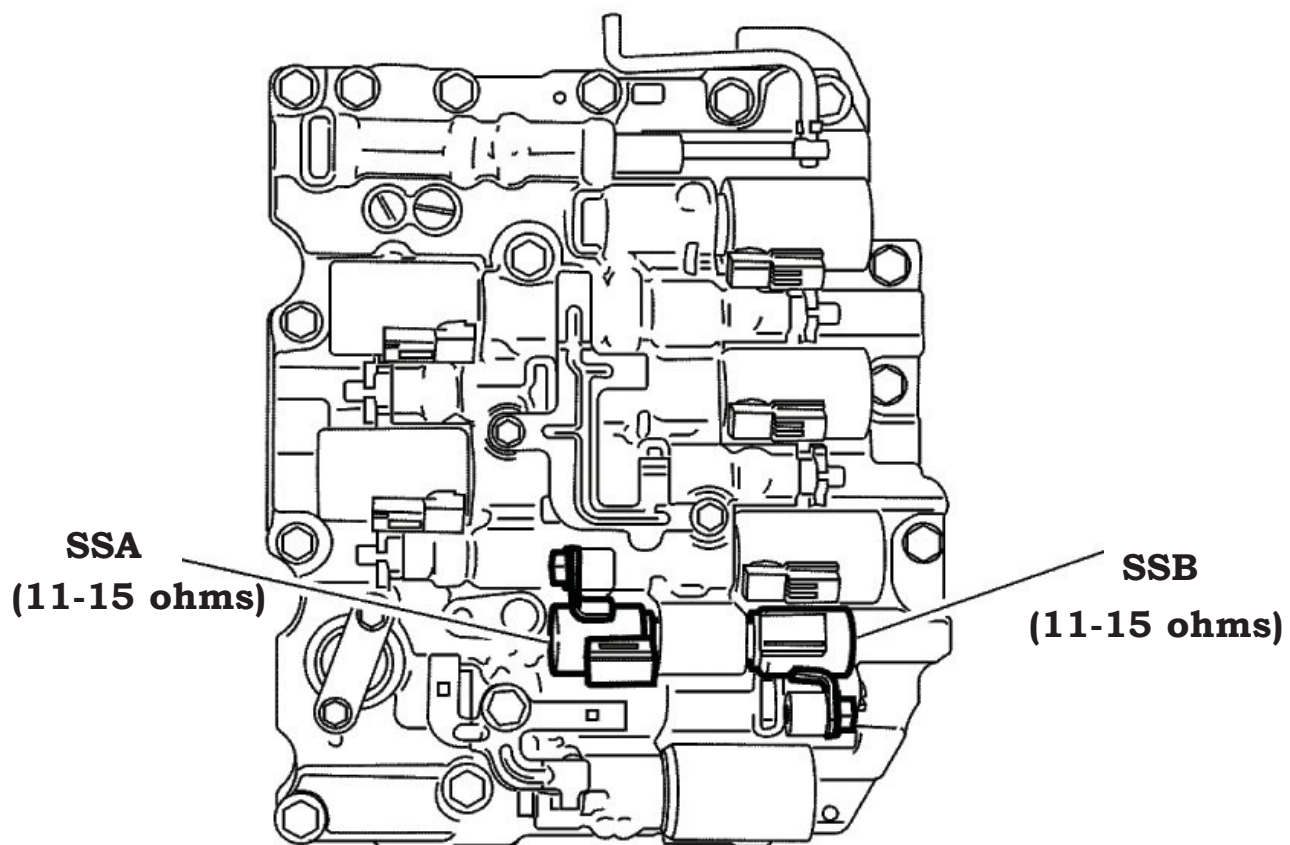


TFT		
°C	°F	Ohms
10	50	6.445
25	77	3.5
110	230	0.247

AF2I-B

Three Way Shift Solenoids

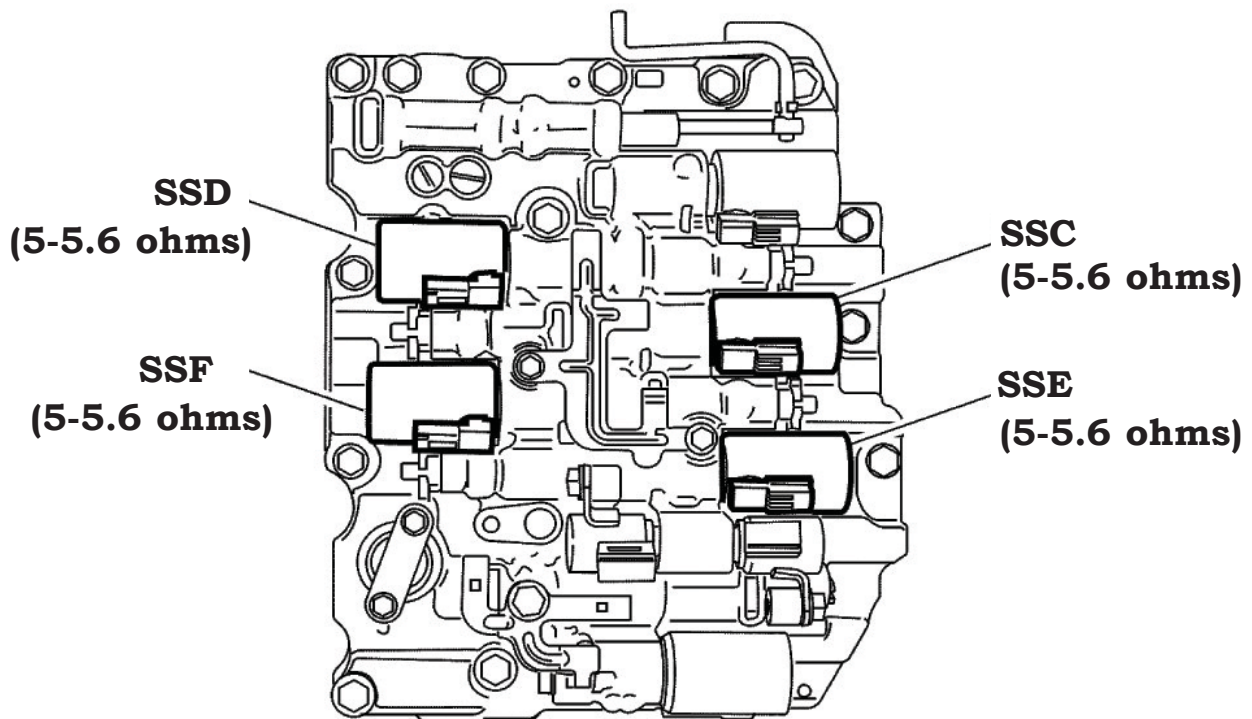
The transaxle 3-way solenoid assembly (SSA) is installed on the middle valve body. The transmission 3-way solenoid assembly (SSB) is installed on the front valve body. The solenoids turn ON and OFF in response to signals output from the TCM. According to the ON or OFF status of SSA or SSB, the 1st gear engine brake operates or the gear shifts into REVERSE. As a fail-safe function, if any transmission 3-way solenoid assembly abnormality occurs, the TCM will disable the current to the solenoids.



AF2I-B

Shift Control Solenoids

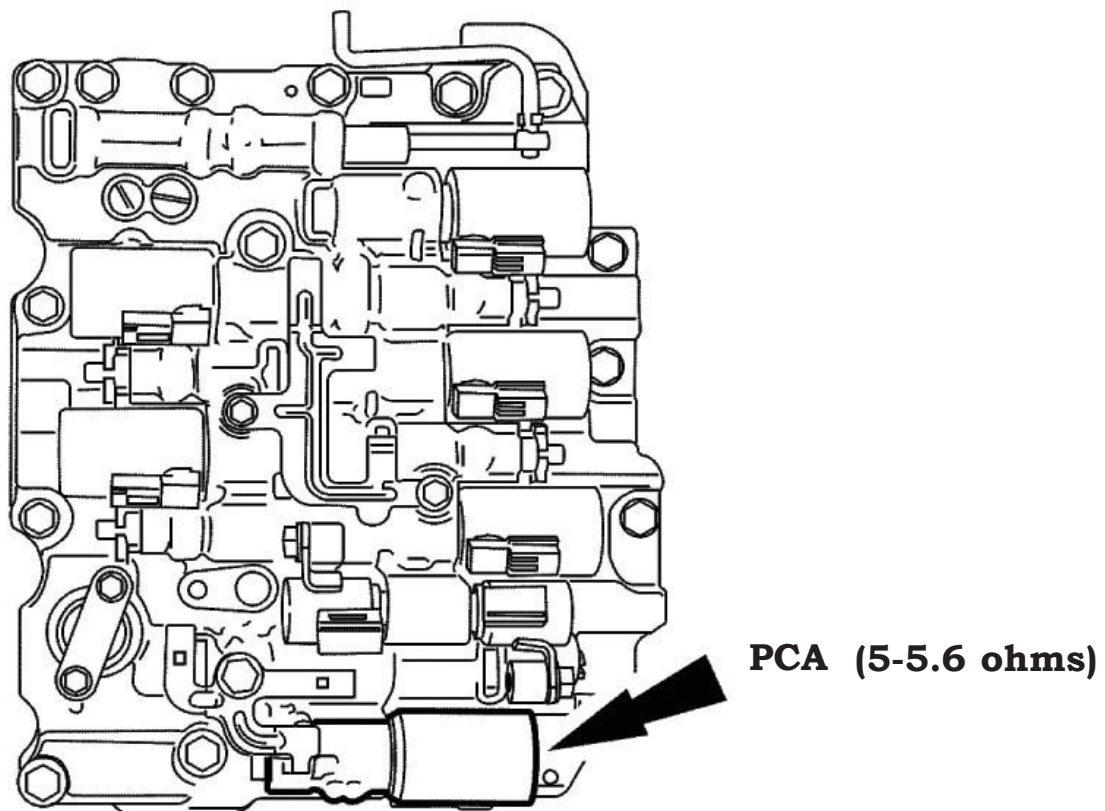
The shift control solenoid assembly (SSC, SSD, SSE, SSF) is installed on the front valve body. The solenoids linearly control hydraulic pressure in response to signals, output from the TCM. Through this, it controls hydraulic pressure to the clutch (C1, C2, C3) and brakes (B1) for smooth shifting. According to the combination of ON or OFF status of the shift control solenoid assembly, the transmission shifts from 1st gear into 6th gear and vice versa. As a fail-safe function, if any shift control solenoid assembly abnormality occurs, the TCM will disable the current to the shift control solenoids.



AF2I-B

Pressure Control Solenoid

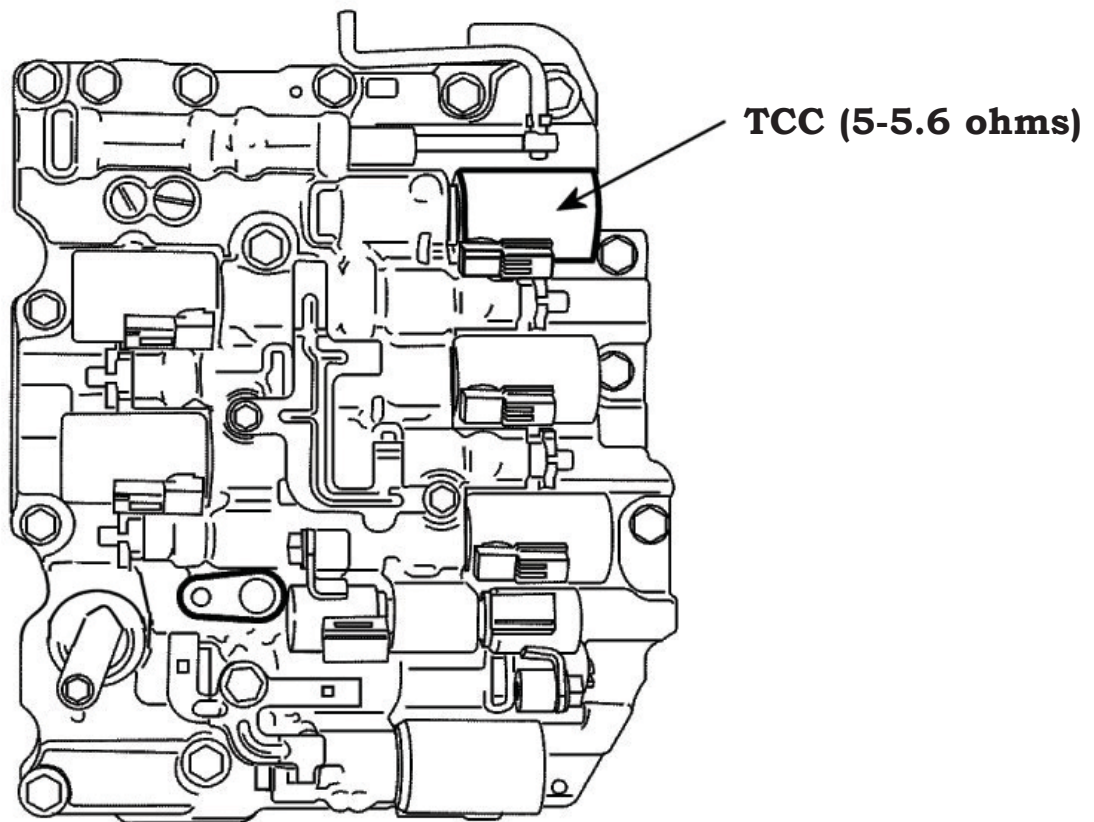
The pressure control solenoid (PCA) is installed on the front valve body. Based on a signal indicating the degree to which the throttle is opened, engine torque, and according to a duty ratio predetermined in the TCM, the solenoids control line hydraulic pressure by linearly changing the comparable throttle hydraulic pressure. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. As a fail-safe function, if any shift control solenoid assembly abnormality occurs, the TCM will disable the current to the shift control solenoids. The line pressure is maximized, if the shift control solenoid assembly current is disabled when any abnormality other than locking occurs.



AF2I-B

Torque Converter Solenoid

The torque converter clutch (TCC) solenoid is used in the transaxle control system to control the application, modulation and release of the torque converter clutch. The TCC control solenoid is installed on the front valve body. Based on engine rpm, throttle opening degree signals and speed sensor signals, it linearly controls clutch hydraulic pressure. Through this, engagement and slip are controlled. As a fail-safe function, if any control solenoid assembly abnormality occurs, the TCM will disable the current to the TCC solenoid.



AF2I-B

Adaptive Learning

Adaptive Shift Control

The TCM has an adaptive learning strategy to electronically control the transaxle which will automatically adjust the shift feel. The first few hundred miles of operation of the transaxle may have abrupt shifting. This is a normal operation. If the battery has been disconnected for any reason it will need to be kept disconnected for approximately 20 minutes to reset the adaptive shift pressure strategy or use the diagnostic tool to carry out the keep alive memory (KAM) reset.

Driver Adaptive Shift Control

This automatic transaxle does not have a driving mode selection switch that allows drivers to select a mode themselves. The vehicle is ordinarily in adaptive mode. However, when specific conditions are met, the transmission control unit (TCU) selects a shifting pattern appropriate to driving conditions from all of the shifting patterns and switches automatically.

GREEN — Mode 1 — Switched from mode 2 to warm up the transmission fluid. This mode acts to protect the transaxle before the adaptive mode.

GREEN — Mode 2 — After engine start-up, warm-up speed is increased for a certain period when transmission fluid temperature is low and the vehicle speed is 0.

HIGH TEMP — When fluid temperature becomes too high, this mode activates lock-up at an earlier timing to stop the temperature rise and lower the temperature.

DOWN SLOPE — When driving down a slope, the transmission control module (TCM) detects a down slope based on the engine control unit signal and output rpm. TCM switches to down slope mode to alleviate the load to the brake by down shifting.

Chrysler

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Transmission ID

Making Your Job Easier!

Electronically controlled transmissions and their functions can be broken down into three (3) areas of control. Understanding these areas will greatly reduce diagnostic time and prevent premature failures when repairing these units. These areas are:

- **The mechanical portion** - Mechanical components allow the transfer of torque through gears, clutches, and rotating shafts.
- **The hydraulic portion** - Hydraulic fluid supplies the necessary pressure to move a piston or valve in the transmission to link the electric portion to the mechanical portion.
- **The electrical/electronic portion** - The electrical/electronic portion provides the means to give a full and direct control of the clutches. The use of electronics optimizes the shift quality, fuel economy, adaptation for conditions, and driver preference.

Understanding these three areas completely will give the technician confidence when faced with diagnostics – rebuilding – repairs that they are faced with day by day.

Each character in the name of the transmission has a specific meaning and helps identify the transmission type:

41TE

- **4** – Four forward speeds
- **1** – Duty rating
- **T** – Transverse
- **E** – Electronically controlled

41AE

- **4** – Four forward speeds
- **1** – Duty rating
- **A** – All wheel drive
- **E** – Electronically controlled

42LE

- **4** – Four forward speeds
- **2** – Duty rating
- **L** – Longitudinal mounted
- **E** – Electronically controlled

42RLE

- **4** – Four forward speeds
- **2** – Duty rating
- **R** – Rear wheel drive
- **L** – Longitudinal mounted
- **E** – Electronically controlled

45RFE

- **4** – Forward speeds
- **5** – Duty rating
- **R** – Rear wheel drive
- **FE** – Fully electronic

545RFE

- **5** – Forward speeds
- **4** – Forward speeds
- **5** – Duty rating
- **R** – Rear wheel drive
- **FE** – Fully electronic

Diamler/Chrysler

Autos and Truck Designations

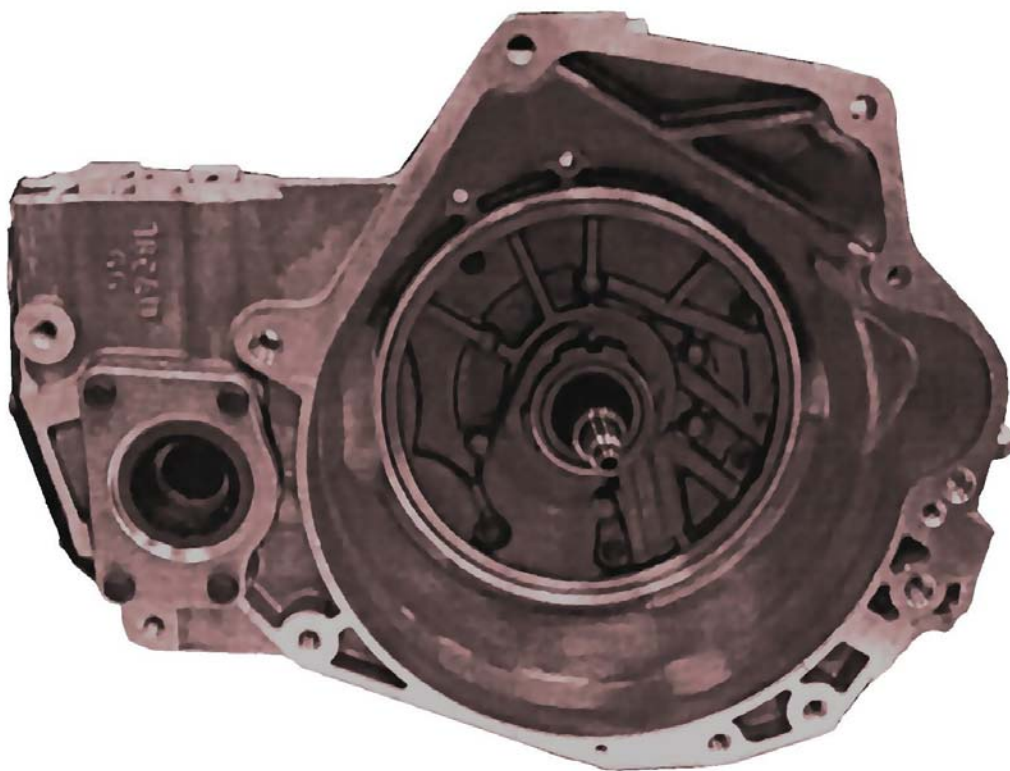
BODY	YEAR	MAKE
AA	1989 - 1995	Spirit/Acclaim/Lebaron Sedan
AB	1989 - 2003	Ram Van/Wagon
AC	1989 - 1993	Dynasty/New Yorker/New Yorker Sedan
AD	1989 - 1993	Ram Truck
AG	1989 - 1994	Daytona
AH	1989	Lancer/Lebaron GTS
AJ	1989 - 1995	Lebaron Coupe/Lebaron Convertible
AK	1989 - 1990	Aries/Reliant
AL	1989 - 1990	Horizon/Omni
AM	1989	Diplomat/Gran Fury/New Yorker Fifth Avenue
AN	1989 - 2004	Dakota
AP	1989 - 1994	Shadow/Sundance
AQ	1990 - 1991	Maserati
AY	1990 - 1993	Imperial/New Yorker Fifth Avenue
BR/BE	1994 - 2003	Ram Truck
CS	2004 - 2005	Pacifica
DN	1998 - 2003	Durango
DR	2002 - 2005	Ram Truck 1500/2500/3500 (Including Diesel)
FJ	1995 - 2000	Sebring/Avenger/Talon
GS	2000	Chrysler Voyager (International Market)
HB	2004 - 2005	Durango
JA	1995 - 2000	Cirrus/Stratus/Breeze
JR	2001 - 2005	Sebring Sedan & Convertible/Stratus Sedan
JX	1996 - 2000	Sebring Convertible
KJ	2002 - 2004	Liberty
LH	1993 - 2004	Concorde/Intrepid/Vision/LHS/New Yorker/300M
LX	2005	Chrysler 300/Magnum
ND	2005	Dakota
NS	2000	Town & Country/Caravan/Voyager
PS	1995 - 2005	SRT-4/Neon
PG	2002 - 2003	PT Cruiser (International Markets)
PT	2001 - 2005	PT Cruiser
PR	1997 - 2002	Prowler
RG	2001 - 2005	Chrysler Voyager (International Markets)
RS	2001 - 2005	Town & Country/Caravan/Voyager
TG	1997 - 2004	Wrangler
WG	2001 - 2004	Grand Cherokee (International Markets)
WJ	1999 - 2004	Grand Cherokee
YJ	1989 - 1995	Wrangler
ZB	2005	Viper
ZG	1996 - 1998	Grand Cherokee (International Markets)
ZH	2005	Crossfire
ZJ	1994 - 1998	Grand Cherokee/Grand Wagoneer

40TE

Updates

Several changes have been made to the FWD electronic transaxle family. These changes include:

1. New 40TE transaxle used on small engine packages
2. Stamped steel/bonded seal pistons
3. DC pump, new to the 40TE and modified for other transmissions
4. L/R Belleville spring changes



40TE

40TE, 41TE/AE, 42LE, 42RLE Updates

Dual Cyclodial Pump

In 2003, the pump design changed to improved performance and fuel economy. The design of this pump helps to prevent loss of prime, which can delay engagement and cause a rough 4-3 downshift. Codes associated with pump problems can include P0841 (L/R pressure switch) or P0944 (loss of prime). If a fault occurs in Reverse only, there will be no code set. Previous design pumps had a tilted gear pocket for the pump gears. The Dual Cyclodial pump has a square design gear pocket to prevent drain back issues that were associated with the early design pump. If the torque converter fails, this new pump can be easily damaged.

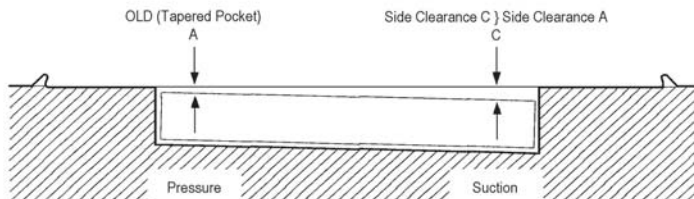


40TE, 41TE/AE, 42LE, 42RLE

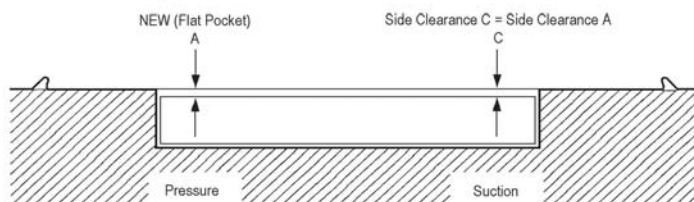
Updates (continued)

Dual Cyclodial Pump (continued)

Early pumps had a tilted pocket that was machined with a difference of 55 microns air gap across the face of the pump gears and pump face, allowing the torque converter to drain. This machining issue resulted in air, rather than fluid, being drawn into the pump causing the loss of prime condition to occur. The cressent and gears on the Dual Cyclodial pump are narrower than the first design pump.



Early pump was tilted



Late pump is straight

Dual Cyclodial Pump Pocket Machining

40TE, 41TE, 42TE (except JR)

Updates (continued)

2004 model year (except JR) Pistons

The UD, 2-4, and L/R pistons changed to stamped steel with bonded reusable seals. These replaced the cast aluminum pistons that use D-ring seals.

The new L/R piston is **not back serviceable** as the vent orifice was removed for durability issues (this reduced warranty-related issues due to the vent orifice becoming unseated).



Stamped Steel Pistons

40TE

Updates (continued)

Pistons

The 40TE (introduced in 2004) is used in smaller engine applications. Because of this the load capacity of this unit does not require the same amount of friction clutch plates that the 41TE uses. The UD, 2-4, and L/R pistons are taller to make up the difference for eliminating one friction and one steel plate from the stack ups.

**41TE
Shorter**



**40TE
Taller**



**41TE
Shorter**



**40TE
Taller**



**41TE
Shorter**



**40TE
Taller**



Stamped Steel Pistons

40TE, 41TE, 42RLE

Updates (continued)

L/R Belleville Return Spring.

The L/R Belleville return spring had to be made taller and larger in diameter for the stamped steel/bonded piston. The new spring has 10 fingers, compared to the 8 on the old return spring. This spring will not back service on aluminum piston designs.

Early



**Late
(Bonded Piston)**



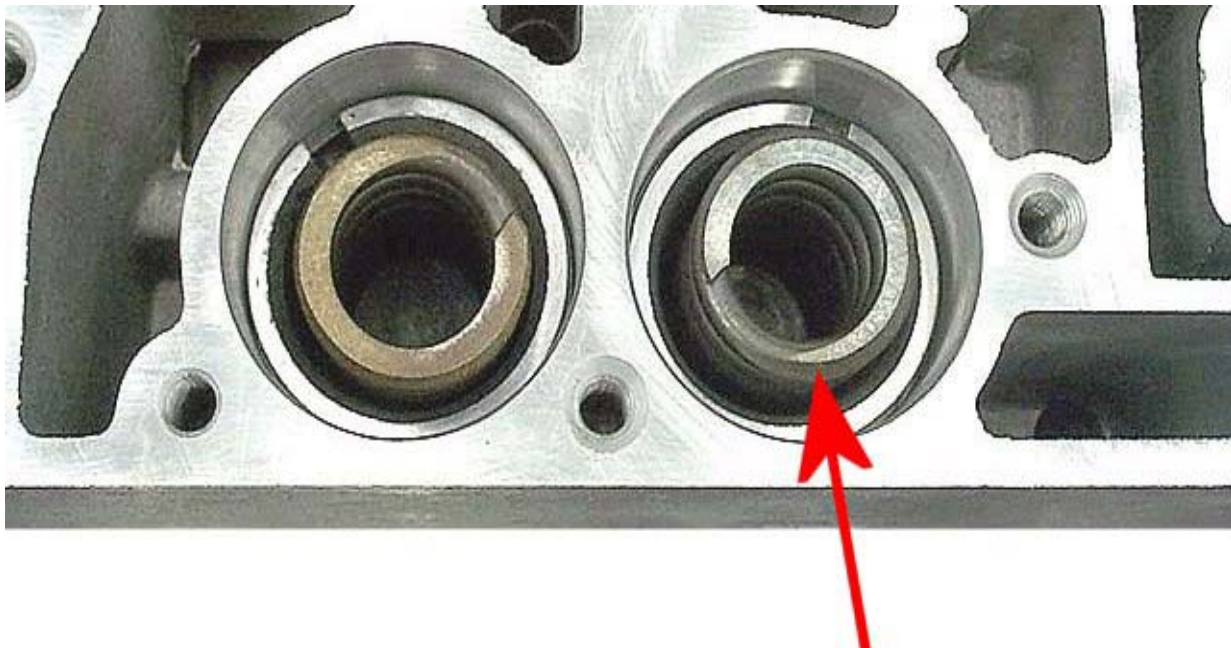
L/R Belleville Springs

40TE, 41TE

Updates (continued)

UD Accumulator Spring

The UD accumulator spring for the 2.0L, 2.4L, and 2.7L UD clutch has a higher spring rate to accommodate a smoother 2-1 kickdown shift. The spring is blue in color to differentiate it from the old green accumulator spring. The reason for this increase is due to the logic which requires the SSV to actuate.



UD Accumulator Spring

40TE, 41TE, 42LE/RLE

Updates (continued)

Accumulator Pistons

The Rev (and reverse accumulator cover), 2-4, OD, and UD clutch accumulator pistons are now made of stamped steel with a bonded seal material. This was to improve production and performance of the accumulators. Improved performance is now a Zero Leak accumulator.

Factory recommendation is to NOT back service these steel accumulators with earlier aluminum pistons. Early pistons should be serviced with the D-ring seals.



L/R Accumulator Bonded Pistons



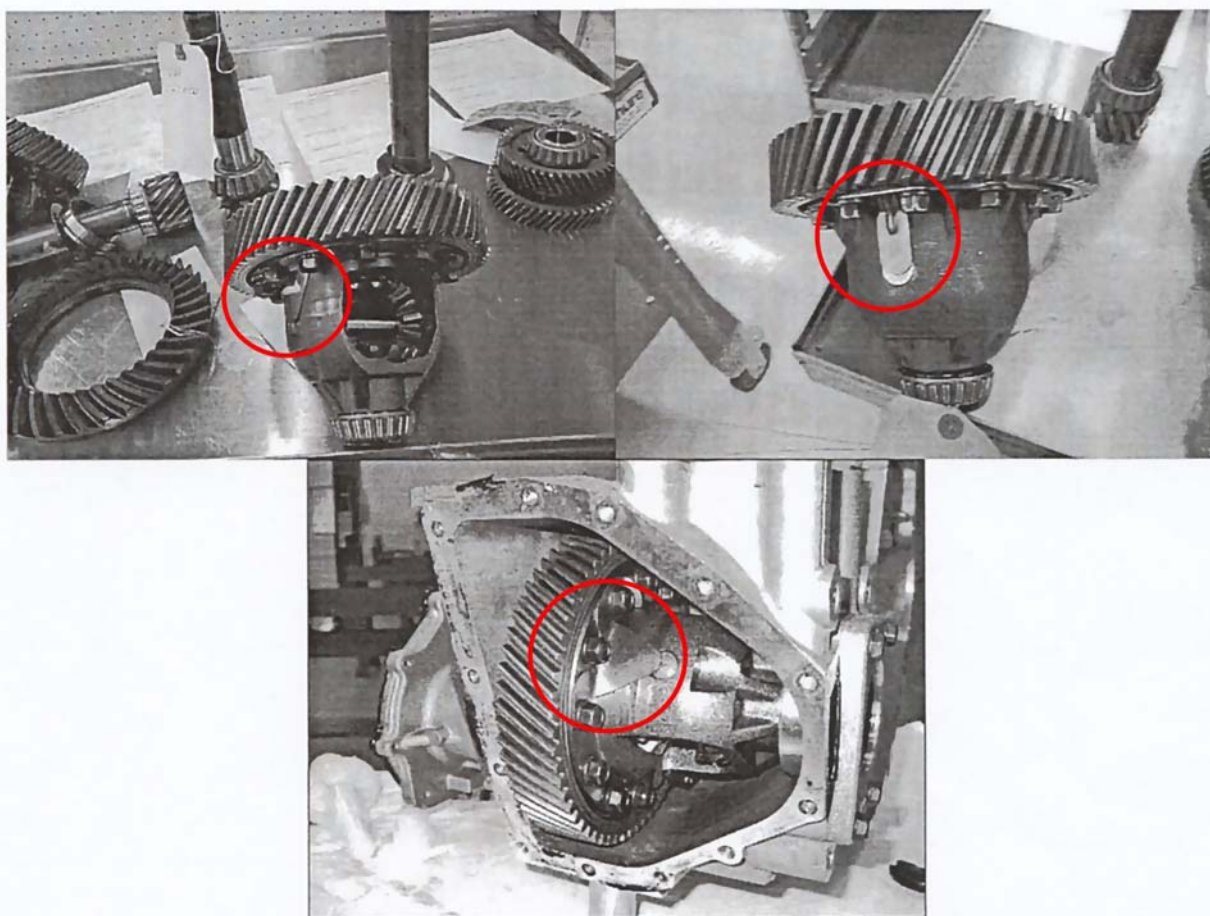
Accumulator Bonded Pistons

40TE, 41TE

Updates (continued)

Pinion Shaft Clip

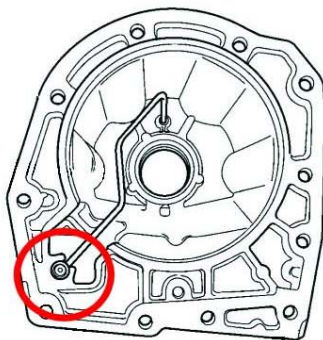
In 2000, the use of a pinion shaft retainer is being used on the one piece differential assembly for all light duty transaxles. A different retainer is used on the two-piece differential for the 3.3L and 3.8L applications. This clip is available from OE as well as the Aftermarket.



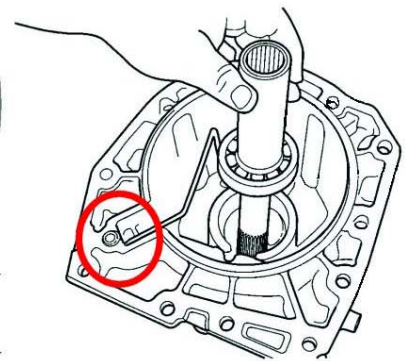
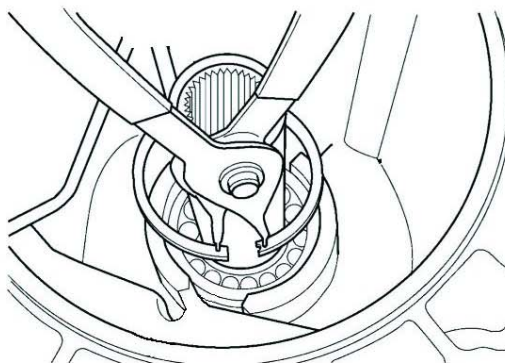
42RLE

Bearing Failure

The 42RLE replaces the 45RFE in smaller engine applications. The extension housing bearing requires a special lube tube to lubricate the rear bearing. Always use a brand new seal.



4WD



2WD

42RLE

Updates (continued)

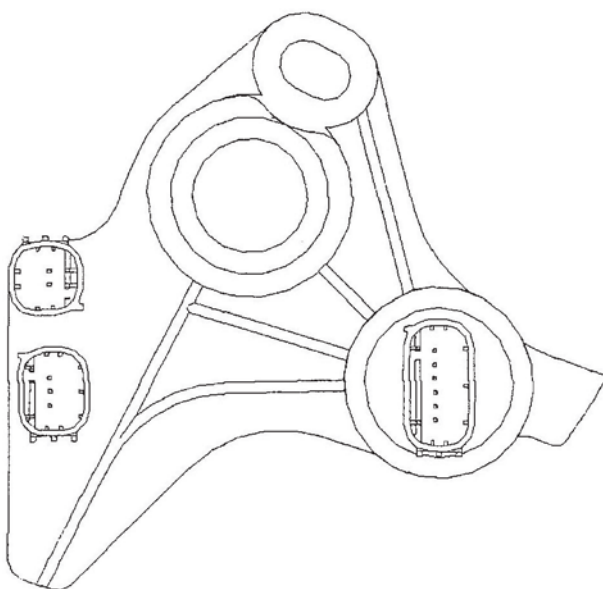
Line Pressure Solenoid

The 42RLE applications will adopt the use of a variable line pressure solenoid in 2005 model year. The valve body will be revised to incorporate the Pressure Control Solenoid/Variable Force Solenoid and also house the line pressure sensor.

New VFS (Intergrated connector on pressure transducer) Modified 45RFE VFS (New MCM VFS for 2006 model year)

- New pressure transducer
- New VLP header
- New solenoid switch valve
- New regulator spring
- Anodized valve body and transfer plate

Pin	Circuit	Inrsh I (A)	Cont I (A)	Stall I (A)	Crkt Name	Circuit Function
1	Not Connected					
2	LP +5 Volts	0.2A	0.25A	0	F856	ENG – 5 VOLTS ENGINE SENSOR SEC SUP
3	LP Signal	0.2A	0.25A	0	T38	TRX – LINE PRESSURE TRANSDUCER SIGNAL
4	LP Return grd	0.2A	0.25A	0	K900	ENG – ENGINE CONT COMMON SENSOR
5	VFS Switched Batt	1.5A	1A	0	T16	TRX – SWITCH BATTERY FEED
6	VFS Solenoid	1.5A	1A	0	T118	TRX – VARIABLE FORCE SOLENOID FEED

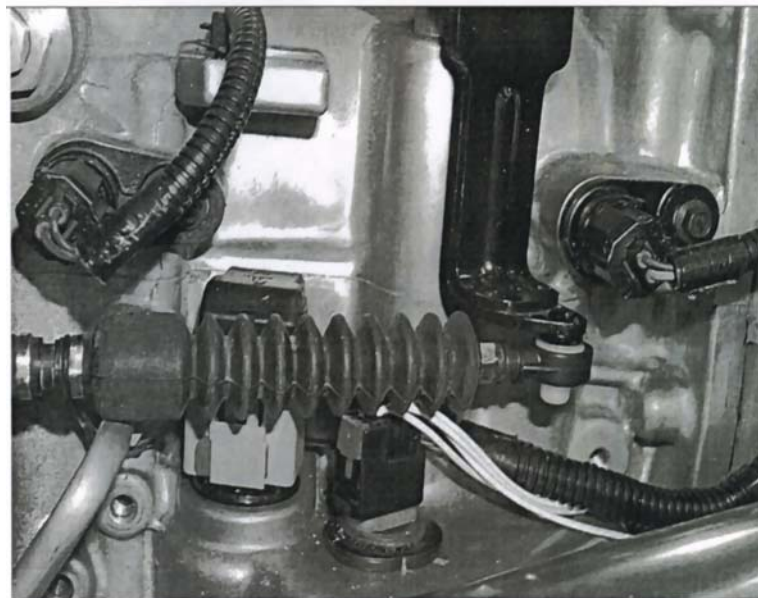


42RLE

Updates (continued)

Pressure Regulator Valve

The line pressure regulator valve has been revised to accommodate the Variable Line Pressure Control capability. To add this feature, the design of the case had to also change to allow for the new connectors.



42RLE

Updates (continued)

Variable Line Pressure Operation

How the system works:

The Variable Line Pressure (VLP) feature requires changes to the 42RLE transmission control system. This feature uses the basic 45RFE line pressure control logic with modifications to accommodate the hardware differences. The 42RLE transmission with the VLP feature has a line pressure sensor to monitor the actual line pressure and a Variable Force Solenoid (VFS to control the line pressure).

The basic control strategy “reduces” line pressure during in-gear conditions to lower transmission oil pump load and other parasitic losses, and it, thereby, improves fuel economy. During shifts, the line pressure is raised to a programmed level to provide good hydraulic response and consistent shift quality; this also allows shifts to be made at higher input torques than were possible with fixed line pressure.

The following changes are being added to Module Strategy.

1: Line pressure targets are added to support different shifts, ensure adequate torque capacities of the clutches (both the element clutches and the torque converter clutch), and ensure adequate lubrication of the transmission.

- i. Line pressure targets for shifts: The pressure targets are adapted from the line pressure values used in the current 41TE/42RLE transmissions. This allows keeping most of the previous calibrations for the transmissions with the VLP feature.
- ii. Line pressure target in-gear: The drive gear pressure target is based on the clutch torque required to carry the input torque. The pressure target in Neutral is balanced between the fuel economy and the transmission lubrication.
- iii. Line pressure target upper limits: the upper limits for the line pressure target are adapted from the fixed line pressure values used in the 41TE/42RLE transmissions.
- iv. Line pressure target lower limit: The lower limits for the line pressure target are established to provide the desired torque capacity of the clutches and adequate lubrication for the transmission.

42RLE

Updates (continued)

Module Strategy

**The following changes are being added to Module Strategy.
(continued)**

2: A closed-loop line pressure control algorithm is added: The algorithm compares the actual pressure with the target pressure and controls the actual pressure to the desired value. In order to maintain drivability with the faulty pressure sensor, an open-loop control algorithm is also implemented.

3: A clutch-slip correction and line pressure adjustment algorithm is added. When either an element clutch or the torque converter clutch slips unexpectedly, the VLP feature raises the closed-loop control target pressure to its upper limit temporarily to stop the slip and then adjusts the line pressure target calculation to prevent future slip. In the event of a faulty line pressure sensor where open-loop control is activated, this feature adjusts the open-loop VFS duty cycle calculation to correct and prevent future slip.

4: New and revised control logic is added to adapt the existing logic to variable line pressure.

5: A VLP enable bit is added to allow selection of VLP feature on an engine application basis.

6: Failsafe logic is added to detect a VLP system failure, activate alternative control strategies to maintain drivability, prevent possible further damage to the hardware, and provide diagnostic information about the fault.

7: Torque Management logic is added to ensure stable torque converter CC-On operation with throttle tip-ins. Throttle tip-ins during Torque converter CC-On operation could cause unexpected torque converter slip until the converter clutch pressure stabilizes.

8: Desired line pressures are being modified to improve the clutch capacities for certain shifts and in-gear conditions, to improve shift consistency, or to accommodate recent lab test results. Some logic is modified to improve reliability.

45RFE/42RLE

Updates (continued)

Replacement for Small Engine Applications

In 2003 the 42RLE replaced the RFE in smaller engine applications. The change was for cost savings due to weight and fuel economy. the 42RLE is a proven quality 42LE that has gone rearwheel drive. The vehicles that use the 42RLE are as follows:

Year	Body Model	Engine Size
2003	TJ	4.0L and 2.4L
2003.5	KJ	3.7L
2004	HB and AN	3.7L
2004.5	LX	2.7L and 3.5L
2005	ND	

42RLE

Updates (continued)

Transfer Case Adapter

The 4WD transfer case adapter and oil lube tube changed when the 42RLE was initially launched in the 2003 TJ with the 2.4L engine and on the 2003.5 KJ with the 3.7L. The TJ transfer case adapter has a 10 mm difference in length, but a common intermediate shaft. The lengths differ for proper fit in the different platforms.



Transfer Case Adapter

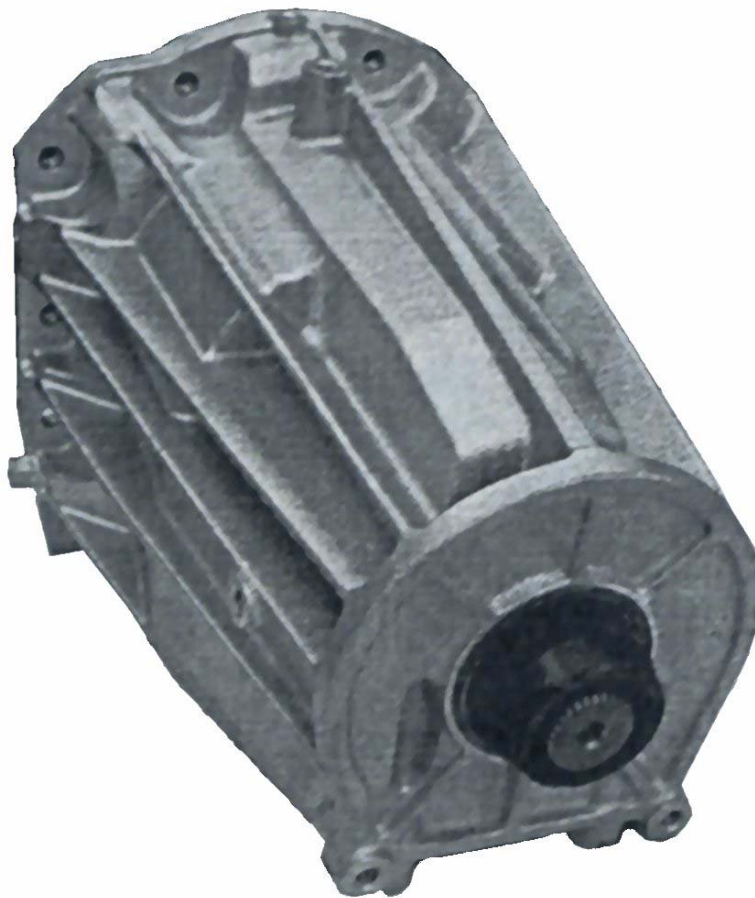
42RLE

Updates (continued)

2WD Adapter

In the middle of 2003 the 42RLE introduced the extension assembly with shaft, bearing, and housing assembly necessary to adapt on the 2WD vehicles. The parts on this extension housing are serviced separately. A lube tube extends from the front of the extension housing to the output shaft seal to lubricate the seal and bearing.

This extension housing is used on the AN, KJ, and HB two wheel drive applications. The seal, bearing and snapping are all common.



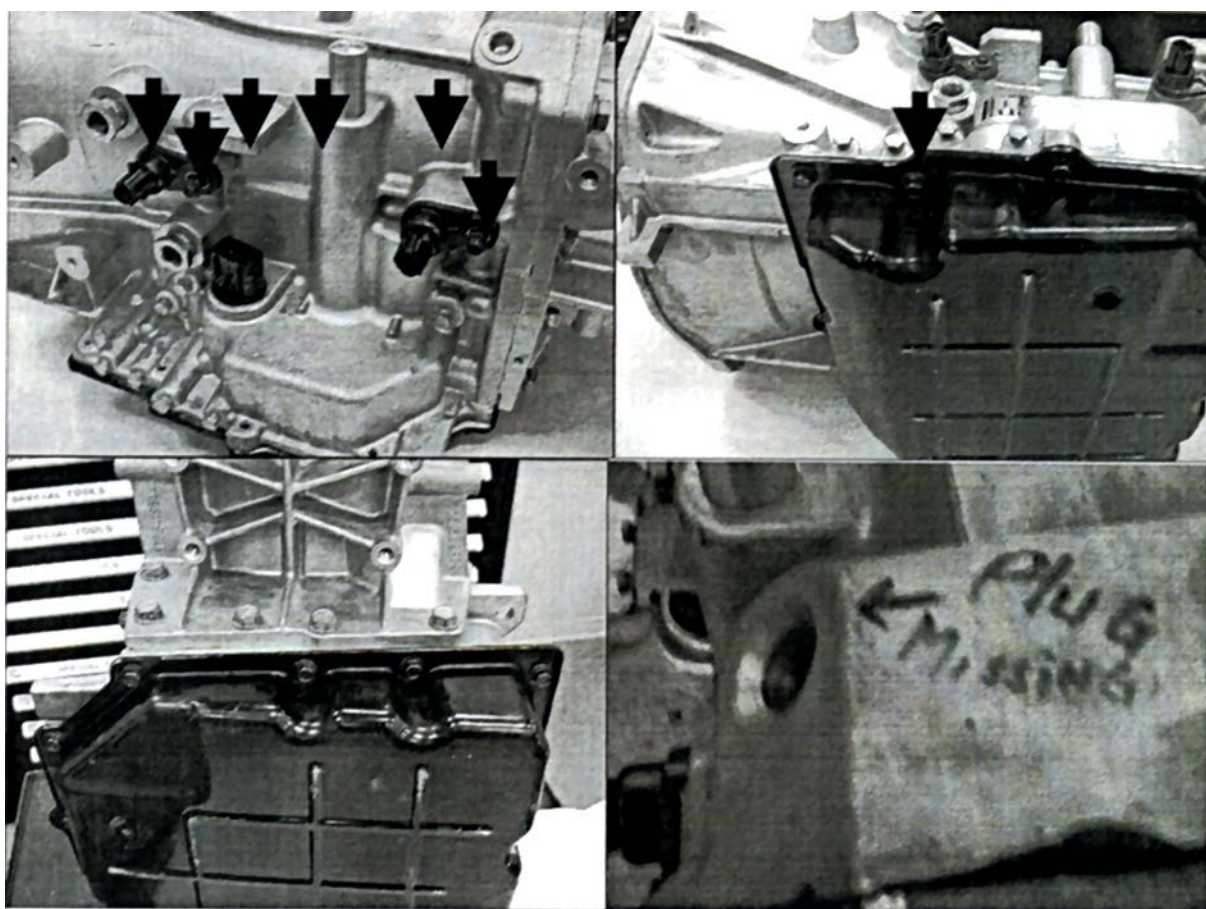
2WD Extension Housing

42RLE

Updates (continued)

Transmission Case Seepage

In the 2003 KJ and TJ, transmissions, fluid may seep at the input or output sensor to case fasteners, the adapter housing bolts, and extension to lower case fasteners. If any of these fasteners are seeping, replace all fasteners with the new patch bolts. Leaks have also been found at pan bolts under the pressure tap locations and these bolts also must be replaced with the new patch bolts. The replacement bolts have a pre-applied sealer designed for a one-time use.



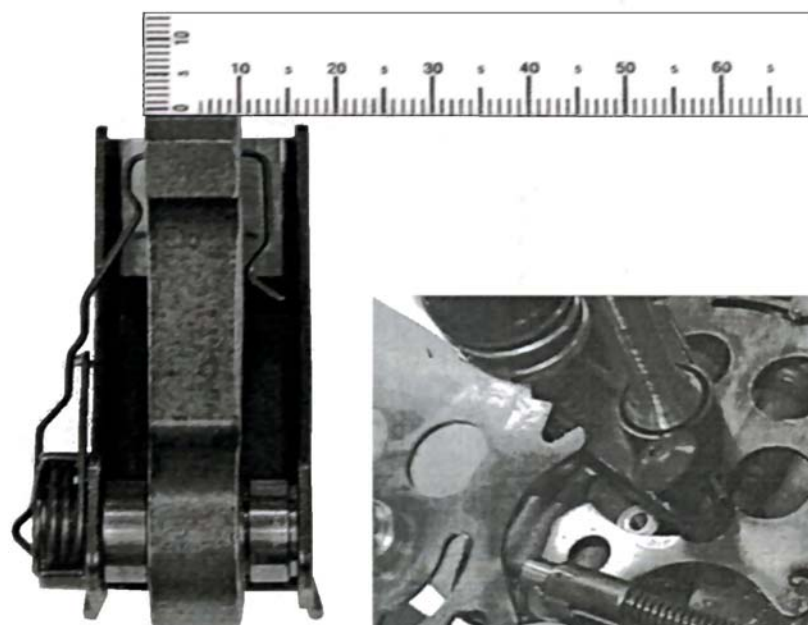
Patch Bolt Locations and Transmission with Missing Plug

42RLE

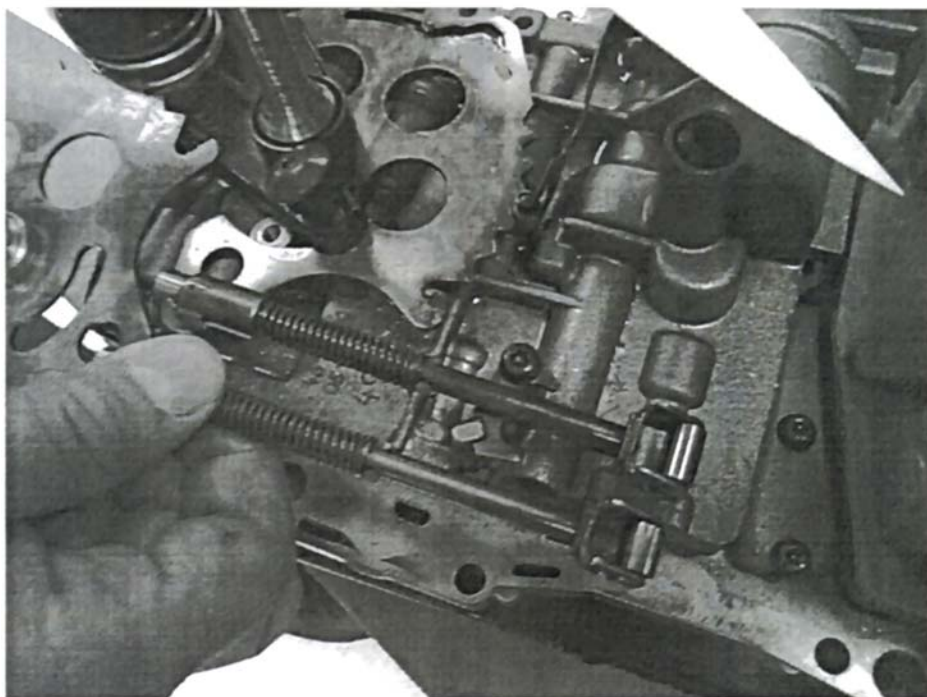
Updates (continued)

New Parking Pawl

2003 TJ applications with the 4.0L or 2.4L and the KJ with a 3.7L had modifications so the transmission could hold the 10,000 gross combined vehicle weight (GCVW) rating tow capacity rated vehicles in the park position. To achieve this, a wider 2.5 mm parking sprag was installed as well as a different parking pawl, narrower spacer, parking guide, and wider park rod. On these applications the case has been modified to make room for the larger parking assembly. If a new case is ordered, the upgraded parking assembly is included with this setup.



Parking Pawl



Park Rod Clipped in Place and Park Rod Comparison

42RLE

Updates (continued)

Input and Output Speed Sensors

The input and output speed sensors were changed on the 42RLE and they are not backward compatible with any other model. The input speed sensor is common with the 45RFE, but the output speed sensor is unique. Make sure when ordering you specify which sensor you want.

Neither sensor will interchange with one another, their mounting surfaces are different.



42RLE

Updates (continued)

Output Shaft on 4WD applications

The rear spline was lengthened and the snapping groove became wider and deeper to house a locking ring for the stub shaft. This was necessary for the 4WD applications starting with the 2003 TJ with the 2.4L and the KJ with the 3.7L engines. The shaft can be hard to remove because of this locking ring. Always install a new ring when servicing the shaft removal.

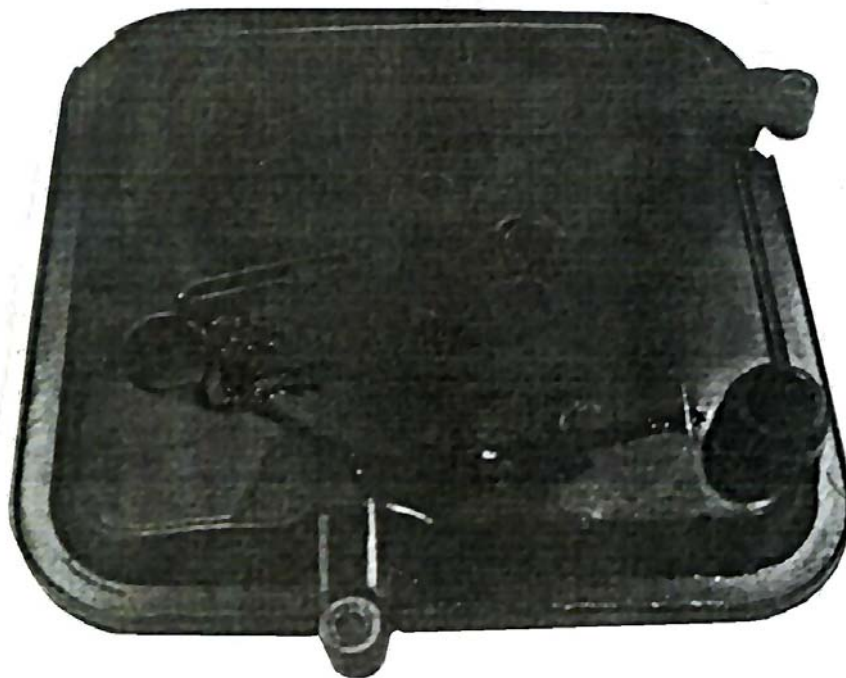


42RLE

Updates (continued)

Transmission Case, Pan and Filter

The transmission case was changed by adding a sump. The filter added an elliptical circle snorkel for added fluid pickup that was optimized so the filter is not starved during extreme maneuvers.



42RLE Filter

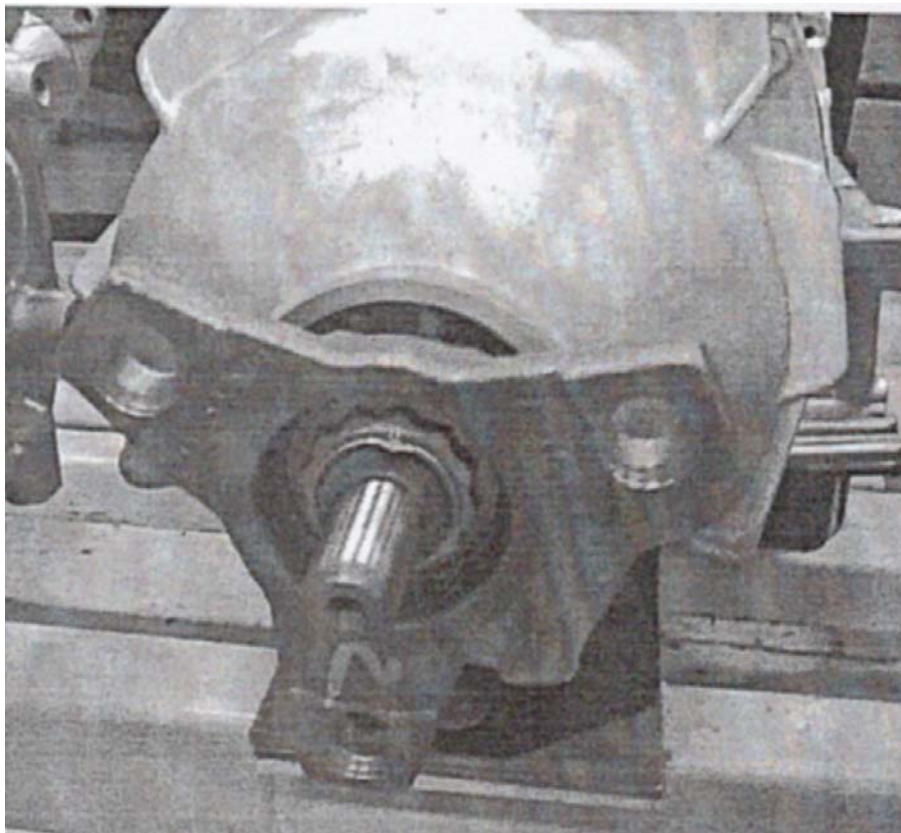
42RLE

Updates (continued)

Output Flange

LX Applications

In the middle of 2004, the 42RLE used in the LX 2.7L and 3.5L applications required a fixed output flange. When servicing the yoke always install a new locking nut.



42RLE

Solenoid/Pressure Switch Codes

2004 Dakota (AN), 2004-2005 Durango (HB), 2003-2005 Liberty (KJ), 2003-2005 Cherokee *International Models* (KJ), 2005 300/Magnum (LX), 2005 Dakota (ND), 2003-2005 Wrangler (TJ) models may experience any of the following codes:

- P0750
- P0755
- P0760
- P0765
- P0846
- P0871
- P0841

This condition can be caused by moisture in the solenoid/switch assembly connector. Inspect for any signs of corrosion and moisture in the connector. Many times this corrosion will damage the pins on the solenoid/switch assembly and both may need to be replaced. Part #'s are:

Wiring 10-Way Pigtail Harness ————— 05102405AA

Solenoid/Pressure Switch Assembly — 05143151AA

41TE, 42LE, 42RLE

Code P1776

2004 Dakota (AN), 2004-2005 Pacifica (CS), 2003-2004 Seabring Convertible/Seabring Sedan/Stratus Sedan (JR), 2003-2004 Liberty (KJ), 2003-2004 Cherokee *International Markets* (KJ), **2002**-2004 300M/Concorde/Intrepid (LH), 2003-2004 Neon/SX 2.0 (PL), 2003-2005 PT Cruiser (PT), 2003-2005 Chrysler Voyager *International Markets* (RG), 2003-2005 Town & Country/Voyager/Caravan (RS), and 2003-2004 Wrangler (TJ)

Code P1776 (Solenoid Switch Valve Latched in the LR position) may be caused by one of the following concerns:

NOTE: The solenoid switch valve is not in the solenoid pack, it is in the valve body.

TRS Code Reads TR2

If the “TRS Code” displays “TR2” it is an indication that the manual valve was not fully in the OD position at the time the DTC was set. Check the shifter cable adjustment and adjust if necessary. Also Check the shift control system for excessive friction and/or routing issues.

TRS Code Reads OD

If the “TRS Code” displays “OD” then a sticky solenoid switch valve is the primary cause. Perform the proper diagnosis for the valve body. Inspect for foreign material in the solenoid switch valve and plugs.

Model	Engine	Transmission
AN	3.7L	42RLE
CS	3.5L	41TE
JR	2.4L or 2.7L	41TE
KJ	3.7L	42RLE
LH	2.7L or 3.5L	42LE
PL	2.0L	41TE
PT	2.0L or 2.4L	41TE
RS/RG	2.4L, 3.3L or 3.8L	41TE
TJ	4.0L	42RLE

41TE, 42LE, 42RLE

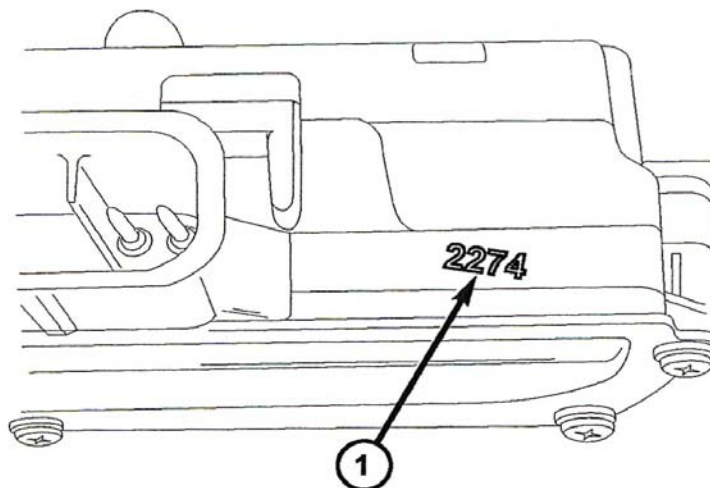
Code P1776 (continued)

2002-2004 LH Models Only

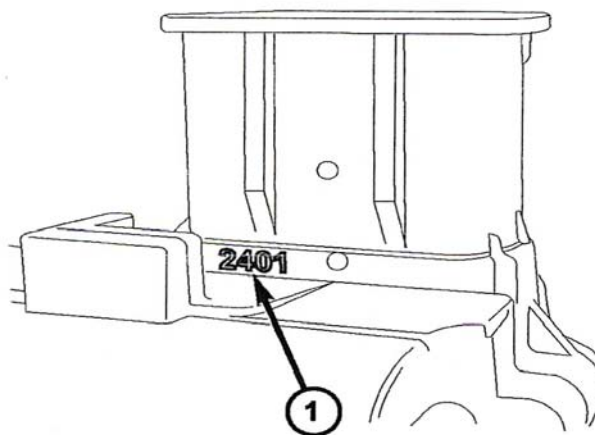
FOR 2002-2004 LH MODELS ONLY

If replacing the valve body assembly for DTC P1776 Solenoid Switch Valve Latched in LR Position first inspect the build date on the solenoid pack. If the build date range falls in between 3001 and 0603 replace the solenoid pack not the valve body**

Solenoid identification build date numbers.



BUILD DATE RANGE LOCATION 1



BUILD DATE RANGE LOCATION 2

41TE, 42LE, 42RLE

Delayed Engagements

The transaxle/transmission may experience a long delay or temporary loss of transmission engagement after initial start up. This condition usually happens after an extended soak (several hours) and may be accompanied by a harsh 4-3 downshift. DTC P1791/P0944 (loss of prime) may also be present at time of service.

To correct the concern replace the front pump and check the TCM for the latest software revision level

Refer to the following table for specific applications:

Model	Engine	Transmission	**Build dates**
CS	3.5L	41TE	**Built on or before** July 10, 2003 (MDH 0710XX)
JR	2.4L or 2.7L	41TE	**Built on or before** July 2, 2003 (MDH 0702XX)
KJ	3.7L	42RLE	
LH	2.7L or 3.5L	42LE	**Built on or after June 2, 2002 (MDH 0602XX)**
PL	2.0L	41TE	**Built on or after June 2, 2002 (MDH 0602XX)**
PT	2.0L or 2.4L	41TE	**Built on or after June 2, 2002 (MDH 0602XX)**
RS/RG	2.4L, 3.3L or 3.8L	41TE	**Built on or after June 2, 2002 (MDH 0602XX)
TJ	4.0L	42RLE	

Part Number:

41TE Oil Pump 05127197AA

42LE Oil Pump 05127198A

42RLE Oil Pump 05127199AA

41TE, 42LE, 42RLE

Harsh 4-3 Downshift

On 2004 Pacifica (CS), 2003-2004 Sebring Convertible/Sebring Sedan/Stratus Sedan (JR), **2003** Liberty (KJ), **2003** Cherokee *International Markets* (KJ), 2003-2004 300M/Intrepid (LH), 2003 Neon/SX 2.0 (PL), 2003 PT Cruiser (PT), 2003 Chrysler Voyager *International Markets* (RG), 2003 Town & Country/Caravan/Voyager (RS), and 2003 Wrangler (TJ) vehicles that experience a harsh 4-3 downshift under normal driving, after an extended soak (several hours), confirm the following in diagnoses:

- Fluid level correct
- Proper fluid installed in the unit
- Engine does not have any performance issues (codes)

If the following is experienced and the basics have been covered, the fix is in reprogramming the transmission control module (TCM)

Model	Engine	Transmission	Built On or Before
CS	3.5L	41TE	July 10, 2003
JR	2.4L or 2.7L	41TE	July 2, 2003
KJ	3.7L	42RLE	
LH	2.7L or 3.5L	42LE	
PL	2.0L	41TE	
PT	2.0L or 3.5L	41TE	
RS/RG	2.4L, 3.3L or 3.8L	41TE	
TJ	4.0L	42RLE	

45/545RFE

Updates

Tow/Haul (OD OFF) Changed

For reasons of fuel economy, driveability, and customer satisfaction, the HB, WK, and DR line of vehicles with 4.7L and 5.7L 545RFE Tow/Haul was added. These features include:

- Provides a replacement to the OD off feature
- Enables the vehicle to up-shift to 4th gear under certain conditions to provide NVH and fuel economy benefits
- Delays up-shifts to avoid shift “hunting” while towing
- Automatic downshifts during grade descent provide engine braking

On past vehicles, when the OD OFF was activated the transmission would not shift into overdrive. The OD OFF switch is now the Tow/Haul switch and uses a different strategy for operation. Unlike the OD OFF switch, the Tow/Haul switch allows the RFE transmission to operate in 4th gear when certain conditions are met. When activated, the transmission upshifts are delayed and the instrument panel indicator is illuminated to notify the driver. Also, when the Tow/Haul feature is active the vehicle can shift back into third gear for engine braking automatically. This occurs when the Tow/Haul logic detects a closed throttle and a vehicle speed increase of 5 mph, or if the brake is applied for more than 2 ¼ seconds. Vehicles other than the WK, HB, and DR will retain the OD OFF function.



Typical Tow/Haul Switch

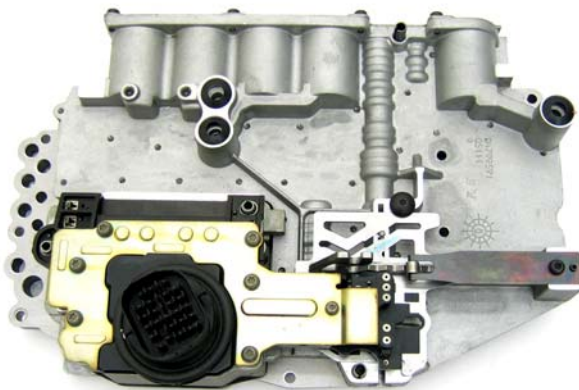
45/545RFE

Updates (continued)

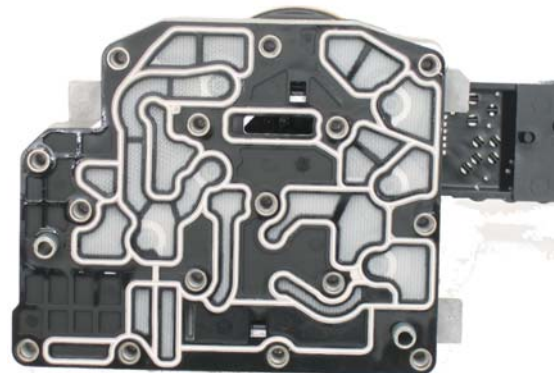
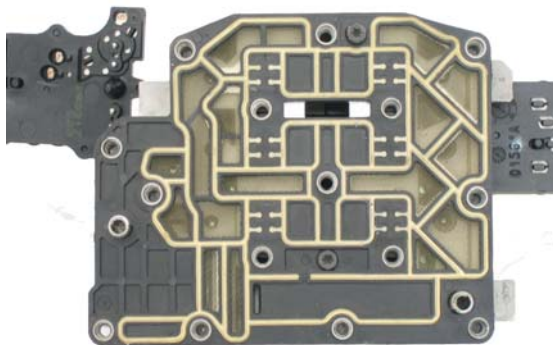
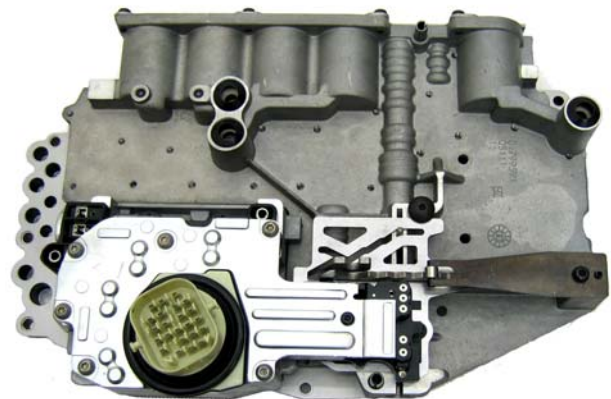
Revised Valve Body for 2005

In 2005 a new valve body was released with a revised separator plate to improve reverse shift quality. The R1 (reverse orifice) is now smaller to improve reverse shift quality which eliminated a bump feel going into reverse. This new valve body is “not backwards compatible” to 2004 model year. Torque management was added in the transmission software to accommodate the smaller orifice and there at this time is no reflash to compensate for the changes. NOT Interchangeable.

Early



Late



45/545RFE

Updates (continued)

C2 Check Valve added to Pump Valve Body

A running change to the oil pump valve body involved the installation of the C2 check valve. The spring loaded check valve is threaded into the pump valve body housing. The purpose of this new valve is to prevent converter drainback. Casting changes happened before the valve was introduced so not all castings that have the open passage will have the C2 valve installed. This pump body will NOT interchange with earlier models.



45/545RFE

Updates (continued)

2C Clutch Piston

The 2C Clutch Piston is now made of stamped steel with a bonded rubber lip seal. The change was a cost saving issue. This piston is compatible and can be used to back service all RFE transmissions.



2C Molded Rubber Clutch Piston

45/545RFE

Updates (continued)

4C Clutch Piston

In 2005 the 4C clutch piston was changed to improve a higher torque capacity. The 4C piston has been modified in 2005 from the aluminum casting design to a stamped steel piston with bonded lip seal. This piston is not “backward” compatible because of a recess in the 2C/4C clutch retainer that will not allow full travel of the piston. If the 2C/4C retainer, as an assembly, is replaced than the use of this new design piston can be back serviced.



4C Molded Rubber Piston
(will not back service early 2C - 4C Retainer)

45/545RFE

Updates (continued)

L/R Clutch Piston

For reasons of higher torque capacity the L/R piston and Belleville spring are both new for the 2005 model year. The L/R piston is now stamped steel with bonded rubber lip seals. The Belleville spring is also unique. The diameter of the spring is larger and the fingers are longer than original early designed return spring. As an assembly this new piston is backward serviceable as long as the correct return spring is used. Parts can not be mixed when changing designs.



L/R Clutch Piston and Belleville Spring

45/545RFE

Updates (continued)

ERS Added on WK Vehicles

The WK model has a newly designed shifter assembly (same as used in the NAG1 applications). This new Electronic Range Select (ERS) shifter allows the driver to select the desired top gear range providing more control. The WK offers two different powertrain packages: NAG1 in 3.7L applications and the 545RFE behind the 4.7L and 5.7L engines. To provide a common feel, the shifters share a common base assembly. Since there are different strategies used to control these transmissions, some of the components inside the shifter assembly are different.

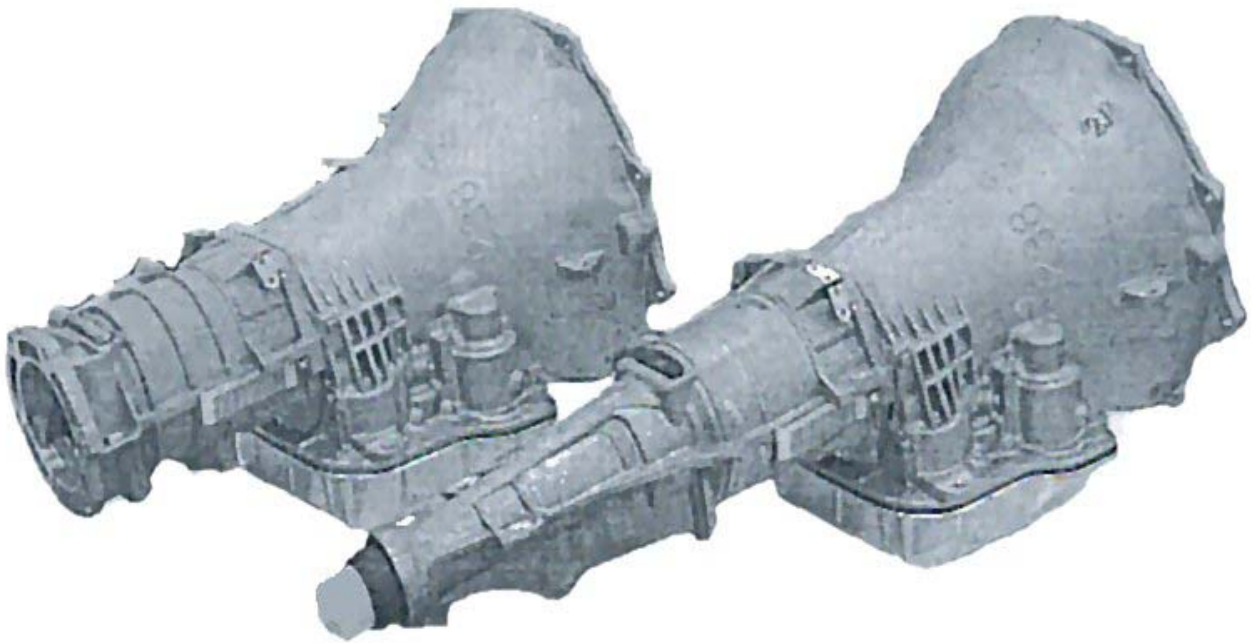


48RE

Updates

Beginning in 2005 there were changes made in the 48RE applications. These changes included:

- A new case with two extra bosses to except a Throttle Actuator Motor (Diesel Applications)
- Software changes in the Tow/Haul Strategy



48RE

Updates (continued)

Throttle Valve Actuator

The transmission Throttle Valve Actuator (TTVA) is a new motor/actuator that is mounted to the side of the transmission case and used to drive the throttle shaft. This component eliminates the previous under hood actuator and linkage. The Transmission case had 2 bosses added to the side for the actuator to mount to. The detent feel was removed from the valve body and the throttle shaft was made 2 mm longer. The change was required for Diesel applications only. The V10 transmission will not have the actuator.

The new transmission will not service past designs.

The TTVA has a six pin connector, that supplies 12 volts to drive a motor from the Cummins engine controller and uses 2 feedback potentiometers to report position back to the controller to identify the correct position.

The TTVA consists of an electric DC motor, tow potentiometers, and a gear drive system. The TTVA is mechanically connected to the transmission throttle valve in the valve body by the “D” shaped opening in the pottom of the TTVA shaft.

Changes in the TTVA position are therefore transferred to the throttle valve and cause changes in the transmission throttle pressure. All changes in the throttle valve position are controlled by the Engine Control Module (ECM)

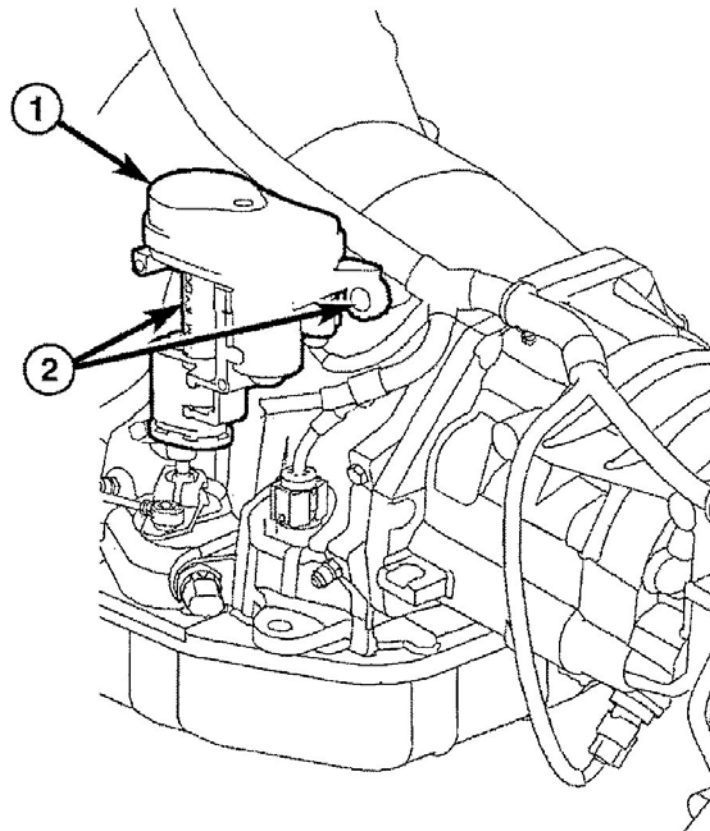


48RE

Updates (continued)

Adjustments

The Transmission Throttle Valve Actuator (TTVA) does not require any mechanical adjustments. All changes in throttle valve position are controlled by the Engine Control Module (ECM). The TTVA does require an initialization period after the actuator has been removed or replaced. After the actuator has been removed or replaced, move the ignition to the ON position for thirty (30) seconds. This will allow the ECM sufficient time to perform the internal calibration procedures to learn the TTVA's current "zero" position. Once this is done, check the ECM for diagnostic trouble codes (DTCs). If no DTCs are set relating to the TTVA, the TTVA is fully calibrated and ready for use.



Transmission Throttle Valve Actuator

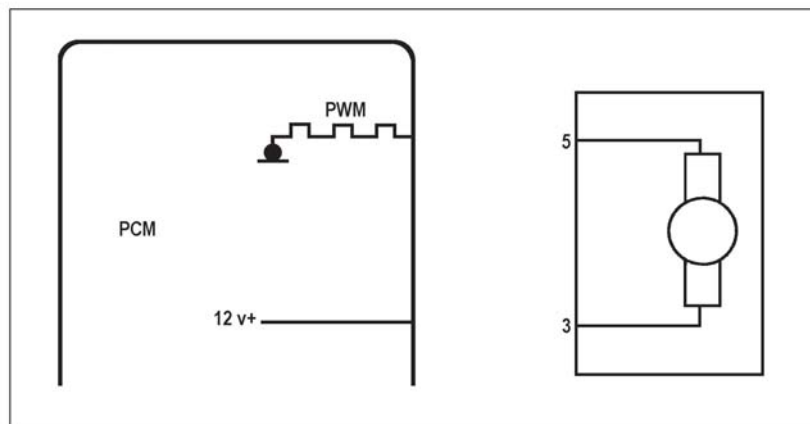
- 1) Transmission Throttle Valve
- 2) Mounting holes

48RE

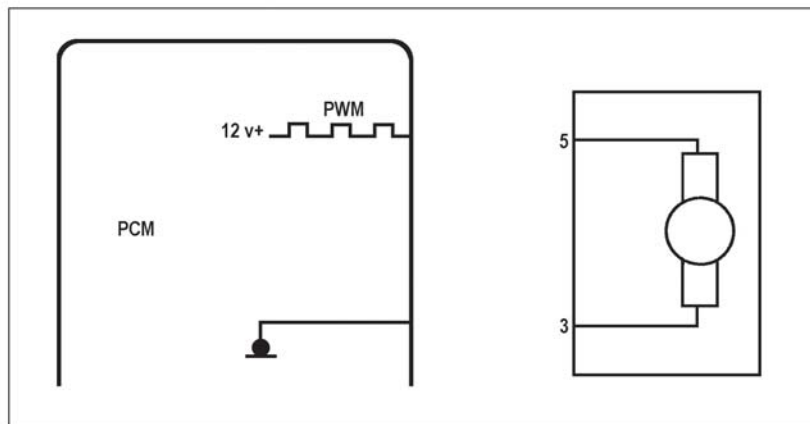
Updates (continued)

Transmission Throttle Valve Motor Circuit

The motor circuit reverses polarity to drive the transmission throttle (TTVA) shaft to either the full (TTV) shaft position or the closed TTV shaft position. The TTVA connector pin 5 is the Pulse Width Modulated side of the motor circuit. The motor circuit is completed through Pin 3. Most of the time, circuit polarity causes the actuator motor to either move the TTV shaft to full throttle position or hold the TTV shaft in the closed throttle position against spring tension. To do this, Pin 3 is grounded and Pin 5 is powered. To reverse the motor and rapidly change the position of the TTV shaft, the circuit reverses polarity. Pin 3 supplies 12V and Pin 5 supplies ground.



TTVA Motor Polarity with Throttle Valve shaft (throttle closed)



TTVA Motor Polarity with Throttle valve shaft in the full throttle position

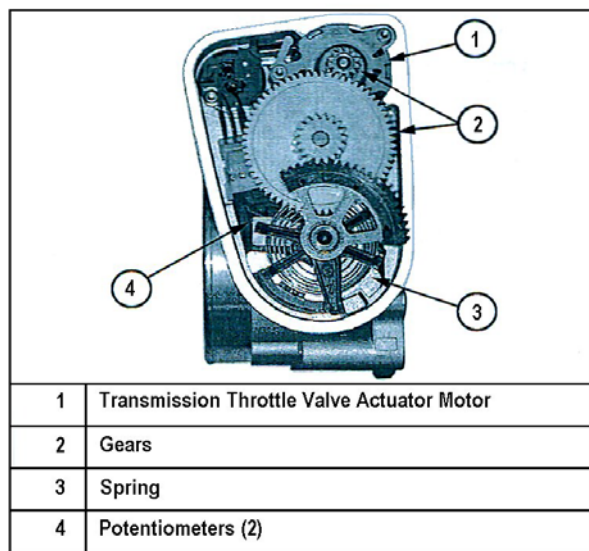
48RE

Updates (continued)

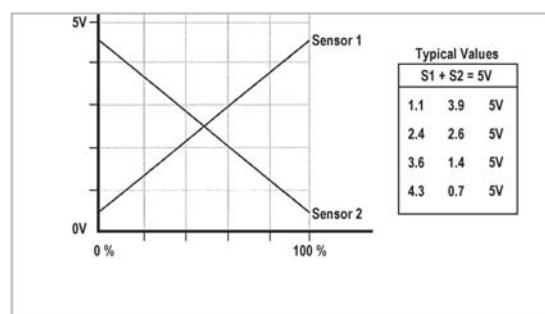
Transmission Throttle Valve Potentiometer

Two potentiometers are built into the TTVA body and provide two transmission throttle valve shaft position signals to the PCM. Two sensors are used for failsafe redundancy and error checking. The sensors output analog signals to inform the PCM that the TTV shaft moves as expected.

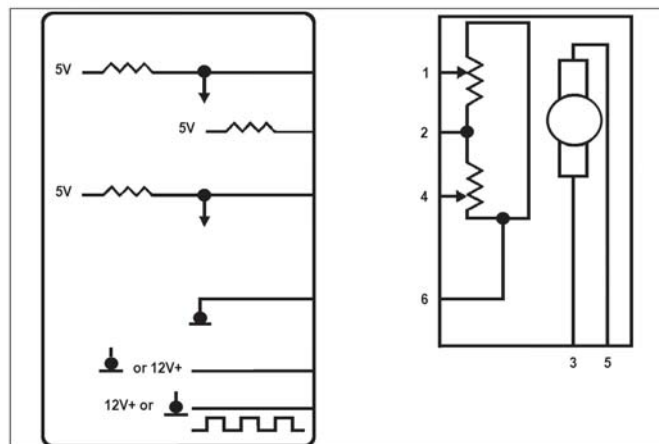
Two three-wire potentiometer sensors are used. The sensors use a common 5V reference and sensor return. Each sensor outputs an analog signal in proportion to TTV shaft position, but one sensor uses reverse logic. As the TTV shaft rotates to full throttle, the signal voltage from potentiometer #1 increases, and the signal voltage from potentiometer #2 decreases. The sum of the two potentiometer signal voltages should always equal approximately 5V. The PCM monitors this value to check the system integrity.



Transmission Throttle valve Actuator Motor, Potentiometers, Spring and Gears



Potentiometer Signal Voltages vs TTV shaft Position

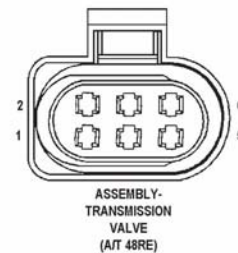
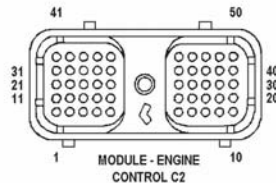
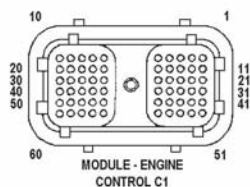
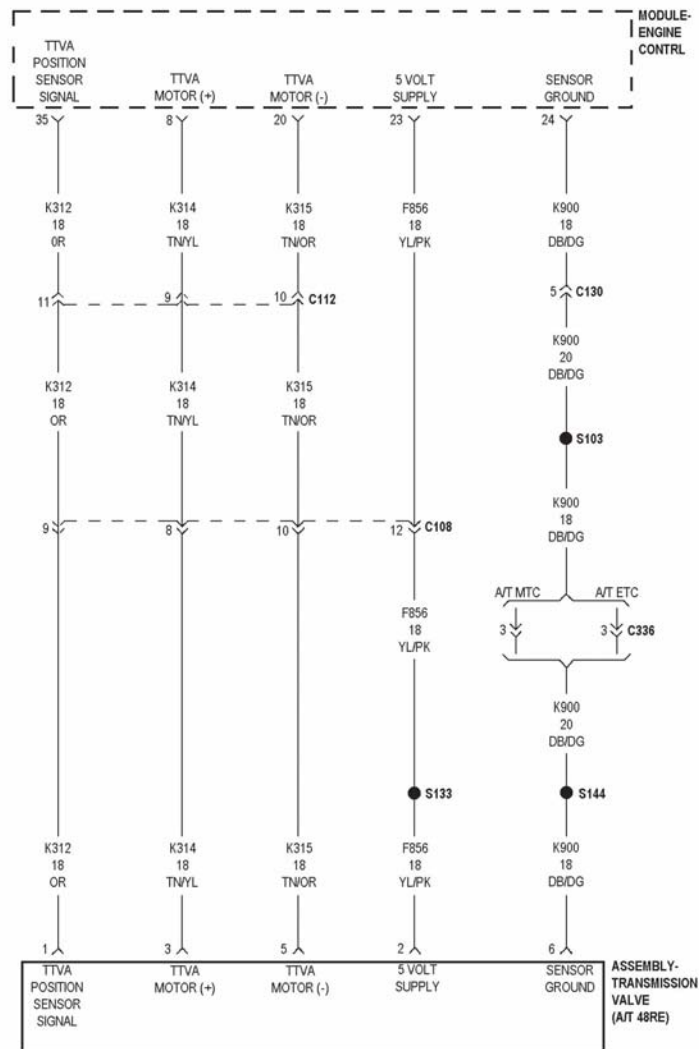


TTVA Circuit

48RE

Updates (continued)

TTVA Transmission Circuit Diagram



TTVA Transmission circuit diagram

Honda

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Honda/Acura

Factory Warranty Extensions

Warranty extended on transmissions and torque converters to 7 years or 100,000 miles, whichever comes first.

Honda

1999-2001 Odyssey - ALL

2000-2001 Accord - ALL

2000-2001 Prelude - ALL

Acura

1999-2002 3.2TL - ALL

2003 3.2TL (except Type S):

From VIN 19UUA5...3A000001 thru 19UUA5...3A019556

2003 3.2TL Type S:

From VIN 19UUA5...3A000001 thru 19UUA5...3A019061

2001-2002 3.2CL - ALL

2003 3.2CL (all models):

From VIN 19UYA42...3A000001 thru 19UYA42...3A005203

Diagnostics

First Approach

Road Test and Lift Inspection

Get a description of the symptoms from the customer. Ask when the symptoms occur (cold, first startup in the morning, after the vehicle is driven for a while and warmed up, etc).

1. Road test vehicle and note any symptoms and when they occur (cold, hot, long drive, etc.)
2. Note any howling or gear whine noises.
3. Put vehicle up on a lift. Check axles and seals and note if there are signs of leakage and/or excessive radial axle movement.
4. Drain fluid through a paint strainer into a clean container. Dark or black fluid indicate possible clutch failure.
5. Note the amount and type of metal debris on the drain plug magnet. Fine black metal is normal. Shiny, flaky metal particles are a red flag for hard parts failure.

Note: New solenoids are expensive and can be ruined if they are installed and run on a contaminated unit. It is recommended that you carefully check for signs of contamination or internal failure before replacing solenoids.

Beware of vehicles that have had a “miracle service”, or have been flushed and had the fluid changed before they came to your shop. Evidence of contamination and internal failure may have been temporarily removed.



Diagnostics

Scan Tool

Scan Tool Functions

DATA LIST: Order and number of PID's displayed can be customized
LED's can be selected to indicate 4 ON/OFF PID's

BAR GRAPH can be selected to indicate 4 PID's

LINE GRAPH can be selected to graph two PID's

SNAPSHOT: Records data from -12.6 seconds to +12.6 seconds with 0.2 second resolution. Trigger point can be changed to give more time before or after trigger. Can be set to trigger when any DTC sets, or trigger manually.

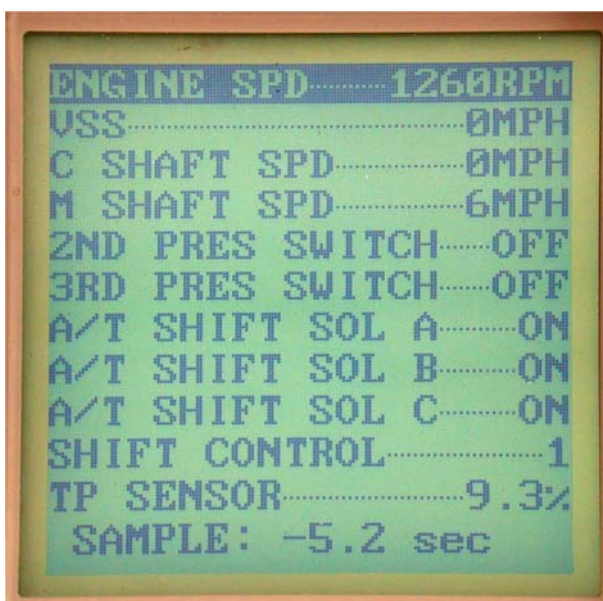
FREEZE DATA: A single frame of engine PID's that are stored when a DTC is set.

DTC/DATA CLEAR: Clears codes and freeze data.

TCM/PCM RESET: Resets PCM adaptive memory, fuel trim, and transaxle adaptive memory.

LOCKUP SOL TEST: Cycles lockup solenoid on and off for 15 seconds (engine must be off).

SHIFT SOL TEST: Cycles Shift Solenoid A, B, or C on and off for 15 seconds (engine off).



Scan Tool functions

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Advanced Diagnostics

Information

Factory service manual information on Honda/Acura transaxle performance DTCs can be vague, making them difficult to diagnose or verify repair. Here are the DTC definitions and conditions the PCM is looking for to set these codes:

P0730:

Problem in Shift Control System

Conditions for setting DTC:

- Engine coolant temperature: between 158°F (70°C) and 212°F (100°C)
- Engine speed: 500 rpm or higher
- Vehicle speed: 10 mph (17 km/h) or higher
- Selector in D3 or D4 position
- No other sensor or transmission solenoid DTC's active
- Actual gear ratio (calculated with mainshaft and countershaft speed) is less than 80% or more than 125% of the commanded gear for 12 seconds
- Single drive cycle, MIL ON

P0740:

Problem in Lockup Control System

Conditions for setting DTC:

- Engine coolant temperature: between 158°F (70°C) and 212°F (100°C) for 4 cylinder applications between 167°F (75°C) and 212°F (100°C) for V6 applications
- Vehicle speed: between 49 mph (79 km/h) and 73 mph (117 km/h)
- Selector in D4 position 4th gear
- No other sensor or transmission solenoid DTC's active
- Torque converter clutch is commanded to Full Apply
- The mainshaft speed is 95% - 98% of engine speed or less for 20 seconds or longer
- Single drive cycle, MIL on

Advanced Diagnostics

Information (continued)

P0780:

Mechanical Problem in Hydraulic Control System for Shift Solenoid A and Clutch Pressure Control Solenoids A and B, or Problem in Hydraulic Control System

Conditions for Setting DTC:

- ATF temperature: -13°F (-25°C) or above
- No other sensor or transmission solenoid DTCs active
- One of the following conditions is present:
 - A 1-2 shift is commanded and the actual gear is 1st
 - A3-4 shift is commanded and the actual gear is 3rd
 - A 3-4 shift is commanded and the actual event is a 3-2 shift
 - 4th gear is commanded and the actual gear is 2nd
- The condition is present for 20 seconds when ATF temperature is below 32°F (0°C)
- The condition is present for at least 13 seconds when the ATF temperature is above 32°F (0°C)
- Single drive cycle, MIL on, D4 light flashes

P1750

Mechanical Problem in Hydraulic Control System for Clutch Pressure Control Solenoids A and B, or Problem in Hydraulic Control System

Conditions for Setting DTC:

- Engine Coolant Temperature: 50°F (10°C) or higher
- Vehicle Speed: 2 mph (3 km/h) or higher
- Throttle Position: 6.3% or higher
- Throttle variation: 5.2 degrees / 0.2 seconds or less
- ATF temperature: 32°F (0°C) or higher
- No other sensor or transmission DTC's active
- One of the following conditions is present:
 - A 1-2, 2-3, or 3-4 upshift is commanded, and a sudden increase in engine speed is detected
- Single drive cycle, MIL on, D4 light flashes

Advanced Diagnostics

Information (continued)

P1751:

Mechanical Problem in Hydraulic Control System for Shift Solenoid B and A/T Clutch Pressure Control Solenoids A and B, or Problem in Hydraulic Control System

Conditions for Setting DTC:

ATF temperature: -13°F (-25°C) or above

No other sensor or transmission solenoid DTCs active

A 2-3 upshift is commanded and the actual gear is 2nd

The condition is present for 20 seconds when ATF temperature is below 32°F (0°C)

The condition is present for at least 13 seconds when the ATF temperature is above 32°F (0°C)

Single drive cycle, MIL on, D4 light flashes

P0740

Problem in the Lockup Control System

P0740:

Problem in Lockup Control System

P0740 is set when the PCM/TCM sees excessive TCC slip or no TCC apply by comparing engine speed and mainshaft speed when full TCC apply is commanded. It can be difficult to diagnose and verify repair of P0740 because TCC slip parameters are not displayed in scan data, and there is no easy way to accurately monitor TCC slip.

There are several possible causes for P0740. In this section we will outline how the TCC is controlled, the common failures, and what needs to be addressed to successfully repair and prevent P0740.

Common Causes for P0740:

1. TCC lining failure
2. Filter clogging from clutch or other internal failure
3. Sticky valves / solenoids
4. Valve body wear / leaking end plugs
5. Valve body misassembly
6. Worn Pump; excessive gear side clearance
7. Damaged, deteriorated, or wrong torque converter hub o-ring
8. Low fluid level

Converter Hub O-Ring (32mm x 1.9mm)

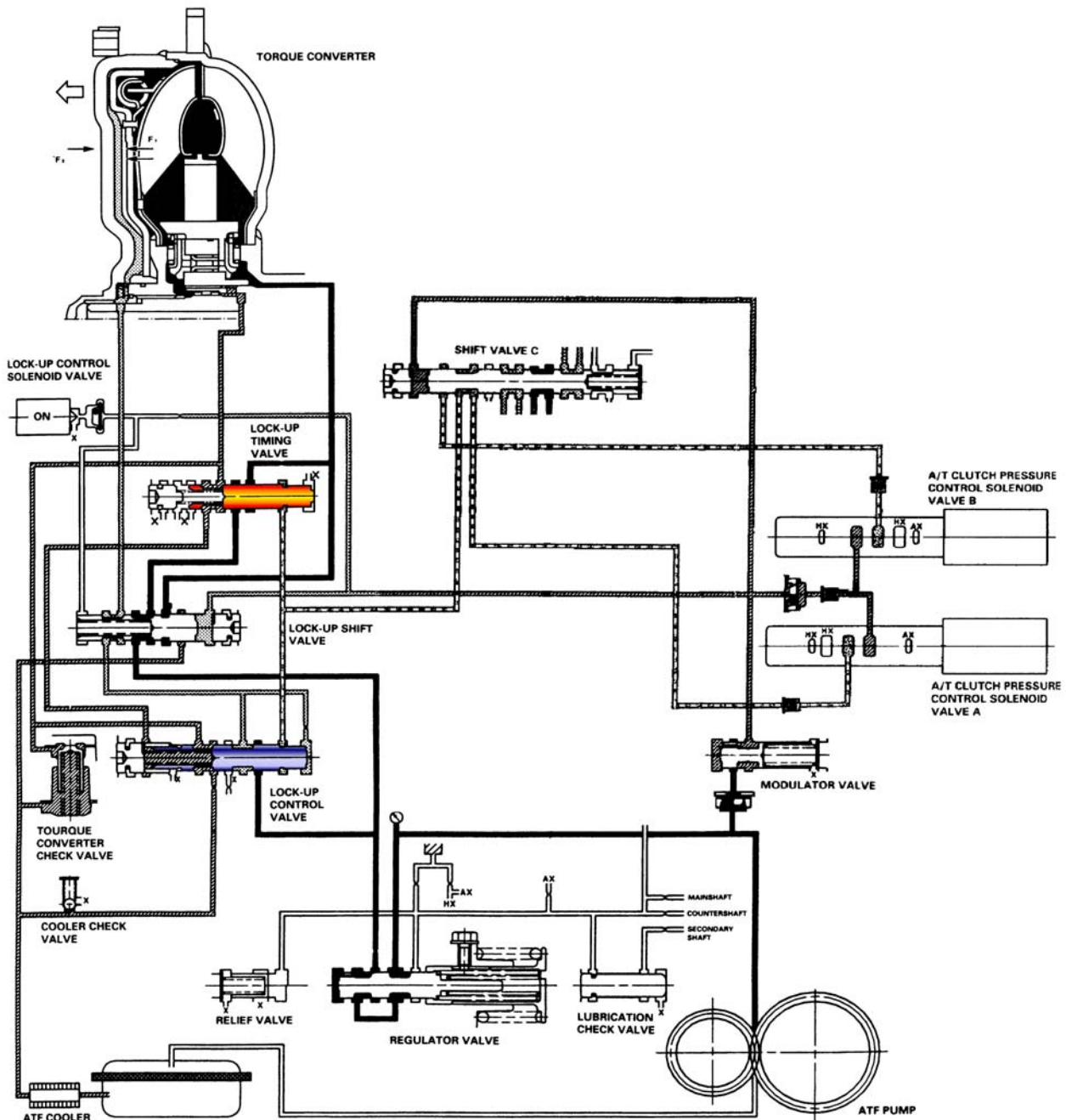
Honda Part Number:
91302-P7A-003



P0740

Problems in the Lockup Control System (continued)

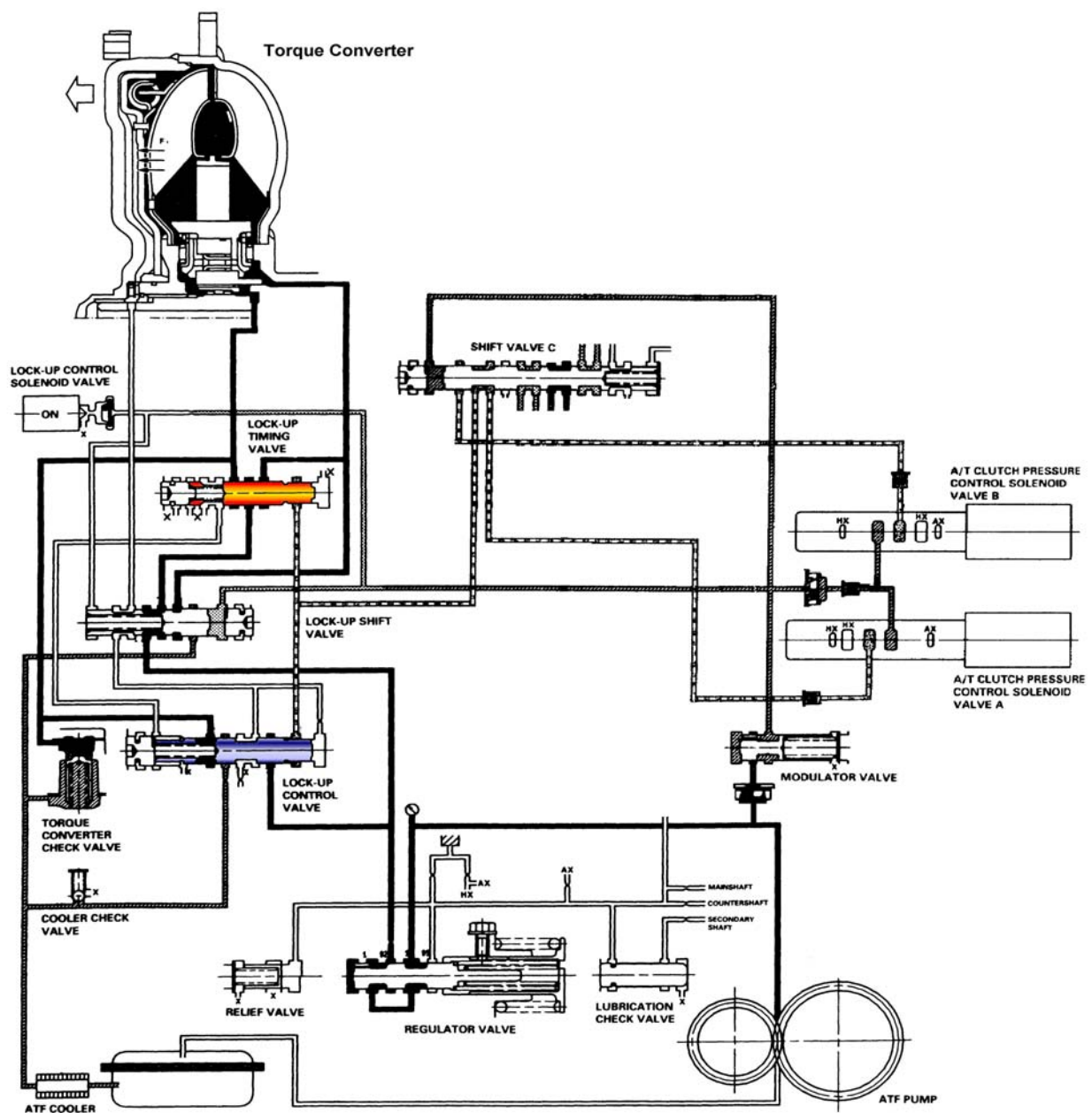
TCC Control: Partial Lockup Oil Circuit Diagram



P0740

Problems in the Lockup Control System (continued)

TCC Control: Full Lockup Oil Circuit Diagram

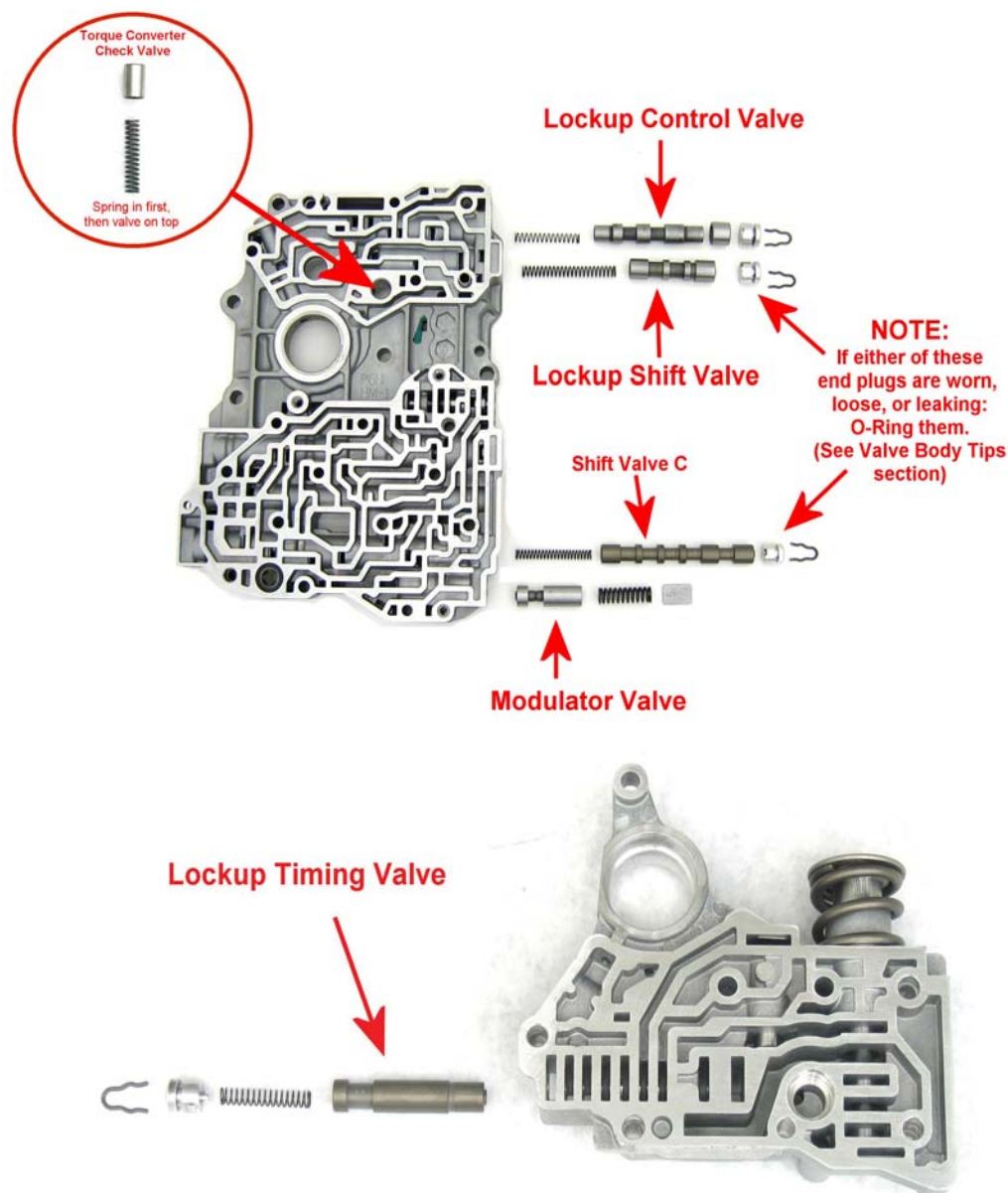


P0740

Problems in the Lockup Control System (continued)

Listed are the critical valves that affect lock-up control and close attention should be paid to these valves during overhaul.

Valve Body and TCC Related Valves



Collision Damage

Common Concerns/Problems



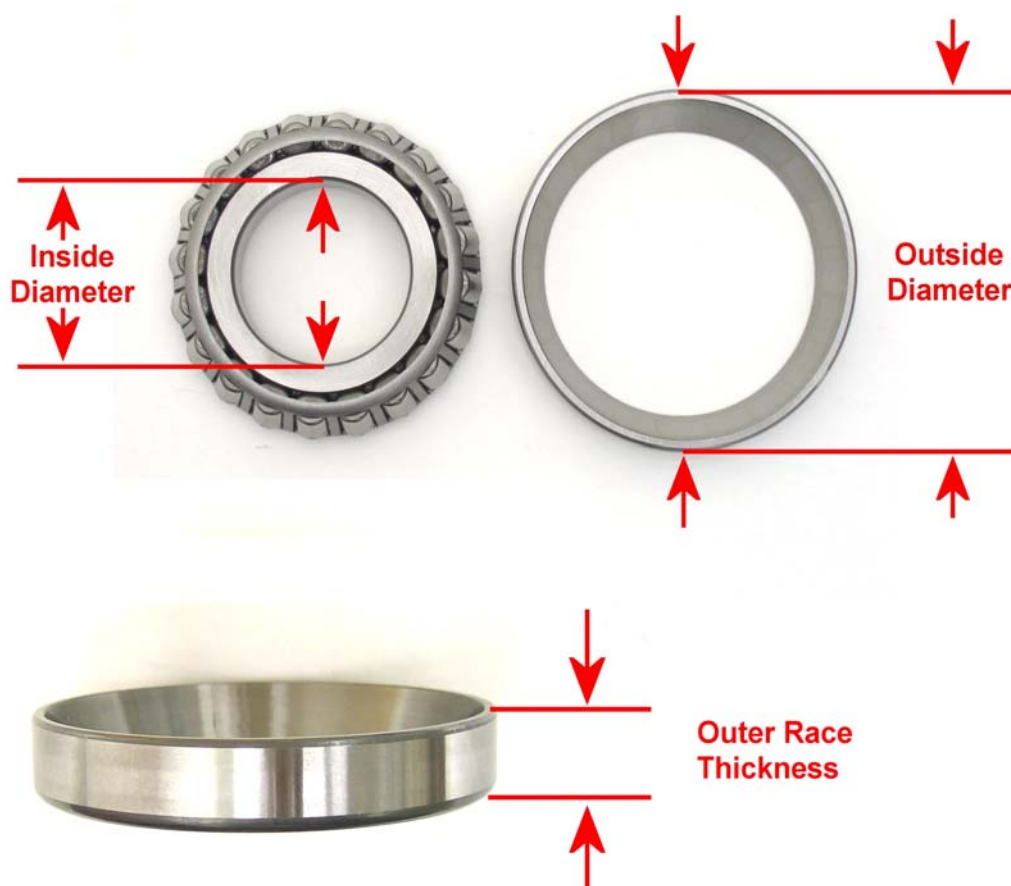
Common Transmission Problems Caused by Collision Damage

Honda/Acura automatic transmissions have all of their solenoids located externally. This makes them vulnerable to being damaged when the vehicle is involved in a collision and surrounding body parts are crushed in on the transaxle.

1. Poor shift quality, flares, bindups, neutralizing, delayed and or harsh engagements, P0715, P0730, P0740, P0780, P1750, P1751: check for bent/damaged solenoids
2. Damaged wire harnesses, improperly repaired wiring.
3. Grounds left loose, dirty, damaged, painted over, or left off.
3. Kinked cooler lines

Carrier Bearings

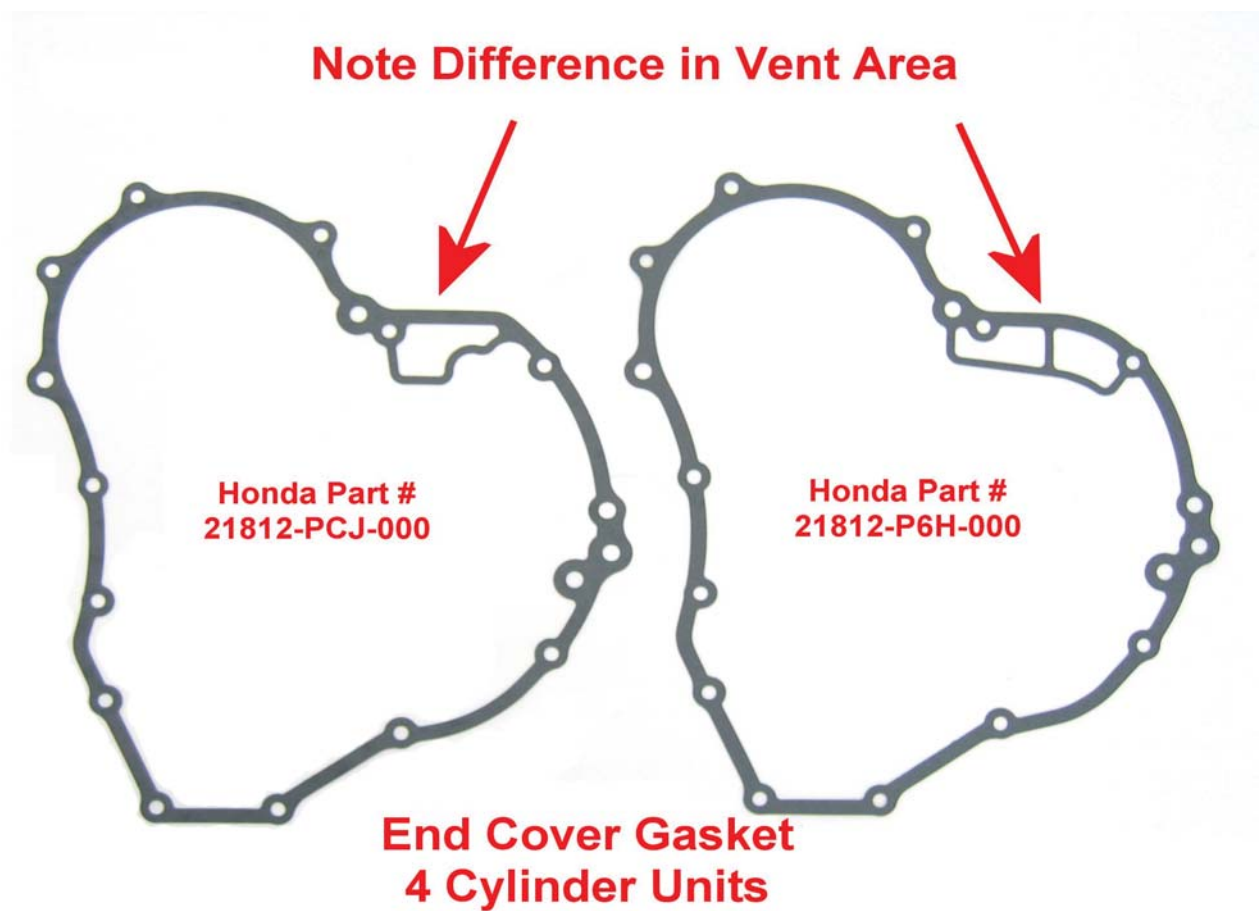
Identifications and Part Numbers



Part Number	Inside Diameter	Outside Diameter	Outer Race Thickness
91121-P7T-305	1.772" (45mm)	3.150" (80mm)	0.549" (13.95mm)
91124-PGH-305	1.772" (45mm)	3.189" (81mm)	0.490" (12.45mm)
91122-P7V-J02	1.574" (40mm)	3.189" (81mm)	0.490" (12.45mm)
91121-P6H-013	1.574" (40mm)	3.150" (80mm)	0.539" (13.70mm)
91122-P6H-013	1.574" (40mm)	2.922" (76.25mm)	0.510" (12.95mm)
91121-P7V-J02	1.574" (40mm)	3.150" (80mm)	0.549" (13.95mm)

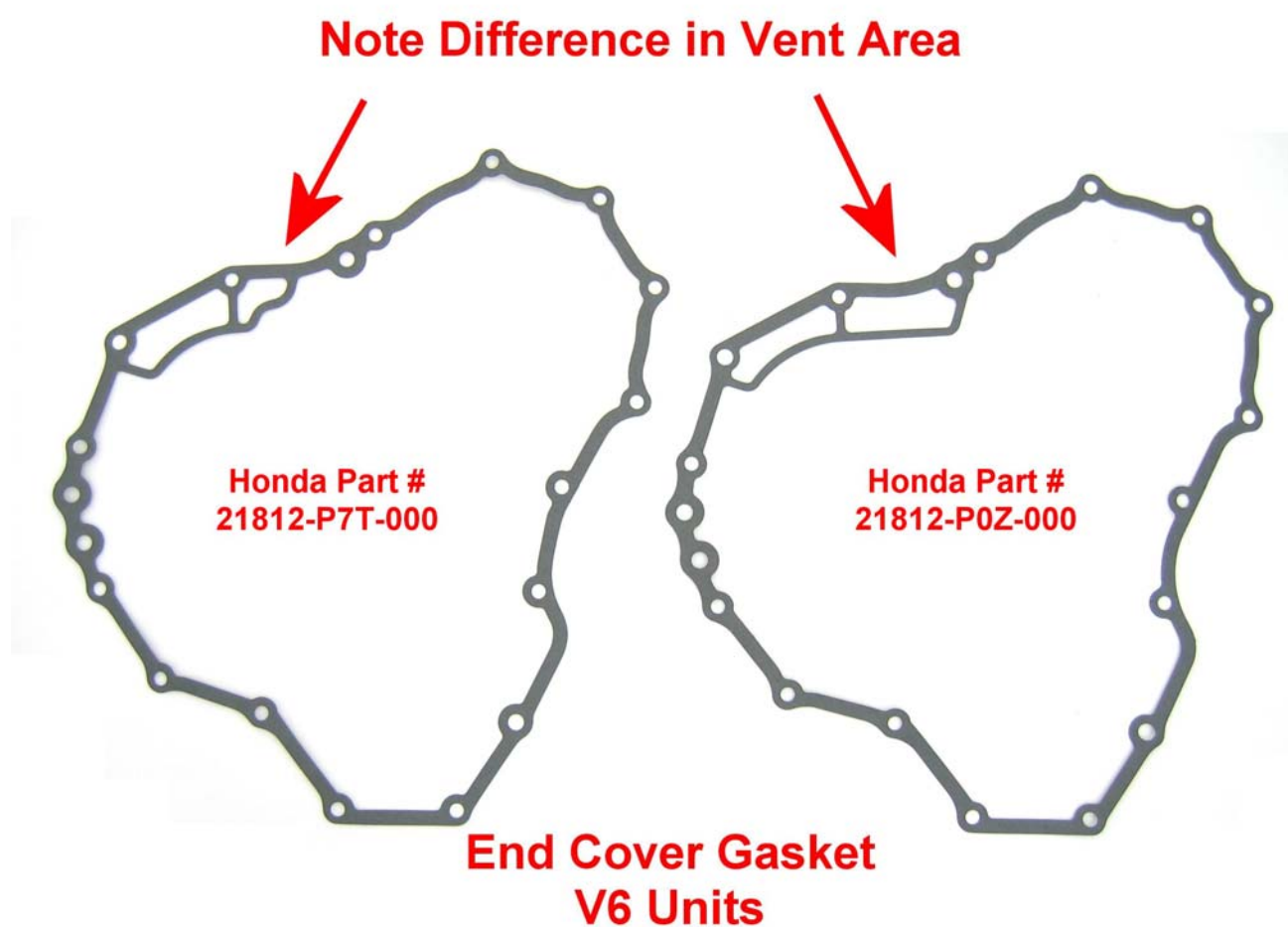
Venting Fluid

End Cover Gasket Mismatch



Venting Fluid

End Cover Gasket Mismatch (continued)



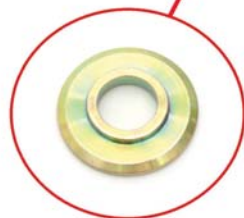
1998 BAXA, B6VA

Control Shaft Collar

Some 1998 year model 4 cylinder Accords and 2.3CLs had a problem with the transaxle side cover casting. A selective collar was fitted behind the control lever on the control shaft to repair the affected vehicles.

It is important to note the installation of this collar whenever the transaxle is removed or transaxle service work is performed and make sure the collar is reinstalled correctly.

If you are replacing the transaxle side cover, or the selective collar has been lost, use the following page to identify the side cover and/or order the correct selective collar.



**Selective Collar
fitted under Control Lever**

1998 BAXA, B6VA

Control Shaft Collar (continued)

Identifying the Side Cover

Affected 1998 side covers can be identified by the casting date code on the side cover. The date code can be cast in any position (upside down, sideways, etc.) so look carefully at the numbers to determine which way is up. The affected casting date codes are 10/19 thru 11/18. These will require the installation of the selective control shaft collar.



If the side cover is replaced with a used part, you want to inspect the replacement side cover to determine if it requires the installation of a control shaft collar. Also check for casting roughness at the ridge shown below.



1998 BAXA, B6VA

Control Shaft Collar (continued)

Selecting the Correct Collar

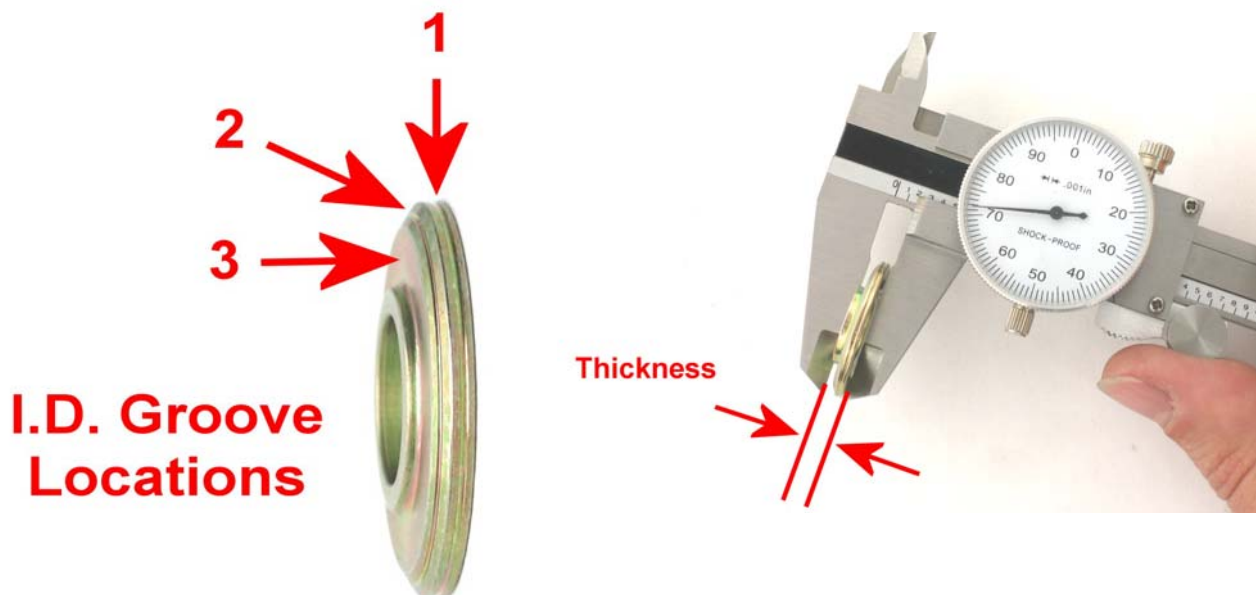
Install collar “B” behind the control lever, then check the clearance between the collar lip and control lever using a feeler gauge. The desired clearance is 0.004” to 0.018”. If the clearance is not correct, select a thicker or thinner collar from the chart on the following page.



1998 BAXA, B6VA

Control Shaft Collar (continued)

Identifying the Collars



Part Number	Designation	ID Groove Locations	Thickness
90401-PAX-305	"A"	1	0.172" (4.37 mm)
90402-PAX-305	"B"	None	0.161" (4.09 mm)
90403-PAX-305	"C"	2	0.149" (3.79 mm)
90404-PAX-305	"D"	1 and 2	0.137" (3.48 mm)
90401-PAX-305A *	"AA"	3	Not available at this time

* Note: this is a controlled part and will have to be ordered through the Controlled Parts Ordering (CPO) system and a VIN will be required to order.

5 Speed V6 Units

Oil Jet Kit

An oil jet kit was added to certain 5 speed V6 applications to address a problem with insufficient cooling and lubrication of 2nd gear.

Oil Jet Kit Part Numbers:

Honda

Accord: P/N 06250-RDG-315

Odyssey and Pilot: P/N 06250-PGH-305

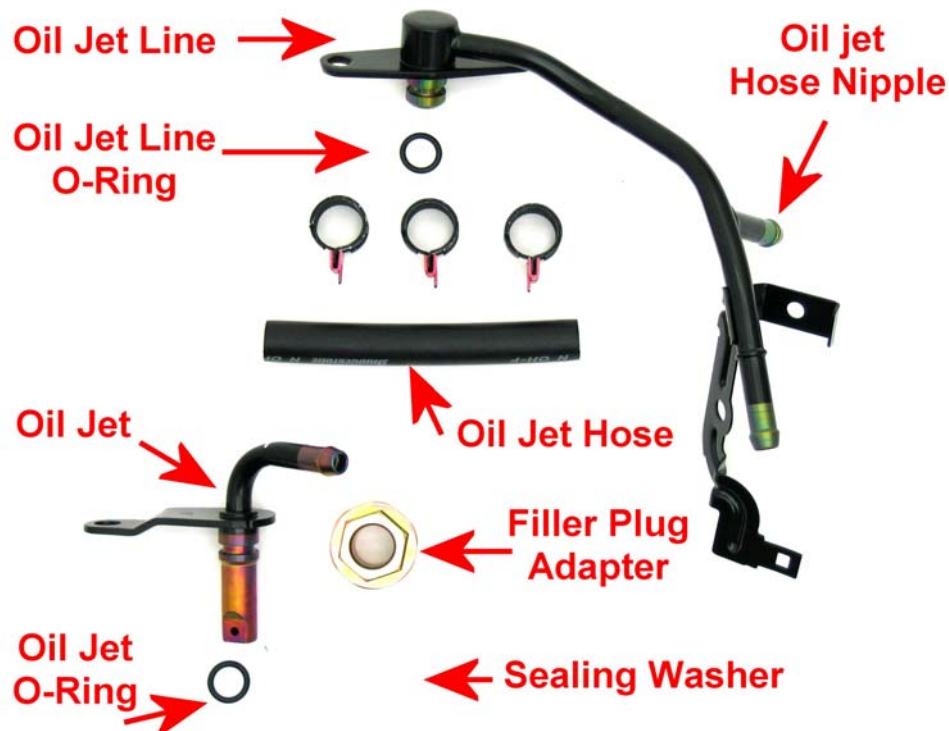
Acura

3.2CL and 3.2TL: P/N 06250-P7W-305

2004 TL: P/N 06250-RDG-315

MDX: P/N 06250-PGH-305

Note: Honda/Acura remanufactured units have been modified internally to eliminate the need for the external oil jet kit.



5 Speed V6 Units

Oil Jet Kit (continued)

Affected Vehicles:**2003 Accord V6 2 door and 4 door: ALL****2004 Accord V6 2-Door:**

From VIN 1HGCM82..4A000001 thru 1HGCM82..4A007538

2004 Accord V6 4-Door

From VIN 1HGCM66..4A000001 thru 1HGCM66..4A030387

VIN 1HGCM66..4A032783

VIN 1HGCM66..4A036643

VIN 1HGCM66..4A039356

VIN 1HGCM66..4A040381

2002-2003 Odyssey: All**2004 Odyssey:**

From VIN 5FNRL18..4B000001 thru VIN 5FNRL18..4B051620

2003 Pilot: ALL**2004 Pilot:**

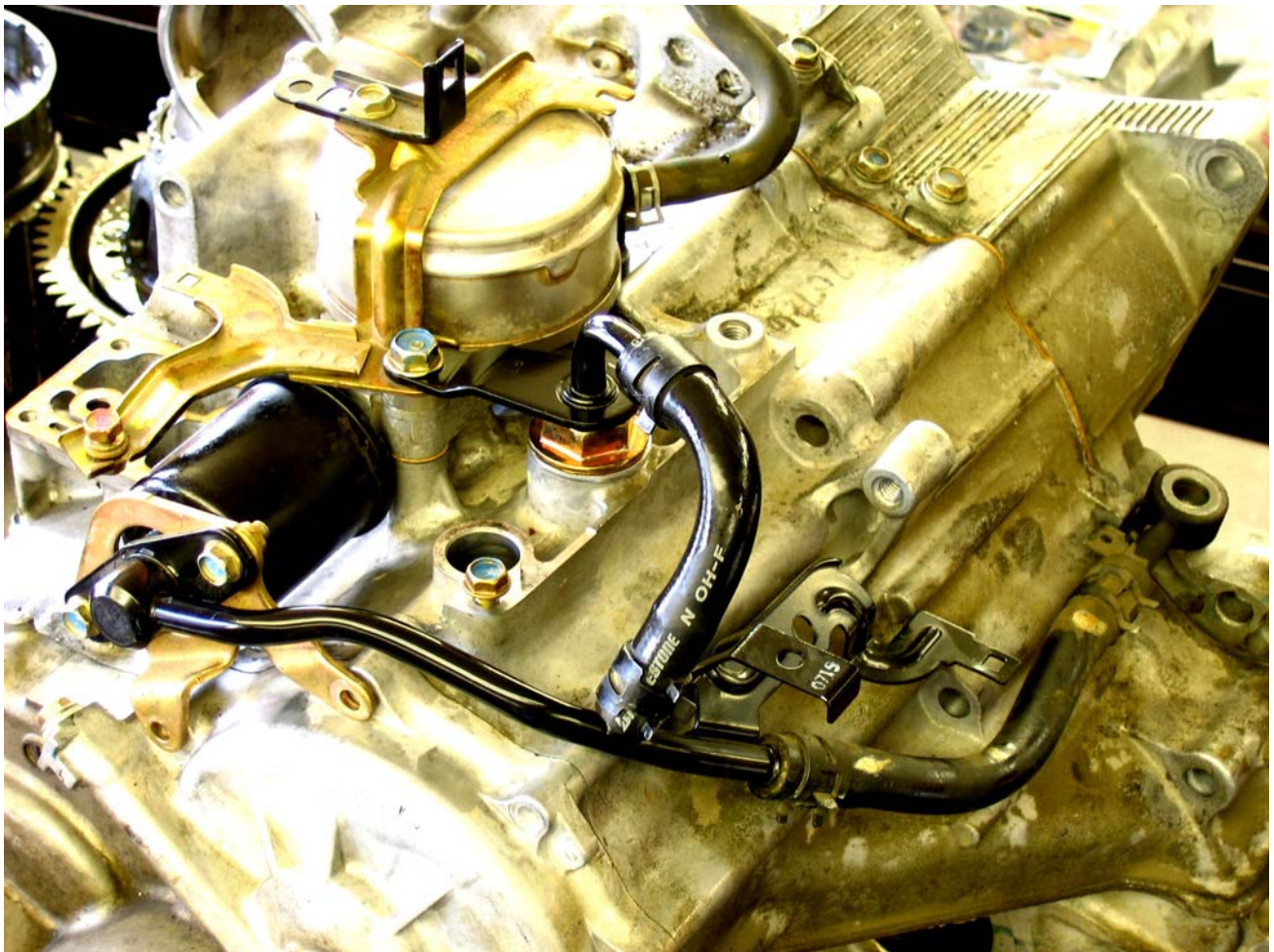
From VIN 2HKYF18..4H500001 thru VIN 2HKYF18..4H546877

2001-2003 3.2CL (including Type S): All**2000-2003 3.2TL (including Type S): All****2001-2002 MDX: All****2004 TL:**

From VIN 19UUA66..4A000001 thru VIN 19UUA66..4A014224

5 Speed V6 Units

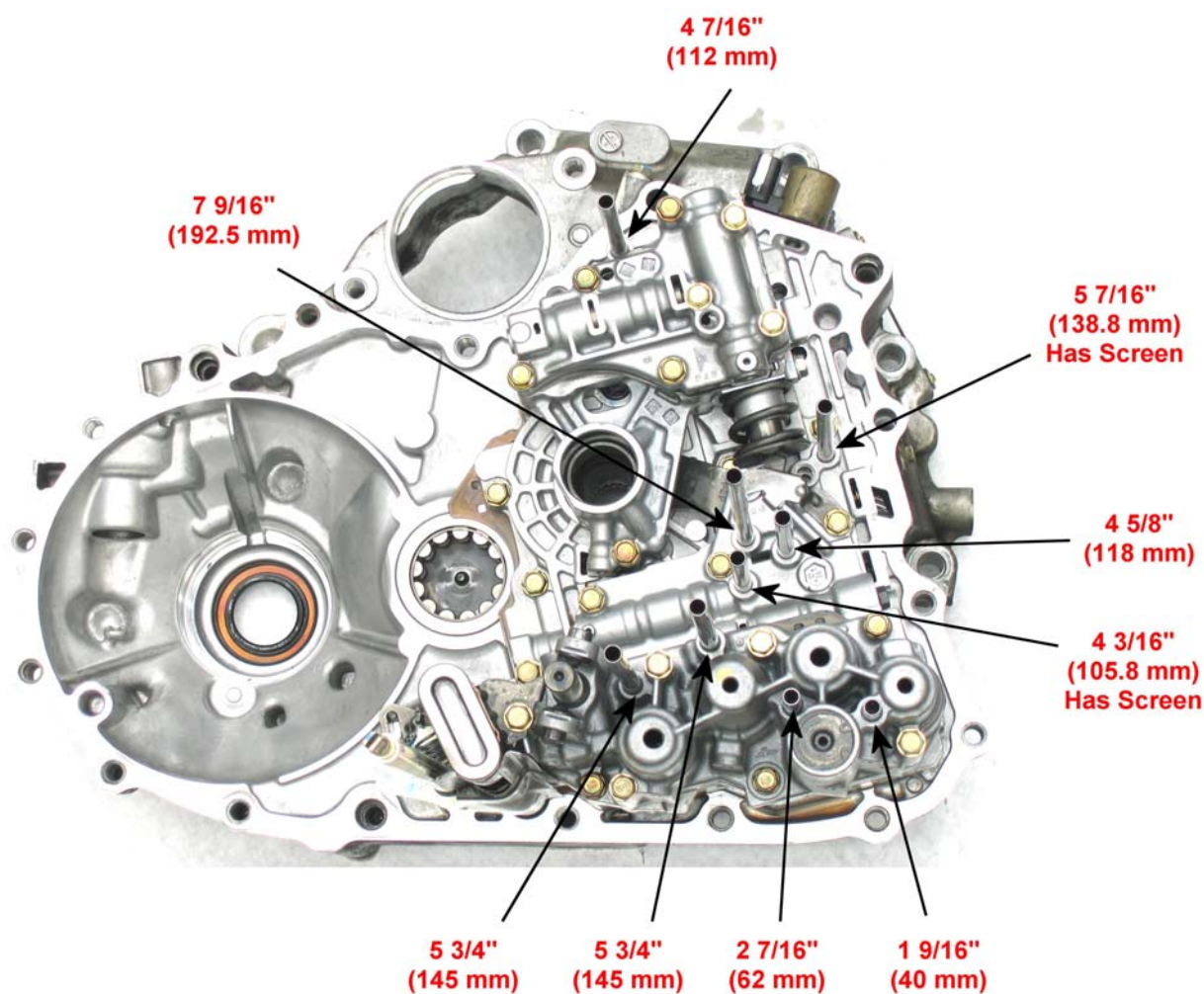
Oil Jet Kit (continued)



BMXA

Feed Pipe Locations

Use the following diagram to identify the pipes and their correct locations.

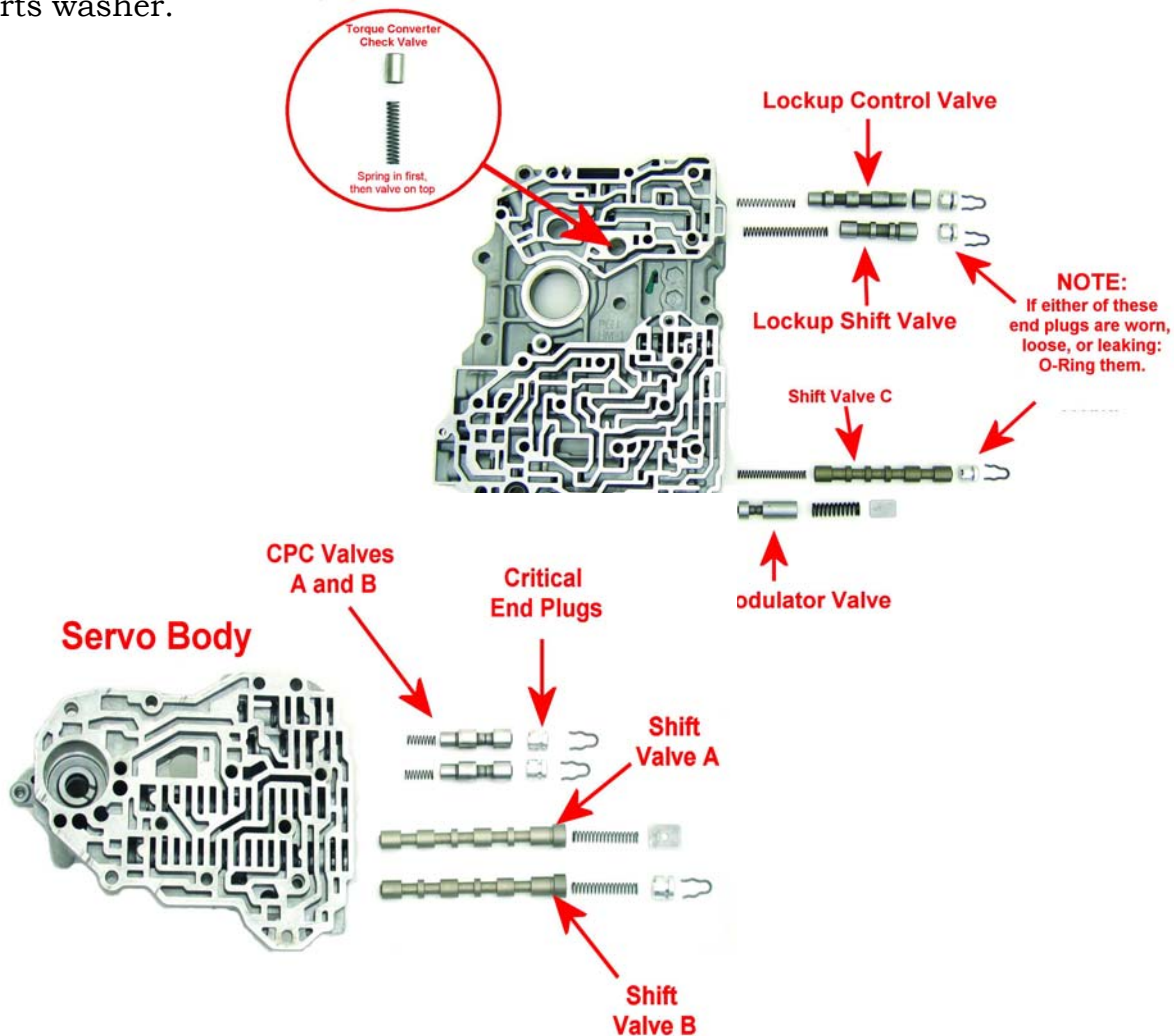


Valve Body

Rebuild Tips

Emphasize “CLEAN!”. VB has to be clean, especially after a bearing / hard parts failure.

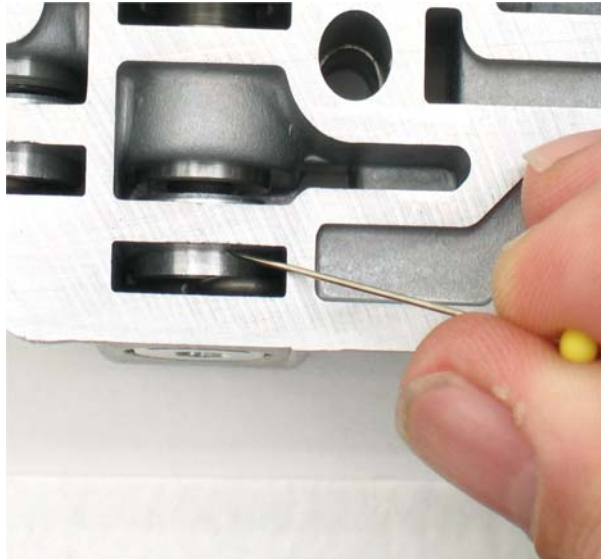
1. Remove and clean all valves, make sure they are free in their bores
2. Air check CPC valves
3. Check end plugs
4. Center springs
5. Flush cooler thoroughly
6. Install inline filter
7. Scrub sump, drums, and geartrain parts with brush and solvent, then wash in parts washer.



Valve Body (continued)

O-Ring End Plugs

Install the end plug and scribe two lines with a sharp pin (one line on each side of the partition closest to the valve/spring)



Use these lines as a guide for cutting the o-ring groove. The groove should be offset toward the valve/spring to help compensate for flexing of the retainer clip and movement under pressure.



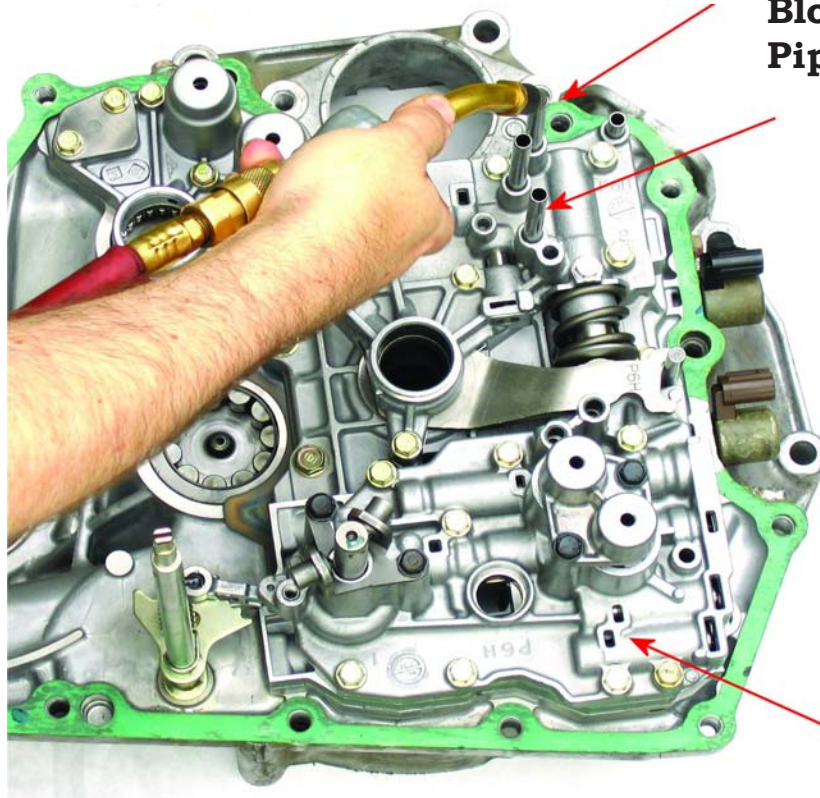
Valve Body (continued)

Checking CPC Valves and Center Springs

Center Springs



Checking CPC Valves



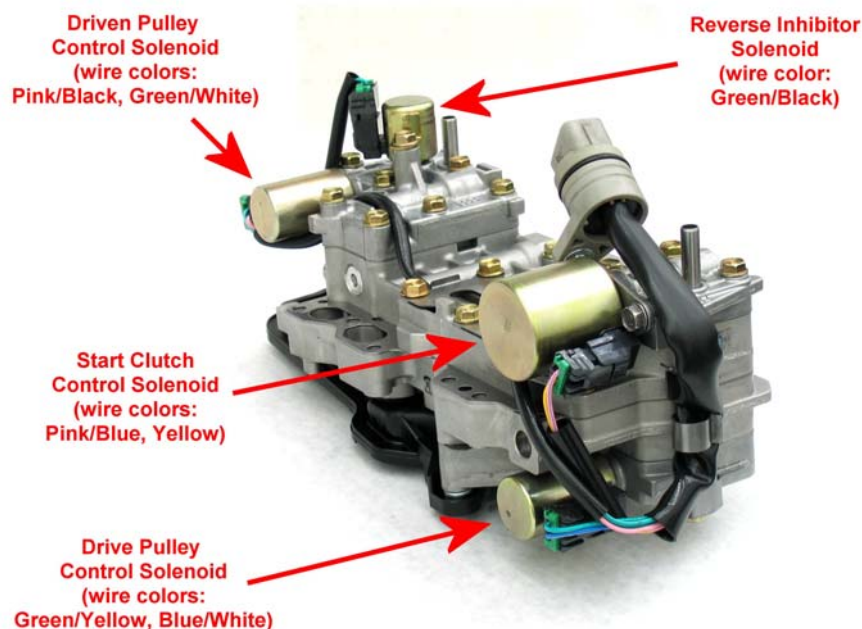
**Blow air Into
Pipes**

**Watch for
CPC
Valves A &
B to Move
Freely**

SZCA

Civic Hybrid CVT

Valve Body

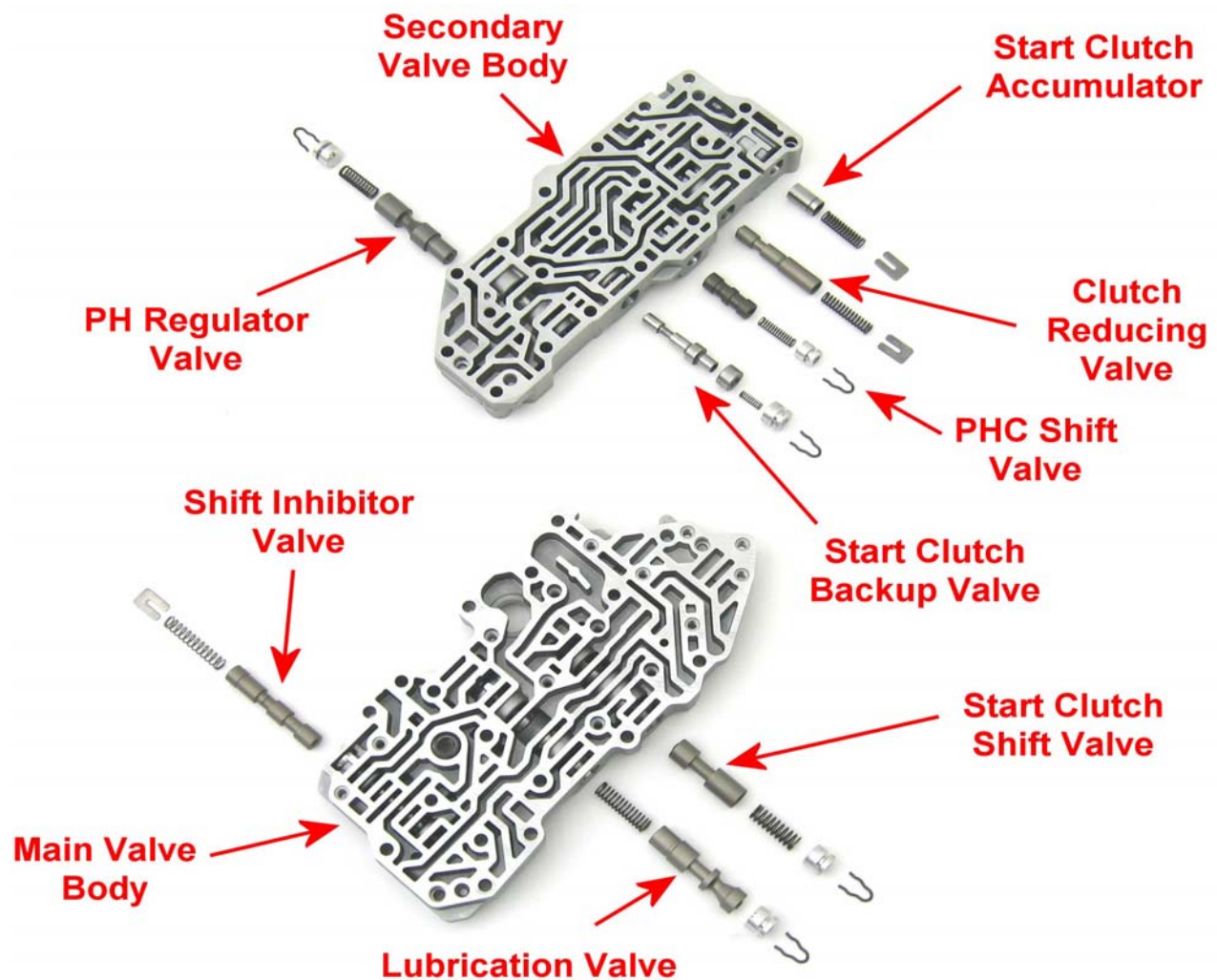


Solenoid	Measure Between	Resistance Specification
Drive Pulley Control Solenoid	Terminals 3 and 7	3.8 - 6.8 ohms
Driven Pulley Control Solenoid	Termnals 2 and 6	3.8 - 6.8 ohms
Start Clutch Control Solenoid	Terminals 4 and 8	3.8 - 6.8 ohms
Reverse Inhibitor Solenoid	Terminal 5 and the valve body	11.7 - 21.0 ohms

SZCA

Civic Hybrid CVT

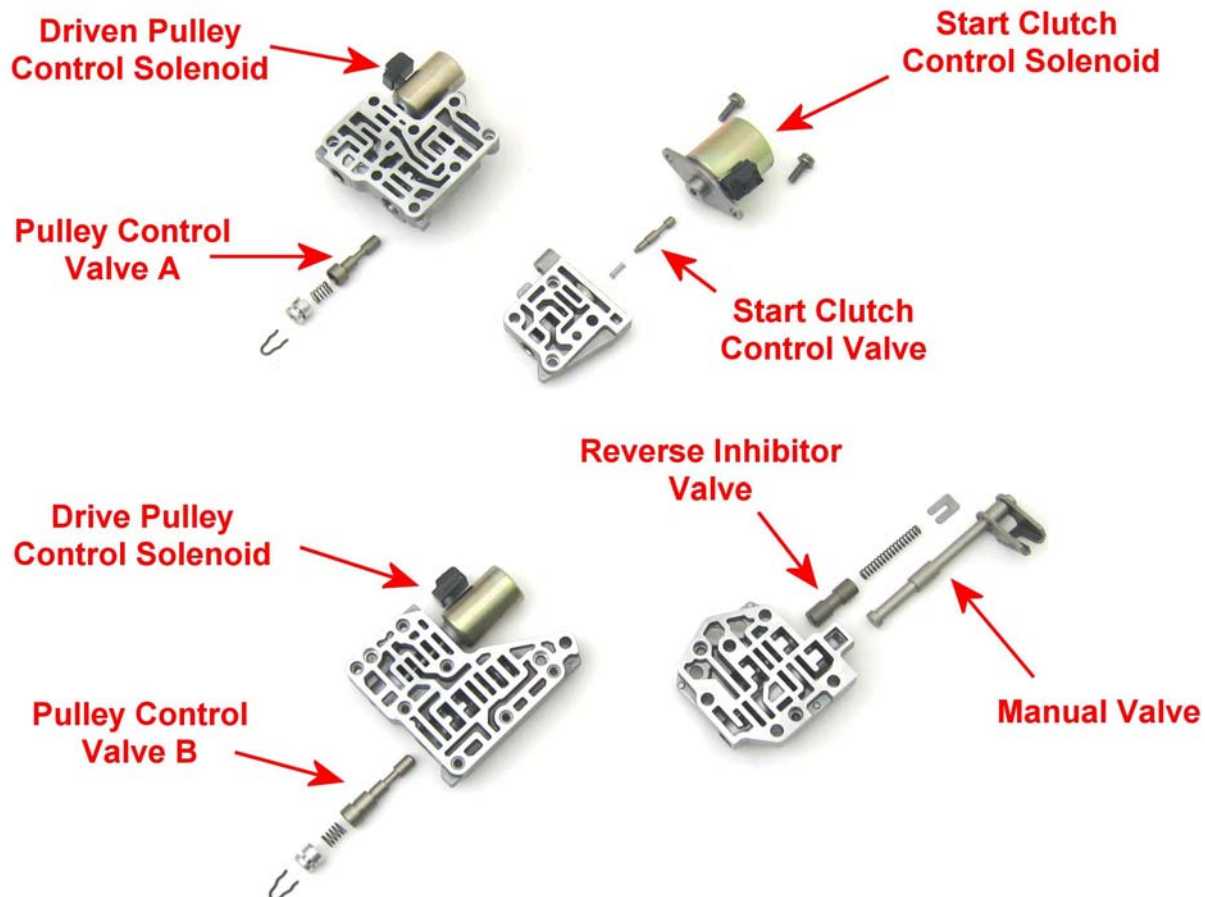
Valve Body (continued)



SZCA

Civic Hybrid CVT

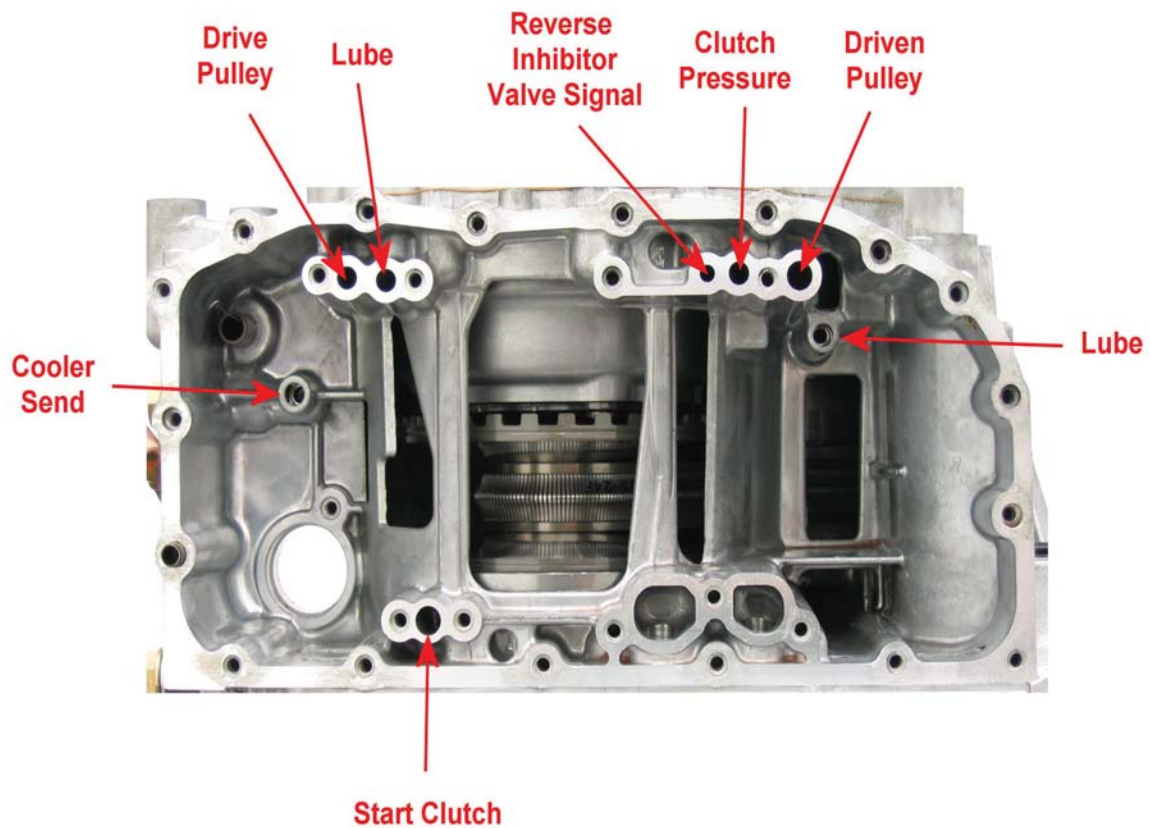
Valve Body (continued)



SZCA

Civic Hybrid CVT

Air Testing



Delayed Upshifts After Cold Start

Affected Vehicles:

1998 and newer Accord
1996 and newer Civic
1997 and newer CR-V
1999 and newer Odyssey 1997 and newer 3.0CL
1999 and newer 3.2TL
2001 and newer 3.2CL
2001 and newer MDX

Cause:

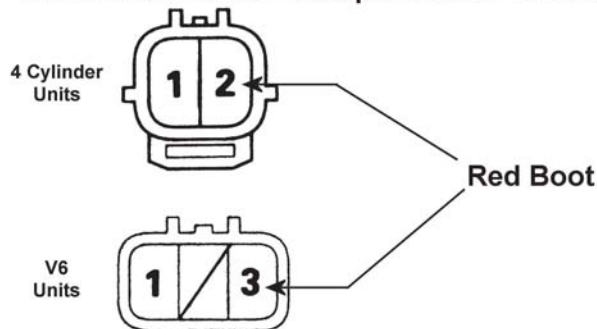
It is normal to have delayed 1-2 and 2-3 upshifts immediately after a cold engine startup. The PCM is programmed to shift at higher engine RPM when the engine is cold in order to help warm up the catalytic converter and reduce exhaust emissions.

Signal Monitor Hookup

4 Speed Units

Terminal Identification and Signal Monitor Connections:

Shift Solenoid A / Lockup Solenoid Connector



Note: To monitor lockup solenoid signal, connect the red boot alligator clip to terminal 1

Shift Solenoid B Connector



Shift Solenoid C Connector



Yellow Boot; Black Band,
Red Boot; Black Band,
Black Boot:
All Connect to Ground



Transmission Shift Pattern			
1st Gear			
Shifting 1-2			
2nd Gear			
Shifting 2-3			
3rd Gear			
Shifting 3-4			
4th Gear			

Signal Monitor Hookup

5 Speed V6 Units

Terminal Identification and Signal Monitor Connections:

Shift Solenoid A Connector



Shift Solenoid B Connector



Shift Solenoid C Connector



Yellow Boot; Black Band,
Red Boot; Black Band,
Black Boot:
All Connect to Ground



This is the pattern you should see with your signal monitor:

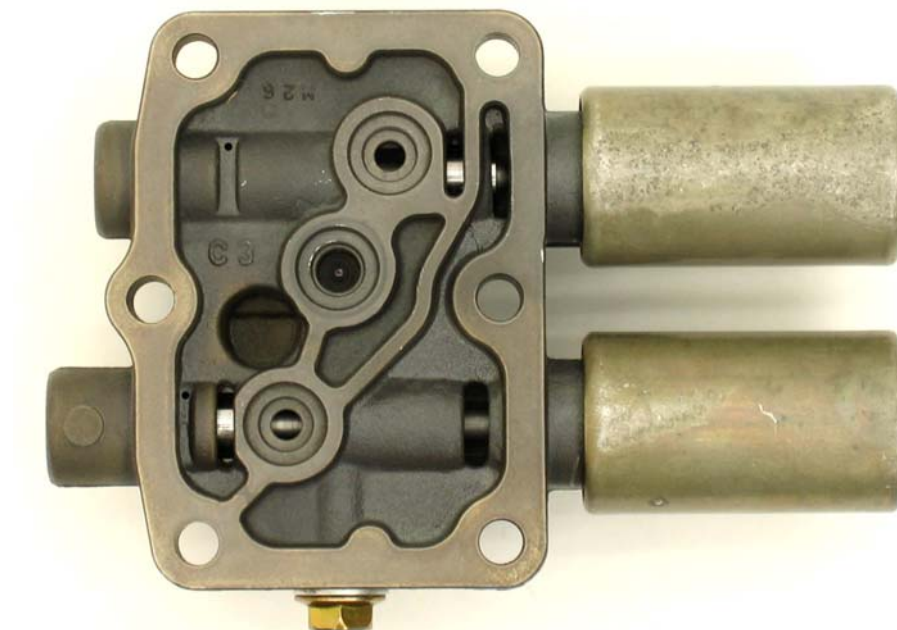
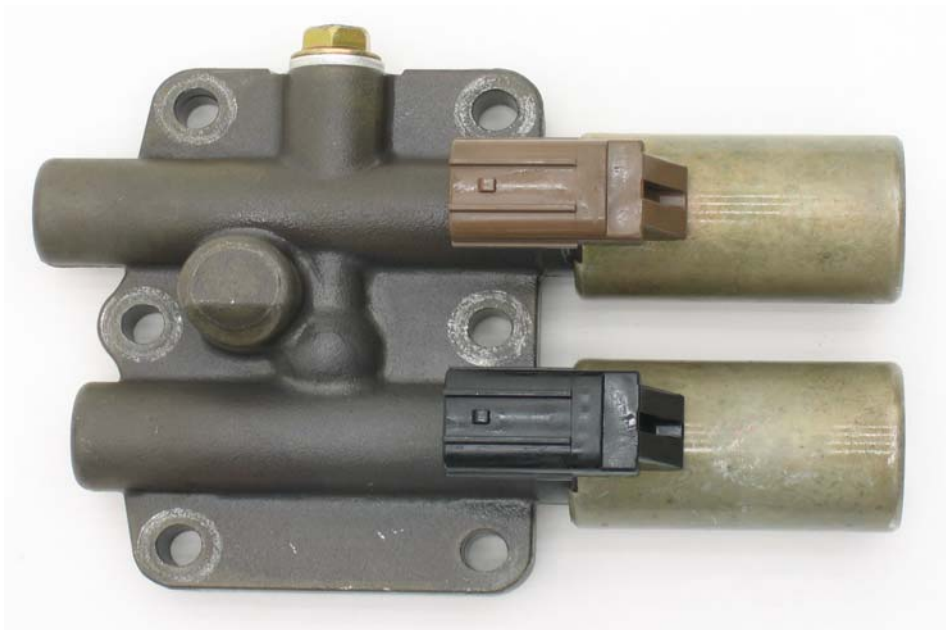
Transmission Shift Pattern			
1st Gear			
Shifting 1-2			
2nd Gear			
Shifting 2-3			
3rd Gear			
Shifting 3-4			
4th Gear			
Shifting 4-5			
5th Gear			

Solenoid and Pressure Switch Guide

Honda Part Number: 28250-P6H-024

Linear Solenoids

Note: 4 speed units and 5 speed V6 units; Accord, Odyssey, Prelude, TL, CL, MDX: CPC A and B Solenoids

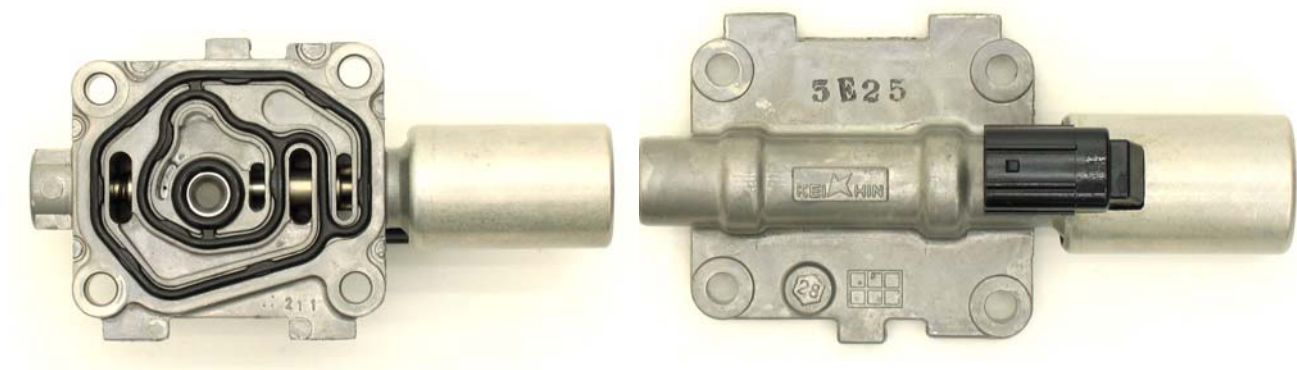


Solenoid and Pressure Switch Guide (continued)

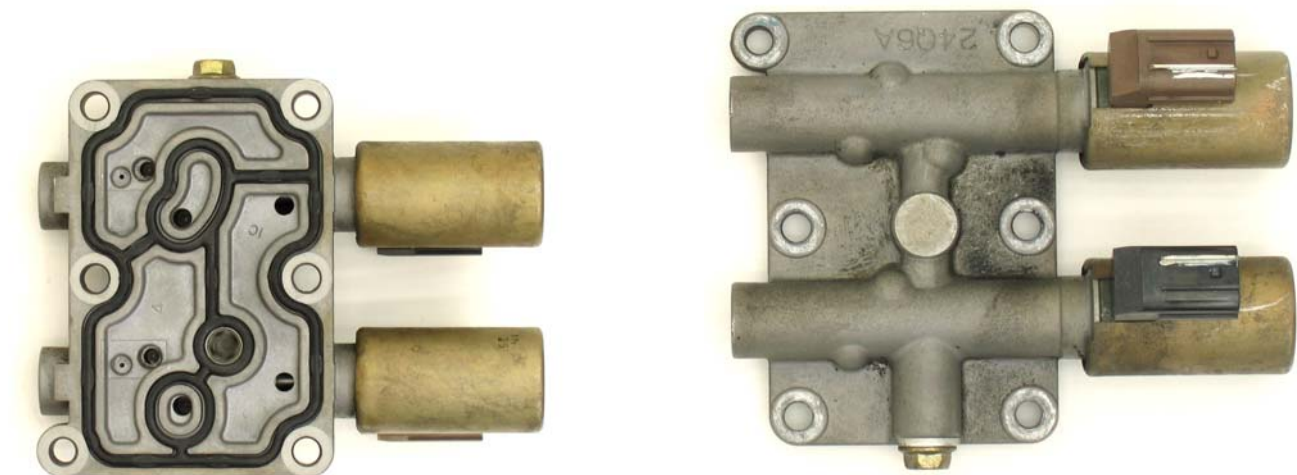
Honda Part Number: 28250-P7W-003

Linear Solenoid

Note: 5 speed V6 units Lockup pressure control

**Honda Part Number: 28250-PLX-305**

Linear Solenoids



Solenoid and Pressure Switch Guide (continued)

Honda Part Number: 28250-P4R-315

Linear Solenoid

Note: Civic (thru 2000), CRV (thru 2001)



Honda Part Number: 28500-P6H-003

Brown Connector



Solenoid and Pressure Switch Guide (continued)

Honda Part Number: 28400-P6H-003

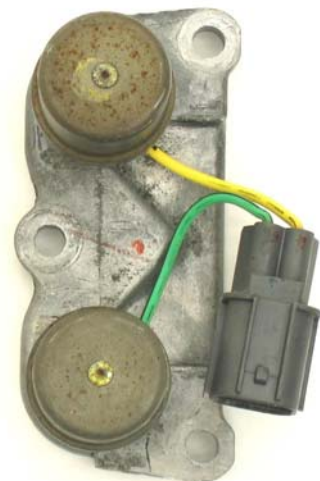
Black Connector



Honda Part Number: 28300-P24-J01

Lockup Solenoids

Notes: Civic (thru 2000), CRV (thru 2001)



Solenoid and Pressure Switch Guide (continued)

Honda Part Number 28200-P4R-003

Shift Solenoids

Notes: Civic (thru 2000), CRV (thru 2001)

**Honda Part Number: 28200-PLX-003**

Shift Solenoids

Note: BMXA Shift Solenoid A and B assembly

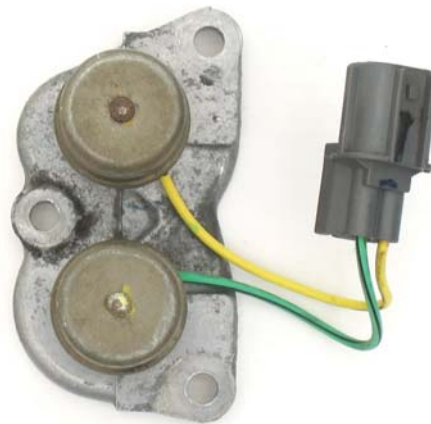


Solenoid and Pressure Switch Guide (continued)

Honda Part Number: 28300-PX4-003

Lockup / Shift Solenoid A assembly

Notes: 4 cyl. 4 speed units; Accord, 2.3CL

**Honda Part Number: 28200-P0Z-003**

Lockup / Shift Solenoid A assembly

(V6 4 speed unit)



Solenoid and Pressure Switch Guide (continued)

Honda Part Number: 28600-P6H-003

2nd clutch pressure switch: (Green Connector)



Honda Part Number: 28600-P7Z-003

3rd clutch pressure switch (black connector)



Toyota

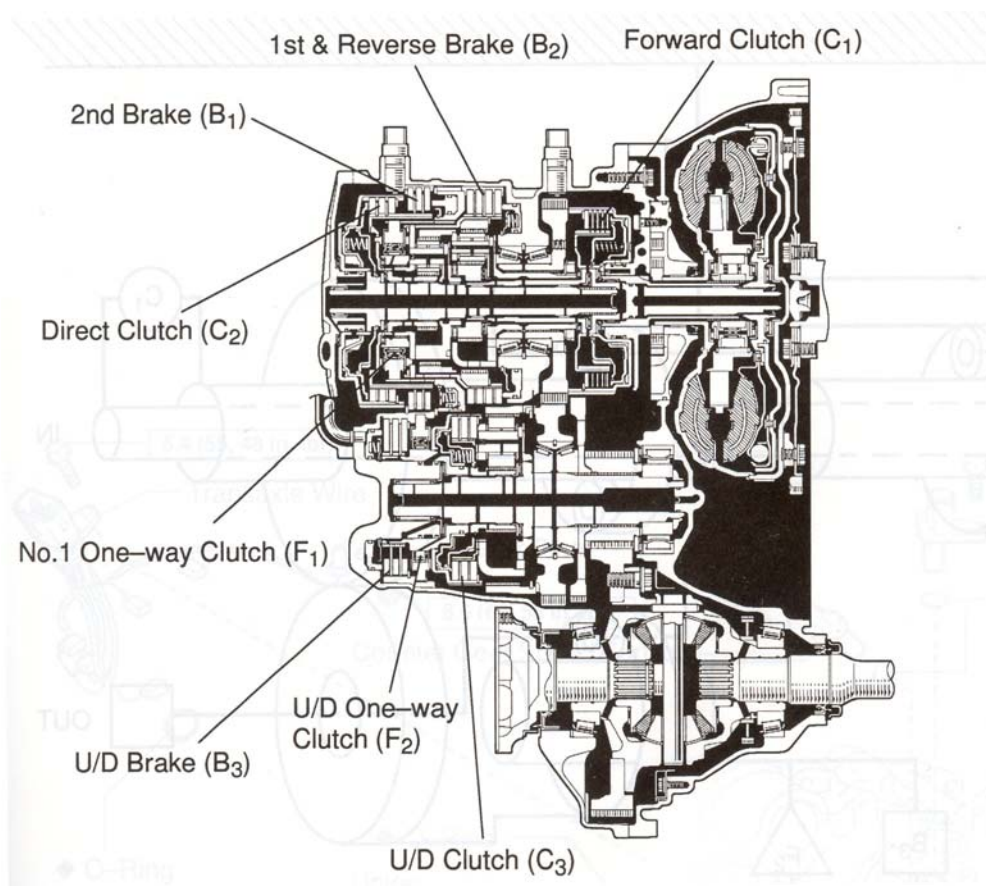
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U140E/U241E

Identification



Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
P	Parking						X		
R	Reverse		X			X	X		
N	Neutral						X		
D	1st	X					X	X	X
	2nd	X			X		X		X
	3rd	X	X				X		X
	4th	X	X	X					
2	1st	X					X	X	X
	2nd	X			X	X	X		X
L	1st	X				X	X	X	X

U140E/U241E

No 4th, No TCC

A No command for 4th gear or TCC, no detent downshifts above 30 mph. The cause of this may be a Knock Sensor

A Knock Sensor DTC may be present (P0330). Whenever a knock sensor DTC is set 4th gear and TCC are inhibited and engine management goes into reduced power strategy and detent downshift timing is affected. It is common for the knock sensors themselves to fail.

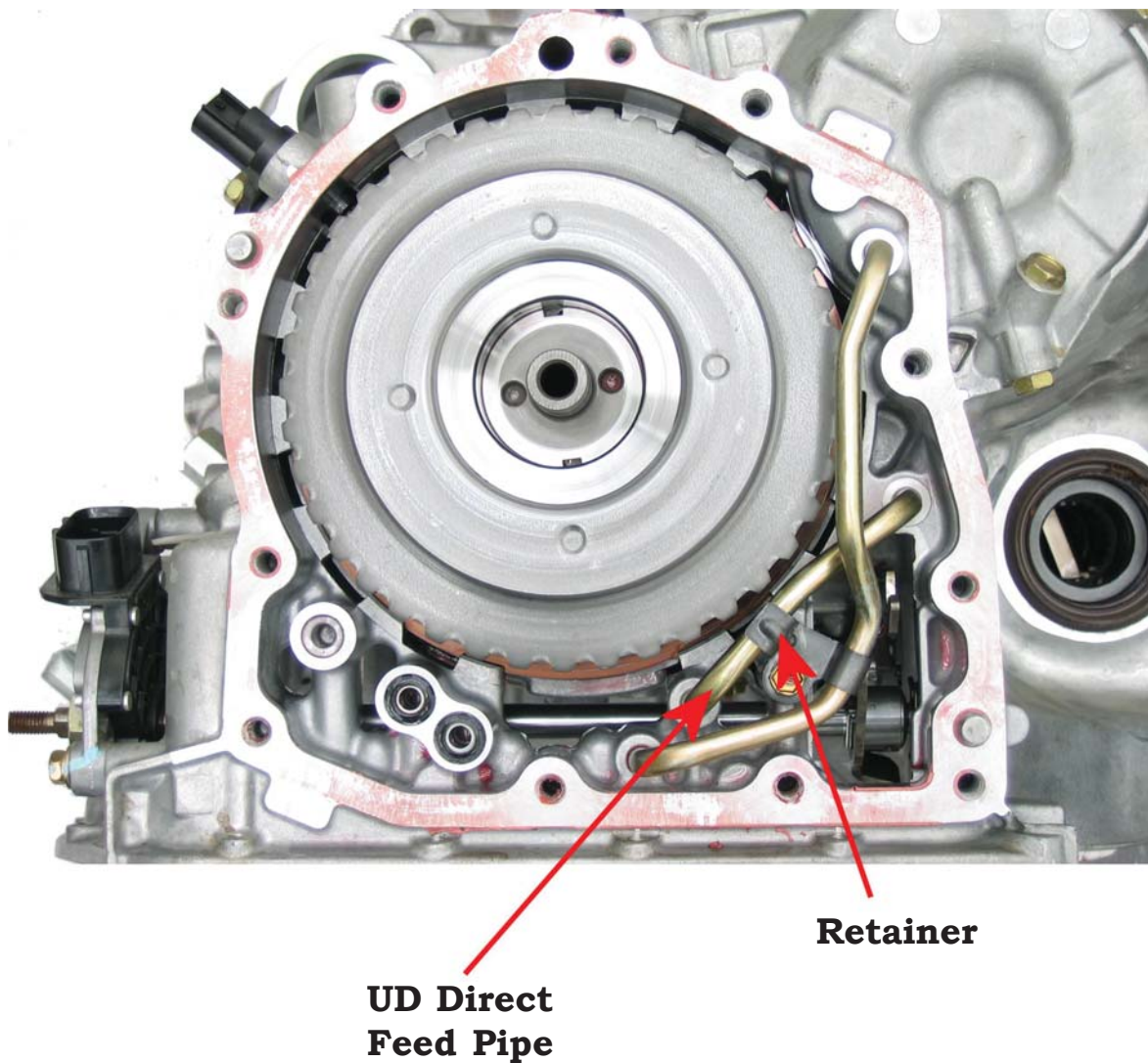
To repair the concern replace the knock sensor.

Notes: If knock sensor DTC is cleared normal shifting and operation will be restored until PCM performs knock sensor test routine and DTC is set again. There are two PID's in scan data: OD CUT1 and OD CUT2. OD CUT1 responds to OD cancel switch (switches from YES to NO). OD CUT2 indicates PCM OD inhibit strategy.

U140E

Slips in 4th, No 4th, Falls Out of 4th, P0765

During dissassembly the UD/Direct clutch feed pipe brackets can be damaged. Any abnormal bends or cracks can cause the pipe to push out. If the Pipe is not installed correctly a leak in the 4th gear circuit will occur.



U140E/U241E

3rd/Reverse Concerns

2-3 Flare, 2-3 Neutral, Slip in 3rd, No 3rd, Slips in Reverse, No Reverse

Replace molded piston on every overhaul.

It is common for the Direct clutch drum to ring groove.



U140E/U241E

3rd/Reverse Concerns (continued)

2-3 Flare, 2-3 Neutral, Slip in 3rd, No 3rd, Slips in Reverse, No Reverse

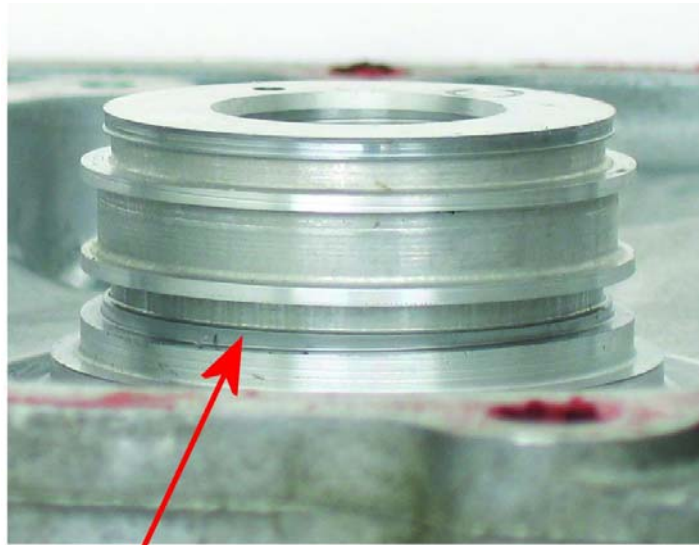
During reassembly always check the sealing ring side clearance. The clearance should be between 0.003"-0.005".



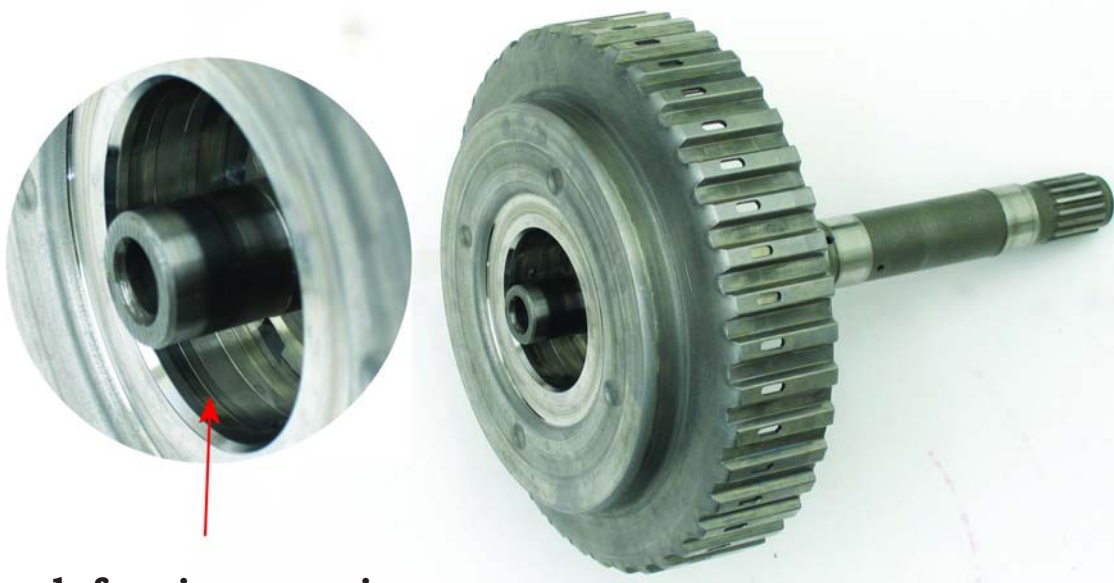
U140E/U241E

3rd/Reverse Concerns (continued)

2-3 Flare, 2-3 Neutral, Slip in 3rd, No 3rd, Slips in Reverse, No Reverse



Check for worn ring lands



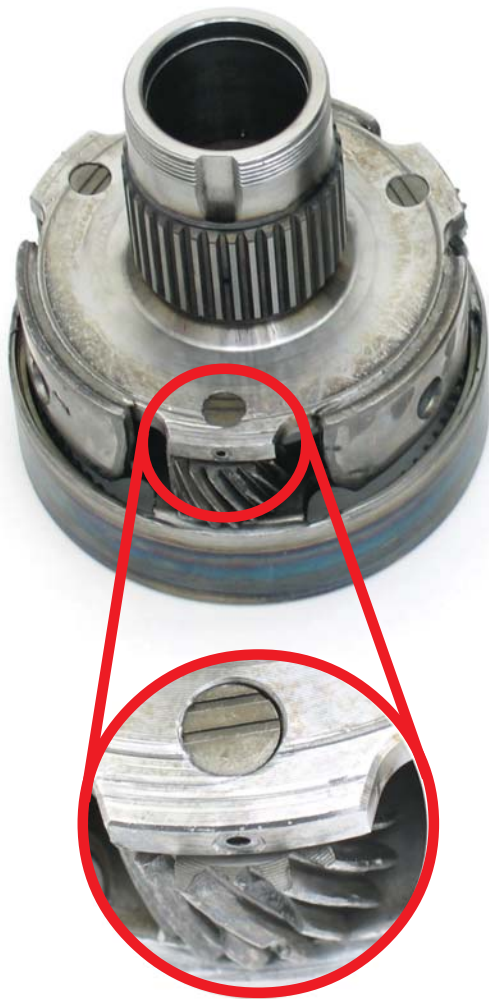
Check for ring grooving

U140E/U241E

Rear Planet Failure

Pinion gear shafts get loose in carrier, causing uneven gear tooth loading. Pinion shafts can eventually come out. Weld pinion shafts to carrier on early planets.

Early (Light/Shiny)

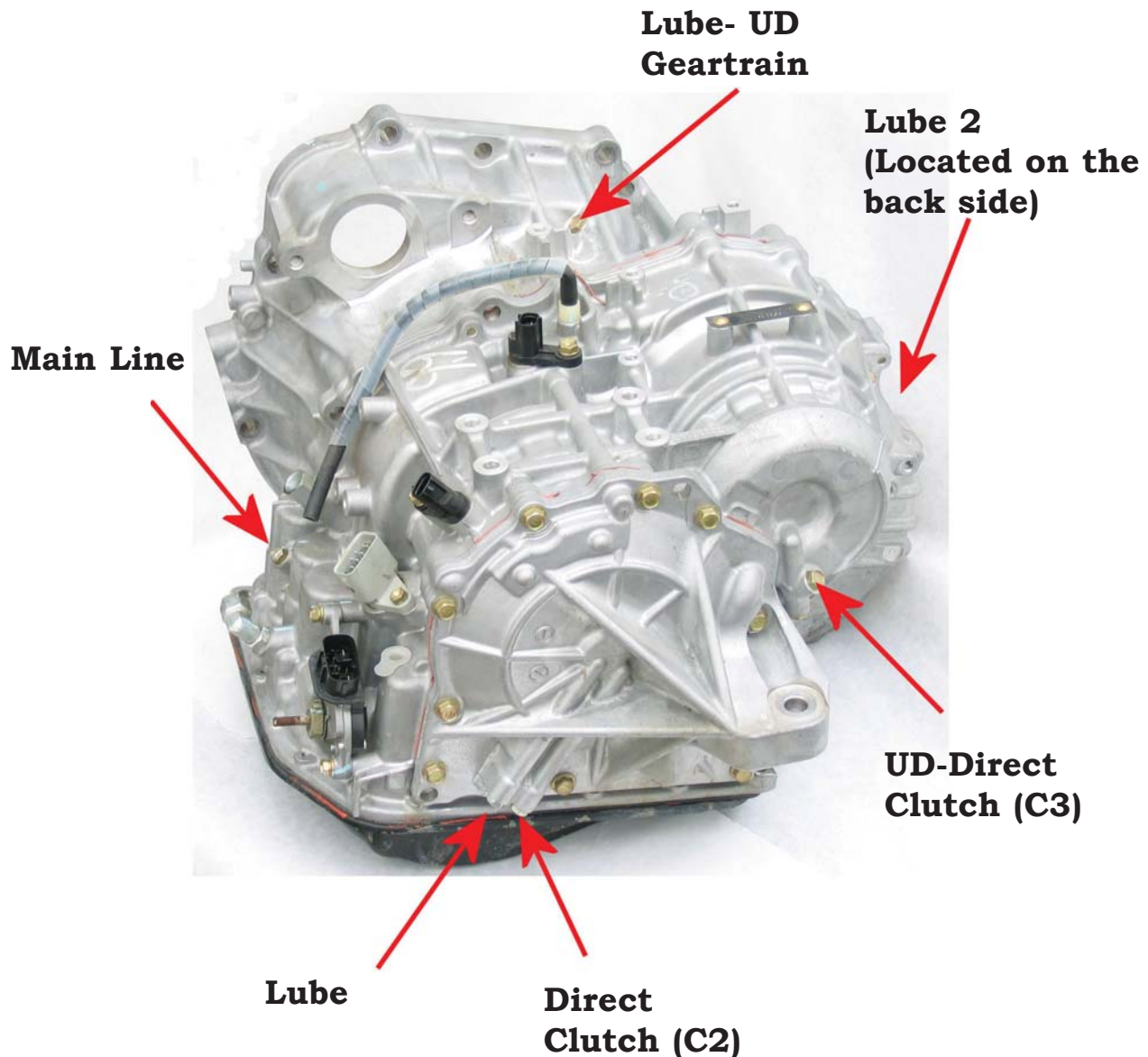


**Late
Hardened and Heat
Treated (Dark)**



U140E/U241E

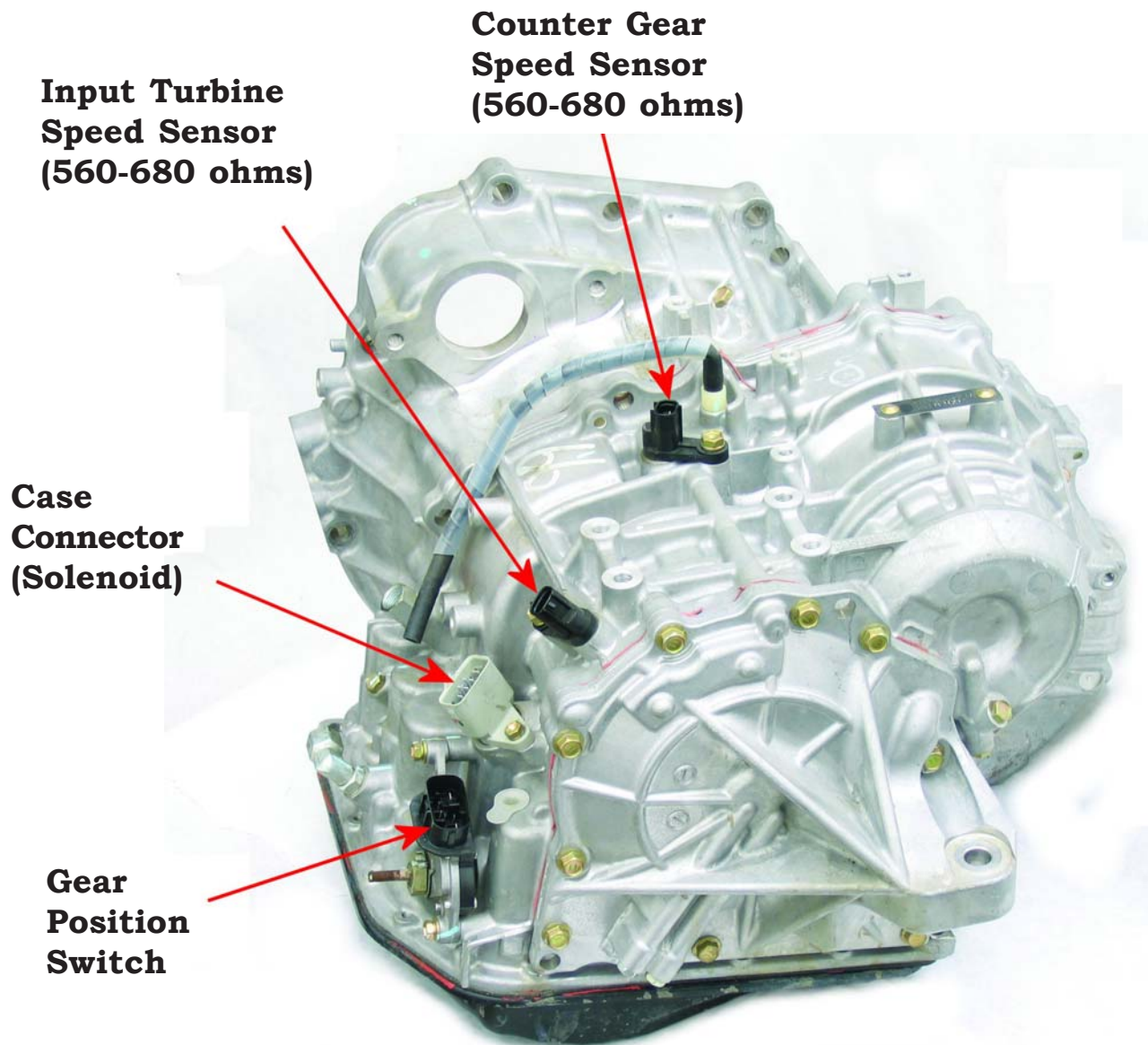
Pressure Taps and Specifications



Pressure Specifications		
Range	Idle	Stall
Drive	54-59 psi	134-139 psi
Reverse	97-107 psi	255-284 psi

U140E/U241E

External Component Location

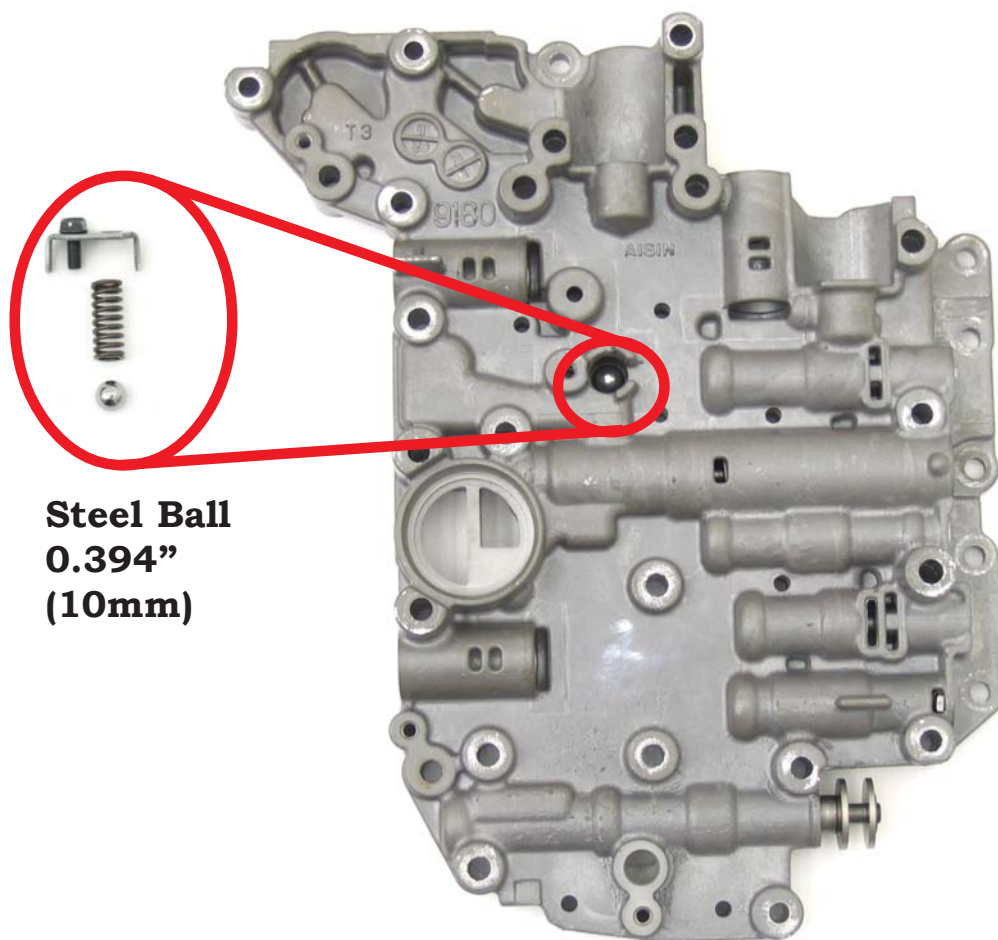


U140E/U241E

Valve Body Breakdown

Lower Valve Body

Some service information shows this steel ball and location incorrectly and in some cases the picture is unidentifiable. Use the following picture as the correct location and ID.



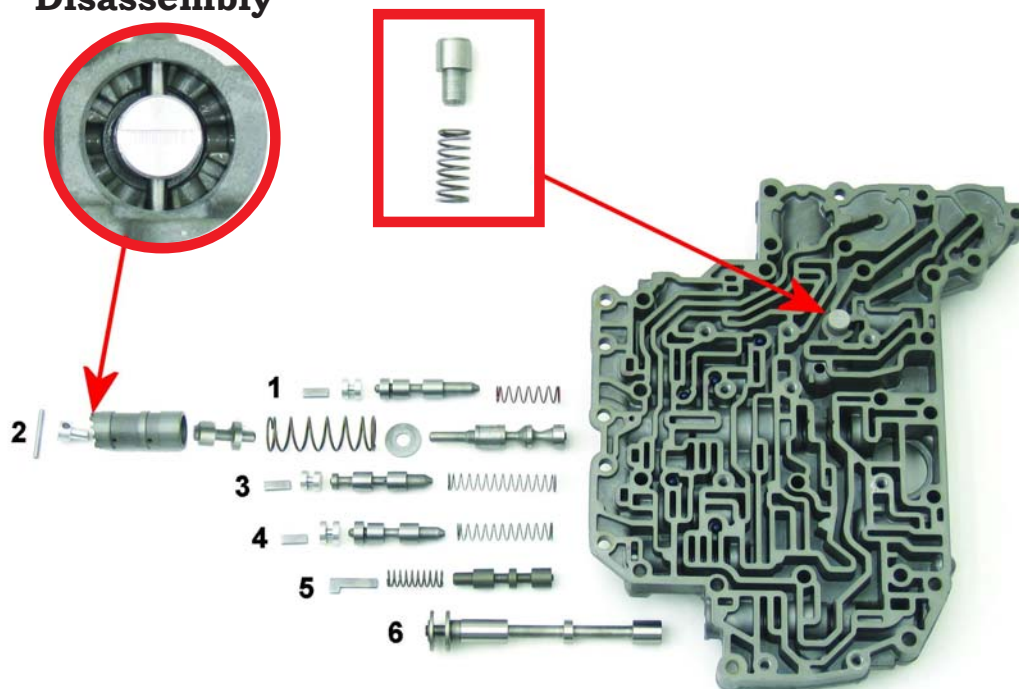
Steel Ball
0.394"
(10mm)

U140E/U241E

Valve Body Breakdown (continued)

Lower Valve Body

**Record PR
Setting Before
Disassembly**

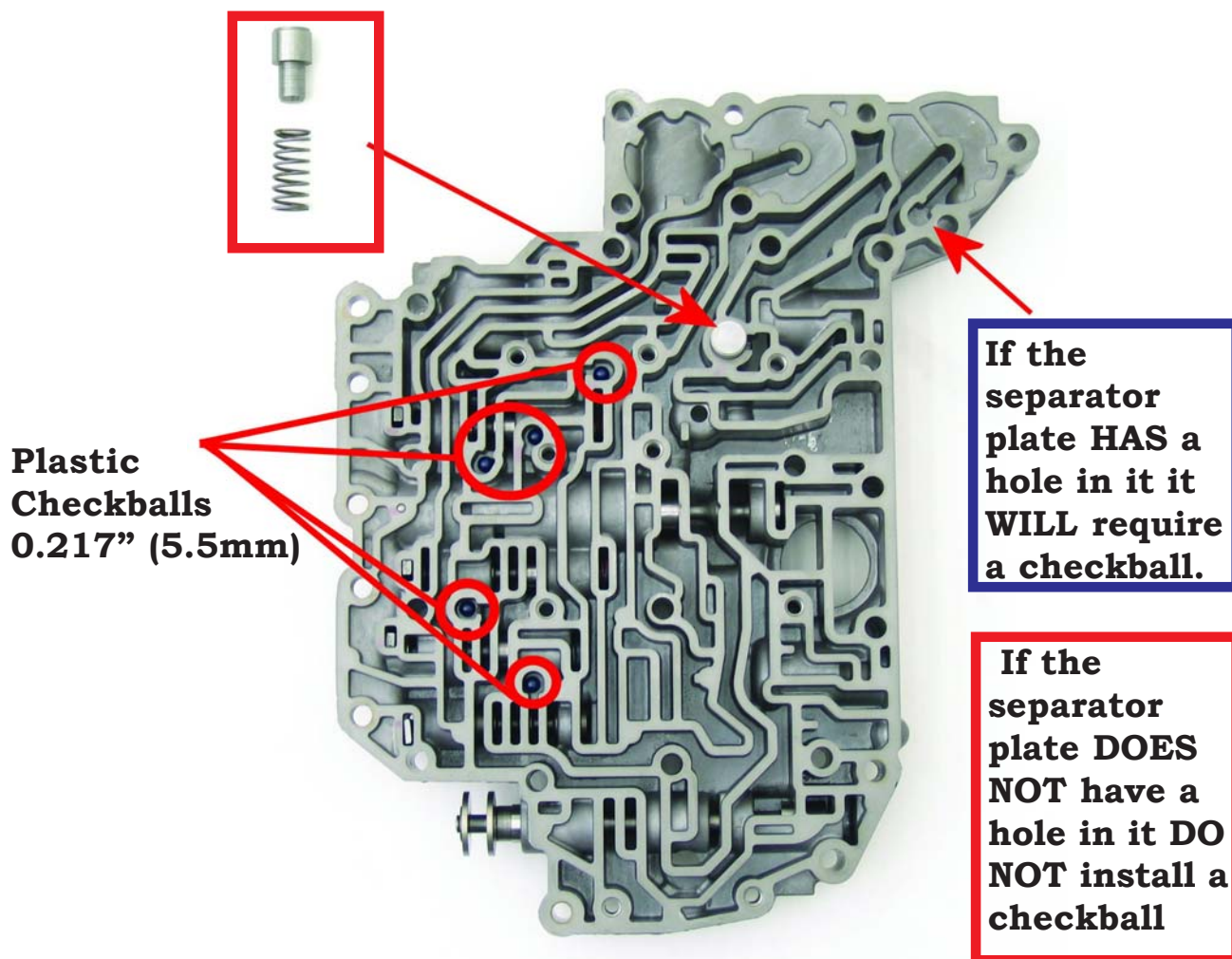


ID	Description
1	C2 Control Valve
2	Primary Regulator Valve Line-up
3	B2 Control Valve
4	B1 Control Valve
5	3-4 Shift Valve
6	Manual Valve

U140E/U241E

Valve Body Breakdown (continued)

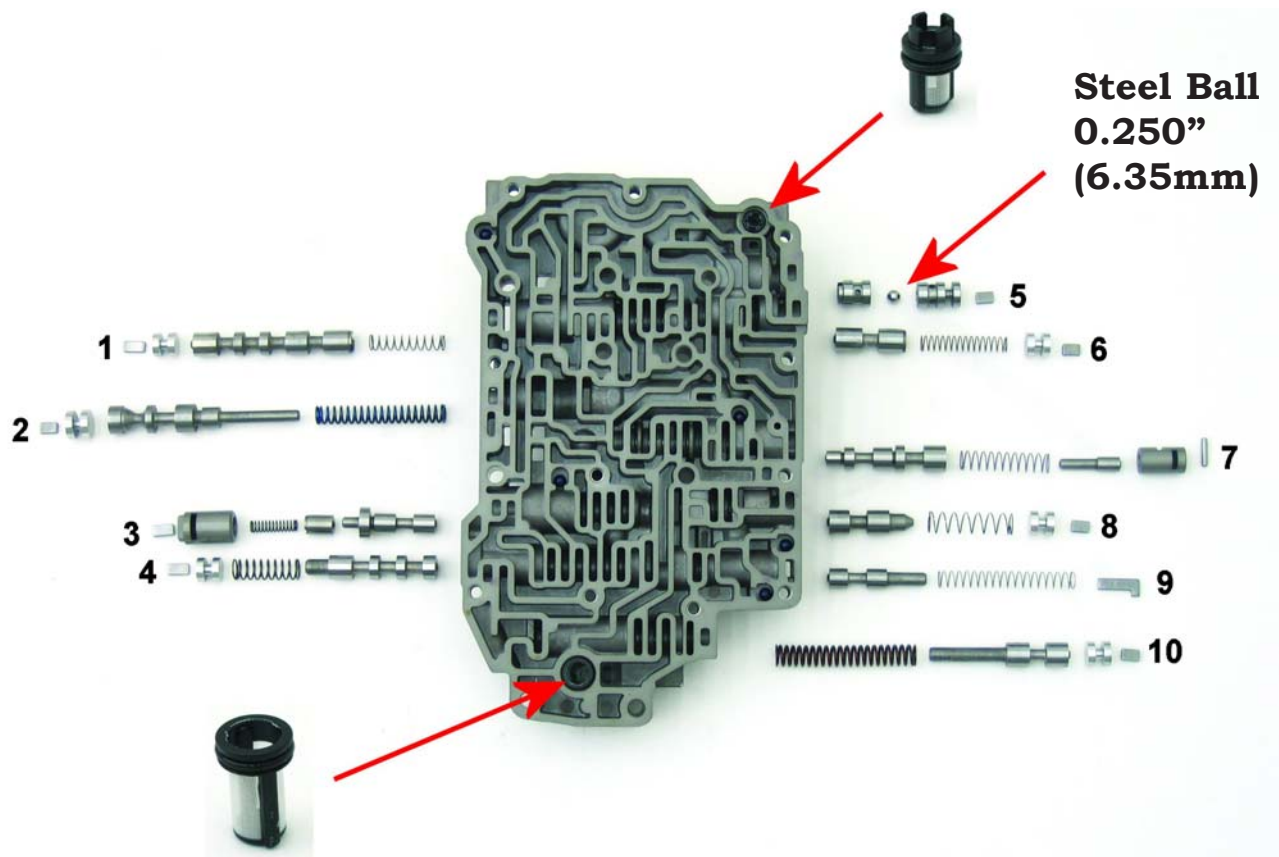
Lower Valve Body



U140E/U241E

Valve Body Breakdown (continued)

Upper Valve Body



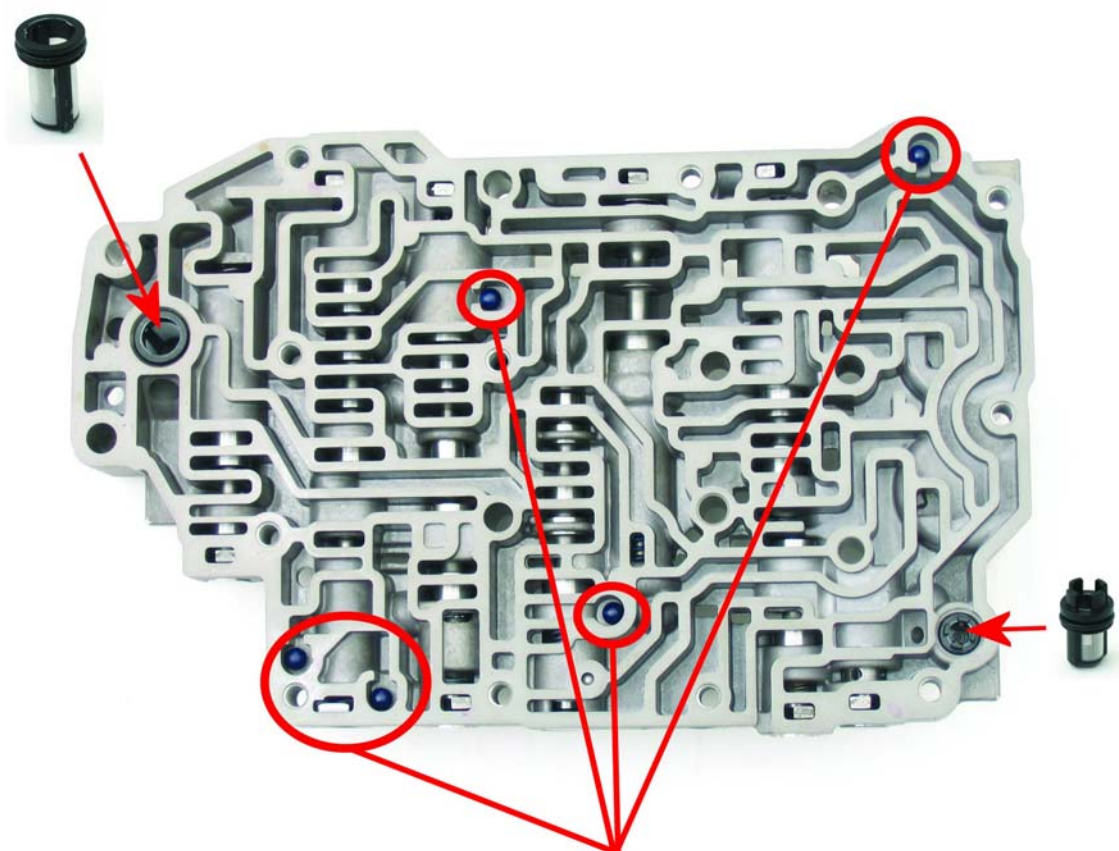
- 1. C2 Lock valve
- 2. Secondary Regulator Valve
- 3. Lock-up Control valve
- 4. Lock-up relay Valve
- 5. Check Valve #2/3 Assembly

- 6. C2 Exhaust Valve
- 7. Clutch apply Control Valve
- 8. B1 Lock Valve
- 9. B3 Orifice Control Valve
- 10. Solenoid Modulator Valve

U140E/U241E

Valve Body Breakdown (continued)

Upper Valve Body

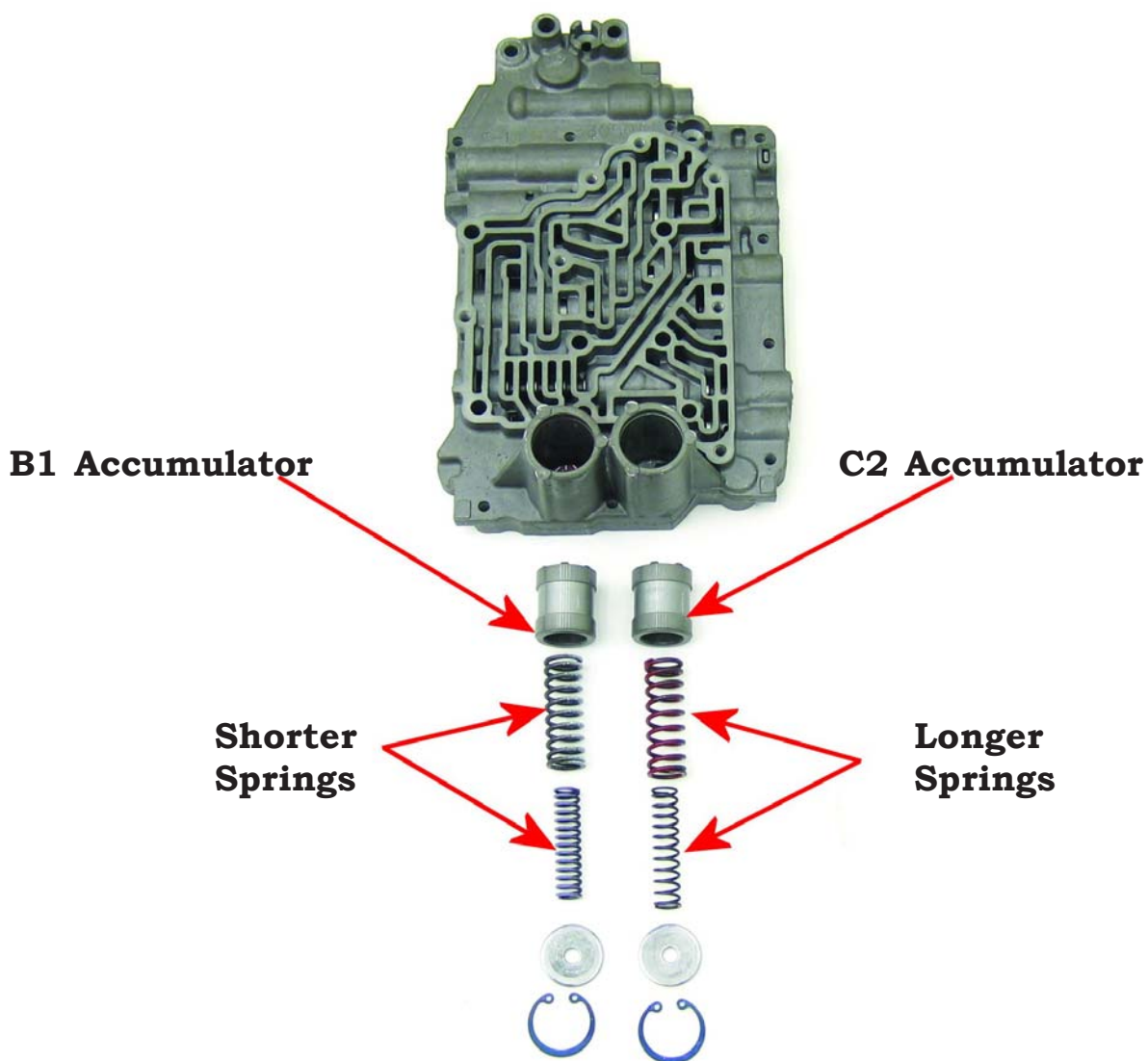


5 Plastic Checkballs
0.217" (5.5mm)

U140E/U241E

Valve Body Breakdown (continued)

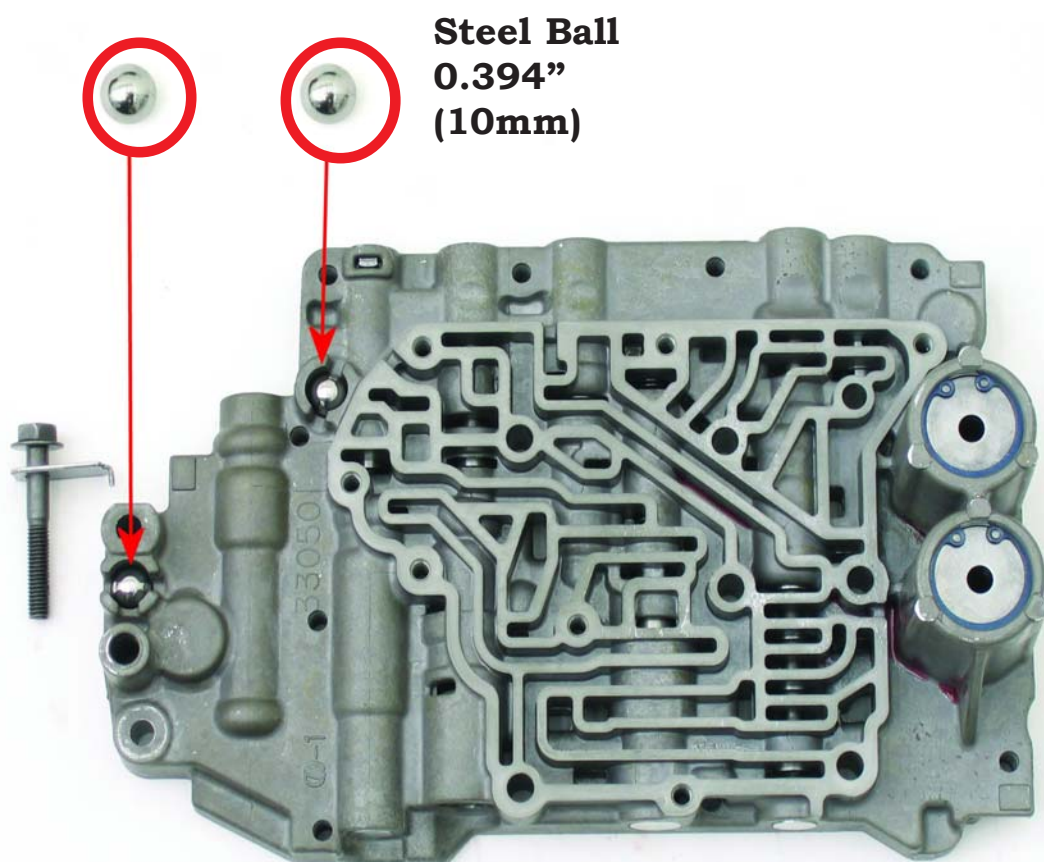
Upper Valve Body



U140E/U241E

Valve Body Breakdown (continued)

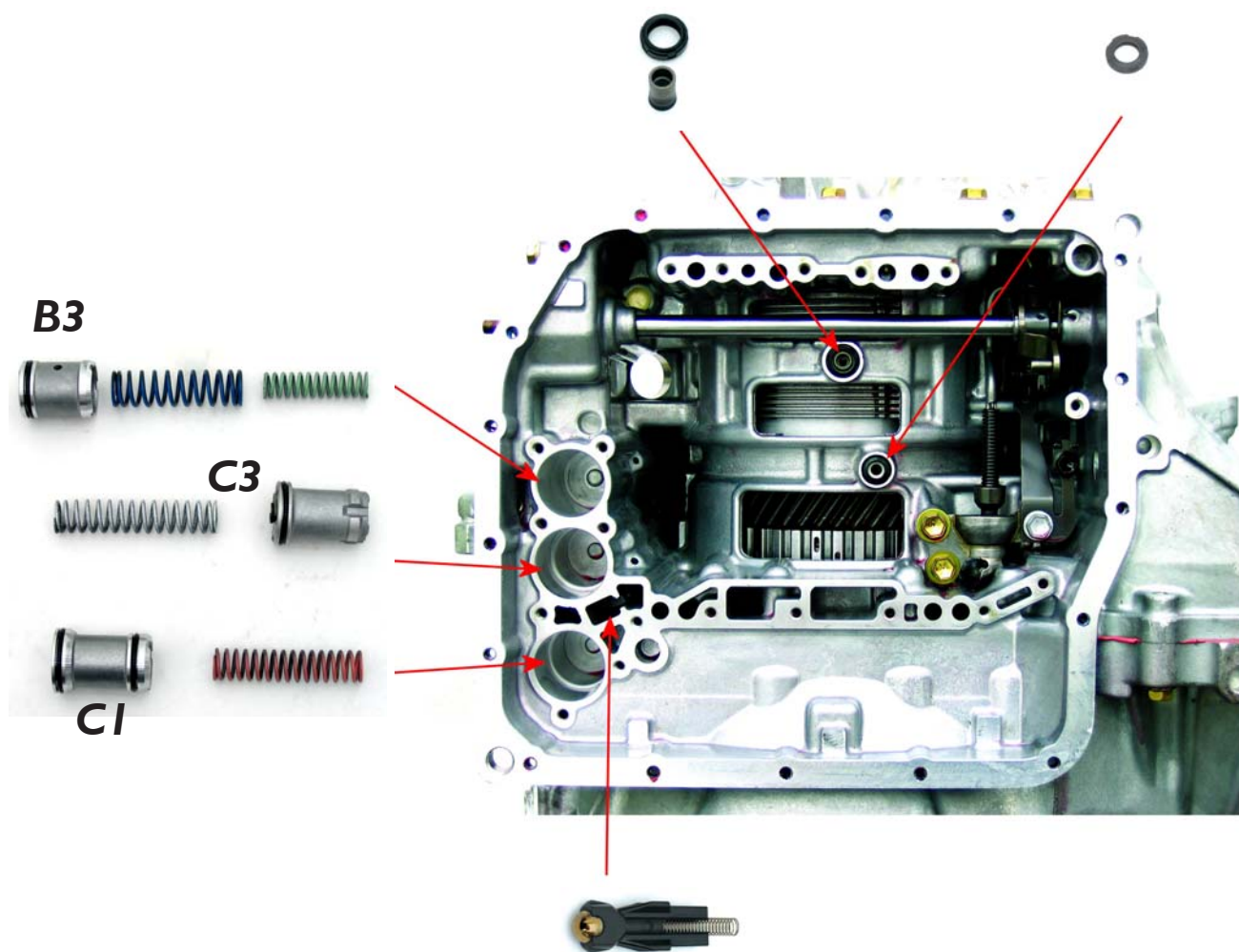
Upper Valve Body



U140E/U24IE

Case

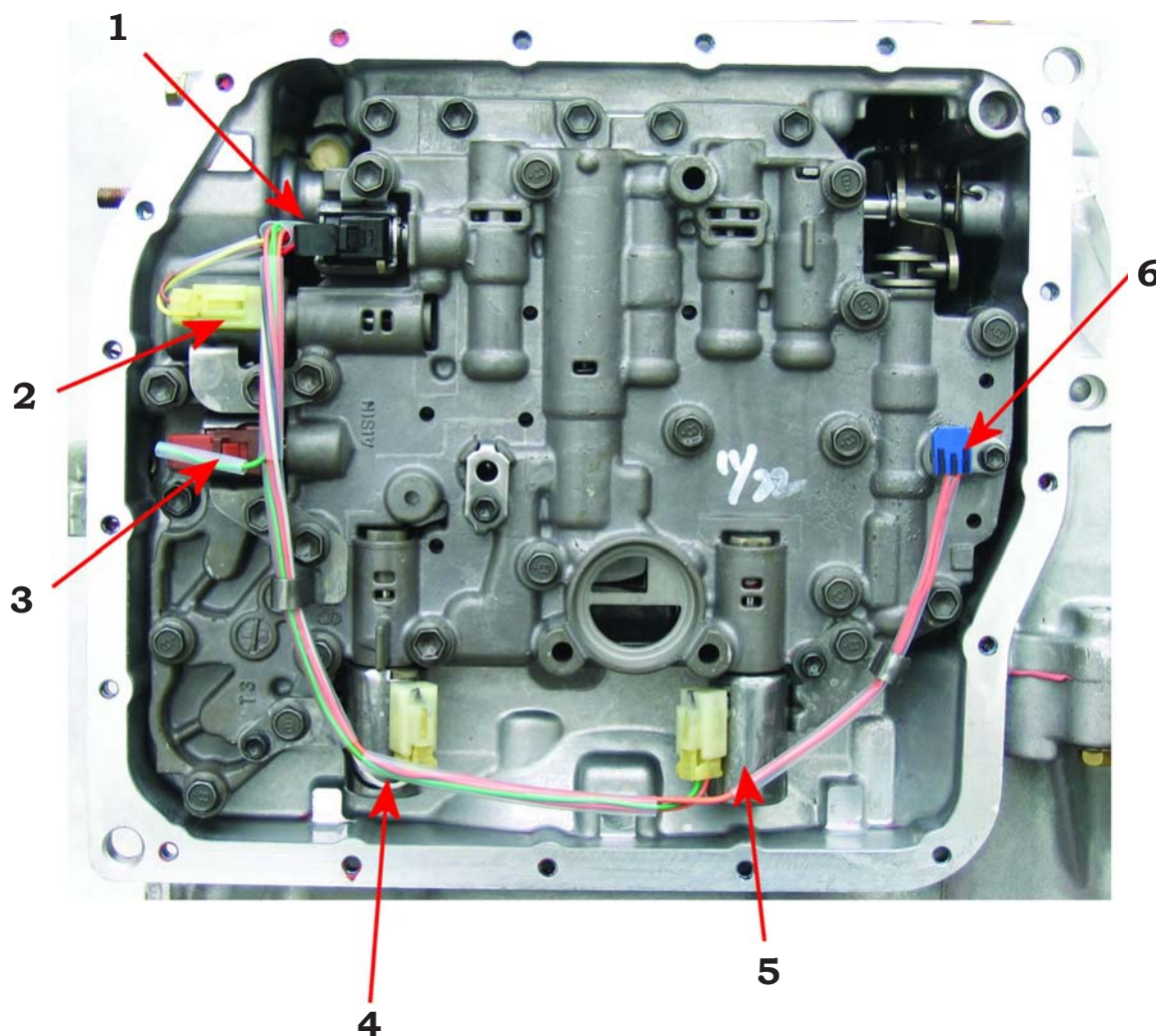
Accumulators, Seals, Check Valve



Cooler send check valve

U140E/U241E

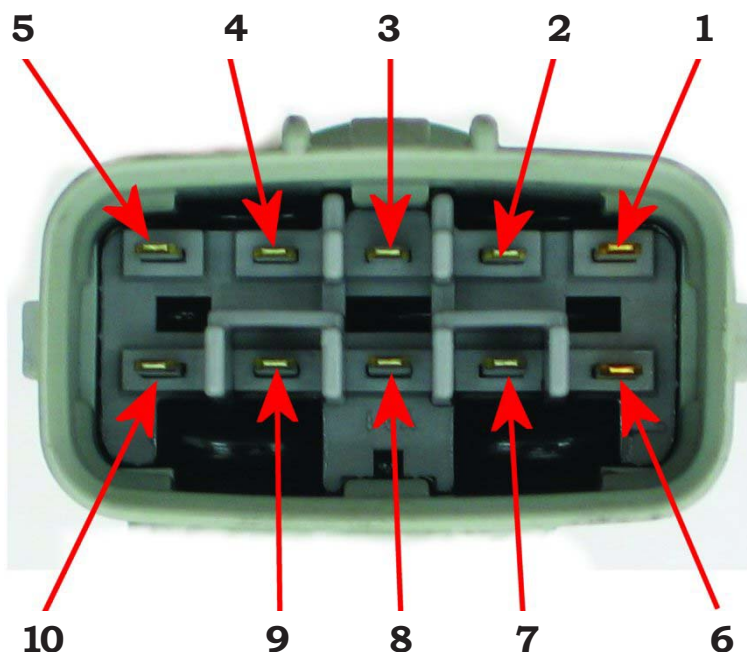
Solenoid Identification



Repair Manual Solenoid Name		Part Catalog Description
1	S4	Solenoid Assembly, Transmission 3-Way (No. 2)
2	SL2	Solenoid Assembly, Clutch Control No. 2
3	DSL	Solenoid Assembly, Transmission 3-Way
4	SL1	Solenoid Assembly, Clutch Control No. 1
5	SLT	Solenoid Assembly, Line Pressure Control
6	TFT	Transmission Fluid Temperature
NOTE: Part numbers have not been added due to the constant changing of part numbers. Check with your local parts distributors for the most recently updates		

U140E/U241E

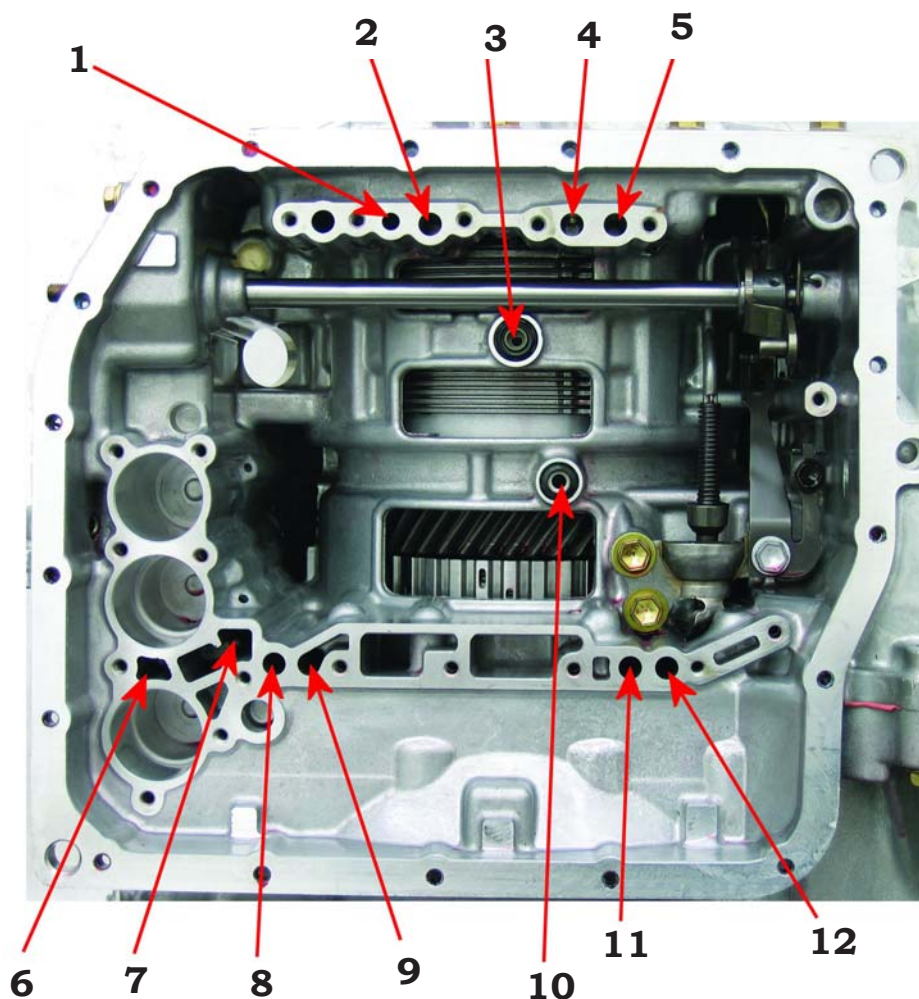
Case Connector Identification and Solenoid Resistance



Case Connector & Solenoid Resistance		
Solenoid	Terminals	Resistance
SL1	5 & 10	5.1 - 5.5 Ω
SL2	4 & 9	5.1 - 5.5 Ω
SLT	2 & 7	5.0 - 5.6 Ω
DSL	3 & GND	11 - 15 Ω
S4	8 & GND	11 - 15 Ω
TFT	1 & 6	3.5K Ω at 77°F (25°C) 231 Ω - 263 Ω at 231°F (110°C)

U140E/U241E

Case Passage Identification



ID	Decription
1	Lube
2	Direct Clutch (C2)
3	2nd Brake (B1)
4	UD Brake (B3)
5	UD Direct Clutch (C3)
6	Line Pressure Tap/Accumulator Shoulder
7	Cooler send
8	Forward Clutch
9	TCC Release
10	1st and Reverse brake (B2)
11	Lube
12	TCC Apply/Converter Charge

U140E/U241E

Solenoid Function and Apply Chart

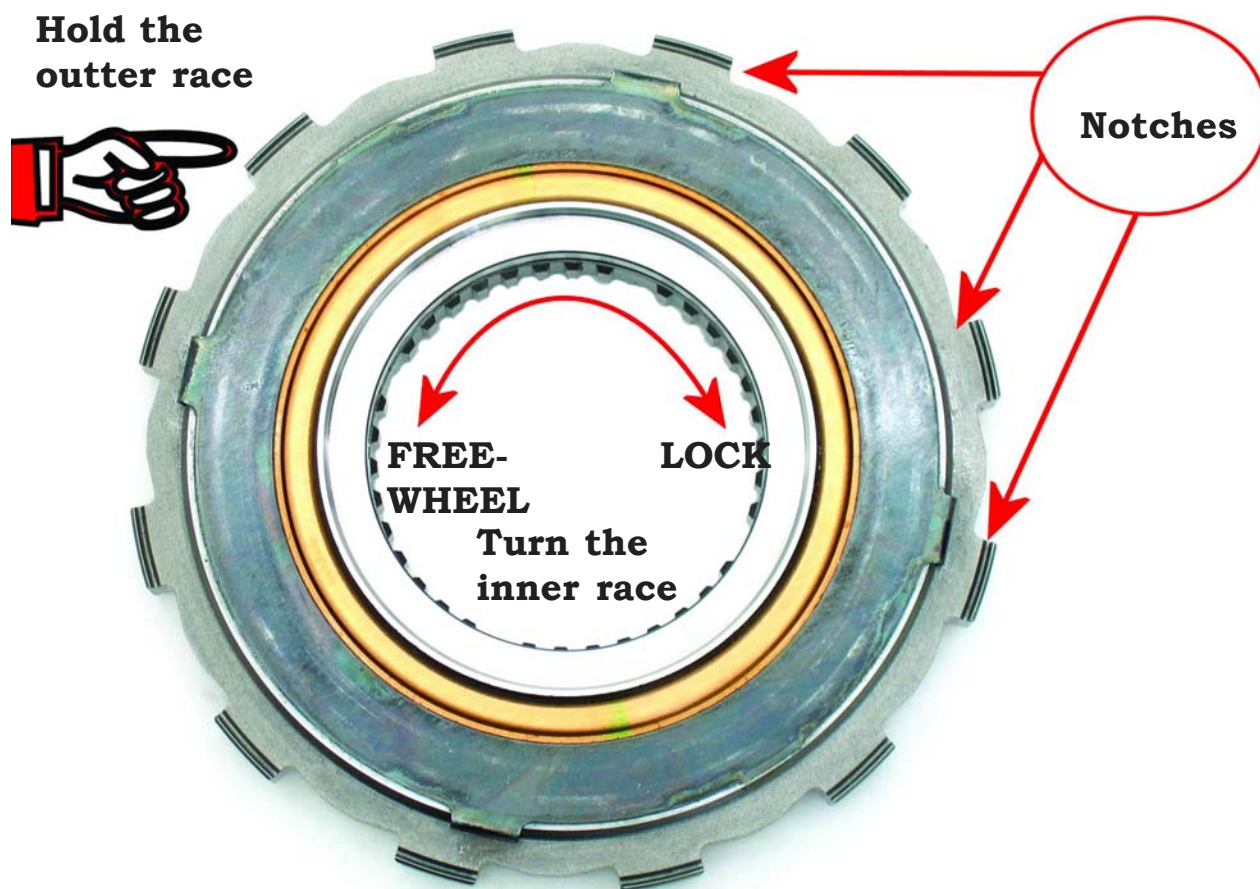
In the chart shown below, notice there is no application for SL1 in 3rd and 4th gear. This is because of the internal hydraulics, the SL1 solenoid can be ON or OFF, it is NOT Applicable to the operation of the transmission in these gears.

GEAR	SL1	SL2	S4
1	ON	ON	OFF
2	OFF	ON	OFF
3		OFF	OFF
4		OFF	ON

Solenoid Operation
SL1: Controls the B1 Brake
SL2: Controls the C2 clutch
SLT: Controls Line Pressure
S4: Controls the 3-4 Shift
DSL: Controls Lock-Up clutch
N-D Engagement: 3rd Gear is commanded during the engagement then 1st after the engagement is complete.

U140E/U241E

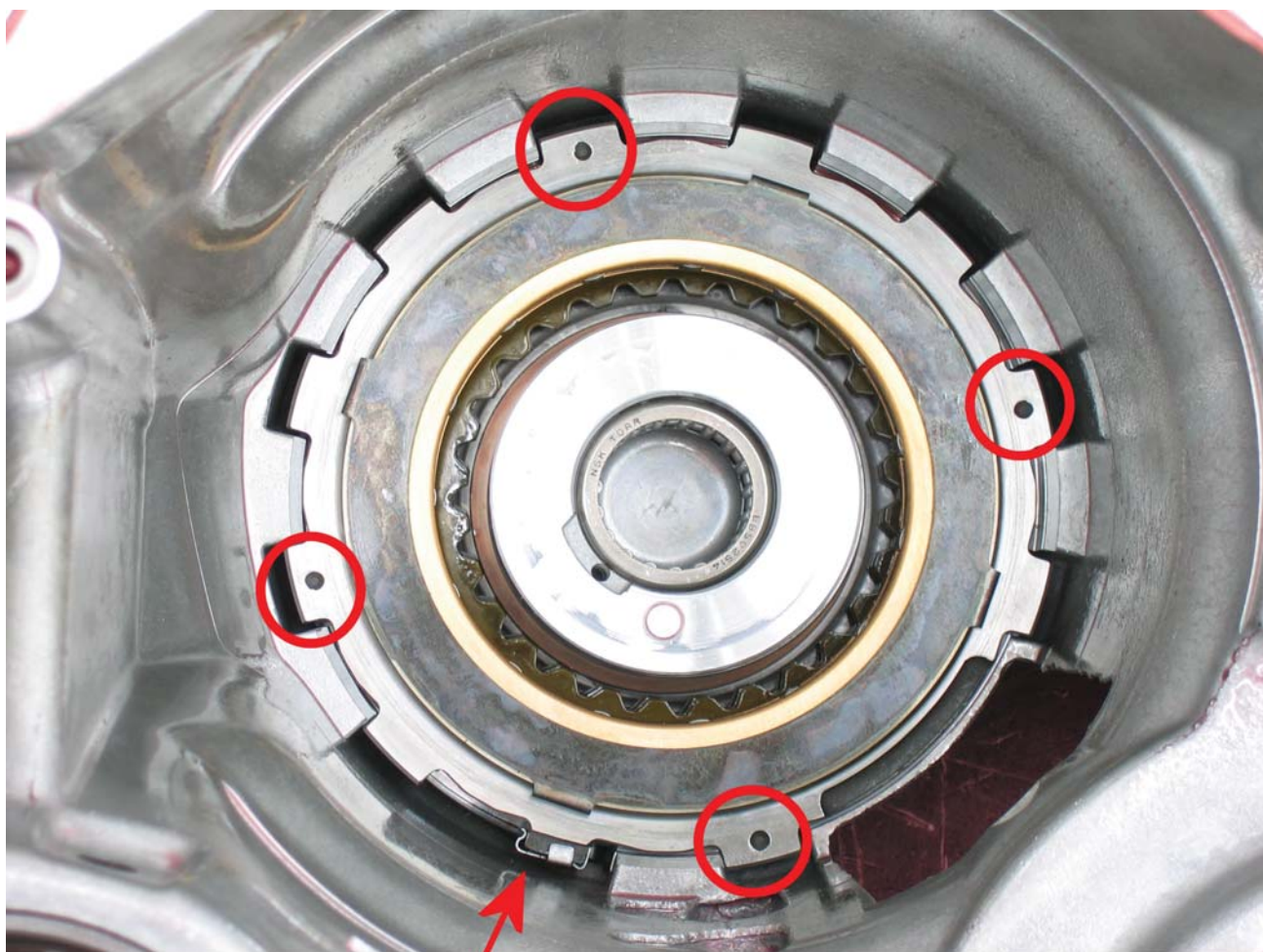
(FI) Sprag Rotation



U140E/U241E

(F2) Sprag Rotation

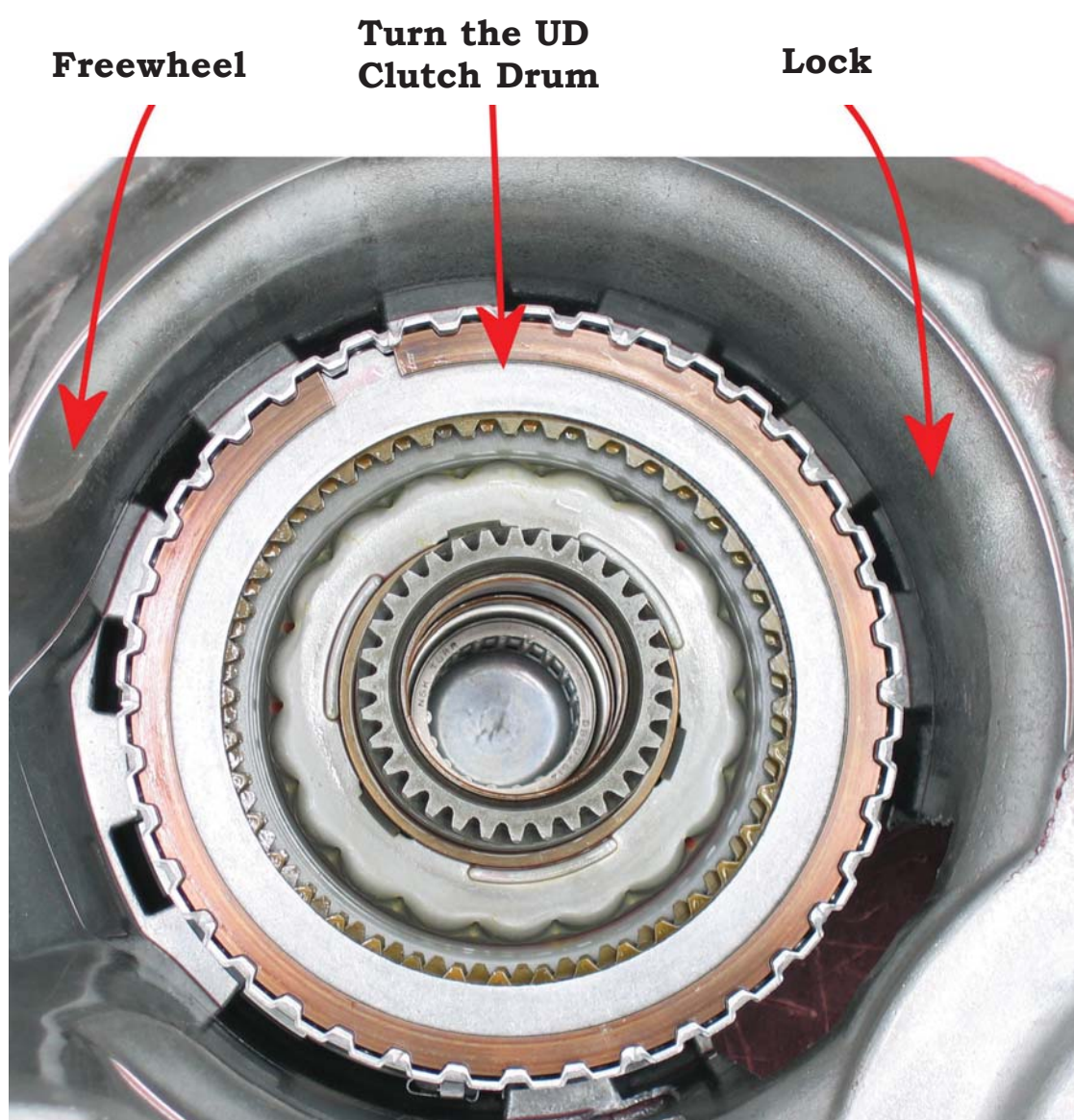
Dots must be facing you after installation



Clip

U140E/U241E

(F2) Sprag Rotation (continued)



UI40E

Pump Differences

(2 different pumps)

Make sure the pumps are assembled as a matched set. They can be interchanged as a complete assembly. However, the Pump halves CAN NOT be inched between crescent and non-crescent.

Crescent Type



NON-Crescent Type



U140E

Adaptive learn

Harsh Shifts After Overhaul

Reset adapts with factor scan tool. Battery disconnect or extensive driving may not be successful.

Whenever an automatic transmission is replaced, overhauled or individual components are replaced, use this procedure to erase the Engine Control Module (ECM, SAE term: Powertrain Control Module, PCM) "Learned Values" and minimize subsequent performance concerns.

Caution:

Failure to follow the following procedures may lengthen the time to readjust the "Learned Values", potentially resulting in performance concerns.

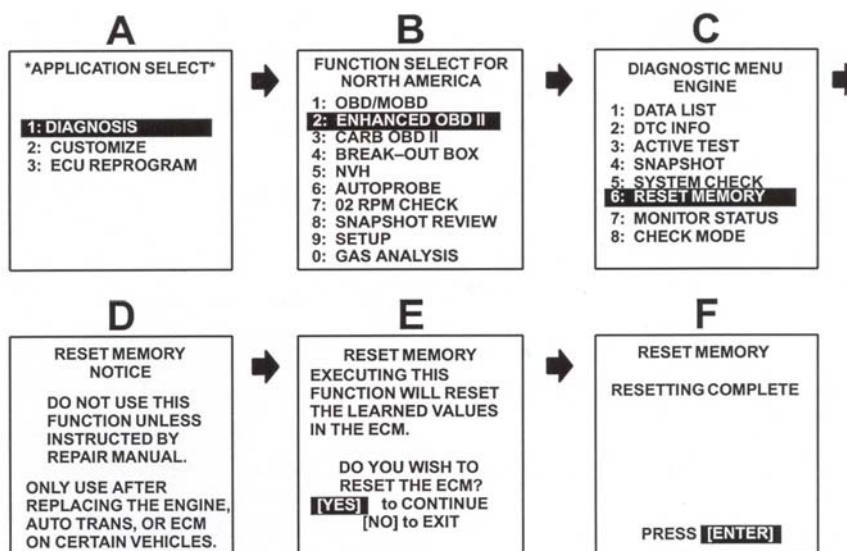
Procedure 1

1999-2003 ES 300 and RX 300

2003-2005 GX 470

2004-2005 RX 330

1. Connect the Lexus Diagnostic Tester to the vehicle.
2. Reset the ECM (PCM). Refer to the procedures below.



3. Start the engine and warm it up to normal operating temperature
4. Perform a thorough test drive with several accelerations from a stop with "light throttle" application until proper transmission shifting is verified.

Mercedes

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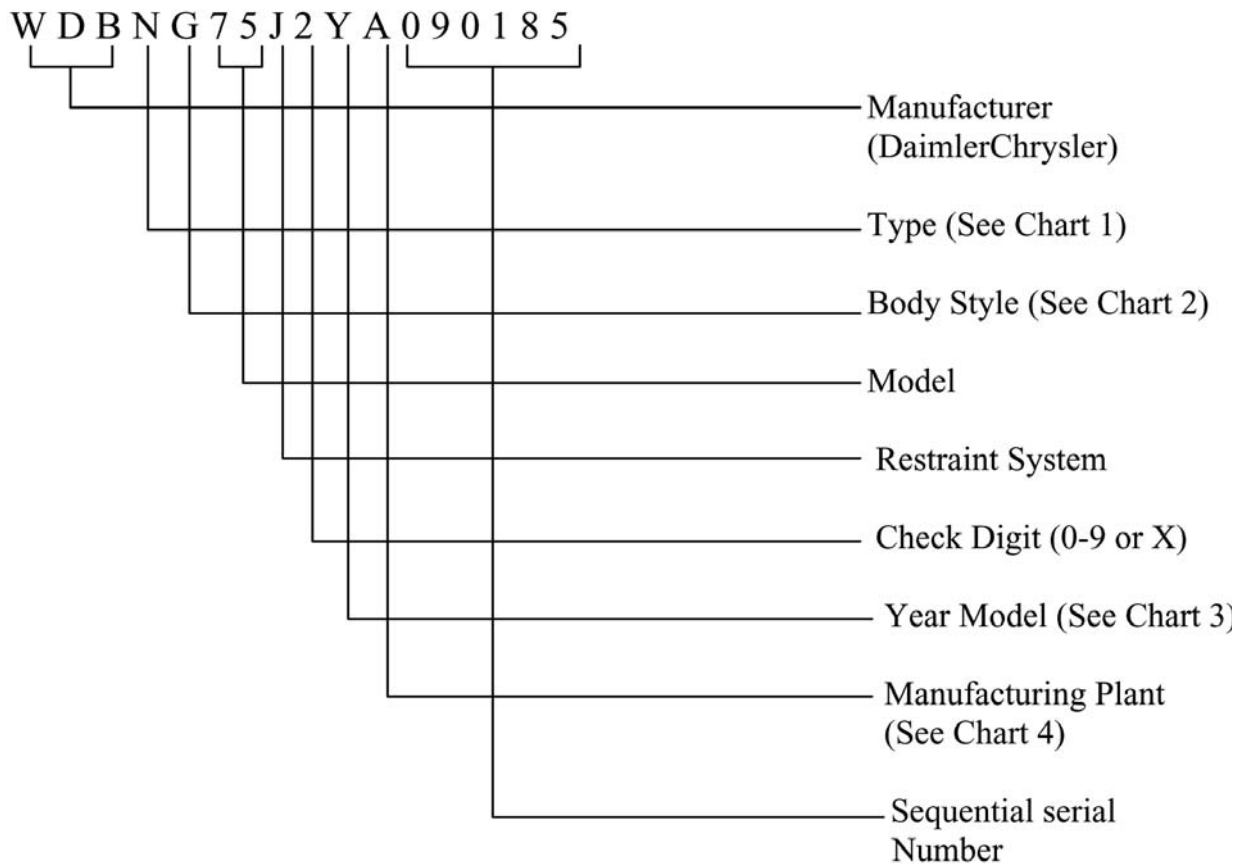
Vehicle Identification



722.6/NAG I

Vehicle Identification (continued)

North American Mercedes Vehicle Identification Number (VIN)



Footnote: On G Class and M Class models, this position pertains to the Weight Class.
E=6001-7000 lbs. F=7001-8000 lbs.

722.6/NAG I

Vehicle Identification (continued)

Chart 1, Type Designation Codes

A=163 ¹	F=129	P=215
A=123	G=140	R=203
A=199 ²	H=202	S=230
B=107	J=210	T=209
C=126	K=170	U=211
D=201	L=208	W=171
E=124	N=220	Y=463 ³

¹ When Manufacturer Code is 4JG

² As of calendar year 2004

³ When Manufacturer Code is WDC

Chart 3, Model Year Codes

A = 1980	M = 1991	2 = 2002
B = 1981	N = 1992	3 = 2003
C = 1982	P = 1993	4 = 2004
D = 1983	R = 1994	5 = 2005
E = 1984	S = 1995	6 = 2006
F = 1985	T = 1996	
G = 1986	V = 1997	
H = 1987	W = 1998	
J = 1988	X = 1999	
K = 1989	Y = 2000	
L = 1990	1 = 2001	

Chart 2, Body Style Codes

F = Sedan
G = Sedan Long
H=Station Wagon
J = Coupe
K=Cabriolet/Roadster
M = AMG
N = Sport Coupe
B = Long Body ¹
R = Gasoline ²
¹ When Mfg. Code is 4GJ
² When Mfg. Code is WDC

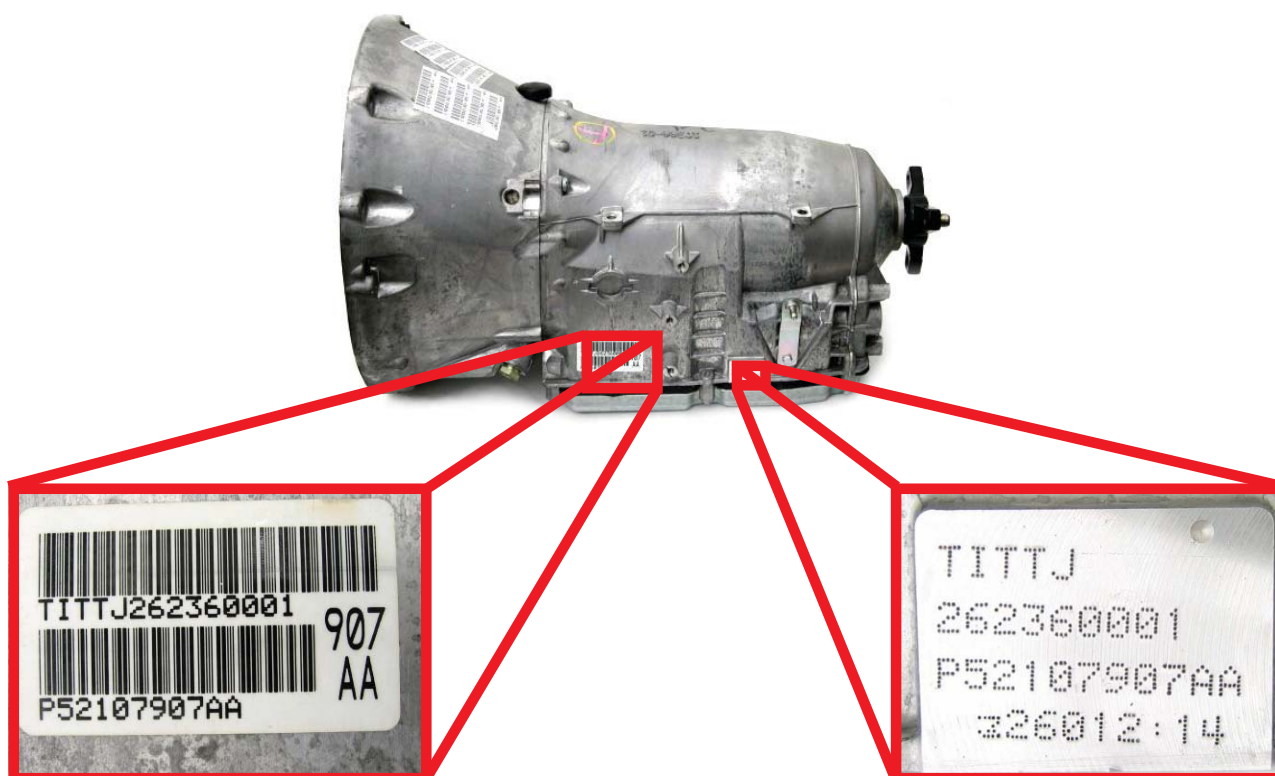
Chart 4, Manufacturing Plant Codes

A -D = Sindelfingen, Germany
A = Vance, Alabama, USA, When Mfg. Code is 4JG
E = Juiz de Flora, Brazil
F-H = Bremen, Germany
J = Rastatt, Germany
M = Woking, Great Britain
T = Osnabrucck, Germany
X = Graz, Austria

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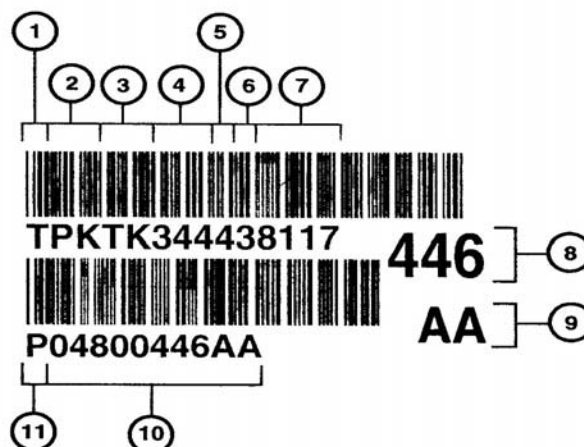
Transmission Identification

Transmission ID Locations



Transmission Bar Code Label Interpretation

1. Traceability
2. Supplier Code
3. Component Code
4. Build Day (Julian Date)
5. Build Year
6. Line/Shift Code
7. Build Sequence
8. Last Three Part Number Digits
9. Revision Level
10. Transmission Part Number
11. Part Number Prefix



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Transmission Identification (continued)

Julian Calendar

Julian Calendar												
Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	1	32	60	91	121	152	182	213	244	274	305	335
2	2	33	61	92	122	153	183	214	245	275	306	336
3	3	34	62	93	123	154	184	215	246	276	307	337
4	4	35	63	94	124	155	185	216	247	277	308	338
5	5	36	64	95	125	156	186	217	248	278	309	339
6	6	37	65	96	126	157	187	218	249	279	310	340
7	7	38	66	97	127	158	188	219	250	280	311	341
8	8	39	67	98	128	159	189	220	251	281	312	342
9	9	40	68	99	129	160	190	221	252	282	313	343
10	10	41	69	100	130	161	191	222	253	283	314	344
11	11	42	70	101	131	162	192	223	254	284	315	345
12	12	43	71	102	132	163	193	224	255	285	316	346
13	13	44	72	103	133	164	194	225	256	286	317	347
14	14	45	73	104	134	165	195	226	257	287	318	348
15	15	46	74	105	135	166	196	227	258	288	319	349
16	16	47	75	106	136	167	197	228	259	289	320	350
17	17	48	76	107	137	168	198	229	260	290	321	251
18	18	49	77	108	138	169	199	230	261	291	322	252
19	19	50	78	109	139	170	200	231	262	292	323	253
20	20	51	79	110	140	171	201	232	263	293	324	254
21	21	52	80	111	141	172	202	233	264	294	325	255
22	22	53	81	112	142	173	203	234	265	295	326	256
23	23	54	82	113	143	174	204	235	266	296	327	257
24	24	55	83	114	144	175	205	236	267	297	328	258
25	25	56	84	115	145	176	206	237	268	298	329	259
26	26	57	85	116	146	177	207	238	269	299	330	360
27	27	58	86	117	147	178	208	239	270	300	331	361
28	28	59	87	118	148	179	209	240	271	301	332	362
29	29		88	119	149	180	210	241	272	302	333	363
30	30		89	120	150	181	211	242	273	303	334	364
31	31		90		151		212	243		304		365

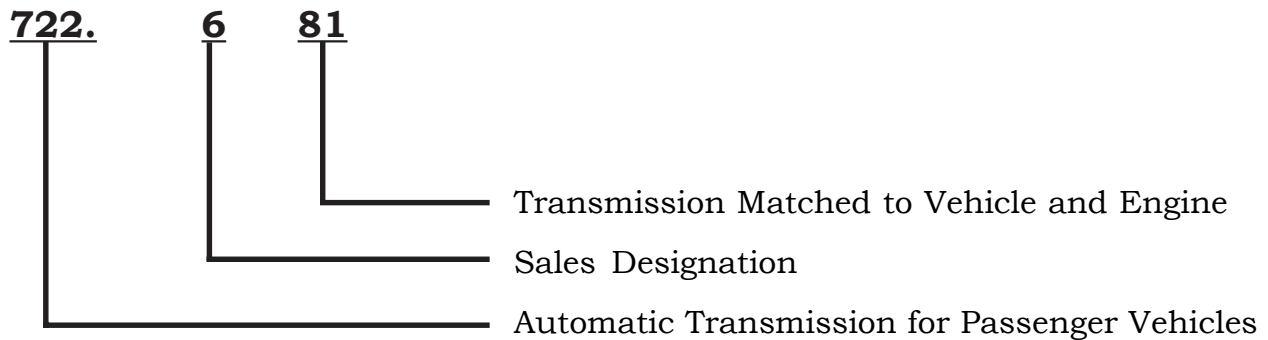
722.6/NAG I

Model Designation

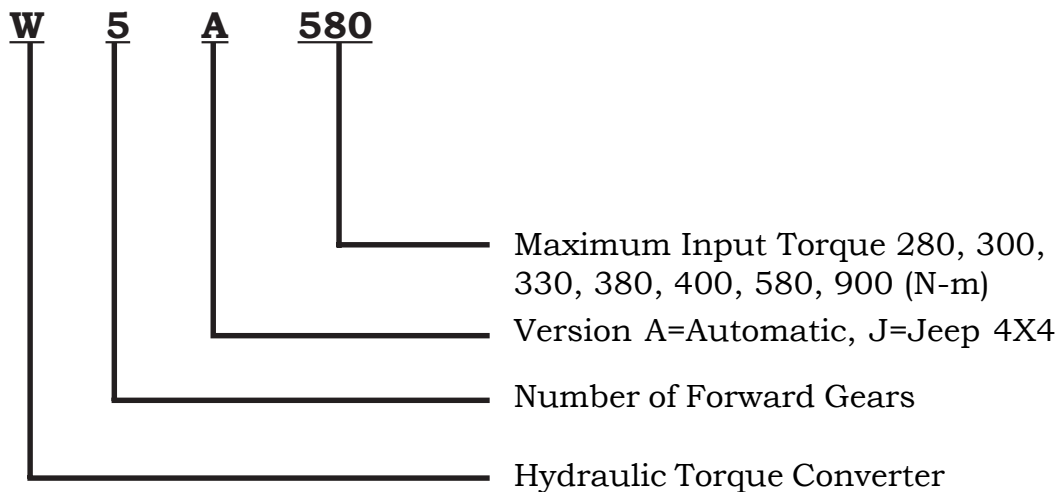
Mercedes: With 722.6

Chrysler: Sprinter and Crossfire.

Engineering Designation



Sales Designation



722.6/NAG I

Chrysler/Jeep Applications

Chrysler/Jeep Transmissions Applications					
Year	Vehicle Family	Market	Engine Application Sales Code	Trans Sales Code	Sales Code Description
2002	Grand Cherokee (WG)	BUX*	2.7L 5-Cyl. Diesel (ENF)	DGJ	Five Speed Auto Trans (W5J400)
2003	Grand Cherokee (WG)	BUX*	2.7L 5-Cyl. Diesel (ENF)	DGJ	Five Speed Auto Trans (W5J400)
2003	Sprinter (VA)	U.S.	2.7L 5-Cyl. Diesel (EX9)	DGJ	Five Speed Auto Trans (W5A380)
2004	Sprinter (VA)	U.S.	2.7L 5-Cyl. Diesel (EX9)	DGJ	Five Speed Auto Trans (W5A380)
2004	Crossfire (ZH)	U.S., Canada, Mexico, and BUX*	3.2L 6-Cyl. Gas (EGX)	DGU	Five Speed Auto Trans (W5A330)
2005	Sprinter (VA)	U.S.	2.7L 5-Cyl. Diesel (EX9)	DGJ	Five Speed Auto Trans (W5A380)
2005	Chrysler 300C and Dodge Magnum (LX)	U.S., Canada, Mexico, and BUX*	5.7L 8-Cyl. Gas (EZB) 3.5L Gas AWD	DGJ	Five Speed Auto Trans (W5A580)
2005	Grand Cherokee (WK)	U.S., Canada, Mexico	3.7L 6-Cyl. Gas (EKG)	DGJ	Five Speed Auto Trans (W5A580)
2005	Grand Cherokee (WH)	BUX*	3.7L 6-Cyl. Gas (EKG) or 3.0L 6- Cyl. Diesel	DGJ	Five Speed Auto Trans (W5A580 or W5J400)
2005	Crossfire (ZH)	U.S., Canada, Mexico, and BUX*	3.2L 6-Cyl. Gas (EGX)	DGU	Five Speed Auto Trans (W5A330)
* Built Up For Export					

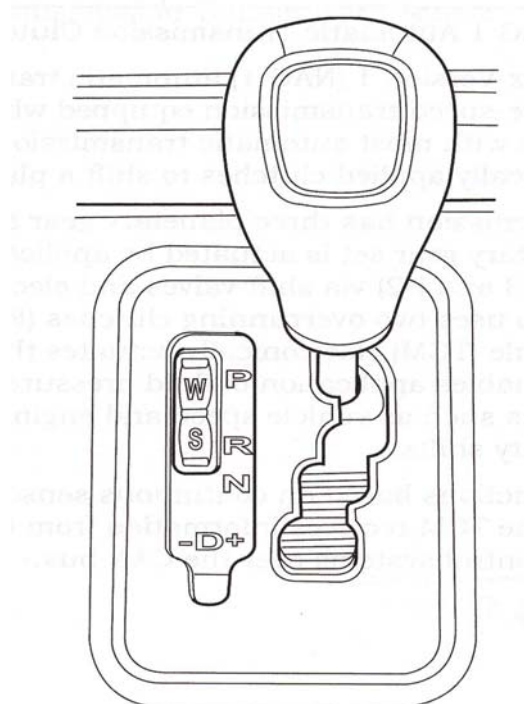
722.6/NAG I

Mercedes Transmission Applications

Mercedes Transmission Applications	
Engineering Designation	Sales Designation
722.600 – 722.619	W5A 330
722.620 – 722.645	W5A 580
722.646 - 722.647	Not Available 8/14/05
722.648 – 722.649	W5A 900
722.661 – 722.622	W5A 300
722.663	W5A 400
722.664 – 722.665	W5A 300
722.666	W5A 400
722.667 – 722.668	W5A 300
722.669 – 722.670	W5A 400
722.671 – 722.672	W5A 580
722.673 – 722.676	W5A 400
722.69	W5A 300
722.695 – 722.699	W5A 330

722.6/NAG I

Transmission Ranges and Operation



"Touch" Shifter Transmission Ranges		
Shift Lever Position	Gear Selection	Description
P		Parking and starting position
R	Reverse	Reverse gear, Standard mode, Winter mode, and default reverse
N		Neutral and starting position. No transmission of power. The vehicle can be moved freely. Allows starting engine with the vehicle in motion.
D	D	Shifts 1,2,3,4,5. TCC is available in 3 rd , 4 th , and 5 th gear.
D – (1 time)	4	Shifts 1,2,3,4, engine braking available
D – (2 times)	3	Shifts 1,2,3, engine braking available
D – (3 times)	2	Shifts 1,2, engine braking available
D – (4 times)	1	First gear only, maximum engine braking

722.6/NAG I

Transmission Ranges and Operation (continued)

Daimler-Chrysler has many different shifter part numbers but there are only two basic types that a driver would notice. One is a common shifter like all other cars and the second one is the “Touch” shifter as shown. When the shifter is in the D range the shifter will also move side to side. If you push the shifter handle sideways toward the driver, or to the Minus sign, (-) for a moment the transmission will down shift to the next lowest range. If you push the shifter side ways away from the driver, or to the Plus sign, (+) it will up shift to the next highest gear. The shifter can be used this way for sporty manual shifting. If you want it to go back to full automatic shifting, push the shifter sideways away from the driver and hold it for at least one second.

On most Daimler-Chrysler vehicles the Transmission Control Module will not let the engine RPM exceed a safe operating speed so it may up shift to a higher gear than the driver has selected. Also it may prevent or delay a down shift that has been requested by the driver if a safe engine RPM will be exceeded.

The shifter shown on the opposite page has a Standard Mode/Winter Mode switch. (Not all shifters will have a mode switch). In the Standard Mode all shifts will be normal. The Winter Mode is for better traction on slippery roads in both forward and reverse, it will take off in second gear and will shift earlier. It will also take off in a higher ratio reverse than in the Standard Mode.

Gear Range	Ratio	Ratio
	W5A580 W5J400 W5A380	W5A330
First	3.59	3.95
Second	2.19	2.423
Third	1.41	1.486
Fourth	1	1
Fifth	0.83	0.833
Reverse	3.16	3.147
Reverse 4X4 low or Winter mode	1.93	1.93

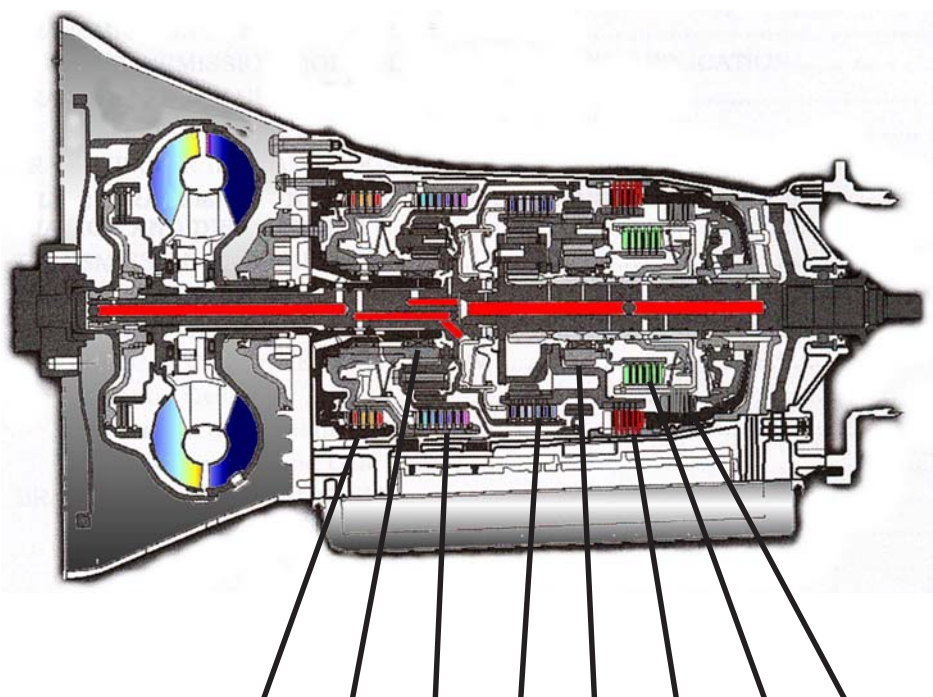
722.6/NAG I

Component Application Chart

Power Flow

Component Application

The Mercedes 722.6 uses six multi-plate clutches and two sprags (freewheels) to achieve its five forward and two reverse ranges (standard and winter modes). The following chart shows which elements are used for each gear.



Gear	B1	F1	K1	K2	F2	B3	K3	B2
1	X ₍₁₎	X			X		X ₍₁₎	X
2 ₍₂₎			X		X		X ₍₁₎	X
3			X	X				X
4			X	X			X	
5	X	X ₍₁₎		X			X	
N	X						X	
R	X ₍₁₎	X				X	X	
R ₍₂₎			X			X	X	
(1) For engine braking (2) When in 4X4 low (if equipped) or Winter mode (if equipped)								

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Solenoid Operation

Solenoid Overview

The Mercedes 722.6 transmission uses six solenoids on the valve body to control transmission operation; three shift solenoids, a converter clutch solenoid, a pressure control solenoid, and a shift pressure control solenoid. Mercedes uses terms for their solenoids that may not relate to an obvious function. The three shift solenoids: the 1-2/4-5 shift, 2-3 shift, and 3-4 shift solenoids are obvious. However, the lock up solenoid is referred to as a PWM solenoid, the pressure control solenoid is referred to as the modulating pressure regulator solenoid. The shift pressure control solenoid is somewhat unique and we'll cover its function later.

Solenoid Operation

The modulating pressure regulating solenoid controls line rise by raising pressure to the spring side of the pressure regulator. This is a standard function like most all computer-controlled transmissions. It also controls oil to three other valves.

The PWM solenoid is also a fairly standard solenoid in that it controls converter clutch operation.

Where the Mercedes transmission is radically different in solenoid operation is with the shift solenoids. Because each shift releases one clutch while applying another, timing is very important so you don't get a flare or bind-up during the shift "transition". Each shift solenoid uses a bank of four valves to control the shift transitions. These valves are called:

1. Command Valve
2. Holding Pressure Shift Valve
3. Shift Pressure Shift Valve
4. Pressure Overlap Control Valve

722.6/NAG I

Solenoid Operation (continued)

Keep in mind that each shift solenoid uses four of these valves, so in total there are 12 valves that control all of the shift transitions.

The basic operation of these four valves is the same for each shift. To initiate a shift transition the computer turns on one of the shift solenoids. For example, for a 1-2 shift the computer turns on the 1-2/4-5 shift solenoid. This strokes the command valve and *initiates* a shift “transition”. The other three valve control the release rate of the B1 brake and the apply rate of the K1 clutch. Once the transition is complete, the 1-2/4-5 shift solenoid is turned off. To make a 2-1 down shift the computer again turns on the 1-2/4-5 shift solenoid to initiate a transition. In this case, since the transmission is in second gear the transmission transitions back to first gear.

For a shift from second to third the 2-3 shift solenoid is energized to initiate the transition. And just like to 1-2 shift, once the transition is complete the solenoid is turned off. For a 3-2 downshift, the 2-3 shift solenoid goes through this cycle again. Each shift works in this fashion.

During each transition apply pressure is controlled by the shifting pressure control solenoid. The release rate is controlled, in part, by the modulating pressure regulator solenoid. These two solenoids work together to control the overlap for each shift transition.

722.6/NAG I

Solenoid Application Chart						
Gear	1-2 /4-5 Shift Solenoid	2-3 Shift Solenoid	3-4 Shift Solenoid	Modulating Pressure Control Solenoid	Shift Pressure Control Solenoid	TCC Pressure Control Solenoid
Park			Modulate	Regulate	Regulate	
P-to-R			Modulate	Modulate	Modulate	
Reverse				Regulate	On	
R-to-N			Modulate	Regulate	Modulate	
Neutral			Modulate	Regulate	Regulate	
N-to-D (1 st)			Modulate	Regulate	Modulate	
1 st				Modulate	On	
1 st to 2 nd	Modulate			Modulate	Modulate	
2 nd				Modulate	On	
2 nd to 3 rd		Modulate		Modulate	Modulate	
3 rd				Modulate	On	Modulate
3 rd to 4 th			Modulate	Modulate	Modulate	Modulate
4 th				Modulate	On	Modulate
4 th to 5 th	Modulate			Modulate	Modulate	Modulate
5 th				Modulate	On	Modulate
5 th to 4 th	Modulate			Modulate	Modulate	
4 th				Modulate	On	
4 th to 3 rd			Modulate	Modulate	Modulate	
3 rd				Modulate	On	
3 rd to 2 nd		Modulate		Modulate	Modulate	
2 nd				Modulate	On	
2 nd to 1 st	Modulate			Modulate	Modulate	
1 st				Modulate	On	
1 st to N			Modulate	Regulate	Regulate	
Neutral			Modulate	Regulate	Regulate	
N to R			Modulate	Regulate	Modulate	
Reverse				Modulate	On	
R to P			Modulate	Regulate	Regulate	
Park			Modulate	Regulate	Regulate	
The shift solenoids are off electrically when the transmission is in any gear. The shift solenoid is on for 1.5 seconds when shifting. ON =Regulated line pressure Regulate = Constant Pressure Modulate = Pulse Width Modulated (PWM)						

722.6/NAG I

Torque Converter Operation

The Torque Converter Clutch (TCC) is hydraulically operated and electronically controlled. The TCC consists of a piston and friction discs that provide a mechanical link between the impeller and turbine. When pressure is applied to the rear of the TCC piston, TCC engagement is obtained. The torque converter clutch is never fully engaged. The TCC when engaged, is always slipping at a rate of somewhere between 5% and 95%. This reduces excess heat build-up, engine vibration and pulse transmission through the torque converter and improves fuel economy.

TCC operation can be activated in 3rd, 4th or 5th gear ranges, depending on transmission model, application, shift lever position, transmission temperature and other factors.

The hub of the torque converter housing drives the transmission oil pump at engine speed.

NOTE: Don't be fooled by the dis-coloration of the torque converter, a blueish tint color is normal. When the factory furnace brazes the fins in the torque converter, the color of the metal takes on the look of a failed or burnt converter. Do NOT replace the converter on its look alone without a proper test to verify a failure.



722.6/NAG I

Torque Converter Shudder

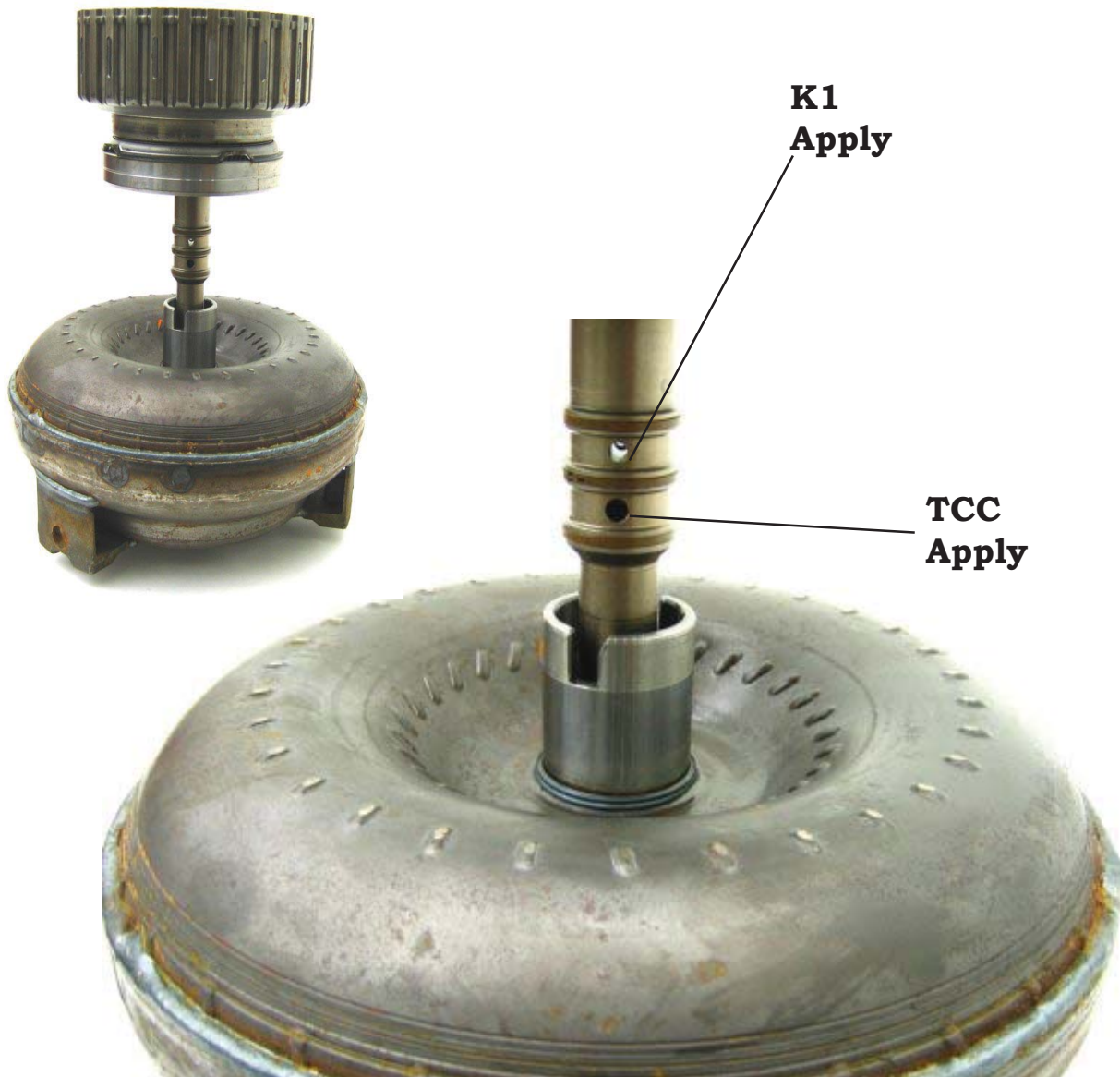
TCC shudder or Ratio codes may be caused by installing the wrong torque converter. The torque converter can have one, two or three friction clutches. It can also be equipped with or without a spring dampner. Always match the torque converter to the vehicle application. The two common areas to look for the proper application are the torque converter and the transmission ID tag on the side of the transmission.



722.6/NAG I

Air Checking the Torque Converter

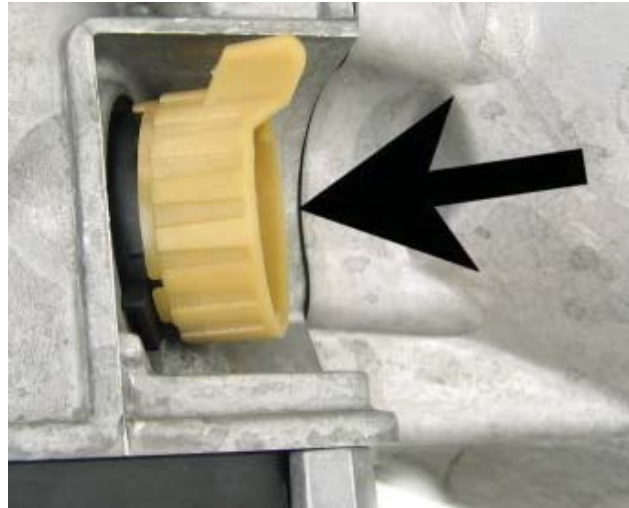
The torque converter air checks just like an internal clutch pack and drum assembly. To air check the torque converter install the K2 drum and turbine shaft into the torque converter locking the splines of the turbine shaft to the splines of the converter.



722.6/NAG I

Case Connector Removal and Installation

The wiring harness connectors have an internal worm track that splines to one another. In order to remove the wiring harness, you must turn the external connector tab counterclockwise and then pull forward on the wiring harness towards the bell housing.



**Case Connector Bolt
7mm Head**



722.6/NAG I

Updated Connector O-Rings

Early connector seals can be red or black in color. New updated seals are white in color.

O-Ring Part# A026 997 41 48

O-Ring Part# A026 997 40 48

Case connector Part# A203 540 00 53



722.6/NAG I

Transmission Fluid

Transmission fluid serves a number of purposes including application of hydraulics, lubrication, cooling, cleaning and seal conditioning. Transmission shift quality, heat dissipation and Transmission Control Module (TCM) calibration all dictate the type of transmission fluid that is used. Transmission fluids are similar but have different characteristics such as viscosity and the additives in the fluid, which is why there will be different fluids used in Crossfire, Sprinter and 300C. Drain and refill the transmission fluid at the recommended service interval of 80,000 miles. Most other models are life time fill.

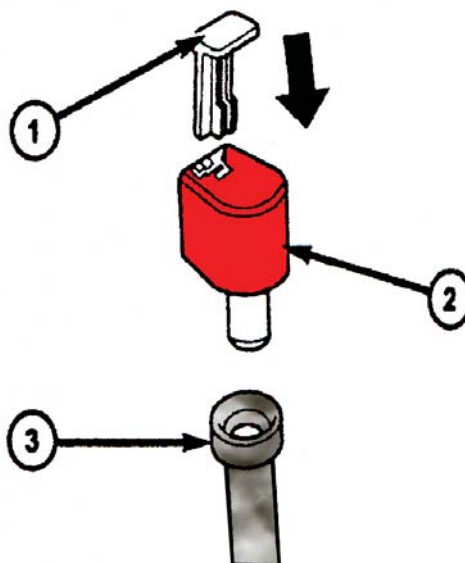
The transmission has varying capacities depending on vehicle application. Transmission fluid capacity includes the transmission, the torque converter and the transmission fluid cooler.

The fill tube in Sprinter, Crossfire, Jaguar, and Mercedes vehicles is sealed from the factory and requires a special service dipstick tool (#8863A) to check the fluid level. A special cap is used for sealing the transmission dipstick tube. When the locking pin is removed it will break off. The locking pin part number is A 140 991 00 55 when ordered from a Mercedes dealer. The 300C (LX) requires a special service dipstick tool (9336). Grand Cherokee (WJ) comes equipped with a dipstick.

Dipstick tools are available from miller tools for Chrysler vehicles.

Dipsticks are also available from Mercedes under part number 140 589 15 21 00

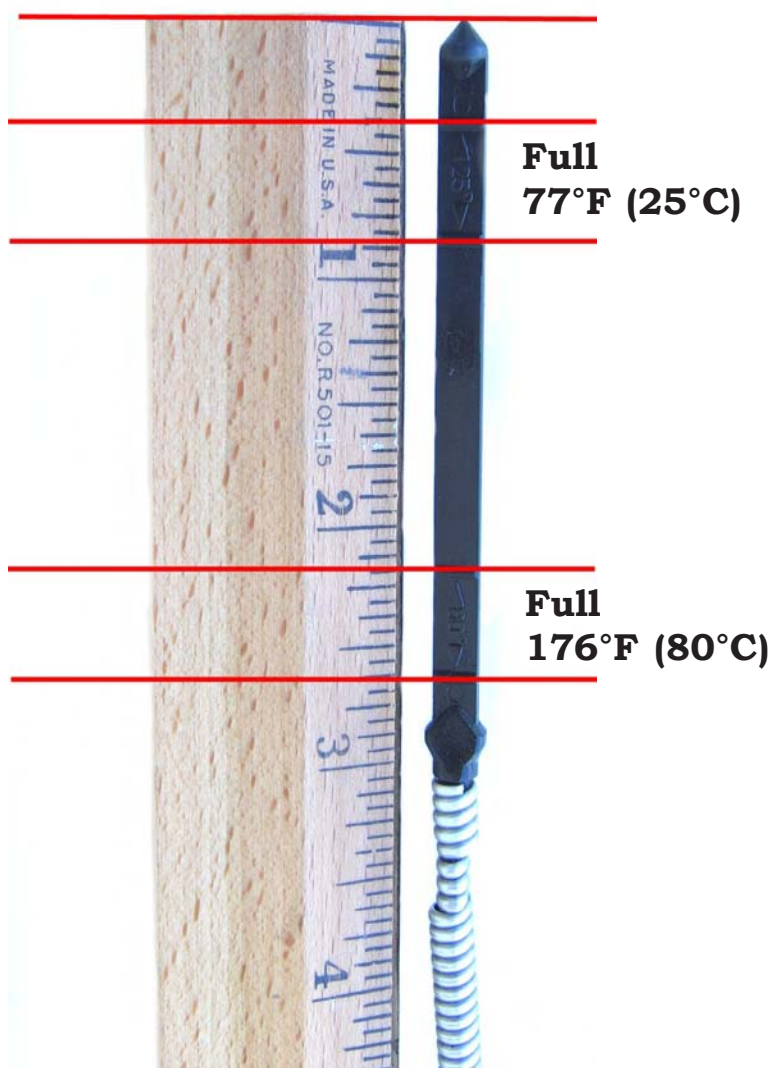
1. Locking Pin
2. Fill Tube Cap
3. Fill Tube



722.6/NAG I

Transmission Fluid

When checking the fluid level, always check it in the Park position.



722.6/NAG I

Transmission Fluid

**For ALL Mercedes and
Chrysler Sprinter and
Crossfire applications**



**Part#
A 001 989 07 03
Meets Spec 236.10**

**For ALL Jeep and other
Crysler applications
(EXCEPT Sprinter and
Crossfire)**

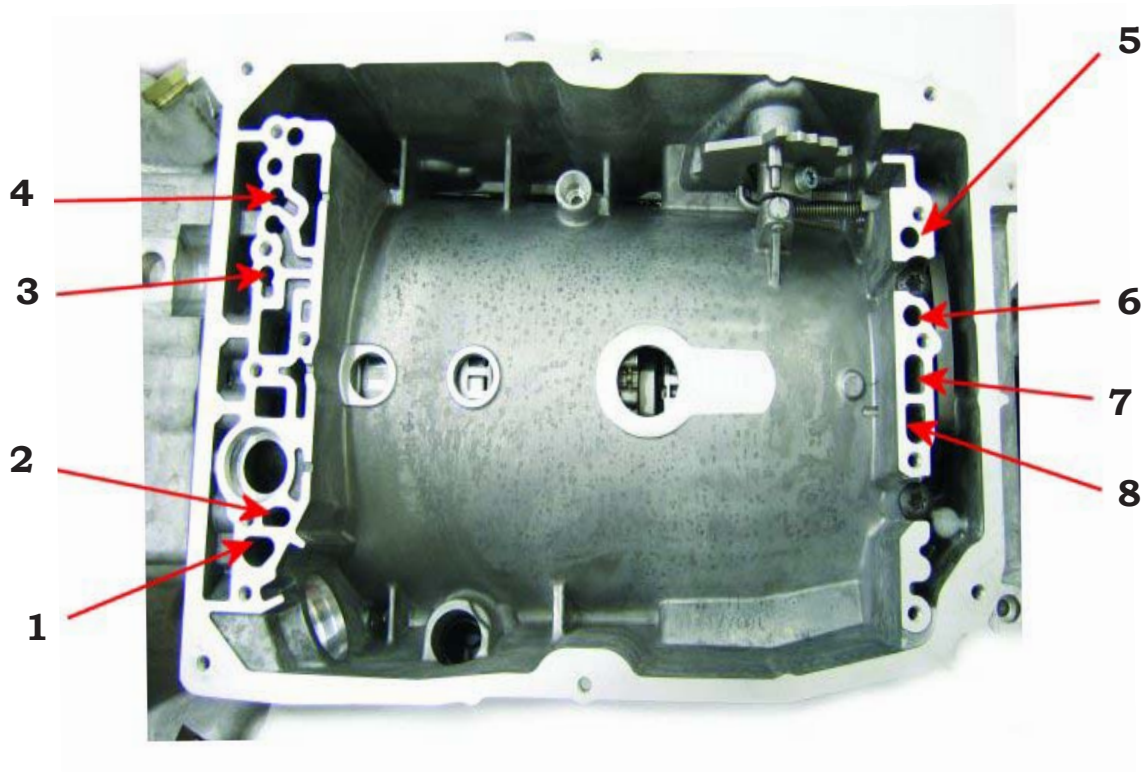


**Chrysler Part#
05013457AA
(Type 9602)**

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Air Checking the Case

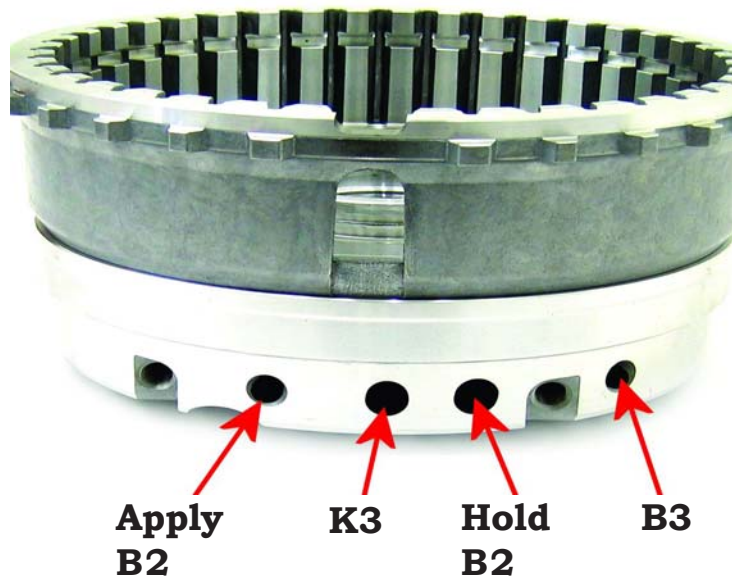
When applying air to the clutch packs, use a maximum of 30 psi.



1. K1 Clutch Apply Port
2. B1 Brake Apply Port
3. K2 Clutch Apply Port
4. Torque Converter Clutch Apply Port
5. B3 Clutch Apply Port
6. B2 Brake Counter-Pressure Port (Do Not Air Test This Port)
7. K3 Clutch Apply Port
8. B2 Brake Apply Port

722.6/NAG I

Air Testing the B2, B3, and C-Drum



Before disassembly, use a punch to make alignment dots on both components as shown. This will allow you to realign the components during reassembly.

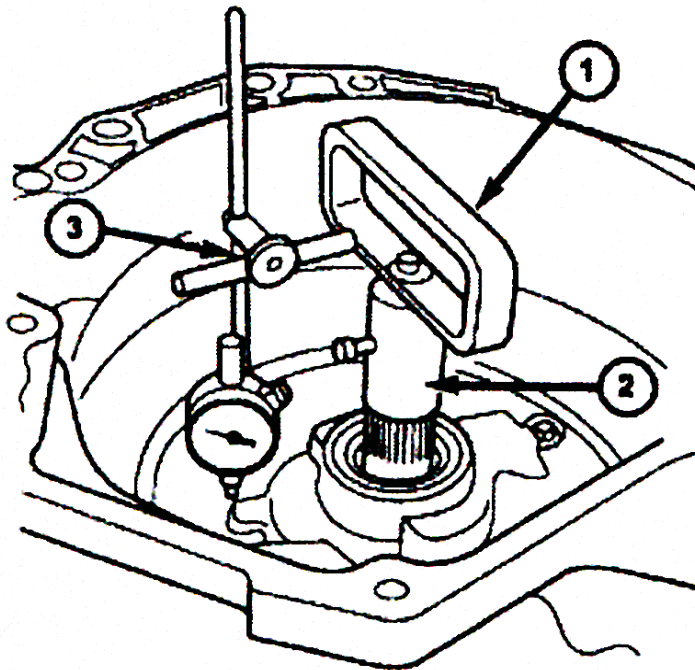


722.6/NAG I

Geartrain End-Play

Geartrain end play is a very critical pre-disassembly check to help determine the condition of the transmission. End play readings greater than specification (larger gap) indicate that a bearing or thrust plate is either missing, worn or has disintegrated, in which case there will be debris in the oil pan. End play readings that are below specification (smaller gap) indicate that a bearing is out of position or that the transmission might have been previously set-up incorrectly.

Support the transmission in a vertical position, **DO NOT rest the transmission on the output shaft.** Attach the tools as shown to measure end play. The gear train end play is measured differently when the transmission is being reassembled. Measure the end play between the park pawl gear and the end of the housing and between the rear of the bearing contact surface and the end of the housing. The difference between the two measurements is the gear train end play. Select the appropriate shim so that the end play is between 0.3-0.5 mm (0.012-0.020 in.).



722.6/NAG I

Oil Pump Assembly

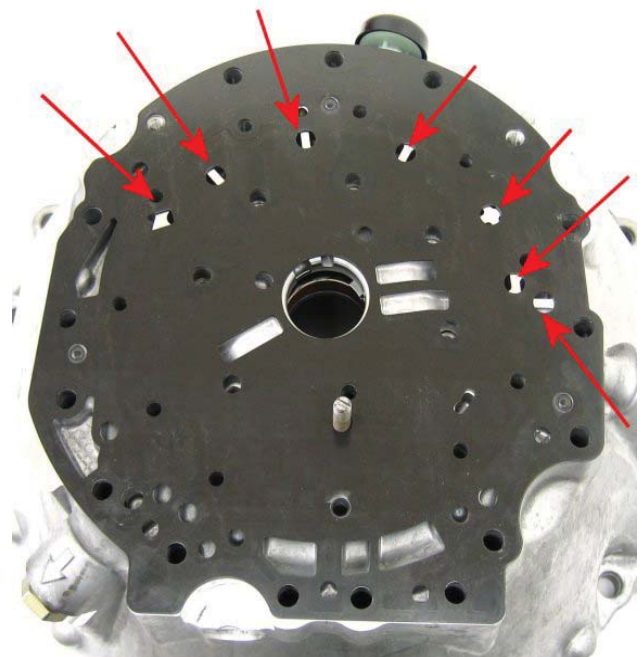
The oil pump assembly supplies fluid under pressure to the transmission hydraulic circuits and to the torque converter. The version of the gear pump used in the transmission is called a crescent gear pump. The crescent gear pump consists of an externally toothed gear that meshes with an internally toothed gear inside the pump housing. The inner gear, driven by the engine through lugs on the rear of the torque converter, drives the outer gear. A crescent-shaped piece extends into the pumping chamber and lies between the two gears. The crescent separates the inlet and outlet ports. As the gears rotate, the clearance increases at the inlet port, creating the low pressure that allows atmospheric pressure to push in the fluid. The gear teeth carry the fluid to the outlet port to discharge the fluid under pressure.

The oil pump is mounted in the transmission converter housing. The oil pump can only be serviced by disassembling the transmission. The bolts securing the oil pump in the housing are inside the transmission through the B1 brake assembly.

Dowel Pin Location



It is normal for the holes not to line-up



722.6/NAG I

Oil Pump Assembly (continued)

Inspection

Before measuring any oil pump components, perform a thorough visual inspection of all the components. If any sign of scoring, scratches, or other damage is seen, replace the oilpump as an assembly.

Side Clearance

Side clearance is the difference between the thickness of the pump gears and the depth of the pocket in the pump housing. Side clearance can be measured by laying a flat plate across the mounting surface of the pump housing, and measuring the distance between the plate and the gears.

Chanffer always goes down into the pump body



722.6/NAG I

Oil Pump Assembly (continued)

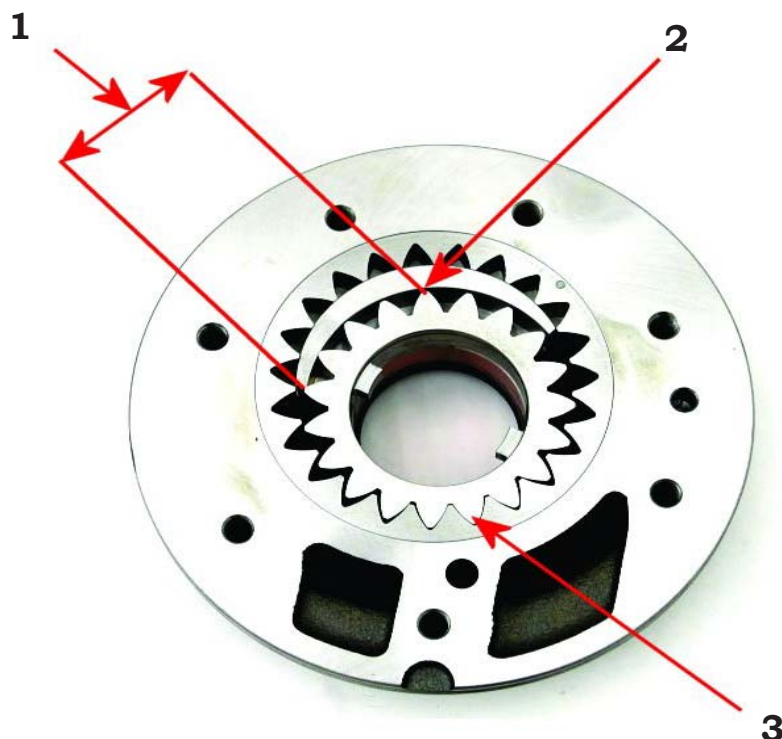
Measure the pump gears.

Tip Clearance

Tip clearance is the difference between the tip diameters of the gear teeth and the corresponding diameters of the pocket in the pump housing.

Tip clearance for the inner gear can be checked by moving the inner gear into tight mesh (2) (Oil Pump Measurement) with the outer gear as shown. Clearance between the ID of the crescent feature of the housing and the OD of the teeth of the inner gear (3) should then be measured at a point 37 mm from the corner of the crescent (1) feature as shown.

1. **Measure 37mm (1.4578") from the corner of the crescent.**
2. **Tight mesh here.**
3. **Measure Tip clearance here.**



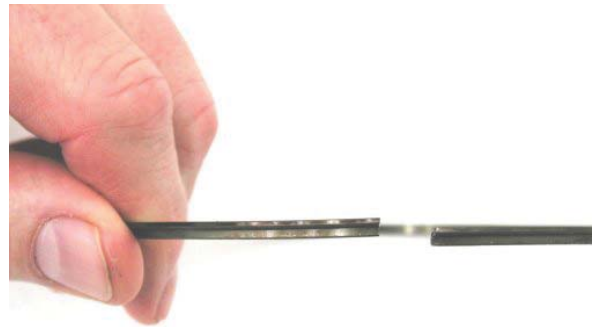
Acceptable tip clearance for the inner gear is 0.85mm (0.033") max

Acceptable side clearance for the inner gear is 0.064mm (0.0025") max. Outer gear 0.069mm (0.0027") max.

722.6/NAG I

B1 Brake Clutch

The B1 brake clutch assembly is secured to the torque converter housing from the outside with 11 bolts. The oil pump assembly is retained from the inside through the B1 brake. Remove the oil pump bolts to remove both the oil pump and the B1 brake assembly. With the B1 brake assembly removed, the separator plate can be lifted from the torque converter housing. Special tools are used to disassemble the B1 brake. With the B1 brake selective snap ring, disc pack and spring removed, a multiple use spring compressor (8900) available from Miller tools, is used to remove the B1 piston snap ring. Remove the spring and the, blow the piston out using 20 psi air pressure at the port (A) shown.

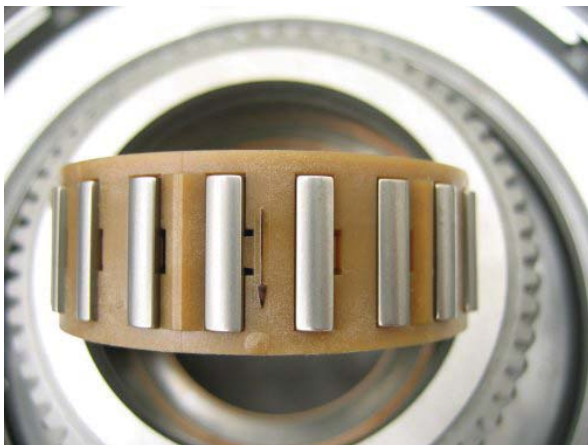


722.6/NAG I

F1 Sprag Installation

When installing the F1 sprag, use the arrow to determine the direction of the installation. the arrow always goes towards the front of the transmission. When replacing the sprag assembly, always update it to the twenty (20) element sprag assembly.

**NOTE: Disregard all information stamped on the brass end-caps.
Mercedes Sprag Part# A 220 270 01 31**



**Always install the sprag
with the ARROW pointing
towards the front of the
transmission**

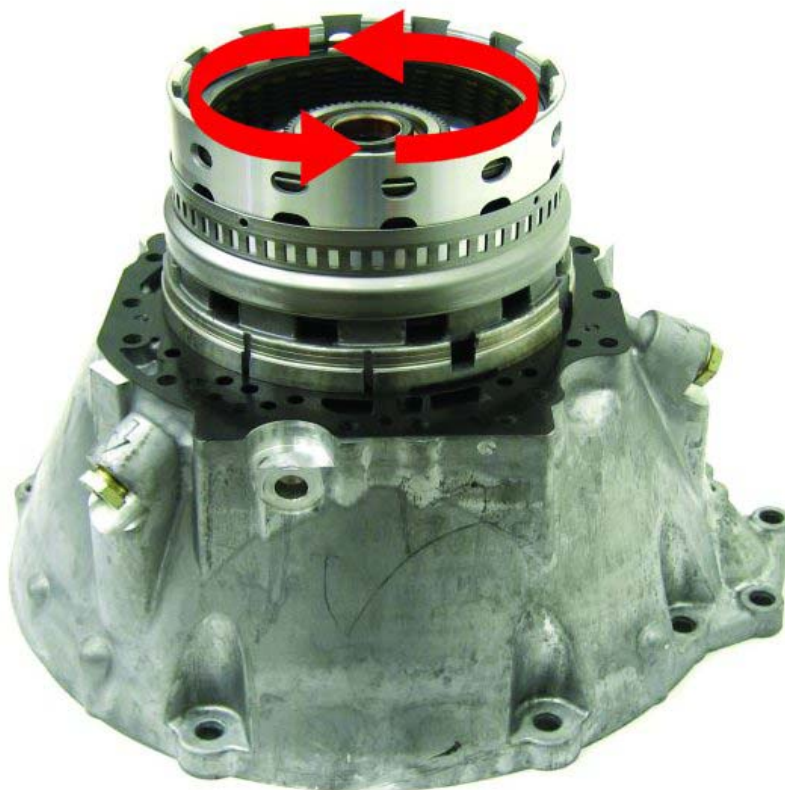


722.6/NAG I

Fl Sprag Rotation

Install the K1 Drum assembly onto the stator support, rotate the drum

Freewheels counter clockwise



722.6/NAG I

Output Shaft Planetary Failure

Rear Planet Assembly

Planetary failure may be caused by installing the wrong planetary assembly. There are two types of planetary assemblies: Three pinion and Four pinion.

The design of the planetary gears have been changed to have less thrust loads on the needle bearings. There are two designs currently available, however there are many different ratios. Never install a three pinion planet in place of a four pinion planet. Make sure you order the correct part using the vehicle VIN number.

Nose Diameter:

1st Design: 0.906 in

2nd Design: 0.865 in

Inspect the bearing race area for damage. (pitting)



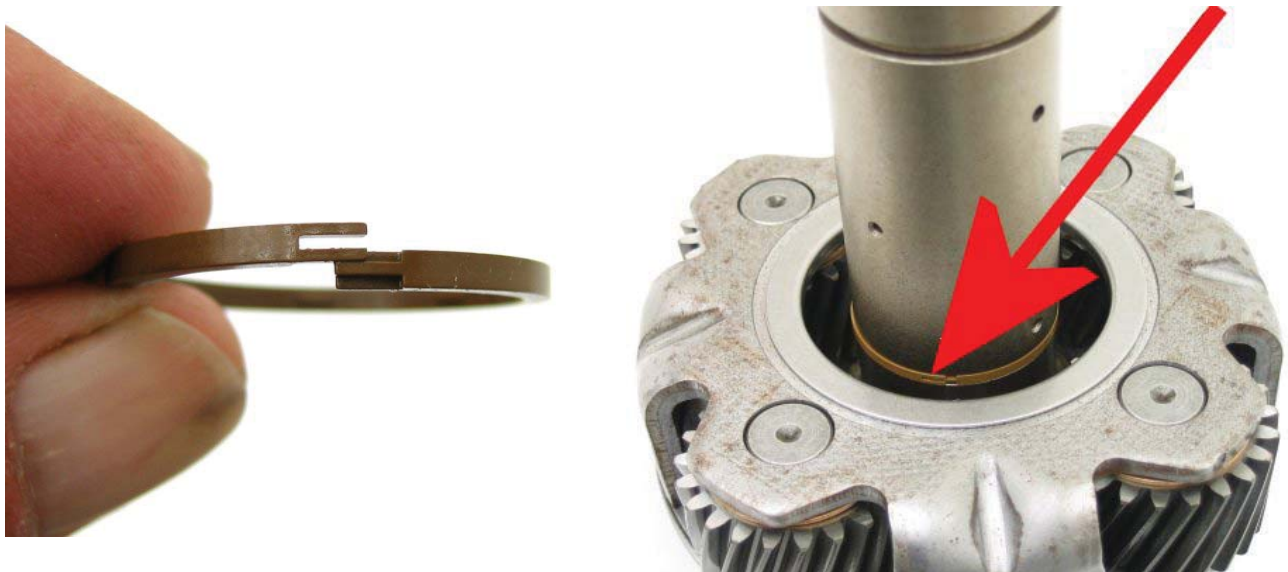
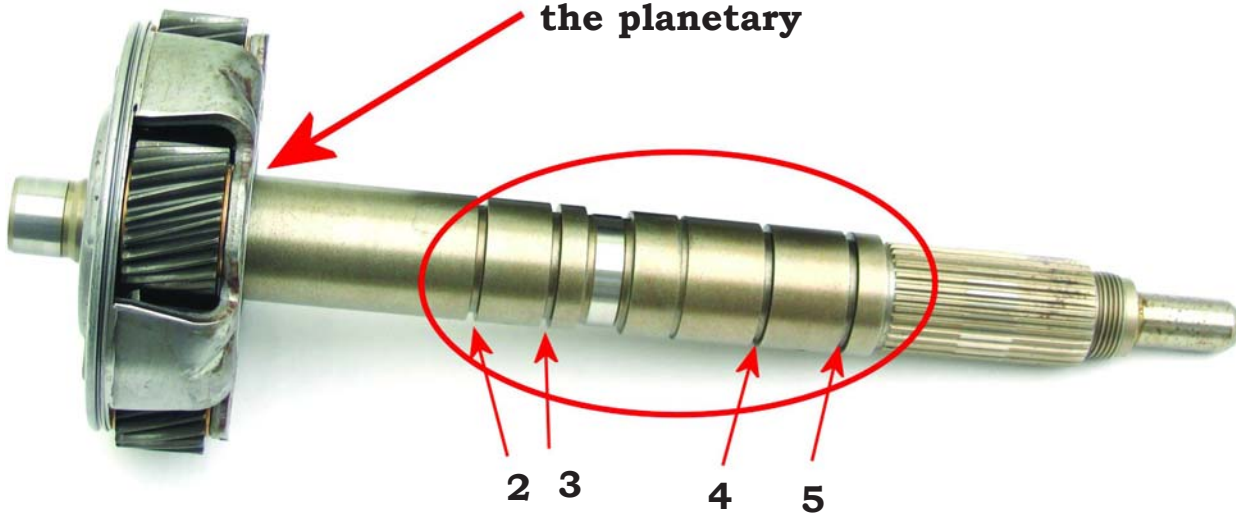
NOTE: If planetary damage is visible you MUST replace the Output planetary, Sun gear and Ring gear as an assembly.

722.6/NAG I

Output Shaft Sealing Rings

Some manuals say there are six sealing rings on the output shaft. There are only five. There are two types of sealing rings, the first design is gray teflon™ scarf-cut sealing rings. The second design seals are yellow interlocking plastic type rings.

NOTE: The #1 ring is behind the planetary



722.6/NAG I

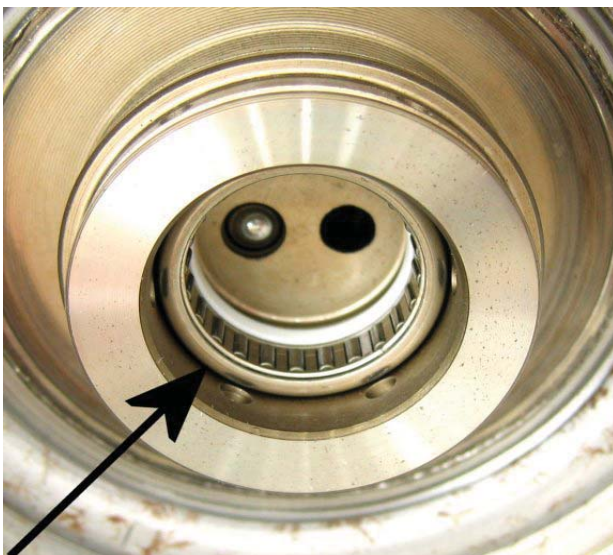
K2 Drum Assembly

Input to Output Shaft Bushing/Bearing

Mercedes requires you to replace the K2 drum assembly when the bushing/bearing is damaged. An aftermarket bushing/bearing assembly is available.



NOTE: Always install the needle race on the K2 drum assembly



722.6/NAG I

F2 Sprag Assembly

Always replace the early 14 element sprag assembly with the new updated 20 element sprag assembly.

Mercedes Sprag part # A 220 270 01 31



The Early Model has 14 elements with the bronze bushing support.

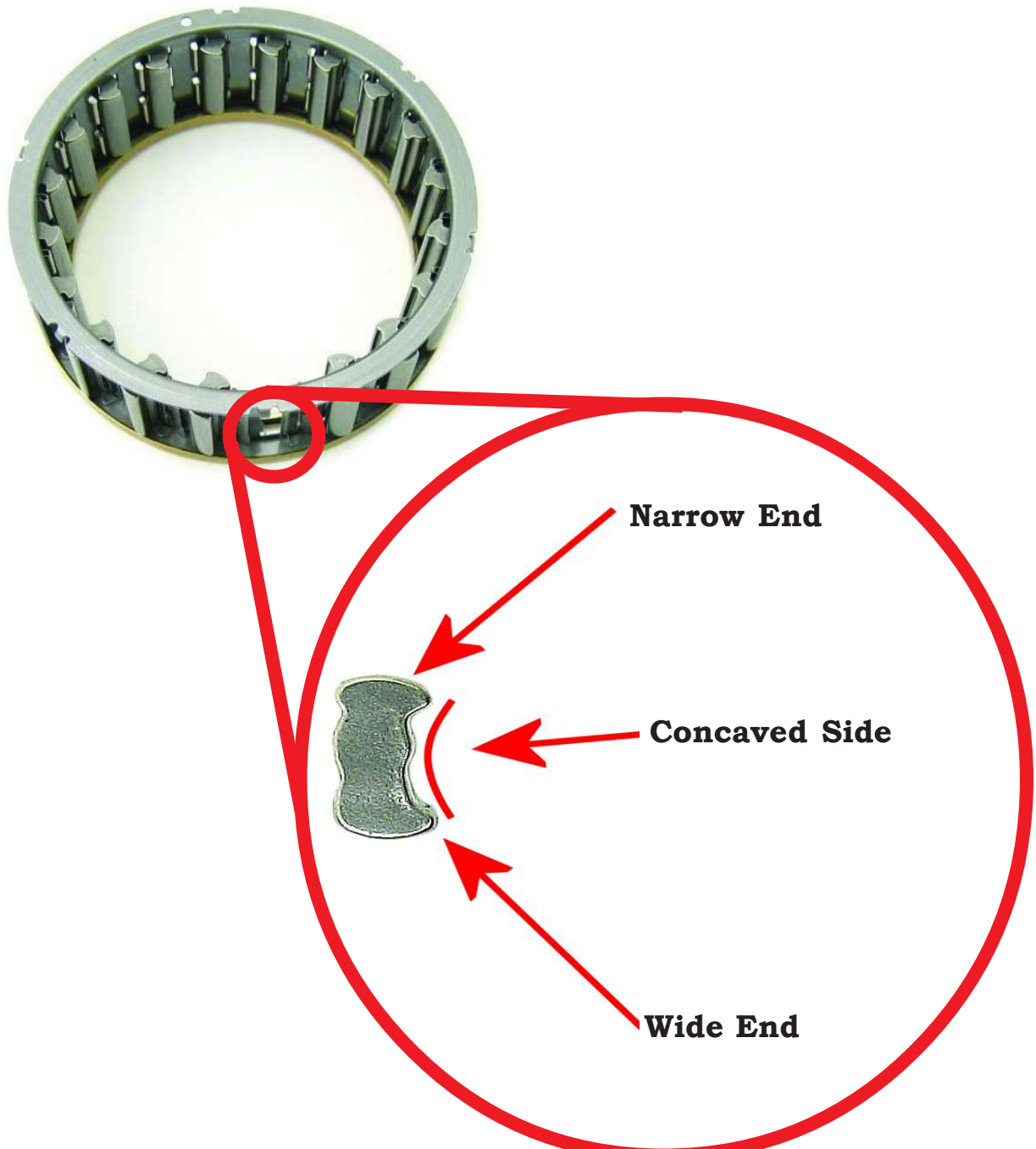


The Late model has a 20 elements with ball bearing support.

722.6/NAG I

F2 Sprag Assembly (continued)

There are four ways the element can go into the cage, only one way is correct. With the brass cap end facing down against the work bench, install elements as shown.



722.6/NAG I

F2 Sprag Rotation



722.6/NAG I

B2 Brake Disassembly and Reassembly

The B3 brake is located in front of the B2 brake at the rear of the case. The B3 brake disc is comprised of five (5) double-sided friction discs and five (5) steel discs.



Mark the drums with an alignment dot to ensure proper alignment during assembly.

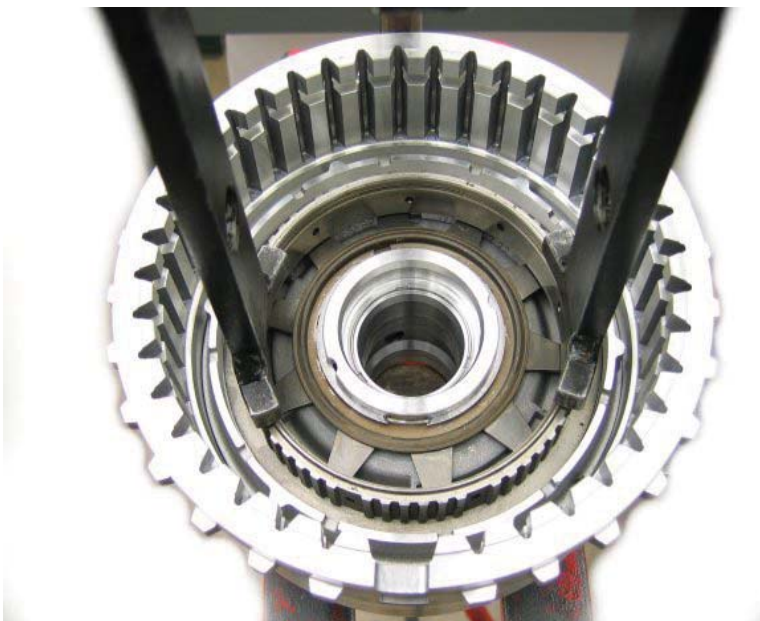


722.6/NAG I

B2 Brake Disassembly and Reassembly (continued)

To compress the Belleville return spring use a Ford AX4S Sprag race. Install the Race against the Belleville spring as shown.

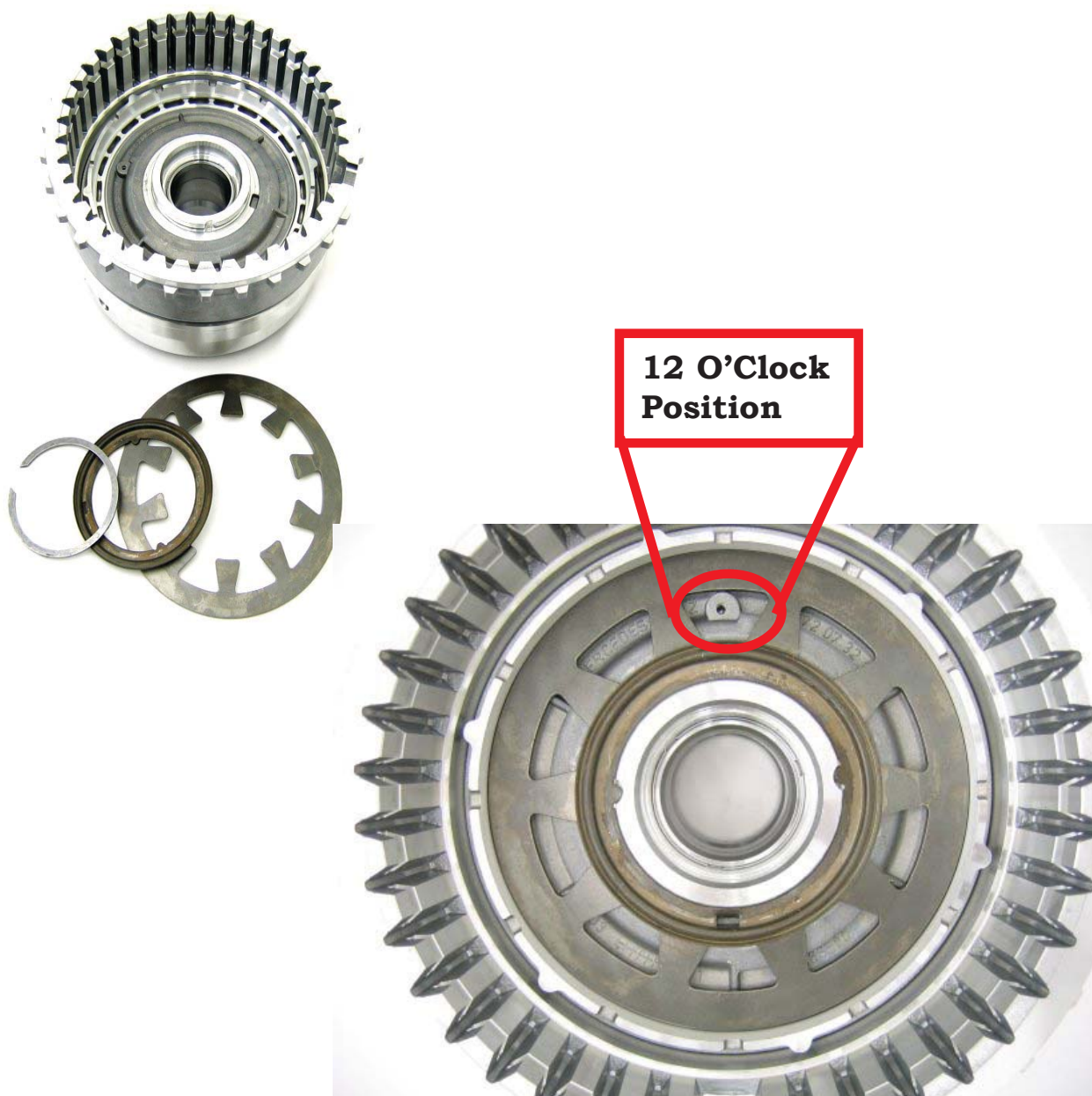
**Ford AX4S
Sprag Race**



722.6/NAG I

Binds During the Shift

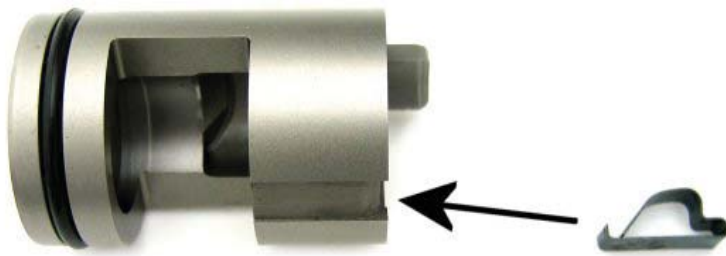
When assembling the Belleville spring, make sure it does not cover the air bleed check ball.



722.6/NAG I

Park Linkage Retainer

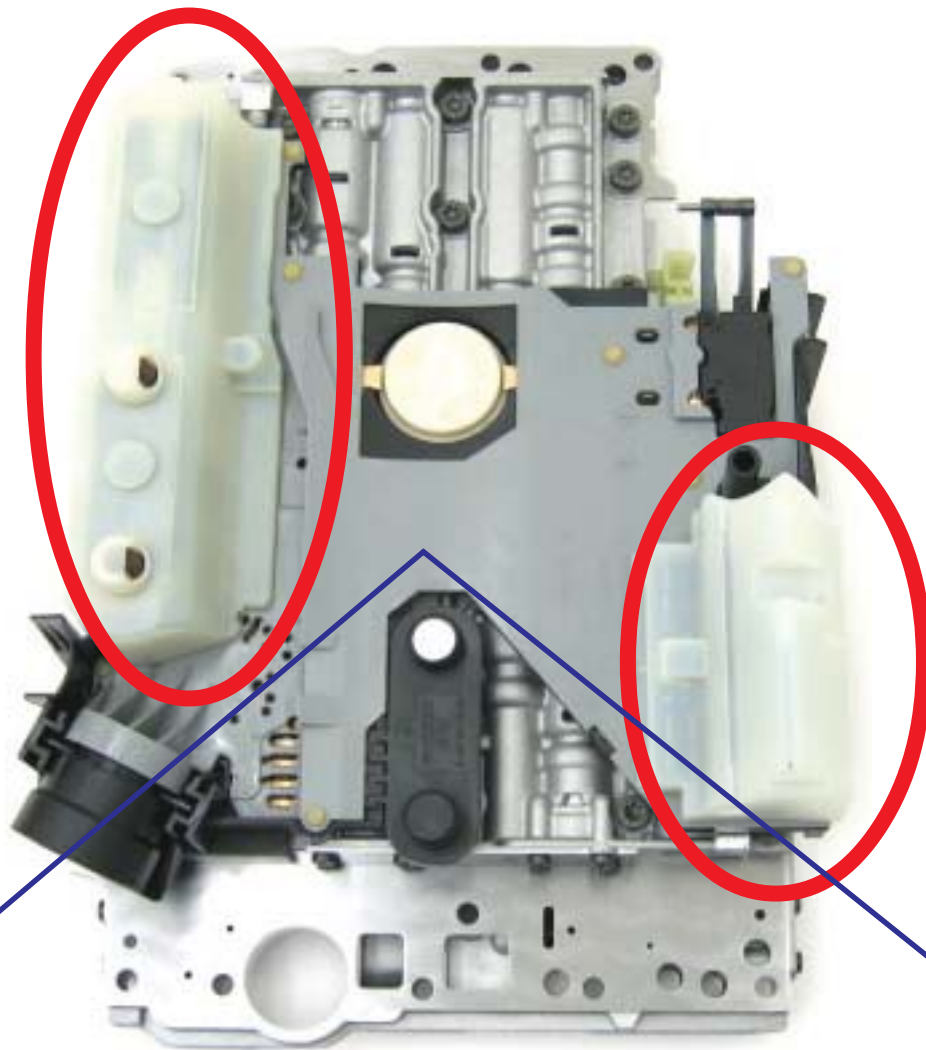
The park linkage guide has a clip installed in it. If the clip is missing and you install the retainer you may not be able to remove the linkage out of the park position



722.6/NAG I

Valve Body

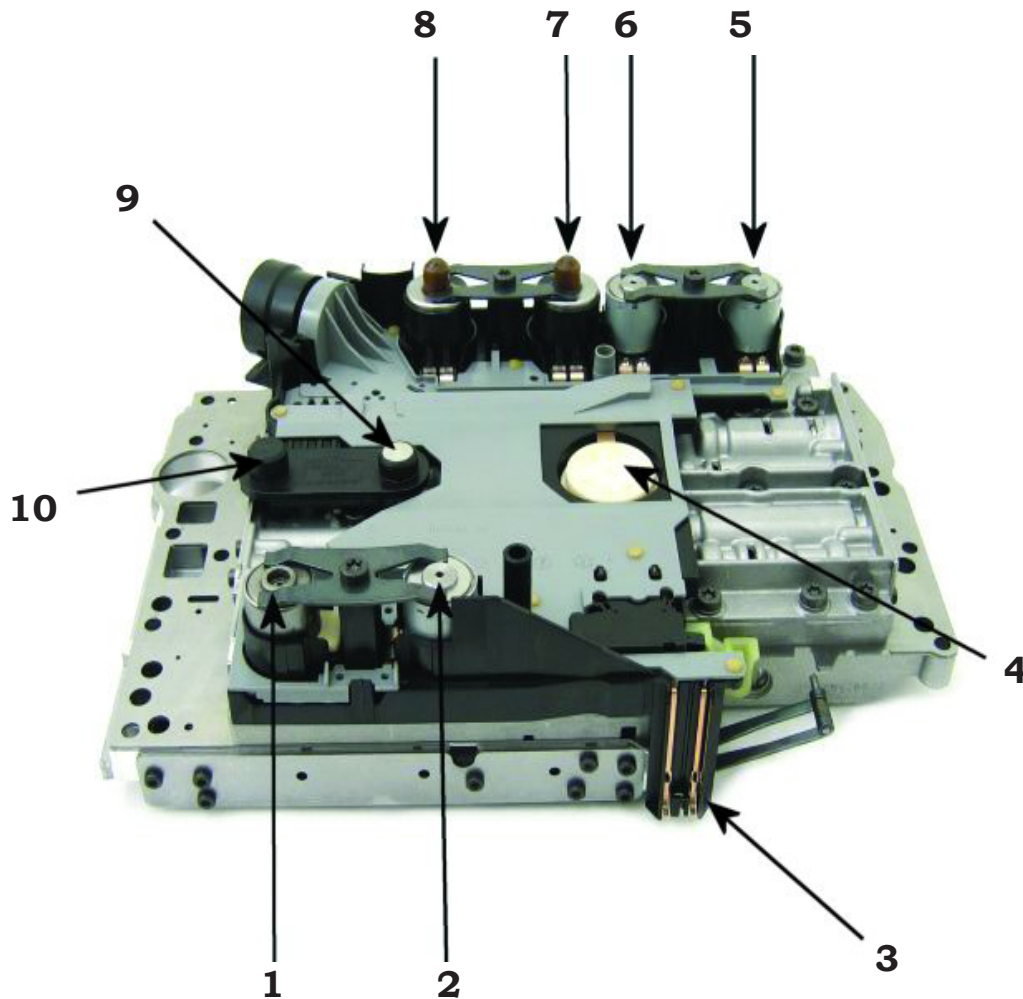
Make sure during reassembly that you have the Solenoid covers installed. Failure to install the covers may cause Solenoid codes. The covers protect the solenoids from short circuiting from metal particles



Always replace the Circuit board on models built before 2003

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Solenoid Valves



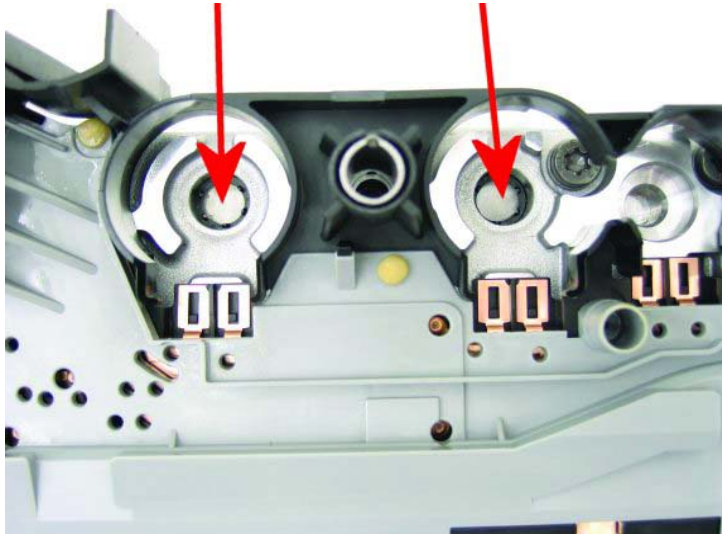
ID	Description	Ohms
1	TCC Solenoid	2.5
2	2-3 Shift Solenoid	4
3	P-N Start ATF Temp	
4	Float	
5	3-4 Shift Solenoid	4

ID	Description	Ohms
6	1-2/4-5 Shift Solenoid	4
7	Shift Pressure Regulating Solenoid	5
8	Modulating Pressure Solenoid	5
9	N2 Speed Sensor	
10	N3 Speed Sensor	

722.6/NAG I

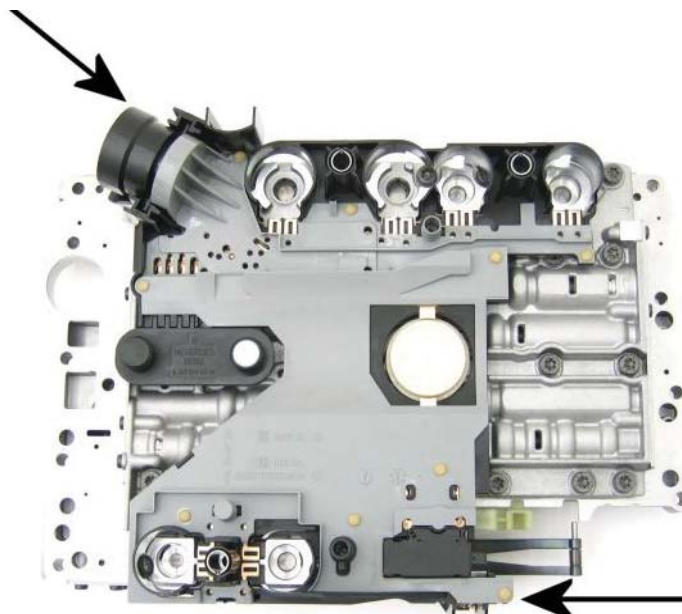
Valve Body Screen and Latch Point

Screens



During reassembly, check balls should only be retained using Vaseline or Trans-Gel. DO NOT use inappropriate greases (such as wheel bearing or white lithium grease).

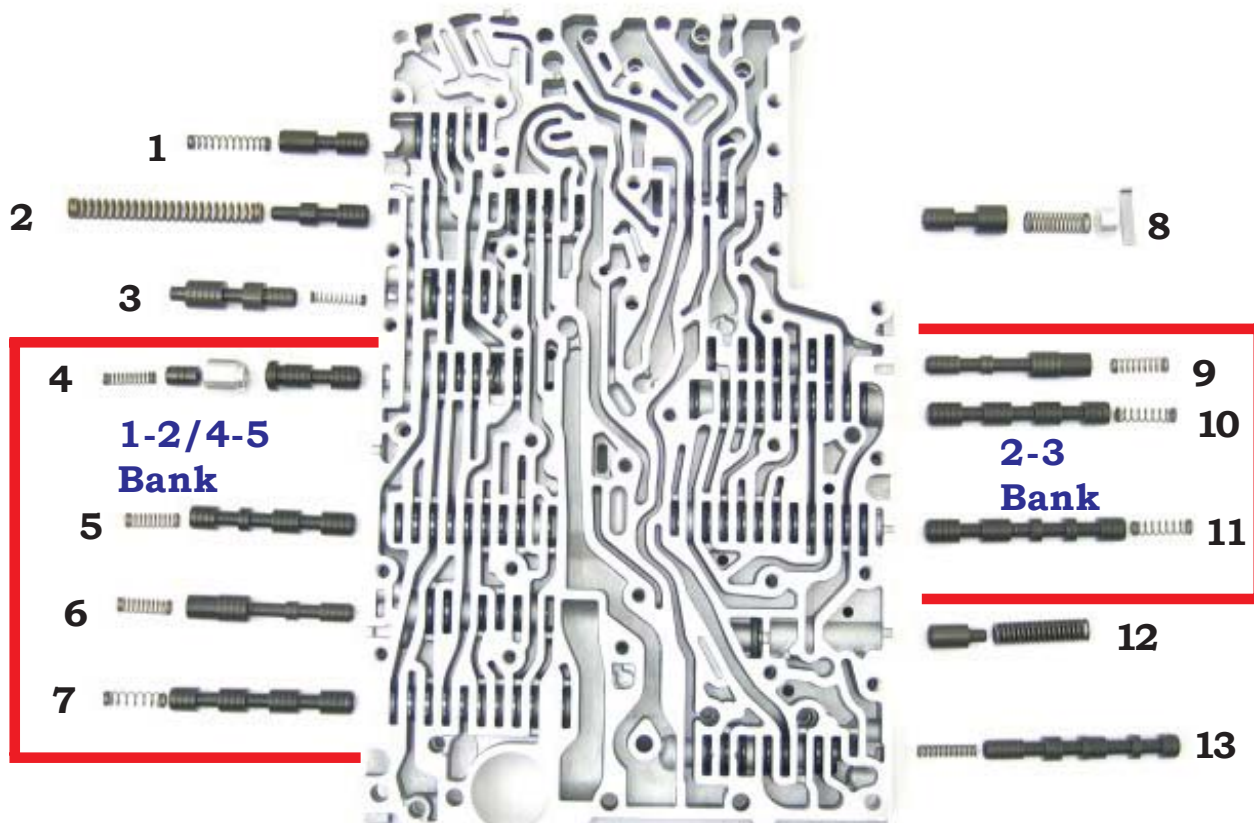
**Latch
Point**



**Latch
Point**

722.6/NAG I

Valve Identification



ID	Lower Valve Body Identification
1	Shift Valve Pressure Regulating Valve
2	Pressure Regulating Valve
3	Shift Pressure Regulating Valve
4	1-2/4-5 Overlap Regulating Valve, Sleeve and Piston
5	1-2/4-5 Shift Pressure Shift Valve
6	1-2/4-5 Holding Pressure Shift valve
7	1-2/4-5 Command Valve
8	B2 Shift Valve
9	2-3 Holding Pressure Shift Valve
10	2-3 Command Valve
11	2-3 Shift Pressure Shift Valve
12	TCC Damper Valve
13	TCC Lock-up Regulating Valve

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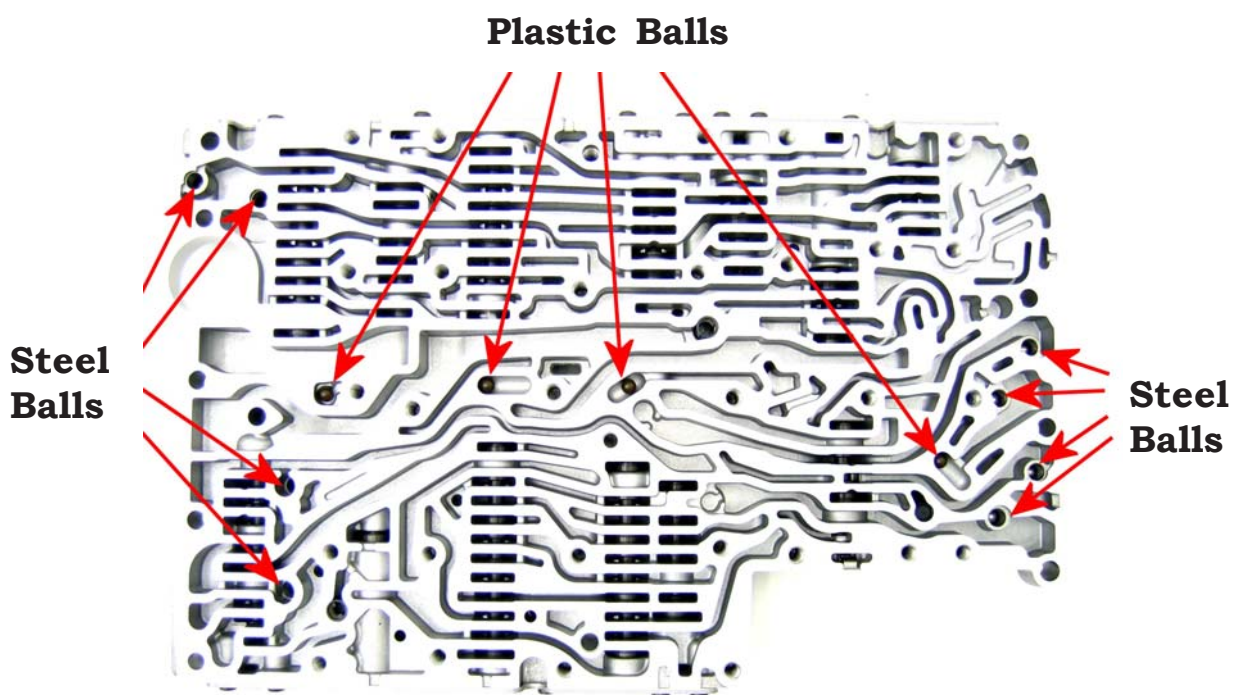
Valve Identification



ID	Upper Valve Body
1	Operating Pressure Regulating Valve
2	Lubricating Pressure Regulating Valve
3	2-3 Overlap Regulating Valve, Sleeve and Piston
4	3-4 Overlap Regulating Valve, Sleeve and Piston
5	3-4 Shift Pressure Shift Valve
6	3-4 Command valve
7	3-4 Holding Pressure Shift valve
8	Manual Valve

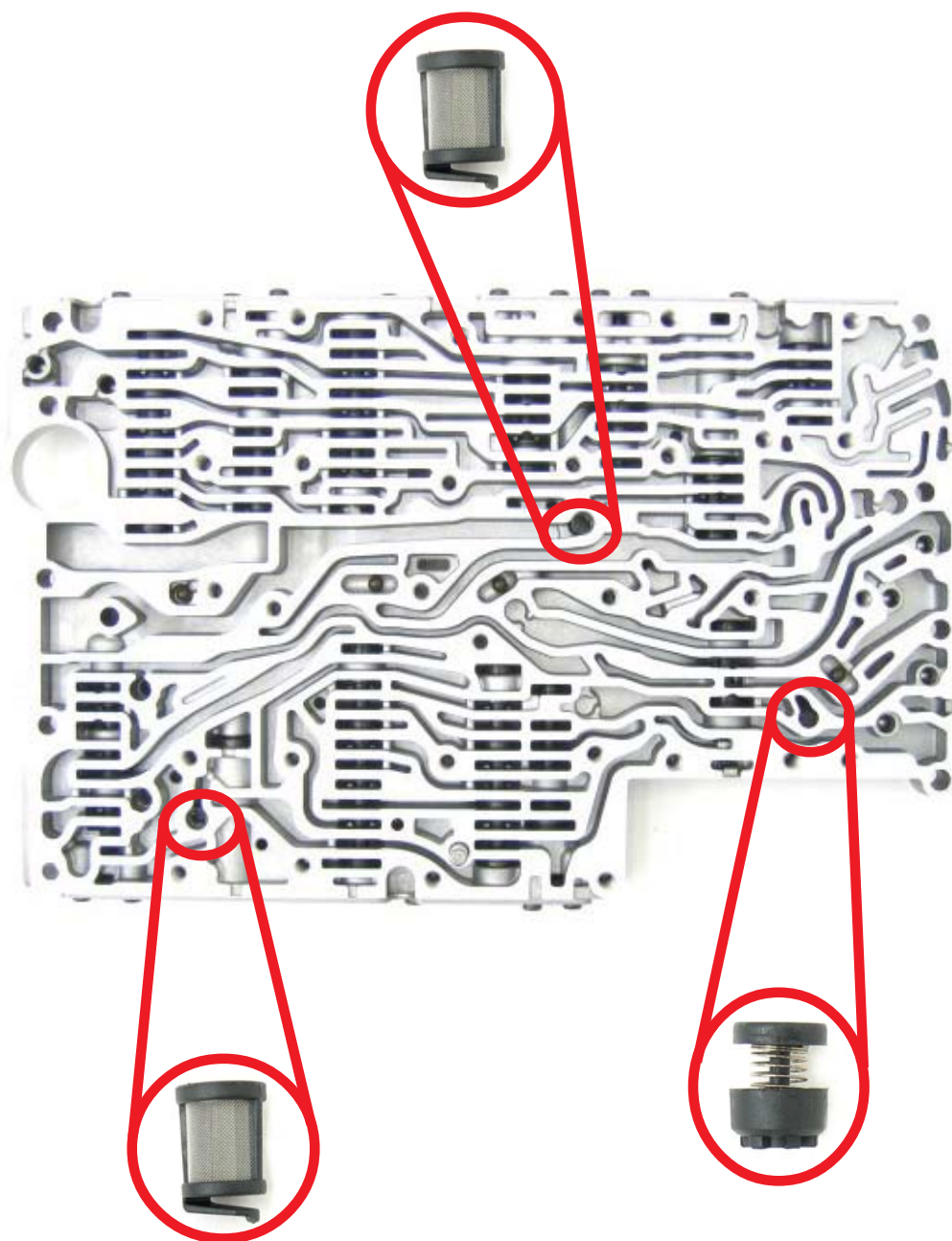
722.6/NAG I

Check Ball Locations



722.6/NAG I

Filter and Pressure Feed Locations







The
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Dennis Madden
Chief Executive Officer

Welcome to the 2007 ATRA Technical Seminar!

Lance Wiggins and the ATRA Technical staff have really worked hard to get you the most up-to-date and relevant technical information that you can put to work right away... and again, in full color!

For those of you who have attended past ATRA seminars you'll be delighted to know this seminar material is just what you expected from ATRA, or even more. If you've never attended an ATRA seminar before you're in for a treat.

This seminar, along with everything else at ATRA is a group effort, with a lot of people working in the background to make this seminar a success. I am honored to be part of such a worthy organization and to work with such great people. ATRA is changing all the time. Not only with the way we distribute technical material, but in almost every area where we serve our members, and the industry at large.

On behalf of the ATRA staff, and the ATRA Chapters that work so hard to bring you this seminar, welcome.

Sincerely,

A handwritten signature in black ink, appearing to read "Dennis Madden". The signature is fluid and cursive, with a long horizontal line extending from the end.

Dennis Madden,
ATRA, CEO



Lance Wiggins
Technical Director

The ATRA Technical Department is pleased to present its 2007 Technical Seminar. Packed with countless hours of research and development, writing, editing, photography and layout, this year's seminar will stand out as one of the most demanding and useful technical training programs ever developed for this industry.

Once again, this year's technical manual has been produced in full color. With over 250 pages of up-to-the-minute technical information, the 2007 Technical Seminar Manual will remain a valuable resource long after the seminar is just a memory.

We're confident that you'll find this year's seminar presentation and technical manual both informative and profitable. In fact, we're so sure you'll be satisfied with what you learn in this program, we guarantee it!

On behalf of the entire ATRA staff, the International Board of Directors, and all of the ATRA members worldwide, we'd like to thank you for helping to make every day memorable.

A handwritten signature in black ink that reads "Lance Wiggins". The script is fluid and cursive.

Lance Wiggins
ATRA Technical Director

ATRA Technical Team (continued)



Randall Schroeder
Senior Technician
and Seminar Speaker



Steve Garrett
Service Engineer, Technical
Advisor, and Seminar
Speaker



David Skora
Senior Technician,
Seminar Speaker



Weldon Barnett
Technical Advisor and
Seminar Speaker



Mike Brown
Technical Advisor



Mike VanDyke
Technical Advisor and
Seminar Speaker



Pete Huscher
Technical Advisor



Chris Ondersma
Technical Advisor



Bill Brayton
Technical Advisor and
Seminar Speaker

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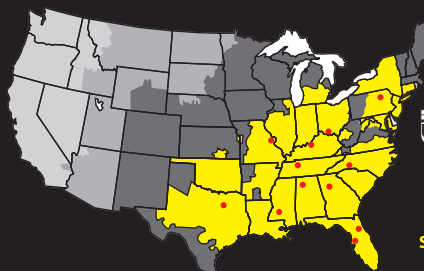
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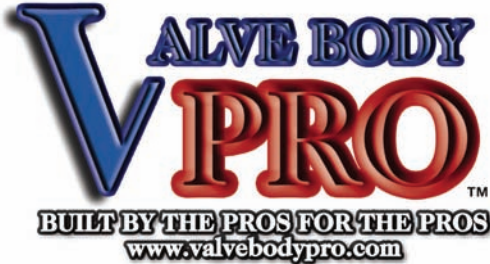
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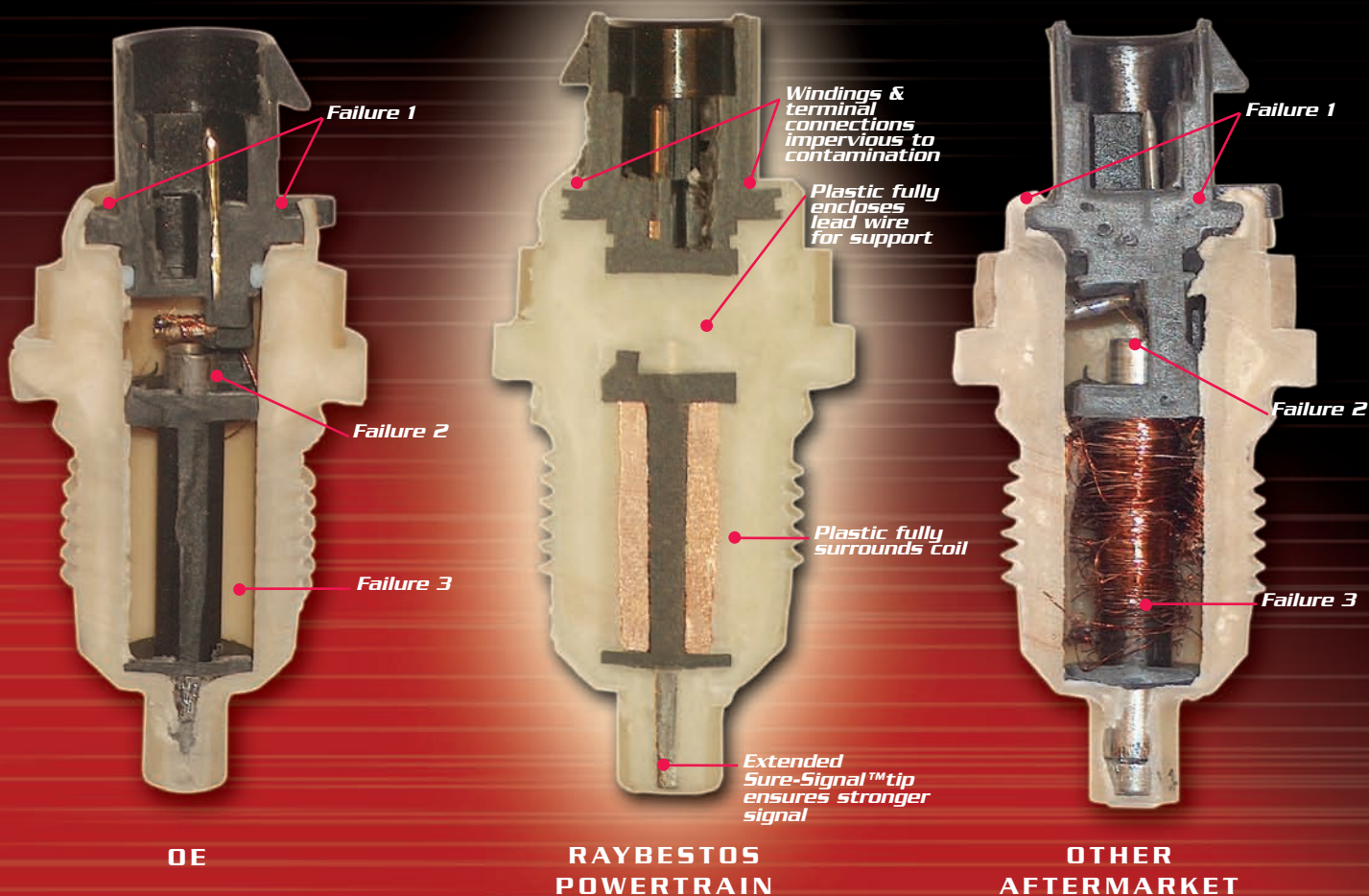
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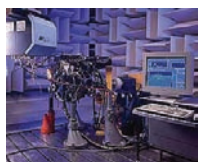
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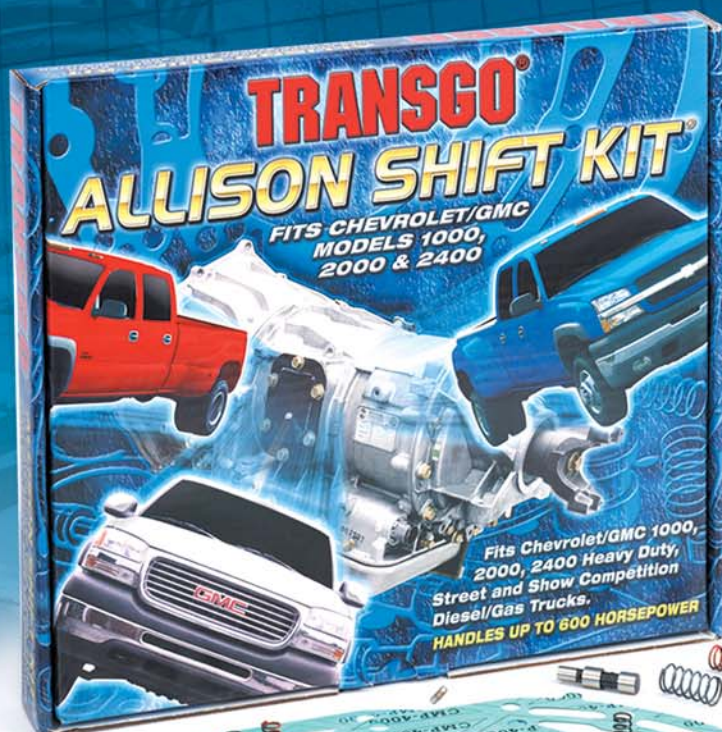


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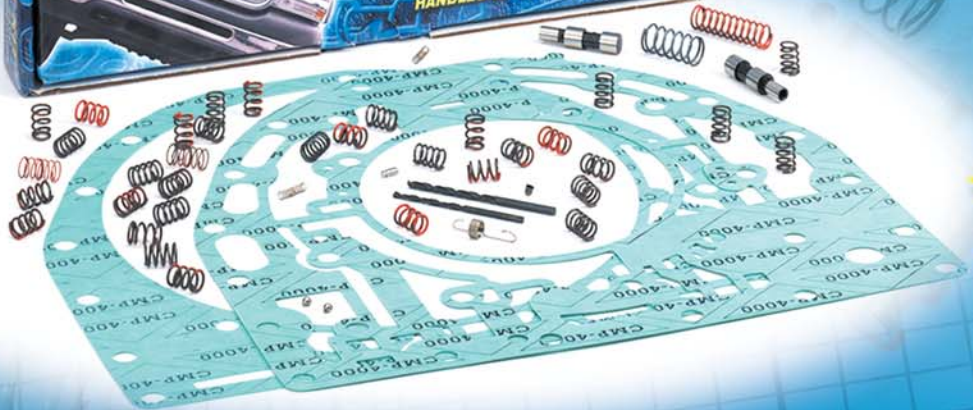
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SC-4L60E*

Full compatibility in units 1995-up with PWM/EC³ control.

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- Excessive endplay

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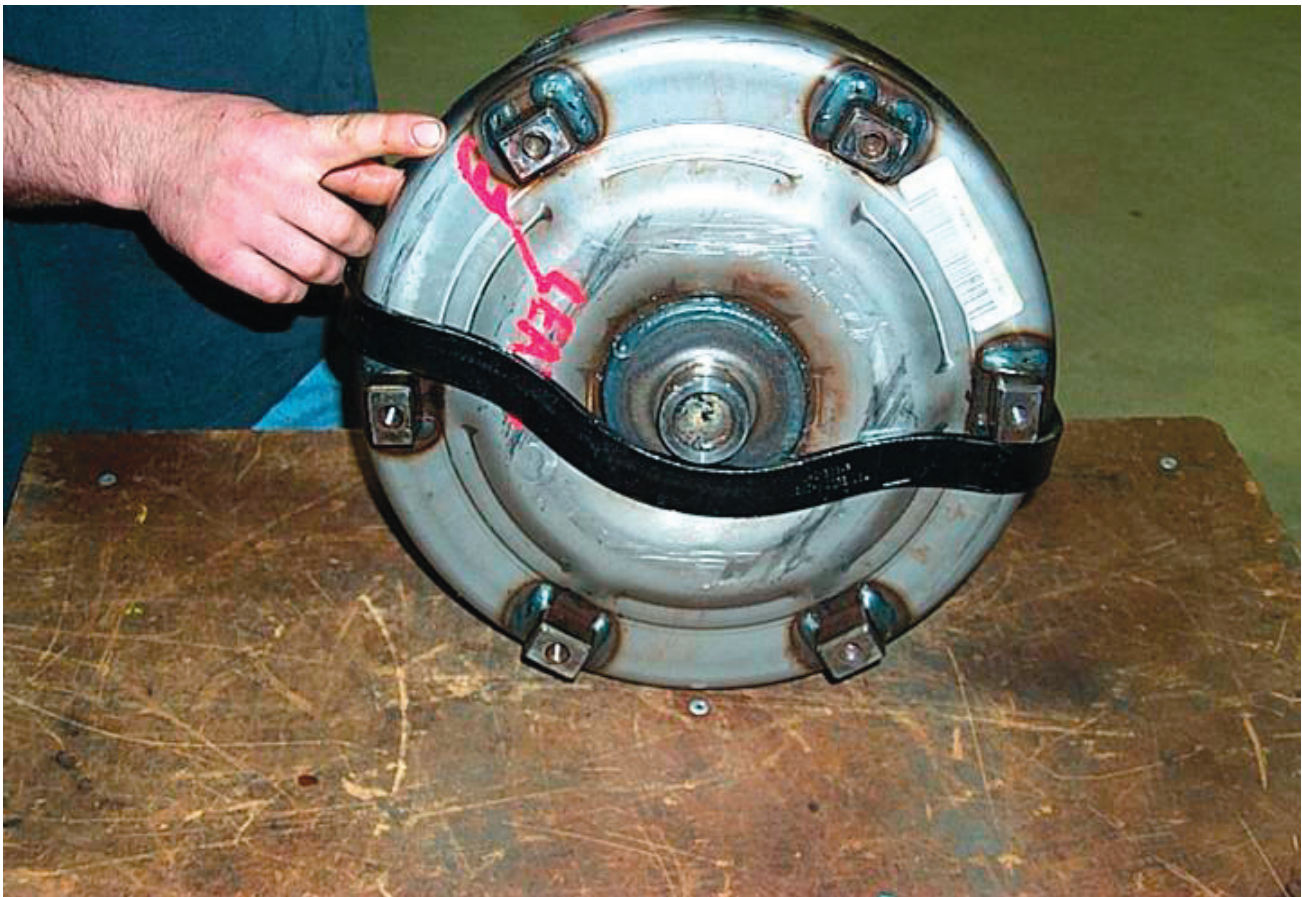
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LCT 1000

Torque Converter Leaks

Outside of the typical front seal/pump bolt and pump leakage the LCT 1000 applications have developed another area where leakage commonly occurs. The leakage can be temperature sensitive and may be difficult to locate. The converter lugs tend to crack at the welds and may start to leak. If a leak is discovered in this area the converter will require replacement. GM has a tool that allows you to pressurize the converter to inspect for leakage once the converter is on the bench, the part number is (J-21369-F)



LCT 1000

M74 Grade Braking

On Allison applications, the grade braking software program is designed to reduce wear on the vehicles braking system when decelerating. The grade braking feature will automatically downshift the transmission to provide engine braking thus reducing wear on the brakes while improving the driver's control of the vehicle. The grade braking system is not designed to reduce the need for the customer to maintain control of the vehicle during deceleration. To accomplish this task the TCM monitors several inputs including:

- * TP position and TP Delta
- * PRNDL Position (NSBU or IMS)
- * Brake Switch Status
- * Calculated grade and load (MAP/MAF/RPM)
- * Vehicle Speed and wheel speed
- * Tow/Haul Switch Position

The grade braking feature is “transparent” to the customer as the TCM determines if grade braking is required or not based on the input data received. The grade braking feature cannot be “shut off” by the customer although it can be overridden by simply stepping on the accelerator pedal.

For the grade braking feature to operate the TCM monitors the PRNDL position, engine/vehicle load, brake switch position, vehicle/wheel speed and engine RPM. For grade braking to function, the brake pedal must be depressed. Grade braking can operate while in either “tow/haul” mode or “normal” mode. If the vehicle is operating in normal mode, the vehicle will downshift from high gear to the next lowest gear range. If the vehicle is being operated in tow/haul mode the vehicle can downshift to a range as low as 2nd gear, one range at a time. The system will not skip shifts/ranges and the shift points will vary based on load and RPM inputs. The grade braking system does not require any customer action to activate the feature.

The TCM calculates the information received from its inputs. Those factors are calculated, weighted and then the sum is calculated. If the calculated sum exceeds the predetermined threshold the TCM will command a downshift and grade braking will become active, overriding the PRNDL position.

LCT 1000

M74 Grade Braking (continued)

The actual shift speeds cannot exceed predetermined engine RPM values. If the TCM determines that the engine speed would be too high if a downshift was commanded, the downshift will be inhibited. (4650 RPM L18 Gas Application, 4000 RPM LB7 Diesel Applications) Conversely, if the load and engine speed continue to increase beyond predetermined limits while decelerating, the TCM will command an upshift to occur. (5000 RPM L18 Gas Application, 4800 RPM LB7 Diesel Applications)

NOTE: The engine is designed to operate in the “Dashed Red” zone of the tachometer during grade braking. The engine should not be allowed to operate in the “Solid Red” zone at any time or engine damage may occur. The TCM software has some predetermined maximum downshift points. The shift points are determined by monitoring road speed via the vehicle speed sensor. The following represents the maximum VSS values the vehicle can be operated at before grade braking will be inhibited.

The grade braking feature may function even if the vehicle is being operated on level roads. In addition the system is able to calculate any additional loads such as when pulling a trailer.

If the vehicle is being operated on snow or ice covered roads the feature may be disabled if the EBCM determines tire slippage is occurring. The TCM receives information from the EBCM regarding the calculated slip (Wheel speed sensors and VSS) If wheel slippage is occurring the TCM will command the transmission into a higher gear.

8.1 L GAS 4.10/3.73 REAR AXLE RATIO	
SHIFT	MAX Transmission Output Speed
5-4	4624
4-3	3266
3-2	2543
2-1	1474

6.6L DURAMAX 3.73 RATIO	
SHIFT	MAX Transmission Output Speed
5-4	4017
4-3	2832
3-2	2196
2-1	1214

Mid-2006-2007 LCT 1000

Updates

Several updates were implemented into production for the Mid-2006-2007 model years. They include:

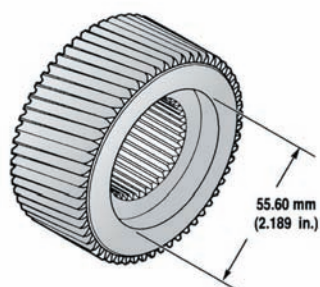
- **T 5 bearing- Improved durability**
- **P2 Carrier- Required for the T-5 bearing update**
- **P2 Sun gear- Required for the T-5 bearing update**
- **Shaft seal rings-Improve durability/new material**

The Sun/Carrier/T-5 went into production in Sept 2006 starting serial # 6310696028 The Rings went into production in May 2006 starting serial # 6310656923, 6320768550, 6320768663.

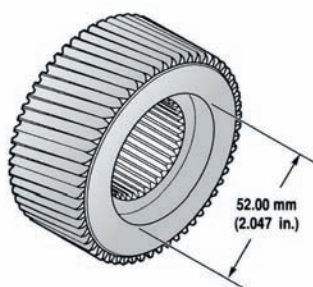
PART	OLD NUMBER	NEW NUMBER	Dimension Changes	Interchangeability
T-5 bearing	29531095	29541702	Thickness Increased by .45mm OD decreased by .55mm ID decreased by 4.15 mm	No if used by itself Yes if used with the updated carrier and sun gear assembly
P2 Carrier	29536971	29545240	Shaft area no longer under cut. OD of shaft are decreased by 2.15 mm Pocket depth increased by 1.2 mm	No if used by itself Yes if used with the updated sun gear and T-5 bearing
P2 Sun	29543208	29545931	Pocket decreased by 3.6mm	No if used by itself Yes if used with the updated carrier and T-5 bearing
Sealing Rings	29538941 29538942	29538158 29531038 All the updated rings come in the kit part number 29536406	End gap on rings have changed from a Double lap joint design to a butt cut style. In addition the material has also changed	Fully interchangeable

Mid-2006-2007 LCT 1000

Updates (continued)



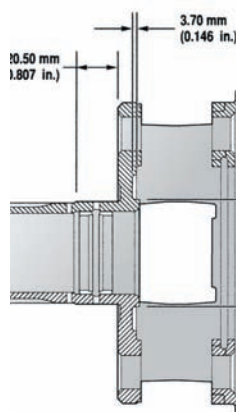
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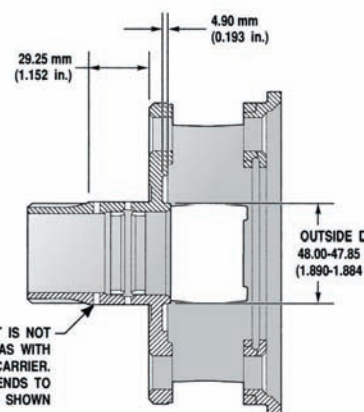
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P2 Sun Gear

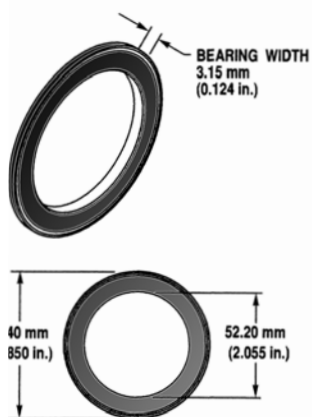
P2 Carrier



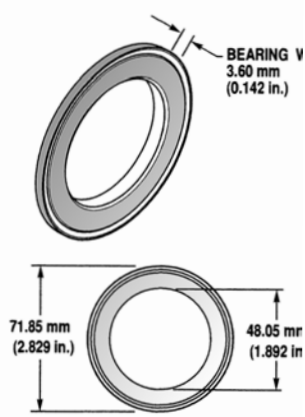
FORMER
P/N 29536971



CURRENT
P/N 29545240



FORMER
P/N 29531095



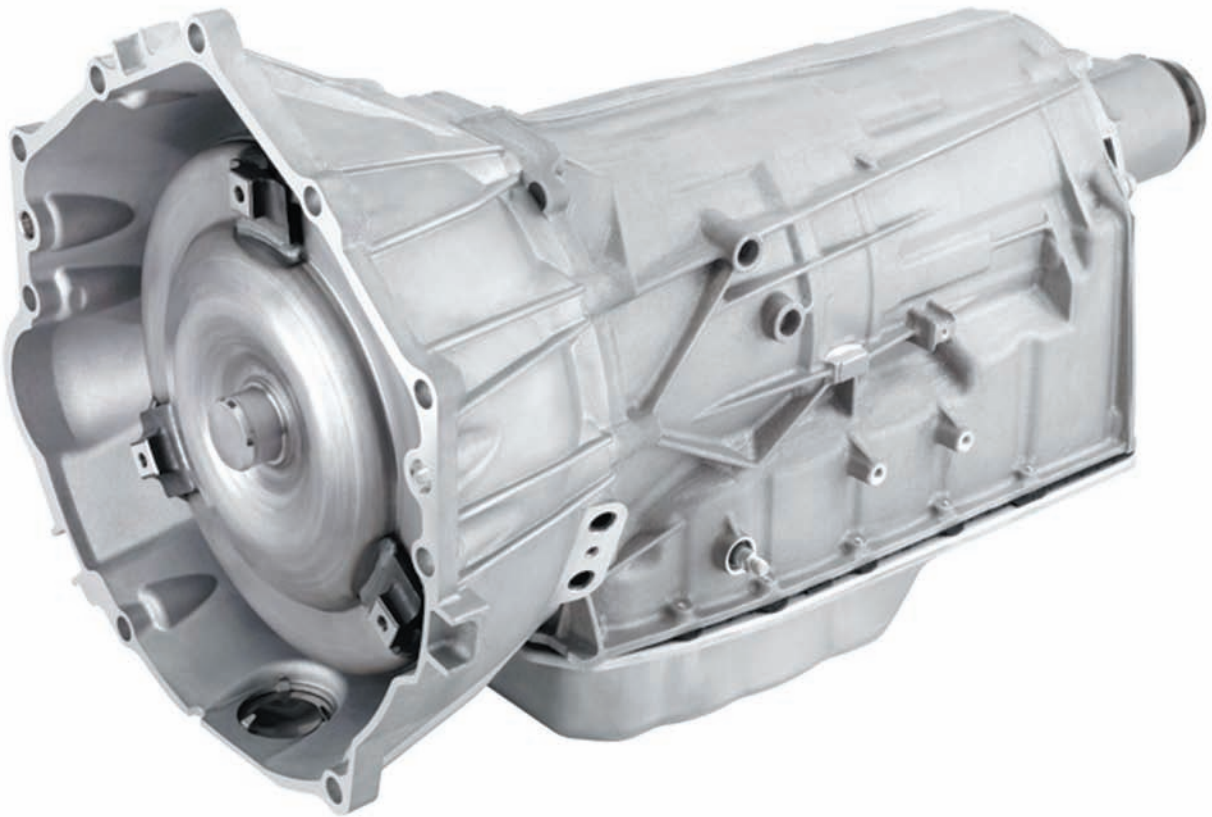
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T5 Bearing

6L50/6L90

Introduction

Two more 6 speed rearwheel drive automatic transmissions have been released by GM for the 2007 model year. The 6L50 (MYB) was introduced in the Cadillac SRX and STS. The 6L90 (MYD) was introduced in the Chevrolet Silverado HD and GMC Sierra HD applications.



Hydra-Matic
6L90 (MYD)
Six Speed RWD Automatic Transmission

6L50/6L90

Introduction (continued)

The 6L50/6L90 transmissions share many parts with the 6L80. This reduces the production cost of the units and improves serviceability. The diagnostic processes and tools are also shared between the 6L50, 6L80 and 6L90. The 6L50 and 6L90 are the latest rearwheel drive 6 speeds to be introduced by GM but they certainly will not be the last. The 6L45 will also make its way shortly into the market place. Like the 6L50/6L80 and 6L90 the 6L45 will also share the same component architecture.

RPO Code:

6L50-MYB
6L90-MYD

2007 Applications:

6L50 Cadillac SRX, STS, BMW X3, X5,
328 coupe
6L90 C/K HD models with 6.0L LY6
engine

Output Torque Capacity:

6L50—480 lb ft (651 Nm)
6L90—885 lb ft (1200 Nm)

Input Torque Capacity:

6L50—332 lb-ft (450 Nm)
6L90—531 lb-ft (720 Nm)

Ratios		
Gear	6L50	6L90
1st	4.06-1	4.03-1
2nd	2.37-1	2.36-1
3rd	1.55-1	1.53-1
4th	1.16-1	1.15-1
5th	.85-1	.85-1
6th	.67-1	.67-1
Reverse	3.02-1	3.02-1

6L50/6L90

Introduction (continued)

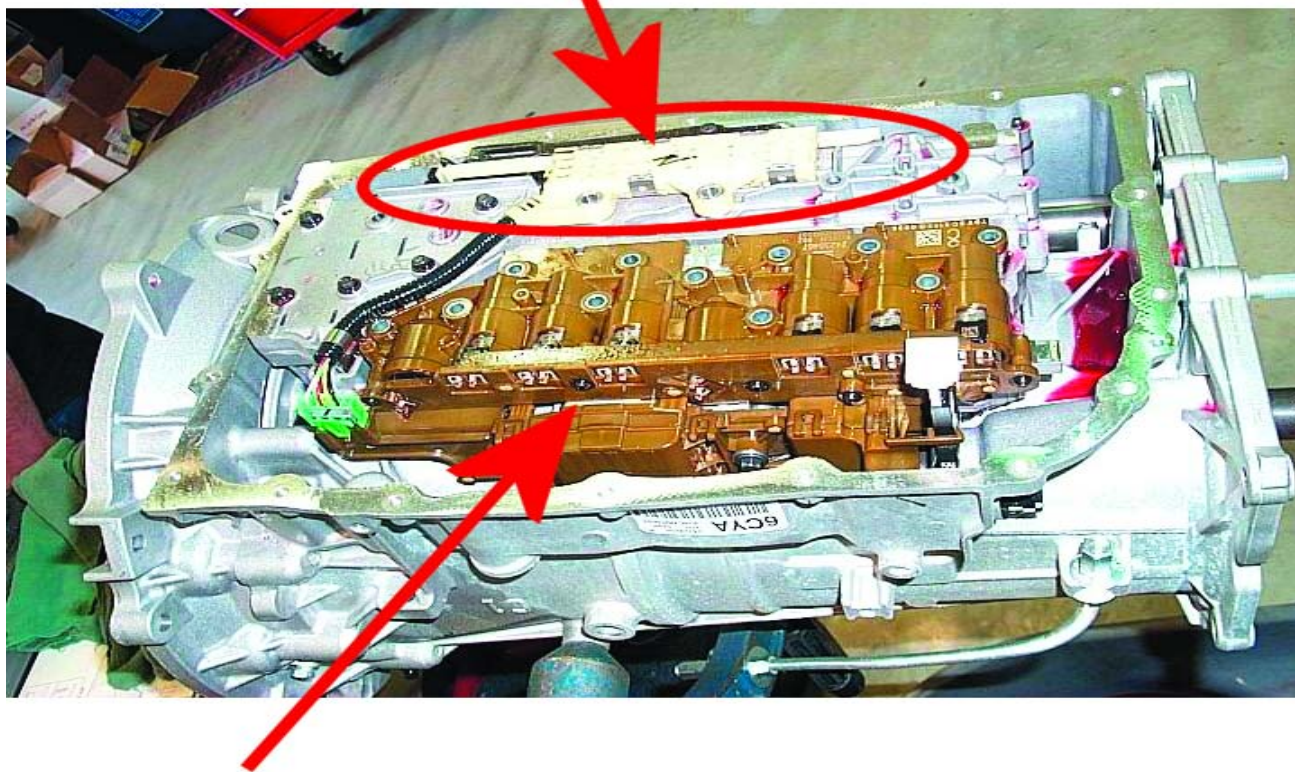
- Maximum shift speed 6500 RPM
- Maximum GVW 6L90—15000 lb 6L50—6613 lb
- Maximum GCVW 6L90—21000 lb 6L50—12505 lb
- PRNDL positions P, R, N, D, (S or M)
- 2 shift solenoids used (On/Off Design), SS1,SS2
- 6 Variable bleed solenoids, PCS, PCS2, PCS3, PCS4, PCS5, TCC
- A Bosch built 32 bit TCM (TEHCM) mounted internal to the transmission on the valve body (Referred to as the “control solenoid valve assembly”) TCM (TEHCM) incorporates Solenoids, pressure switches, TFT and it is bolted to the valve body using 6 bolts.
- Dry weight 6L50— 198 lbs (90 kg) 6L90— 243 lbs (110 kg)
- EC3 Converter 258 twin plate/280mm 6L50 300mm 6L90
- Fluid required, Dexron VI
- Fluid capacity: 6L50 Pan removal 7.25 qts (6.83 liters) Overhaul 10.68 qts (10.10 liters) 6L90 Pan removal 6.3 qts (6.0 liters) Overhaul 10.5 qts (9.9 liters)
- Clutch to clutch shifts, 5 clutches (3 stationary, 2 driving), 1 sprag
- Planetary assemblies, input (Simpson) Output (Dual pinion design)
- Vane style oil pump
- Internally mounted TISS and TOSS hall effect type speed sensors
- Internal Mode Switch (IMS) equipped
- Performance Algorithm Shifting (PAS) programming
- Performance Algorithm Lift foot (PAL) programming
- Sport mode and TAP shift equipped
- Adaptive Strategies with fast learn capabilities
- Reverse lock out feature
- Grade braking

6L50/6L90

Internal Mode Switch Logic

The 6L50/6L90 internal mode switch is mounted to the valve body and it is connected mechanically to the manual valve. Electrically the IMS operates similar to other GM IMS applications. The TCM sends a bias voltage to the IMS on 4 circuits, A, B, C, P. Pin N is used for Park/Neutral starting operations and is supplied by the ECM. As the range selector is moved the IMS will ground/un-ground the circuits or circuit required to indicate the specific manual valve position. By noting the voltage sequence produced, the TCM will be able to identify the range that was selected.

IMS Assembly



Valve Body and TCM

6L50/6L90

Internal Mode Switch Logic (continued)

Selector Position	Range A	Range B	Range C	Range P
Park	Low	High	High	Low
Park/Reverse	Low	Low	High	Low
Reverse	Low	Low	High	High
Reverse/Neutral	High	Low	High	High
Neutral	High	Low	High	Low
Neutral/D6	High	Low	Low	Low
D6	High	Low	Low	High
D6/D4	Low	Low	Low	High
D4	Low	Low	Low	Low
D4/D3	Low	High	Low	Low
D3	Low	High	Low	High
D3/D2	High	High	Low	High
D/2	High	High	Low	Low
Illegal	High	High	High	High
Illegal	Low	High	High	High

Low = Grounded (0Volts)

High= Open (Source Voltage)

6L50/6L90

Speed Sensors

The speed sensors are “hall effect” style assemblies and are mounted to the control valve assembly (Valve Body). The TCM provides a signal voltage of 8.3-9.3 volts for the sensor operation. As the clutch housings rotate the sensors will produce a square wave signal. The TCM will monitor the frequency of the signal to determine the input or output speed. Input Speed Sensor signals are generated by the rotation of the 1-2-3-4 & 3-5-R clutch assemblies and is used to calculate gear ratio and slip rates. The Output Speed Sensor signal is generated by the rotation of the Output Ring gear. The OSS is used for indicating Vehicle speed for shift pattern control as well as Ratio calculations.

6L50 Shift Speed Chart

Shift @ TP	KM/H	MPH	OSS (RPM)
1-2 @ 12.5 TP	10.1	6	242
2-1 @ 12.5 TP	6.9	4	165
2-3 @ 12.5 TP	18.1	11	434
3-2 @ 12.5 TP	16.1	10	386
3-4 @ 12.5 TP	27.3	17	654
4-3 @ 12.5 TP	23.5	15	563
4-5 @ 12.5 TP	35.3	22	846
5-4 @ 12.5 TP	32.1	20	769
5-6 @ 12.5 TP	46.6	29	1117
6-5 @ 12.5 TP	40.7	25	975
1-2 @ 25 TP	12.9	8	309
2-1 @ 25 TP	6.9	4	165
2-3 @ 25 TP	24.7	15	592
3-2 @ 25 TP	16.1	10	386
3-4 @ 25 TP	36.5	23	875
4-3 @ 25 TP	25.4	16	609
4-5 @ 25 TP	47.7	30	1143
5-4 @ 25 TP	32.1	20	769
5-6 @ 25 TP	71.5	44	1713
6-5 @ 25 TP	40.7	25	975

NOTE: The 6L50 shift speed chart is based on stock tires/wheels and 3.23-1 final drive ratio

6L50/6L90

Speed Sensors (continued)

6L90 Shift Speed Chart

Shift @ TP	KM/H	MPH	OSS (RPM)
1-2 @ 12.5 TP	15	9	347
2-1 @ 12.5 TP	10	6	232
2-3 @ 12.5 TP	27	17	625
3-2 @ 12.5 TP	10	6	232
3-4 @ 12.5 TP	43	27	996
4-3 @ 12.5 TP	32	20	741
4-5 @ 12.5 TP	57	35	1320
5-4 @ 12.5 TP	46	29	1065
5-6 @ 12.5 TP	80	50	1852
6-5 @ 12.5 TP	60	37	1389
1-2 @ 25 TP	16	10	370
2-1 @ 25 TP	10	6	232
2-3 @ 25 TP	30	19	695
3-2 @ 25 TP	10	6	232
3-4 @ 25 TP	49	30	1134
4-3 @ 25 TP	35.4	22	820
4-5 @ 25 TP	61.5	38	1424
5-4 @ 25 TP	49	30	1134
5-6 @ 25 TP	83.25	52	1927
6-5 @ 25 TP	65	40	1505

NOTE: The 6L90 shift speed chart is based on stock tires/wheels and 3.73-1 or 4.10-1 final drive ratio

6L50/6L90

Pressure Switches and Clutch Range Reference Charts

Pressure Switches

The pressure switches are housed as part of the control solenoid valve assembly. Four switches are used, 1,3,4 and 5. The switches act as an input to the TCM and are used for 2 basic purposes:

- To monitor clutch regulator valve and clutch hydraulic operation
- To monitor clutch CVI (Adaptive learning)

TFP Switch	Clutch/Circuit Monitored
1	3-5 clutch
3	2-6 clutch
4	1-2-3-4 clutch
5	4-5-6 and L/R Clutch

Clutch Range Reference Charts

COMPONENT	PARK NEUTRAL	REV	1 ST BRK	1 ST	2 ND	3 RD	4 TH	5 TH	6 TH
1-2-3-4 CLUTCH			ON	ON	ON	ON	ON		
3-5 REV CLUTCH		ON				ON		ON	
4-5-6 CLUTCH							ON	ON	ON
LOW/REV CLUTCH	ON	ON	ON						
2-6 CLUTCH					ON				ON
LOW SPRAG			ON	ON					

6L50/6L90

Shift Solenoid Operation

Shift solenoid and PCS operation is controlled by the TEHCM (TCM). The TCM regulates the feed voltage to the solenoids to a value between 8.3-9.3V. The TCM then regulates the current flow through the solenoids. The shift solenoids are On/Off design with the TCM controlling the power for the solenoid. The pressure control solenoids are high side PWM controlled. The TCM is over current and overtemp protected.

Bosch refers to the solenoid's by their state, NL or NH. Normally High (N.H.) is used to describe a solenoid that allows pressure to travel to the clutch when the solenoid is turned off. Normally Low (N.L.) is used to describe a solenoid that prevents pressure from getting to a clutch when the solenoid is turned off. The solenoids are protected by the filter plate. The filter plate is housed between the valve body and the control solenoid valve assembly (TEHCM) and must be replaced anytime the valve body or control solenoid valve assembly (TEHCM) is replaced or unbolted from each other. The Filter plate is serviced with the control solenoid valve assembly (TEHCM) but it must be ordered separately if you are ordering valve body.

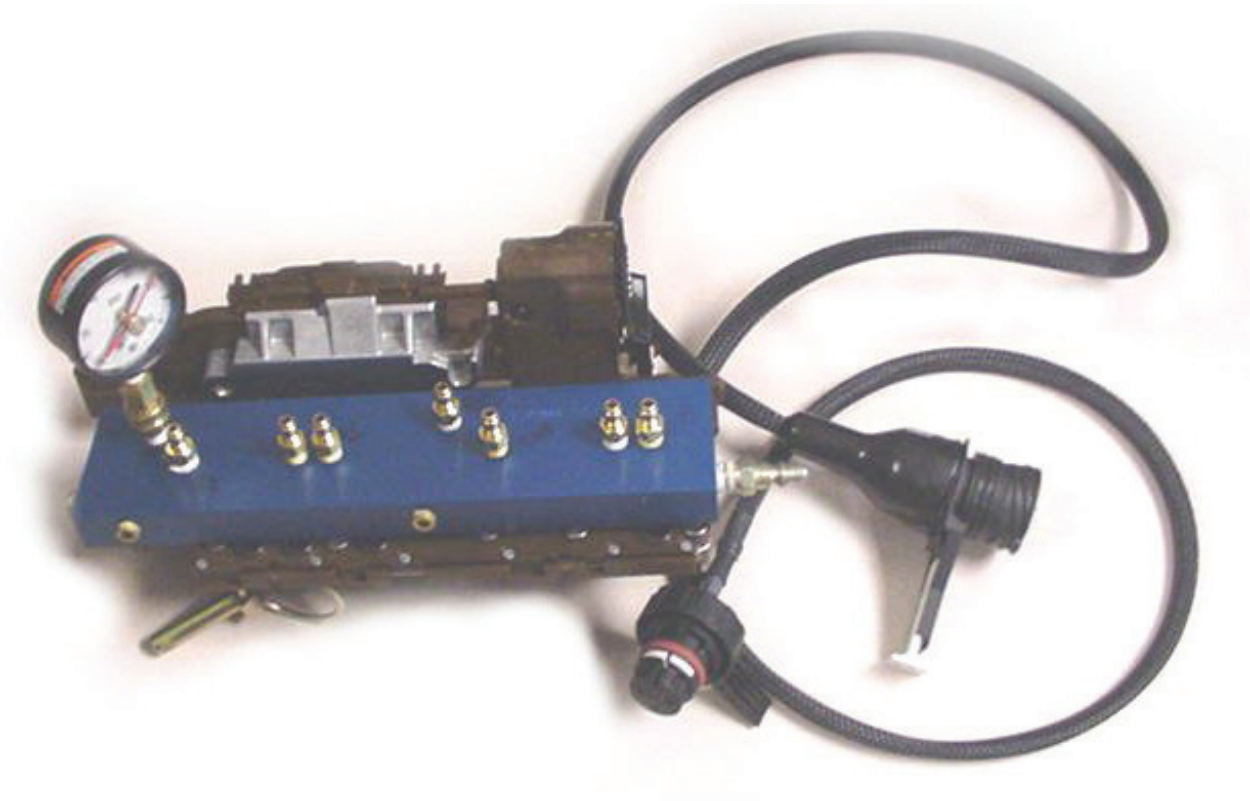
NOTE: If the Control valve body assembly is removed from the case the support seals located in the case must also be replaced.

GEAR	SS1	SS2	PCS 2 (N.H.)	PCS3 (N.H.)	PCS4 (N.L.)	PCS5 (N.L.)
PARK	ON	ON	OFF	ON	OFF	OFF
REVERSE	ON	OFF	ON	ON	OFF	OFF
NEUTRAL	ON	ON	OFF	ON	OFF	OFF
1 ST ENG BRK	ON	ON	OFF	ON	OFF	ON
1 ST	OFF	ON	OFF	OFF	OFF	ON
2 ND	OFF	ON	OFF	OFF	ON	ON
3 RD	OFF	ON	ON	OFF	OFF	ON
4 TH	OFF	ON	OFF	ON	OFF	ON
5 TH	OFF	ON	ON	ON	OFF	OFF
6 TH	OFF	ON	OFF	ON	ON	OFF

6L50/6L90

Solenoid Cleaning Process

An automated process is available that aids in cleaning debris from the solenoid assembly. Your scan tool will instruct the TCM (TEHCM) to cycle the solenoids while the system is pressurized to clean the solenoids. The transmission does not need to be disassembled to perform the cleaning process. Simply follow the instructions on the scan tool to activate the cleaning program. This process should be completed prior to attempting to diagnose the transmission with part# DT-47825-1 tools as described below. If the cleaning process is unsuccessful then you should diagnose the concern with part# DT-47825-1



6L50/6L90

Solenoid Diagnostics

Like other GM transmissions, diagnosis is designed around the use of a quality scan tool. With the 6L50/6L90 this could not be more true as the need to access scan data is critical. Unlike other GM transmissions you have become accustomed to working with over the years, the 6L50/6L90 internal electrical components are not hard wired to the rest of the vehicle via the transmission harness. This means that the diagnostic process has changed considerably. Diagnosis is divided into 2 categories , scan diagnostics and test plate/air check diagnostics. Solenoid and valve body diagnosis requires the following tools:

- A quality scan tool capable of communicating and commanding the TCM and it's solenoids.
- Tool number DT 47825-1 Solenoid test plate and jumper harness

Remove the Control Solenoid Valve Assembly from the transmission. Install tool DT 47821-1 onto the Control Solenoid Valve Assembly (5Nm 44 Lb In). Apply regulated shop air (90-100 psi) to the tool. Connect the scan tool to the Control Solenoid Valve Assembly.

Command the solenoid ON/OFF air pressure should be present on the gauge and then it should exhaust as the solenoid is cycled. If the solenoid or valve are malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly.

If the solenoid checked OK, install the gauge on another solenoid port and command that solenoid ON/OFF with the scan to repeat the process.

6L50/6L90

Solenoid Diagnostics (continued)

Solenoid	Test Plate Port	Key On, Engine Off (KOEO) Normal State	Commanded State	
Line PC Solenoid 1	G	No flow to gage	On - 68-103 Kpa (10-15 psi) per Commanded Amp	
PC Solenoid 2	C	No flow	On - Full flow	Off - No flow
PC Solenoid 3	A	Full flow	On - Full flow	Off - No flow
PC Solenoid 4	B	No flow	On - Full flow	Off - No flow
PC Solenoid 5	F	No flow	On - Full flow	Off - No flow
Shift Solenoid 1	H	No flow	Off - No flow	On - Full flow
Shift Solenoid 2	D	No flow	Off - No flow	On - Full flow
TCC PC Solenoid	E	No flow	On - Full flow	Off - No flow

NOTE: If the solenoid or valve is malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly.

NOTE: The TCM (TEHCM) will normally cycle several of the solenoids ON/OFF to help keep the solenoids and the valves free of debris. Therefore this cleaning function (Dither) may cause the gauge to flicker when the TCM is cleaning the solenoid you are testing.

6L50/6L90

Adaptive Learning

The 6L50/6L90 are fully equipped with several adaptive learning strategies. As with some other GM applications you will need to erase the adaptive values and perform a “Fast Learn” prior to operating the vehicle. Adapts and fast learn procedures should be performed if any of the following occur:

- Internal Transmission repairs have been performed
- The valve body was replaced
- The Control Solenoid valve assembly was replaced
- The TCM was recalibrated
- Internal repairs were performed that could effect shift quality

NOTE: Fast learn is not required if a GM New or Rebuilt 6L50/6L90 is used. The transmission is fast learned prior to it being shipped from the plant

To perform a fast learn:

- Use a scan tool capable of performing the fast learn procedure
- TFT 158-230°F (70-110°C), Move the selector in/out of gear 3 times
- Select the fast learn process from the scan tool menu
- Place the transmission in Drive with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume. Place the transmission in Reverse with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume
- Shut off the engine for at least 30 seconds, open and close the door to allow “RAP” to expire or false DTC’s may set, After a minimum of 30 seconds the car can be restarted , power off the scanner
- The process is now complete

The fast learn procedure will not run if:

- DTCs are set
- TFT is not between 158-230 °F (70-110°C)
- The brake switch is not working
- TP is 0% but engine RPM increases during the test
- P/N switch is improperly adjusted or is not functioning correctly
- Line pressure control system is malfunctioning

4L60E/65E/70E

Input Speed Sensor

The 2005 and 2006 ATRA seminars covered the changes involved with the addition of the input speed sensor in the 4L60E/65E and 4L70E applications (RPO's M30,M32, M33, M70). The input speed sensor was not used on all 2006-2007 applications so some confusion may occur regarding build combinations for these products. Some of the parts from the ISS equipped applications and a Non ISS equipped applications cannot be intermixed.

A failure to identify the build combination you are working with may result in line pressure, TCC and/or Clutch apply/release/cross leak concerns. Five design variations have occurred between Non ISS applications and the final fully functional ISS applications. These changes include the following:

- Redesigns of the turbine shaft—Repositioning of the seal rings on the shaft, adding a ISS toothed wheel.
- Redesign of the pump cover- Updating the passage design and passage position in the stator support sleeve. Adding a boss to the cover for the ISS.
- Shortening the P/R valve train to make room for the input speed sensor wiring and connector.
- Updating the wiring harness for the input speed sensor.
- Adding DTC's for ISS diagnostics.



4L60E/65E/70E

Input Speed Sensor (continued)

Design Variation Turbine Shaft:

Four NON ISS shaft sizes are available they are:

245mm/258mm shaft (Part # 17803688)

280mm/300mm shaft (Part # 17803687)

300mm HD/300mm M70 (Part #17803686)

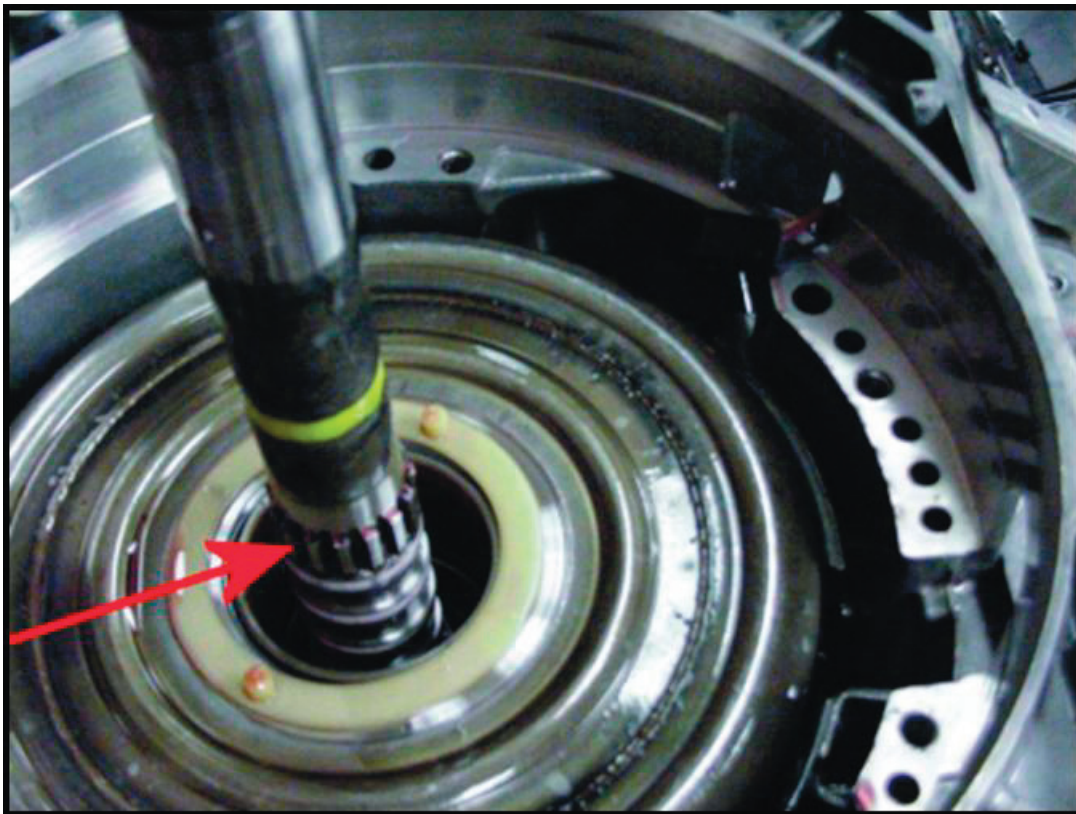
258mm PHT (Part # 17803685)

Three ISS equipped shafts are available, they are:

245mm/258mm (Part #24232438)

280mm/300mm (Part # 24230653)

300mm HD/M70 (Part #24230654)



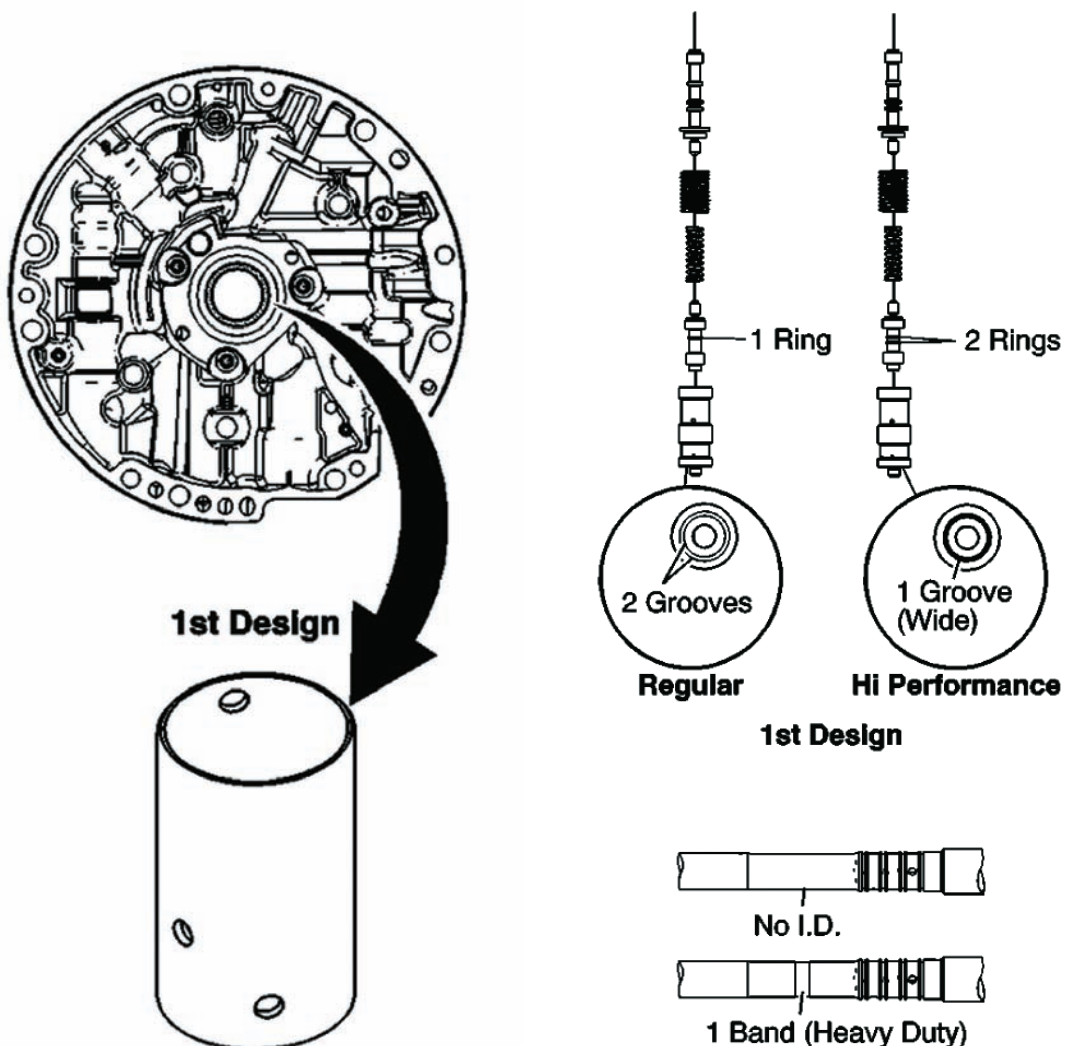
4L60E/65E/70E

Pump Cover

The design of the shaft can be identified by the ID marks on the shaft. The ID mark is simply a 9.5mmX.5mm groove that located on the shaft. Some shafts have ID marks while others do not.

Pump Cover: 5 pump covers are available, they are:

1997-2005 model: No input sensor boss, used 1st design stator support bushing and 1st design P/R valve train.

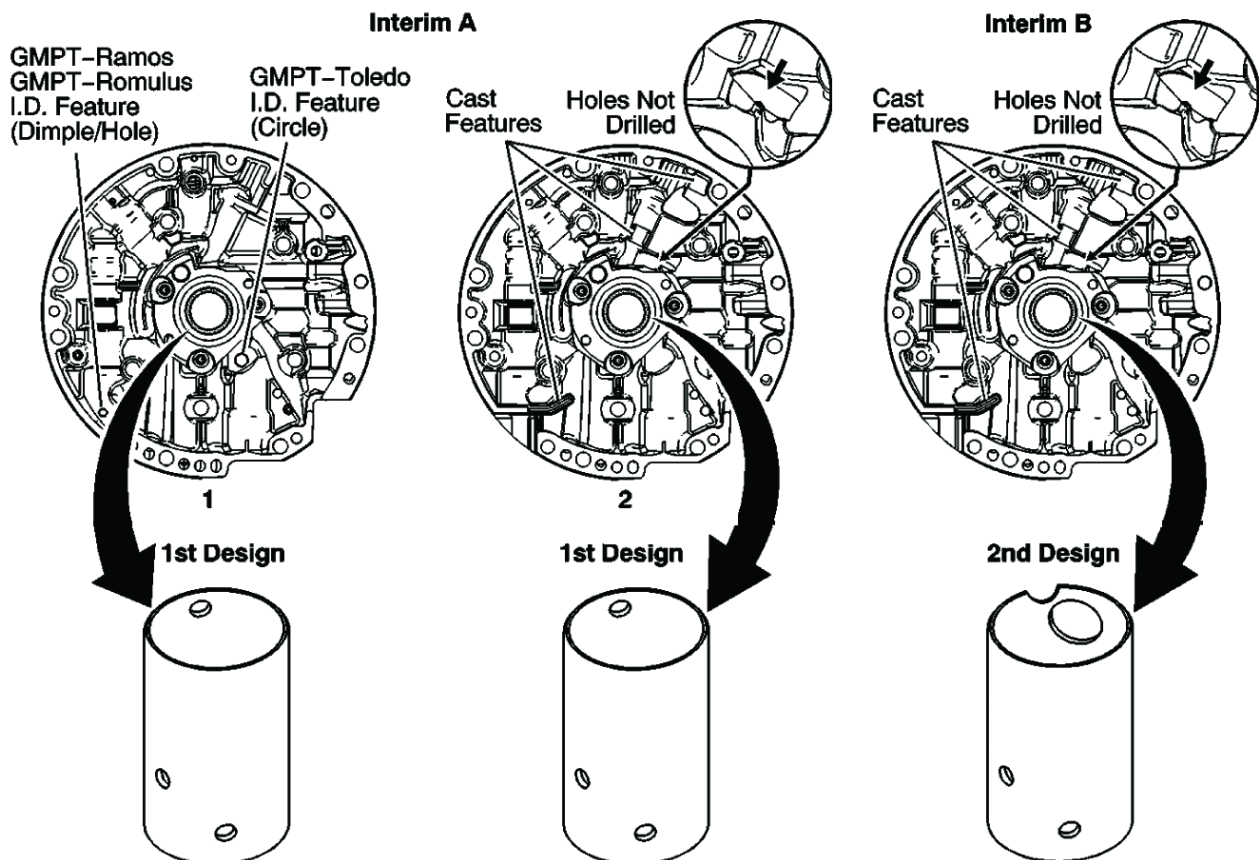


4L60E/65E/70E

Pump Cover (continued)

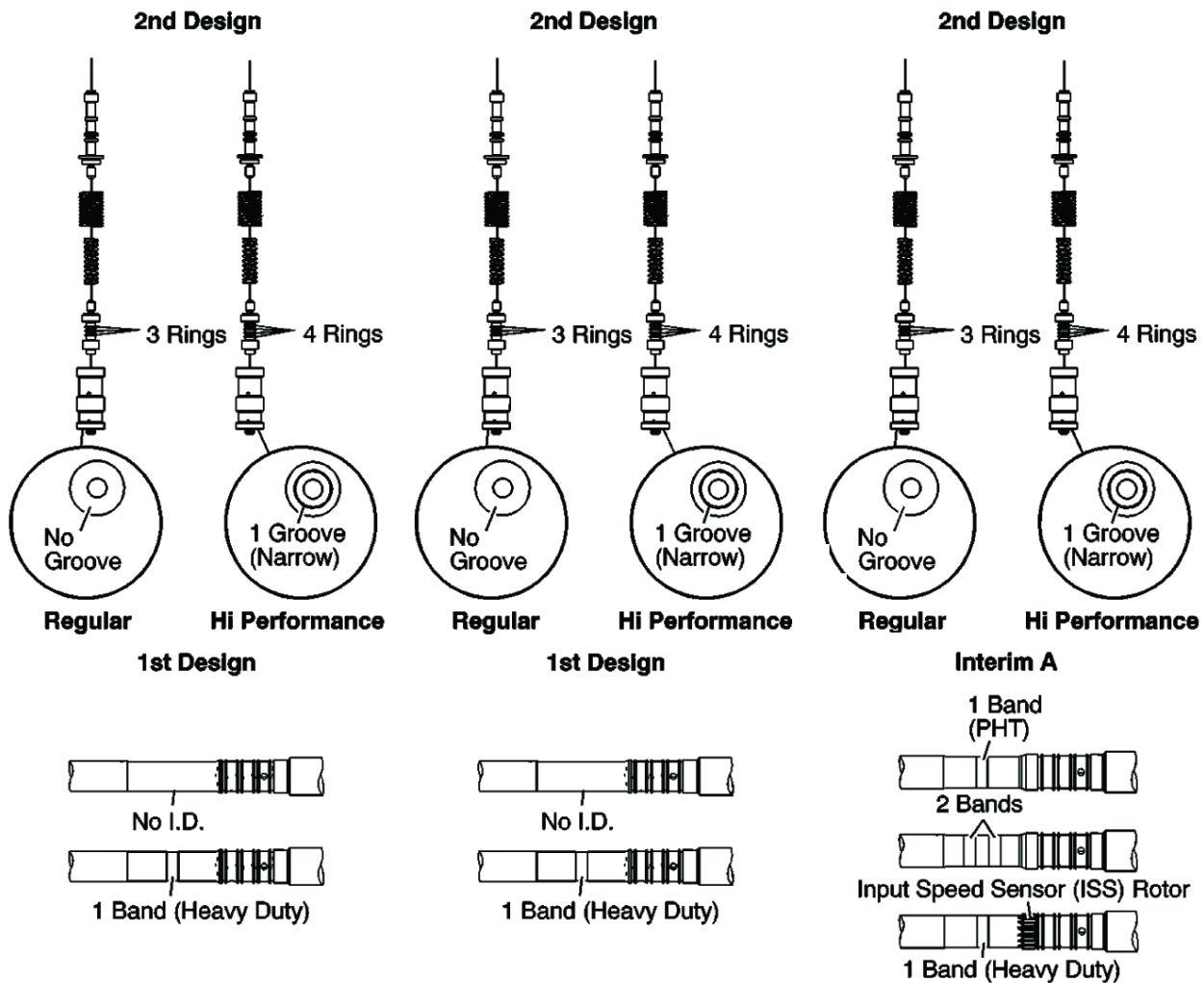
2005 I model: No input sensor boss, used 1st design stator support bushing and 2nd design P/R valve train.

2005 I model: Includes a input speed sensor boss, but the boss is not drilled, 1st design stator support sleeve and 2nd design P/R valve train.



4L60E/65E/70E

Pump Cover (continued)



4L60E/65E/70E

Pump Cover (continued)

2006: The input speed sensor boss was drilled on those models that used an ISS. A 2nd design stator support sleeve and a 2nd design P/R valve train were used. This combination requires the ISS shaft design or a shaft design that relocates the turbine seal ring position.

2006 and later: All models of pumps use the input speed sensor boss and all of the bosses are drilled. If the ISS is not used a rubber plug will be used in the ISS hole. A 2nd design stator support sleeve and a 2nd design P/R valve train were used. This combination requires the ISS shaft design or a shaft design that relocates the turbine seal ring position.

Pump cover kits:

1998-2005: 12491417, 12491421

2006 and later Non PHT: 24236486, 24236489

2006/07 PHT: 24239202

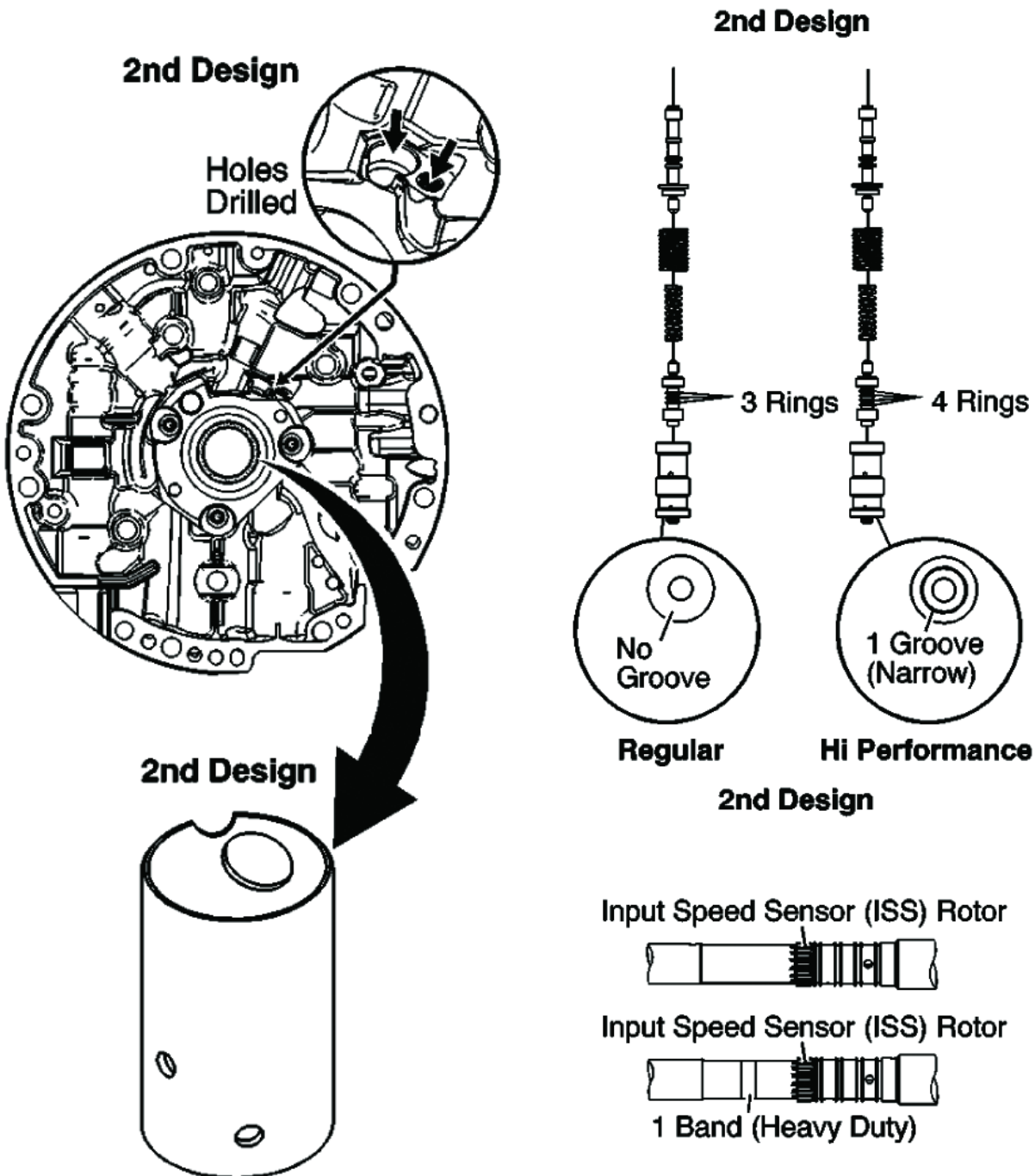
Reverse boost valve kits:

2005 and earlier (Long valve train): 24234396 regular, 24234397 High Perf

Short valve train 24234396 regular, 24234397 High Perf

4L60E/65E/70E

Pump Cover (continued)



4L60E/4L65E/4L70E

Speedometer Inop, 3rd Gear Starts

S/T Truck 5.3L/6.0L

Some customers may complain that their Speedometer is inoperative and the transmission may be starting in 3rd gear. In addition a Body code B0540 may be set. The ABS and SES lights may be illuminated. Transmission DTC's will not typically be set and you may be unable to communicate with the TCM. This condition applies to all V-8 (5.3L/6.0L) S/T truck applications as they use a stand alone TCM which is wired differently when compared to the 4.2L applications

Inspect fuse #53 ("15 A Trans") in the under hood junction block. If the fuse is blown inspect circuit #139 for a short to ground.

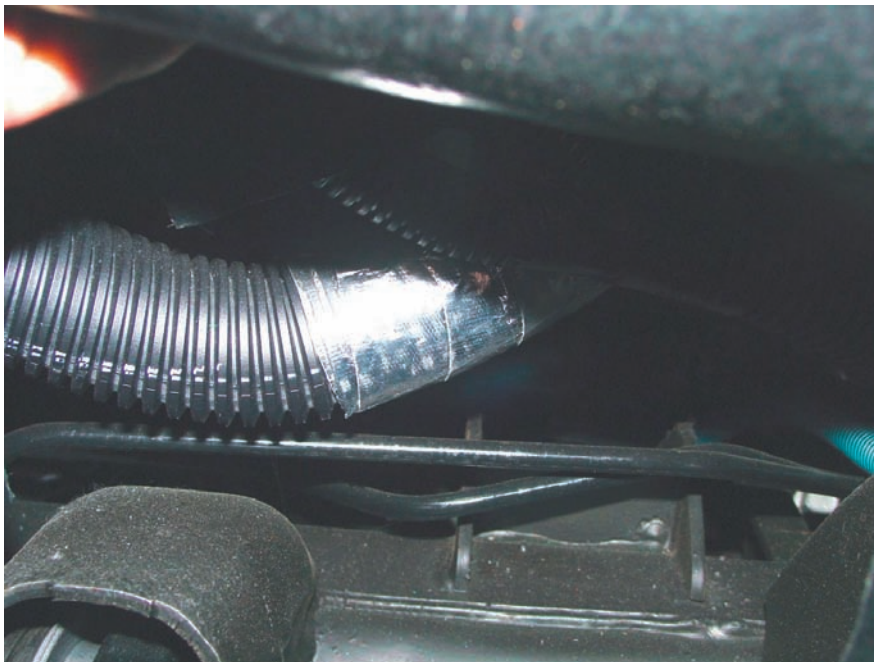


4L80E/4L60E

Multiple DTC's G-Van

Some 1996-2006 G-van (Express/ Savanna) Applications may set various engine and/or transmission related DTC's. The DTC's may vary regarding the number of DTC's set, as well as their type and description. The DTC's may be intermittent in nature. The type and number of DTC's set will depend on which and how many circuits were damaged.

A common cause for this concern is the wiring harness for the PCM. The PCM is mounted on the driver's side inner fender well. The harness faces the vehicle chassis. The steering gear power steering line is designed to be routed under the PCM harness. If the line is routed on top of the harness or if the clips holding the harness are missing or broken the harness can contact the frame or upper control arm leading to harness damage. Repair the damage and reroute the harness to repair this condition.



WARNING: Wiring harness IN-CORRECTLY installed

4L80E/4L60E

Multiple DTC's G-Van (continued)

Another common issue on this application is road splash or windshield run off penetrating the PCM connector. This may cause the PCM terminals and harness pins to corrode. If corrosion is present the PCM and the damaged harness terminals will need to be replaced. If corrosion is present inspect for the presence of a harness deflector and road splash shield. If the shields are not present they will need to be installed.

1996-99- Install harness deflector Part# 15091839, Splash shield Part# 15183966 and bracket 15766026

2000-2002- Built prior to December 2001. Install harness deflector Part# 15091839, Splash shield Part# 15183966

2002 and later- Built after December 2001. On these applications the deflectors were installed at the plant but they were greatly modified to aid the assembly process. This may compromise the effectiveness of the shield/deflector so you may need to install new ones. Install harness deflector Part# 15091839, Splash shield Part# 15183966

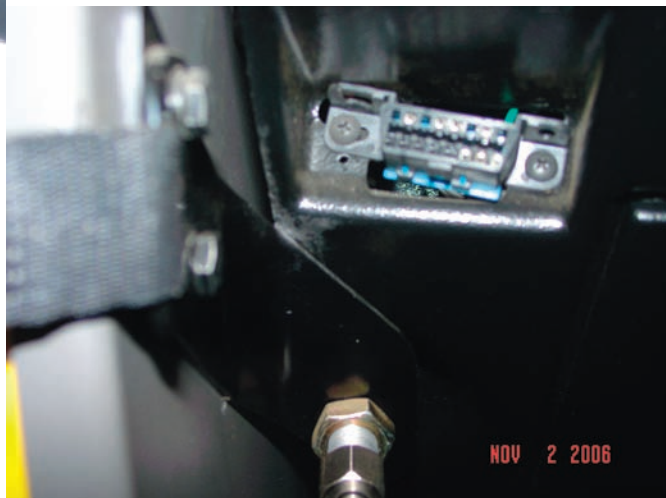


This is the CORRECT routing of the wiring harness

4L80E

Hummer H1 DLC Location

Some confusion has occurred regarding where the DLC is located on the Hummer H1 application. The DLC location is different depending on the year of the vehicle. On 94-95 applications the DLC is located on top of the drivers side “Hush Panel”. To access the DLC it may be necessary remove the plastic hush panel to gain access. Many times the connector is simple laying on top of the panel and you will need to look for it after you have removed the panel. On some applications the DLC can be accessed by opening the access door in the hush panel, sticking your hand up through the access hole to locate the connector. On 96 -06 applications the DLC is located on the drivers side “A pillar”. The connector can be accessed easily without removing any panels. In many instances the DLC has been removed from its factory location so a brake controller can be installed in the factory DLC location. If the DLC is not in the factory location the hush panel will need to be removed to locate the connector.



4T45E

Updates

Several updates have been made to some 4T45E applications for the 2007 model year. These updates include:

- A 4-3 downshift solenoid was added
- New spacer plates, valve body and channel plate
- An auxiliary fluid pump was added
- A new design PSM
- 7/8" Drive chain
- 4 new DTC's were added

A hybrid design vehicle application was released for the 2007 model year which utilizes the 4T45E transmission. Known as "BAS" (Belt Alternator Starter) the hybrid design was introduced in the Saturn Vue. Other passenger car models such as the Malibu are scheduled for release utilizing the same BAS system.

The BAS system utilizes a new type of generator which is also capable of acting as the vehicle's starter during specific driving maneuvers. The hybrid applications are equipped with an AUTO STOP feature to improve fuel economy. To initiate the auto stop feature simply step on the brake and bring the vehicle to a stop. With the vehicle stopped, while in OD range the engine will automatically shut off.

This feature will operate unless one of the following conditions occurs:

- The engine/transmission or hybrid battery are not fully warmed up
- Outside temp is above 95°F (35°C) and the A/C or defrost modes are selected
- The shift lever is in a range other than OD
- The hybrid battery charge is low
- High charging system voltages are required
- The hood is not fully closed

The engine will automatically restart when the brake pedal is released and the accelerator pedal is depressed. The engine may also automatically restart if any of the following occur:

- The shifter is moved from OD to Park, Neutral, Intermediate, Low or Reverse
- The A/C mode is selected
- The hybrid battery charge is low
- The auto stop time exceeds 2 minutes

4T45E

Updates (continued)

Case Assembly

The case was updated to house a new auxiliary pump. The new case casting includes a new line pressure tap, a feed boss for the pump and 4 mounting holes on the side of the case for the pump. A line connects the pump to the line pressure feed on the side of the case. The line contains a cartridge check valve to prevent drain back. The pump is required to prevent the transmission from dropping out of gear when the vehicle is in auto stop. The pump will run anytime auto stop is active, once the engine starts running the pump will be shut off. The updated case is not interchangeable with Non BAS applications.

BAS (Belt Alternator Starter)

The BAS system utilizes a new design spacer plate, channel plate and valve body. The new plate is a bonded design and is used for BAS equipped transmissions. The updated channel plate and valve body are designed for the BAS applications. The updated plate, channel plate and valve body are not interchangeable with Non BAS applications.

PSA

The BAS designed pressure switch assembly is color coded to prevent interchange problems. It contains an additional pressure switch (PRND4). The PRNDL pressure switch lets the TCM know when the driver commands neutral. This logic is used by the TCM to prevent a false pump DTC from setting. The updated PSM is not interchangeable with Non BAS applications.

4-3 Downshift Solenoid

A 4-3 downshift solenoid was added to the BAS applications. The solenoid is mounted to the channel plate. The solenoid is designed to improve the 4-3 downshift by delaying the pressure to the coast clutch during a manual shift. (Prevents tie up with band is coming off and clutch is coming on) During a 4-3 shift the solenoid is energized (ON). During all other shifts the solenoid is de-energized (OFF).

Drive Chain

An update to the drive chain occurred. The new chain is 7/8" wide and is made of 8600 grade material. A 32/38 drive and driven sprocket ratio is used with this chain application.

4T45E

Updates (continued)

4 new DTC's were added to aid in diagnosis of the auxiliary pump. The include:

- P0787- 4-3 Downshift solenoid circuit voltage Low
- P0788- 4-3 Downshift solenoid circuit voltage High
- P2796- Aux pump circuit voltage Low
- P2797- Aux pump performance

P0787 will set if:

- The 4-3 shift solenoid is commanded OFF and the feed back voltage is low
- The condition exists for longer than 4 seconds

If a P0787 is set the TCM will:

- The TCM will command maximum line pressure
- The TCM will freeze shift adaptive values and store the operating conditions as failure record information

A P0788 will set if:

- The 4-3 shift solenoid is commanded ON and the feed back voltage is high
- The condition exists for longer than 150 milliseconds

If a P0788 is set the TCM will:

- The TCM will freeze shift adaptive values and store the operating conditions as failure record information

P2796 will set if:

- The pump relay is commanded OFF and the feed back voltage is low

If a P2796 is set the TCM will:

- Illuminate the SES light on the second consecutive failure (Type B DTC)
- The Starter Generator Control Module (SGCM) will inhibit auxiliary operation
- The TCM will store failure record information

P2797 will set if:

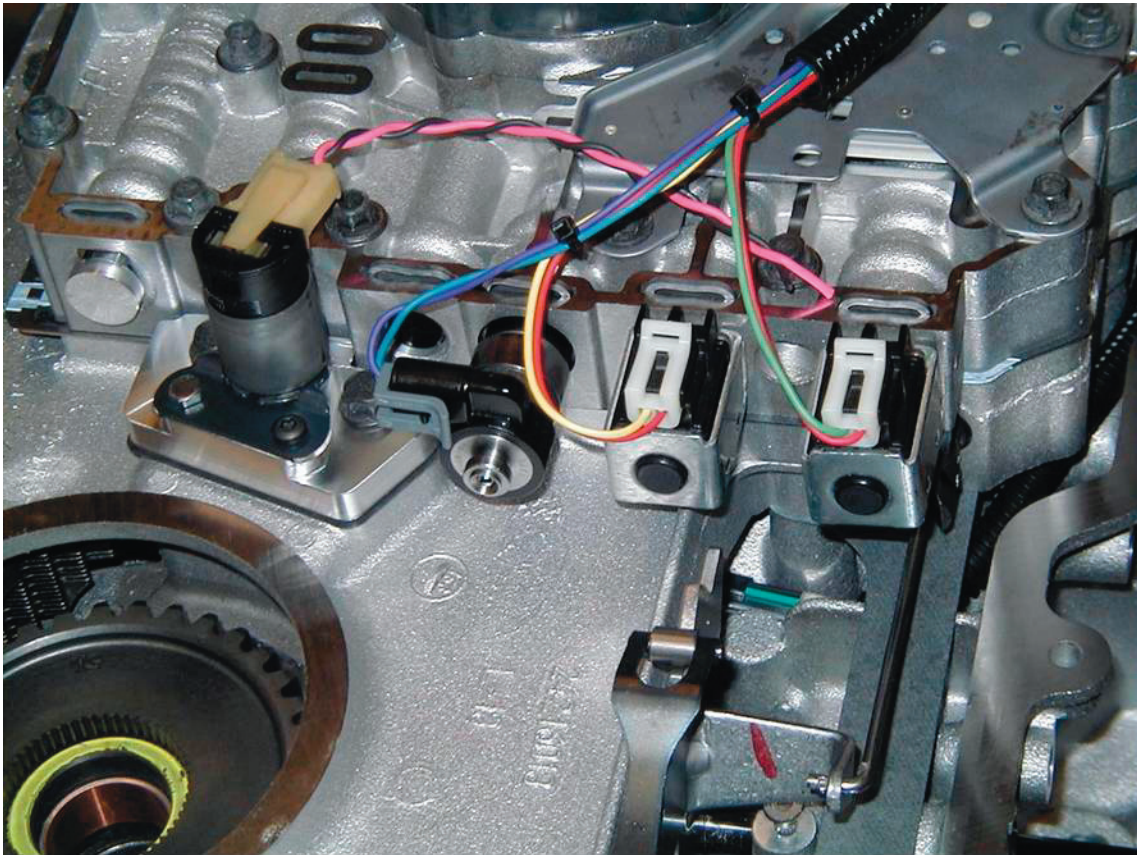
- The auxiliary pump is commanded ON
- The PSM indicates the pump is not running
- The condition lasts longer than 30 seconds

4T45E

Updates (continued)

If a P2797 sets the TCM will:

- Illuminate the SES light on the second consecutive failure (Type B DTC)
- The Starter Generator Control Module (SGCM) will inhibit auxiliary operation
- The TCM will store failure record information
- The SGCM will inhibit auto stop mode



4T40/45E

Low Power, APP DTC's Set

“A”Body

A low power complaint along with some APP DTC's may occur on some 4T40/45E “A” body (Chevrolet HHR/Cobalt, Saturn Ion, Pontiac Pursuit) applications. Any or all of the following DTC's may be set:

- P2120 APP 1 Circuit
- P2122 APP 1 Circuit Low Voltage
- P2123 APP 1 Circuit High Voltage
- P2125 APP 2 Circuit
- P2127 APP 2 Circuit Low Voltage
- P2128 APP 2 Circuit High Voltage
- P2138 APP 1&2 Correlation

The engine harness may be chaffing on the canister purge solenoid bracket. Inspect, repair and reroute the harness. You can add a piece of heater hose to the harness to prevent further damage



4T40/45E

Multiple DTC's

“A” Body

Some “A” body (Cobalt, Pursuit, Ion, HHR, Rendezvous) applications may exhibit any or all of the following DTC's, P0700, P0712, P0713, P0717, P00842,P0843, P0961, P0973, P0974, P0976, P0977. It is common for the concern to be intermittent.

The DTCs relate to transmission related concerns.

P0700- General Transmission DTC, Faults Present

P0712-P0713- TFT Voltage Concerns

P0717- Input Speed Sensor Voltage Concern

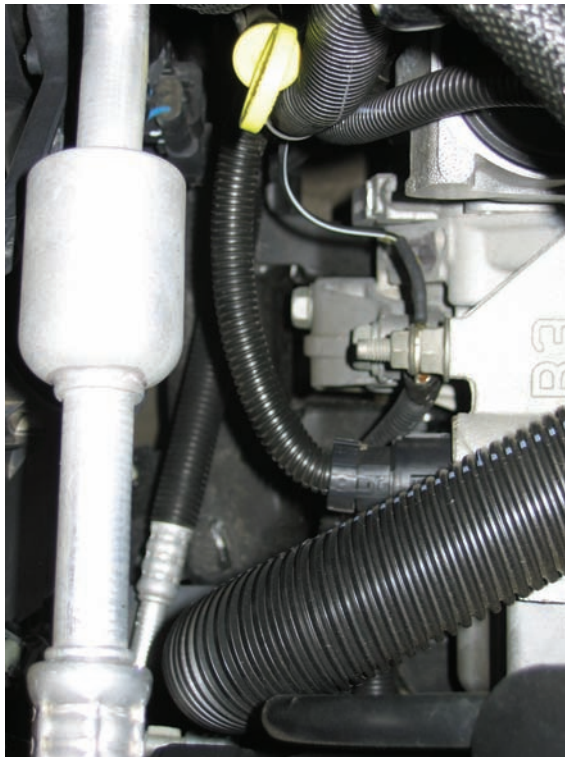
P0842/P0843- TCC Release Switch Circuit Voltage Concerns

P0961- PCS Voltage Concern

P0973/P0974- 1-2 Shift Solenoid/Circuit Voltage Concerns

P0976/P0977- 2-3 Shift Solenoid/Circuit Voltage Concerns

Inspect the transmission wiring harness as it runs toward the engine block near the oil filter for damage/rub thru. As the harness exits the transmission, it can come into contact with engine block as it travels toward the TCM located in the left strut tower area. Inspect the harness for damage, repair and reroute the harness to prevent future damage.



4T65E

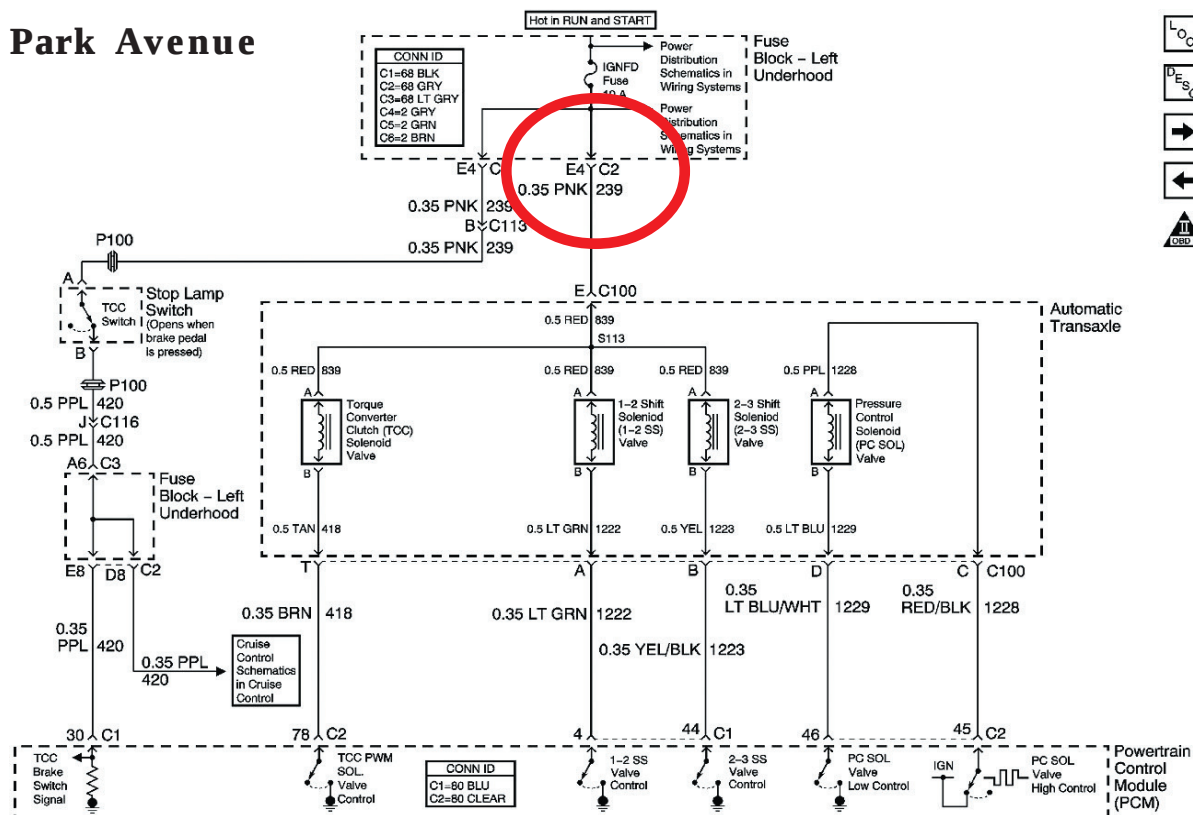
Slips/Wrong Gear Starts/Erratic Shifts/Lack of Power P0753/P0758/P1860

C/H car (Bonneville, Park Avenue, LeSabre) 4T65E applications may exhibit any or all of the following conditions:

- The transmission starts in 3rd gear, which may be interpreted by the customer as a slip related concern or a lack of power complaint.
- If the condition is intermittent the customer may state that the vehicle is shifting erratically without input from the driver (Shift hunt)
- Possible DTC's such as P0753, P1860, P0758

Inspect Circuit 239, IGNFD fuse 10 Amp (Connector C-2 Pin E4) (Park Avenue) at the left under hood fuse block for a poor connection. Inspect circuit 739, Trans fuse 13 10 Amp(Connector C-3 Pin E7) LeSabre/Bonneville applications for a poor connection. Generally the terminal is damaged or incorrectly crimped. If a poor connection is found repair or replace the terminal.

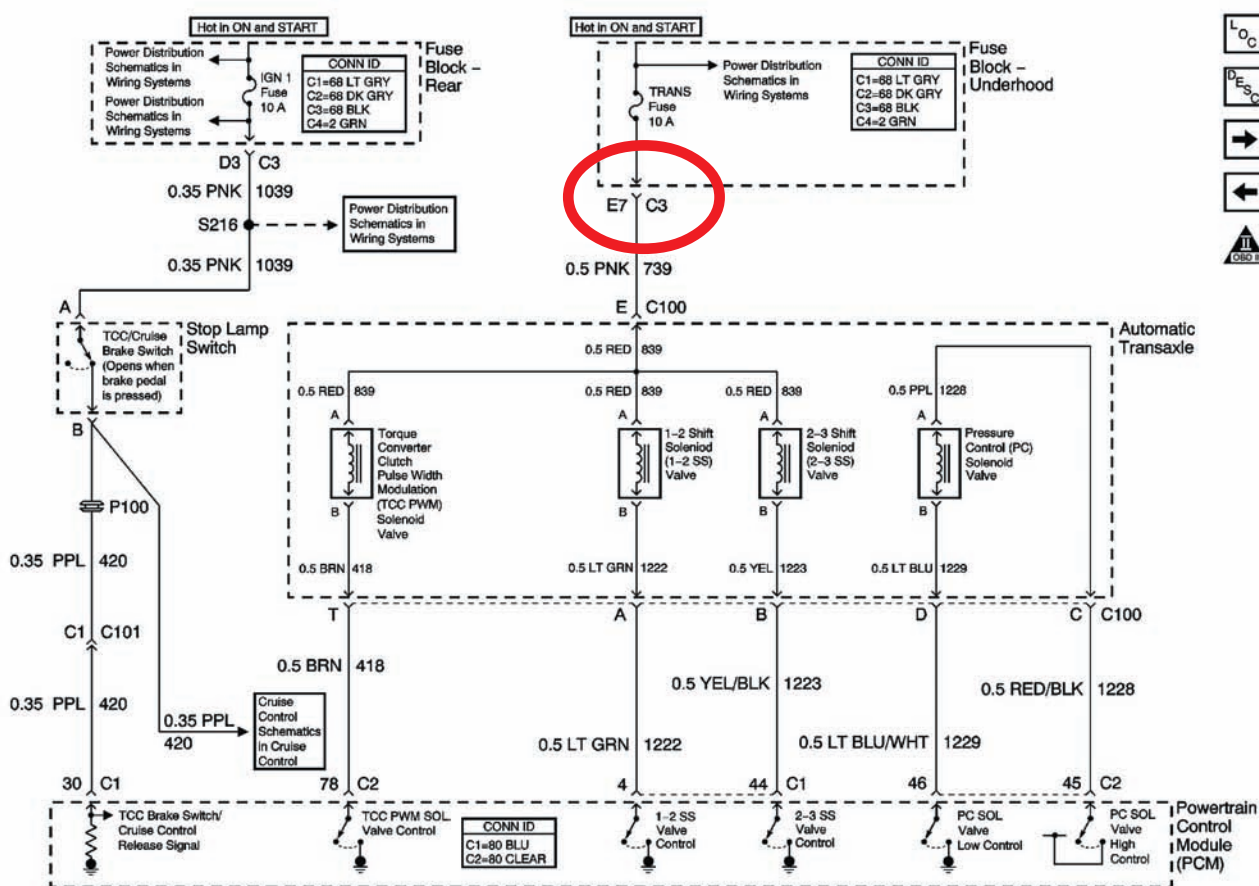
Park Avenue



4T65E

Slips/Wrong Gear Starts/Erratic Shifts/Lack of Power P0753/P0758/P1860

La Sabre, Bonneville



4T80E

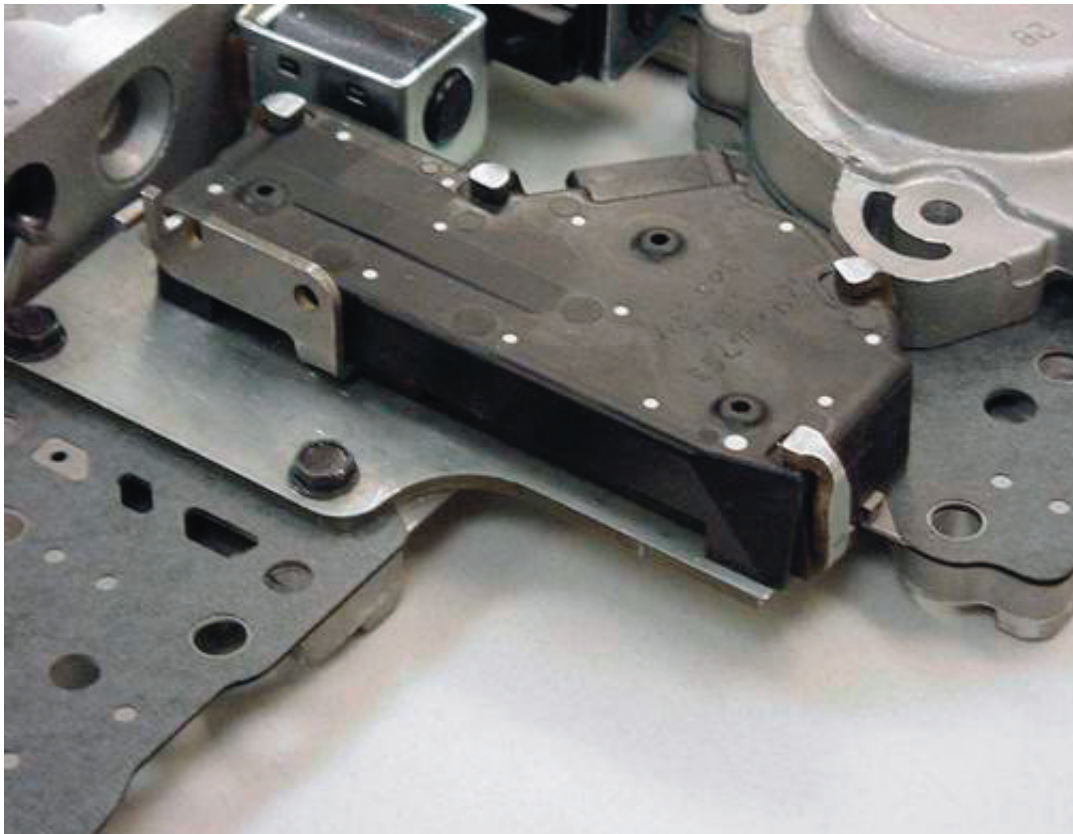
Updates

Several updates were implemented on the 4T80E applications, they include:

- A 6 track IMS
- A New manual valve link and retainer
- Updated wiring harness and pass through connector
- Updated lower wiring harness

6 Track IMS (Internal Mode Switch)

The 6th track adds a stand alone P/N signal circuit (1786) to the IMS function. The 6 track IMS is wider than the 5 track version it replaces. The 6 track will back service earlier transmissions if the link and retainer are used, although the 6th track will not function. The 6 track IMS requires a new tool, DT 47707-1 to properly align the assembly.



4T80E

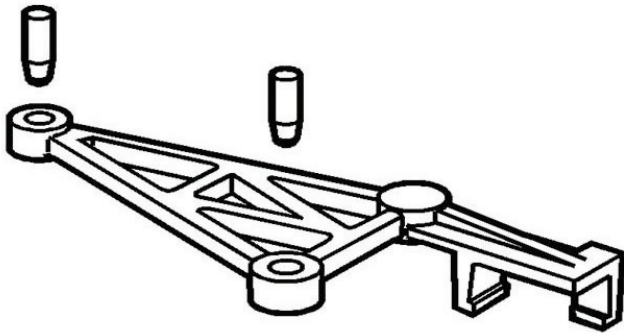
Updates (continued)

Wiring Harness

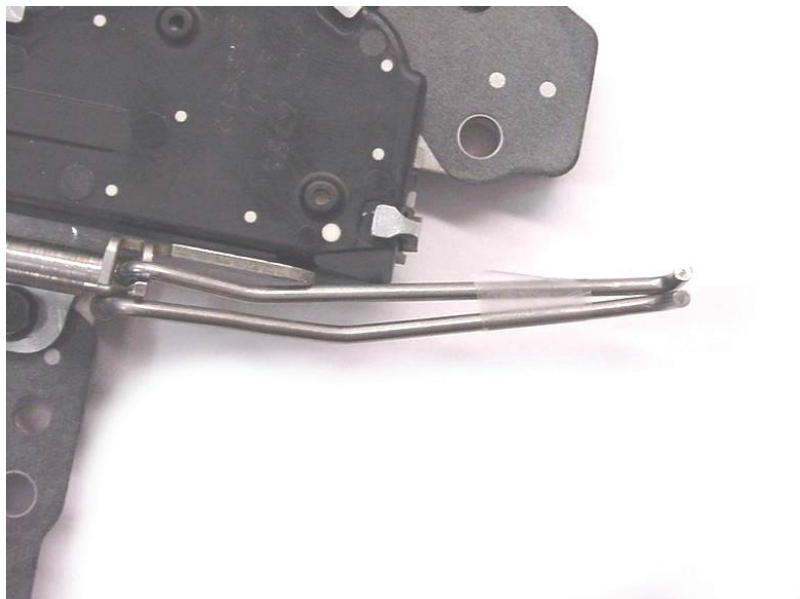
The updated wiring harness is required with the new design IMS. The updated harness will back service the previous IMS design.

Manual Link and Retainer

A new manual link and retainer were required for the wider 6 track IMS. The second design link can be used with the 5 track IMS. The updated retainer is required with the new IMS and it to can back service a 5 track IMS.



The 6 track IMS requires a new tool, DT 47707-1 to properly align the assembly.



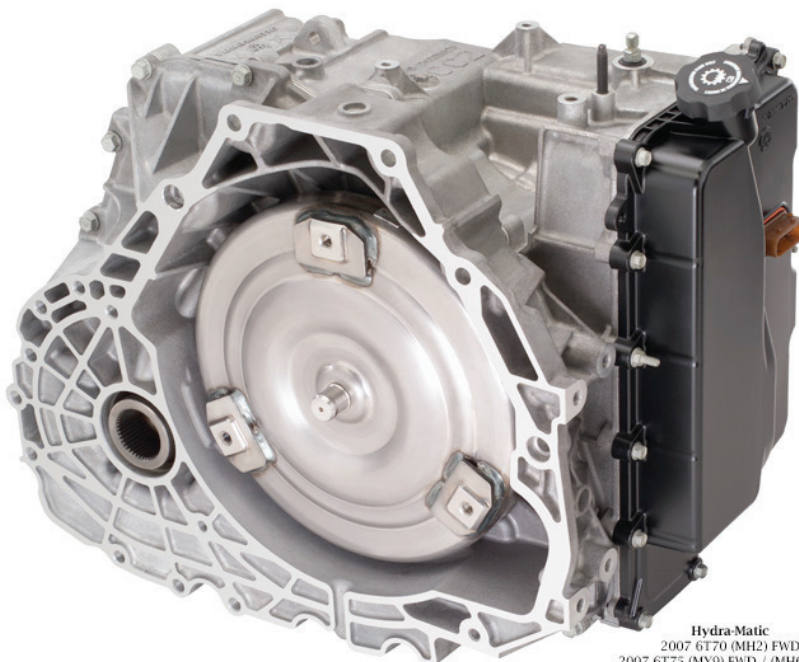
6T70/6T75 Ford 6F55

Introduction

The first in a series of new 6 speed front wheel drive transmissions was introduced for the 2007 model year. The 6T70 and 6T75 entered into the GM lineups with several vehicles such as the Saturn Aura, Pontiac G6 for the car lines, and the GMC Acadia and Saturn Outlook in the truck lines. This generation of transmissions was co-developed with Ford and will enter the Ford line up with the model name 6F55. Many but not all of the components are shared between the Ford and GM versions of the transmissions. By co-developing the transmission R&D costs were significantly reduced.

The 6T70/6T75 improve fuel economy and average of 4 % while performance was improved 8% on average. The 6T70/6T75 share the same architecture and most of the parts are the same. The primary difference is the 6T75 is a heavy duty version of the 6T70. The heavy duty parts in the 6T75 include:

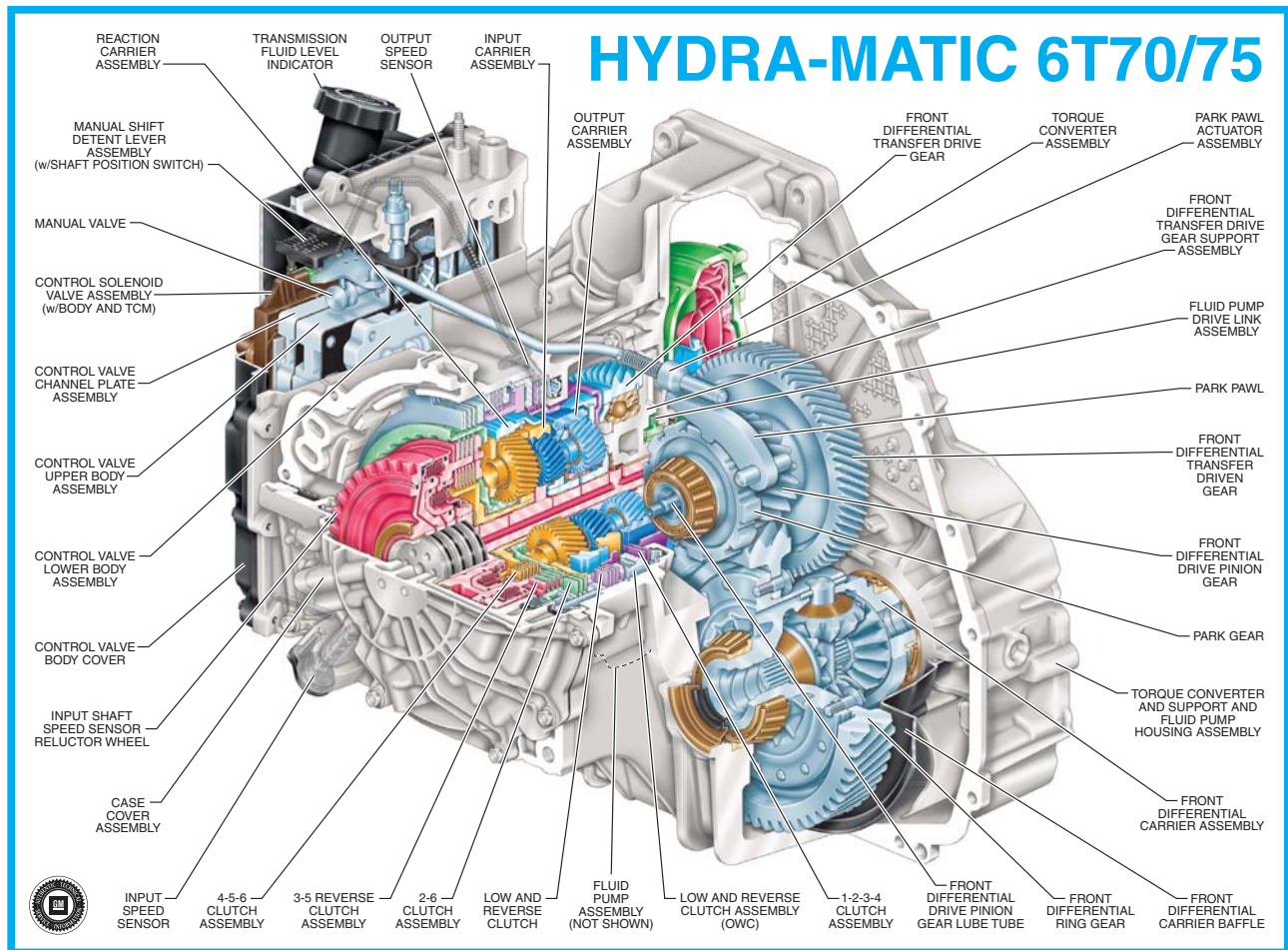
- A shot peened output carrier
- 5 Pinion carrier
- Transfer Gear is wider
- Differential carrier is heavier duty
- Heavier ribbed case



Hydra-Matic
2007 6T70 (MH2) FWD
2007 6T75 (MY9) FWD / (MH6) AWD
Six Speed Automatic Transaxle

6T70/6T75 Ford 6F55

Introduction



6T70/6T75 Ford 6F55

Introduction (continued)

Features include:

RPO Codes:

- * 6T70 car Fwd RPO MH2
- * 6T70 car Awd RPO MH4
- * 6T75 Truck Fwd RPO MY9
- * 6T75 Truck Awd RPO MH6
- * Input torque capacity 6T70 280 lb-ft (380 Nm)
- * Output torque capacity 6T70 462 lb-ft (515 Nm)
- * Maximum GCVW 6T70-4000 lbs 6T75-4850 lbs
- * Weight 216 lbs (98kg)
- * Transfer design- 3 axis
- * Compact design, 357mm length, 197 mm width
- * Differential and Side bearing preloads are adjustable

- Fluid Type—Dexron VI
- Fluid capacity Valve body cover removal—5.3-7.4 qts (5-7 liters)
- Fluid capacity fluid change—4.2-6.3 qts (4-6 liters)
- Fluid capacity Overhaul— 7.4-9.5 qts (7-9 liters)
- The vent for the transmission is incorporated into the dipstick
- EC3 246 mm “hyper elliptical” furnace brazed torque converter. Torque converter contains a lip seal that will be damaged if the converter is removed or installed in any position other than “vertical”. Special tools are available J46409
- 5 clutches (3 holding, 2 driving) clutch to clutch shifting
- 1 diode/ratchet type one way clutch
- 2 shift solenoids used (On/Off Design), SS1,SS2
- 6 Variable bleed solenoids, PCS1, PCS2, PCS3, PCS4, PCS5, TCC

6T70/6T75 Ford 6F55

Introduction (continued)

- A Bosch built 32 bit TCM (TEHCM) mounted internal to the transmission on the valve body (Referred to as the “control solenoid valve assembly”). The TCM (TEHCM) incorporates Solenoids, pressure switches, TFT and it is bolted to the valve body. A special spring loaded bracket is used to force the TCM against a heat sink on the valve body. Failure to install the bracket will result in TCM thermal shutdown
- Remote mounted, off axis, Chain Driven Vane type oil pump
- Internal Mode Switch (IMS) equipped
- Performance Algorithm Shifting (PAS) programming
- Performance Algorithm Lift foot (PAL) programming
- Sport mode and TAP shift equipped
- Adaptive Strategies with fast learn capabilities
- Reverse lock out feature
- Grade Braking
- Fwd/Awd applications can be dingy towed but Awd applications cannot be dolly towed. Neither application can be towed with the rear wheels in the air, as would happen when the vehicle is being towed by a tow truck. All the applications utilize a “Lube trough” to provide lubrication during towing. Towing the vehicle with the rear wheels elevated will result in a lube failure do to oil draining out of the lube trough.

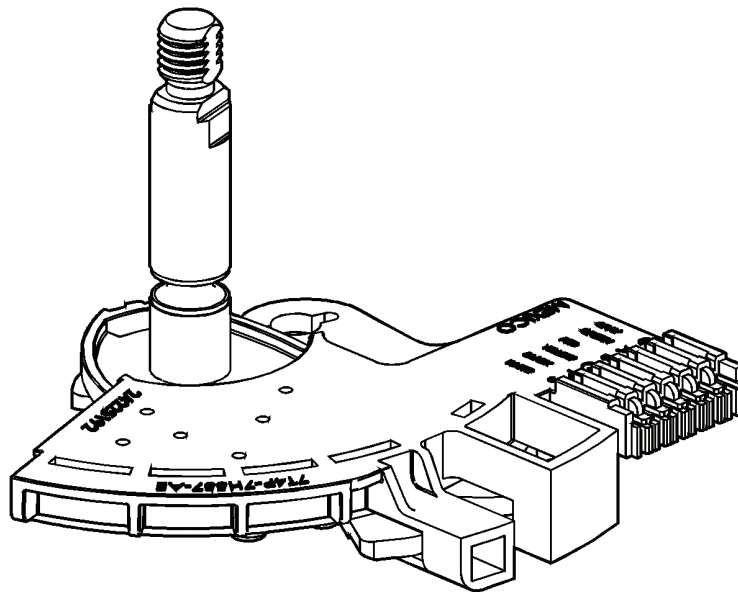
RATIOS:	
1st	4.48-1
2nd	2.87-1
3rd	1.84-1
4th	1.41-1
5th	1-1
6th	.74-1
REV	2.88-1
Final Drive 2.77-1 or 3.16-1	

6T70/6T75 Ford 6F55

Internal Mode Switch

The 6T70/6T75 internal mode switch is connected mechanically to the manual shaft similar to the 4T65E application. Electrically the IMS operates similar to other GM IMS applications.

Care must be taken when replacing the IMS on the 6T70/6T75 applications. When the IMS nail is removed and the IMS and manual shaft are removed be careful not to pull the parking rod too far. If the parking rod becomes dislodged from the parking pawl you will need to remove the transmission and disassemble it to reinstall the park rod.



6T70/6T75 Ford 6F55

Internal Mode Switch (continued)

The TCM sends a bias voltage to the IMS on 4 circuits, A, B, C, P. Pin N is used for Park/Neutral starting operations and is supplied by the ECM. As the range selector is moved the IMS will ground/un-ground the circuits or circuit required to indicate the specific manual valve position. By noting the voltage sequence produced, the TCM will be able to identify the range that was selected.

Selector Position	Range A	Range B	Range C	Range P
Park	Low	High	High	Low
Park/Reverse	Low	Low	High	Low
Reverse	Low	Low	High	High
Reverse/Neutral	High	Low	High	High
Neutral	High	Low	High	Low
Neutral/D6	High	Low	Low	Low
D6	High	Low	Low	High
D6/D4	Low	Low	Low	High
D4	Low	Low	Low	Low
D4/D3	Low	High	Low	Low
D3	Low	High	Low	High
D3/D2	High	High	Low	High
D/2	High	High	Low	Low
Illegal	High	High	High	High
Illegal	Low	High	High	High

Low = Grounded (0Volts)

High = Open (Source Voltage)

6T70/6T75 Ford 6F55

Speed Sensor

The speed sensors are “hall effect” style assemblies. The input speed sensor is mounted externally in the case side cover next to the line pressure tap. The output speed sensor is mounted under the valve body in the case. The TCM provides a signal voltage of 8.3-9.3 volts for the sensor operation.

The TCM will monitor the frequency of the signal to determine the input or output speed. Input Speed Sensor signals are generated by the rotation of the 3-5-R/4-5-6 clutch assemblies and are used to calculate gear ratio and slip rates. The Output Speed Sensor signal is generated by the rotation of the transfer gear. The OSS is used for indicating Vehicle speed for shift pattern control as well as Ratio calculations.

NOTE: Replacing the ISS in the vehicle will require a tether tool such as DT47734

Shift @ TP	KM/H	MPH	OSS (RPM)
1-2 @ 12.5	18	11.2	400
2-3 @ 12.5	34	21.1	755
3-4 @ 12.5	46	28.6	1021
4-5 @ 12.5	60	37.3	1332
5-6 @ 12.5	74	46	1643
6-5 @ 12.5	69	42.9	1532
5-4 @ 12.5	69	42.9	1532
4-3 @ 12.5	43	26.7	955
3-2 @ 12.5	16	9.9	355
2-1 @ 12.5	16	9.9	355
1-2 @ 25	36	22.4	799
2-3 @ 25	59	36.7	1310
3-4 @ 25	78	48.5	1732
4-5 @ 25	94	58.4	2087
5-6 @ 25	150	93.2	3331
6-5 @ 25	69	42.9	1532
5-4 @ 25	52	32.3	1155
4-3 @ 25	43	26.7	955
3-2 @ 25	16	9.9	355
2-1 @ 25	16	9.9	355

6T70/6T75 Ford 6F55

Pressure Switch and Clutch Range Reference

Pressure Switch

The pressure switches are housed as part of the control solenoid valve assembly (TEHCM). 4 switches are used, 1, 2, 3 and 4. The switches act as an input to the TCM and are used for 2 basic purposes:

- To monitor clutch regulator valve and clutch hydraulic operation
- To monitor clutch CVI (Adaptive learning)

TFP Switch	Clutch/circuit Monitored
1	1-2-3-4 Clutch
2	3-5-R Clutch
3	2-6 Clutch
4	4-5-6 and L/R Clutch

Range Reference Chart

The Low/REV clutch is applied when the vehicle is in a forward range and the vehicle is stationary. As vehicle speed is indicated, the L/R clutch will be released. This increases torque capacity under load with the vehicle stationary

COMPONENT	PARK NEUTRAL	REV	1 ST BRK	1 ST	2 ND	3 RD	4 TH	5 TH	6 TH
1-2-3-4 CLUTCH			ON	ON	ON	ON	ON		
3-5 REV CLUTCH		ON				ON		ON	
4-5-6 CLUTCH							ON	ON	ON
LOW/REV CLUTCH	ON	ON	ON						
2-6 CLUTCH					ON				ON
LOW ONE WAY			ON	ON					

6T70/6T75 Ford 6F55

Shift Solenoid Operation

Shift solenoid and PCS operation is controlled by the TEHCM (TCM). The TCM regulates the feed voltage to the solenoids to a value between 8.3-9.3V. The TCM then regulates the current flow through the solenoids. The shift solenoids are On/Off design with the TCM controlling the power for the solenoid. The pressure control solenoids are high side PWM controlled. The TCM is over current and overtemp protected.

Bosch refers to the solenoid's by their state, NL or NH. Normally High (N.H.) is used to describe a solenoid that allows pressure to travel to the clutch when the solenoid is turned off. Normally Low (N.L.) is used to describe a solenoid that prevents pressure from getting to a clutch when the solenoid is turned off. The solenoids are protected by the filter plate. The filter plate is housed between the valve body and the control solenoid valve assembly (TEHCM) and must be replaced anytime the valve body or control solenoid valve assembly (TEHCM) is replaced or unbolted from each other. The Filter plate is serviced with the control solenoid valve assembly (TEHCM) but it must be ordered separately if you are ordering a valve body.

NOTE: If the Control valve body assembly is removed from the case the support seal located in the case must also be replaced.

GEAR	SS1	SS2	PCS 2 (N.H.)	PCS3 (N.H.)	PCS4 (N.L.)	PCS5 (N.L.)
PARK	ON	ON	OFF	ON	OFF	OFF
REVERSE	ON	OFF	ON	ON	OFF	OFF
NEUTRAL	ON	ON	OFF	ON	OFF	OFF
1 ST ENG BRK	ON	ON	OFF	ON	OFF	ON
1 ST	OFF	ON	OFF	OFF	OFF	ON
2 ND	OFF	ON	OFF	OFF	ON	ON
3 RD	OFF	ON	ON	OFF	OFF	ON
4 TH	OFF	ON	OFF	ON	OFF	ON
5 TH	OFF	ON	ON	ON	OFF	OFF
6 TH	OFF	ON	OFF	ON	ON	OFF

6T70/6T75 Ford 6F55

Solenoid Cleaning Process

An automated process is available that aids in cleaning debris from the solenoid assembly. Your scan tool will instruct the TCM (TEHCM) to cycle the solenoids while the system is pressurized to clean the solenoids. The transmission does not need to be disassembled to perform the cleaning process. Simply follow the instructions on the scan tool to activate the cleaning program. This process should be completed prior to attempting to diagnose the transmission with the DT-47825-1 tools as described below. If the cleaning process is unsuccessful then you should diagnose the concern with DT-47825-1

Solenoid Diagnostics

Like other GM transmissions, diagnosis is designed around the use of a quality scan tool. With the 6T70/6T75 this could not be more true as the need to access scan data is critical. Unlike other GM transmissions you have become accustomed to working with over the years, the 6T70/6T75 internal electrical components are not hard wired to the rest of the vehicle via the transmission harness. This means that the diagnostic process has changed considerably. Diagnosis is divided into 2 categories, scan diagnostics and test plate/air check diagnostics. Solenoid and valve body diagnosis requires the following tools:

- A quality scan tool capable of communicating and commanding the TCM and its solenoids.
- Tool number DT 47825-1 Solenoid test plate and jumper harness DT47825-20

Remove the Control Solenoid Valve Assembly from the transmission. Install tool DT 47821-1 onto the Control Solenoid Valve Assembly (5Nm 44 Lb In). Apply regulated shop air (90-100 psi) to the tool. Connect the scan tool to the Control Solenoid Valve Assembly.

Command the solenoid ON/OFF air pressure should be present on the gauge and then it should exhaust as the solenoid is cycled. If the solenoid or valve are malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly.

If the solenoid checked OK, install the gauge on another solenoid port and command that solenoid ON/OFF with the scan to repeat the process.

6T70/6T75 Ford 6F55

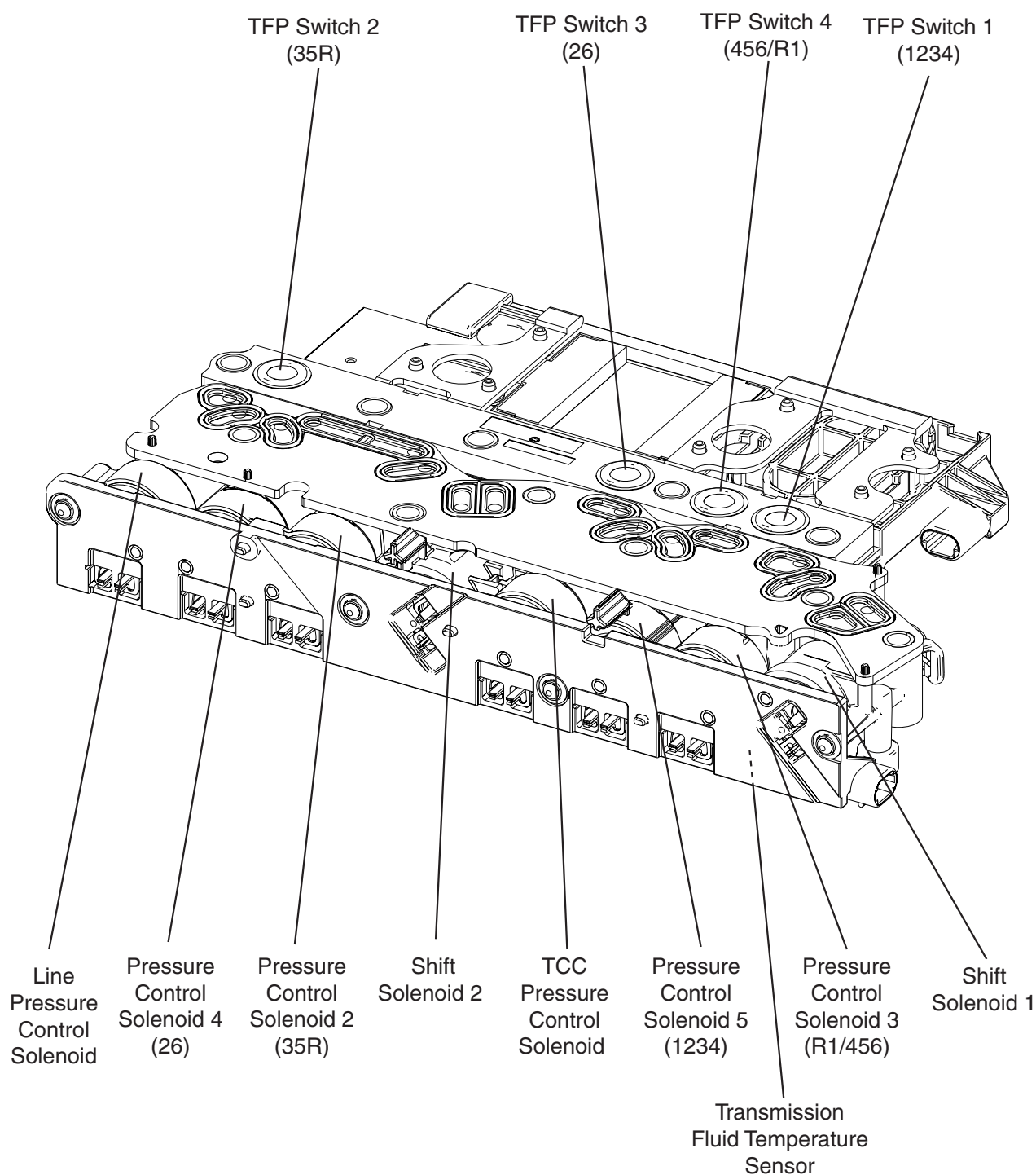
NOTE: If the solenoid or valve is malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly (TEHCM)

NOTE: The TCM (TEHCM) will normally cycle several of the solenoids ON/OFF to help keep the solenoids and the valves free of debris. Therefore this cleaning function (Dither) may cause the gauge to flicker when the TCM is cleaning the solenoid you are testing.

Solenoid	Test Plate Port	Key On, Engine Off (KOEO) Normal State	Commanded State	
Line PC Solenoid 1	G	No flow to gage	On - 68-103 Kpa (10-15 psi) per Commanded Amp	
PC Solenoid 2	C	No flow	On - Full flow	Off - No flow
PC Solenoid 3	A	Full flow	On - Full flow	Off - No flow
PC Solenoid 4	B	No flow	On - Full flow	Off - No flow
PC Solenoid 5	F	No flow	On - Full flow	Off - No flow
Shift Solenoid 1	H	No flow	Off - No flow	On - Full flow
Shift Solenoid 2	D	No flow	Off - No flow	On - Full flow
TCC PC Solenoid	E	No flow	On - Full flow	Off - No flow

6T70/6T75 Ford 6F55

Solenoid Assembly and TCM



6T70/6T75 Ford 6F55

Adaptive Learning

The 6T70/75 are fully equipped with several adaptive learning strategies. As with some other GM applications you will need to erase the adaptive values and perform a “Fast Learn” prior to operating the vehicle. Adapts and fast learn procedures should be performed if any of the following occur:

- Internal Transmission repairs have been performed
- The valve body was replaced
- The Control Solenoid valve assembly was replaced
- The TCM was recalibrated
- Internal repairs were performed that could effect shift quality

NOTE: Fast learn is not required if a GM New or GM Rebuilt 6T70/6T75 is used. The transmission is fast learned prior to it being shipped from the plant

To perform a fast learn:

- Use a scan tool capable of performing the fast learn procedure
- TFT 158-230°F (70-110°C), Move the selector in/out of gear 3 times
- Select the fast learn process from the scan tool menu
- Place the transmission in Drive with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume. Place the transmission in Reverse with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume
- Shut off the engine for at least 30 seconds, open and close the door to allow “RAP” to expire or false DTC’s may set, After a minimum of 30 seconds the car can be restarted , power off the scanner
- The process is now complete

The fast learn procedure will not run if:

- DTC’s are set
- TFT is not between 158-230 °F (70-110°C)
- The brake switch is not working
- TP is 0% but engine RPM increases during the test
- P/N switch is improperly adjusted or is not functioning correctly
- Line pressure control system is malfunctioning

New Service Manual Process

For 25 years General Motors and the aftermarket service manual providers have used a specific format for their service manuals for all applications.

Starting with the 2006 model year, GM will roll out a new format as well as a new process that must be followed to diagnose GM vehicles. This process is likely to be adopted by most if not all of the aftermarket manual providers. The new format is being introduced on 3 models, Y- car (Corvette, XLR) W- car (Impala/Monte Carlo and D-car (Cadillac STS). Known as the “Global Service Information system” the manual and its format will change how you, the technician, use the manual. The changes include:

- Moving several items into different sections. Examples include moving cruise control operation from the engine section to the accessories section. Moving the Power take off section from the Accessories section to the Transmission section. Moving the transfer cases from the driveline/axle section to the transmission section. Several other sections as well as subsections have been relocated above and beyond those mentioned above.
- Eliminating diagnostic DTC charts/tables as you currently know them.
- Reducing redundancy by eliminating duplication of material from one section to another section
- Fewer words but more information
- Rather than explaining exactly how to do a specific test, the manual will simply tell you to do the test, with the expectation that you know how to do the test.

This new format will require the technician to be more technically competent. The technician will need to understand this new format to effectively repair the vehicle. The process is designed to be broken down into 3 steps:

- Circuit/system description
- Circuit/system testing
- Component testing

Unlike the previous design, the new format does not force the technician down a specific path, but rather it allows the technician to decide where to go. This simply means it is more important than ever for the technician to have a thorough understanding regarding “theory of operation”.

The following is an example of the new format:

New Service Manual

Process (continued)

DTC P0961, P0962 or P0963

NOTE: DTC's will be combined when possible. This means one page will cover several DTC's for that circuit event though they may not indicate the same failures

DTC Description

DTC P0961: Line Pressure Control (PC) Solenoid System

DTC P0962: Line Pressure Control (PC) Solenoid Control Circuit Low Voltage

DTC P0963: Line Pressure Control (PC) Solenoid Control Circuit High Voltage

Diagnostic Fault Information

Perform the Diagnostic System Check prior to using this diagnostic procedure

Circuit	Short To Ground	Open/High Resistance	Short To Voltage	Signal Performace
Line PC Solenoid Control	P0962	P0963	P0963	P0961
Line PC Solenoid High Side Driver 2	P1833	P1833	P1834	P0961

NOTE: The type of failure is listed as shown above by the DTC. The bottom chart shows what the scan tool should display

Line PC Solenoid

Circuit	Short To Ground	Open	Short Performace
<i>Operating Conditions:</i> Engine running, normal operating temperature			
<i>Paramter Normal Range:</i> OK			
Line PC Sol. CKT Status	Short to GND	Open/Short to Volts	Open/Short to Volts
High Side Driver 2 CKT Status	Open/Short to GND	Open/Short to GND	Short to Volts

New Service Manual

Process (continued)

Circuit/System Description

The line pressure control (PC) solenoid is part of the control solenoid (w/body and TCM) valve assembly and is not serviced separately. The line PC solenoid regulates the transmission fluid line pressure. The TCM varies the current to the normally high line PC solenoid valve from 0.1 amp for maximum line pressure, to 1.1 amps for minimum line pressure. This is accomplished by varying the desired line pressure in kPa (psi)

Conditions for Running the DTC

- The engine run time is greater than 5 seconds.
- The line PC solenoid is commanded ON or OFF.

DTC P0961

DTC P0961 is not failed this ignition.

NOTE: The manual gives you a brief description of operation. It then lists the factors needed to set the DTC's.

DTC P0962

DTC P0962 is not failed this ignition.

DTC P0963

DTC P0963 is not failed this ignition.

Conditions for Setting DTC P0961

The TCM detects an internal electrical performance malfunction of the line PC solenoid control circuit and the actual line pressure does not equal the commanded line pressure for 300 milliseconds.

The TCM detects an internal low voltage electrical malfunction of the line PC solenoid control circuit for 300 milliseconds.

New Service Manual

Process (continued)

Action Taken When the DTC Sets

DTC P0962

- DTC P0962 is a Type A DTC.
- The TCM defaults the transmission to 3rd gear if the current gear is 1st, 2nd, or 3rd, or 5th gear if the current gear is 4th, 5th, or 6th gear.
- The TCM inhibits the torque converter clutch (TCC).
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.

DTC P0961, P0963

- DTCs P0961 and P0963 are Type C DTCs.
- The TCM freezes transmission adaptive functions.

Conditions for Clearing the DIC/DTC

NOTE: DTC default information, the criteria for clearing the DTC as well as information to aid with diagnosis is included.

- DTCs P0961 and P0963 are Type C DTCs.
- DTC P0962 is a Type A DTC.

Diagnostic Aids

When attempting to set solenoid electrical DTCs, ensure the TCM is warmed up and the transmission is operated in 2nd gear long enough to ensure a 3°C (5°F) increase in TCM substrate temperature. This will place the TCM under the optimal conditions to test solenoid electrical DTCs.

New Service Manual

Process (continued)

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

- [Automatic Transmission Inline 16-Way Connector End View](#)
- [Automatic Transmission Internal Connector End Views](#)
- [Automatic Transmission Related Connector End Views](#)

DTC Type Reference

- [Diagnostic Trouble Code \(DTC\) Type Definitions](#)
- [Diagnostic Trouble Code \(DTC\) List/Type](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

NOTE: Component location, definition, scan basics and “general” repair information links are included. Below you will see how to test the component and circuits. The results of the test are included. You will need to understand system operation to fully utilize this new format.

Scan Tool Reference

- [Scan Tool Output Controls](#)
- [Scan Tool Data List](#)
- [Scan Tool Data Definitions](#)

New Service Manual

Process (continued)

Circuit/System Testing

1. Ensure the transmission fluid temperature is between 50-80°C (122-176°F).
2. Operate the vehicle in 2nd gear long enough to ensure at least a 3°C (5°F) rise in TCM substrate temperature, then operate the vehicle in Park for 5 seconds.
3. Observe the scan tool data parameter Line PC Sol. CKT Status, the parameter should display OK.
 - => If the parameter displays Open, Short to Volts, Short to GND or if the DTC resets, perform the Control Solenoid Valve and Transmission Control Module Assembly Inspection.
 - => If no concerns are found during the inspection, replace the control solenoid (w/body and TCM) valve assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- 1 . Control solenoid (w/body and TCM) valve assembly replacement. Refer to [Control Module References](#) for replacement, setup, and programming.
2. Perform the [Service Fast Learn Adapts](#) .

NOTE: Other information is listed such as how to replace the component and how to perform other services

NOTE: All of the information in “BLUE” is hyperlinked to other information if you are using electronic media. If you are using a regular paper shop manual you will need to look the information up in the various sections it is contained within

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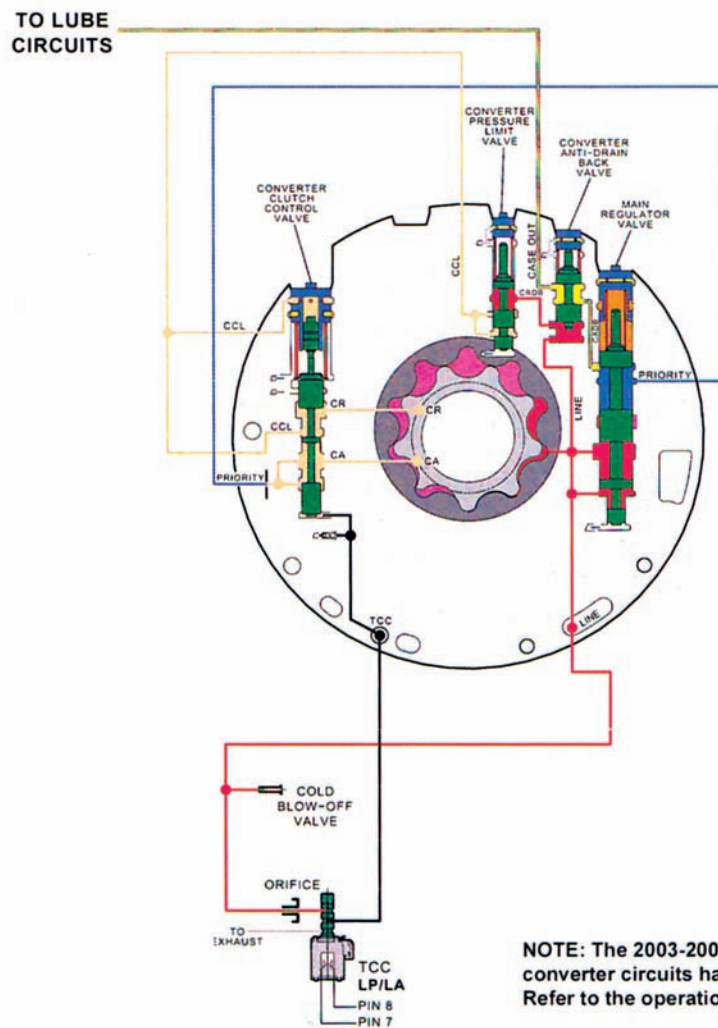
TR Sensor, TFT Sensor 132

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TorqShift

TCC Operation

The Computer can operate the TCC in all Forward range positions. This diagram shows the valves in the lock up off position. The TCC solenoid is a normally OPEN pulse width modulating solenoid that is fed main line oil in all ranges.

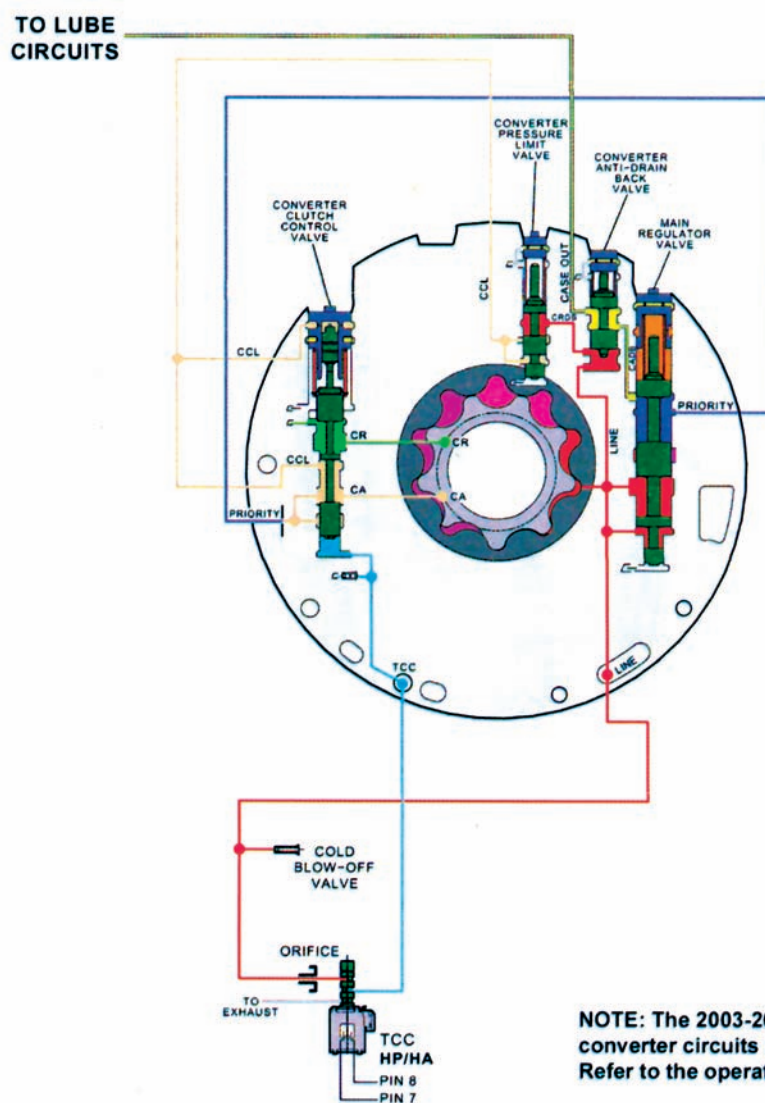


NOTE: The 2003-2004 and 2005 torque converter circuits have minor changes. Refer to the operation section for details.

TorqShift

TCC Operation (continued)

When the computer commands the solenoid to start modulating, the solenoid pushes the valve up and exhausts the oil from the front of the Converter Clutch allowing it to lock-up. This diagram shows the valves in the lock up on position

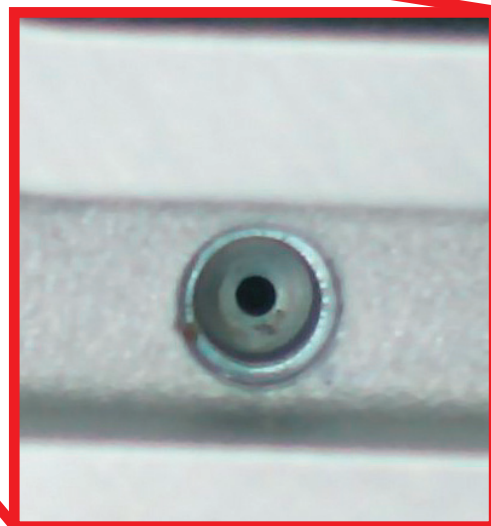
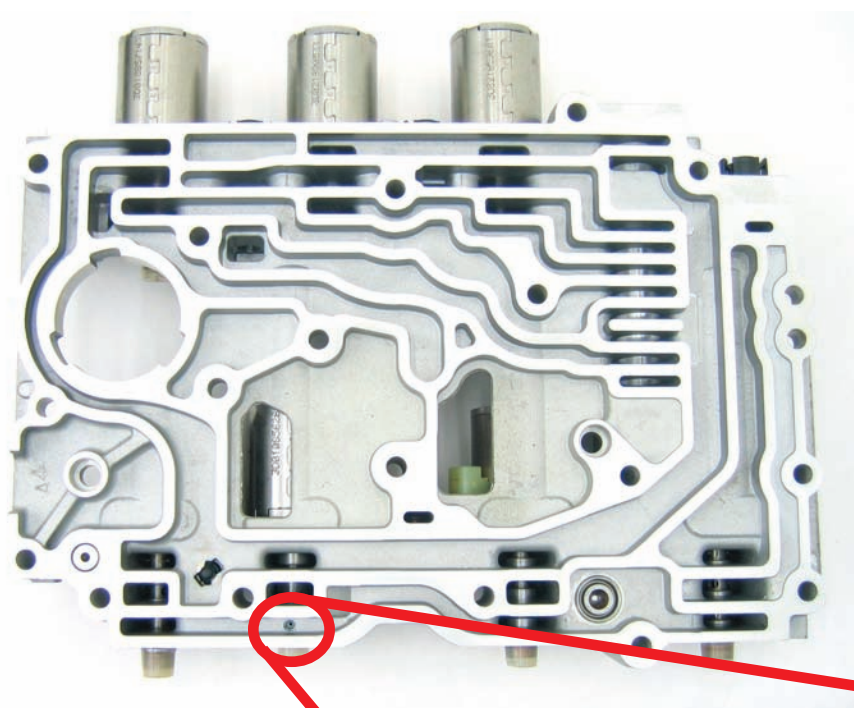


NOTE: The 2003-2004 and 2005 torque converter circuits have minor changes. Refer to the operation section for details.

TorqShift

No Lock-Up Before or After Rebuild

It is very important to be absolutely sure this orifice is clear of debris, if this passage is clogged, main line pressure can't get to the TCC solenoid. This will prevent the TCC from locking-up and cause a number of codes that associate to TCC operation.



TorqShift

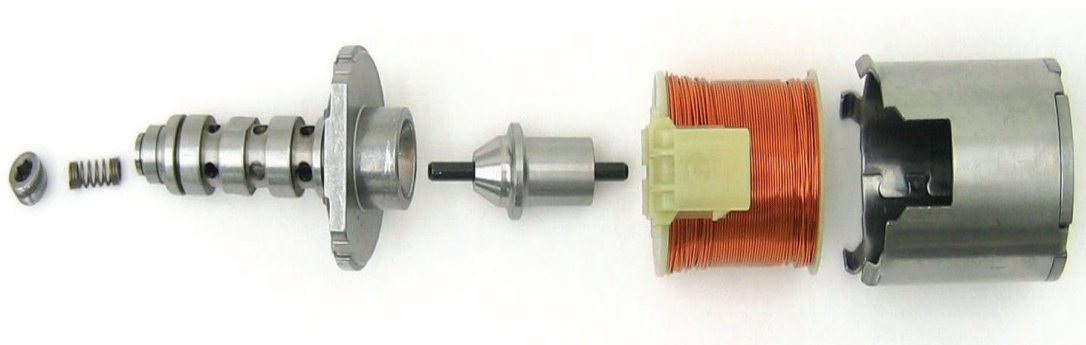
Lock-Up Test Tool

You have built the transmission the best you can and it wont lock up, now what? Simple: build a lock up tool. This tool will tell you absolutely that your Torque converter and pump are working correctly.

Bend the 4 tabs out to remove the solenoid parts.



Carefully pull the solenoid apart. It's not necessary to remove the allen screw and spring from the tip of the solenoid.



TorqShift

Lock-Up Test Tool (continued)

Secure the solenoid plunger to the Snout of the solenoid with a small hose clamp. Be sure the screw portion of the hose clamp is aligned with flat on the solenoid snout. If its not aligned properly it will not fit into the solenoid body



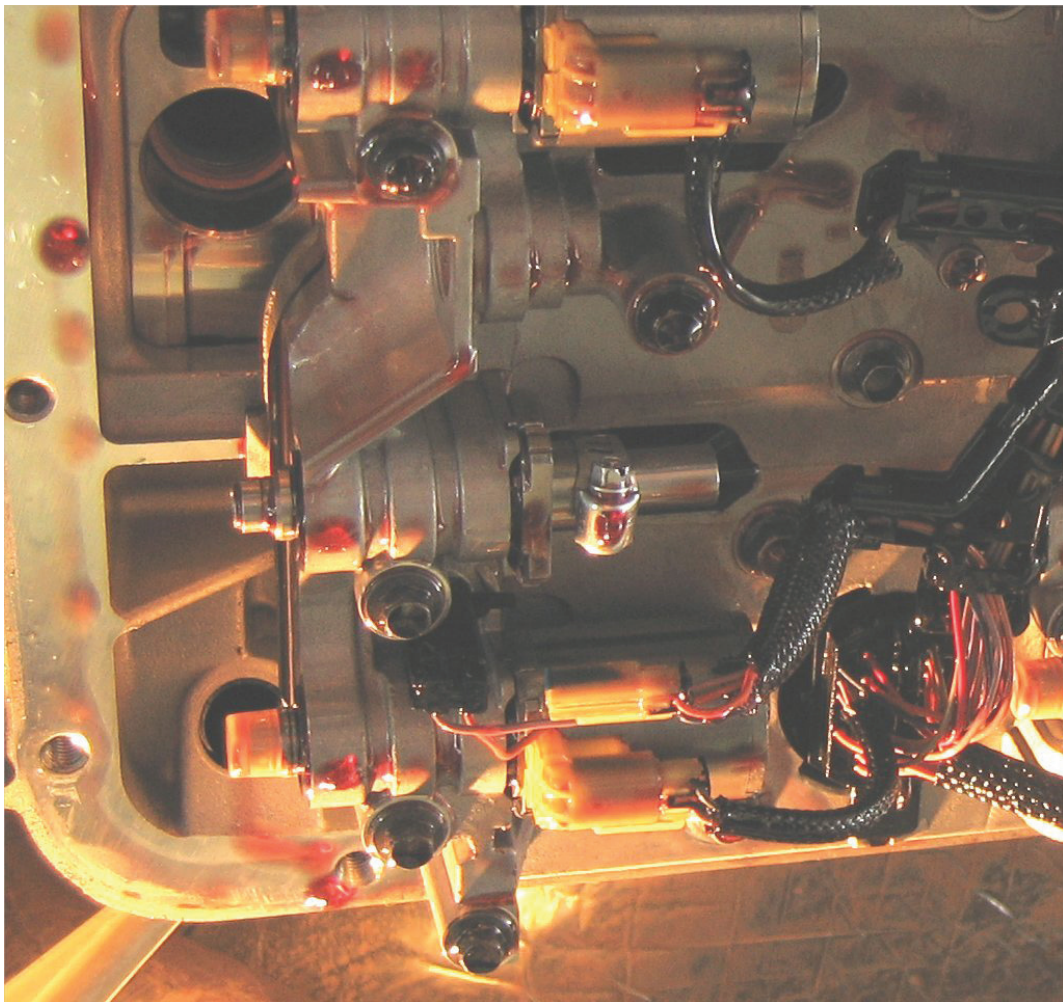
TorqShift

Lock-Up Test Tool (continued)

Remove existing TCC solenoid and install the tool as shown. Put the pan back on and fill with fluid.

CAUTION!

This will cause the TCC to be engaged in all ranges. If the TCC and the pump are operating properly the transmission will kill the engine right away. Engaging the transmission with the TCC on will be very hard on the new TCC lining, so keep this test to a minimum.



TorqShift

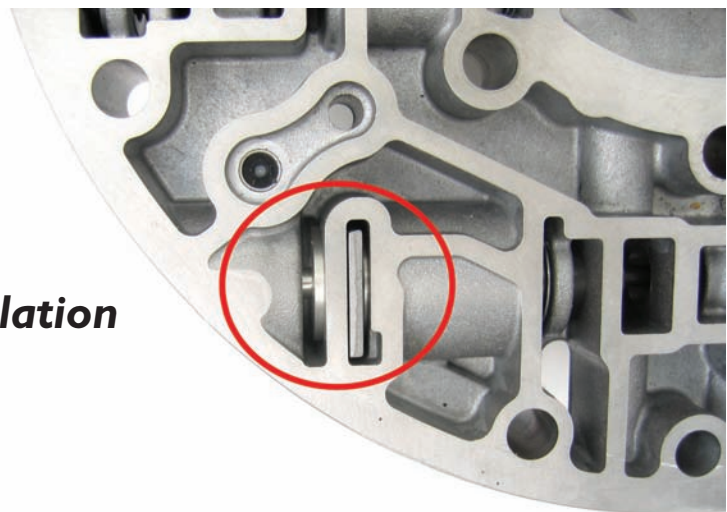
PI744 TCC Performance

This truck was setting a code 1744 TCC performance. This truck also had very little if any lock up feel to it at all. The problem was a misplaced retainer clip. Turns out the rebuilder had pushed the sleeve in one land too far.



Correct installation

This causes a MASSIVE loss of TCC apply oil.

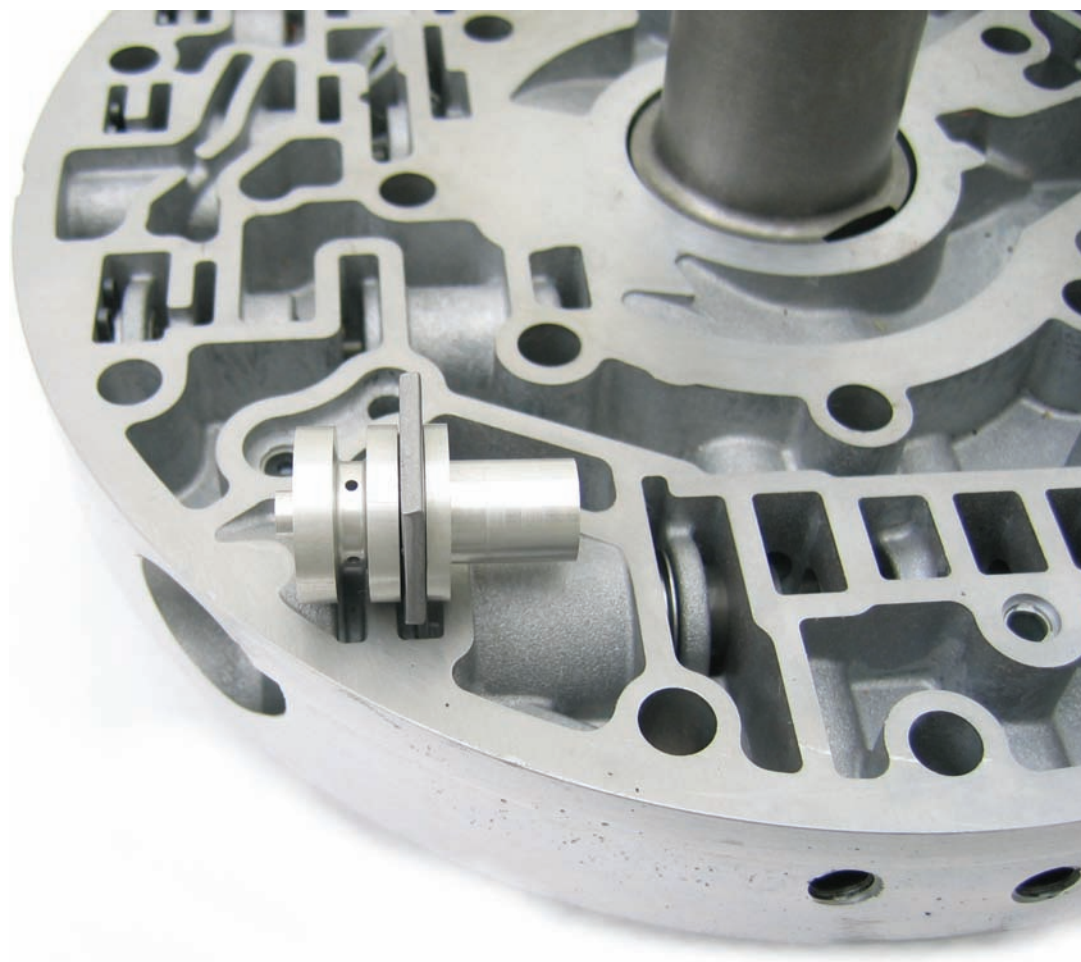


In-correct installation

TorqShift

PI744 TCC Performance

Use the following illustration to correctly install the clip into the pump housing.



TorqShift

TCC Stuck On

Before or after the rebuild and the TCC is on all the time killing the engine. We can modify a solenoid so that no oil is fed to the TCC control valve. If the TCC still locks up then we **KNOW** that this is going to be a hard part issue. This test will completely block oil from getting to the TCC solenoid.



Remove the End cap

**Using an Allen,
remove the screw
from the Solenoid
body**



**Remove the Allen
Screw and Spring**

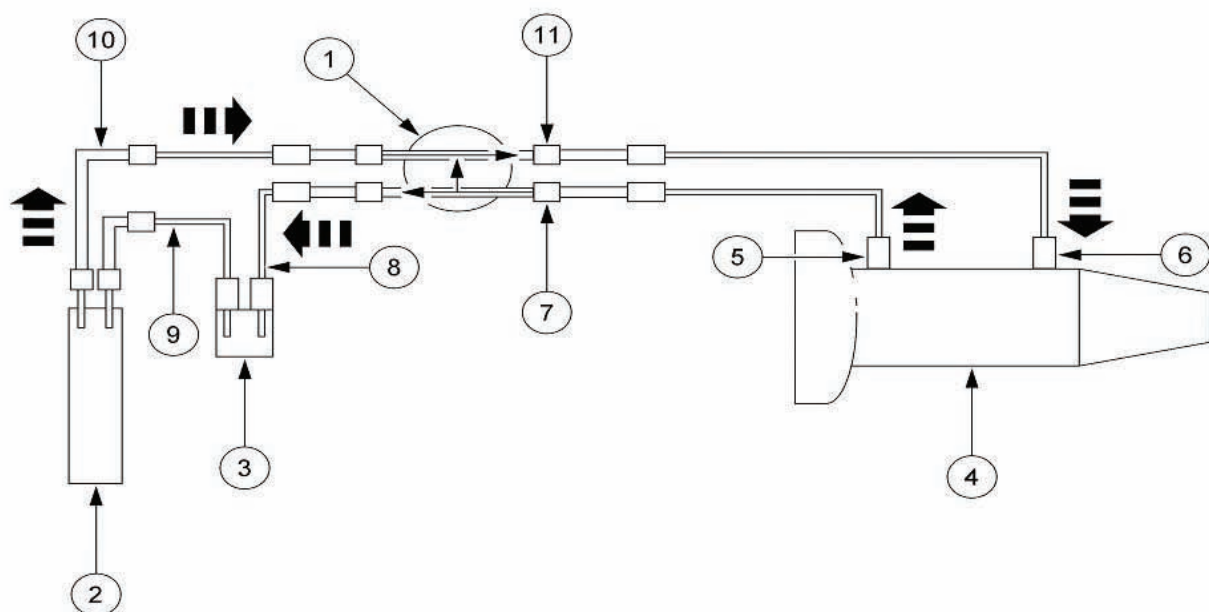
**Install check balls to block
the valve into the solenoid
snout**



TorqShift

Cooling and Filtration

The transmission fluid cooling system is one of the most critical areas in the transmission repair process. Any amount of debris left in this system can and will find its way back into the transmission and most critically into the super sensitive solenoids.



Basic Part#	Identification
1.	Remote filter adapter assembly
2. 7A095	Oil-to-air (OTA) auxiliary cooler
3.	Radiator-in-tank cooler
4. 7000	Transmission
5. 7D273	Transmission fluid cooler fitting (fluid flowing out)
6. 7D273	Transmission fluid cooler fitting (fluid flowing in)
7.	Transmission fluid cooler fitting (fluid flowing into remote filter)
8. 7B028	Transmission fluid cooler line (fluid flowing into radiator-in-tank cooler)
9. 7C410	Transmission fluid cooler line (fluid flowing into oil-to-air (OTA) auxiliary cooler)
10. 7890	Transmission fluid cooler line (fluid flowing from OTA into remote filter)
11.	Transmission fluid cooler fitting (fluid flowing from remote filter back into transmission)

TorqShift

Spin-On Filters

Low mileage spin on filter element



High mileage spin on filter from a transmission with burnt forward clutches



This is an In-pan filter before rebuild. These filters can gather material in the back end of the filter that would not be seen if you did not cut it open.



TorqShift

In-Line Filters

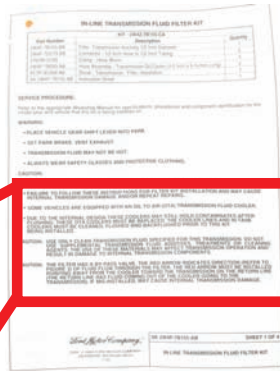
To protect your rebuild always install an in line filter kit. This kit is available from your local Ford dealer Part # FT-151



TorqShift

OTA Coolers

The instructions for the inline filter are not the big deal here. Most would take a look at the contents of the package and throw the instructions away without ever reading them. That is why we are looking at the very important caution notices on the very front page.



CAUTION:

- TO BE USED ON VEHICLES EQUIPPED WITH 1/2 INCH COOLER LINES ONLY.
- FAILURE TO FOLLOW THESE INSTRUCTIONS FOR FILTER KIT INSTALLATION AND MAY CAUSE INTERNAL TRANSMISSION DAMAGE AND/OR REPEAT REPAIRS.
- SOME VEHICLES ARE EQUIPPED WITH AN OIL TO AIR (OTA) TRANSMISSION FLUID COOLER.
- DUE TO THE INTERNAL DESIGN THESE COOLERS MAY STILL HOLD CONTAMINATES AFTER FLUSHING. THESE OTA COOLERS MUST BE REPLACED. THE COOLER LINES AND IN TANK COOLERS MUST BE CLEANED, FLUSHED AND BACKFLUSHED PRIOR TO THIS KIT BEING INSTALLED.

CAUTION: USE ONLY CLEAN TRANSMISSION FLUID SPECIFIED FOR THIS TRANSMISSION. DO NOT USE SUPPLEMENTAL TRANSMISSION FLUID ADDITIVES, TREATMENTS OR CLEANING AGENTS. THE USE OF THESE MATERIALS MAY AFFECT TRANSMISSION OPERATION AND RESULT IN DAMAGE TO INTERNAL TRANSMISSION COMPONENTS.

CAUTION: THE FILTER HAS A BY PASS VALVE. THE RED ARROW INDICATES DIRECTION (REFER TO FIGURE 3) OF FLUID FLOW THROUGH THE FILTER. THE RED ARROW MUST BE INSTALLED POINTING AWAY FROM THE COOLER TOWARD THE TRANSMISSION ON THE RETURN LINE (THE RETURN LINE HAS FLUID COMING OUT OF THE COOLER GOING TO THE TRANSMISSION). IF MIS-INSTALLED, MAY CAUSE INTERNAL TRANSMISSION DAMAGE.

TorqShift

Pump Failure

This is what can happen to a pump when the cooling system is not serviced correctly. This happened in less than a week after rebuild.



This is the result of clogged filters. This truck was moving down the road and just quit moving.



“Special Thanks to Bill Harling at Mr. Transmissions In Sudbury , Canada for the pump.”

TorqShift

Pump Failure (continued)

This is another example of pump wear in the early stages. This pump was not making any pressure when it came out of the truck

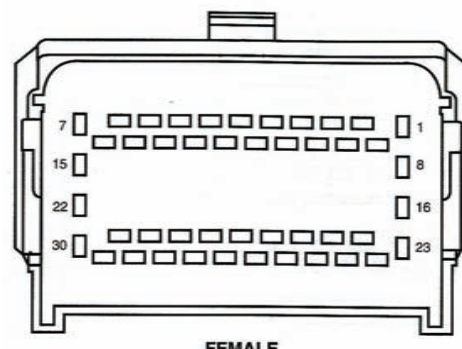


“Special Thanks to Doug Tisdell at Tisdell Transmissions in Londonberry, NH”

TorqShift

PCM Pin Chart

Econoline Series



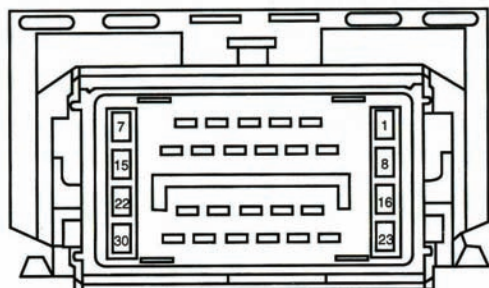
FEMALE

Pin	Circuit	Circuit function
1	1929 (GY/YE)	Reference voltage
2	480 (VT/YE)	Pressure Control (PC-A) solenoid (7G383)
3	1362 (DG/OG)	Reversing Lamp Control
4	—	not used
5	911 (WH/LG)	Transmission Control Indicator Lamp (TCIL), control
6	—	not used
7	391 (RD/YE)	Pressure Control (PC) solenoid, Power
8	—	not used
9	237 (OG/YE)	Shift Solenoid Pressure Control A (SSPC-A) (7J136), control
10	315 (VT/OG)	Shift Solenoid Pressure Control B (SSPC-B) (7J136), control
11	971 (PK/BK)	Shift Solenoid Pressure Control C (SSPC-C) (7J136), control
12	236 (BK/LG)	Shift Solenoid Pressure Control D (SSPC-D) (7J136), control
13	125 (DB/WH)	Shift Solenoid Pressure Control E (SSPC-E) (7J136), control
14	924 (BN/OG)	Torque Converter Clutch (TCC) solenoid (7J136), control

Pin	Circuit	Circuit function
15	—	not used
16	—	not used
17	—	not used
18	—	not used
19	—	not used
20	—	not used
21	—	not used
22	1930 (TN/LG)	Transmission Range Sensor Assembly (TR-P) (7H557), Ground
23	—	not used
24	—	not used
25	199 (LB/YE)	Transmission Range Sensor Assembly (TR-P) (7H557), signal
26	923 (OG/BK)	Transmission Fluid Temperature (TFT) sensor (7H141) signal
27	134 (GY/OG)	Intermediate Shaft Speed (ISS) sensor (7M101), signal
28	136 (DB/YE)	Output Shaft Speed (OSS) sensor (7H103), signal
29	970 (DG/WH)	Turbine Shaft Speed (TSS) sensor (7M101), signal
30	1931 (BN/PK)	Signal return

TorqShift

PCM Pin Chart



FEMALE

Pin	Circuit	Circuit function
1	371 (PK/WH)	Reference voltage
2	480 (VT/YE)	Pressure Control (PC-A) solenoid (7G383)
3	324 (YE/LG)	Reversing lamps relay, control
4	463 (RD/WH)	Transfer case Neutral, signal
5	911 (WH/LG)	Transmission Control Indicator Lamp (TCIL), control (Tow/Haul)
6	–	not used
7	1876 (YE/WH)	Electronic Pressure Control (EPC) solenoid, Power, (Tow/Haul)
8	–	not used
9	237 (OG/YE)	Shift Solenoid Pressure Control A (SSPC-A) (7J136), control
10	315 (VT/OG)	Shift Solenoid Pressure Control B (SSPC-B) (7J136), control
11	971 (PK/BK)	Shift Solenoid Pressure Control C (SSPC-C) (7J136), control
12	236 (BK/LG)	Shift Solenoid Pressure Control D (SSPC-D) (7J136), control
13	125 (DB/WH)	Shift Solenoid Pressure Control E (SSPC-E) (7J136), control
14	924 (BN/OG)	Torque Converter Clutch (TCC) solenoid (7J136), control

Pin	Circuit	Circuit function
15	–	not used
16	–	not used
17	*925 (WH/YE)	Pressure Switch A (PS-A) (7E440), signal
18	*966 (LB/PK)	Pressure Switch B (PS-B) (7E440), signal
19	*535 (LB/RD)	Pressure Switch C (PS-C) (7E440), signal
20	*912 (WH/RD)	Pressure Switch D (PS-D) (7E440), signal
21	*539 (PK/LB)	Pressure Switch E (PS-E) (7E440), signal
22	570 (BK/WH)	Transmission Range Sensor Assembly (TR-P) (7H557), Ground
23	–	not used
24	–	not used
25	199 (LB/YE)	Transmission Range Sensor Assembly (TR-P) (7H557), signal
26	923 (OG/BK)	Transmission Fluid Temperature (TFT) sensor (7H141) signal
27	134 (GY/OG)	Intermediate Shaft Speed (ISS) sensor (7M101), signal
28	136 (DB/YE)	Output Shaft Speed (OSS) sensor (7H103), signal
29	970 (DG/WH)	Turbine Shaft Speed (TSS) sensor (7M101), signal
30	1875 (OG/WH)	Signal return

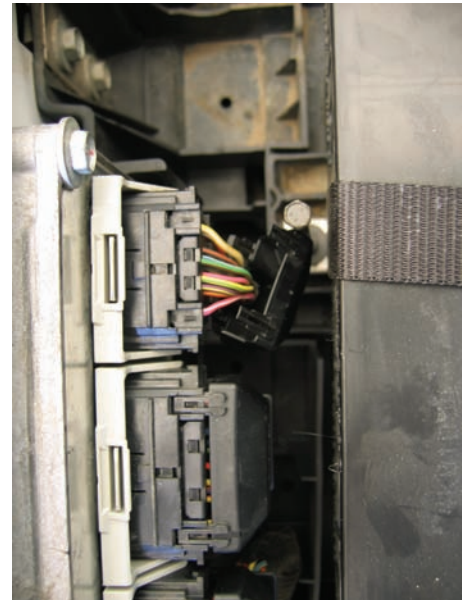
TorqShift

PCM Location



The PCM is located on the Driver's side fender well next to the battery

This is the PCM connector for the Transmission, you will need to remove the shield and housing in order to gain access to the wires.



PCM connector for the Transmission

TorqShift

TR Sensor Readings

These are true readings from a 2006 Ford F350. The purpose of these reading are to show you that the TR_DC percentage changes while the TR_FREQUECY stays constant. This is a normal operation and characteristic of the Ford processing system.



TorqShift

TR Sensor Readings (continued)



TorqShift

Codes

When scanning for codes there will be many generic codes that we will recognize as codes we have seen in years past.

- P0708 TR sensor
- P0740 TCC solenoid fault
- P0722 OSS sensor fault
- P1744 TCC solenoid performance
- P0713 TFT sensor

Clutch Codes

The 27 series codes are clutch packs either failed off or on.
These codes are often accompanied by solenoid malfunction codes.

- P2700 Coast Clutch
- P2701 Overdrive Clutch
- P2702 Intermediate Clutch
- P2703 Direct Clutch
- P2704 Low/Reverse Clutch

Note: The Forward Clutch is not controlled by a solenoid

TorqShift

Codes (continued)

P0900 are the latest generation of codes for the Torqshift series. These code definitions denote Electrical type failures. Shorted to ground and/or power and possibly open circuit failure. The key is to observe what other codes are present. I.E. The 2700 series clutch pack code.

Here are some examples of the P0900 series codes. Most times these code will also come with a note:

This code may also be generated by some other non-electrical hardware

- P0960 PC- A Line Pressure Control Solenoid - solenoid circuit open
- P0974 SSPC-A Coast Clutch Solenoid – solenoid or circuit shorted to power
- P0977 SSPC-B Overdrive Clutch Solenoid - solenoid or circuit shorted to power
- P0980 SSPC-C Intermediate Clutch Solenoid - solenoid or circuit shorted to power
- P0982 SSPC-D Direct Clutch Solenoid – solenoid or circuit shorted to ground
- P0986 SSPC-E Low/Reverse Solenoid – solenoid or circuit shorted to ground

TorqShift

Rear Planetary Failure.

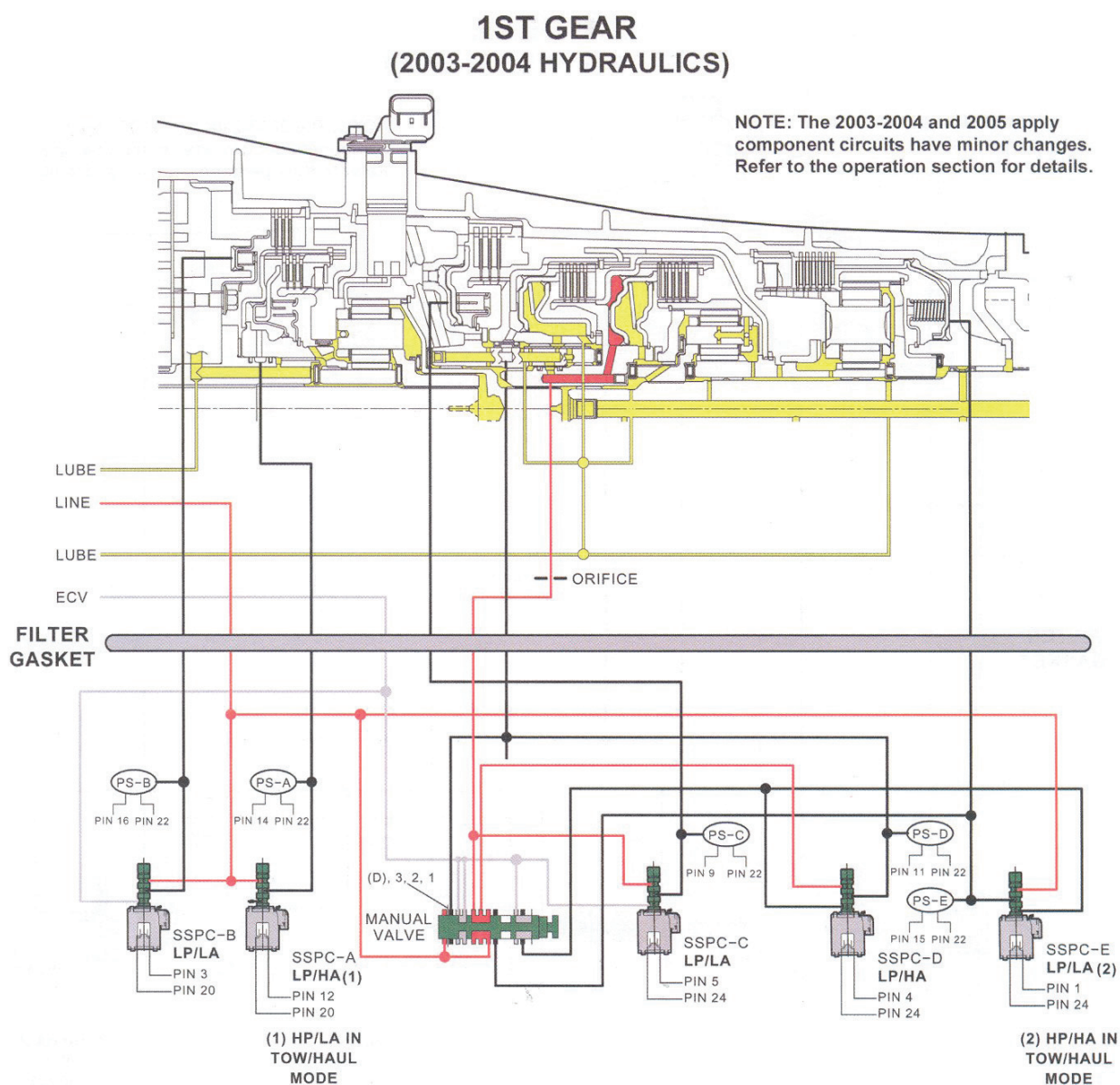
Some of the earlier models had an issue with the pinion pins backing out. The 2005 version will retrofit to 2003 applications.



TorqShift

Delayed Forward Engagements

The Forward Clutch is NOT controlled by a solenoid. The drum is fed main line oil directly from the Manual Valve. If a delayed engagement is felt, check the main line pressure. If the pressure is low, suspect a Manual Valve, Forward clutch and/or a worn pump.



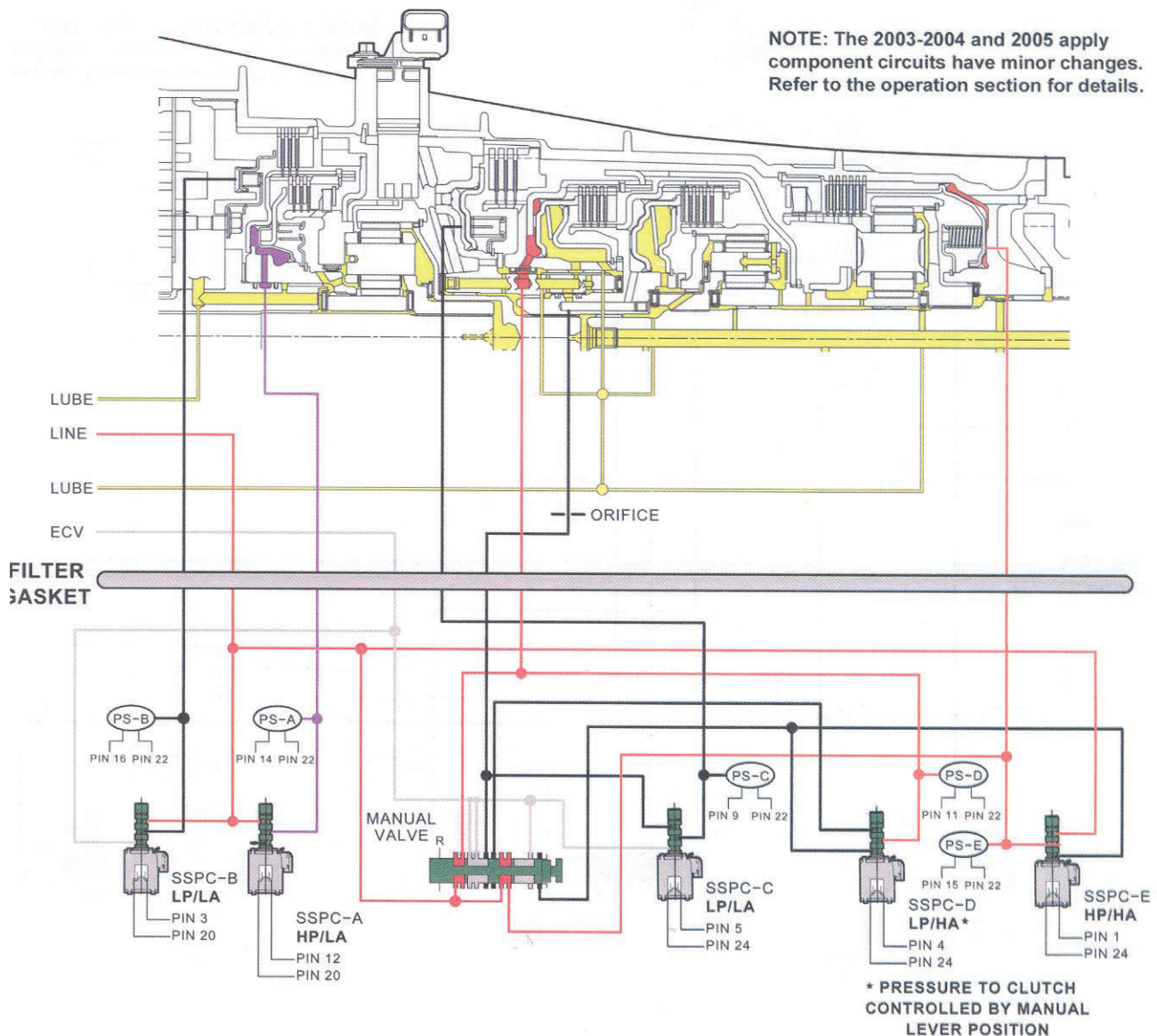
TorqShift

Delayed Reverse Engagement

In the Reverse position the Direct Clutch and the Low/Reverse Clutch are fed main line oil directly from the Manual Valve. If there is a delay in the reverse position check the main line pressure. If the pressure is low suspect a Manual Valve, Direct clutch, Low/Reverse Clutch and/or a worn pump.

REVERSE POSITION (2003-2004 HYDRAULICS)

NOTE: The 2003-2004 and 2005 apply component circuits have minor changes. Refer to the operation section for details.

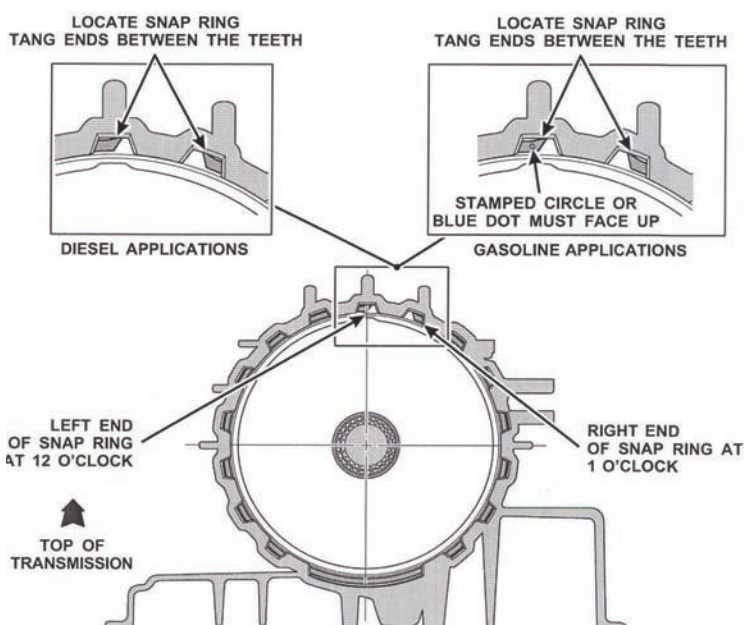


TorqShift

Delayed Reverse with No Engine Braking in Manual Low

The L/R snap ring becomes weak and bounces out of ring groove.

If the ring groove is badly damaged or lugs are missing the case must be replaced.



TorqShift

Erratic Shifts and/or Early and Late Shifts

We have many complaints of shift timing issues or simply shifts that “feel funny”. Many of these problems have been taken care of by disconnecting the battery or batteries. This will reset the Keep Alive Memory (KAM) and reset the computer back to its base settings.

It is a good practice to recalibrate the PCM to the latest level of calibration, particularly when hard parts have been replaced.

All Transmissions

Transmission Fluid Chart

Type Model Year	C6	E4OD	4R100	TorqShift	AOD	AODE	4R70W/ 4R70E	4R75W/E	A4LD	4R44E
1987	V/M				V/M				V/M	
1988										
1989		V/M								
1990										
1991						V/M				
1992										
1993										
1994							V/M			
1995										
1996										V/M
1997										V
1998			V/M				V			V
1999							V			V
2000							V			V
2001							V			V
2002							V			
2003							V			
2004							V	V		
2005							V	V		
2006							V	V		
2007							V	V		
Type Model Year	C6	E4OD	4R100	TorqShift	AOD	AODE	4R70W/ 4R70E	4R75W/E	A4LD	4R44E

SP

Mercon SP Part # XT-6-QSP

CVT

Continuously Variable Chain Type Part # XT-7-QCFT

P

Premium Automatic Fluid Part # XT-8-QAW

M5

Madza Specific Fluid Part # XT-9-QMM5

V/M

Mercon Part # XT-2-QDX and/or Mercon V Part # XT-5-QM

All Transmissions

Transmission Fluid Chart

Type Model Year	4R55E	5R55E	5R55N	5R44E	5R55W/S	6HP/26	6R60/75
1987							
1988							
1989							
1990							
1991							
1992							
1993							
1994							
1995							
1996	V/M						
1997		V					
1998		V					
1999		V					
2000		V	V				
2001		V	V	V			
2002		V	V	V	V		
2003		V		V	V		
2004		V		V	V		
2005		V		V	V		
2006		V		V	V	SP	SP
2007		V		V	V	SP	SP
Type Model Year	4R55E	5R55E	5R55N	5R44E	5R55W/S	6HP/26	6R60/75

SP

Mercon SP Part # XT-6-QSP

CVT

Continuously Variable Chain Type Part # XT-7-QCFT

P

Premium Automatic Fluid Part # XT-8-QAW

M5

Madza Specific Fluid Part # XT-9-QMM5

V/M

Mercon Part # XT-2-QDX and/or Mercon V Part # XT-5-QM

All Transmissions

Transmission Fluid Chart

Type Model Year	ATX	Mazda ATX	F4EAT	4F20E	CD4E	4F27E	AXOD	AX4S	4F50N	CVT
1987	V/M	V/M					V/M			
1988										
1989										
1990										
1991								V/M		
1992										
1993										
1994										
1995										
1996										
1997										
1998										
1999										
2000										
2001										
2002										
2003										
2004										
2005										
2006										
2007										
Type Model Year	ATX	Mazda ATX	F4EAT	4F20E	CD4E	4F27E	AXOD	AX4S	4F50N	CVT

SP Mercon SP Part # XT-6-QSP

CVT Continuously Variable Chain Type Part # XT-7-QCFT

P Premium Automatic Fluid Part # XT-8-QAW

M5 Mazda Specific Fluid Part # XT-9-QMM5

V/M Mercon Part # XT-2-QDX and/or Mercon V Part # XT-5-QM

All Transmissions

Transmission Fluid Chart

Type Model Year	AWF-21	AW ECVT	FNR5	6F50
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998				
1999				
2000				
2001				
2002				
2003				
2004				
2005	P	V/M		
2006	P		M5	
2007	P		M5	V
Type Model Year	AWF-21	AW ECVT	FNR5	6F50

SP Mercon SP Part # XT-6-QSP

CVT Continuously Variable Chain Type Part # XT-7-QCFT

P Premium Automatic Fluid Part # XT-8-QAW

M5 Mazda Specific Fluid Part # XT-9-QMM5

V/M Mercon Part # XT-2-QDX and/or Mercon V Part # XT-5-QM

Ford 4X4 Tow Feature

Neutral Tow Capabilities

Various vehicles are neutral tow capable. Refer to the following chart to determine neutral tow capability for specific vehicle applications, and to determine if a Service Kit is required to make the vehicle neutral tow capable.

2004-2006	Focus
2004	F-150 Heritage
2004-2005	Explorer Sport Trac
2004-2006	Escape, Explorer, F-150-350 Series, Ranger
2005-2006	Escape Hybrid
2007	Explorer Sport Trac
2006	Mark LT
2005-2006	Mariner
2006	Mariner Hybrid

Review the neutral tow application chart and order the kit, if applicable. Reprogramming of various modules may be required for some installations. Installation instructions are included with the kit.

Part Number	Part Name
6L2Z-7H332-A	Neutral Tow Kit
3L2Z-7H332-AA	Neutral Tow Kit
1L2Z-7H332-AB	Neutral Tow Kit

Ford 4X4 Tow Feature

Neutral Tow Capabilities

Neutral Tow Application Chart						
MODEL YEAR	VEHICLE	ENGINE	TRANS	DRIVELINE	CAPABILITY	KIT REQUIRED
2007	Explorer Sport Trac	4.6L V8	Auto	4x4	Yes	6L2Z-7H332-A
	Explorer Sport Trac	4.0L V6	Auto	4x4	Yes	1L2Z-7H332-AB
	Explorer Sport Trac	ALL	Auto	4x2	No	
2006	Focus	ALL	Manual	FWD	Yes	None
	Focus	ALL	Auto	FWD	No	
	Escape	14	Manual	ALL	Yes	None
	Escape/Mariner	ALL	Auto	ALL	No	
	Escape/Mariner Hybrid	Hybrid	CVT	ALL	Yes	None
	Ranger	ALL	Auto	4x4	Yes	3L2Z-7H332-AA
	Ranger	ALL	Manual	All (1) (2) (3)	Yes	(1) (2) (3)
	Explorer	4.6L V8	Auto	4x4	Yes	6L2Z-7H332-A
	Explorer	4.0L V6	Auto	4x4	Yes	1L2Z-7H332-AB
	Explorer	ALL	Auto	4x2	No	
	F-150	ALL	Auto	4x4 MSOF (2)	Yes	(2)
	F-150	ALL	Auto	4x4 ESOF	No	
	F-150 Harley	ALL	Auto	ALL	No	
	F-150	ALL	Manual	4x2 (3)	Yes	(3)
	Mark LT	ALL	ALL	ALL	No	
	F-250/F-350 Super Duty	ALL	Manual	All (1) (2) (3)	Yes	(1) (2) (3)
	F-250/F-350 Super Duty	ALL	Auto	4x2	No	
	F-250/F-350 Super Duty	ALL	Auto	4x4 ESOF	No	
	F-250/F-350 Super Duty	ALL	Auto	4x4 MSOF (2)	Yes	(2)
2005	Focus	ALL	Manual	FWD	Yes	None
	Focus	ALL	Auto	FWD	No	
	Escape	14	Manual	ALL	Yes	None
	Escape/Mariner	ALL	Auto	ALL	No	
	Escape Hybrid	Hybrid	CVT	ALL	Yes	None
	Ranger	ALL	Auto	ALL	No	
	Ranger	ALL	Manual	All (1) (2) (3)	Yes	(1) (2) (3)
	Explorer	ALL	Auto	4x2	No	
	Explorer	ALL	Auto	4x4	Yes	1L2Z-7H332-AB
	Explorer Sport Trac	ALL	Auto	4x4	Yes	3L2Z-7H332-AA
	F-150	ALL	Auto	4x4 MSOF (2)	Yes	(2)
	F-150	ALL	Auto	4x4 ESOF	No	
	F-250/F-350 Super Duty	ALL	Manual	All (1) (2) (3)	Yes	(1) (2) (3)
	F-250/F-350 Super Duty	ALL	Auto	4x2	No	
	F-250/F-350 Super Duty	ALL	Auto	4x4 ESOF	No	
	F-250/F-350 Super Duty	ALL	Auto	4x4 MSOF (2)	Yes	(2)
2004	Focus	ALL	Manual	FWD	Yes	None
	Focus	ALL	Auto	FWD	No	
	Escape	14	Manual	FWD (only)	Yes	None
	Escape	V6	Auto	ALL	No	
	Ranger	ALL	Auto	ALL	No	
	Ranger	ALL	Manual	All (1) (2) (3)	Yes	(1) (2) (3)
	Explorer	ALL	Auto	4x2	No	
	Explorer	ALL	Auto	4x4	Yes	1L2Z-7H332-AB
	Explorer Sport Trac	ALL	Auto	4x4	Yes	3L2Z-7H332-AA
	F-150	ALL	Auto	4x4 MSOF (2)	Yes	(2)
	F-150	ALL	Auto	4x4 ESOF	No	
	F-150 Heritage	ALL	Manual	4x2 (3)	Yes	(3)
	F-150 Heritage	ALL	Manual	4x4 (2) (3)	Yes	(2) (3)
	F-250/F-350 Super Duty	ALL	Manual	All (1) (2) (3)	Yes	(1) (2) (3)
	F-250/F-350 Super Duty	ALL	Auto	4x2	No	
	F-250/F-350 Super Duty	ALL	Auto	4x4 ESOF	No	
	F-250/F-350 Super Duty	ALL	Auto	4x4 MSOF (2)	Yes	(2)

(1) (ESOF) Electronic Shift On-the-Fly rotary control in 2-high position and the transmission in NEUTRAL.

(2) (MSOF) Manual transfer case shifted into Neutral.

(3) Manual Transmission in NEUTRAL.

5R44/55E

Shifter Stuck in the Park Position

Some Ford Rangers built prior to August 8, 2006 may have a concern of the shifter stuck in the Park position. This may be caused by the Brake Booster Push Rod misassembled from the factory.

1. Disconnect the Battery.
2. Remove the redundant speed control deactivation switch.
3. Remove the cover and the self-locking pin.
4. Remove the Brake stop lamp switch and stop lamp switch spacer from the brake booster push rod and the brake pedal assembly.
5. Remove the brake booster push rod from the brake pedal assembly.
6. Rotate the brake booster push rod 180 degrees (1/2 turn) from its original position.
7. Reinstall the brake booster push rod onto the brake pedal assembly.
8. Reinstall all other parts in reverse order.

6R60

Transmission Description

This transmission has an internal thermal bypass valve contained within the case. The thermal bypass valve will not allow the use of any type of transmission fluid exchange machine to be used on this transmission.

This transmission uses planetary gears with hydraulic electronic controls. The transmission control module (TCM) and the main control valve body units form a composite element that is installed as a single unit inside the automatic transmission.

This transmission has the following features:

- Six forward speeds
- Torque converter with an integral converter clutch
- Electronic shift and pressure controls
- Single planetary gear set
- Double planetary gear set
- Two fixed multi-disc clutches
- Three multi-plate clutches

All hydraulic functions are directed by electronic solenoids to control:

- Engagement feel
- Shift feel
- Shift scheduling
- Modulated torque converter clutch (TCC) applications

This transmission has a mechatronic unit also referred to as a TCM which contains:

- Turbine shaft speed (TSS) sensor
- Output shaft speed (OSS) sensor
- An internal P, R, N, D selector shaft position sensor
- Transmission fluid temperature (TFT) sensor

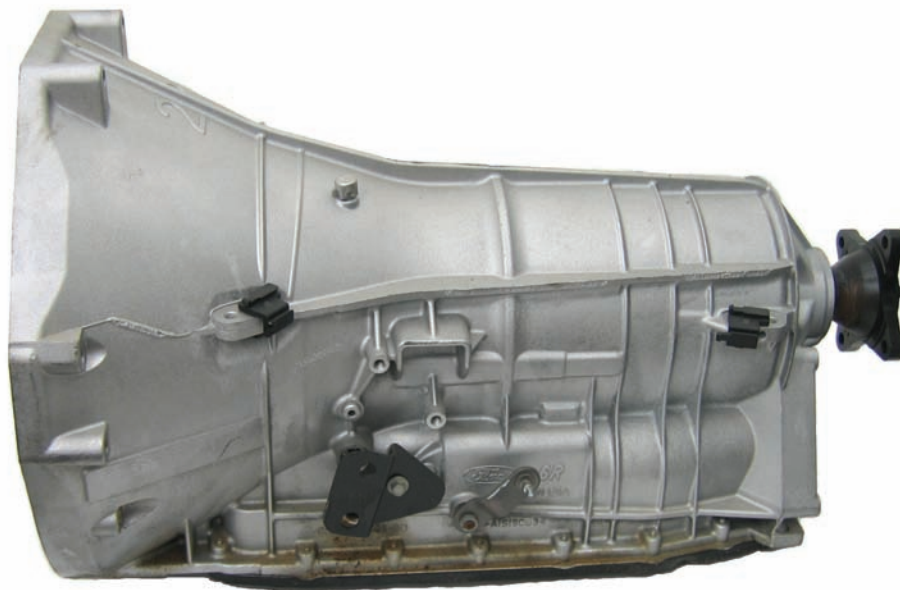
6R60

Transmission Description

Engine power reaches the transmission by a torque converter with an integral converter clutch. The 6 forward gears and one reverse gear are obtained from single planetary sets.

This automatic transmission is a 6-speed electronically controlled transmission comprising the basic elements of a TCM, main control valve body unit, torque converter, one solenoid valve and 6 pressure regulators. Gear selection is achieved by the control of automatic transmission fluid flow to operate various internal clutches. The TCM operates the electrical components and provides for the control of gear selection shift pressure, which increases refinement and torque converter slip.

In the event of a system fault, the TCM also provides for failure mode effect management (FMEM) to maintain maximum functional operation of the transmission with a minimum reduction in driver, passenger or vehicle safety. In the event of a total loss of control or electrical power, the basic transmission functions P, R, N and D are retained. Also 3rd or 5th gear is retained by the hydraulic system. The gear retained is dependent upon the gear selected at the time of the failure.



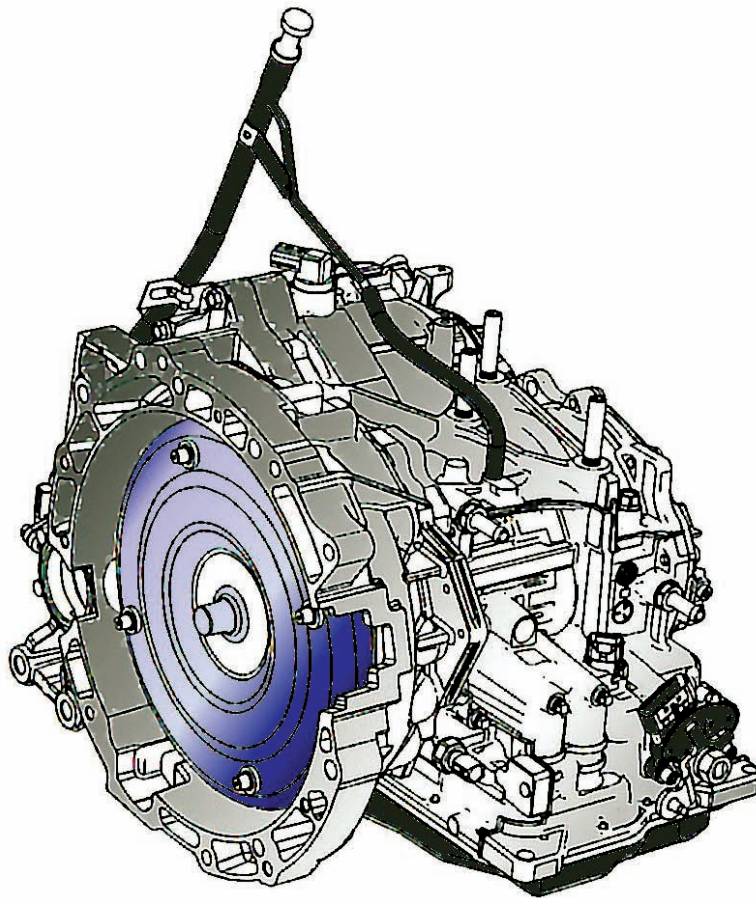
FNR5

Transmission Description

The FNR5 is a fully automatic, electronically controlled 5-speed transmission designed for front-wheel drive vehicles. Built for the Ford Fusion.

Its abbreviated designation FNR5 means:

- FN – front-wheel drive
- R – Model designation
- 5 – 5-speed transmission



FNR5

Transmission Description

The individual ratios are achieved through 2 planetary gear sets, connected one behind the other.

The individual components of the planetary gear sets are driven or held by means of 3 multi-plate clutches, a multi-plate brake, a brake band and a roller one-way clutch. The torque is transmitted to the final drive assembly through an intermediate gear stage.

FNR5 Automatic Transmission Fluid is the fluid specified for the FNR5 transaxle. The fluid is changed as directed by the Scheduled Maintenance Guide that is supplied with the vehicle.

The default gear for this transaxle is 3rd gear.

To minimize fuel consumption, the torque converter lock-up clutch is closed by the transmission control module (TCM) in 3rd, 4th and 5th gears depending on the throttle position and the vehicle speed.

The transmission has electronic synchronous shift control (ESSC), which guarantees extremely smooth gear shifting over the entire life of the transmission.

A hydraulic emergency operating program maintains limited operation in the event of failure of important electrical components.

The transmission can be tested using a diagnostic tool through the data link connector (DLC) in the passenger compartment.

The transmission also has its own fluid part # XT-9-QMM5



FNR5

Lever Positions and Operations

Manual selector lever position “P”

In manual selector lever position “P”, no gear is selected. The parking pawl is engaged manually by the manual selector lever cable and the shift shaft.

For safety reasons, always apply the parking brake whenever the vehicle is parked.

Manual selector lever position “R”

In manual selector lever position “R”, reverse gear is selected. REVERSE allows the vehicle to be operated in a rearward direction, at a reduced gear ratio.

Manual selector lever position “N”

In manual selector lever position “N”, no gear is selected. The driveline is not locked, so the wheels are free to rotate.

The vehicle may be started in NEUTRAL.

Manual selector lever position “D”

In manual selector lever position “D”, the transmission control allows all the gears to be selected.

Manual selector lever position “L”

In manual selector lever position “L”, the transaxle provides more engine braking when the accelerator pedal is released than in “D”.

If the manual selector lever is moved to position “L” at an excessive vehicle speed for 1st gear, the transmission control only allows the downshift to take place when the corresponding vehicle speed has been reached.

FNR5

Valve Body

The valve body contains 8 solenoid valves:

- Three pulse width modulation (PWM) solenoid valves
- Three shift solenoid (on/off) valves
- Two main regulating valve pressure control solenoids

The individual clutches and bands are supplied pressure from the PWM solenoid valves and the shift solenoid (on/off) valves and thus the gears are shifted.

The PWM solenoid valves allow direct actuation of the clutches and bands to make sure of extremely smooth gear shifting through precise pressure regulation.

The shift solenoid (on/off) valves switch the hydraulic path to the clutches and bands, reducing the number of required modulating valves.

The main regulating valve (variable force solenoid) makes sure that sufficient hydraulic pressure is available in all operating conditions.

FNR5

Valve Body (continued)

1. PWM solenoid valves

PWM solenoid valves control the pressure to the bands and clutches.

2. Shift solenoid (on/off) valves

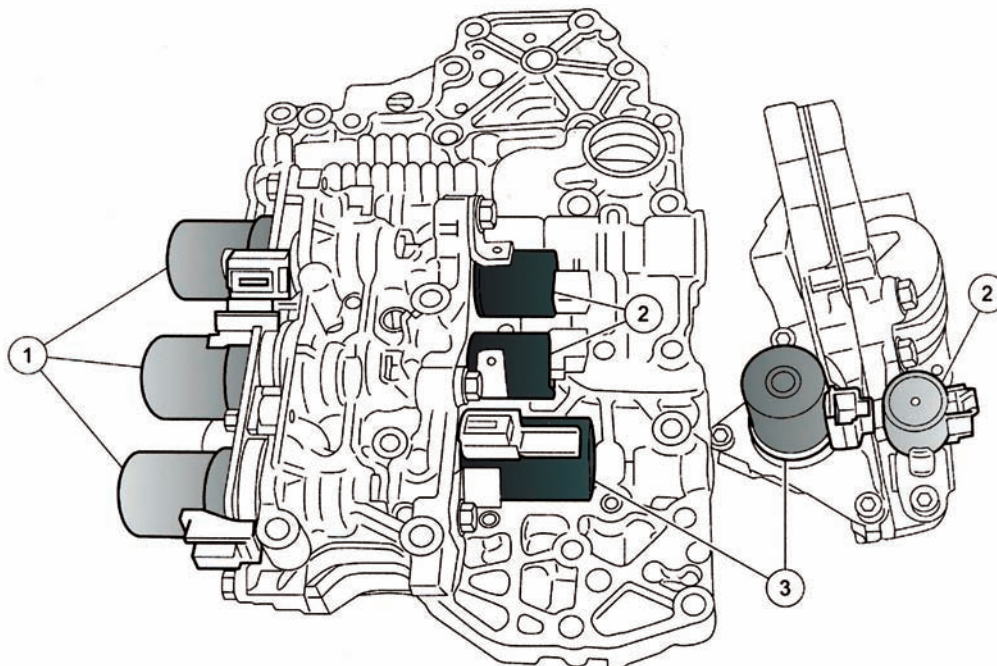
The shift solenoid (on/off) valves switch the different oil passages in the valve body to direct the pressure to the individual clutches and bands.

The shift solenoid valves are needed for direct actuation of the individual clutches and bands.

3. Main regulating valve pressure control solenoid

The main regulating valve (pressure control solenoids) control the required main line pressure for the individual transmission ranges.

The main line pressure is controlled dependent on the current engine load.



1. PWM Solenoids

2. Shift Solenoids On/Off

3. Pressure Control Solenoids

FNR5

TCM

The TCM is located under the instrument panel on the LH side. On vehicles with automatic transmissions, the TCM controls the transmission. In this case, a module with 16- and 24-pin connectors are used.

The TCM evaluates the incoming signals from the individual sensors and actuates the solenoid valves in the valve body of the transmission directly according to the operating state.

Diagnostic checks can be carried out on the transmission through the data link connector (DLC) above the central junction box (CJB).

Emergency Operating Program

If the correct gear shifting can no longer be guaranteed due to failure of certain signals, the TCM changes to an emergency operating program.

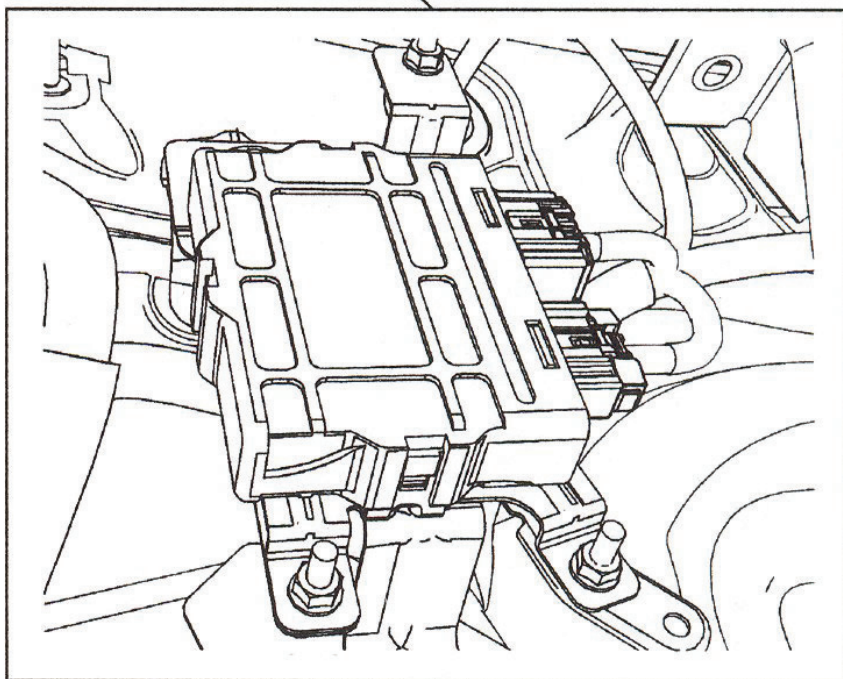
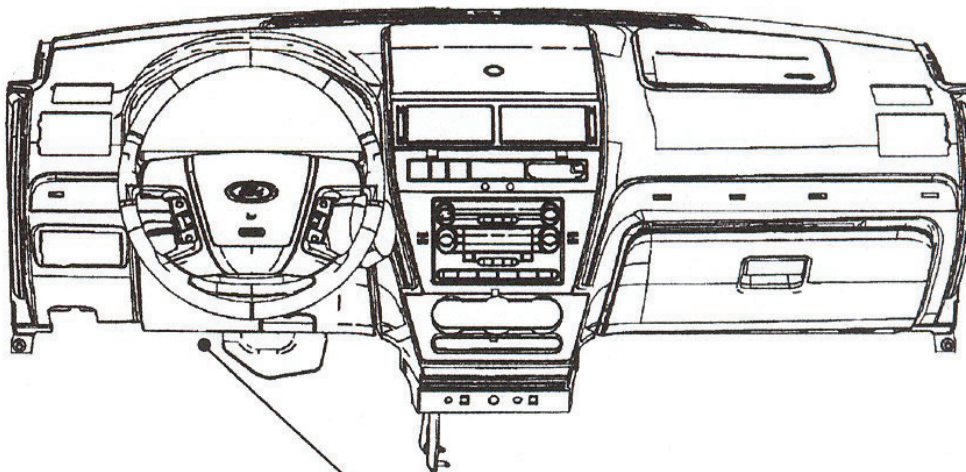
The driver is informed of the operation of the emergency operating program by the illumination of the powertrain warning indicator in the instrument cluster.

Continued motoring is guaranteed in the following limited conditions:

- Maximum main line pressure
- 3rd gear in manual selector lever positions “D”, “2” and “1” without the torque converter clutch
- Reverse gear in manual selector lever position “R”

FNR5

TCM Location



FNR5

Electronic Synchronous Shift Control (ESSC)

Control of Shift Operations

During a shift operation certain elements are released while others are actuated. Ideally, this process takes place simultaneously (synchronously) to avoid jerky gear shifting.

The time for the shift operation should remain within the time limits provided.

When the shift operation is controlled conventionally, the pressure buildup and reduction at the shift elements are set and defined for ideal conditions (synchronous shifting).

As there is no way of influencing the control in the event of different levels of wear in the shift elements, when the transmission has been used for a fairly high mileage it is possible that the pressure buildup and reduction may no longer be synchronous.

The result of premature pressure reduction at the element to be switched OFF is an unwanted rise in the turbine shaft speed as the element to be switched ON cannot transmit the input torque.

The result of delayed pressure reduction at the element to be switched OFF is an unwanted decrease in the turbine shaft speed as both shift elements transmit the input torque. In the process the torque is transmitted to the transmission housing through internal locking.

In both cases a jerk will be felt during the shift operation.

In addition, wear in the shift elements leads to a lengthening of the shift operation. Therefore, shifting takes longer when the transmission has accumulated a higher mileage.

FNR5

Electronic Synchronous Shift Control (ESSC)

Control of Shift Operations with ESSC

In the automatic transmission, electronic synchronous shift control (ESSC) is used.

ESSC monitors the shift operations and is able to adapt to the wear in the shift elements over the life of the transmission.

This is possible since the shift elements are actuated by modulating valves.

The system monitors the shift time whether the shift operation is synchronous.

If the TCM detects a deviation from the stored values for the shift time and synchronization of the shift operation, the pressure buildup or reduction is adapted accordingly.

Reference: Band/Clutch Application Chart

Gear/ Engaged Clutch	Primary Gearset					Secondary Gearset	
	Forward Clutch	Reverse Clutch	2-4 Brake Band	3rd/4th Clutch	Low/ Reverse Brake (OWC)	Direct Clutch	Reaction Brake (OWC)
Reverse		X			X		X
L1	X				X		X
L2	X		X				X
L3	X			X			X
L4			X	X			X
L5			X	X		X	
D1	X				(X)		X
D2	X		X				X
D3	X			X			X
D4			X	X			X
D5			X	X		X	

FNR5

Inputs

Throttle position (TP) sensor

The throttle position (TP) sensor is located on the throttle body. It supplies information to the PCM about the position of the throttle plate. The TCM receives the signal from the PCM. It also detects the speed of actuation of the throttle plate. The TCM uses the following functions, among other things:

- To determine the shift timing.
- To control the main line pressure
- To control the torque converter clutch

For kickdown in case of absence of the TP signal, the engine control uses the signals of the Mass Air Flow (MAF) and Intake Air Temperature (IAT) sensors as a substitute signal. The main line pressure is increased and hard shifts may occur.

Mass air flow (MAF) and intake air temperature (IAT) sensor

The mass air flow (MAF) sensor is located between the air cleaner housing and the air intake hose leading to the throttle housing. The intake air temperature (IAT) sensor is incorporated in the housing of the MAF sensor.

The MAF sensor, in conjunction with the IAT sensor, provides the PCM with the primary load signal. The TCM receives the signals from the PCM and uses them for the following functions, among other things:

- To control the shift operations
- To control the main line pressure

If the MAF sensor fails, the signal of the throttle position (TP) sensor is used as a substitute.

Crankshaft position (CKP) sensor

The crankshaft position (CKP) sensor is located on the engine/transmission flange. The CKP sensor is an inductive sensor which provides the PCM with information about the engine speed and position of the crankshaft.

The TCM receives the signals from the PCM and uses them for the following functions among other things:

- To control the torque converter clutch
- To check the torque converter slip
- To control the main line pressure

No substitute signal is available for the CKP sensor. If the signal is not present, the engine stops.

FNR5

TR Sensor, TFT Sensor

TR Sensor

The transmission range (TR) sensor is located on the manual shaft on the transmission housing. When the manual shaft engagement pin, located in the inner ring of the TR sensor, moves through the different positions. The signals are transmitted to the TCM, the reversing lamps and the starter inhibitor relay.

NOTE: Correct operation of the TR sensor is only guaranteed when the manual selector lever cable is adjusted correctly.

The signals of the TR sensor are used for the following functions:

- To recognize the manual selector lever position
- To actuate the starter inhibitor relay
- To actuate the reversing lamps

No substitute signal is available for the TR sensor.

If the connection is cut, the vehicle cannot be started.

TFT Sensor

The transmission fluid temperature (TFT) sensor is located on the internal wiring harness to the solenoid valves in the fluid pan. It is a resistor and measures the transmission fluid temperature.

The transmission fluid temperature is used by the TCM for the following functions:

- Applying the torque converter clutch is not permitted until the transmission fluid reaches a certain temperature.
- Engagement of 4th gear is prevented in extreme sub-zero temperatures until the normal operating temperature is reached.
- If the transmission fluid temperature is excessive, a pre-set fixed shift curve is selected and the torque converter clutch is closed in “2”, “3”, “4” and “5”; of the transmission warning indicator is activated. No substitute signal is available for the TFT sensor.

FNR5

Speed Sensors

Turbine Shaft Speed (TSS) Sensor

The Turbine Shaft Speed (TSS) sensor is located in the transmission housing over the transmission input shaft. The TSS sensor is an inductive sensor which senses the speed of rotation of the transmission input shaft.

The signal is used for the following functions:

- To control the shift operations
- To control the torque converter clutch
- To check the torque converter slip

If the TSS sensor fails, the signal of the output shaft speed (OSS) sensor is used as a substitute signal.

Intermediate Shaft Speed Sensor

The Intermediate Shaft Speed (ISS) sensor is located in the transmission housing over the transmission intermediate shaft. The intermediate shaft speed sensor is an inductive sensor which senses the speed of rotation of the transmission input shaft.

The signal is used for the following functions:

- To determine the shift timing
- To control the shift operations
- To control the torque converter clutch

If the intermediate shaft speed sensor fails, the signal of the output shaft speed and turbine shaft speed sensors is used as a substitute signal.

Output shaft speed (OSS) sensor

The output shaft speed (OSS) sensor is located in the transmission housing above the rotor in the differential.

The OSS sensor is an inductive sensor which detects the vehicle speed by means of a rotor on the differential.

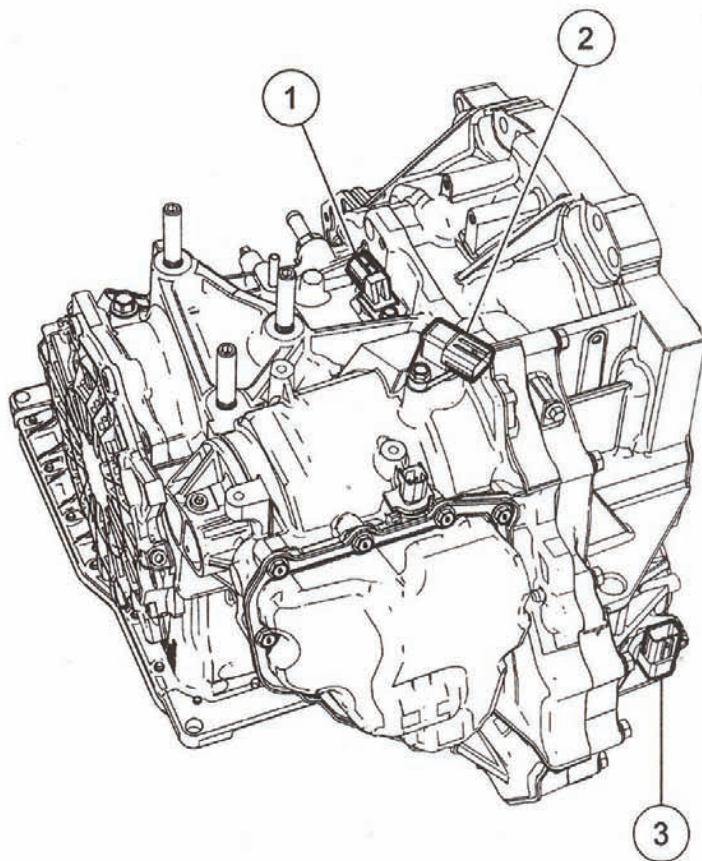
The signal is used for the following functions among other things:

- To determine the shift timing
- To supply the vehicle speed input signal for the TCM

If the OSS sensor fails, the signal of the TSS sensor is used as a substitute signal.

FNR5

Speed Sensors



Item	Part Number	Description
1	7M101	Turbine shaft speed (TSS) sensor
2	7H103	Intermediate shaft speed sensor
3	7H103	Output shaft speed (OSS) sensor

Chrysler Table of Contents

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45RFE/545RFE

New Solenoid Assembly

This kit contains the following 45RFE/545RFE transmission components:

Kit P/N 68002342AB (1999-2003) contains the following 45FRE/454RFE transmission components:

1 Solenoid assembly	52119435AB
1 TRS cam plate assembly	04799654AC

Kit P/N 05170877AC (2004-2006) contains the following 45RFE/545RFE transmission components

1 Solenoid assembly	52119435AB
---------------------	------------

A “quiet” (NVH) solenoid assembly was released for 2004 MY (and later) RFE transmissions. This new solenoid requires a revised TRS cam plate assembly, which includes a deeper “trough” for TRS pin clearance in the Reverse PRNDL position. The “deep trough” cam plate assembly (04799654AC) has also been in production since 2004 MY.

A new version of the NVH solenoid (52119435AB) may now be used to service prior model (1999-2003) transmissions, **ONLY** if the “deep trough” cam plate assembly is installed along with the solenoid.

Using the new NVH solenoid (52119435AB) with the original (1999-2003) cam plate assembly may result in improper (intermittent or no) backup light function. Using the previous NVH solenoid (52119435AA) in 1999-2003 MY transmissions, **EVEN WITH** the new cam plate assembly, may cause invalid DTCs, limp-in, etc. and is not allowed. The “deep trough” cam plate assembly may be used with any style solenoid in any MY.

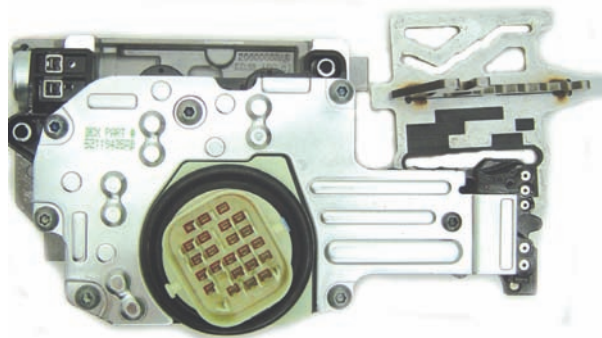
This kit contains the new NVH solenoid and the “deep trough” cam plate assembly. When servicing 1999-2003 MY transmissions, install **BOTH** components from this kit as a set. The solenoid in this kit may be used individually **ONLY** in 2004 MY and later transmissions. Both parts in this kit are also available as a separate service parts for use in 2004 MY and later units.

45RFE/545RFE

New Solenoid Assembly (continued)

OEM Part No: 68002342AB (Solenoid w/ black connector OEM #4799934AD)
also available from the aftermarket

DESCRIPTION: Solenoid Assembly Chrysler/Jeep 45RFE/545RFE Includes Range Sensor & EPC Solenoid (Black Connector) (Replaced by the late Solenoid w/ white connector) (99-03 must use the adapter plate)



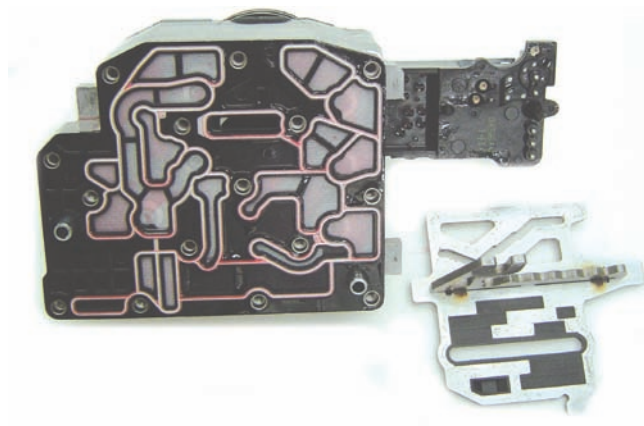
Replaced by white connector solenoid & adapter plate (1999-03)

OEM Part No: 5170877AA

DESCRIPTION: Solenoid Assembly Chrysler/Jeep 45RFE/545RFE
2004-Up (1999-03 requires an adapter plate included in
D72420)

Includes Range Sensor & EPC Solenoid (White Connector)

1999-03 Adapter Plate

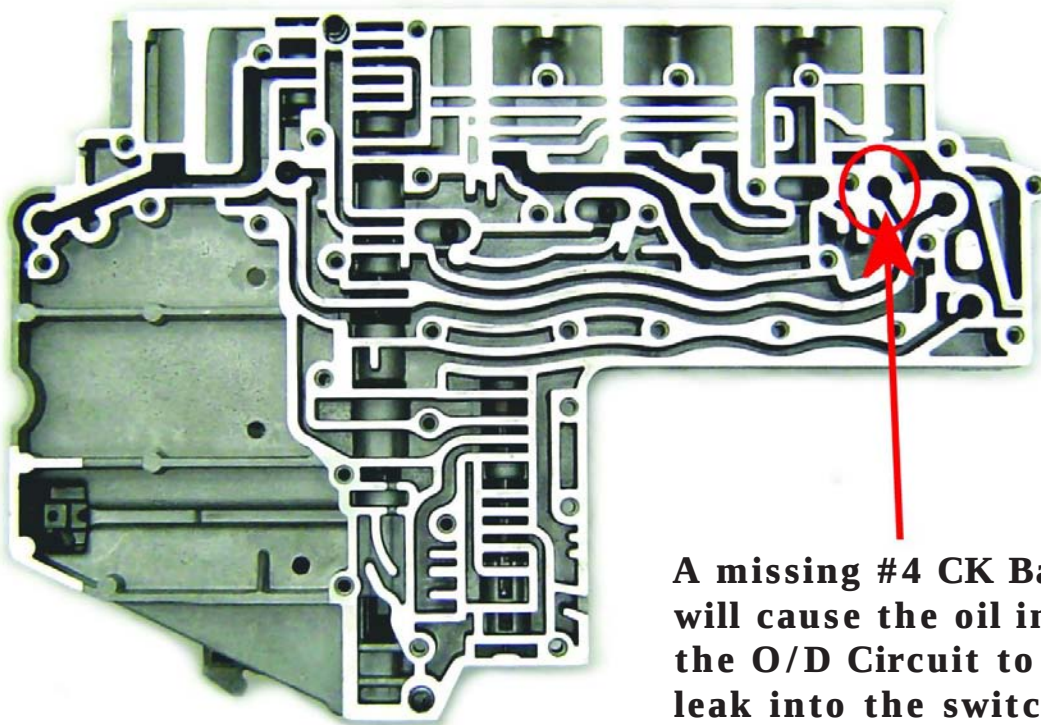


45RFE

Stalls the Engine in Drive

A missing #4 CK Ball will cause the oil in the O/D Circuit to leak into the switch valve circuit (following page).

Off the manual valve, oil feed that is normally blocked by the #4 check ball feeds into the O/D circuit. This oil ends up between the switch valve pucks forcing them to separate and move the solenoid switch valve into the TCC position. This causes the L/R sol signal oil to feed the Converter Clutch Regulator Valve causing the TCC to apply.



A missing #4 CK Ball will cause the oil in the O/D Circuit to leak into the switch valve circuit (following page).

Stalls the Engine in Drive (continued)



RE Series All

Governor Diagnosis

Finally, a complete guide to the RE Series electronic Governor diagnosis.

Although the system seem complex, it truly is not. With a brief understanding of each of the circuits as inputs we can understand how the computer responds in controlling the regulation of Governor pressure. The system hydraulically is basically the same as the RH (mechanical governor) when it controls movement of the shift valves. Line oil feeds the governor solenoid and is converted into governor pressure as the module regulates flow through voltage control.



RE Series All

Governor Diagnosis (continued)

Pressure testing the Governor: Chrysler uses a series of 6 tests to check the hydraulic circuits in the transmission. The governor test is 5 in the order. When testing, remember that governor pressure is used to move shift valves, (electronically controlled) = road speed (diesel higher than road speed after 20 mph). Must be less than 5 psi standing still!

Test 5

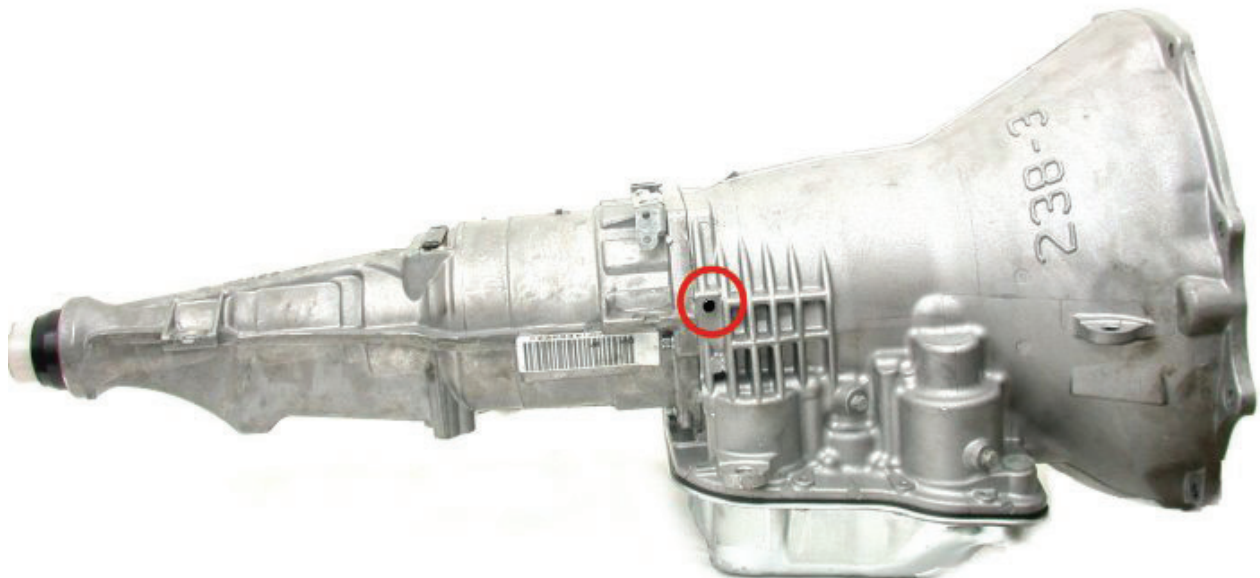
Checks governor operation by measuring governor pressure response to change in wheel speed (signaled by the OSS). It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift.

Governor Port - 0-100 psi gauge

Drive vehicle on the road (important, make sure that the hose will not hit against anything as the vehicle is being driven.)

Idle in drive - Less than 3 psi.

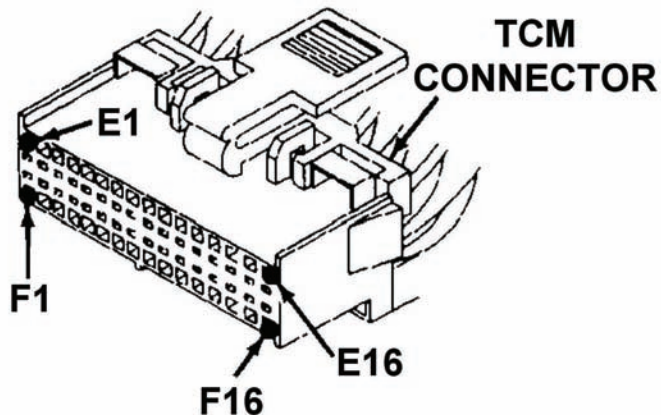
Slowly increase vehicle speed. Pressure should rise in proportion of vehicle speed. Diesel applications will increase in a higher increment above 20 mph (almost doubling wheel speed).



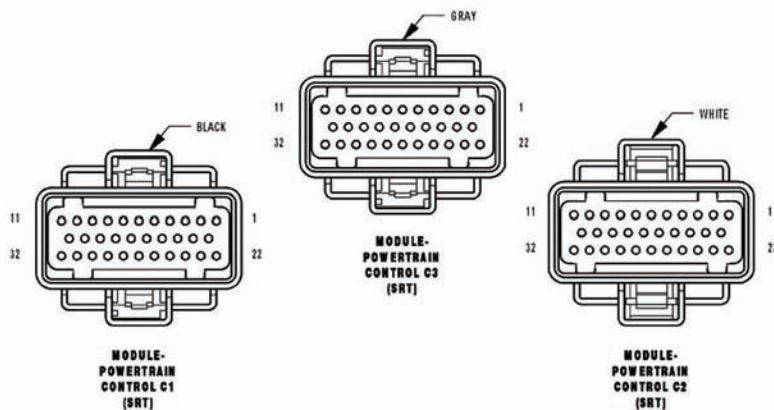
RE Series All

Computer Connectors

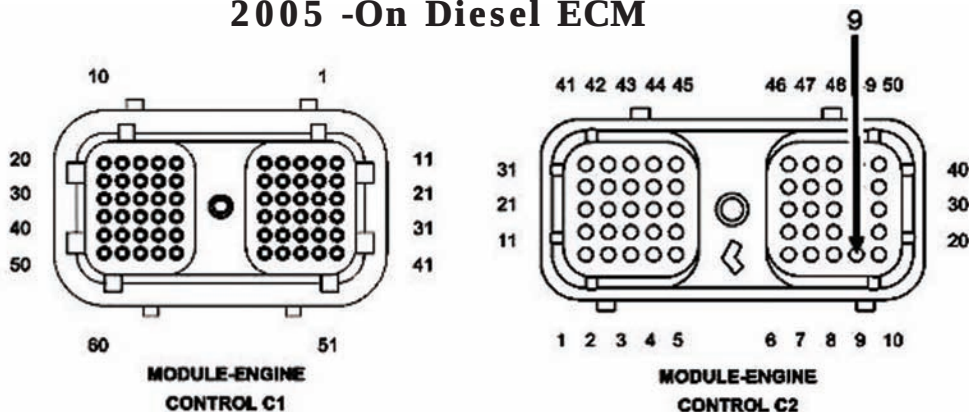
1993 1/2 to 1995 Jeep TCM



1996 - On PCM

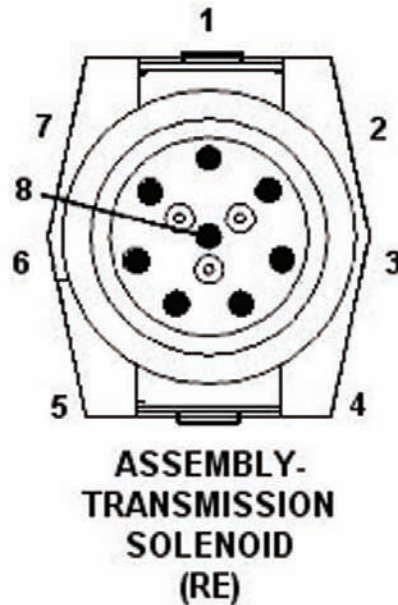


2005 -On Diesel ECM



RE Series All

Case Connector Pins



Transmission Solenoid Assembly

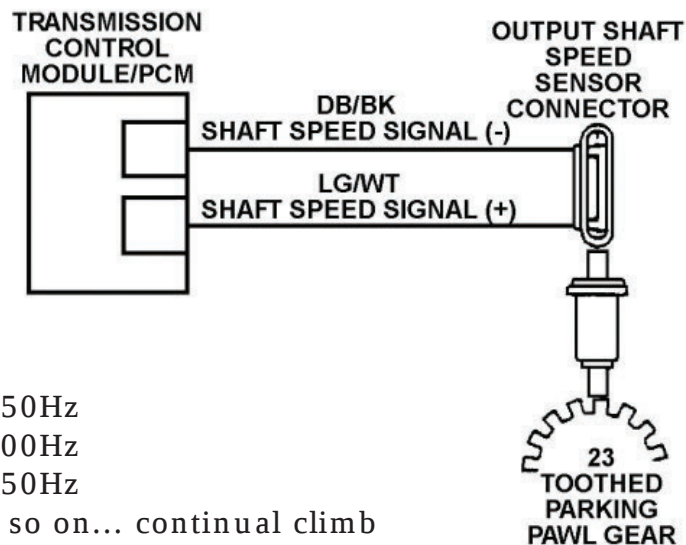
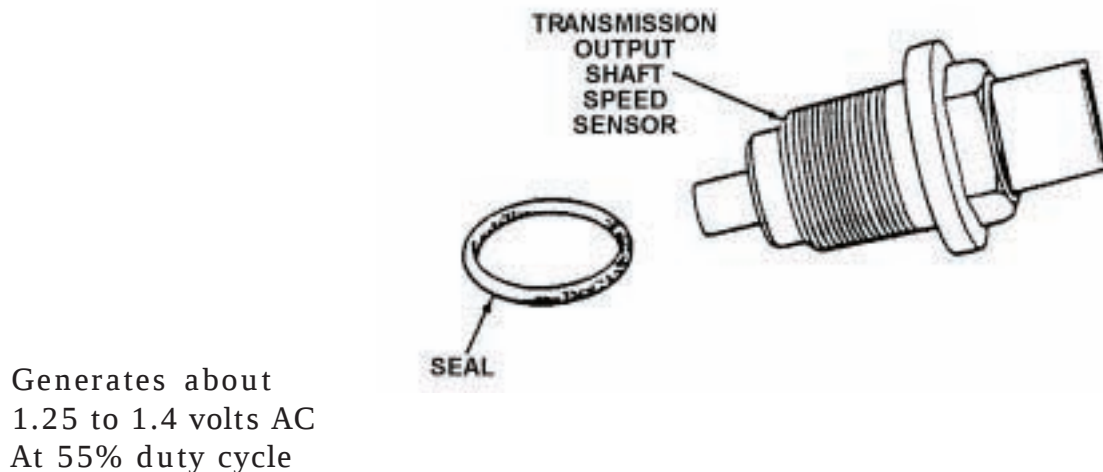
CAV	FUNCTION
1	TRANSMISSION RELAY OUTPUT
2	5 VOLT SUPPLY
3	SENSOR GROUND
4	GOVERNOR PRESSURE SIGNAL
5	GOVERNOR SOLENOID CONTROL
6	OVERDRIVE SOLENOID CONTROL
7	TCC SOLENOID CONTROL
8	TRANSMISSION TEMPERATURE SENSOR SIGNAL

POWER (+) and GROUND (-)

RE Series All

Output Shaft Speed (OSS) Sensor

This sensor is the primary input to the controller for governor control based on the output speed. The output speed is a generator signal voltage to the module.



10 mph.....150Hz
20 mph.....300Hz
30 mph.....450Hz
and so on and so on... continual climb

RE Series All

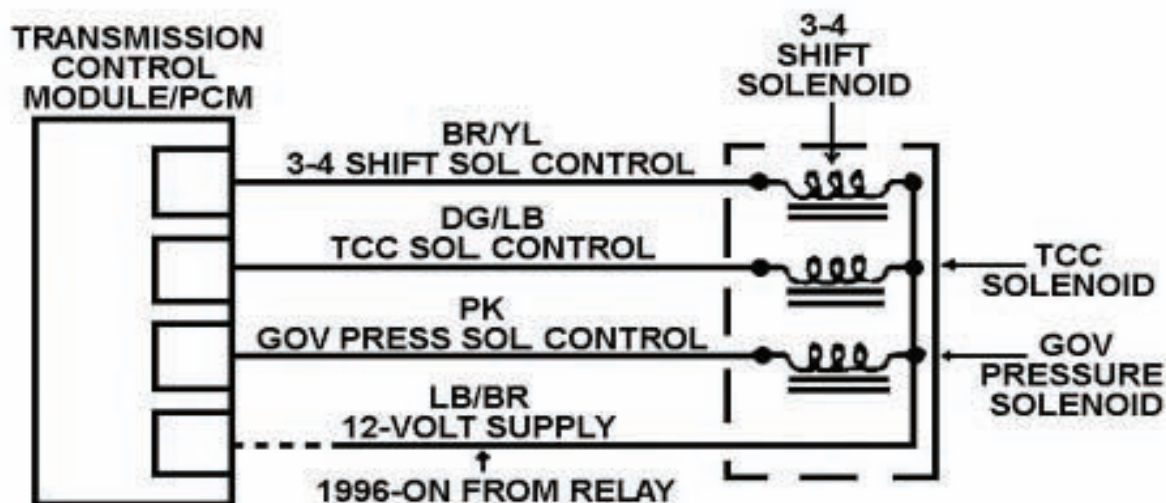
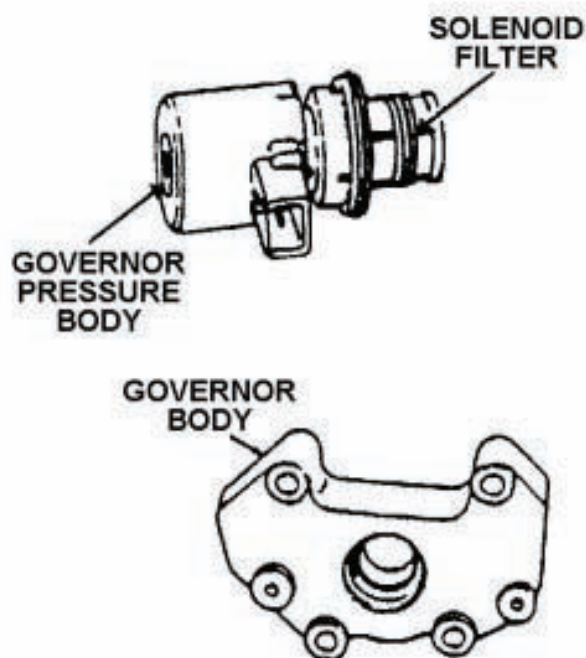
Governor Solenoid

Engine running ignition battery voltage is the main supply, the ground side of solenoid varies to control pressure.

1993 1/2 to 1995 this power was supplied by the module. 1996- on the module controlled the relay ground and power was supplied by a fused relay.

0 mph.....	4.6 volts DC
15 mph.....	4.4 volts DC
20 mph.....	4.2 volts DC
25 mph.....	4.0 volts DC
30 mph.....	3.7 volts DC
35 mph.....	3.4 volts DC
40 mph.....	2.9 volts DC
45 mph.....	2.7 volts DC
50 mph.....	2.5 volts DC
55 mph.....	0 volts DC

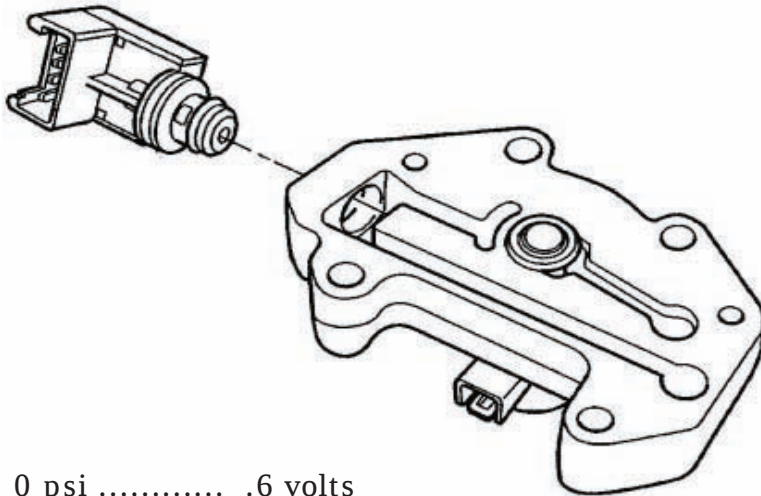
Resistance in solenoid 3.8 to 4.0 ohms



RE Series All

Governor Pressure Sensor (Transducer)

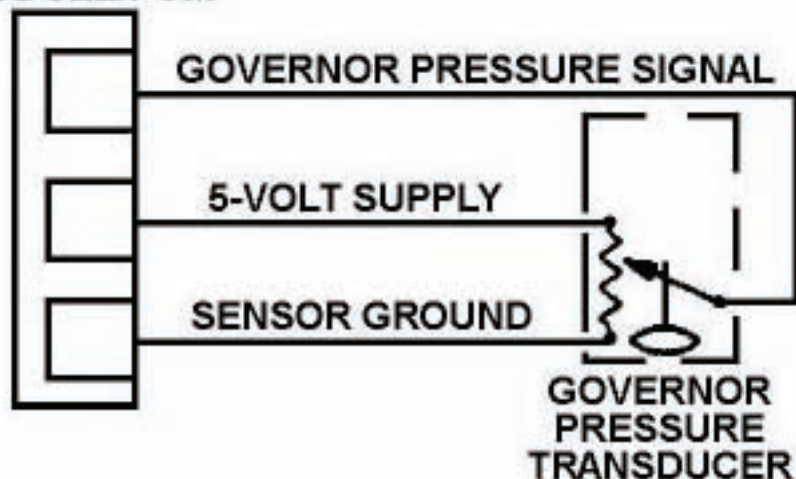
Works just like a Throttle Sensor. Has a 5 volt reference, ground, and varying voltage signal sent back to controller.



0 psi6 volts
 5 psi8 volts
 10psi1.0 volts
 15psi1.2 volts
 20psi1.4 volts
 25psi1.6 volts
 30psi1.8 volts
 and so on and so on up
 to 100 psi at 4.85 volts.

If the pressure exceeds
 105 psi a code will set.

TRANSMISSION
 CONTROL
 MODULE/PCM



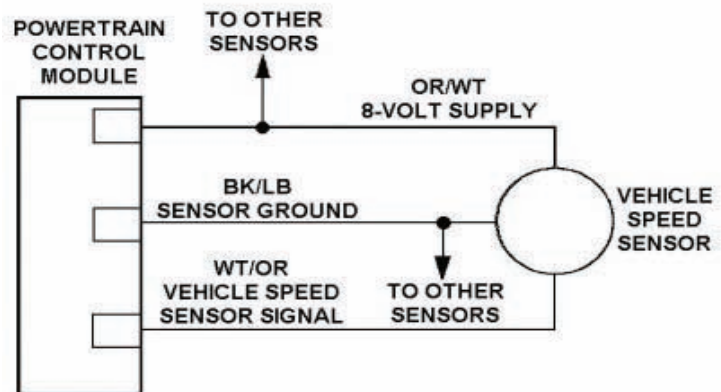
Increases in 0.2 volt increments.

RE Series All

Vehicle Speed Sensor (VSS)

Vehicle speed must be greater than 25 mph before the transmission will up shift to overdrive. Sensor is a Hall effect device. Sensor pulses 8,000 times per mile. Used for lock up and 4th gear, as well as a back-up signal for the OSS.

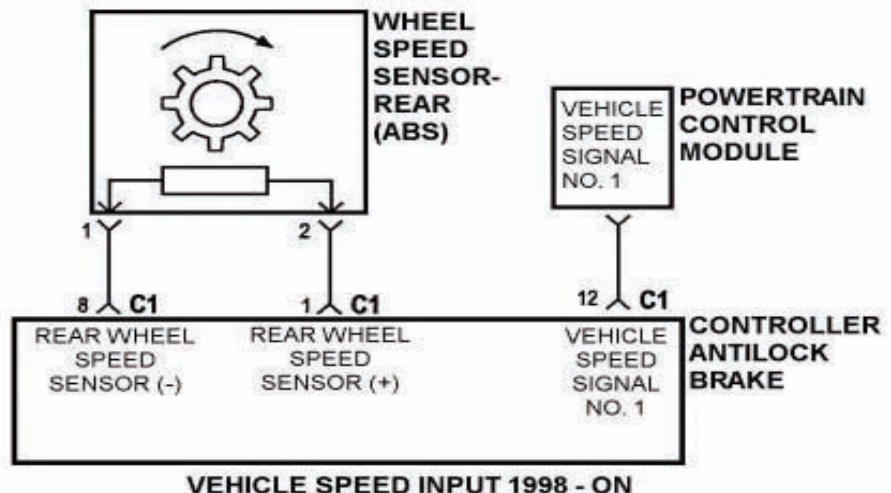
**1993 1/2 thru 1997
the sensor is located
in the tail housing or
in the 4X4 Transfer
case**



Sensor input is 2.5 volts DC
 10 mph—16Hz
 20 mph—36Hz
 30 mph—46Hz
 40 mph—56Hz

Starting in 1998 the Vehicle Speed Signal was moved from a direct input to a shared input. The signal from the VSS now goes directly to the ABS Module before being shared via the Network with the other modules.

**1998 - On the
VSS is located
at the rear
differential**



RE Series All

Throttle Position Sensor

The TP Sensor determines what the load (driver demand) on the engine is. Sensor has a 5 Volt reference, 0 volt ground, and a varying voltage signal sent back to the controller.

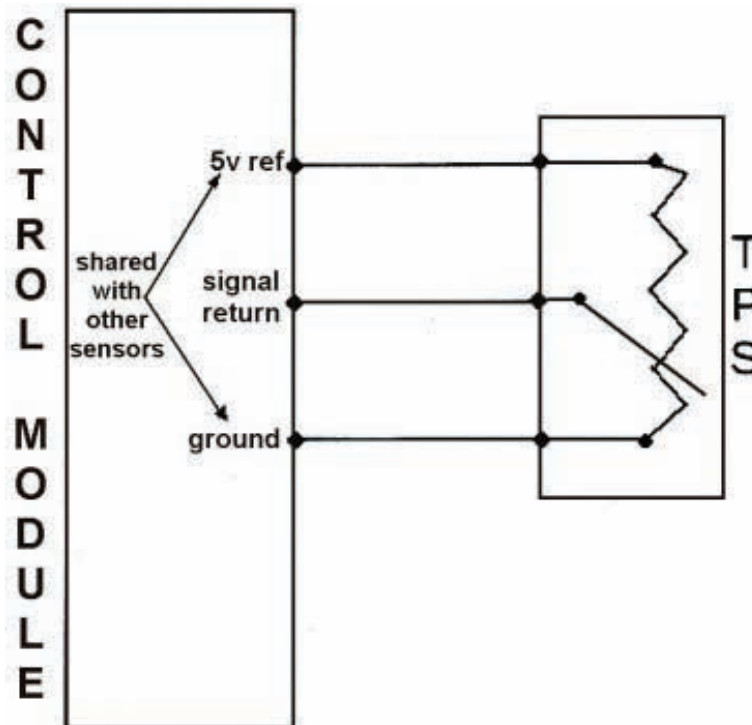
Diesel 1998-on: TPS signal originates from the engine module (mounted on the side of the engine block) known as **APPS voltage**. From the engine module this signal is mirrored and sent out as **TPS voltage** to the powertrain module.

Gas:

1 volt or less at idle 4.50 at full throttle

Diesel:

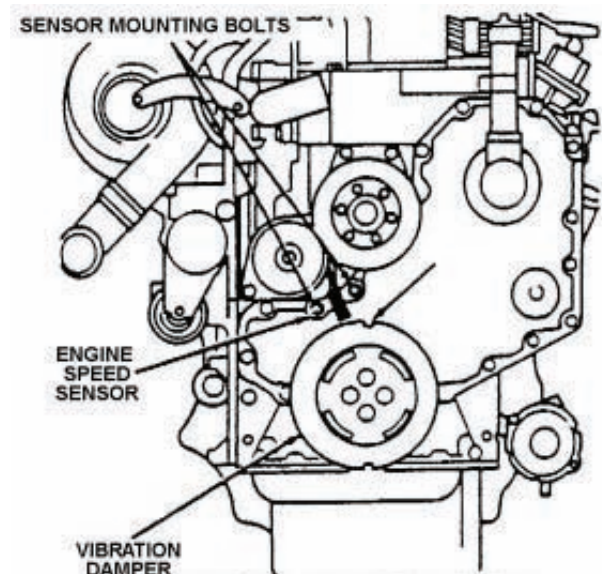
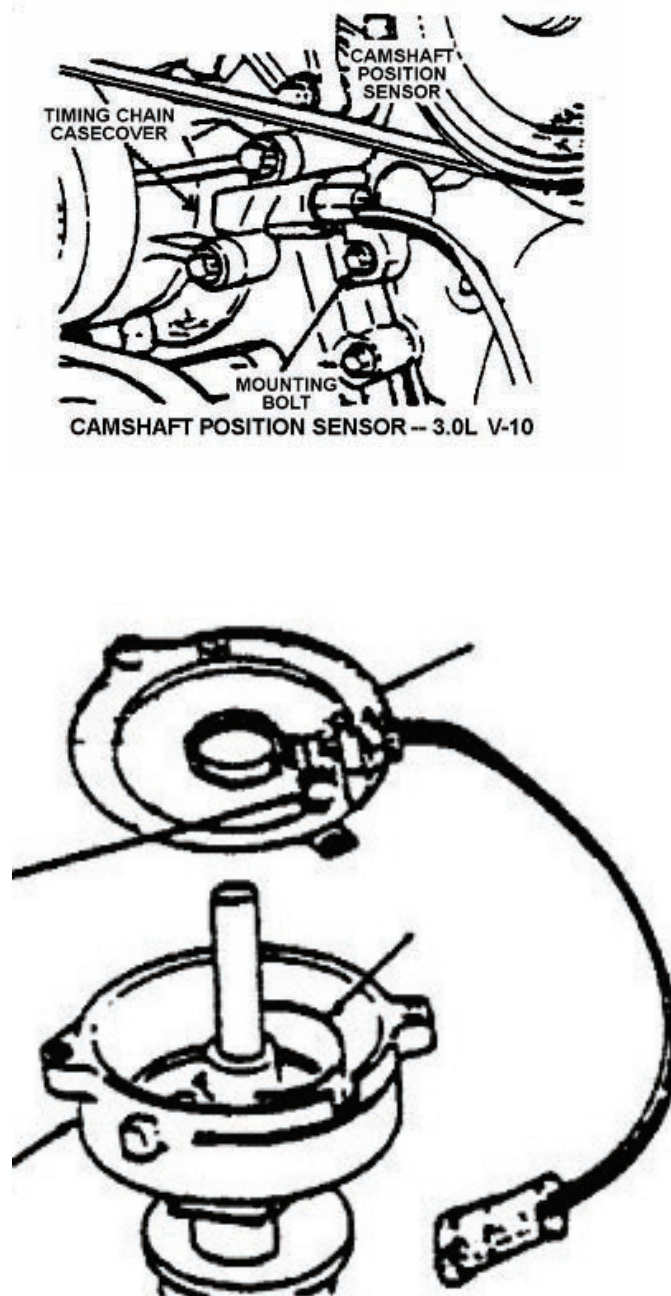
1 volt or less at idle 3.50 volts at full throttle



RE Series All

Engine RPM Sensor

RPM sensor is a typical Hall-Effect sensor that sends a pulse signal to the module in reference to engine RPM is. The sensor can be located in a wide range of areas from the front of engine such as a Diesel which is mounted in the side of the engine block reading a pulse wheel mounted onto the crank shaft. Signal voltage is similar to Vehicle Speed signal.

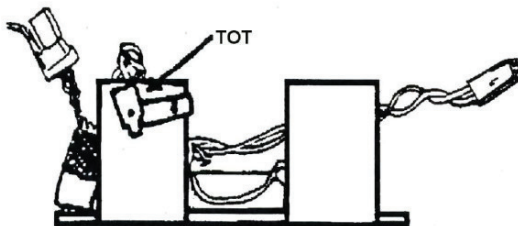


Diesel RPM Sensor

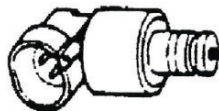
RE Series All

Temperature Sensors (ECT & TFT)

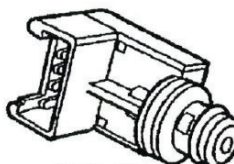
These sensors are variable resistance sensors. As fluid temperatures increase and decreases a signal voltage wire advises the module as to what the temperature is. Early sensors had a decrease in resistance as temperature increased and starting in 2000 on the transmission sensor it was opposite. Resistance increases as temperature increases. **Very important DO NOT mix these sensors up.** Earlier years these signals helped to determine when the transmission could go into TCC and OD. With the RE units these signals are still important for TCC and OD but also for governor control (part of the governor curve strategies). The TOT sensor originally was riveted to the solenoid block (1993 1/2). Because of ease in manufacturing and sharing the ground circuit with the transducer, the sensor was moved into the governor sensor.



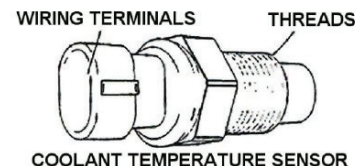
1993 1/2 THRU UPGRADE
TRANSMISSION TEMP SENSOR



1993 1/2 (REPLACEMENT)
THROUGH 1999
TRANSDUCER



2000 - ON
TRANSDUCER



COOLANT TEMPERATURE SENSOR

TRANSMISSION
CONTROL
MODULE/PCM



TRANSMISSION/COOLANT
FLUID TEMP
SENDER

SENSOR GROUND

FLUID TEMP SIGNAL

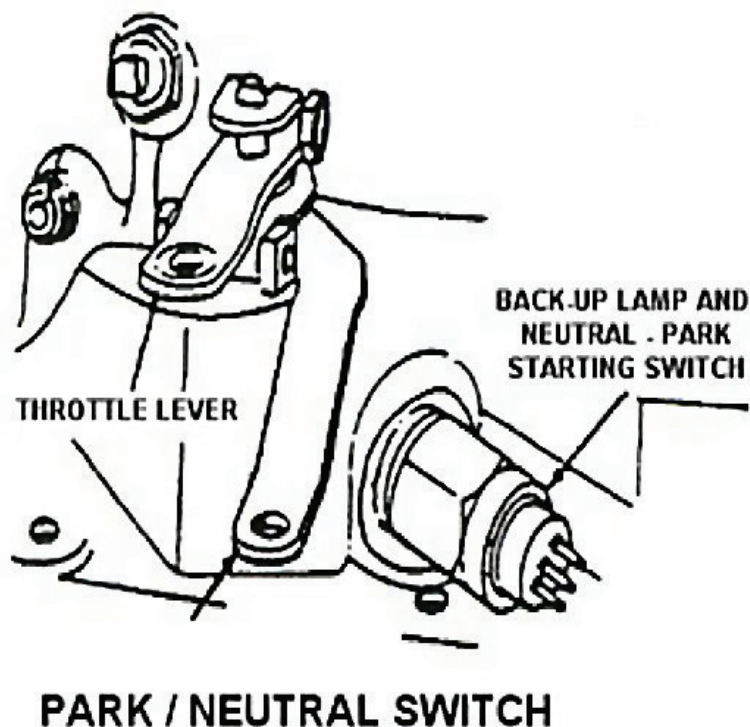
Coolant Temperature Sensor Transmission Temperature Sensor up to 1999 Temperature vs Resistance			
°C	°F	Min ohms	Max ohms
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

TOT Temperature vs Resistance 2000-on			
°C	°F	Min ohms	Max ohms
-40	-40	1094	1176
0.0	32	1587	1672
25	77	1960	2040
70	158	2709	2860
100	212	3284	3500
120	148	3684	3950
150	302	4110	4450

RE Series All

Park Neutral Switch

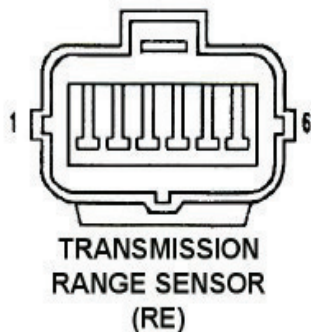
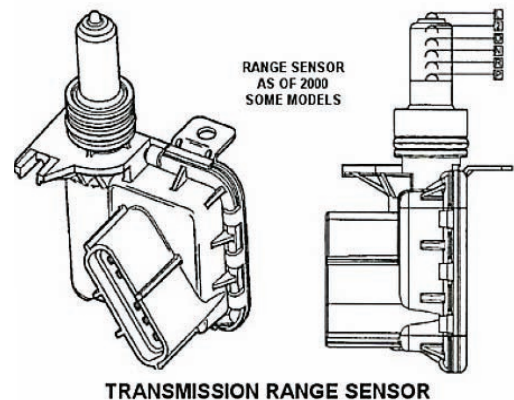
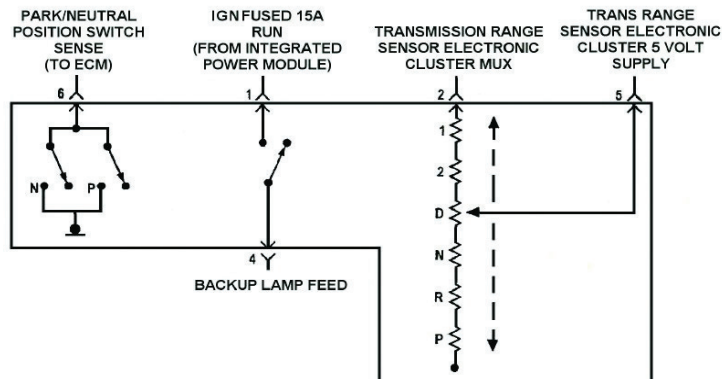
This is a safety switch that allows the vehicle to be started in Park and Neutral. Other responsibilities of the switch are to supply a signal voltage to the reverse lights and also to inform the module when the shifter has been moved from park or neutral into drive range. In Park and Neutral signal voltage is low (grounded) in Reverse and Drive ranges the signal voltage is high (battery voltage) allowing the computer to recognize forward movement and governor control. If the module does not get a correct signal from this switch, governor control is prevented as well as shifts into OD and TCC.



RE Series All

Transmission Range Sensor

The Transmission Range sensor has 6 pins in which only 5 are used. Pins two and five are used to signal the computer for each of the shifter positions. This new switch works off of resistors to drop or raise voltage supply to the module informing these actual positions.



TRANSMISSION RANGE SENSOR (RE) - 6 WAY

CAV	
1	FUSED IGNITION SWITCH OUTPUT (RUN)
2	TRANS RANGE SENSOR ELECTRONIC CLUSTER 5 VOLTS
3	
4	BACKUP LAMP FEED
5	TRANS RANGE SENSOR ELECTRONIC CLUSTER
6	PARK/NEUTRAL POSITION SWITCH SENSE (T41)

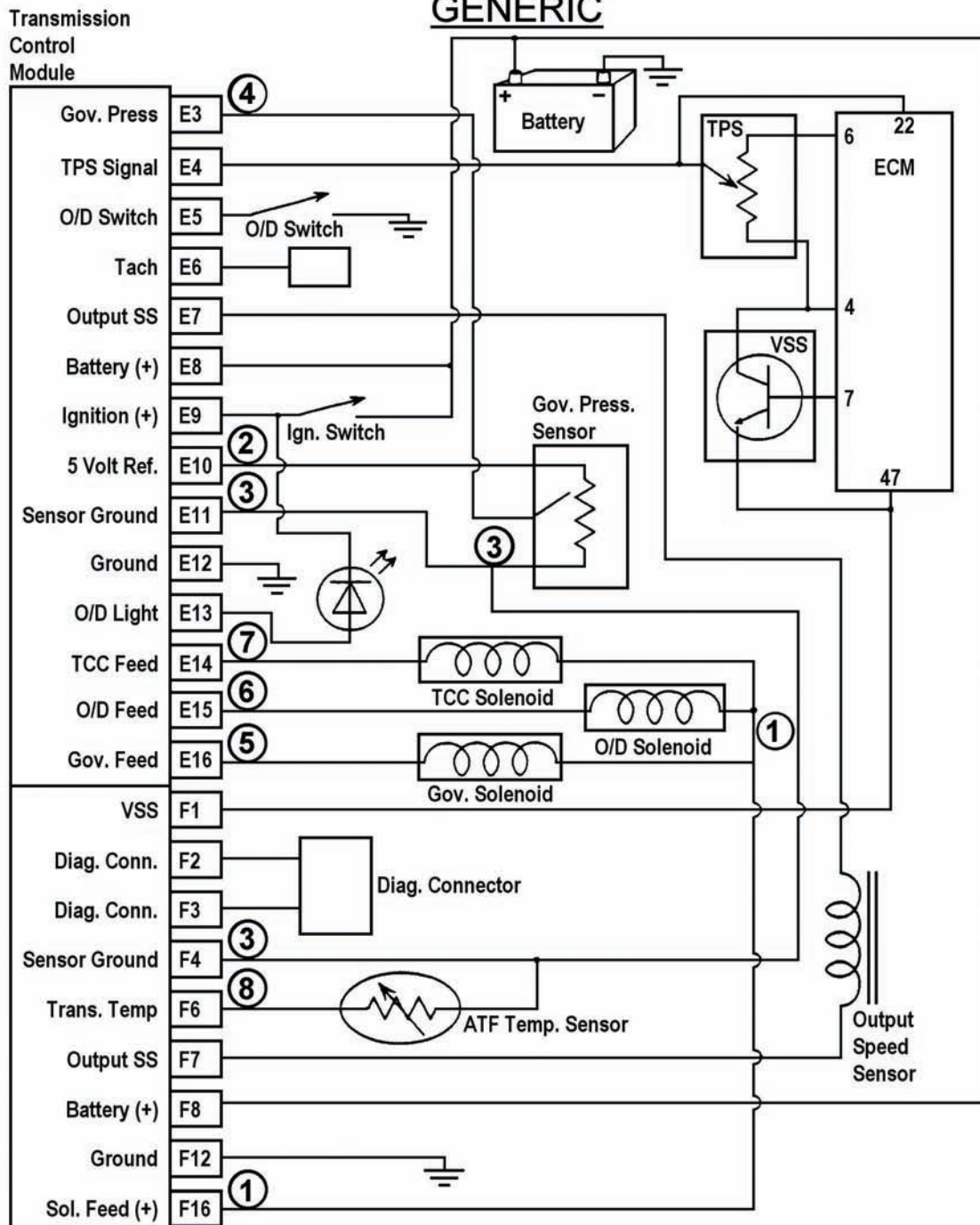
RE Series All

Wiring Diagrams

1993 1/2 to 1995 Jeep

42 RE 1993 1/2 TO 1995 (JEEP)

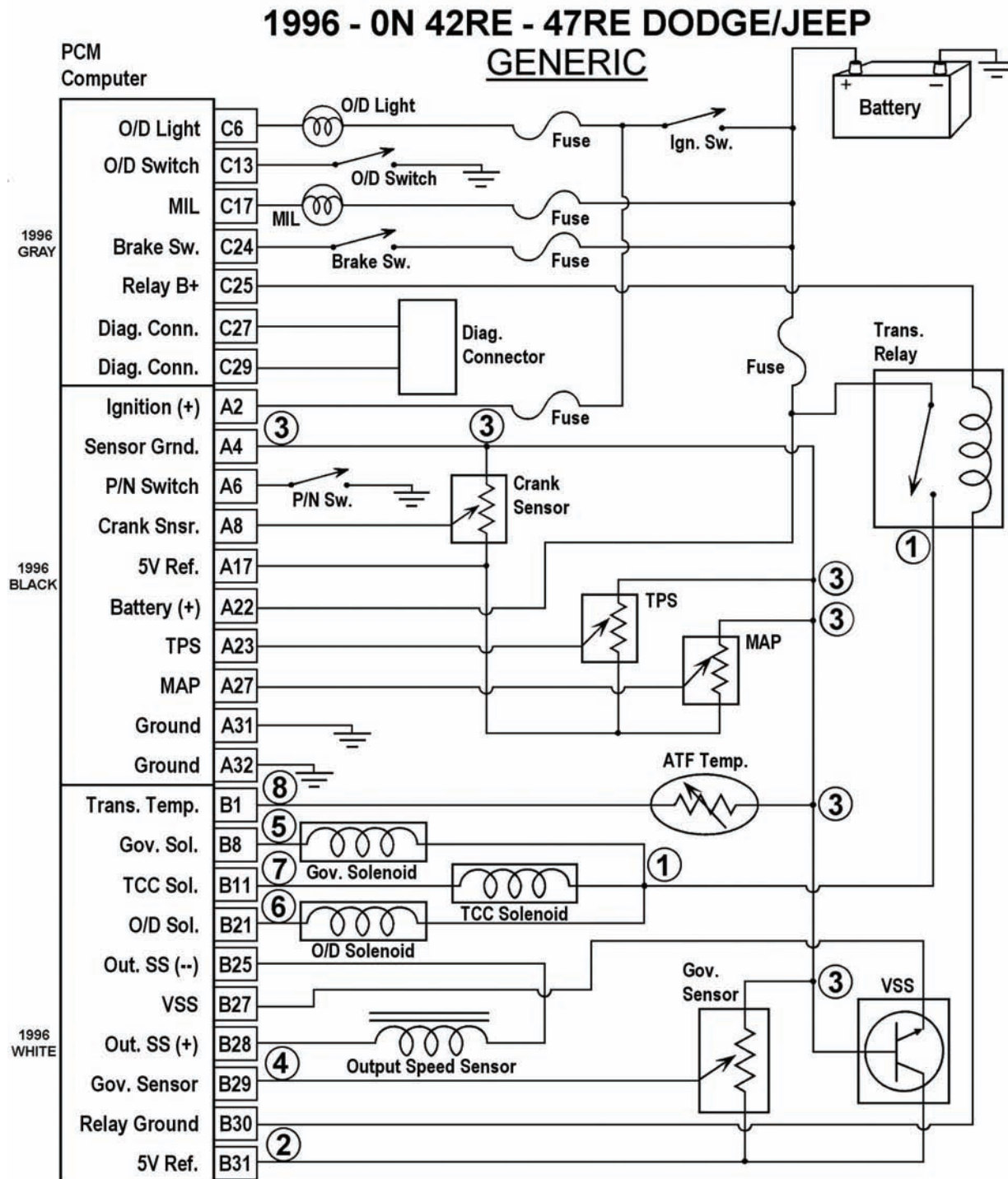
GENERIC



RE Series All

Wiring Diagrams

1996 -On Jeep and Chrysler



RE Series All

Quick Reference Signal Voltages for Governor Control

Note: When doing electrical testing, save yourself valuable time. Always disconnect and clean battery terminals before doing any electrical testing.

At that time confirm that battery surface voltage is at least 12.45 volts (70% capacity of battery ability). Any ground locations, make sure that there is no voltage in the ground wires (redundant visible grounds).

For testing, it is important to know that volt meter leads will be moved for testing. All controller tests with the exception of two (2) of the tests will be done with the negative lead of the DVOM on the negative battery post and the module will be back probed with the positive lead.

The governor solenoid test will be done with the positive (+) lead of the DVOM on the positive battery post and the module will be back probed with the negative lead to determine the working voltage on the governor solenoid. The output speed sensor (AC generator) will need both the DVOM leads on the two (2) computer wires receiving a signal from this sensor. Important, this is AC voltage.

Keep alive battery voltage should not be below 12.45 volts. Running voltages need to be no more than 14.6 volts (generally around 13.2). Computer grounds must have no more than 0.02 volts. Sensor grounds can be a little higher than system grounds about 0.04. The Switches change state when a button is pushed (OD Cancel). Normally there is voltage at the computer pin for the switch, and when switch is pushed (grounded) voltage will be pulled low and then will return to system voltage when released.

TCC and OD Solenoids Both the TCC and OD Solenoids will have battery voltage present up to the point that the module supplies the ground to energize the solenoid. At this point, voltage will be pulled low as the solenoid is turned ON.

RE Series All

Quick Reference Signal Voltages for Governor Control

Output Speed Sensor	
Wheels Spinning 1.25v AC – 1.50v AC	
MPH	hTz
10	150
20	300
30	450
40	600

Vehicle Speed Sensor	
Wheels Spinning 2.5v	
MPH	DC hTz
10	16
20	36
30	46
40	56

Governor Transducer	
Governor PSI	DC Voltage
0	0.6
5	0.8
10	1.0
15	1.2
20	1.4
25	1.6
30	1.8
35	2.0
40	2.2
45	2.4
50	2.6
55	2.8
60	3.0
Note: These voltage values are not desired values from the module. They are specific to actual governor pressure.	

Governor Solenoid	
MPH (SPEED0)	DC Voltage
0	4.6
15	4.4
20	4.2
25	4.0
30	3.7
35	3.4
40	2.9
45	2.7
50	2.5
55	0.0

RE Series All

In-Shop Testing

1. Raise Vehicle off Ground
2. Install pressure gauge on GOVERNER pressure tap.
3. Lower vehicle; Check for battery voltage. (Must be no lower than 12.4).
Diesel – Check Both Batteries

Note:

Clean battery Posts and Clamps before testing.

4. Make appropriate tests for circuit concerns (document findings).
5. Repair problem - Retest to confirm that system is ok.

Note:

Keep a running log of vehicles tested for future reference.

RE Series All

Volt Meter Test Procedures

General Tests:

Test with the negative lead of the volt meter connected to negative battery, back-probing controller with the positive lead. (DC voltage)

Output Speed Generator Tests:

Test with both leads of the volt meter hooked to the controller. (AC Voltage and Frequency)

Governor Solenoid Test:

Test with the positive lead of volt meter hooked to positive battery, back-probe controller with negative lead. (DC voltage)



Computer Pin Test Lead



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62TE

Introduction

In total, the 62TE provides seven forward ratios and one reverse.

The underdrive compounder assembly has two modes of operation: Direct and Reduction.

The 2-3, 3-2, and 4-2 shifts require a “double swap” shift. This occurs when two elements are turned off while two different elements are engaged.

The clutch-to-clutch synchronization takes place within 40 – 70 milliseconds, producing a smooth shift. If the underdrive compounder assembly shifts too early (in relation to the shifts taking place in the main centerline), a shudder or harsh shift results. If the underdrive assembly shifts to late, the driver experiences a “double bump” sensation.

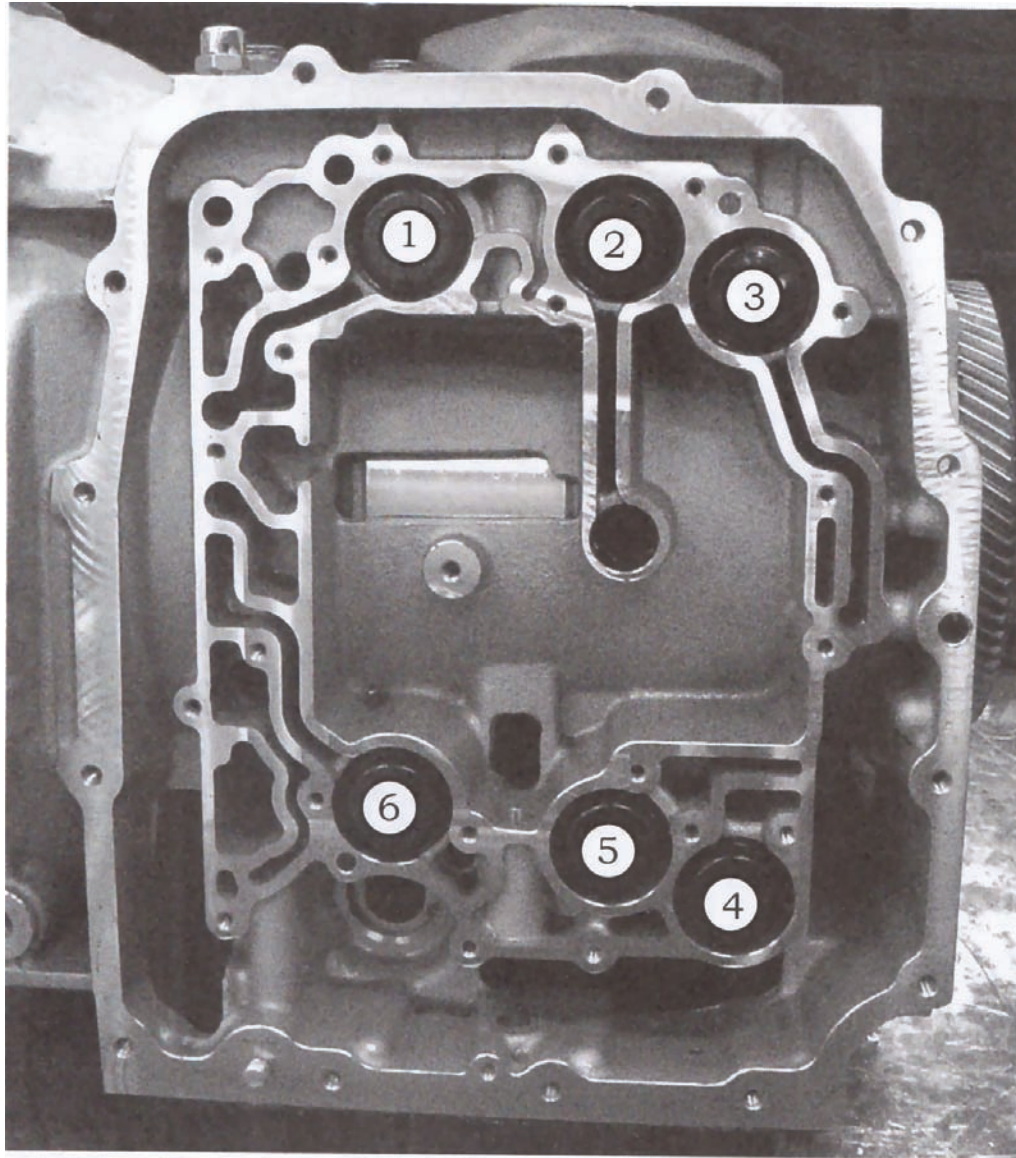
To avoid a double swap shift in a 6-4 downshift, the transaxle shifts into 4th prime, which requires the deactivation of the OD clutch and the simultaneous application of the UD clutch.

CLUTCH APPLICATION CHART									
ELEMENTS APPLIED									
GEAR	RATIO	UD	OD	R	2-4	L-R	LC	DC	ORC
1	4.127	A				A	A ^		H
2	2.842	A				A		A	
3 *	2.284	A			A		A ^		H
4	1.573	A			A			A	
4	1.452	A	A				A ^		H
5	1	A	A					A	
6	0.689		A		A			A	
R	3.215			A		A	A		

- A = Applied
- H = Holding
- * = Limp-in Mode
- ^ = Applied in coast only

62TE

Accumulator ID



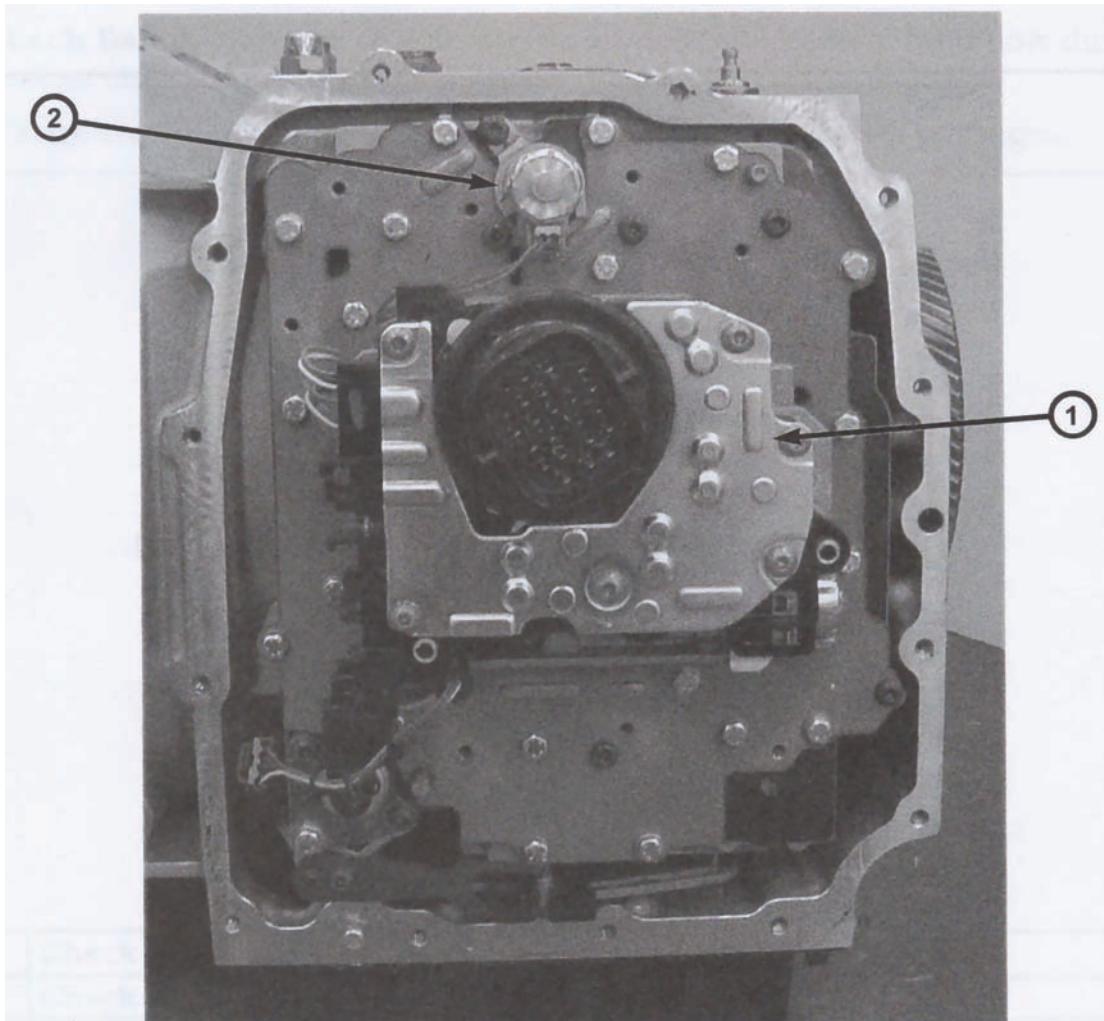
Accumulator ID			
1	UD Accumulator	4	LC Accumulator
2	2/4 Accumulator	5	DC Accumulator
3	L/R accumulator	6	OD Accumulator

62TE

Solenoid ID and Function

The 62TE transaxle has eight solenoids. Six solenoids use ON/OFF or PWM operation and are part of the solenoid/pressure switch assembly. The TCC solenoid has a VFS design and is mounted on the solenoid/pressure switch assembly. The PCS mounts on the valve body and is a separate component.

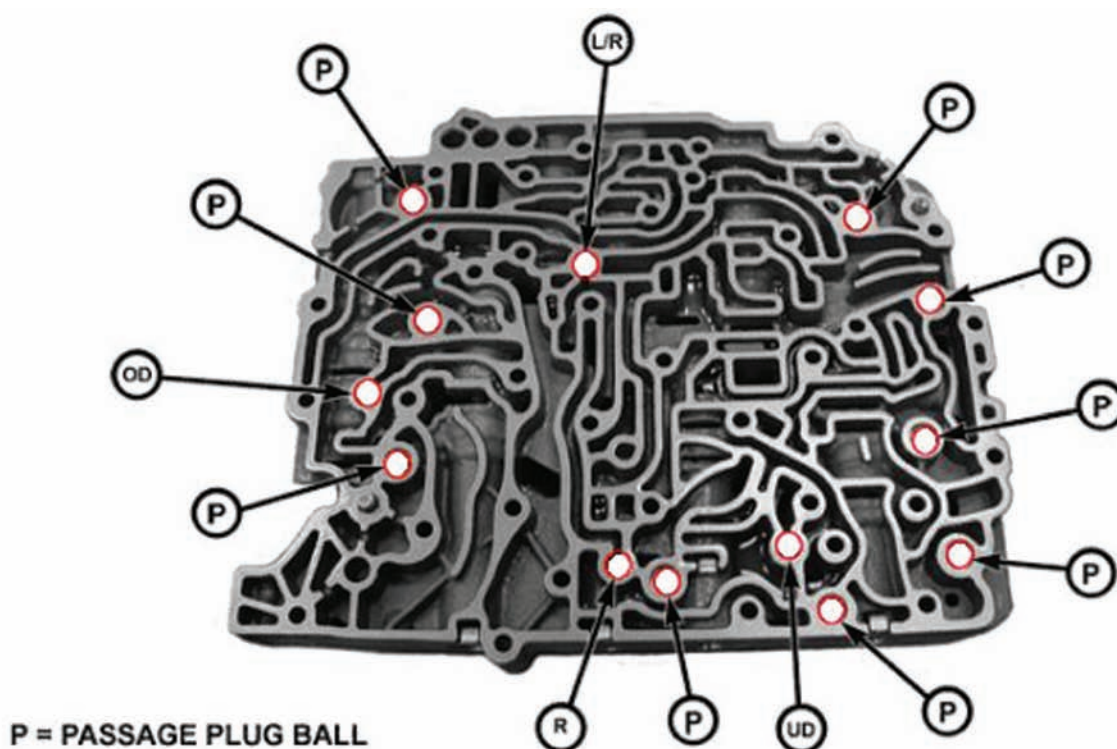
In the event of a transmission/transaxle electrical fault, a “limp-in” mode procedure is programmed in the transmission controller. To achieve “limp-in” mode, the normally applied 2/4 and UD solenoids only allow fluid flow to obtain Park, Reverse, Neutral and Third in Drive.



- 1. Solenoid/Pressure Switch Assembly**
- 2. Pressure Control Solenoid**

62TE

Check Ball ID and Location



The 62TE valve body has nine checkballs in total, four are used in the hydraulic circuit and the other five are used as plugs:

L/R Clutch circuit: Prevents L/R clutch application in Drive-Third gear, Fourth gear, Fifth gear and Sixth gear.

UD Clutch circuit: Allows an orifice to control fluid flow during UD clutch application

OD Clutch: Allows an orifice to control fluid flow during OD clutch application

Reverse clutch: Allows an orifice to control fluid flow during reverse clutch application

48RE

Out of Park Sense Alarm

2006 (DH/DI) Ram Truck

Vehicles with a diesel engine and an automatic transmission are equipped with an alarm that warns the customer, upon exiting the vehicle, that the transmission is not in the “Park” position. This feature will only be functional under following conditions:

- Engine running
- Foot off the brake pedal
- Driver’s seat belt is unbuckled
- Driver’s door is open

When this feature is triggered the horn will sound, the high beams and turn signal lamps will flash. This will continue until one of the following conditions is met:

- Engine is turned off
- Transmission is in “Park”
- Driver’s seat belt is buckled
- Brakes applied

NOTE: This feature is standard equipment and cannot be disabled.

42LE

Transfer Gear Whine

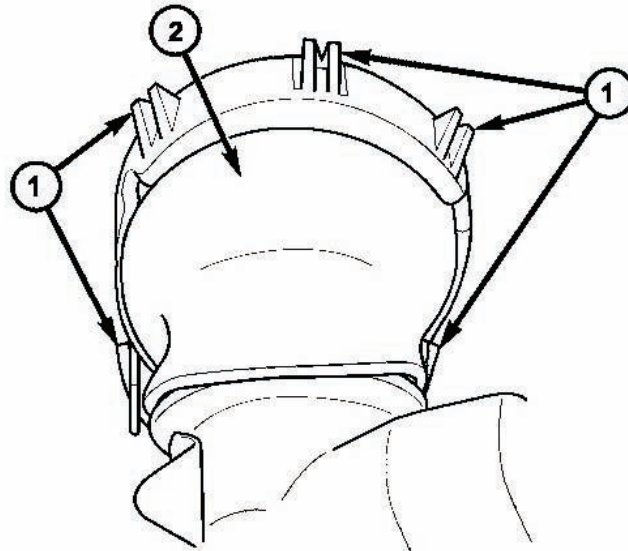
2003-2005 (JR) Sebring Convertible/Sebring Sedan/Stratus Sedan

Vehicle operator may experience a transfer gear whine sound while vehicle is either accelerating or coasting down between 68 mph (109 kph) and 84 mph (135 kph). This condition may also be described as a whistling sound.

Repair Procedure:

1. Raise Vehicle on a hoist.
2. Inspect the lower steering column boot to see if it is sealed properly against the bulkhead. The lower steering column boot should be pressed against the bulkhead (Fig. 1). If the lower steering column boot is installed properly further diagnosis is required. If lower steering column boot is not installed properly continue to Step #3.

1 Lower Steering Column Boot)



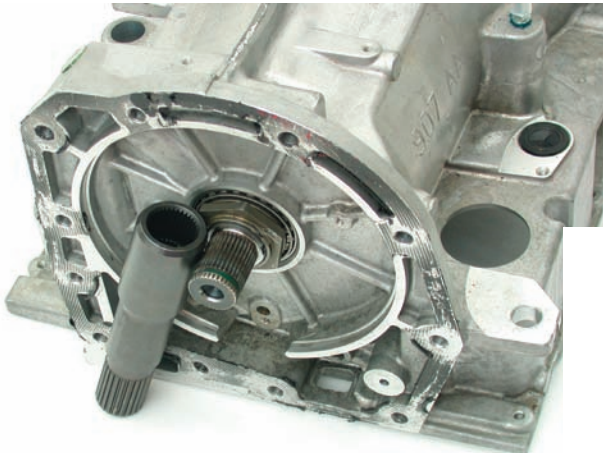
LOWER STEERING COLUMN BOOT

- 1 – Clips (Clip #6 not shown)
- 2 – Steering Column Boot
3. Lower Vehicle.
4. Pull back carpet from around lower steering column boot.
5. Using a rubber mallet, tap boot on the perimeter until all six (6) clips are seated.
6. Re-install carpeting.

42RLE

Adapter Shaft Retaining Clip

The retaining clip is often destroyed and or distorted when the output shaft is removed. The new part number is 528 52916-AA



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OEM Service Information Websites

This OEM website information is provided to help assist you in your daily needs, some of the advantages are:

- Latest up to date TSB's.
- OEM DTC definitions and diagnostic information.
- Reprogramming information, software, and calibration files.
- Scan tool rental info.

Manufacturer	Web Address	Manufacturer	Web Address
Aston Martin	www.astonmartintechinfo.com	Kia	www.kiatechinfo.com
Audi	www.ebahn.com	Land Rover	www.landrovertechinfo.com
Bentley	www.bentleytechinfo.com	Maserati	www.maseratitechinfo.com
BMW	www.bmwtechinfo.com	Mazda	www.mazdatechinfo.com
Daimler Chrysler	www.techauthority.com	Mercedes	www.startekinfo.com
Ferrari	www.ferraritechinfo.com	Mini	www.minitechinfo.com
Ford	www.motorcraftservice.com	Mitsubishi	www.mitsubishitechinfo.com
General Motors	www.gmtechinfo.com	Nissan	www.nissan-techinfo.com/nissan
GM Calibration	http://calid.gm.com	Porsche	https://techinfo.porsche.com
Honda/Acura	www.techinfo.honda.com	Saab	http://saabtechinfo.com
Hyundai	www.hmaservice.com	Subaru	http://techinfo.subaru.com
Isuzu	www.isuzusource.com	Suzuki	www.suzukipitstop.com
Isuzu Truck	www.isuzutruckservice.com	Toyota	http://techinfo.toyota.com
Infiniti	www.nissan-techinfo.com/infiniti	Volkswagen	www.ebahn.com
Jaguar	www.jaguartechinfo.com	Volvo	www.volvotechinfo.com

OEM Scan Tools

OEM scan tools can be very helpful when it comes down to those difficult problems that the aftermarket tools can not find, some of the advantages are:

- Information on OEM scan tools can often be found at the auto manufacturers service information website.
- Some manufacturers offer scan tool rental.

Manufacturer	Scan Tool	Web Address
GM, Isuzu, Saab	Vetronix TechII	www.vetronix.com
Ford	PDS (Pocket PC) IDS (PC)	www.motorcraftservice.com
Chrysler (without CAN)	DRBIII	www.techauthorityonline.com
Chrysler (with CAN)	StarSCAN	www.techauthorityonline.com
Honda/Acura	Vetronix Mastertech with Honda/Acura software	www.vetronix.com
Honda Acura (except Passport/SLX)	Teradyne HDS (PC or Tablet) Teradyne Pocket Tester	www.helminc.com (PC software, tool rentals) www.teradyne.com (Pocket Tester)
Mitsubishi	MUT-III	www.mitsubishitechinfo.com
Toyota	Vetronix Mastertech with Toyota/Lexus software	www.vetronix.com
Nissan	Consult II	www.nissan-techinfo.com
Volkswagen/Audi (VAG)	VAS 5051 VAS 5052	www.ebahn.com
Volvo	VIDA	www.volvotechinfo.com

Aftermarket Scan Tools

Advantages

- One tool covers many manufacturers

Disadvantages

- May not have all OEM level access and functions

You should have at least two different types of scan tools

Scan Tool/Company	Notes	Web Address
Auto Tap	PC scan tool software and Palm based packages with domestic and Asian coverage. Allison DOC scan tool. Medium and Heavy Truck. GM tuner software.	www.autotap.com
Baum	Broad coverage scan tools and software. Regarded for their European and Asian functionality.	www.baumtools.com
Ease Diagnostics	PC scan tool software packages with Domestic coverage and Toyota. PDA scan tool packages. Scan tool and reprogramming packages using J2534 interface. Diagnostic and test equipment.	www.easediagnostics.com
Launch X431	Broad coverage scan tool. Regarded for its European functionality.	www.x431usa.com
OTC Genisys	Broad coverage; Domestic, Asian, and European. Oscilloscope and gas analyzer packages. GM reprogramming package.	www.genisysotc.com
Ross-Tech	PC based Volkswagen/Audi scan tool software. BMW/Mini scan software in the works.	www.ross-tech.com
Snap-On	Broad coverage scan tools including gas analyzer and oscilloscope packages. CAN compatible with adapter. Domestic, Asian, and European coverage.	www.snapon.com
Vetronix Mastertech	Broad coverage; Domestic and Asian, medium and heavy truck. OEM for Honda and Toyota. GM reprogramming package.	www.vetronix.com
Vetronix KTS 550/650	European scan tool with built in 2 channel meter and oscilloscope.	www.vetronix.com

Scan Tool and Network Communication Essentials

Make sure your scan tool software and hardware are up to date.

Valuable time can be wasted trying to diagnose a scan tool communication problem only to find out you don't have the necessary scan tool software updates or adapters required to communicate with the vehicle.

Get a backup scan tool.

It's a good idea to have a back up scan tool. You never know, your scan tool can break down, or get broken, and leave you without the key piece of diagnostic equipment necessary to diagnose today's vehicles. It also helps to have a scan tool from a different manufacturer to give yourself some diversity in your diagnostic arsenal.

A module needs three basic things to communicate properly.

1. Power (both keep alive power and switched ignition power) and ground.
2. Connection to functioning network circuits.
3. Other modules on the network to talk with.

Grounds are very critical, especially in a single wire network.

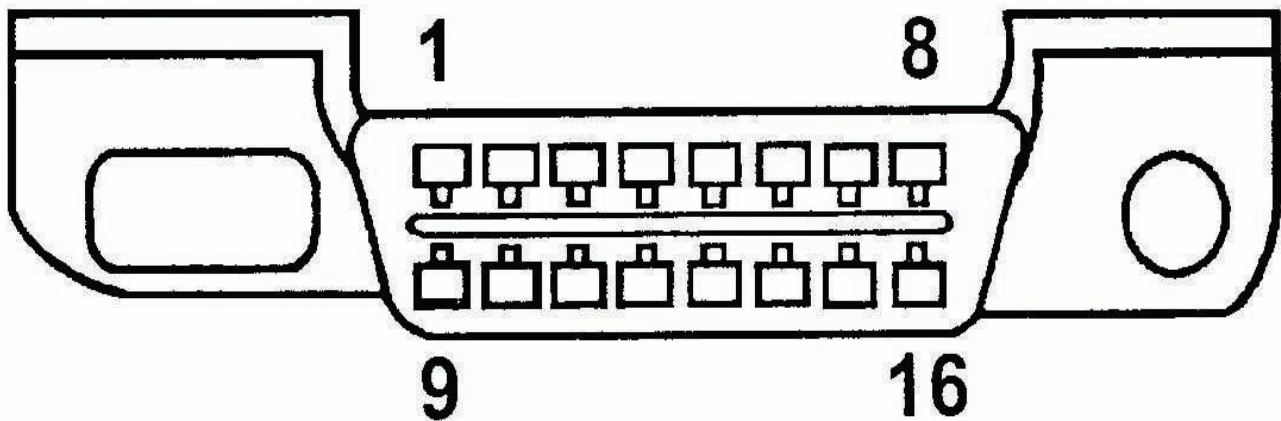
Network communication is done by each module translating binary information (1's and 0's) into voltage levels. With a single wire network or data link, each module compares the network voltage to ground in order to tell the 1's and 0's apart and 'read' the data on the network. If modules have significantly different ground voltages, they won't be able to communicate.

Check for vehicle software updates.

Again, much time can be wasted diagnosing a network communication problem when the manufacturer has a software update to address the problem.

J1962 OBDII Connector

J1962 OBDII Connector



1. Manufacturers Discretion
2. J1850 (Bus+)
3. Manufacturers Discretion
4. Chassis Ground
5. Signal Ground
6. CAN HI
7. K line (ISO 9141)
8. Manufacturers Discretion

9. Manufacturers Discretion
10. J1850 (Bus -)
11. Manufacturers Discretion
12. Manufacturers Discretion
13. Manufacturers Discretion
14. CAN LO
15. L Line
16. Battery +

- **Terminal 16: Battery + at all times**
- **Terminal 4: Chassis Ground**
- **Terminal 5: Signal Ground**
- **Other terminals are for diagnostic and data circuits, and will vary according to vehicle make, model, year and options.**

NOTE: If your Scan tool DOES NOT have communication with the vehicle, check for blown fuses, especially on GM and Ford applications. It is common for the data link connector, cigar lighter, and power ports to all be fed from the same fuse.

J1962 OBDII Connector

Breakout Box

For communication problems and manual code retrieval, use a J1962 Breakout Box. This Box is used for testing data link connector circuits and also checking for codes.

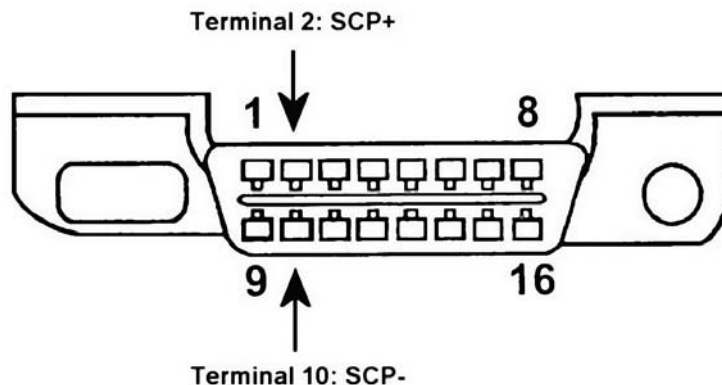
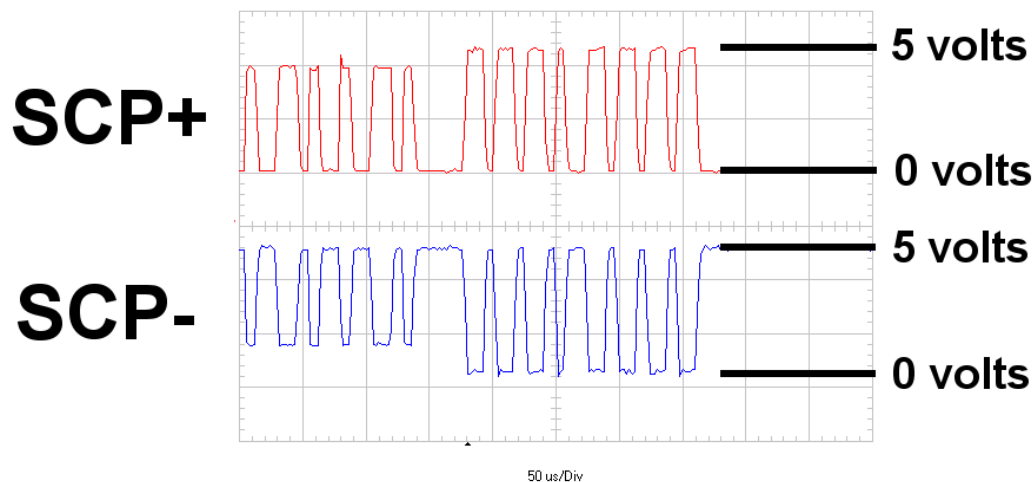


www.sjdiscounttools.com
Part number NUD420-167

J1962 OBDII Connector

Ford SCP (Standard Corporate Protocol) (PWM)

- Two wire (twisted pair) differential bus.
- Parallel Network; all modules share the same SCP+ and SCP- circuits.
- Used for scan tool and inter-module communication.
- Fault tolerant; can continue to operate in one wire mode.
- When data is transmitted, SCP+ is toggled 0- 5 volts, SCP- toggled 5- 0 volts (SCP+ and SCP- waveforms are mirror images of each other)



Ford SCP (PWM) Network Wiring

WIRING DIAGRAM FOR 1994 FORD TAURUS

Legend:

- 1: FUSE 200 10A
- 2: FUSE 200 10A
- 3: FUSE 200 10A
- 4: FUSE 200 10A
- 5: FUSE 200 10A
- 6: FUSE 200 10A
- 7: FUSE 200 10A
- 8: FUSE 200 10A
- 9: FUSE 200 10A
- 10: FUSE 200 10A
- 11: FUSE 200 10A
- 12: FUSE 200 10A
- 13: FUSE 200 10A
- 14: FUSE 200 10A
- 15: FUSE 200 10A
- 16: FUSE 200 10A
- 17: FUSE 200 10A
- 18: FUSE 200 10A
- 19: FUSE 200 10A
- 20: FUSE 200 10A
- 21: FUSE 200 10A
- 22: FUSE 200 10A
- 23: FUSE 200 10A
- 24: FUSE 200 10A
- 25: FUSE 200 10A
- 26: FUSE 200 10A
- 27: FUSE 200 10A
- 28: FUSE 200 10A
- 29: FUSE 200 10A
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- 38: FUSE 200 10A
- 39: FUSE 200 10A
- 40: FUSE 200 10A
- 41: FUSE 200 10A
- 42: FUSE 200 10A
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- 46: FUSE 200 10A
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- 89: FUSE 200 10A
- 90: FUSE 200 10A
- 91: FUSE 200 10A
- 92: FUSE 200 10A
- 93: FUSE 200 10A
- 94: FUSE 200 10A
- 95: FUSE 200 10A
- 96: FUSE 200 10A
- 97: FUSE 200 10A
- 98: FUSE 200 10A
- 99: FUSE 200 10A
- 100: FUSE 200 10A

Wiring Connections:

- Driver Seat Module (Under Driver's Seat) (W/Memory):**
 - 1: GRY/WHT 4 AH80
 - 9: BLU/YOR 5 AH80
- Driver Door Module (In Driver's Door):**
 - 3: GRY/YOR 4 EG13
 - 4: BLU/BLK 5 EG13
- Remote Emergency Satellite Cellular Unit (Rescue) (Left Side of W/Package Comp):**
 - 11: GRY/WHT (OR GRY/BLU) 4 GP8
 - 5: BLU/YEL 5 GP8
- Rear Electronic Module (Right Side of W/Package Comp):**
 - 1: GRY/WHT 4 EG12
 - 2: BLU/YOR 5 EG12
- Front Electronic Module (In Left "A" Pillar):**
 - 7: GRY 4 EG11
 - 1: BLU 5 EG11
- ABS Test Connector (Left Rear of Engine Comp):**
 - 4: GRY/WHT 4 CF53
- ABS Control Module (Right Front Side of Engine Comp):**
 - 11: GRY 4 CF6
 - 17: GRY 4 CF6
 - 10: BLU 5 CF6
 - 10: BLU 5 CF6
 - 23: GRY 4 EE6
 - 13: GRY 4 EE6
- Restraint Control Module (In Center Console):**
 - 5: GRY 4 EE1
- Powertrain Control Module (Right Rear of Engine Comp):**
 - 3: GRY 4 RE8
 - 4: BLU 5 RE8
 - 13: YEL/GRN 7 RE14
- Instrument Cluster:**
 - 5-G L58: BLU/BLK
 - 4-G L58: GRY/YOR
 - 5-E010: BLU/YEL
 - 4-E010: GRY/BLK
 - 5-E08: BLU/WHT
 - 4-E08: GRY/VIO
- Electronic Automatic Temperature Control Module (Behind Center of Dash):**
 - 5-FA10: BLU/YEL
 - 4-FA10: GRY/BLK
- Audio Unit (Behind Center of Dash):**
 - 5-FA10: BLU/YEL
 - 4-FA10: GRY/BLK
- Central Junction Box:**
 - 1: FUSE 200 10A
 - 2: FUSE 200 10A
 - 3: FUSE 200 10A
 - 4: FUSE 200 10A
 - 5: FUSE 200 10A
 - 6: FUSE 200 10A
 - 7: FUSE 200 10A
 - 8: FUSE 200 10A
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 - 62:

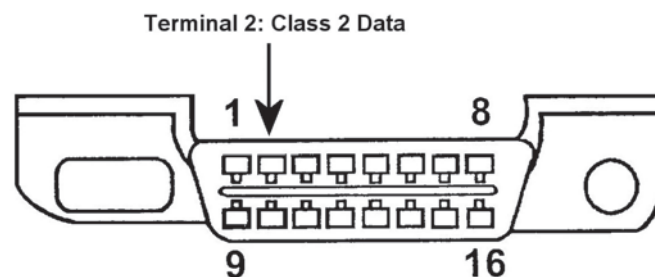
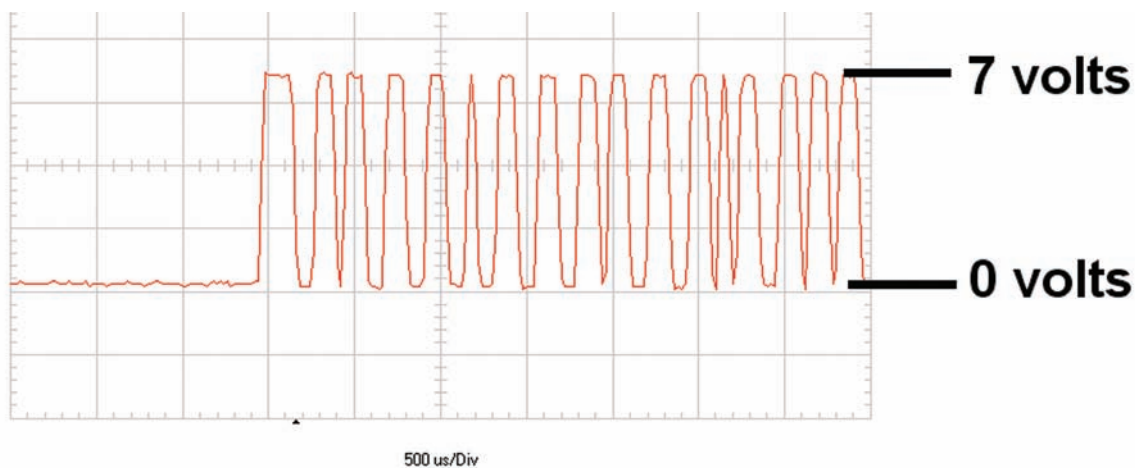
J1962 OBDII Connector

GM Class 2/Chrysler PCI (Programmable Communication Interface)

- Single wire network.
- Used for both scan tool and inter-module communication.
- When data is transmitted voltage toggles from 0-7 volts.
- A Daimler-Chrysler vehicle can have either PCI or CCD bus network, but not both.
- PCI is typically not used for scan tool communication with the PCM, SCI is used instead.

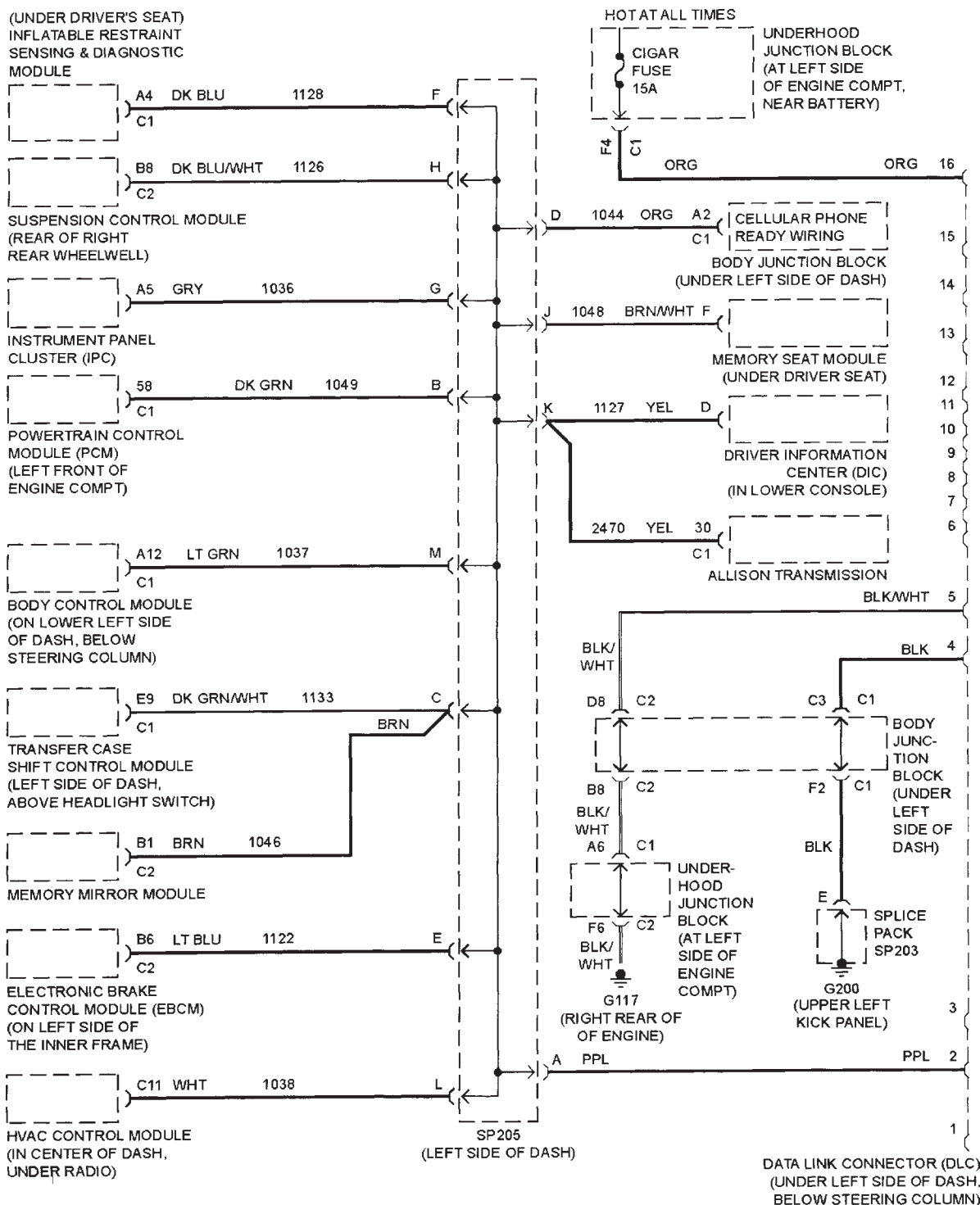
A short anywhere in the network will disable all communication. An open will disable communication between modules on either side of the fault location.

Consider the scan tool as just another module on the network. If the whole network is down, you will have no scan tool communication. If there is an open between scan tool and another module, you will not be able to communicate with that module.



J1962 OBDII Connector

GM Class 2 Network Wiring Diagram

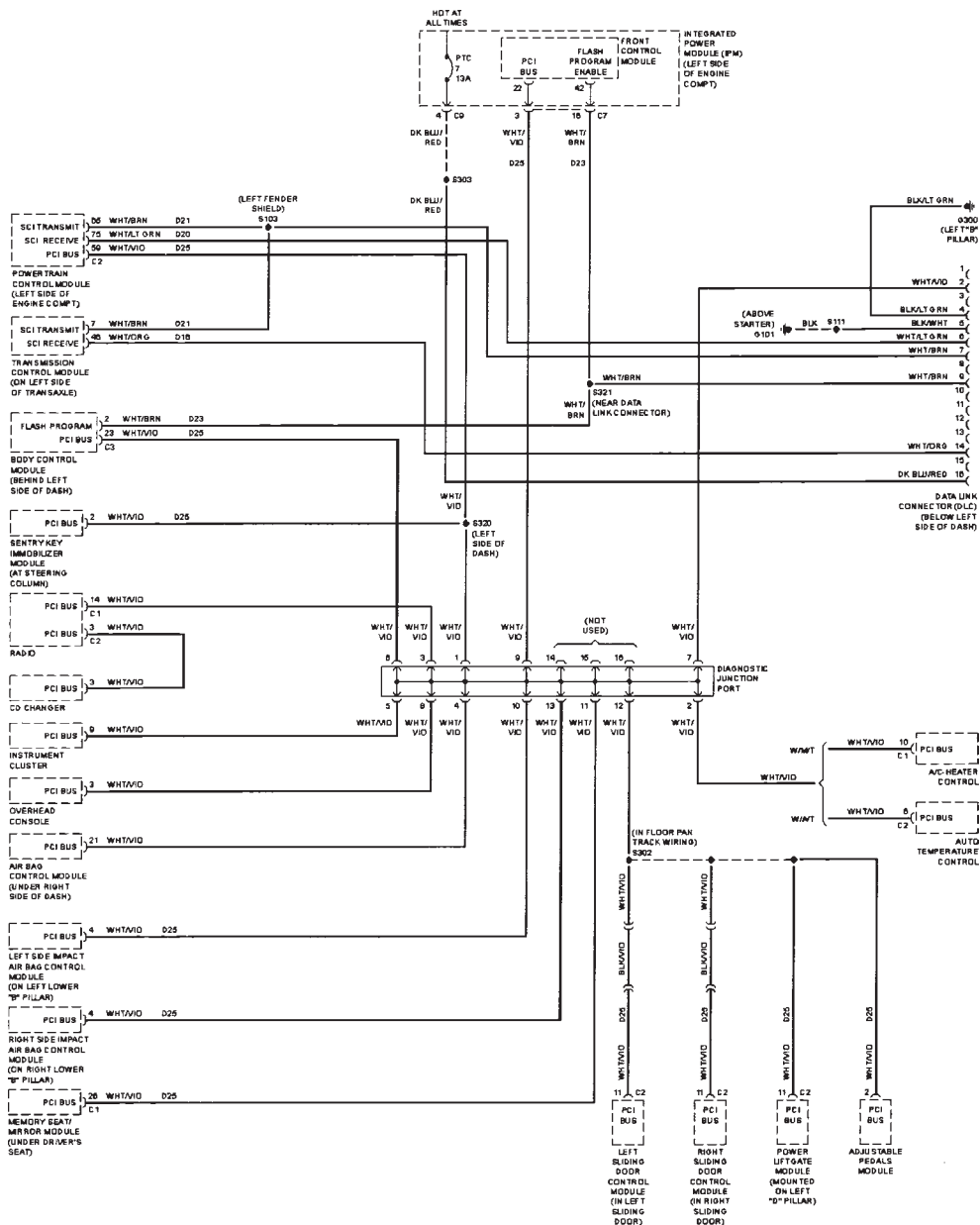


J1962 OBDII Connector

Chrysler PCI Network Wiring Diagram

PCI is essentially the same configuration as GM Class 2 with the exception of the SCI scan tool data link for the PCM, which is used for scan tool communication with the PCM.

The whole PCI network can be down, but scan tool will still be able to communicate with PCM.



J1962 OBDII Connector

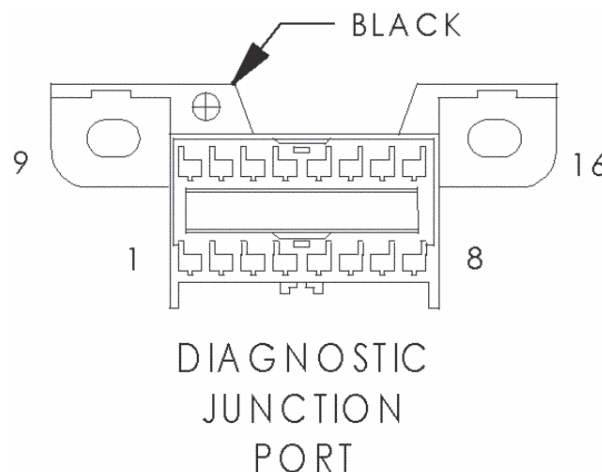
GM Class2/Chrysler PCI Diagnosis

This is the common connection point, or “Star” connection in the network wiring. Unplug the “Star” connector to isolate and check each leg of the network. With circuits isolated, continuity can then be checked on each individual circuit leg. Circuits can be jumped to data link connector one by one to establish scan tool and inter-module communication with individual modules.

GM Vehicles: SP205 Splice Pack



Chrysler Vehicles: Diagnostic Junction Port



J1962 OBDII Connector

Chrysler CCD (Chrysler Collision Detection) Bus

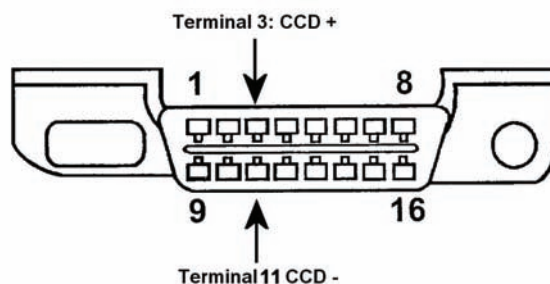
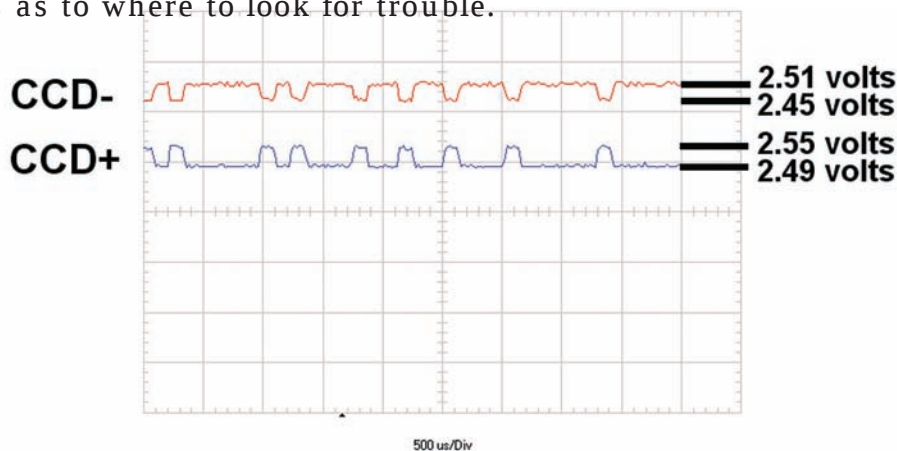
- Two wire (twisted pair) differential bus.
- Parallel network; all modules connected to the same CCD+ and CCD- circuits.
- Used for inter-module and scan tool communication.
- CCD bus started being Replaced by the single wire PCI bus in the late 1990's.
- Not fault tolerant.
- When data is transmitted, CCD+ is toggled between 2.49 - 2.55 volts, CCD- is toggled between 2.51 - 2.45 volts (CCD+ and CCD- waveforms are mirror images of each other).

CCD and PCI Network Diagnostic Tips:

The instrument cluster is the best visual indication of which modules are communicating.

- Tachometer and engine gauge data comes from the engine control module.
- Speedometer and gear position indicator data comes from the transmission control module.

Simply looking at what is and is not functioning on the instrument cluster will give clues as to where to look for trouble.



J1962 OBDII Connector

Chrysler CCD Bus

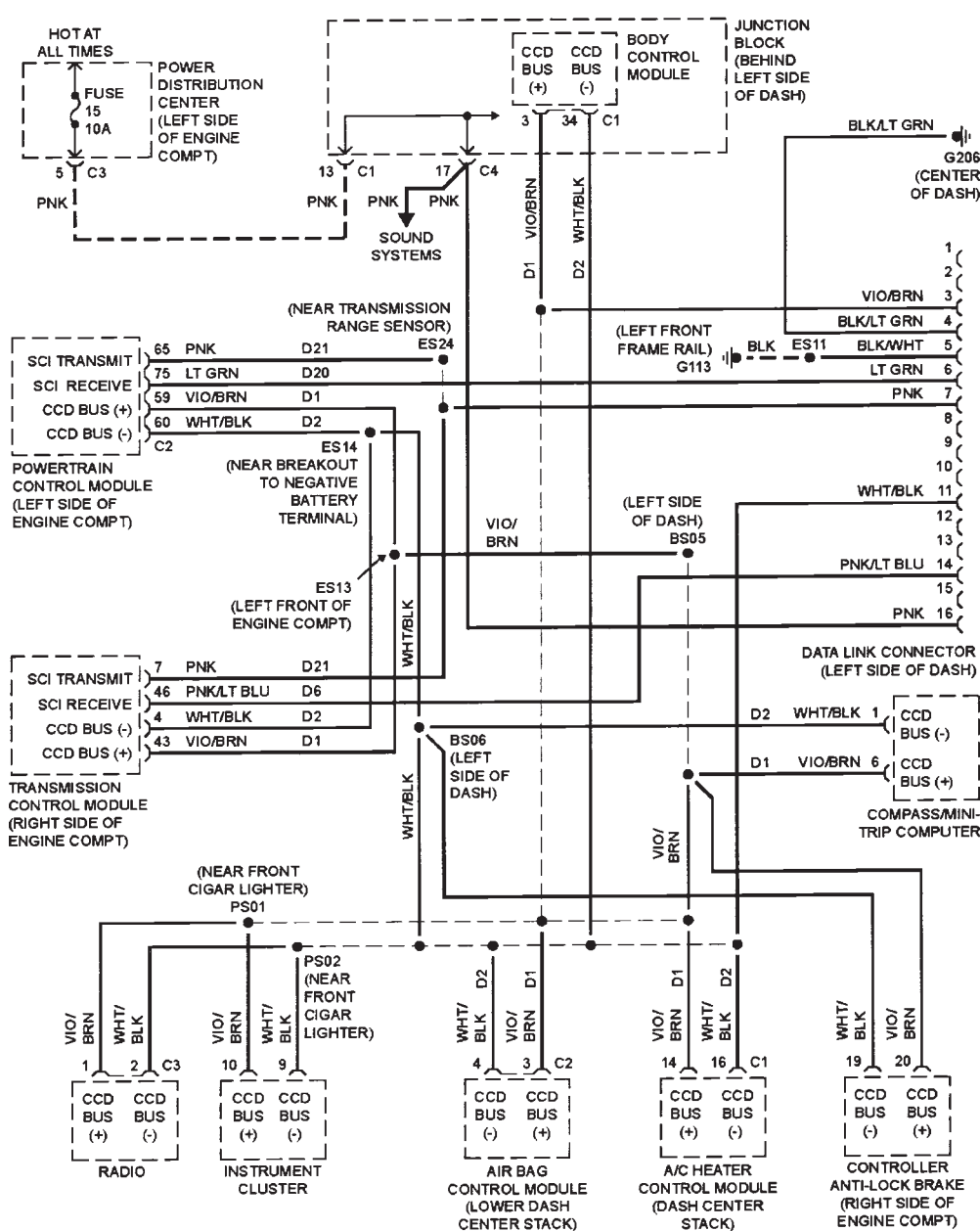
CCD bus will typically have many splices in different locations in the harness, making it a pain to track down wiring problems.

Measuring DC voltages

With a meter:

CCD+ will have about 2.49 volts,

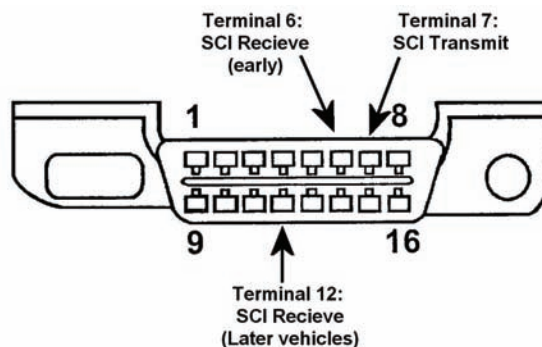
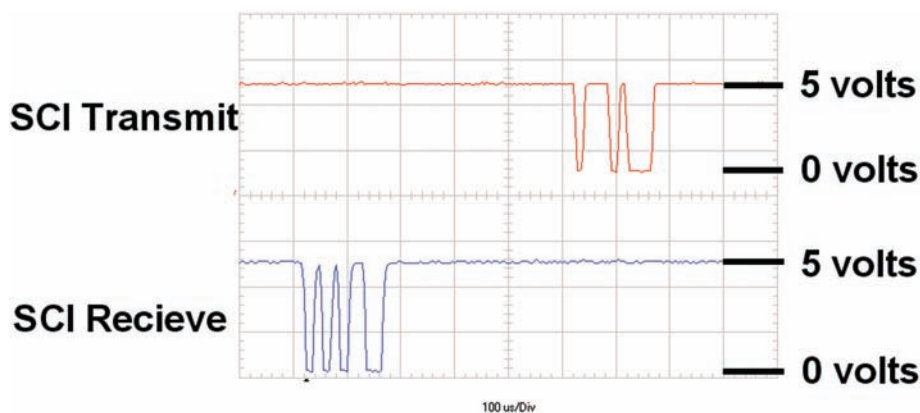
CCD- will have about 2.51 volts.



Chrysler SCI

(Serial Communication Interface) Diagnostic Data Link

- Two wire scan tool communication link to PCM or ECM.
- TCM will use CCD bus or PCI bus for scan tool communication.
- Not used for inter-module communication, scan tool only.
- Slow and fast messages are often mixed together during communication.
- SCI Transmit carries data from PCM to scan tool, SCI Recieve carries data from scan tool to PCM.
- SCI Transmit circuit was designed to also work with ISO 9141 in generic mode, to make CCD bus equipped vehicles OBDII compliant.
- SCI Transmit is 0 volts until scan tool is plugged in. Scan tool will usually default to 12 volt bias on SCI Transmit circuit until vehicle information is entered into scan tool and PCM is selected. SCI transmit will then switch to 5 volt bias.
- SCI Recieve will have 5 volt bias without scan tool plugged in.
- SCI Transmit and SCI recieve independently toggle 0-5 volts during data transmission.



Diagnostic Data Link

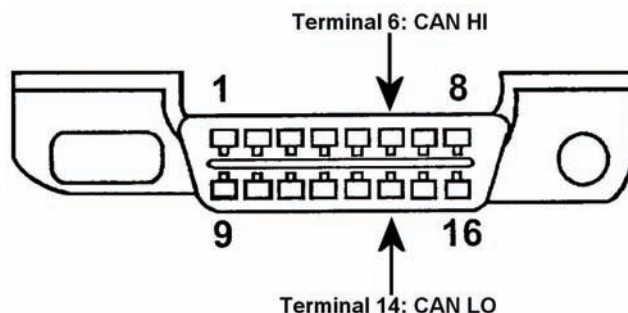
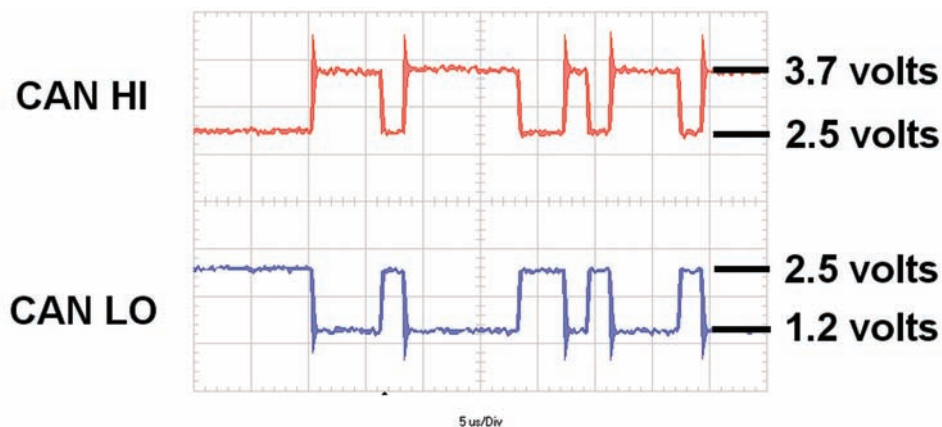
[illegible]

CAN

CAN (Controller Area Network) is the new standard scan tool communication link required on all 2007 and newer vehicles.

Auto manufacturers started phasing in CAN diagnostic link in 2003.

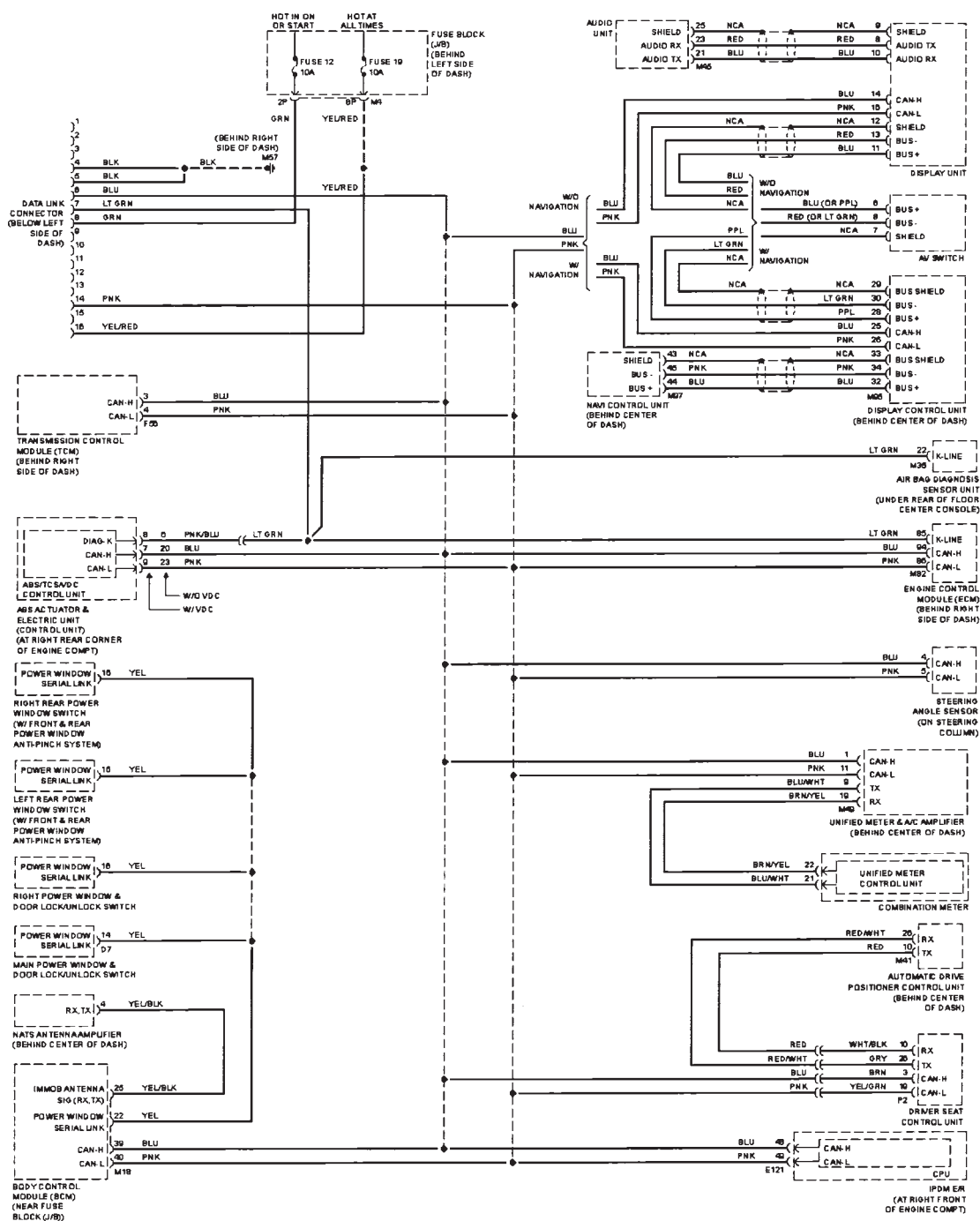
- Two wire (twisted pair) differential bus
- May be wired as a parallel or series bus configuration.
- Used for both inter-module and scan tool communication.
- Not fault tolerant. A short or open in CAN HI or CAN LO circuit will stop all communication.
- When data is transmitted CAN HI toggles between 2.5 and 3.7 volts, CAN LO toggles between 2.5 and 1.2 volts (CAN HI and CAN LO waveforms are mirror images of each other).



CAN

Wiring Diagram

Two wire parallel configuration is most common, but some vehicles will use series configuration with one module having a dedicated diagnostic link to the data link connector.



CAN

Interface

If you are using a “stand alone” type scan tool (NOT PC scan tool software), you will need a CAN adapter to communicate with many 2003 and newer vehicles. Here are some examples of adapters required for specific scan tools:

1. Snap-On: CAN 1B
2. Tech II: CAN di module
3. Mastertech: CAN VIM



Snap-On: CAN 1B

If you are using a J2534 interface with PC scan tool software, the interface has CAN built in and DOES NOT require an additional adapter. The J2534 interface will be discussed in the RECALIBRATION section.

**EASE Diagnostics
J2534 Interface**



CAN

Vehicles Requiring CAN Interface

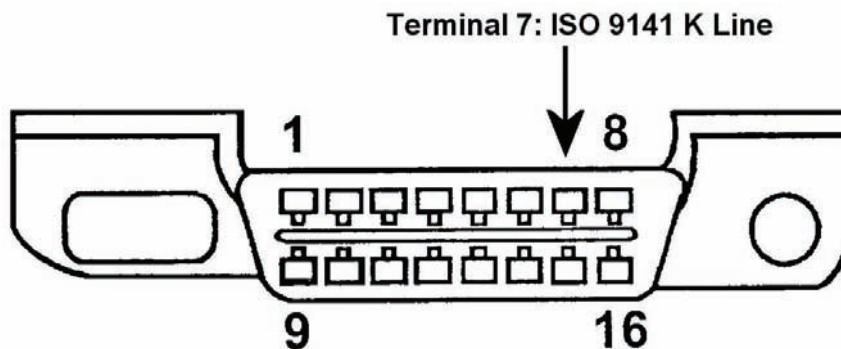
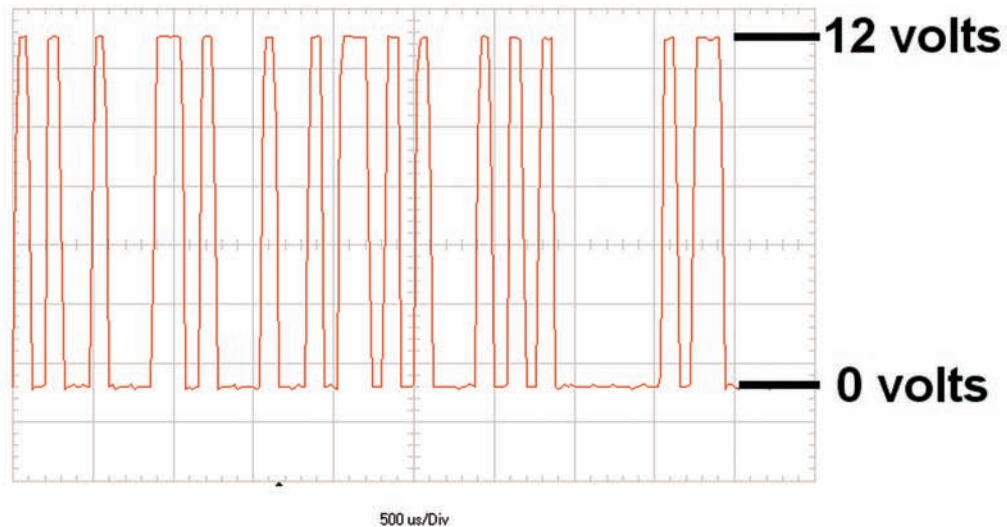
Year	Make	Model	Year	Make	Model
2003	Ford	2.3L Focus 3.9L Thunderbird	2005	Cadillac	CTS, SRX, STS, XLR
2003	Lincoln	LS 3.0L Automatic Trans. LS 3.9L Automatic Trans.	2005	Chevrolet	Cobalt, Corvette, Equinox, Malibu, SSR, Trailblazer EXT
2003	Mazda	2.3L Mazda 6 3.0L Mazda 6	2005	Chrysler	300C
2003	Porsche	Cayenne S Cayenne Turbo	2005	Dodge	Dakota, Durango, Magnum
2003	Saab	9-3 Sedan (175 HP) 9-3 Sedan (210 HP)	2005	Ford	Crown Victoria, E150, E250, E350, Escape, Excursion, Expedition, Explorer, F150, F250, F350, Five Hundred, Focus, Freestyle, Mustang, Taurus, Thunderbird
2003	Saturn	ION	2005	GMC	Envoy ESV Envoy XL
2004	Buick	Rendezvous	2005	Isuzu	Ascender
2004	Cadillac	CTS, SRX, XLR	2005	Jeep	Grand Cherokee
2004	Dodge	Durango	2005	Land Rover	LR3
2004	Ford	Explorer, F150, 2.3L Focus, Taurus, Thunderbird	2005	Lexus	LS 400, LS 430, GX470
2004	Lexus	LS 430	2005	Lincoln	LS, Navigator, Town Car
2004	Lincoln	LS	2005	Mazda	Mazda 3, Mazda 6, RX8, MPV, Tribute
2004	Mazda	Mazda 3, Mazda 6, RX8	2005	Mercedes	SLK350
2004	Mercury	Mountaineer, Sable	2005	Mercury	Grand Marquis, Mariner, Montego, Mountaineer, Sable
2004	Porsche	Cayenne S Cayenne Turbo	2005	Pontiac	G6, Grand Prix, GTO
2004	Saab	9-3	2005	Porsche	Cayenne S Cayenne Turbo
2004	Saturn	ION	2005	Saab	9-3 9-7X
2004	Toyota	Prius	2005	Saturn	ION
2004	Volvo	S40 2.4L S40 2.5L	2005	Toyota	Avalon, Prius, Tacoma, 4Runner, Tundra, Sequoia
2005	Audi	A4, A6	2005	Volvo	S40, V50, S60, V70, S80, XC90
2005	Buick	LaCrosse, Rainier, Rendezvous			

ISO 9141 (K Line)

ISO (International Standards Organization)

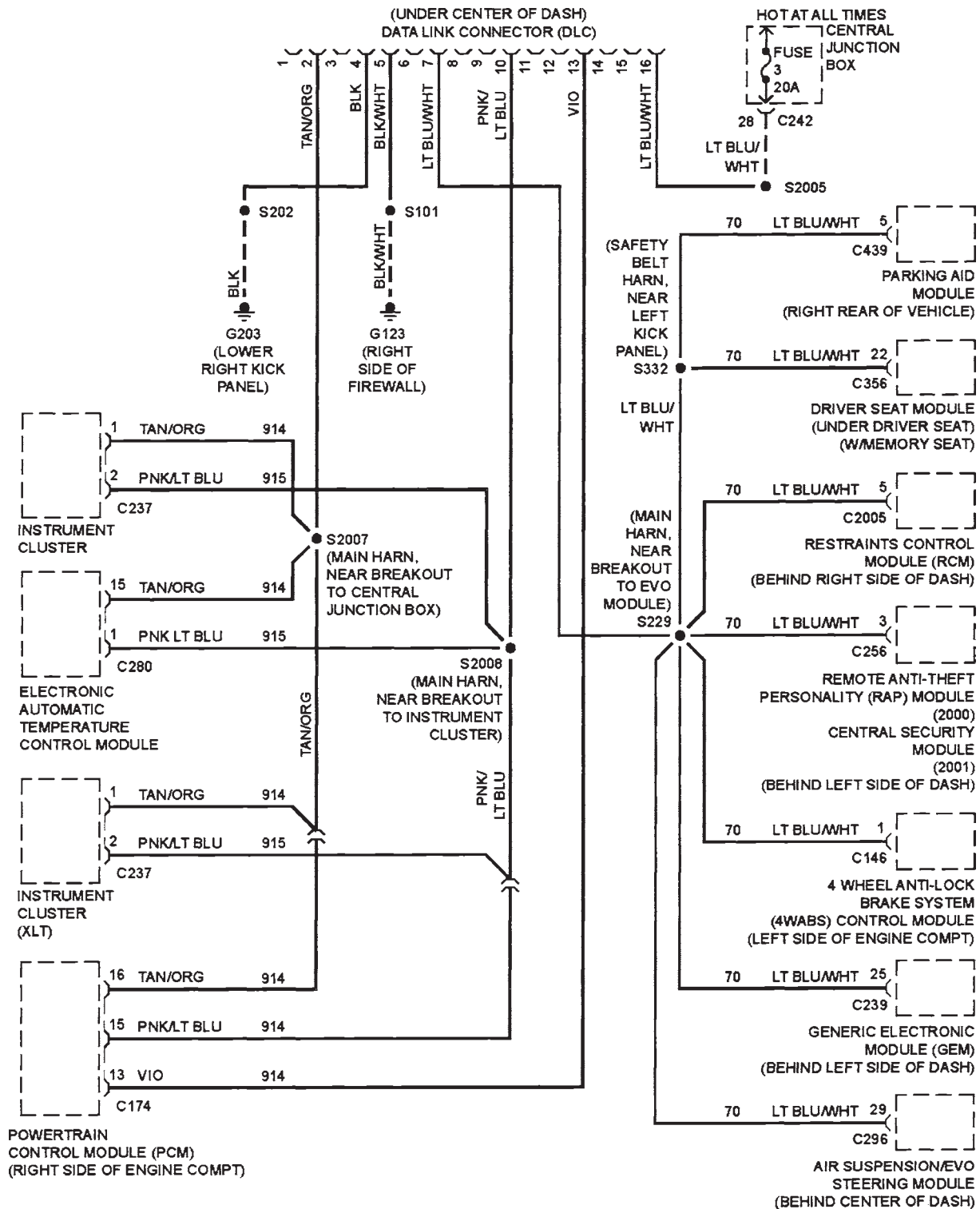
- Used on Asian and European vehicles, also on Ford GEM and airbag module scan tool data link.
- Single wire data link. Usually shared by several modules.
- Use for scan tool communication only (not used for inter-module communication).
- When data is transmitted, voltage is toggled between 0 and 12 volts.

**ISO 9141
K Line**



ISO 9141 (K Line)

Wiring Diagram



NOTES:

Recalibration

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J2534 Interface

J2534 is a scan tool and reprogramming interface standard for all auto manufacturers. All 2003 and newer vehicles are required to be J2534 compatible. The J2534 interface translates data between PC and vehicle network/data link. It is used for 'Pass Thru' reprogramming and scan tool communication.

Most OBDII vehicles, especially domestics, can be reprogrammed via J2534 Pass Thru. Each auto manufacturer has their own J2534 PC software for reprogramming. Calibrations and J2534 software are available either from auto manufacturers service information website or by purchasing a CD-ROM.

J2534 Pass Thru Manufacturers		
Manufacturer	Product	Web Address
Actia	PassThru+ XS	www.actiaus.com
Blue Streak Electronics	BSE-2534 Global Programmer	www.bsecorp.com
Eepod	McS1	www.eepod.com
Drew Technologies	CarDAQ-Plus	www.drewtech.com
Ease Diagnostics	Universal Reprogrammer	www.easediagnostics.com
Snap-On	Pass Thru Pro	www.snapon.com
Vetronix	E6510 Flasher	www.vetronix.co

**Vehicle
Diagnostic
Connector**



**J2534
Interface**

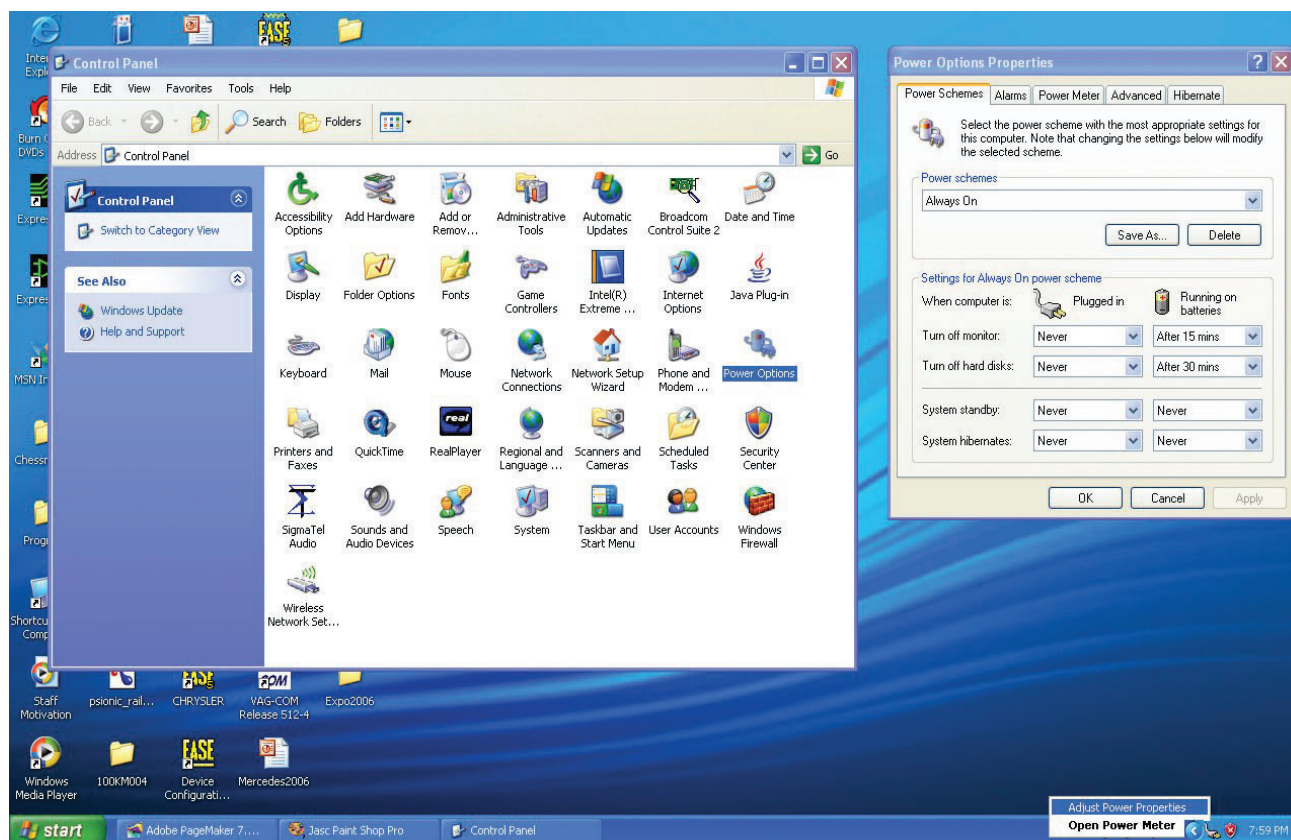


PC

Recalibration PC Setup

Make sure PC power management settings will not allow PC to go into standby or hibernate. If PC goes into standby or hibernate during reprogramming the ECM can be ruined.

The J2534 interface will require either RS232 or USB connection to PC, make sure PC is appropriately equipped to connect to the J2524 interface. A wireless card may come in handy.



Recalibration TSB's

A lot of diagnostic time can be wasted on problems that are fixed with programming updates. OEM service websites have the most up to date TSB and recalibration information. Common for updated calibration to address shifting problems, engine performance problems, parts interchange, and false DTC's.

GM Reflash TSB Examples		
TSB Number	Vehicles	Complaint
03-06-04-057	2002-2003 Trailblazer 2002-2003 Envoy 2002-2003 Bravada with 4.2L engine	Harsh 1-2 shift, Slipping 1-2 shift, Harsh engagement
03-07-30-016	2003 Saturn Vue 2wd with 2.2L VT25E transaxle	TCC Shudder / Vibration (Reprogram TCM)
99-07-30-007	1998 LeSabre, Eighty Eight, Park Avenue, and Bonneville with 3.8L engine	Shudder when accelerating after coming to a stop.
03-07-30-021A	1995-2003 Cavalier 1997-2003 Malibu 1999-2003 Alero 1995-2003 Sunfire 1998-2003 Grand Am	Flare shift or neutralizing, no 1-2 shift, DTC's P1810, P1815 set.
05-07-30-008	2002-2003 Saturn Vue with AF33-5 Transaxle	2-3 Flare (Reprogram TCM)
04-07-30-005	2003-2004 Saturn Vue 2003-2004 Saturn ION with VT25E Transaxle	Hiss / chirp noise in Park or Neutral (Reprogram TCM)
04-04-21-001	2004 Ranier 2002-2004 Trailblazer, EXT 2002-2004 Envoy, XL 2004 Envoy XUV 2002-2004 Bravada with NVG 126 or NVG 226 transfer case	Delayed engagement of front wheels during a slip condition. (Reprogram TCCM)
03-07-30-051A	2003-2005 Saturn VUE with VT25E transaxle	Low speed grind and / or hesitation while driving. (Reprogram TCM)
02-04-21-006E	2004 Ranier 2002-2004 Trailblazer, EXT 2003-2004 Avalanche, Suburban, Tahoe 2002-2004 Envoy, XL 2003-2004 Sierra, Yukon, XL 2004 Envoy XUV with Electronic Shift or Active Transfer Case	Inoperative 4WD / AWD lights, inoperative 4WD / AWD system, DTC C0550 set no communication with TCCM (Reprogram TCCM)

Recalibration TSB's

Ford Reflash TSB Examples		
TSB Number	Vehicles	Complaint
00-21-6	2000 Ranger 3.0L	Delayed or Slipping 1-2 shift.
00-24-6	1999 Super Duty F Series with 6.8L engine, build dates 1/12/98 thru 7/3/99	Erratic shifting, early and/or late shifts.
01-14-5	2000-2001 Lincoln LS built before 10/17/2000	Delayed engagements, harsh shifts, erratic shifts, delayed downshifts near 20 mph.
01-25-4	2000-2001 Focus	Final drive gearset ratio change: delayed shifts after final drive gearset ratio change or transaxle replacement.
02-23-4	1999-2002 Mustang 2000-2002 Focus 1999-2002 Expedition, F150 2000-2002 E series 2001-2002 Explorer Sport Trac, Sport, and Ranger 1999-2002 Town Car, Navigator 2002 Blackwood 2002 Mountaineer all above with gasoline engine	After PCM or instrument cluster replacement, 4x4 indicator lamp illuminated and speedometer inaccurate. (program VID block in PCM)
02-24-2	2003 Crown Victoria Police Built 3/26/2002-6/30/2002	Loss of 4th gear, burned or damaged OD band.
03-21-40	1997 F250, F350 1999-2000 F Super Duty 2000 Excursion all above with 7.3L engine	Buck/surge with speed control engaged
04-25-16	2003-2004 Excursion, F Super Duty 2004 E series	MIL illuminated with DTC P0756, P0761, P0771 after installing a Torqshift with 2005 level components.
05-24-5	2005-2006 Five Hundred, Montego with 6 speed automatic transaxle, built before 10/17/2005	Harsh/erratic/slow downshifts or tip in hesitation.
98-24-2 98-13-11	1998-1999 Contour, Mystique built through 5/31/98 1999 Cougar built through 6/11/98	Calibration update for service replacement transaxle. Replacement servo, spring and calibration update for harsh 1-2 shift at light throttle, harsh 3-2 downshift after 1-3 upshift.

Recalibration TSB's

Chrysler Reflash TSB Examples		
TSB Number	Vehicles	Complaint
18-001-03A	2002-2003 Dakota with 3.9L engine, 42RE transmission, built before 11/22/2002	Transmission will not shift out of second gear while climbing a hill.
18-013-04	2003 Dakota, Durango, Ram Pickup, Liberty, KJ Cherokee, WG and WJ Grand Cherokee	Transmission shift speed and feel improvements, MIL illumination.
18-030-01	1999 Ram Van, Dakota, Ram Truck, Durango with 46RE transmission	Shift quality and durability improvements, especially for repeated N-D and N-R engagements.
18-11-00	1999 Avenger, Sebring, Sebring Convertible, Cirrus, Stratus, Breeze, Concorde, Intrepid, LHS, 300M, Town and Country, Caravan, Voyager, Prowler	Low voltage clutch protection. Added DTC P1714: low battery voltage.
18-29-96	1997 Caravan, Voyager, Town and Country	Transaxle shuttle shifting between 3rd and 2nd gear, usually when climbing a grade.
21-004-05	2004 Pacifica 2002-2004 Sebring, Stratus Sedan 2003 Liberty, Cherokee, Wrangler 2002-2003 Neon, PT Cruiser 2002-2004 300M, Concorde, Intrepid	Delayed engagement. Reprogram TCM and replace pump.
21-004-06	2003-2005 Town and Country, Voyager, Caravan	False DTC P1776, solenoid switch valve latched in L/R position.
21-01-00	2000 Ram Van, Durango, Dakota, Ram Truck, Cherokee with 46RE built before 12/01/99	Intermittent harsh reverse engagement. Reprogram PCM and install updated valve body.
21-02-98A	All vehicles with 41TE/AE and 42LE transaxles with internal range sensor. (TFT)	Shudder on light throttle 1-2 shift, shudder on 2-3 upshift after 3-2 or 4-2 kickdown.
21-04-00	All vehicles with RE series transmission and build date before 12/18/98	Erroneous P1763, governor pressure sensor voltage too high.

Recalibration TSB's

Toyota Reflash TSB Examples		
TSB Number	Vehicles	Complaint
EG003-01	2001 Lexus IS300	Improvements to throttle response and 5-2 downshift time.
EG004-02	2002 Lexus GS 300, IS 300, and IS 300 SportCross	DTC P0300-P0306, or harsh 2-3 shift during acceleration.
EG005-02	2001 GS 300, IS 300	Harsh 2-3 shift during light throttle acceleration.
EG013-01	2002 Toyota Camry with 1MZ-FE engine and U140E transaxle	Updated calibration to improve shift quality.
EG025-02	2002 Toyota 4Runner and Tacoma V6	Erroneous DTC P0770, SSE (TCC) performance fault when driving in hot weather, climbing a grade or hauling a heavy load.
TC003-05	2004-2005 Toyota Camry with 3MZ-FE engine and 5 speed automatic transaxle	Downshift lag when accelerating from 10-20 mph, gear hunting when on/off accelerator at 20-30 mph (driving in traffic), improved response on heavy acceleration from a stop.
TC004-03	2002-2003 Lexus ES 300 2004-2005 Lexus ES 330	Same symptoms as above.
TC005-03	2004-2005 Lexus RX 330	Same symptoms as above.
TC005-05	2004-2005 Toyota Camry with 1MZ-FE engine and 5 speed automatic transaxle	Same symptoms as above.
TC006-04	2004-2005 Lexus LS 430	Updated calibration to enhance low speed shifting.

GM Recalibration

Equipment needed:

- J2534 interface.
- AC Delco TIS CD's and USB key.

Install the TIS software from the Application CD.

Install the Data CD to update TIS and access calibration data.

Other considerations:

GM calibration information website: <http://calid.gm.com>

A GM calibration update takes about 30 minutes.



GM Recalibration

Diagnostic Tool:

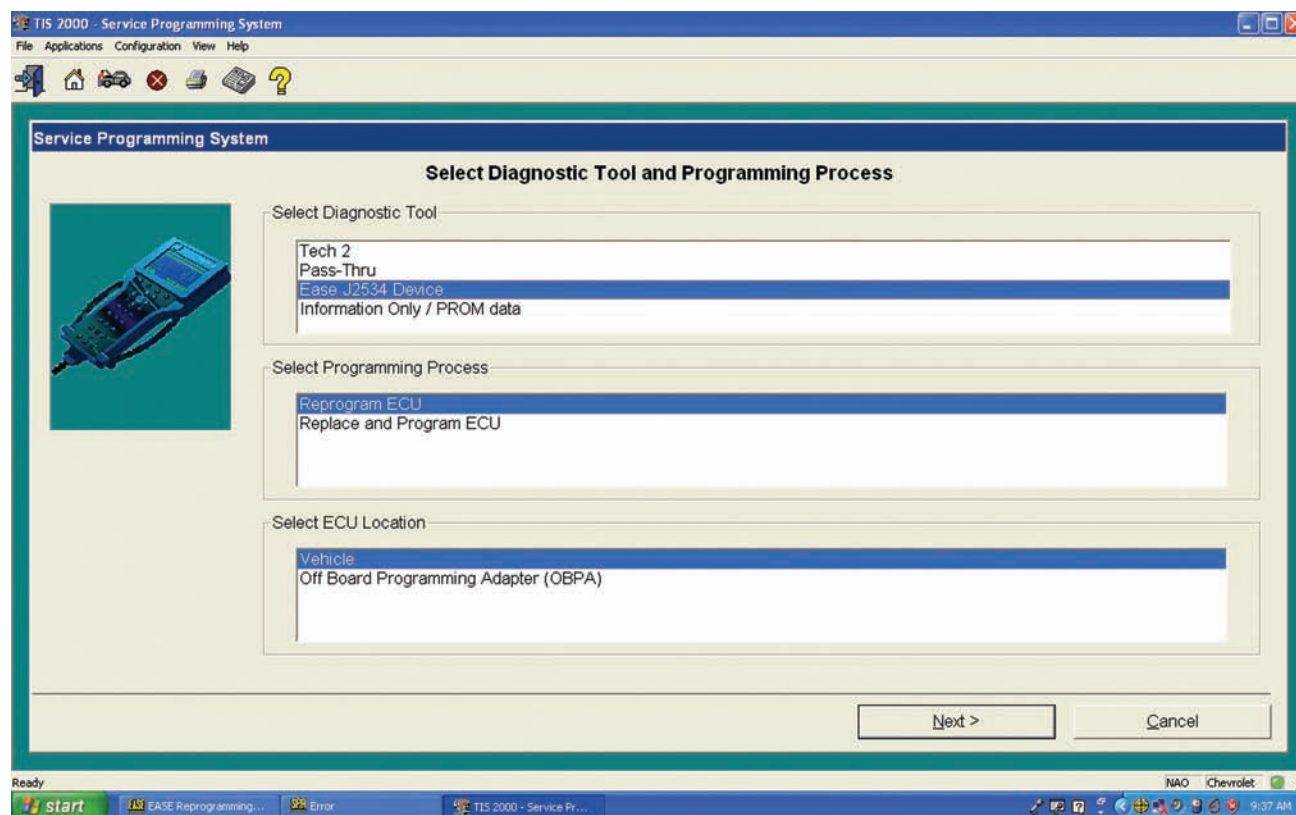
Select Pass-Thru or Ease J2534 device

Programming Process:

Select Reprogram ECU to recalibrate existing module select Replace and Program ECU to configure and program a new/used ECU

ECU Location:

Options are for in vehicle programming (through data link connector), or Off Board Programming (requires off board programming cables)



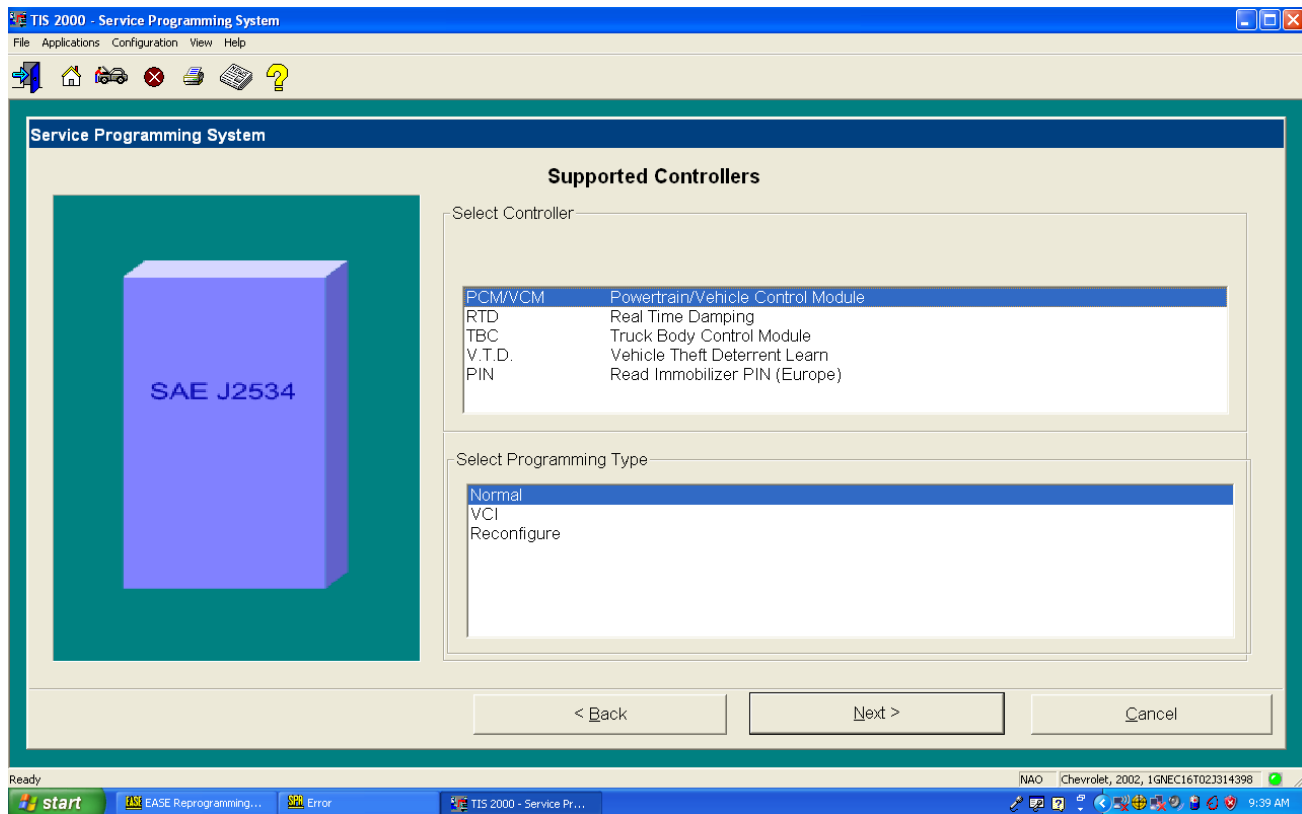
GM Recalibration

Select Controller:

Lists modules on vehicle supported for programming

Programming Type:

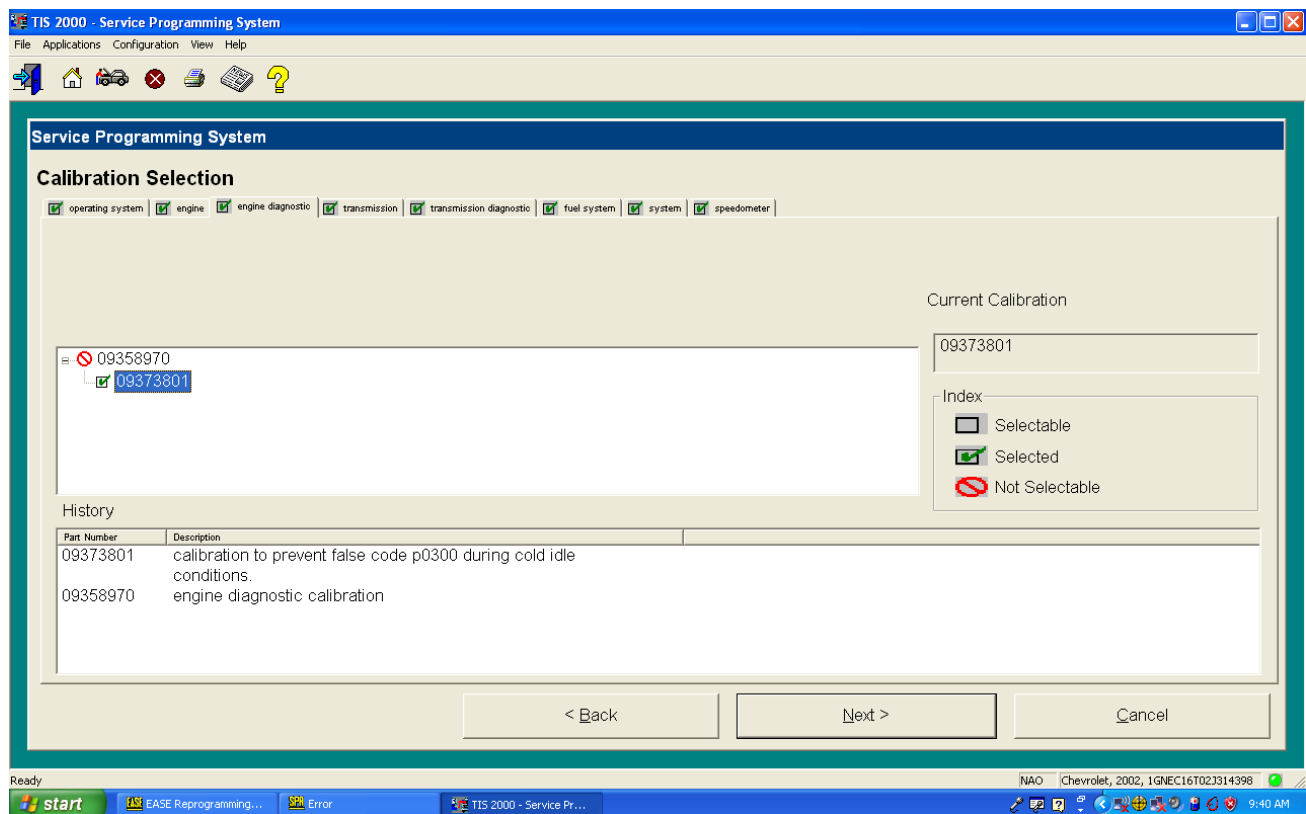
Normal to update to new calibration/software reconfigure if you are installing a new or used module, or changing configuration



GM Recalibration

Calibration Selection:

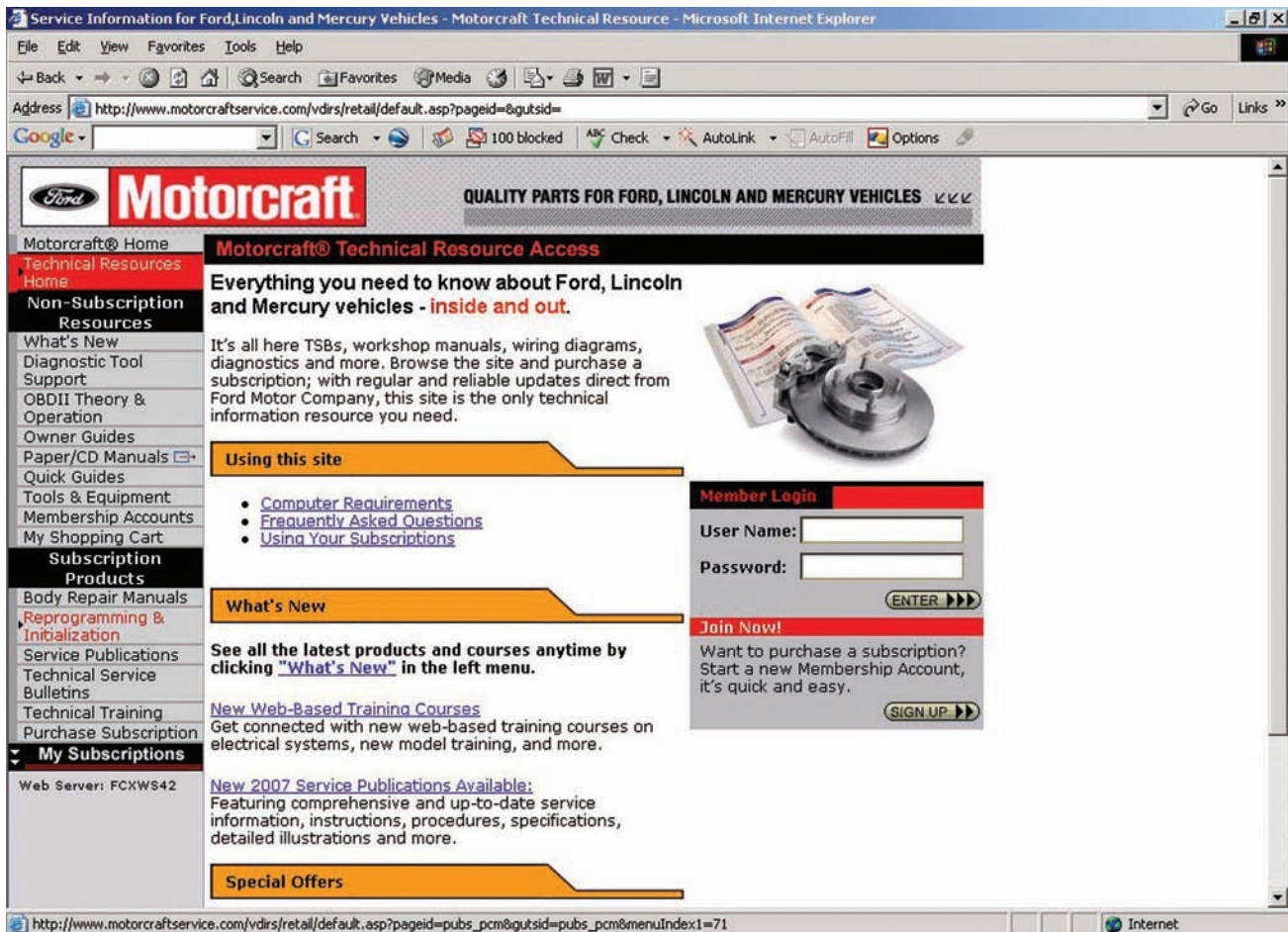
This is much like the calid.gm.com website, where you will select the specific calibration files you wish to program into the module.



Ford Recalibration

Needed:

- J2534 Pass Thru interface.
- PC with internet connection. PC must be connected to the internet (online) and the J2534 Pass Thru interface at the same time.
- Subscription to Motorcraft Module Reprogramming and Initialization.
- Download and install Ford Module Programming software from www.motorcraftservice.com (login required).



Ford Recalibration

- You will probably be instructed to remove the fuel pump, cooling fan, and FICM (diesel application) relays or fuses. Familiarize yourself with their locations.
- Calibration information can be found in the “Latest Calibration” spread sheet at www.motorcraftservice.com on the Reprogramming and Initialization page.
- Calibration number is the “Module ID” or “Module Part Number” retrieved with a scan tool.
- Calibration can be found with the catchword, or with vehicle information and current calibration number. Use “Latest Calibration” spreadsheet. Module programming software will automatically install the latest calibration file.
- It takes about one hour to reprogram a Ford.

Ford Recalibration

The “catchword” is a four character code on the PCM build/tear tag. It is usually located on the PCM connector and is visible without having to remove the PCM.



Note that the catchword is printed in larger characters. The catchword in this example is “BCL2”.

Ford Recalibration

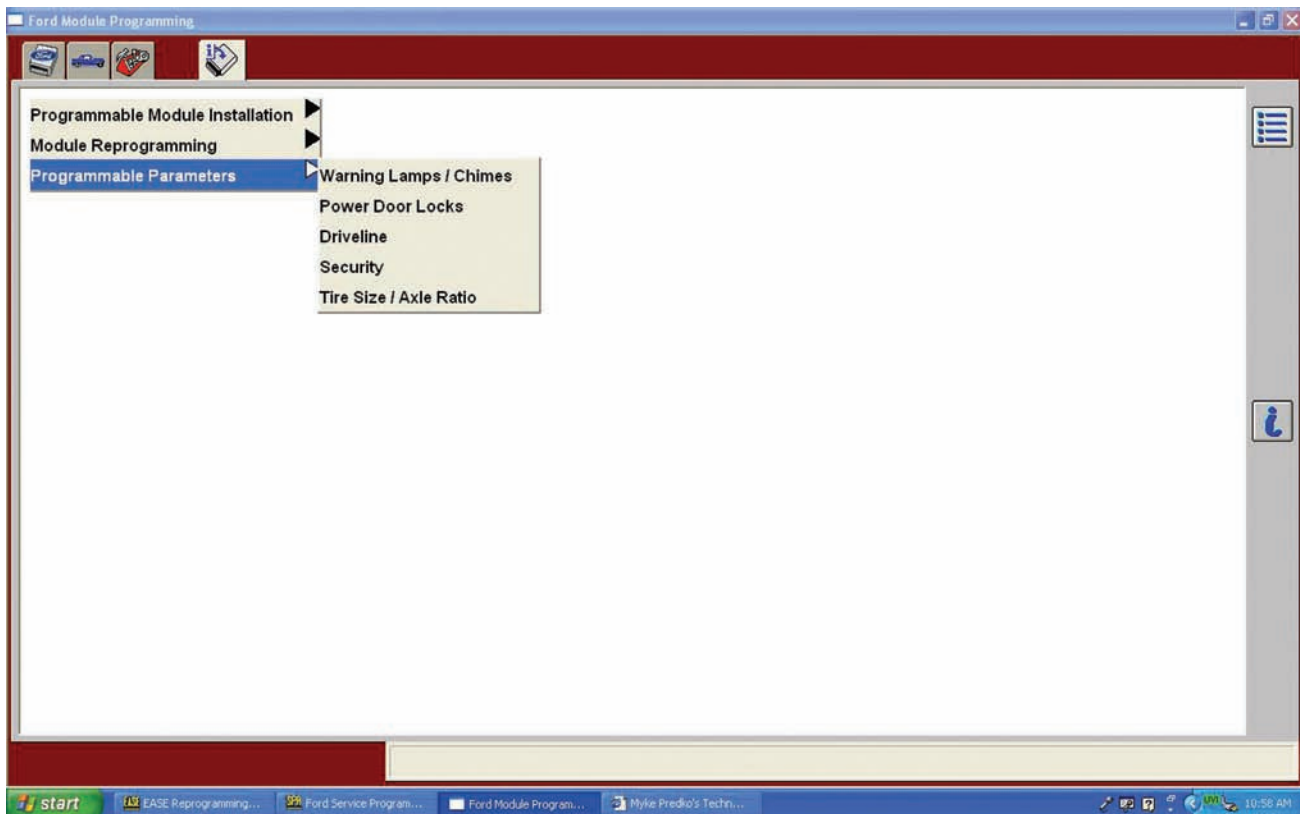
Use the latest calibration spreadsheet to look up calibration information using either the vehicle information (I.E. Year, model, engine size) or the catch code on the PCM or a combination of both to help you narrow your search down.

Year	Model	Engine	PartNum	NewPartN	Catchw	ModuleDN
1980	RANGER	M78	F87F-BMA	F87F-BMC	RCE0	PCM
1981	RANGER	M78	F87F-BMB	F87F-BMC	RCE1	PCM
1982	RANGER	M78	F87F-BMC	-	RCE2	PCM
1983	RANGER	M78	F87F-CAA	XL5F-BHB	MLC0	PCM
1984	RANGER	M78	F87F-CBA	XL5F-BJB	MJT0	PCM
1985	RANGER	M78	F87F-JA	F87F-JC	PCT0	PCM
1986	RANGER	M78	F87F-JB	F87F-JC	PCT1	PCM
1987	RANGER	M78	F87F-JC	-	PCT2	PCM
1988	RANGER	M78	F87F-KA	F87F-KD	WWO0	PCM
1989	RANGER	M78	F87F-KB	F87F-KD	WWO1	PCM
1990	RANGER	M78	F87F-KC	F87F-KD	WWO2	PCM
1991	RANGER	M78	F87F-KD	-	WWO3	PCM
1992	RANGER	M78	F87F-PA	F87F-PB	HLX0	PCM
1993	RANGER	M78	F87F-PB	F87F-PC	HLX1	PCM
1994	RANGER	M78	F87F-PC	-	HLX2	PCM
1995	RANGER	M78	F87F-SA	XL5F-ARB	FLH0	PCM
1996	RANGER	M78	F87F-SB	XL5F-ARB	FLH1	PCM
1997	RANGER	M78	F87F-SC	XL5F-ARB	FLH2	PCM
1998	RANGER	M78	F87F-TA	XL5F-EC	BCL0	PCM
1999	RANGER	M78	F87F-TB	XL5F-EC	BCL1	PCM
2000	RANGER	M78	F87F-TC	XL5F-EC	BCL2	PCM
2001	RANGER	M78	F87F-UA	F87F-UB	CNP0	PCM
2002	RANGER	M78	F87F-VA	F87F-VC	DUU0	PCM
2003	RANGER	M78	F87F-VB	F87F-VC	DUU1	PCM
2004	RANGER	M78	F87F-VC	-	DUU2	PCM
2005	RANGER	M78	F87F-UB	-	CNP1	PCM
2006	RANGER	M78	XL5F-ARB	XL5F-ARC	GAJ1	PCM
2007	RANGER	M78	XL5F-ARC	-	GAJ2	PCM
2008	RANGER	M78	XL5F-BHB	XL5F-BHC	XNA1	PCM
2009	RANGER	M78	XL5F-BHC	-	XNA2	PCM
2010	RANGER	M78	XL5F-BJB	-	MRM1	PCM
2011	RANGER	M78	XL5F-EC	XL5F-ED	EPC2	PCM
2012	RANGER	M78	XL5F-ED	-	EPC3	PCM

E	F	G	H
PartNum	NewPartN	Catchw	ModuleDN
F87F-BMA	F87F-BMC	RCE0	PCM
F87F-BMB	F87F-BMC	RCE1	PCM
F87F-BMC	-	RCE2	PCM
F87F-CAA	XL5F-BHB	MLC0	PCM
F87F-CBA	XL5F-BJB	MJT0	PCM
F87F-JA	F87F-JC	PCT0	PCM
F87F-JB	F87F-JC	PCT1	PCM
F87F-JC	-	PCT2	PCM
F87F-KA	F87F-KD	WWO0	PCM
F87F-KB	F87F-KD	WWO1	PCM
F87F-KC	F87F-KD	WWO2	PCM
F87F-KD	-	WWO3	PCM
F87F-PA	F87F-PB	HLX0	PCM
F87F-PB	F87F-PC	HLX1	PCM
F87F-PC	-	HLX2	PCM
F87F-SA	XL5F-ARB	FLH0	PCM
F87F-SB	XL5F-ARB	FLH1	PCM
F87F-SC	XL5F-ARB	FLH2	PCM
F87F-TA	XL5F-EC	BCL0	PCM
F87F-TB	XL5F-EC	BCL1	PCM
F87F-TC	XL5F-EC	BCL2	PCM
F87F-UA	F87F-UB	CNP0	PCM
F87F-VA	F87F-VC	DUU0	PCM
F87F-VB	F87F-VC	DUU1	PCM
F87F-VC	-	DUU2	PCM
F87F-UB	-	CNP1	PCM
XL5F-ARB	XL5F-ARC	GAJ1	PCM
XL5F-ARC	-	GAJ2	PCM
XL5F-BHB	XL5F-BHC	XNA1	PCM
XL5F-BHC	-	XNA2	PCM
XL5F-BJB	-	MRM1	PCM
XL5F-EC	XL5F-ED	EPC2	PCM
XL5F-ED	-	EPC3	PCM

Ford Recalibration

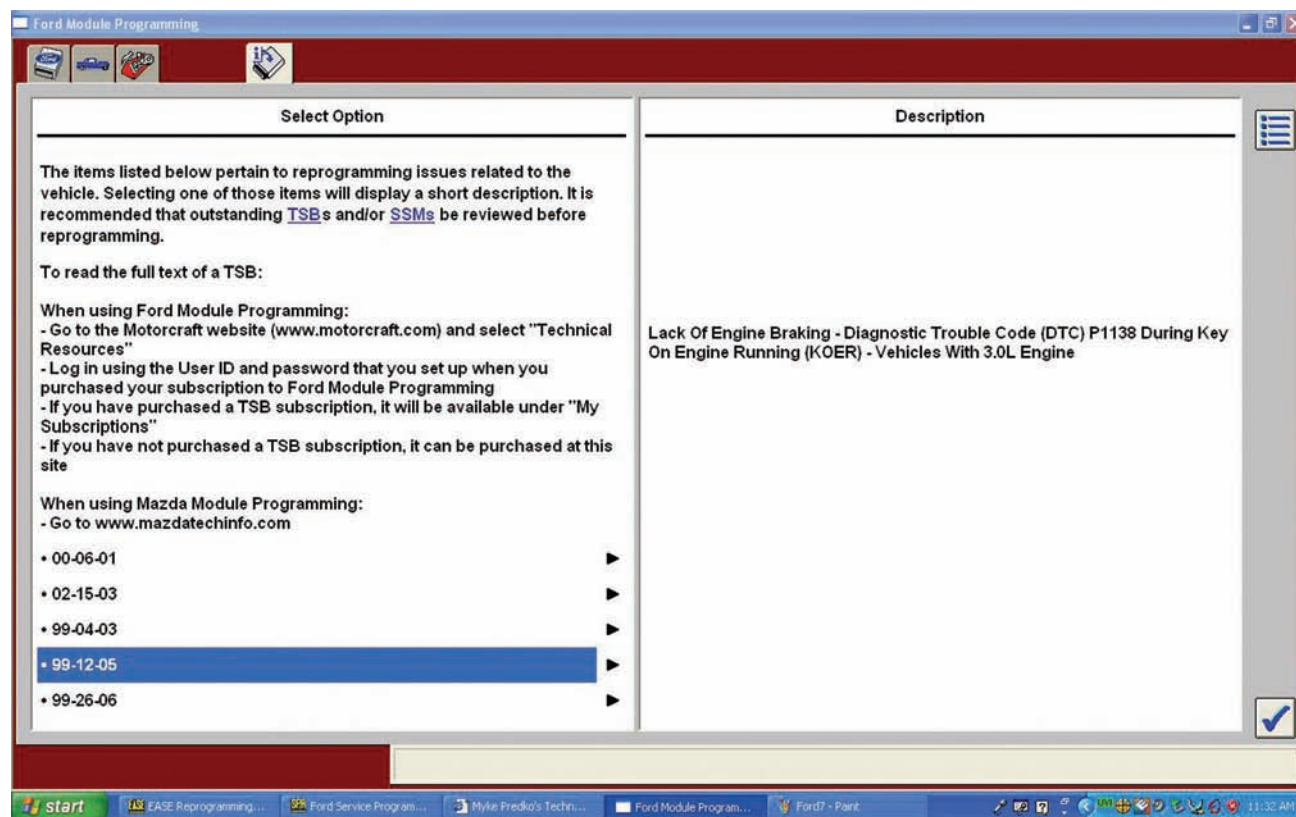
The Ford Module Programming software also enables you to change configuration and settings on other vehicle systems, such as warning chimes, power door locks, key programming, speedometer calibration for tire size and axle ratio, etc.



Ford Recalibration

Ford Module Reprogramming will also show any TSB's related to calibration updates.

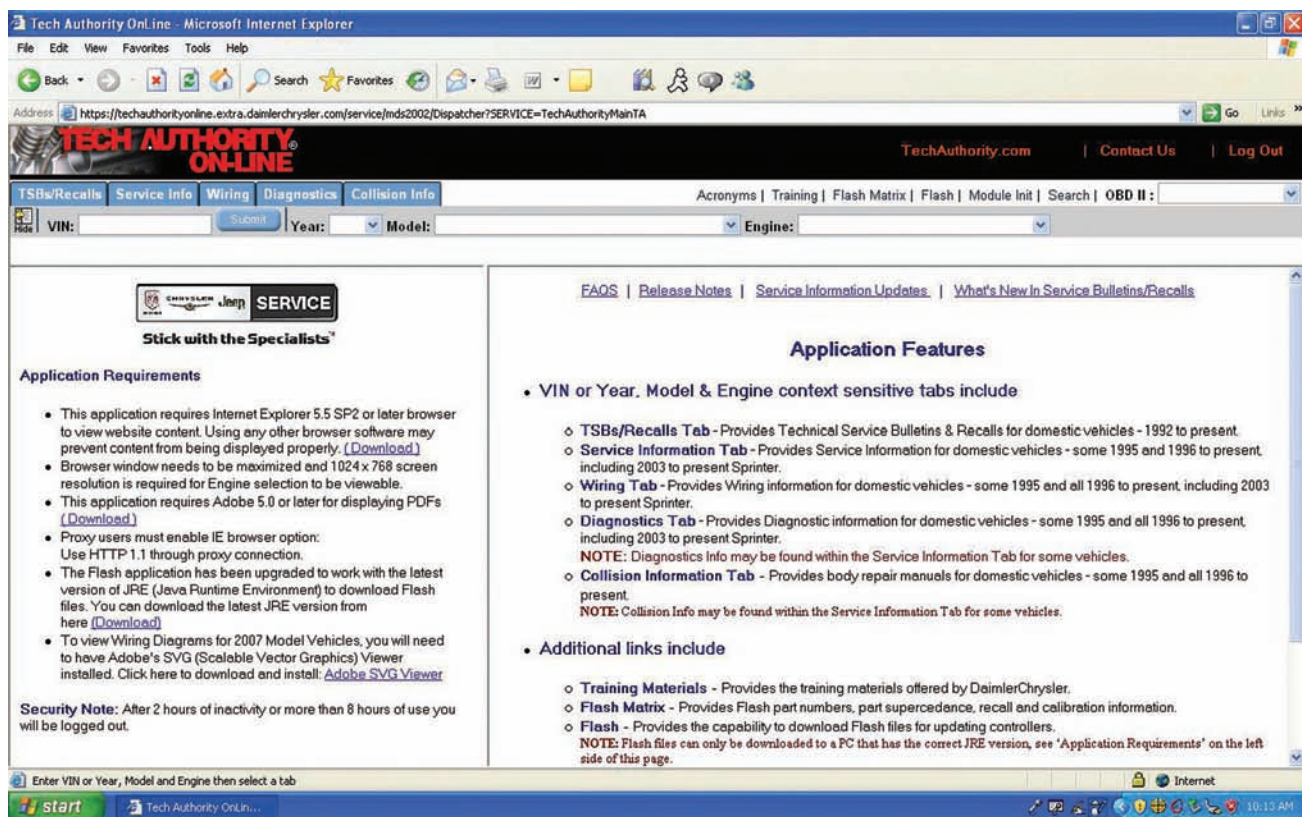
Note: Not all updated calibrations will have a TSB. It is common for Ford to update calibration with no TSB or reference as to why the calibration was changed.



Chrysler Recalibration

Equipment needed:

- J2534 interface
- Subscription to Tech Authority website
- Download and install the DCX2534 setup



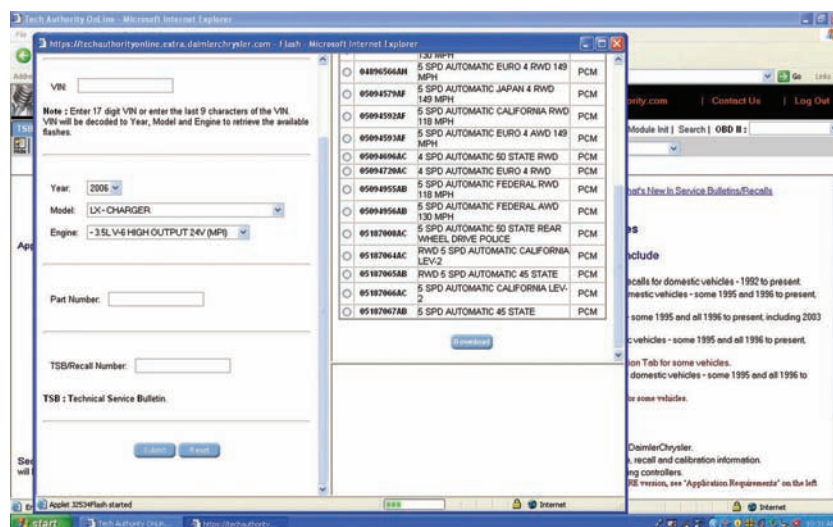
Chrysler Recalibration

Other considerations:

If the DCX2534 Update Manager program cannot be found, check:
C:\Program Files\DaimlerChrysler and set file path accordingly.

TechAuthority website has a calibration software search where you can enter either the VIN, vehicle information, or current software number to get the most current software part numbers.

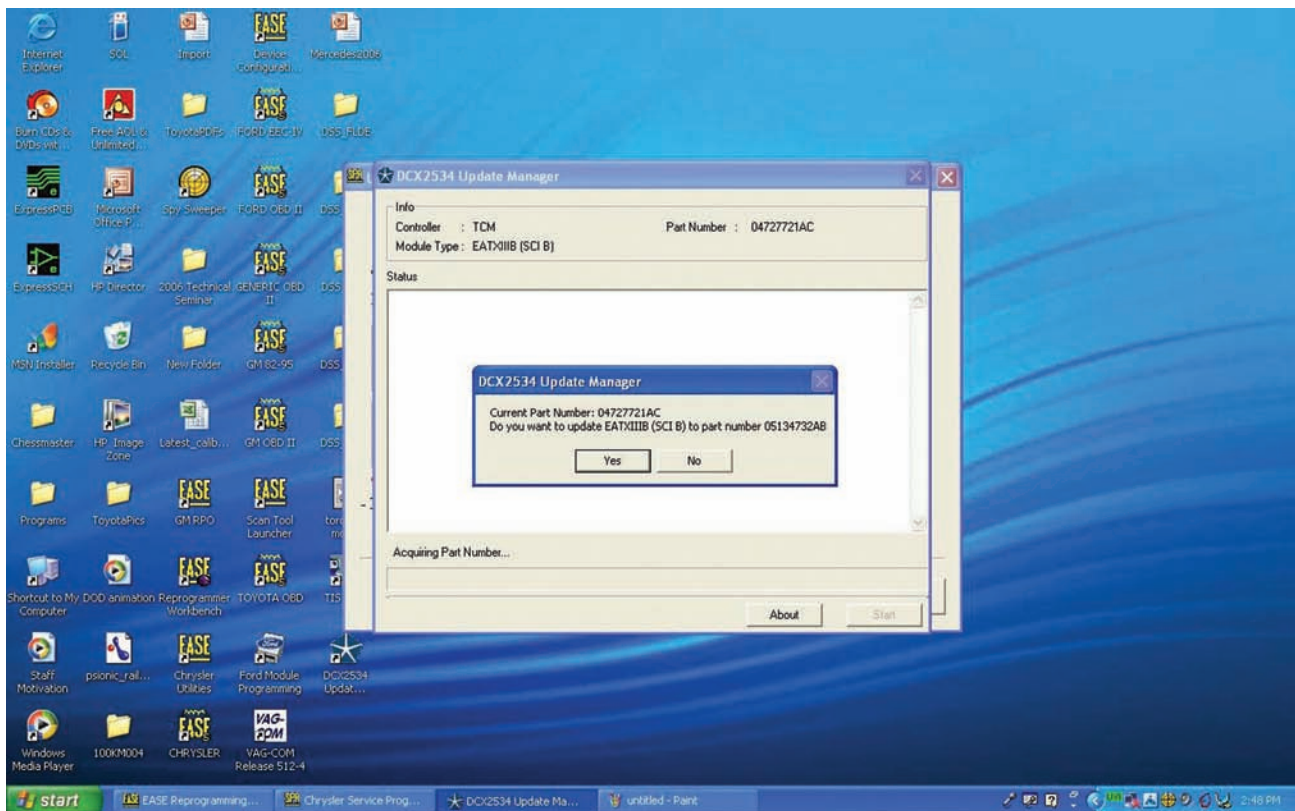
There is also a “Flash Matrix” table which lists the software calibration number update history for each vehicle model.



Chrysler Recalibration

Last two letters indicate revision level.

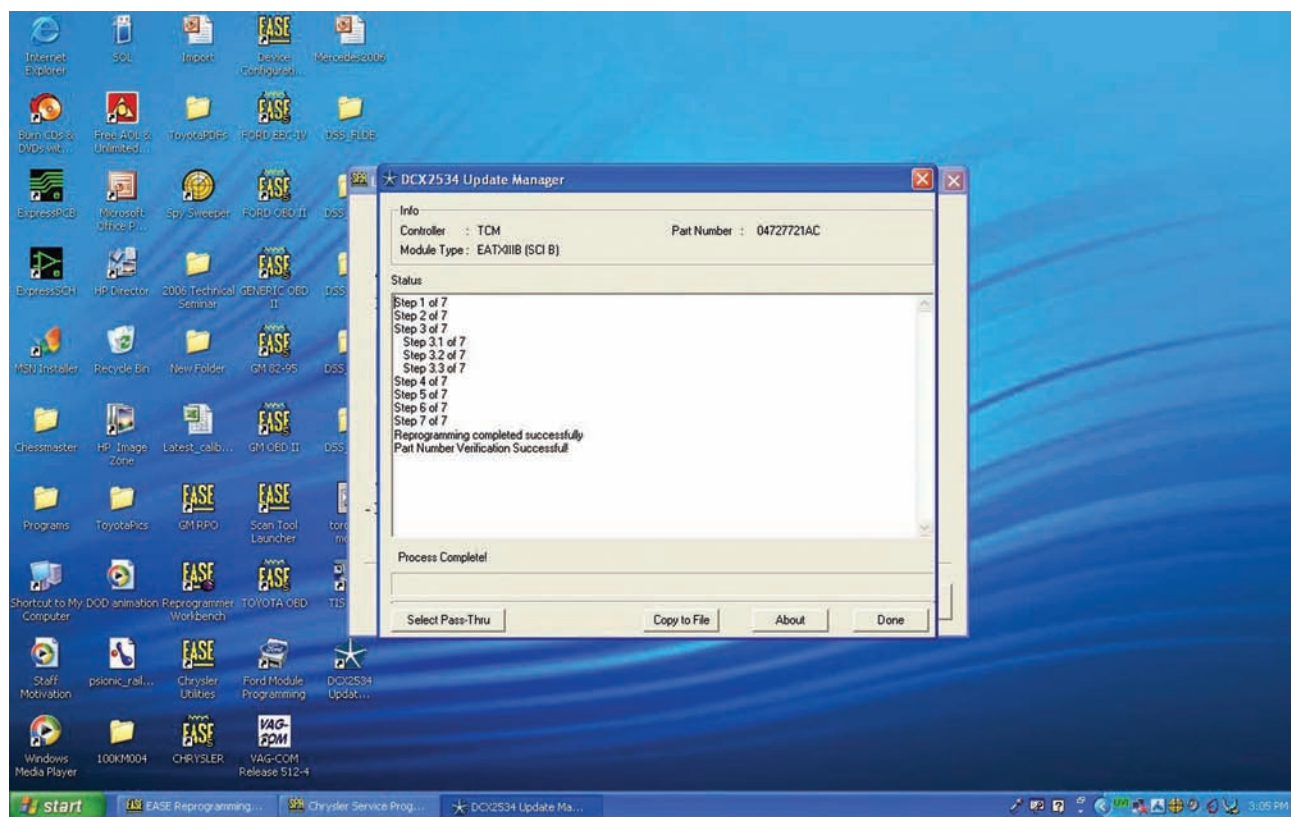
Select calibration and click Download. File will be downloaded into DCX2534 folder where DCX2534 application will access it.



Chrysler Recalibration

DCX2534 application will read current calibration number from module and compare it to what you have downloaded.

Calibration part number will be displayed when reprogramming operation is complete so you can verify the new calibration has in fact been installed.



Toyota Recalibration

Equipment needed:

- J2534 interface
- Toyota Flash Reprogramming CD Part# 00456-REPRG-001

Order CD from Toyota Materials Distribution. Phone number 800-622-2033 \$55.00 U.S. plus shipping. Disc has calibration files and all calibration related TSB's.

Install the Calibration Update Wizard and VIN Update Wizard programs from the disc.

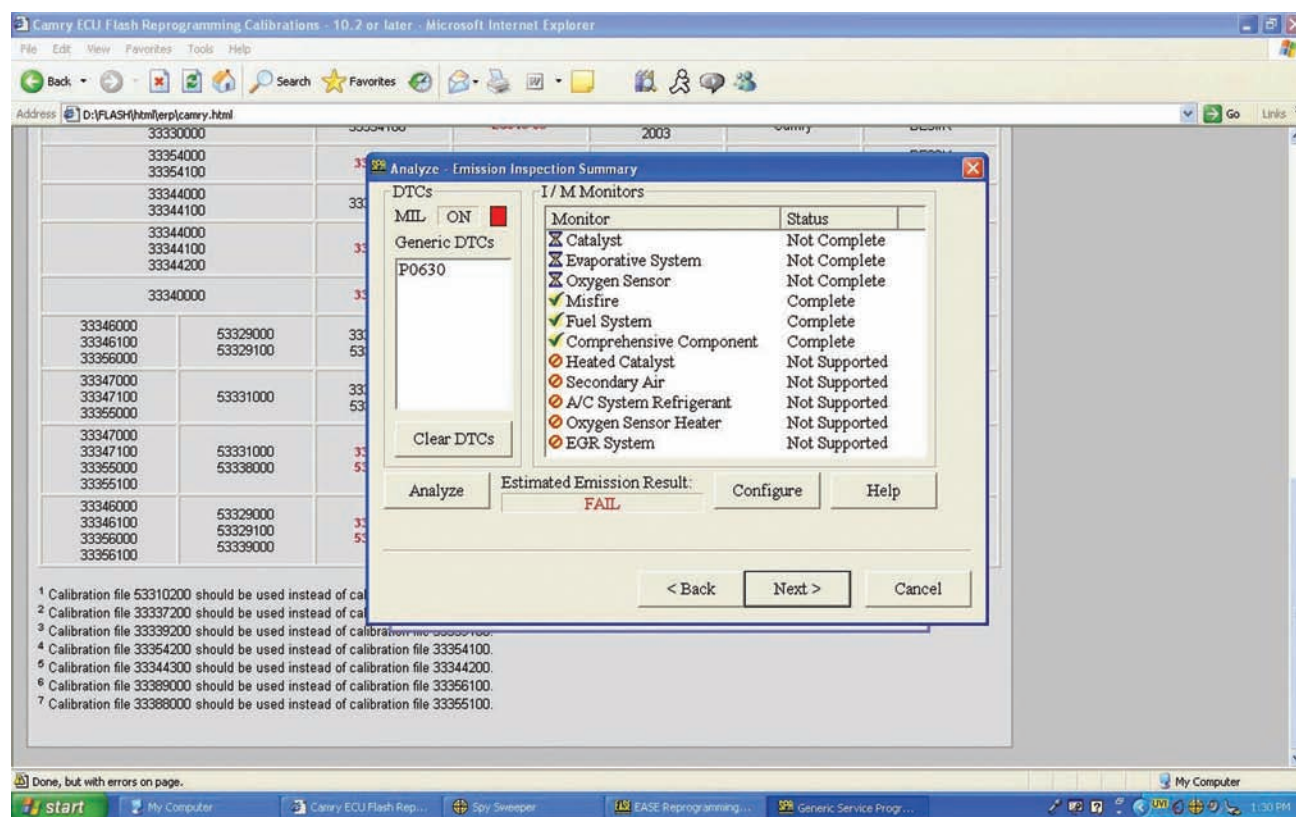
Other considerations:

- If the Calibration Update Wizard program cannot be found, check:
C:\Program Files\Toyota Diagnostics\Calibration Update Wizard\CUW.exe
- VIN may have to be programmed into module after reprogramming, use VIN Update Wizard.



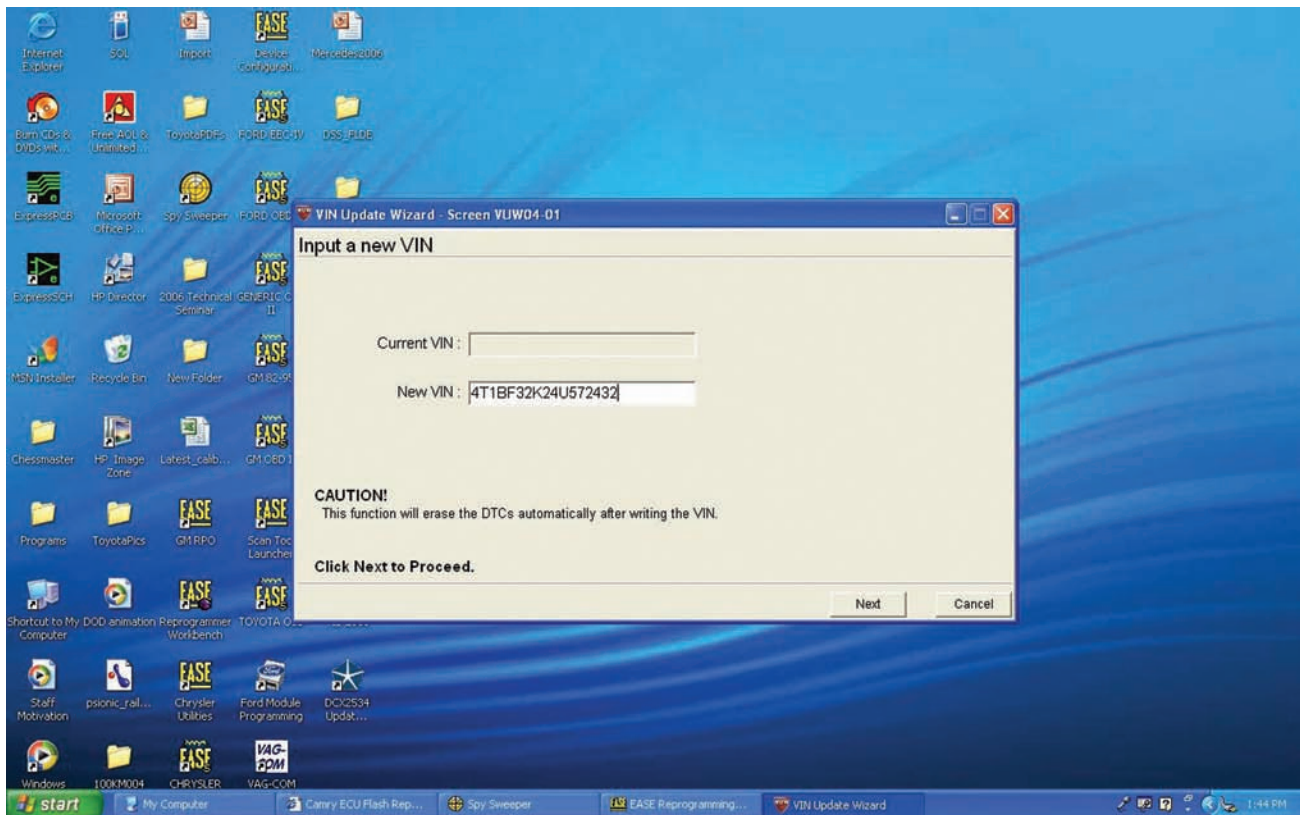
Toyota Recalibration

P0630 may set after reprogramming because the VIN can be erased by the reprogramming process.



Toyota Recalibration

Use the VIN Update Wizard application to program the VIN back into the PCM.



Resetting the Shift Adapts

Many vehicles, specifically GM and Toyota, learn pressure up quickly, but learn pressure down very slowly. The result can be a harsh shifting transmission that will take a lot of driving to relearn, and may cause transmission damage in the meantime. It is always best to perform the proper reset and relearn functions to ensure a good working unit and a happy customer.

- Ford: Disconnect battery for five (5) minutes (KAM reset), turn key on, and touch battery cables together
- Ford AF21-B: Disconnect battery for 20 minutes.
- GM with Allison LCT 1000: Initiate FastLearn with scan tool, follow driving instructions given by scan tool.
- Other GM with EPC: Disconnect battery for at least 20 minutes.
- Chrysler with TE, LE, RLE, RFE transmission: Execute Quicklearn function with scan tool.
- Toyota and Lexus vehicles with “U” series transaxles: Perform PCM Memory Reset with scantool.

NOTES:

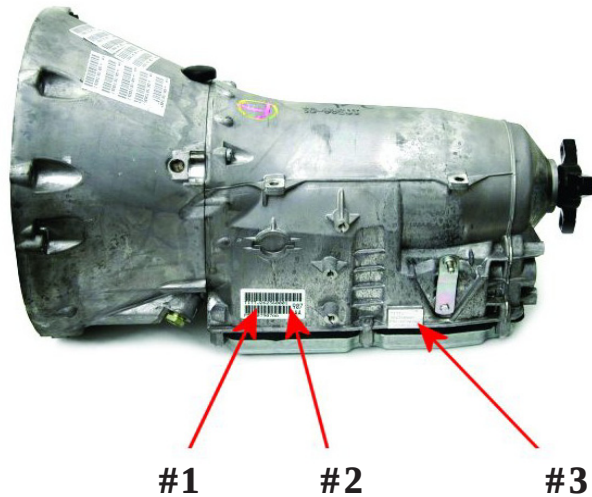
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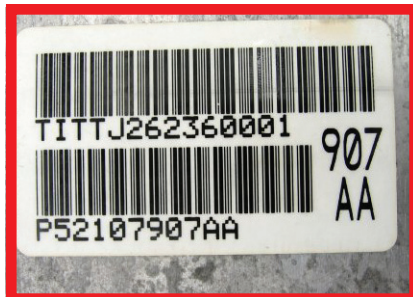
722.6/NAG I

Transmission ID

Transmission ID Locations



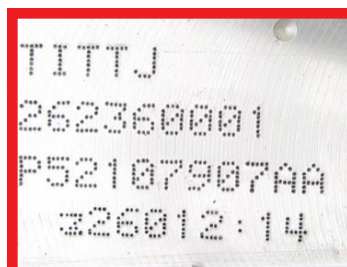
#1
Chrysler ID
Printed Bar Code



#2
Mercedes ID# Metal
Metal Stamp Number

722.600
2102707100
0141994

#3
Chrysler ID Dot Punched
(same Info as Bar Code)



722.6/NAG I

Transmission ID (conintued)

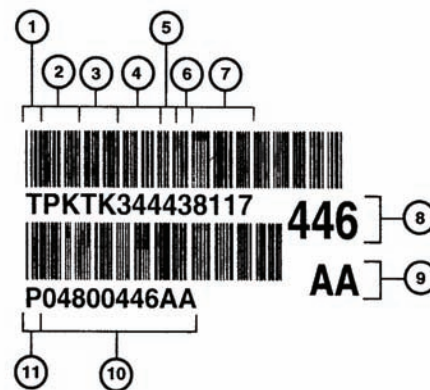
Transmission ID Locations

**Do not interchange transmissions with different model numbers.
It may set ratio codes, destroy planets, or burn frictions!**

Chrysler / Dodge / Jeep

Printed Bar Code and Dot Punched Code Interpretation
Dot Punched information is duplicate Bar Code Information

1. Traceability
2. Supplier Code
3. Component Code
4. Build Day (Julian Date)
5. Build Year
6. Line/Shift Code
7. Build Sequence
8. Last Three Part Number Digits
9. Revision Level
10. Transmission Part Number
11. Part Number Prefix



Mercedes / Jaguar / Sprinter

Metal Stamped Interpretation

722.600	—	Typical Model #: 6 digits
2102707100	—	Typical Part#: 10 digits
0141994	—	Typical Serial #: 7 digits

The order of the information from top to bottom can change. The row of numbers with six digits is the transmission model. The row of numbers with ten digits is the transmission part number. The remaining row of numbers will be the serial number. OEM remans may only have two rows, if so the model number is not used. The serial number is commonly used to identify updates.

722.6

Output Shaft Planetary Failure

Rear Planet Assembly

Planetary failure may be caused by installing the wrong planetary assembly. There are two types of planetary assemblies: Three pinion and Four pinion.

The design of the planetary gears have been changed to have less thrust loads on the needle bearings. There are two designs currently available, however there are many different ratios. Never install a three pinion planet in place of a four pinion planet. Make sure you order the correct part using the vehicle VIN number.

Nose Diameter:

1st Design: 0.906 in

2nd Design: 0.865 in

Inspect the bearing race area for damage. (pitting)



NOTE: If planetary damage is visible you MUST replace the Output planetary, Sun gear and Ring gear as an assembly.

722.6

Rear Planetary Gearset Durability

The following is a list of when the 2nd design went into production

(Except 722.601/612/614) ## as of 2102731 as of 21/3/00

722.621/623/624/626/628/63#/661 ## as of 2094082 as of 16/3/00

722.662 ## as of 2102731 as of 21/3/00

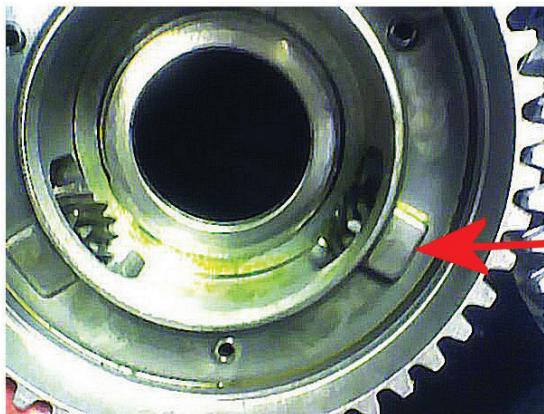
722.663 ## as of 2094082 as of 16/3/00

722.664/665 ## as of 2102731 as of 21/3/00

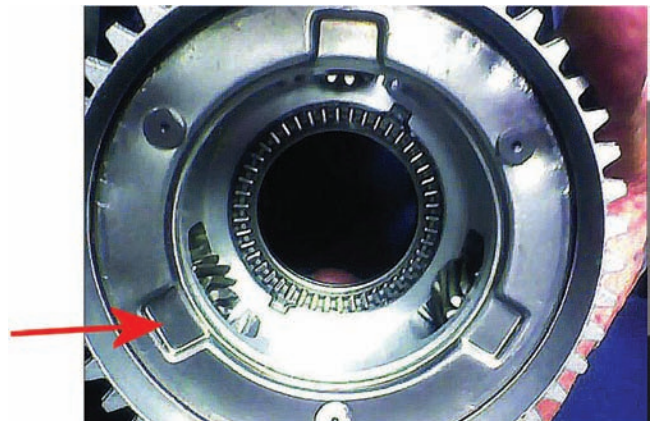
722.666/669 ## as of 2094082 as of 16/3/00

722.69 ## as of 212731 as of 21/3/00

NOTE: The helical gearing angle in the front and rear sets was changed from 18 degrees to 23 degrees to improve the life of the gear set.



**Correct!
Tabs face
Outward
(up)**



**Incorrect!
Tabs do not
Face down**

“Special Thanks to John Gaston”

722.6

Transmission Fluid

For all Jeep, Dodge or other Chrysler applications, (EXCEPT Sprinter and Crossfire) use Fluid type ATF +4 (MS-9602)



Chrysler Part # 05013457AA



Valvoline Part# VV346



CarQuest Part# CQ440

722.6

Transmission Fluid (conintued)

For ALL Mercedes, Chrysler Sprinter and Crossfire, and Jaguar applications with the 722.6 transmission use 236.10 and 236.12 specification fluid.

Other Transmission fluids that are used in Europe and rarely in North America that are not shown here are Shell Part # ATF 3403 M115 meets spec 236.10
Shell Part # ATF 3353 meets spec 236.12
Fuches Part # ATF 3353 meets spec 236.12



**Chrysler Part #
05127382AB**



**Mercedes Part#
A 001 989 07 03
Meets Spec 236.10**



**Mercedes Part#
A 001 989 45 03
ATF 3353
Meets Spec 236.12**

722.6

Clutch Pack Clearance Tool

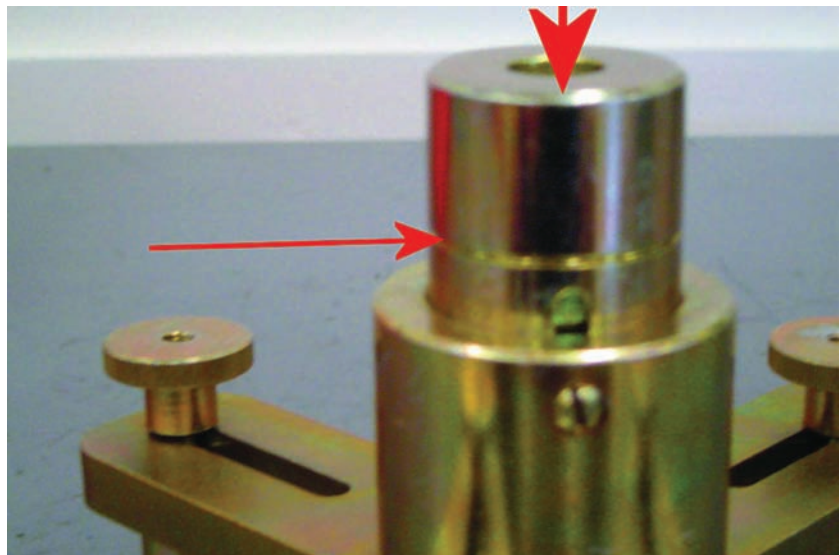
In order to properly check clutch pack clearance, use this tool and a press. Press down on tool until line just disappears and then check clutch pack clearance.

**Spring Loaded
Gauging Tool
Part# 8901**



In order to properly check the clutch pack clearance, you must use a clearance tool.

Press down on the tool until the line just disappears and then check the clutch pack clearance.



722.6

No Upshift

Output Speed Sensor at the Rear Axle

Some Mercedes use a single output speed sensor mounted on the rear axle. When it fails the transmission will not shift.



Secifications

800 to 1800 ohms

722.6

Solenoid Operation

Solenoid Overview

Six solenoids are used to control transmission operation, ALL solenoids are pulse-width modulated regardless of their name:

- The “1-2 / 4-5 shift”, “2-3 shift”, and “3-4 Shift” solenoids function as they are named.
- The “PWM” solenoid controls Lockup.
- The “Modulating Pressure Regulator Solenoid” is the pressure control solenoid.
- The “Shift Pressure Control Solenoid” is unique in its function, and will be described below.

Solenoid Operation

For control of each shift transition, each of the shift solenoids uses a bank of four valves to control clutch element apply pressure, release rate, and overlap (or “timing”). These valves are called:

- Command Valve
- Holding Pressure Shift Valve
- Shift Pressure Shift Valve
- Pressure Overlap Control Valve

Each shift solenoid uses four valves, so there are a total of twelve valves used to control all shift transitions. The term for these functions and valves are called “Shift Groups”.

722.6

Solenoid Operation (conintued)

To initiate and complete a 1-2 shift the following sequence is executed:

1. The 1-2/4-5 solenoid is turned on. This strokes the command valve and initiates the shift “transition”.
2. The Holding Pressure Shift Valve, Shift Pressure Shift Valve, and Pressure Overlap Control Valve control the release rate of the B1 Brake and the apply rate of the K1 clutch.
3. Once the transition is complete the 1-2 / 4-5 Shift Solenoid **is turned off.**

To make a 2-1 downshift, the computer again turns on the 1-2 / 4-5 Shift Solenoid to initiate the transition. Since the transmission is in second gear, it will transition back to first gear.

Each shift transition is made in the manner described above, by energizing the appropriate shift solenoid, making the shift transition, then the shift solenoid is turned off when the shift is complete. When the transmission is in 1st, 2nd, 3rd, 4th, or 5th gear, **NO SHIFT solenoids are on.**

The Shifting Pressure Control Solenoid controls the apply pressure for each transition.

The Modulating Pressure Regulator, in part, controls the release rate. These two solenoids work together to control the overlap for each shift transition.

722.6

Solenoid Operation

Solenoid Application Chart						
Gear	1-2 / 4-5 Shift Solenoid	2-3 Shift Solenoid	3-4 Shift Solenoid	Modulating Pressure Control Solenoid	Shift Pressure Control Solenoid	TCC Pressure Control Solenoid
Park			Modulate	Regulate	Regulate	
P-to-R			Modulate	Modulate	Modulate	
Reverse				Regulate	On	
R-to-N			Modulate	Regulate	Modulate	
Neutral			Modulate	Regulate	Regulate	
N-to-D (1 st)			Modulate	Regulate	Modulate	
1 st				Modulate	On	
1 st to 2 nd	Modulate			Modulate	Modulate	
2 nd				Modulate	On	
2 nd to 3 rd		Modulate		Modulate	Modulate	
3 rd				Modulate	On	Modulate
3 rd to 4 th			Modulate	Modulate	Modulate	Modulate
4 th				Modulate	On	Modulate
4 th to 5 th	Modulate			Modulate	Modulate	Modulate
5 th				Modulate	On	Modulate
5 th to 4 th	Modulate			Modulate	Modulate	
4 th				Modulate	On	
4 th to 3 rd			Modulate	Modulate	Modulate	
3 rd				Modulate	On	
3 rd to 2 nd		Modulate		Modulate	Modulate	
2 nd				Modulate	On	
2 nd to 1 st	Modulate			Modulate	Modulate	
1 st				Modulate	On	
1 st to N			Modulate	Regulate	Regulate	
Neutral			Modulate	Regulate	Regulate	
N to R			Modulate	Regulate	Modulate	
Reverse				Modulate	On	
R to P			Modulate	Regulate	Regulate	
Park			Modulate	Regulate	Regulate	
The shift solenoids are off electrically when the transmission is in any gear. The shift solenoid is on for 1.5 seconds when shifting. ON = Regulated line pressure Regulate = Constant Pressure Modulate = Pulse Width Modulated (PWM)						

722.6

Shifter Assembly

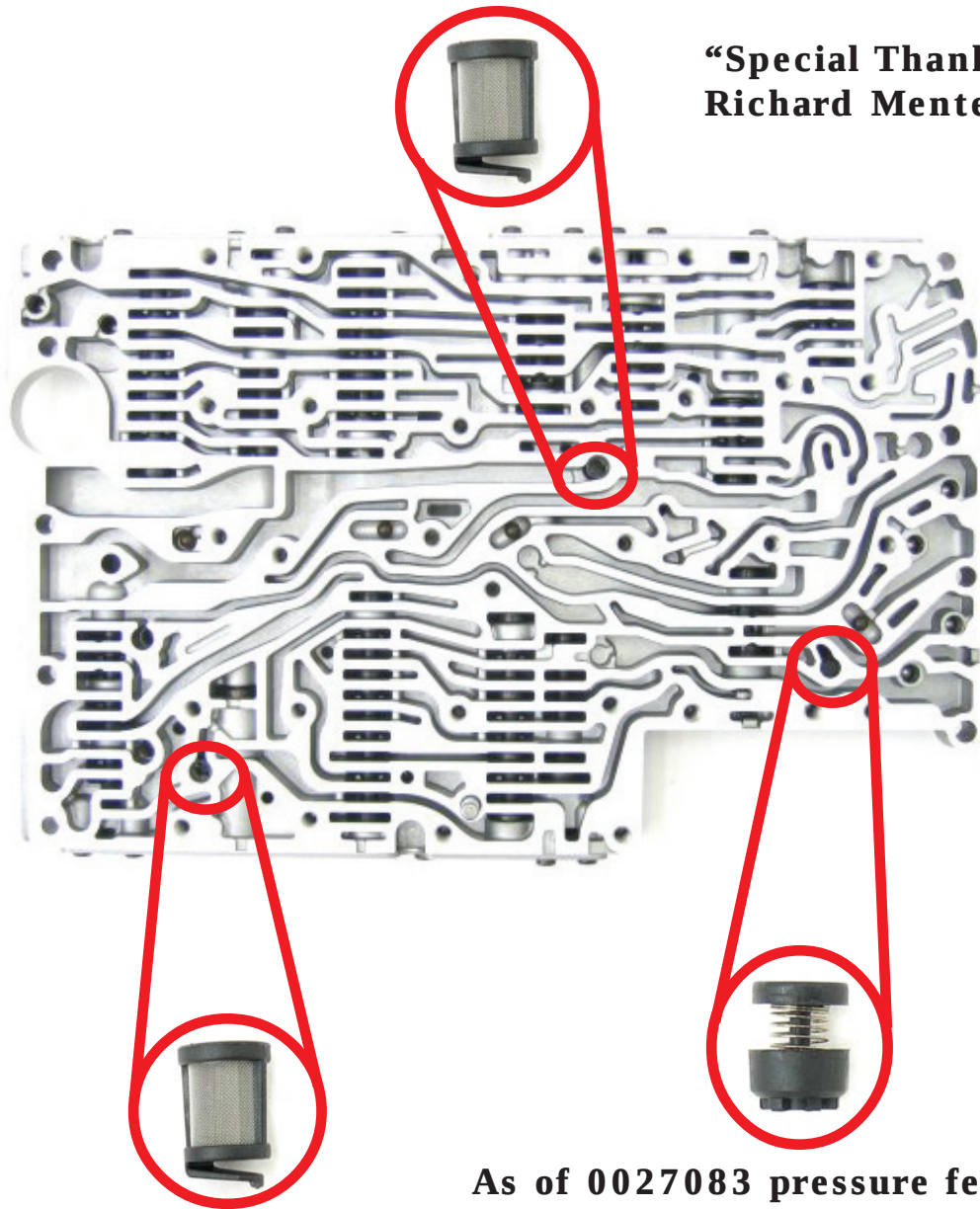
In some cases a vehicle may come into your shop with a dead battery. In this case the shifter will not operate properly. It will be necessary to remove the shifter housing. Using a pencil push the Override release and move the shifter into the desired position.



722.6/NAG I

Harsh 3-2 Down Shift

Filter and Pressure Feed Locations



**“Special Thanks to
Richard Mente”**

**As of 0485895 the
screen is installed to
prevent contamination
in the TCC circuit**

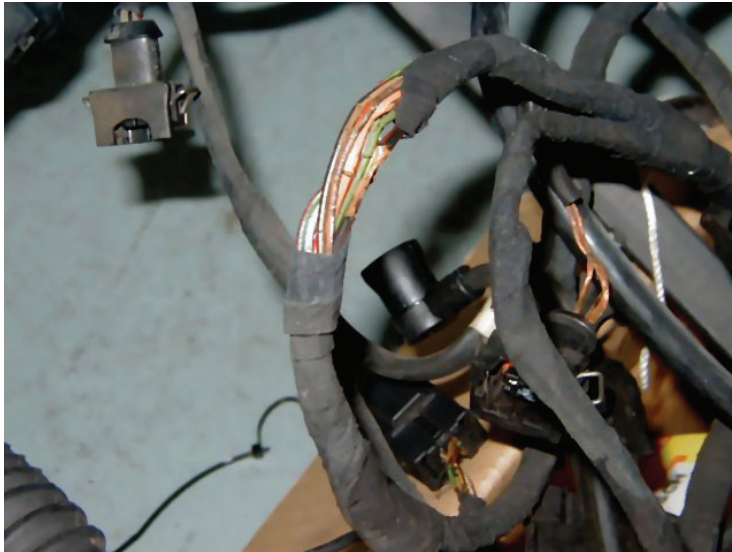
**As of 0027083 pressure feed valve
has been installed to prevent a
harsh 3-2 downshift and roll out
shifts. The check valve must
touch the separator plate. If it
doesn't touch the plate, place a
shim below the check valve.**

722.6

Early/Late Harsh Shifts or Soft Up/Down Shifts

Mass Airflow wiring

It is common for the wiring to have an open or short. It is **NOT** recommended to repair the harness. To properly repair the harness it must be replaced.



**“Special Thanks to
Richard Mente”**

**The Mass Air Flow
sensor is usually
damaged when the
wiring harness is
shorted.**



NOTES:

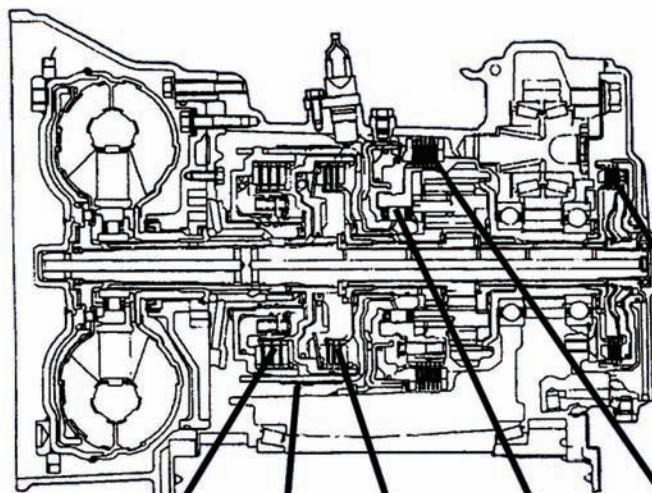
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A4AF3, A4BF2

Clutch and Band Application

The clutch and band application is exactly the same as every KM series transaxle ever made.



Range	Gear	Front Clutch	Kickdown Brake	Rear Clutch	Low Sprag	Low/Reverse Clutch	End Clutch
R	Reverse						
D	1 st						
	2 nd						
	3 rd While Shifting*						
	Shift Complete						
	4 th While Shifting*						
	Shift Complete						
2	1 st						
	2 nd						
L	1 st				★		

 Applied or Holding

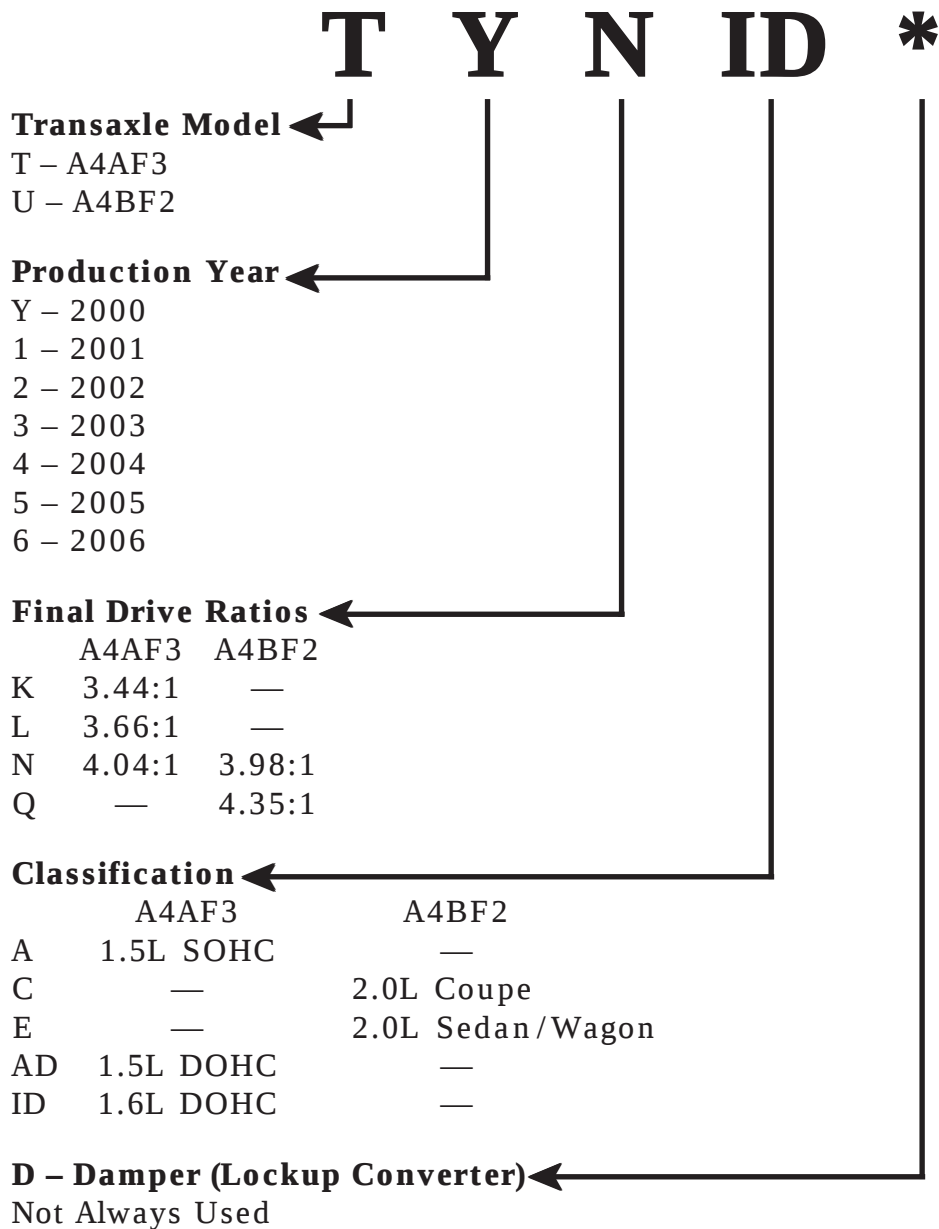
* Ineffective due to the Low Reverse Clutch

* The transition phase that occurs as the unit prepares to shift

A4AF3, A4BF2

Transaxle Identification

With the exception of the Sonata, Hyundai has always used a unique transaxle ID system, compared to other KM-type units. It is extremely important that you use the right transaxle for the application you have. A mismatch will cause ratio errors, which can only be resolved with using the correct planets and final drive, so be careful.

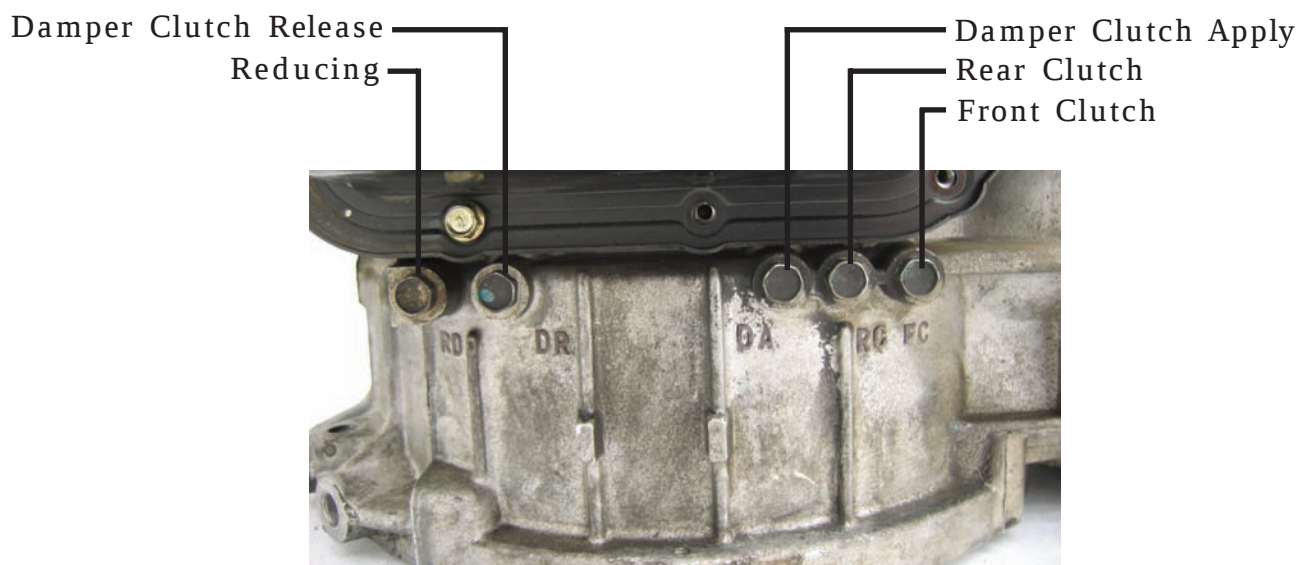


A4AF3, A4BF2

Pressure Testing

Pressure testing for this series of transaxle is almost identical to that of every other KM series unit. The main difference — and it's a significant one — is that this unit lowers pressure in 4th gear when the TCM/ECM turns shift solenoid C on.

KMs don't have a mainline pressure tap. But if the unit is working properly, you should have mainline pressure at the kickdown servo once the transmission has shifted completely into 2nd, 3rd, and 4th gears.

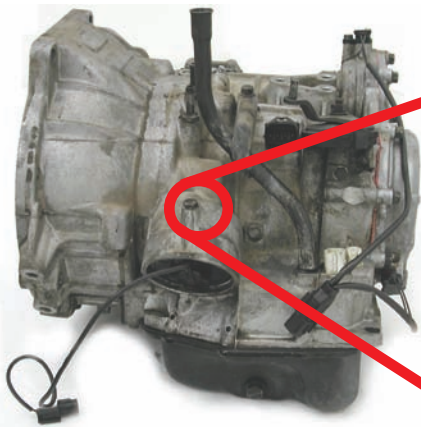


No	Conditions				Pressure PSI (kPa)							
	Selector Lever	Vehicle Speed MPH (km/h)	Engine RPM	Gear Range	Reducing Pressure	Kickdown Brake	Front Clutch	End Clutch	Low/Reverse Brake	Damper Clutch Apply	Damper Clutch Release	Rear Clutch
1	N	0 (0)	Idling	Neutral	58–64 (400–440)	*	*	*	*	*	*	*
2	D	0 (0)	Idling	2nd Gear	58–64 (400–440)	8–21 (58–147)	*	*	*	*	*	*
3	D (SW-On)	68 (110)	2500 RPM	4th Gear	58–64 (400–440)	92–100 (635–695)	*	94–103 (650–710)	*	92–115 (635–790)	*	120–132 (830–910)
4	D (SW-Off)	47 (75)	2500 RPM	3rd Gear	58–64 (400–440)	122–130 (840–900)	117–126 (810–870)	120–132 (830–910)	*	92–115 (635–790)	*	120–132 (830–910)
5	2	31 (50)	2500 RPM	2nd Gear	58–64 (400–440)	122–130 (840–900)	*	*	*	92–115 (635–790)	*	120–132 (830–910)
6	L	0 (0)	2500 RPM	1st Gear	58–64 (400–440)	*	*	*	34–43 (235–295)	36–58 (245–400)	74–88 (510–610)	120–132 (830–910)
7	R	22 (35)	2500 RPM	Reverse	60–70 (420–480)	*	241–298 (1660–206)	*	241–298 (1660–206)	36–65 (245–450)	65–94 (450–645)	*

A4AF3, A4BF2

Pressure Testing (continued)

If you suspect an electrical problem is affecting mainline pressure, unplug the solenoid connector: This puts the transaxle into 3rd gear, and turns the pressure control solenoid off. Unless there's a leak in the system or a valve body problem, you should have mainline pressure at the kickdown servo tap.



⌚ Lowers Pressure

⌚ Raises Pressure

If pressure is out of specification, adjust the PR screw clockwise to lower pressure, and counterclockwise to raise it. Each full turn changes the pressure about 6 PSI.



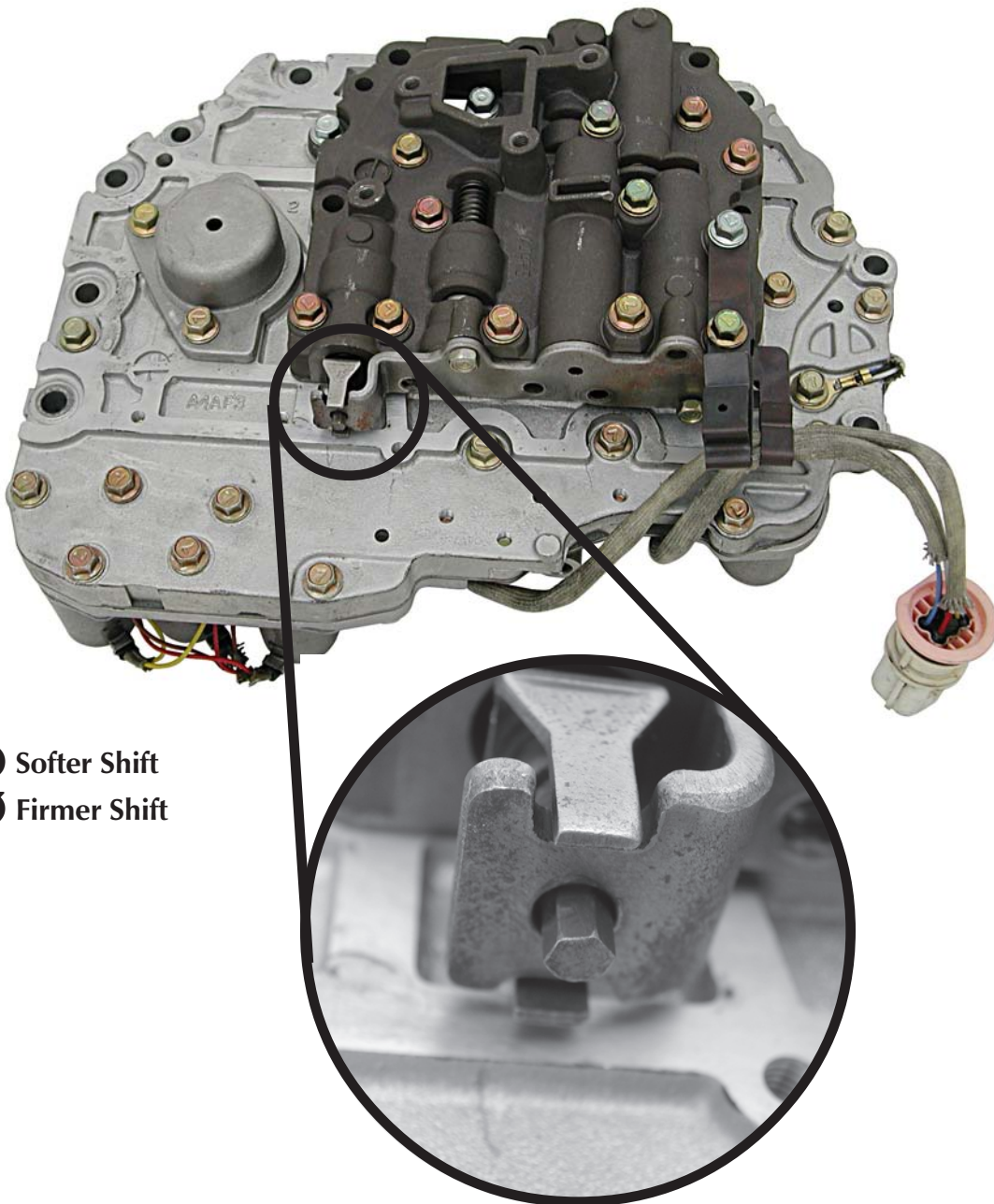
A4AF3, A4BF2

Shift Feel

Changing shift feel is a breeze: Turn the reducing pressure screw one way or the other based on your need:

- Softer Shift = Clockwise
- Firmer Shift = Counterclockwise

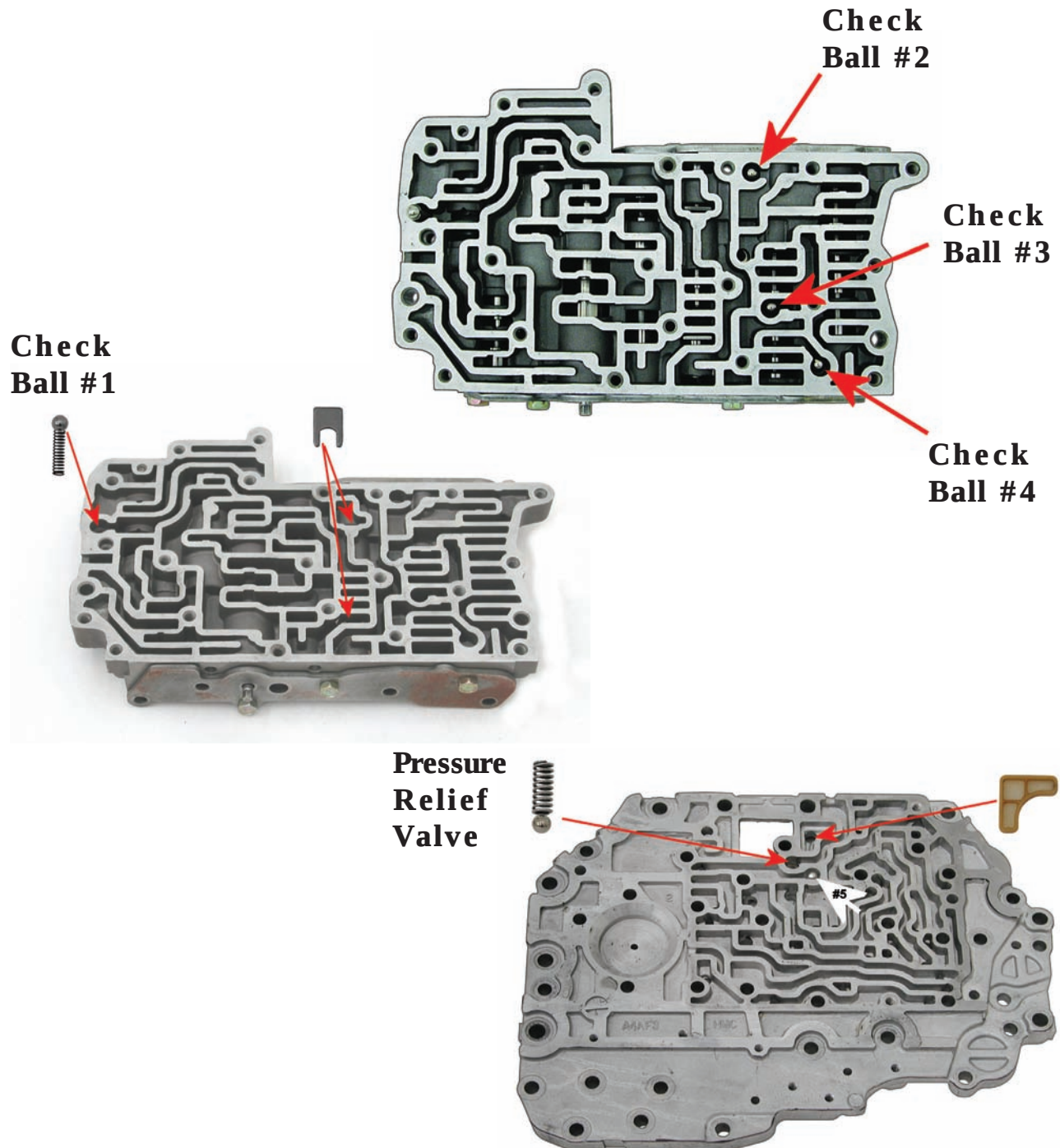
This is a great tool for correcting shift complaints.



A4AF3, A4BF2

Checkball Locations

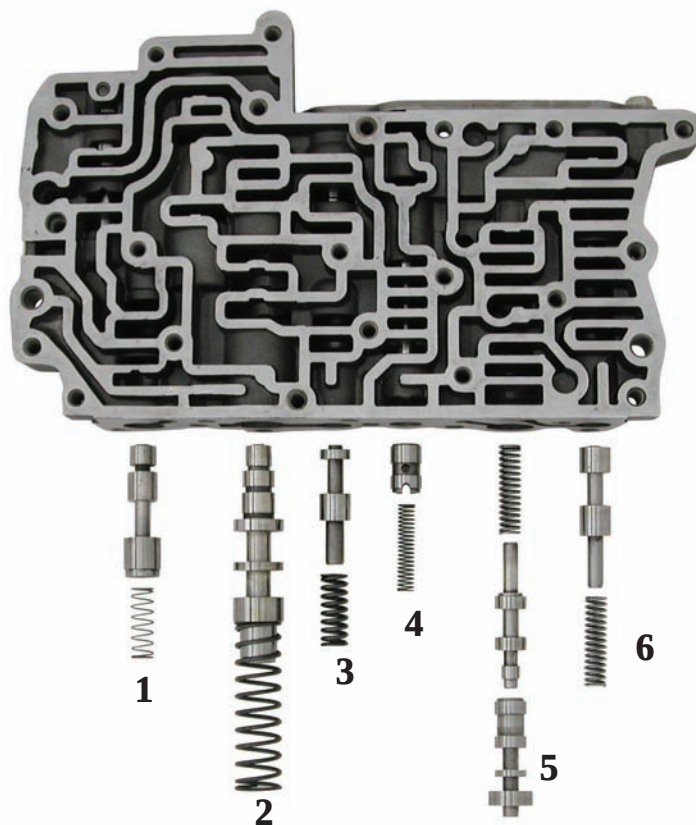
These graphics show the checkball locations for these units. Pay attention to the #1 checkball with the spring.



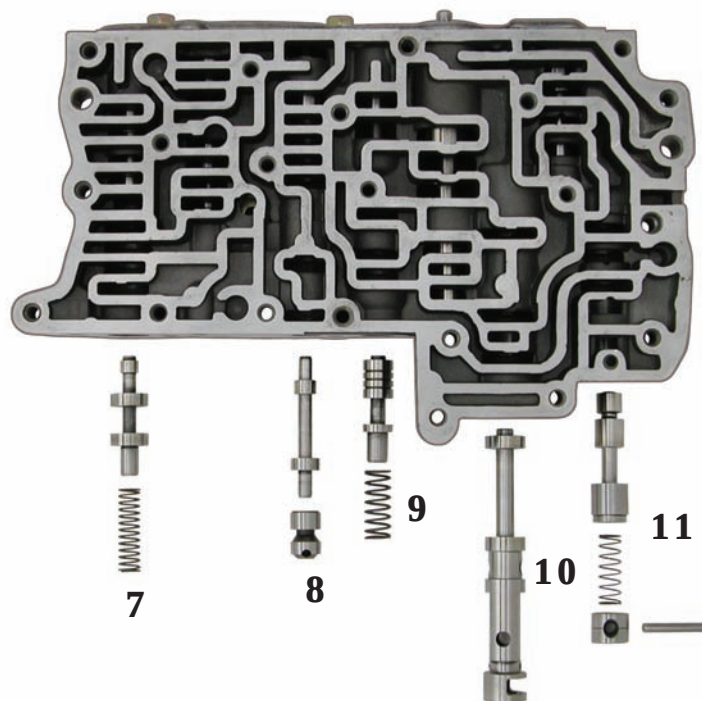
A4AF3, A4BF2

Valve Body Exploded Views

- 1 Pressure Control Valve B
- 2 Pressure Regulator Valve
- 3 Torque Converter Control Valve
- 4 Shift Control Valve Plug
- 5 Rear Clutch Exhaust Valve
- 6 2-3/4-3 Shift Valve



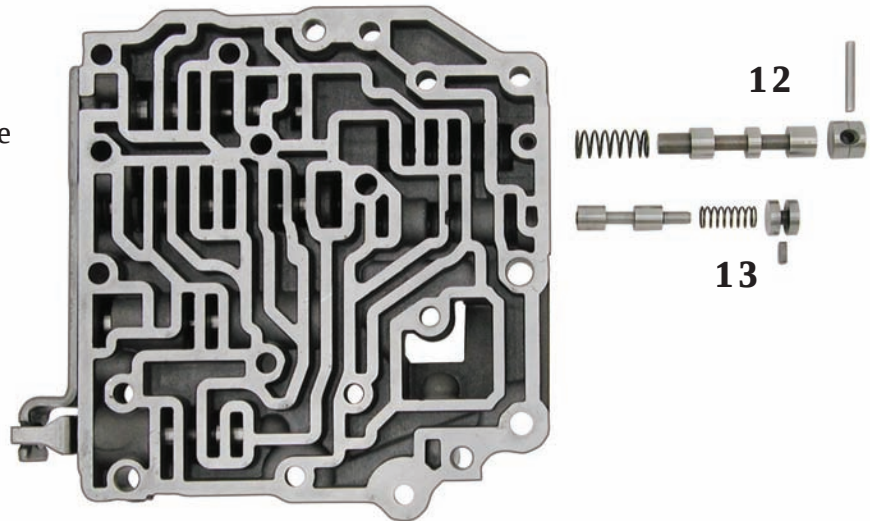
- 7 1-2 Shift Valve
- 8 Shift Control Valve and Plug
- 9 High-Low Pressure Valve
- 10 Manual Valve
- 11 Pressure Control Valve A



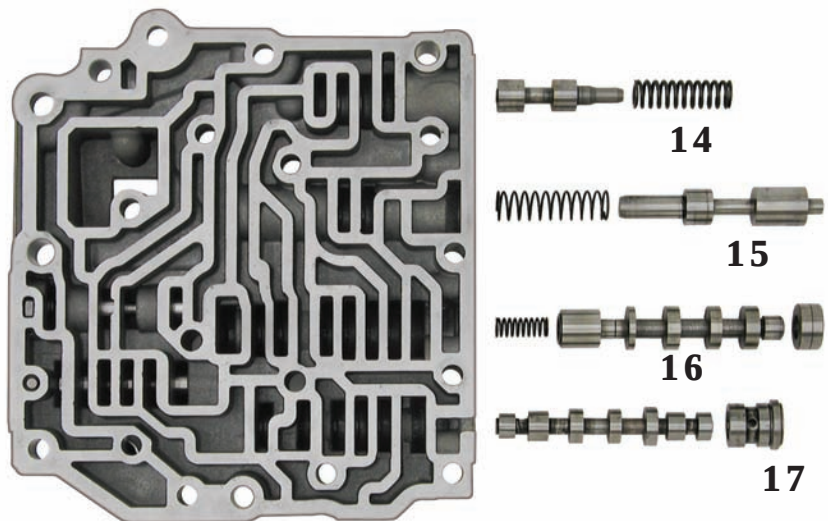
A4AF3, A4BF2

Valve Body Exploded Views (continued)

- 12 Control Switch Valve
- 13 End Clutch Valve



- 14 Reducing Pressure Valve
- 15 N-R Control Valve
- 16 Damper Clutch Control Valve
- 17 Failsafe Valve



A4AF3, A4BF2

Solenoid Identification

Swapping Pressure Control Solenoid A and Pressure Control Solenoid B will prevent the unit from engaging in drive; it will engage in manual low.

Swapping Shift Solenoid A and Shift Solenoid B will cause the unit to shift into neutral on the 1-2 shift.

**Shift Solenoid C
(White Wire)**

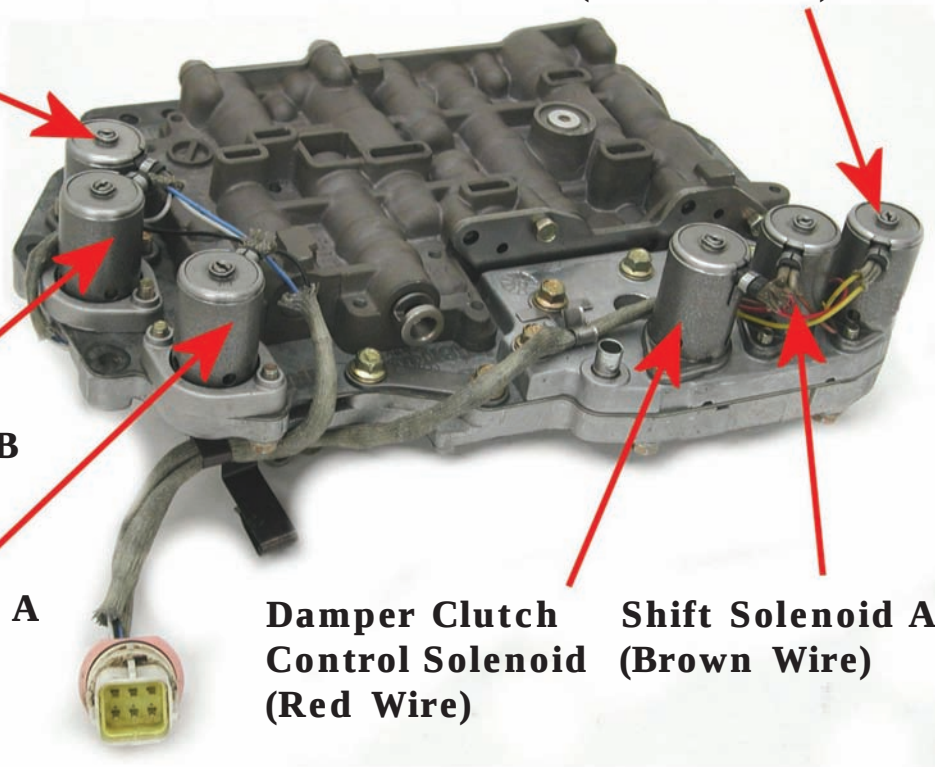
**Shift Solenoid B
(Yellow Wire)**

**Pressure Control B
(Blue Wire)**

**Pressure Control A
(Black Wire)**

**Damper Clutch
Control Solenoid
(Red Wire)**

**Shift Solenoid A
(Brown Wire)**



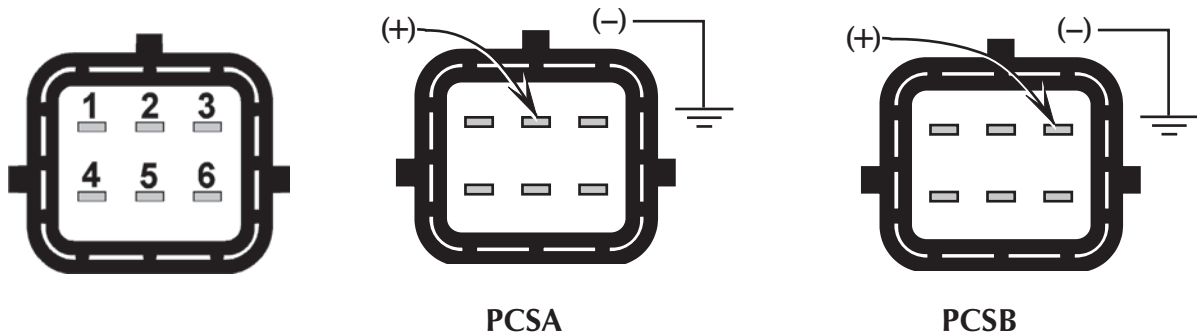
Solenoid	Terminal	Wire Color	Resistance	Operating Voltage	Control Type
Shift Solenoid A	5	Brown	20.8–23.8Ω	System	On/Off
Shift Solenoid B	4	Yellow	20.8–23.8Ω	System	On/Off
Shift Solenoid C	1	White	20.8–23.8Ω	System	On/Off
Damper Clutch	6	Red	2.6–3.2Ω	3	Duty Cycle
Pressure Control A	2	Black	2.6–3.2Ω	3	Duty Cycle
Pressure Control B	3	Blue	2.6–3.2Ω	3	Duty Cycle

A4AF3, A4BF2

Testing the Transaxle Operation

Electronic Pressure Control

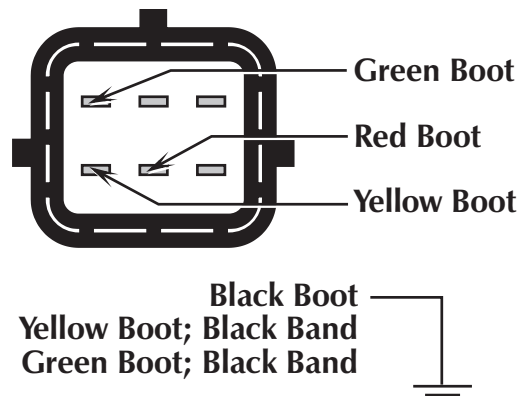
To check the electronic pressure control signals, connect your high-impedance voltmeter or scope to the wires shown.



Checking the Shift Pattern

Here's how to connect your signal monitor to the transaxle diagnostic connector, to check the signals from the computer to the transaxle.

Backprobe the terminals with the harness connector still connected to the transmission.



This is the shift pattern you should see with your signal monitor:

Transmission Shift Pattern			
First Gear			
Second Gear			
Third Gear	Ph1		
	Ph2		
Fourth Gear	Low		
	High		

A4AF3, A4BF2

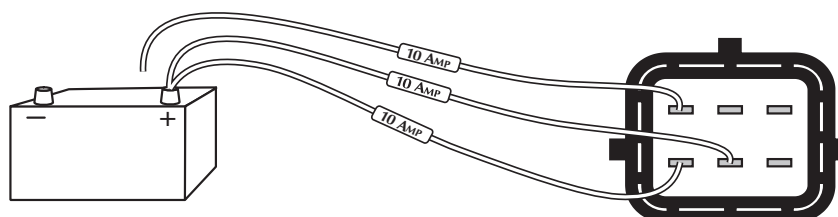
Forcing the Shift

Here's the manual shift pattern you can expect with the transaxle in failsafe:
Here's how to force the transaxle to shift electronically:

Manual Gear Range in Failsafe						
Selector Position	Park	Reverse	Neutral	Drive	2	L
Gear Range	Park	Reverse	Neutral	3rd	3rd	3rd

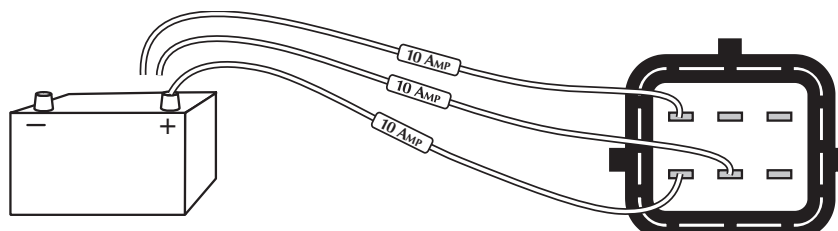
First Gear

In first gear, solenoids A and B will receive power; solenoid C is de-energized.



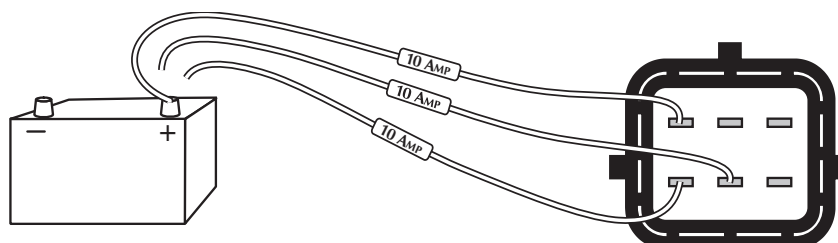
Second Gear

To shift into second gear, the computer de-energizes solenoid A; only solenoid B remains energized.



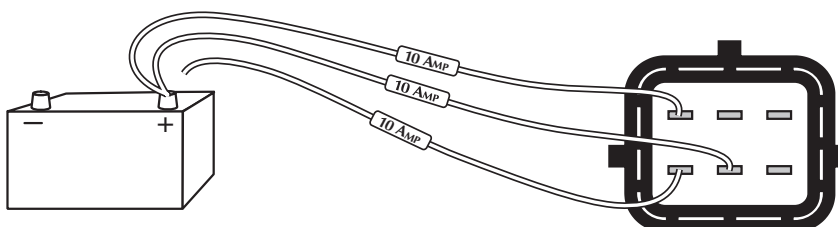
Third Gear

To shift into third gear, disconnect solenoid B. To enter 3rd Gear, Phase 2, the computer energizes solenoid C.



Fourth Gear

To shift into fourth gear, the computer reapplies power to solenoid A — solenoid B remains de-energized and solenoid C remains energized.



Shift Solenoid C isn't needed for 4th gear once the unit has shifted into 3rd gear, phase 2.

A4AF3, A4BF2

No reverse

Most no-reverse problems are caused by outside electrical issues. Try unplugging the solenoid harness and see if you get reverse. If so, you know the problem is electrical. There are two things the computer must know to allow reverse:

1. The car isn't moving.
2. The shifter's in reverse.

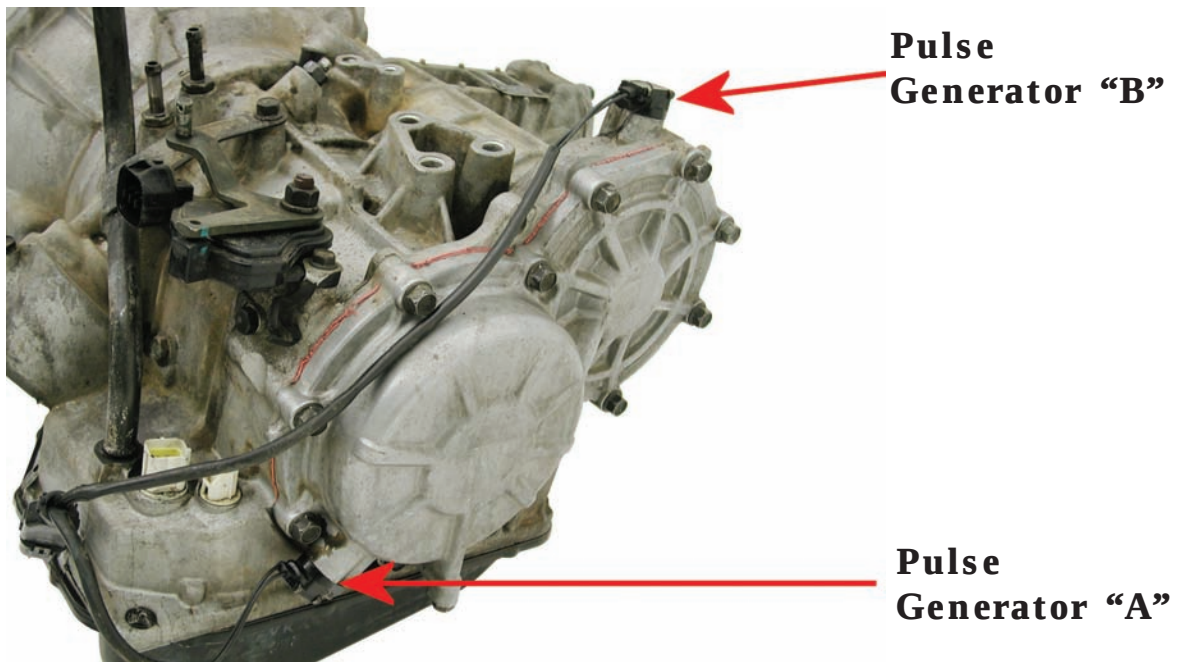
Pulse generator B monitors vehicle speed. Pulse generator A monitors input shaft speed (which rotates in park and neutral). Unlike earlier KM series transaxles, these two pulse generators are configured differently so it's obvious which one bolts where. But that doesn't mean you can't mix them up.

There are two quick tests to see if the pulse generators are mixed up:

1. Disconnect the pulse generators and see if you get reverse.
2. You can shift to drive first, and then quickly into reverse.

If either test gets reverse check the pulse generators.

The second electrical problem that can occur, but isn't nearly as common, is the inhibitor switch doesn't report reverse to the computer. But this problem can be intermittent, even if the inhibitor switch has failed completely. That is, if you drive the car around, and then try reverse, the computer will sometimes allow it, even though the inhibitor switch still didn't report reverse. The best way to test this is to check it right at the switch.



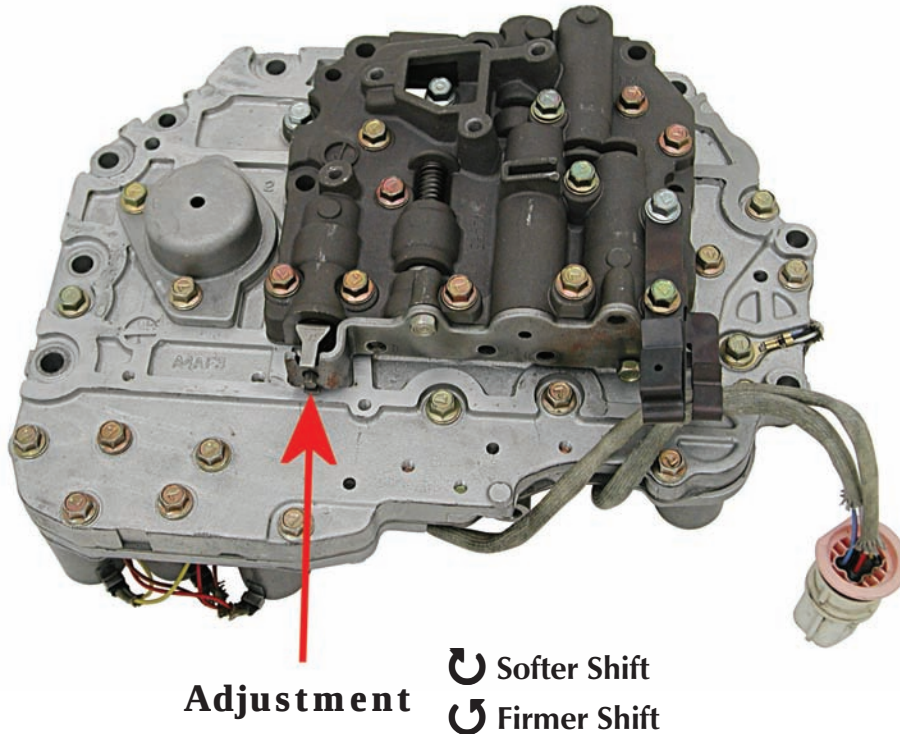
A4AF3, A4BF2

Harsh 2–3 or 2–3 Slide-Bump

Most harsh 2–3 shift complaints on KM series transaxles are caused by the friction material or *low* shifting pressure. The harsh shift or bump that you feel is caused when the end clutch applies. Normally the end clutch applies *after* the front clutch completes the 2–3 shift. If the 2–3 shift isn't completed when the end clutch applies, you'll get a bump. As the front clutch engagement gets worse, the harsh shift or bump gets worse.

To fix this, try increasing reducing pressure. Start with about 1½ turns counter-clockwise. In most cases this'll fix the problem. If not, try increasing it a bit more. Keep in mind, increasing reducing pressure will make the 1–2, 3–4, and converter clutch applies more aggressive.

If these other shifts aren't too aggressive you can increase reducing pressure until the 2–3 complaint is gone. Otherwise, you'll need to replace the friction material in the front clutch.



A4AF3, A4BF2

Shifts 1–3

If shift solenoid C is stuck open, it'll cause the unit to shift into 3rd gear on the 1–2 command. A tip that shift solenoid C is stuck open rather than a commanded 1–3 shift is that the shift will be very aggressive. That's because the clutch applying is the end clutch, and the end clutch isn't regulated during the apply.

The fastest way to test for this is:

- Energize shift solenoid B (2nd gear)
- Start the engine
- Move the shifter to Drive
- Check for pressure at the end clutch

If the end clutch is receiving pressure, either shift solenoid C is stuck open or the control switch valve is stuck. If you want to test it further:

- Move your pressure gauge to servo apply
- Energize shift solenoid A (4th gear)

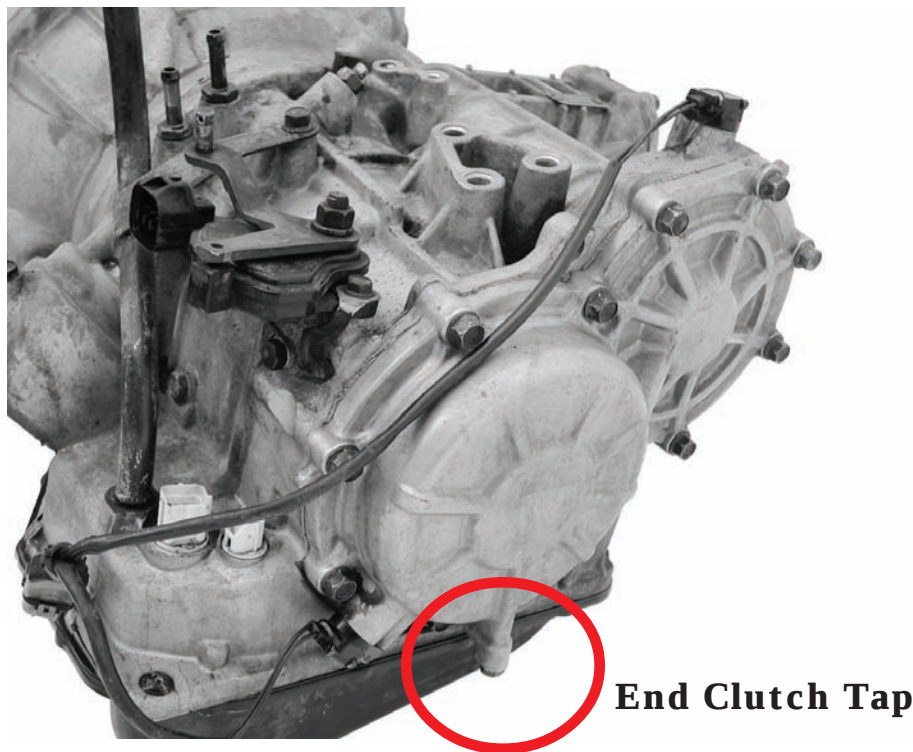
With the transaxle in 4th gear, shift solenoid C serves as a cutback solenoid. If shift solenoid C is stuck open, you'll have about 95 PSI at the servo, rather than about 130 PSI. If you *do* have 130 PSI, check the control switch valve.

A4AF3, A4BF2

Neutrals on 3–4 Shift or No 4th Gear

The computer energizes shift solenoid C in 3rd gear to apply the end clutch. If the end clutch doesn't apply, the transaxle will neutral on the 3–4 shift. After the computer sees this a couple times, it'll disable 4th gear.

The best check here is to disconnect the solenoid harness and run the car in 3rd gear. With a pressure gauge on the end clutch tap, see if you get pressure when you energize shift solenoid C. If you don't get pressure, either shift solenoid C is stuck closed or the control switch valve is stuck.



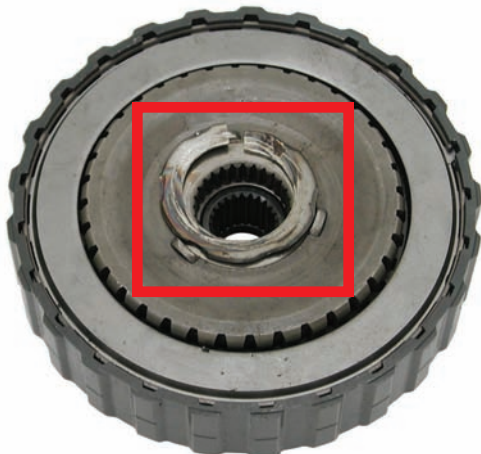
A4AF3, A4BF2

Failed End Clutch Hub Bearing

This may be the most common mechanical failure on this transaxle. There are three main causes for this:

1. The end clutch hub bushing wears out, allowing side movement of the hub and an uneven load on the bearing.
2. Too much clearance between the end clutch hub and bearing, allowing the bearing to move out of place.
3. High line pressure, placing a greater load on the bearing.

This bearing damage indicates a worn hub shaft bushing.



A4AF3, A4BF2

Failed End Clutch Hub Bearing (continued)

Try to keep the clearance between the end clutch hub and bearing below 0.020". Aftermarket shims are available for this. To check the clearance simply use an H-gauge.

Since there's only one sealing ring on the end clutch drum, line pressure pushes the end clutch drum toward the bearing anytime it's pressurized. Unfortunately, Hyundai increased the sealing ring size for this unit, and consequently, increased to load caused by this affect by 40%. Maximum line pressure should not exceed 130 psi. However, it is not uncommon to see pressure at the end clutch as high as 150 psi. 150 psi results in a load of 639 lbs of force on the bearing, compared to 554 lbs of force at 130 psi (a difference of 85 lbs of force). If your line pressure is higher than 130 psi adjust it down at the pressure regulator adjustment on the valve body. A good target is between 125 and 130 psi.



**Always replace the
hub shaft bushing
with a babbitt-style
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So, on behalf of the ATRA staff and the ATRA Chapters that have worked so hard to put this program together, I'd like to welcome you, and thank you for doing your part to keep our industry strong. We hope you have a wonderful day, and a terrific learning experience.

A handwritten signature in black ink, appearing to read "D. Madden", written in a cursive style.

Dennis Madden,
ATRA, CEO



Lance Wiggins
Technical Director



The ATRA technical department is proud to be celebrating another year serving the automatic transmission repair industry. Many changes have taken place over the past few years, technical training has become an integral part of today's transmission repair industry.

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A handwritten signature in black ink that reads "Lance Wiggins". The signature is stylized with a large, sweeping initial "L" and a long, horizontal stroke at the end.

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ATRA Technical Director

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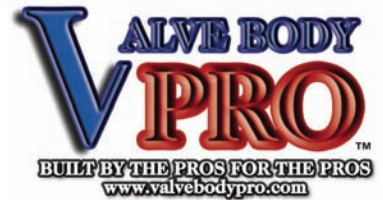
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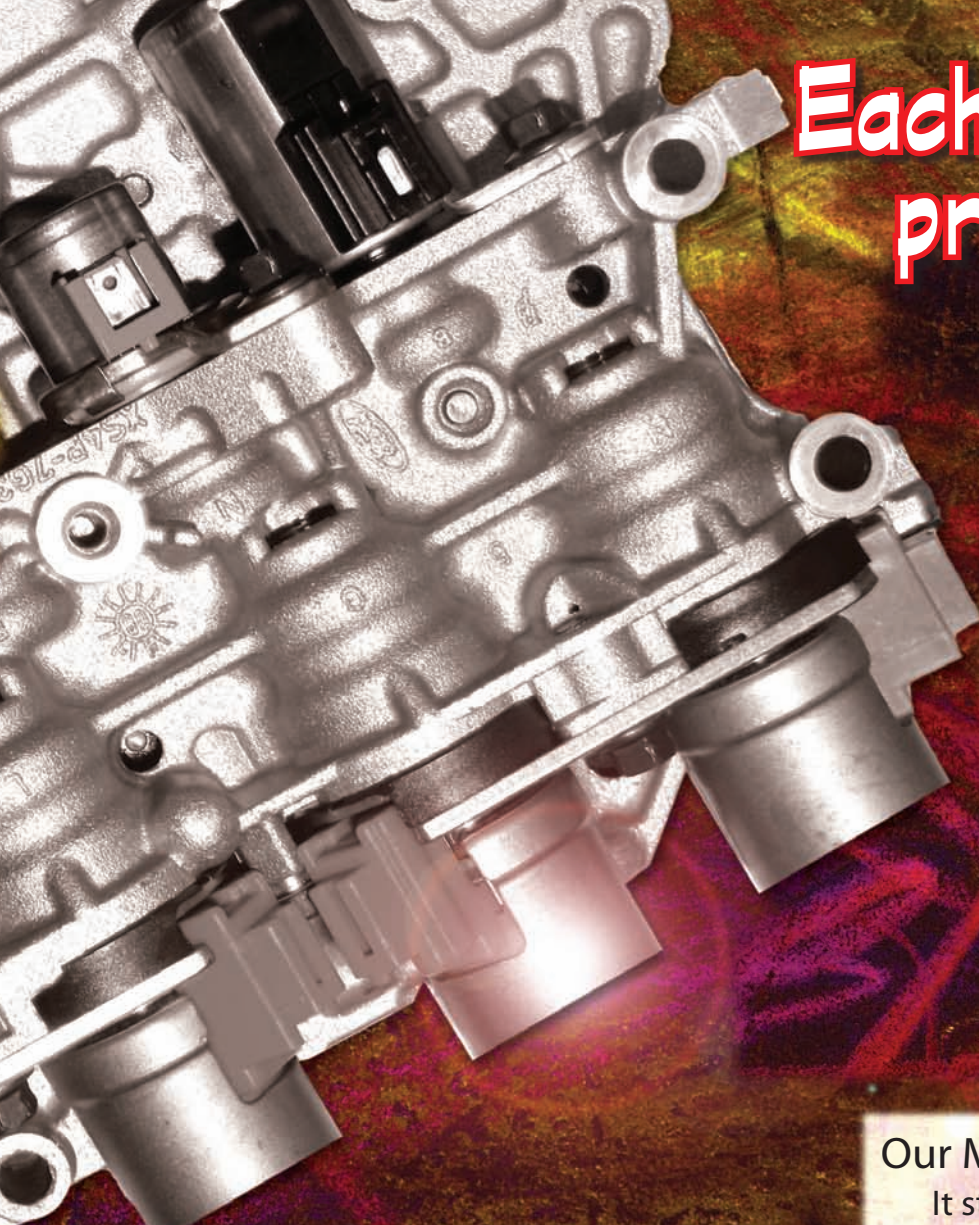


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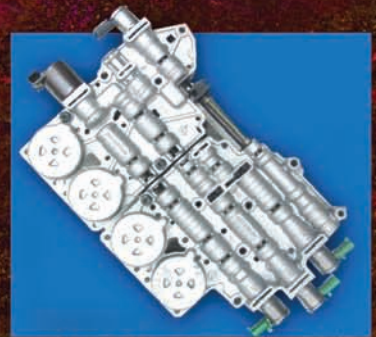
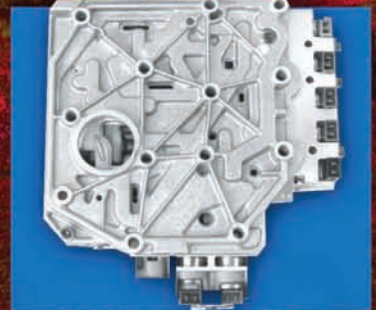
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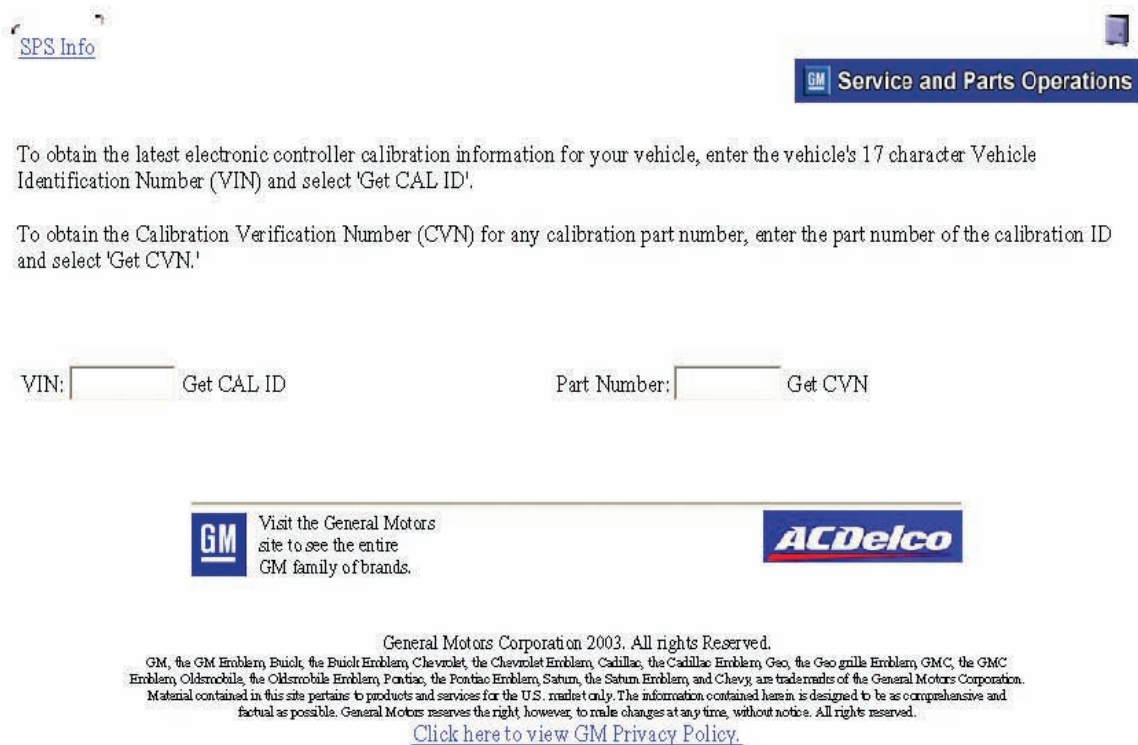
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All Models

GM Calibration Web Site Update

General Motors has implemented a new design web site for calibration information. As with the old site it is free and contains the same features as the previous web site.

The new TIS2 Web site also includes an additional feature, the ability to research specific calibration numbers to see what their application is. This feature is known as the calibration verification number or CVN. To access the site enter the following web address in the address bar, <http://tis2web.service.gm.com>



The screenshot shows the GM Calibration Web Site interface. At the top left is a link for "SPS Info". At the top right is a button labeled "Service and Parts Operations" with the GM logo. Below these are two instructions: "To obtain the latest electronic controller calibration information for your vehicle, enter the vehicle's 17 character Vehicle Identification Number (VIN) and select 'Get CAL ID'." and "To obtain the Calibration Verification Number (CVN) for any calibration part number, enter the part number of the calibration ID and select 'Get CVN'." Below the instructions are two input fields: "VIN: [text box] Get CAL ID" and "Part Number: [text box] Get CVN". At the bottom left is a GM logo with the text "Visit the General Motors site to see the entire GM family of brands." At the bottom right is an AC Delco logo. Below the logos is a copyright notice: "General Motors Corporation 2003. All rights Reserved." followed by a list of GM brands and a disclaimer: "Material contained in this site pertains to products and services for the U.S. market only. The information contained herein is designed to be as comprehensive and factual as possible. General Motors reserves the right, however, to make changes at any time, without notice. All rights reserved." Below the disclaimer is a link: "Click here to view GM Privacy Policy."

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 **Service and Parts Operations**

To obtain the latest electronic controller calibration information for your vehicle, enter the vehicle's 17 character Vehicle Identification Number (VIN) and select 'Get CAL ID'.

To obtain the Calibration Verification Number (CVN) for any calibration part number, enter the part number of the calibration ID and select 'Get CVN'.

VIN: Get CAL ID

Part Number: Get CVN

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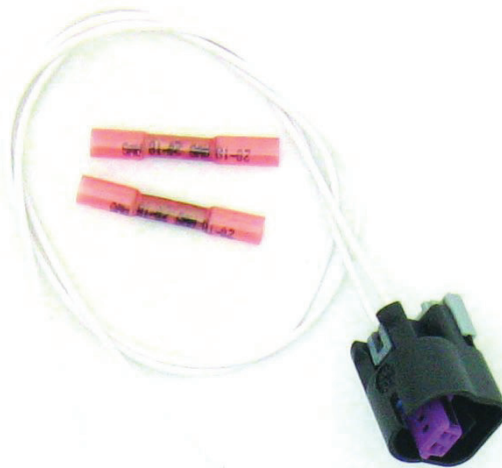
All Models

Calibration Updates

YEAR	BODY STYLE/MODEL	TRANSMISSION OR TRANSFER CASE	CONCERN/COMPLAINT
2007	Z BODY	6T70	Shift Flare/Bump, 6-5, 5-4, 4-3, 3-4, 2-1 or Reverse
2007	Z Body	6T70	P0777, P0797, P1825, P2715 DTC's Set
03-06	Y-D Cadillac	5L40E/6L80	Surge/Chuggle/Noise after TCC applies at low speeds
2007	C/K Truck	6L80	4-5 Flare/hard shift, possible DTC P0756 set
2006	Y Body	6L80	Delayed garage shift engagement Reverse or Forward
04-06	D-E Cadillac	5L50E	Surge/Chuggle/Noise after TCC applies at low speeds
2005	D- Cadillac	5L50E	P2119, P2501, P0315 DTC's
04-05	Z Body	4T40/45E	P0703 set
04-05	Z Body	4T40E/45E	P0335/P0650 Set, extended crank or no start
04-05	S/T	4L60E	Reduced power, P0507 DTC
03-05	S/T/C/K/H/M/L Trucks	4L60E	Lack of power at High Ambient temperatures
2004	S/T Trucks	4L60E	Surge down hill, chuggle
2005	Y car, S truck	4L60/65E	Unable to program TCM
04-05	S/T Trucks	4L60E	Reduced Power, P0606 DTC
04-05	S/T Trucks	4L60E	P0171 DTC
04-05	S/T Trucks	NV 226 T-case	Delayed 4wd application during slip conditions
2007	C/K Truck	NV246 T-Case	Intermittent Slip bump on accel with T-Case in AUTO range (TCCM UPDATE CAL)
06-07	C/K Truck	4L60E/65E or 6L80	P0851 set
2005	L/V Trucks	AF33-5	Poor fuel economy
2005	L/V Trucks	AF33-5	Flare or shudder on shift

NV24I, NV23I, NV243, NV233, NVI36, NV246, NV263, BW4484 Transfer Case Speed Sensor Connectors

A typical problem on high mileage vehicle applications is that the speed sensor connector becomes brittle with use. This typically leads to connector clip/lock damage as you attempt to remove the connector from the speed sensor. In the past, the problem was addressed with a service package #88987183. An updated repair has now been released. The harness connector service kit is now available as part # 15306187



BW 4484 H2 Applications

Locked in 4WD, Binds on Turns

Some customers may comment about the Hummer H2 applications “hopping or binding” when the vehicle is in a turn. Some customers may comment regarding a lack of 4WD operation or about the transfer case failing to come out of 4wd when another range has been selected.

A common cause for this condition is a broken shift fork or collar/sleeve within the transfer case. The shift fork and the shift sleeve/collar are made of plastic and tend to break with use. An updated shift fork is available under part # 88984536 while the updated shift sleeve is available under part # 88984512.

To repair this condition the transfer case must be disassembled. Two precautions should be heeded when servicing the BW 4484 unit, Do not disassemble the planetaries when taking the transfer case apart for this concern, even though your service manual may direct you to do so.

If the planetaries come apart they will need to be retimed. To retime the planetaries locate the planetary pinion timing marks. These marks can be dots, dashes, triangles or a combination of all of the above. The marks are typically on opposite sides of the small verses large gears.

All the timing marks must be located and the pinions rotated until all the “APPROPRIATE” timing marks are facing outward. Reassemble the planetary and make sure it does not bind at all when it is rotated by hand. Failure to properly time the planetary will result in dramatic vehicle handling problems. An improperly timed planetary will bias power to one set of drive wheels, making the vehicle act as if you had a different ratio in the front verses rear differential.

The other area to pay attention to is the shift shaft. Be careful when assembling the shaft as the tip on the end of the shaft can be damaged or broken very easily.

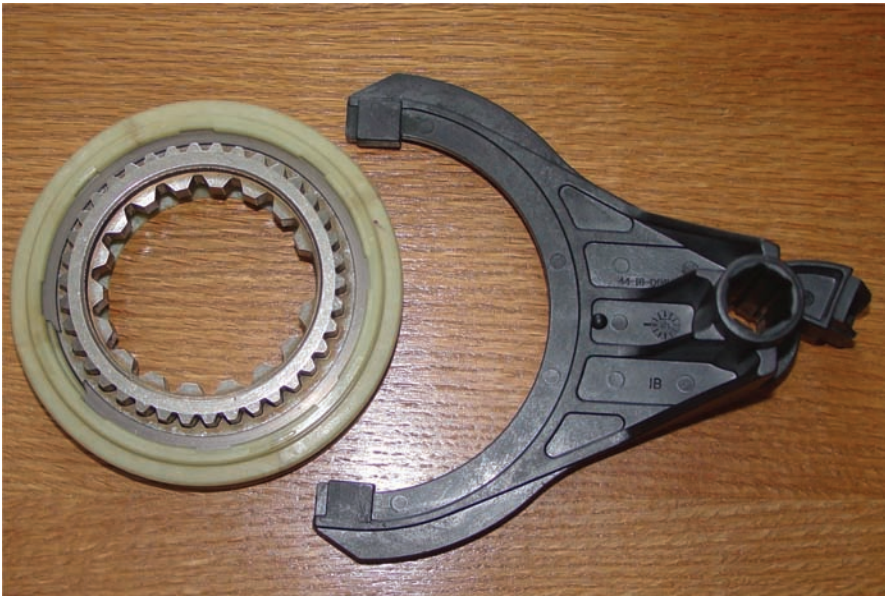
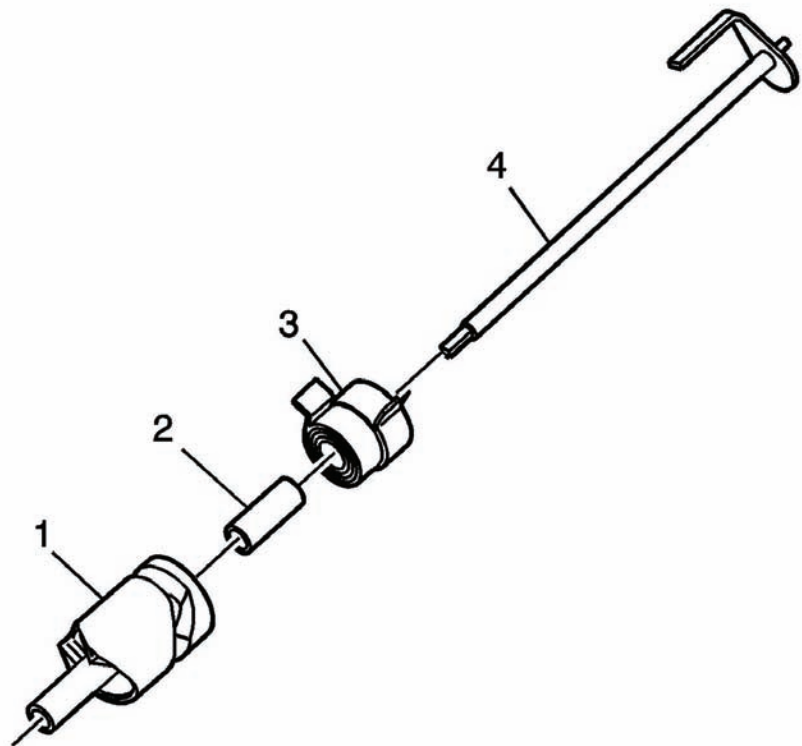
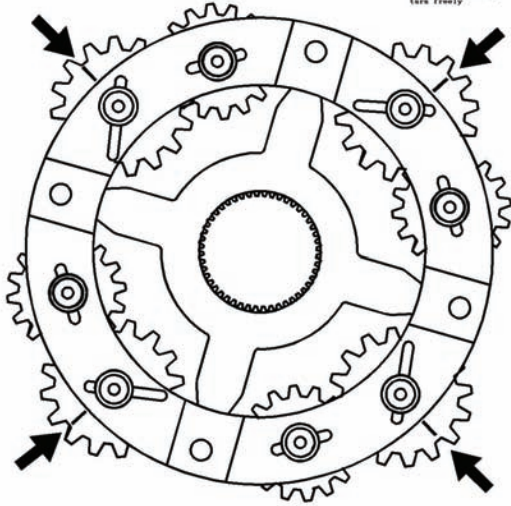
BW 4484 H2 Applications

Locked in 4WD, Binds on Turns (continued)

Maybe lines, dots or triangle that will have to face out

Lines, dots, or triangle on these gears are typically on the other side of the gear. They must face out.

When you have completed the assembly rotate the complete planetary, it must turn freely

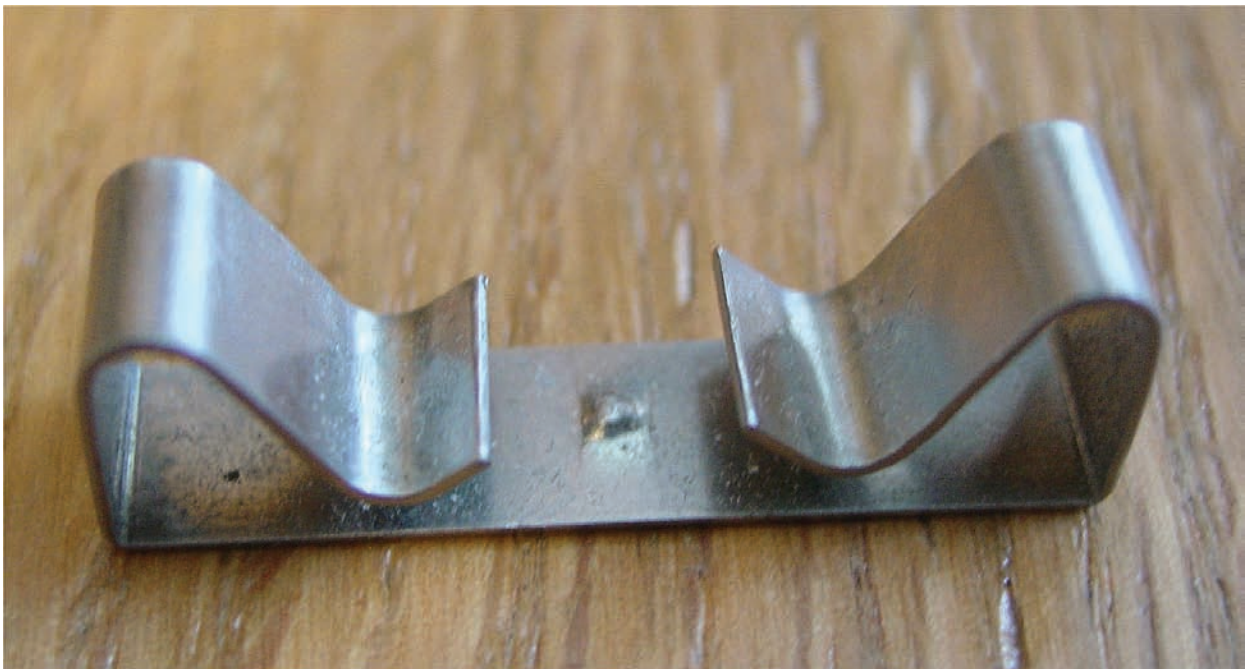


New Venture Transfer Cases

Transfer Case Fluid Leakage (RPO NPI, NP2, NP3, NP4, NP8)

Many 1998-2007 GM light duty truck and sport utility 4WD/AWD applications may experience fluid leakage in the rear case area on New Venture Gear transfer case applications. Upon inspection the technician generally finds a “pin hole” in the housing area where the oil pump is mounted. The condition is caused by movement of the oil pump in the case leading to wear in the rear housing oil pump lug locating slots. This is generally due to a missing, broken or fatigued oil pump wear reaction clip.

To repair this concern or when you have a transfer case apart for service or rebuild it is recommended to always change the reaction clip even if the clip appears to be performing properly. Previously ATRA recommended the use aftermarket reaction clips as the OEM clips would prematurely fatigue. GM has now released a fatigue resistant oil pump wear clip to address this concern. It is available under GM part number 12470559



4L60/65/70E

Burnt Clutches, Hard Shifts

A major change has occurred with the forward sprag assembly. The update was implemented because of two concerns with the previous design.

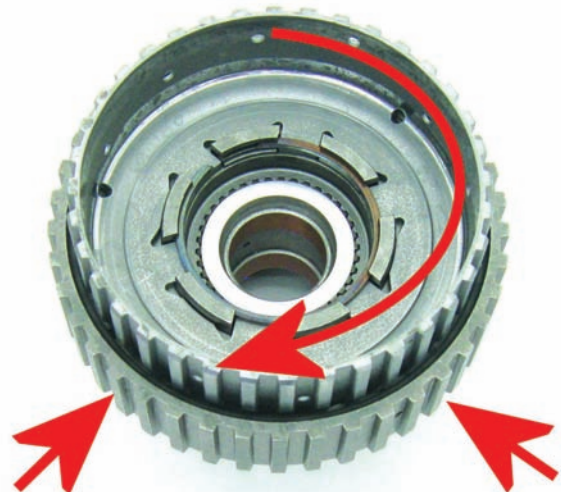
1. Loss of forward when in OD and 3rd range. Has Manual 2nd and 1st (Sprag fails to lock)
2. Burned 3-4 clutch (Sprag fails to freewheel in 4th gear) either of the concerns could be intermittent and the sprag may appear to operate correctly when it is rotated by hand on the bench.

A design and vendor change has occurred to address the concerns. The updated sprag element can be easily identified by the “double cage” design. GM sells the updated design as complete sprag assemblies. The part numbers are as follows:

RPO	PART NUMBER
M30 and M33	24243750
M32 and M70	24241477



The Sprag rotates freely clockwise as shown.



4L60/65/70E

Harsh 1-2 Shift

A calibration update was released for 2006-2008 applications designed to address 1-2 hard shift concerns. The updated calibration increased the shift adaptive learning authority, so the adapts could compensate for the shift feel concern. In addition, the 1-2 accumulator may use one or two piston springs. Applications are as follows:

2 Springs, Model Codes

7CAD, 7CBD, 7KAD, 7KZD, 7SDD, 7SFD, 7SLD, 7TDD, 7TFD, 8CAD, 8KAD, 8SFD, 8SLD, 8TFD, 8TLD

1 Spring, Model Codes

7CFD, 7CHD, 7CJD, 7CLD, 7CMD, 7CSD, 7CVD, 7CWD, 7KCD, 7KFD, 7KLD, 7KMD, 7PCD, 7PKD, 7SBD, 7SJD, 7SKD, 7SZD, 8CFD, 8CJD, 8CLD, 8CVD, 8KFD, 8KLD, 8SJD, 8SKD, 8SUD, 8SWD, 8TKD, 8TWD, 8TZD

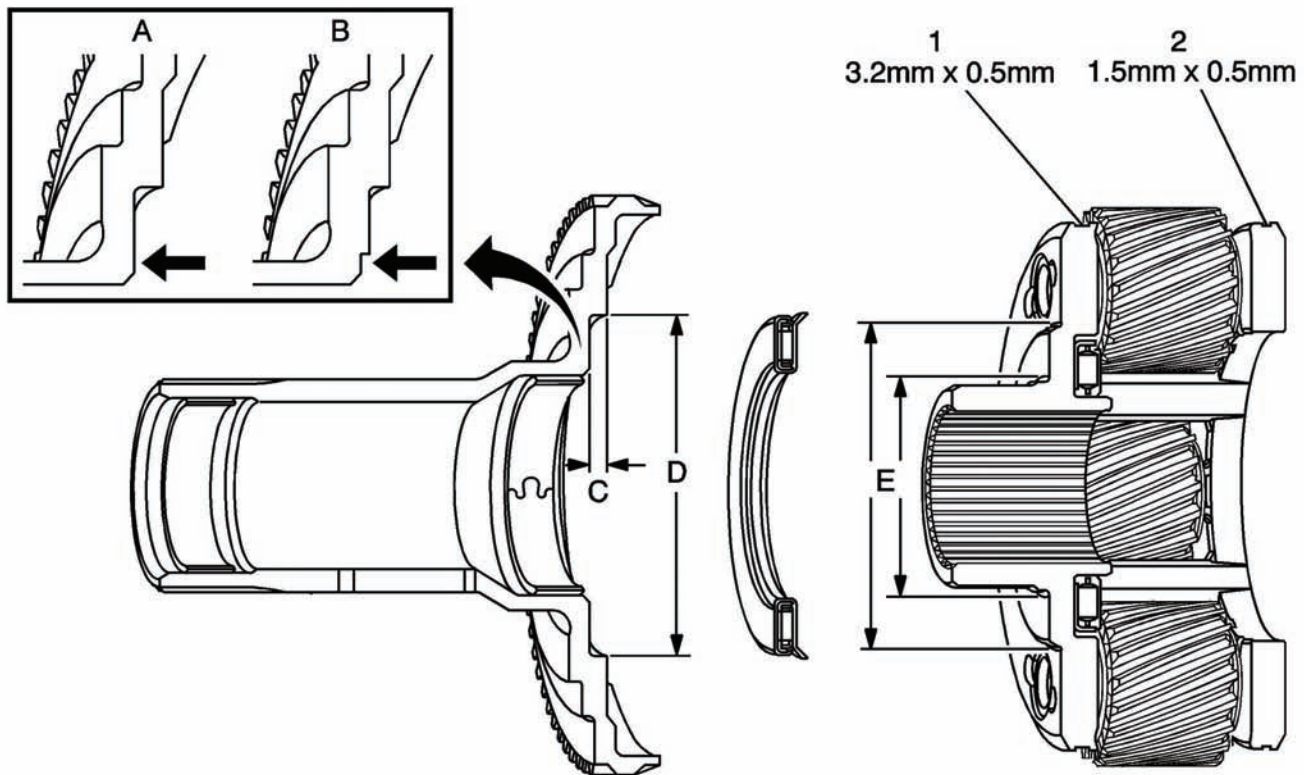


4L60/65/70E

Input Carrier, Reaction Carrier Shaft and Bearing Changes

An updated thrust bearing was implemented in all applications starting on Julian date 7071 (March 12, 2007).

The updated bearing is thicker with a angular lip on it's outside diameter. The carrier and the reaction carrier shaft have been updated to accommodate the change. The update will back service previous design applications if all three parts are replaced. (Bearing, carrier, reaction carrier shaft).



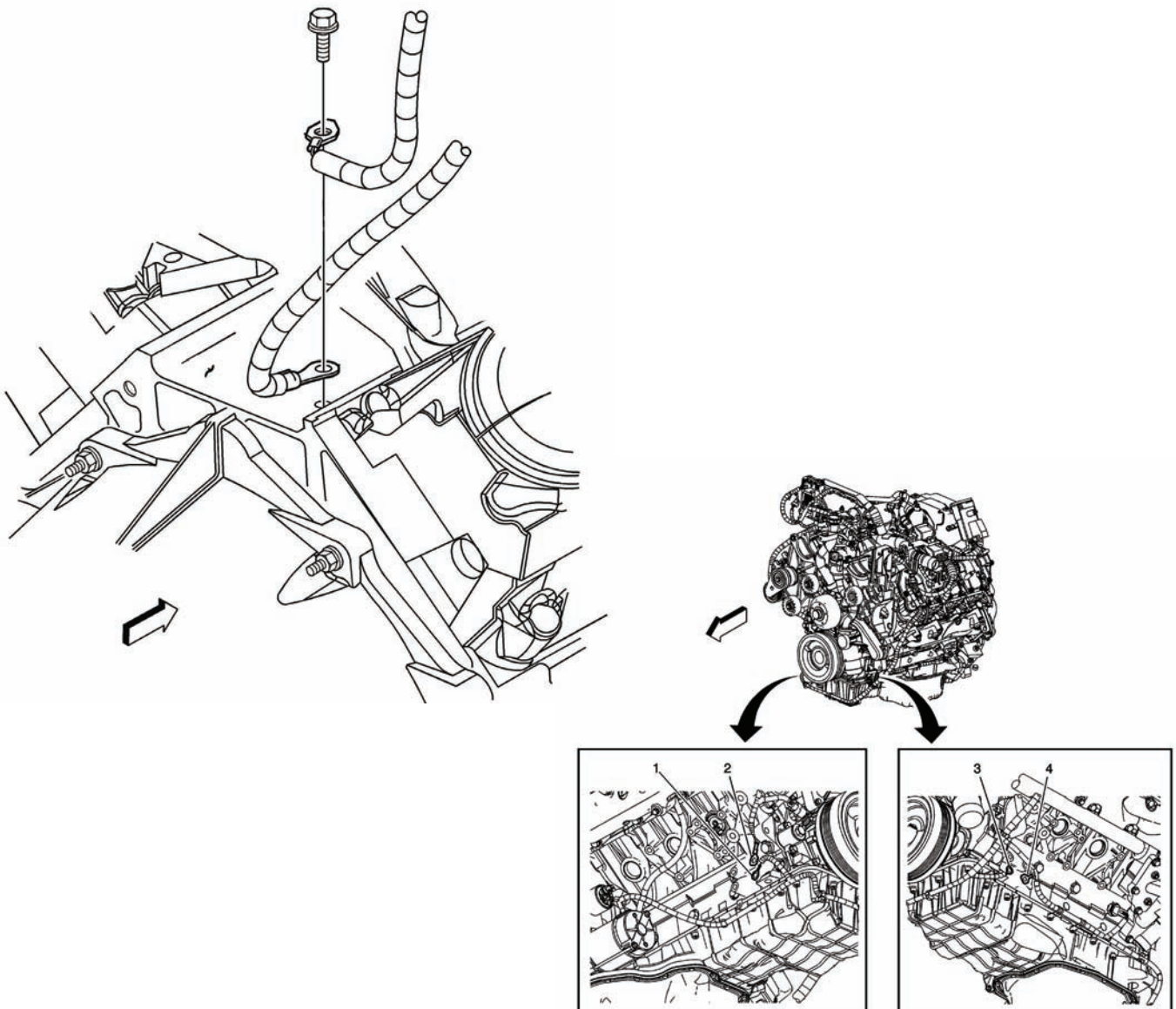
4L60E and 4L80E

Miss/Surge/Chuggle

1997-2007 C/K Truck

Some customers may comment about a Miss/Surge/Chuggle related condition that in many instances is misdiagnosed as a transmission related problem. The concern is many times intermittent and sometimes is temperature sensitive.

A common cause for this concern is G103 located on the front or rear of the cylinder head. The location depends on the engine application. G103 is one of the ECM/PCM grounds. If G103 is corroded/loose or damaged a misfire may result. Repair G103.

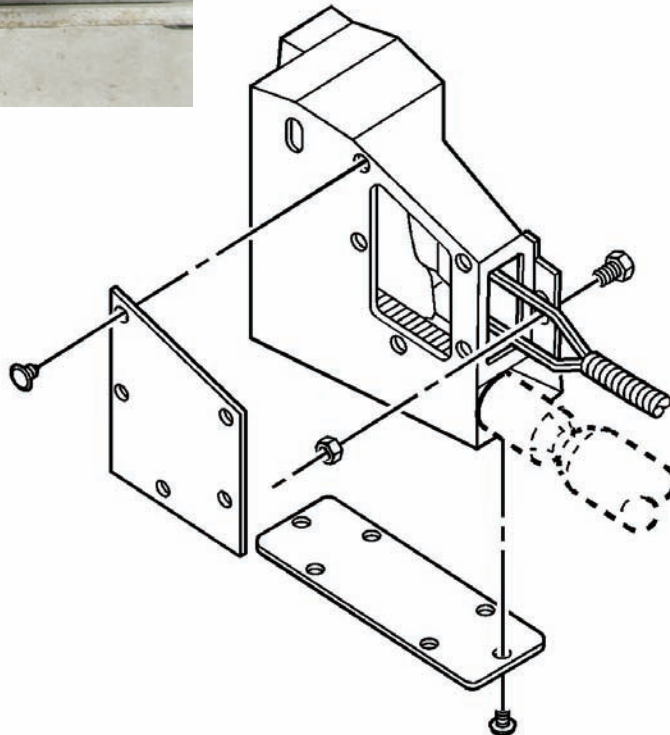
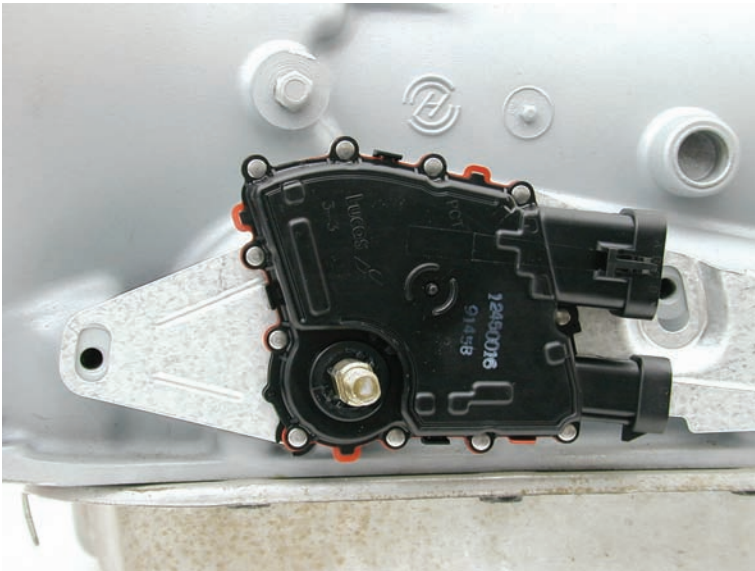


LCT 1000

Shifter Will Not Move Into Proper Position

During the winter months some customers may comment regarding how difficult it is to physically shift the transmission after operating the vehicle in Mud, Snow or Slush.

A buildup of Ice, Mud or Snow may be accumulating on the shift linkage in the NSBU switch area. Allison has addressed this concern by introducing a shield for the shifter linkage. The cover is available from Allison under part # 700028.



6T40 (RPO MH8,MHB) 6T45 (RPO MH7,MHC)

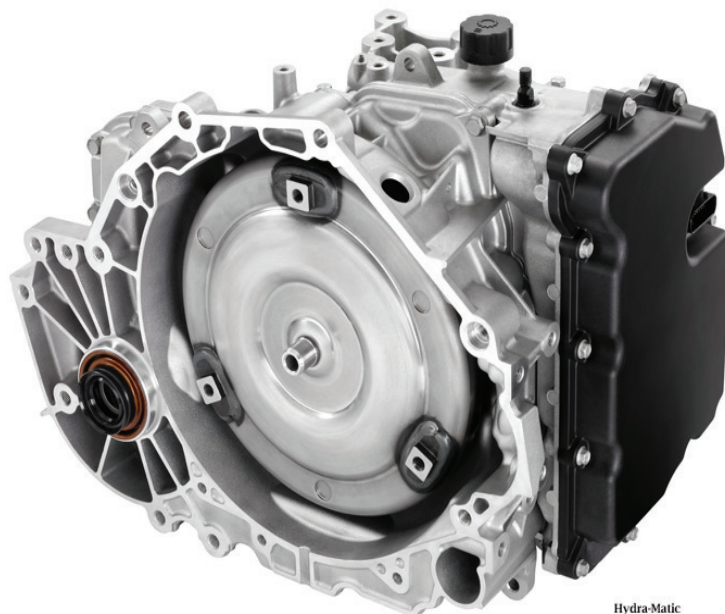
Introduction

Two additional 6 speed transaxles have been introduced into the GM line, the 6T40 and 6T45.

The first car to receive the transmission in the United States will be the 2008 Chevrolet Malibu, followed by the 2009 Saturn Aura and Pontiac G6. The transaxle is also the primary application for the Daewoo Tosca and the Buick Lacrosse in Asia. The 6T40/45 family of transaxles is poised to become the largest 6 speed FWD applications that GM will produce.

Known as the “global 6 speed” or “GF6” the 6T40/6T45 improves fuel economy on average of 4 % while performance was improved 8% on average over its 4 speed cousins. The 6T40/6T45 share the same architecture and most of the parts are the same. The primary difference is the 6T45 is a heavy duty version of the 6T40. The heavy duty parts in the 6T45 include:

- 1.25” wide chain verses a 1” chain with the 6T40
- Input planetary is a 5 pinion assembly
- Heavier ribbed case
- Heavier Differential



Hydra-Matic
2008 6T40 (MH8)
Six Speed FWD Automatic Transaxle

6T40 (RPO MH8,MHB) 6T45 (RPO MH7,MHC)

Features

RPO CODES:

- 6T40 car Fwd RPO MH8
- 6T40 car Awd RPO MHB
- 6T45 car Fwd RPO MH7
- 6T45 car Awd RPO MHC
- Input torque capacity 6T40 177 lb-ft (240 Nm)
- Output torque capacity 6T40 277 lb-ft (375 Nm)
- Weight 178 lbs (81kg)

RATIOS:

1st	4.58-1
2nd	2.96-1
3rd	1.91-1
4th	1.44-1
5th	1-1
6th	.74-1
REV	2.94-1

- Final Drive “effective ratio” 2.89-1, 3.17-1 or 3.87-1
- Fluid Type—Dexron VI
- Fluid capacity Valve body cover removal—5.3-7.4 qts (5-7 liters)
- Fluid capacity fluid change—4.2-6.3 qts (4-6 liters)
- Fluid capacity Overhaul--- 7.4-9.5 qts (7-9 liters)
- No dipstick, oil level checked via a plug (most applications)
- EC3 236 mm “hyper elliptical” furnace brazed torque converter. Torque converter contains a lip seal that will be damaged if the converter is removed or installed in any position other than “vertical”. Special tools are available J46409
- 5 clutches (3 holding, 2 driving) clutch to clutch shifting
- 1 diode one way clutch
- 1 shift solenoid used (On/Off Design), SS1
- 6 Variable bleed solenoids, PCS1, PCS2, PCS3, PCS4, PCS5, TCC

6T40 (RPO MH8,MHB)

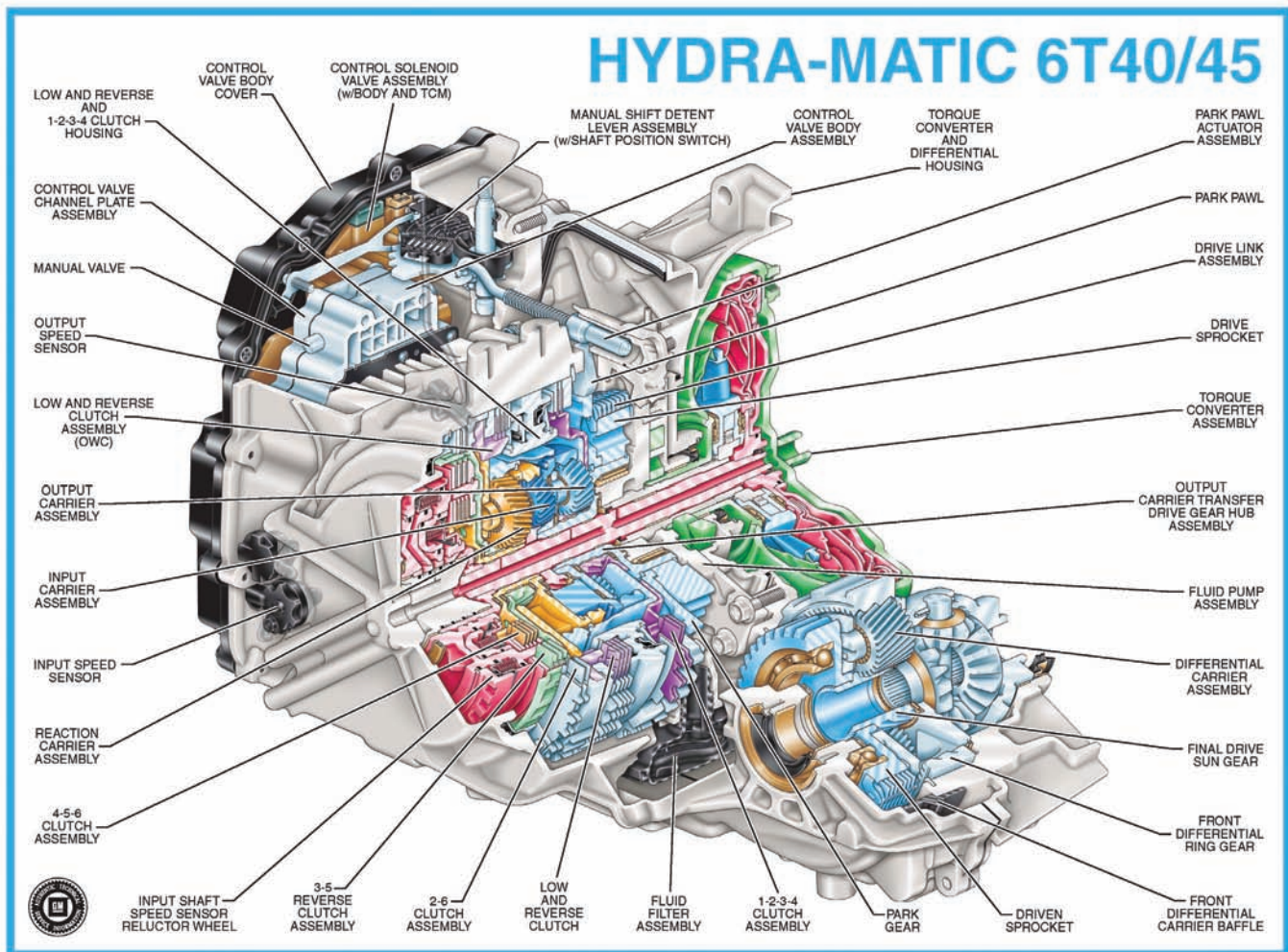
6T45 (RPO MH7,MHC)

Features (continued)

- A Motorola (Continental) built 32 bit TCM (TEHCM) mounted internal to the transmission on the valve body (Referred to as the “control solenoid valve assembly”) The TEHCM incorporates the TCM, Solenoids, pressure switches, TFT sensor and it is bolted to the valve body.
- Gerotor type oil pump, 3 selective gears thicknesses available
- Internal Mode Switch (IMS) equipped
- Hall effect input and output speed sensors
- Performance Algorithm Shifting (PAS) programming
- Performance Algorithm Lift foot (PAL) programming
- Winter mode programming
- Sport mode and TAP shift equipped
- Adaptive Strategies with fast learn capabilities
- Reverse lock out feature
- Grade Braking
- Fwd/Awd applications can be dingly towed but Awd applications cannot be dolly towed. Neither application can be towed with the rear wheels in the air, as would happen when the vehicle is being towed by a tow truck.

6T40 (RPO MH8,MHB) 6T45 (RPO MH7,MHC)

Exploded View



6T40 (RPO MH8,MHB)

6T45 (RPO MH7,MHC)

Checking the Fluid Level

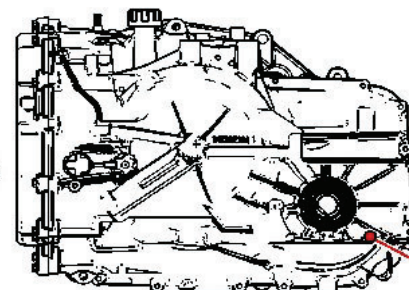
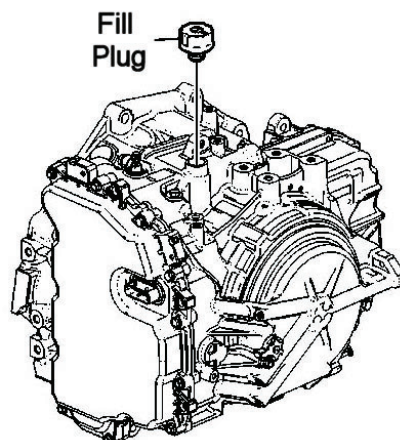
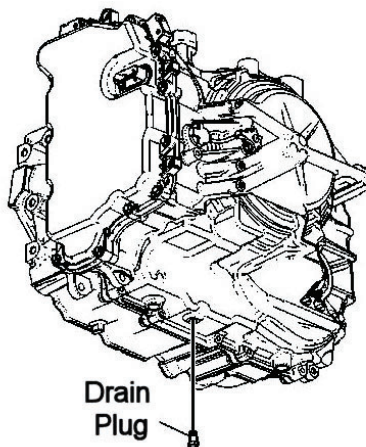
The 6T40/45 utilize a thermal type element to control the oil level in the unit similar to other GM units. Known as a “Fluid Level Control Valve” the unit is basically a thermally controlled stand pipe.

At temperatures below 60°C (140°F) fluid is allowed to drain into the sump. At temps above 60°C (140°F) drain back is blocked, allowing the side cover (valve body area) to fill with fluid.

If you are changing fluid in these units make sure the unit is cold. If you remove the drain plug in the bottom of the case only about 50% of the fluid in the unit will drain, You will need to remove the bottom pan as with other transmissions to completely drain the unit. To check the fluid level, the transaxle TFT value must fall between 85°C-95°C (185°F-203°F).

Fluid temp can be checked from the “driver information center” or by using a scan tool. It is critical that the fluid be at the correct temperature or an overfill or under fill condition may occur. These units are very sensitive to overfill. As little as ½ qt overfull can lead to fluid leaking from the vent. Fluid level is checked with the engine running, fluid temp 85°C-95°C (185°F-203°F), in park, via a plug (most applications) near the axle seal area in the case.

Application	Specification	
	Metric	English
Valve Body Cover Removal - Approximate Capacity	5.0-7.0 liters	5.3-7.4 quarts
Fluid Change - Drain Plug - Approximate Capacity	4.0-6.0 liters	4.2- 6.3 quarts
Overhaul - Approximate Capacity	8.0-8.5 liters	8.5-9.0 quarts



Fill
Check Plug

6T40 (RPO MH8,MHB)

6T45 (RPO MH7,MHC)

Range Reference 6T40/6T45

COMPONENT	PARK NEUTRAL	REV	1 ST BRK	1 ST	2 ND	3 RD	4 TH	5 TH	6 TH
1-2-3-4 CLUTCH			ON	ON	ON	ON	ON		
3-5 REV CLUTCH		ON				ON		ON	
4-5-6 CLUTCH							ON	ON	ON
LOW/REV CLUTCH	ON	ON	ON						
2-6 CLUTCH					ON				ON
LOW ONE WAY			ON	ON					

NOTE: The Low/REV clutch is applied when the vehicle is in a forward range and the vehicle is stationary. As vehicle speed is indicated, the L/R clutch will be released. This increases torque capacity under load with the vehicle stationary

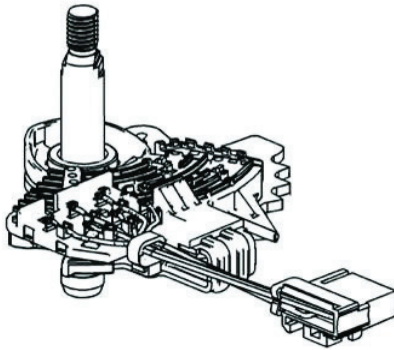
6T40 (RPO MH8,MHB)

6T45 (RPO MH7,MHC)

IMS (Internal Mode Switch)

The 6T40/6T45 Internal Mode Switch is connected mechanically to the manual shaft similar to the 4T65E application.

Electrically the IMS operates similar to other GM IMS applications. The TCM sends a bias voltage to the IMS on 4 circuits, A, B, C, P. Pin N is used for Park/Neutral starting operations and is supplied by the ECM. As the range selector is moved the IMS will ground/unground the circuits or circuit required to indicate the specific manual valve position. By monitoring the voltage sequence produced, the TCM will be able to identify the range that was selected.



Gear Selector Position	Signal A	Signal B	Signal C	Signal P
Park	LOW	HI	HI	LOW
Park/Reverse	LOW	LOW	HI	LOW
Reverse	LOW	LOW	HI	HI
Reverse/Neutral	HI	LOW	HI	HI
Neutral	HI	LOW	HI	LOW
Neutral/Drive 6	HI	LOW	LOW	LOW
Drive 6	HI	LOW	LOW	HI
Drive 6/Drive 4	LOW	LOW	LOW	HI
Drive 4	LOW	LOW	LOW	LOW
Drive 4/Drive 3	LOW	HI	LOW	LOW
Drive 3	LOW	HI	LOW	HI
Drive 3/Drive 2	HI	HI	LOW	HI
Drive 2	HI	HI	LOW	LOW
Open	HI	HI	HI	HI
Invalid	HI	HI	HI	LOW
Invalid	LOW	HI	HI	HI

HI = Source voltage
LOW = 0 volts

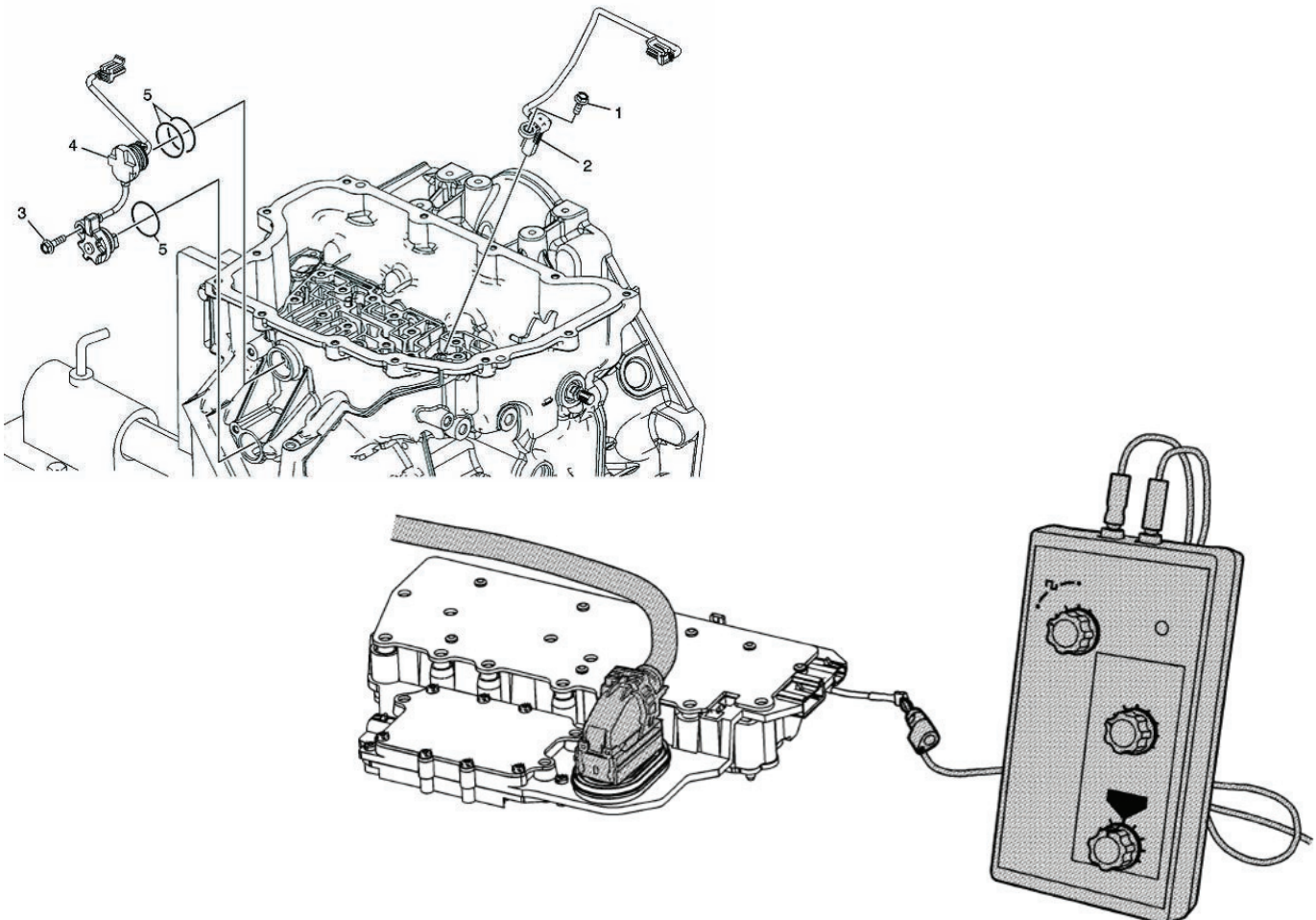
6T40 (RPO MH8,MHB) 6T45 (RPO MH7,MHC)

Speed Sensors

The speed sensors are “hall effect” style assemblies. The input speed sensor is mounted externally in the case. The output speed sensor is mounted under the valve body in the case.

The TCM provides a signal voltage for the sensor operation. As the transmission rotates the sensors will produce a square wave signal. The TCM will monitor the frequency of the signal to determine the input or output speed. Input Speed Sensor signals are generated by the rotation of the 3-5-R clutch assemblies and are used to calculate gear ratio and slip rates.

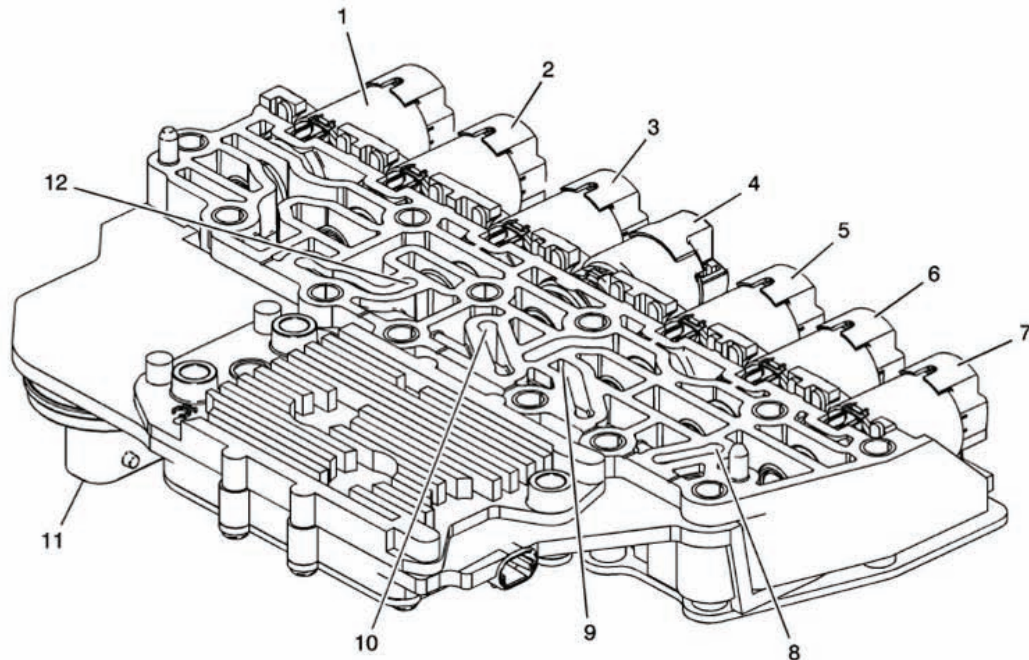
The Output Speed Sensor signal is generated by the rotation of the park gear. The OSS is used for indicating Vehicle speed for shift pattern control as well as Ratio calculations. Diagnosis of the speed sensors is accomplished using a signal generator and a scan tool as with the other 6 speed applications.



6T40 (RPO MH8,MHB)

6T45 (RPO MH7,MHC)

TEHCM Internals



1880316

1. Pressure Control Solenoid 3 (R1/456)
2. Pressure Control Solenoid 2 (35R)
3. Torque Converter Clutch (TCC) Pressure Control Solenoid
4. Shift Solenoid 1 (On/Off)
5. Pressure Control Solenoid 5 (1234)
6. Pressure Control Solenoid 4 (26)
7. Line Pressure Control Solenoid
8. Transmission Fluid Pressure (TFP) Switch 2 (35R)
9. Transmission Fluid Pressure (TFP) Switch 3 (26)
10. Transmission Fluid Pressure (TFP) Switch 1 (1234)
11. Pass Through Connector
12. Transmission Fluid Pressure (TFP) Switch 4 (456/R1)

The control solenoid (w/body and TCM) valve assembly contains the following components:

- Transmission control module (TCM)
- Clutch pressure control solenoids (Clutch PC Sol)
- Shift solenoids (SS)
- Line pressure control solenoid (Line PC Sol)
- Torque converter clutch pressure control solenoid (TCC PC Sol)
- Transmission fluid temperature sensor (TFT Sensor)
- TCM temperature sensor
- Power-up temperature sensor
- Transmission fluid pressure switches (TFP Sw)

6T40 (RPO MH8,MHB) 6T45 (RPO MH7,MHC)

TEHCM Internals (continued)

Pressure Switches:

The pressure switches are housed as part of the control solenoid valve assembly (TEHCM). Four switches are used, 1, 2, 3 and 4. The switches act as an input to the TCM and are used for 2 basic purposes:

- To monitor clutch regulator valve and clutch hydraulic operation
- To monitor clutch CVI (Adaptive learning)

TFP Switch	Clutch/circuit Monitored
1	1-2-3-4 Clutch
2	3-5-R Clutch
3	2-6 Clutch
4	4-5-6 and L/R Clutch

6T40 (RPO MH8,MHB)

6T45 (RPO MH7,MHC)

Solenoids

Shift solenoid and PCS operation is controlled by the TEHCM (TCM). The TCM regulates the feed voltage to the solenoids. The TCM then regulates feed voltage and current to the solenoids. The shift solenoid is an On/Off design (N.C.) with the TCM controlling the power for the solenoid as well as the ground. The pressure control solenoids are PWM controlled. The TCM is over current and overtemp protected.

Motorola refers to the PWM solenoid's by their state, NL or NH. Normally High (N.H.) is used to describe a solenoid that allows pressure to travel to the clutch when the solenoid is turned off. Normally Low (N.L.) is used to describe a solenoid that prevents pressure from getting to a clutch when the solenoid is turned off.

The solenoids are protected by the filter plate. The filter plate is housed between the valve body and the control solenoid valve assembly (TEHCM) and must be replaced any time the valve body or control solenoid valve assembly (TEHCM) is replaced or unbolted from each other. The Filter plate is serviced with the control solenoid valve assembly (TEHCM) but it can also be ordered separately.

Gear	Shift SOL 1	1-2-3-4 CL PC SOL 5 N.L.	2-6 CL PC SOL 4 N.L.	3-5 REV CL PC SOL 2 N.H.	LOW REV 4- 5-6 CL PC SOL 3 N.H.	Gear Ratio
Park	ON	OFF	OFF	OFF	ON	--
Reverse	ON	OFF	OFF	ON	ON	2.94
Neutral	ON	OFF	OFF	OFF	ON	--
1st Braking	ON	ON	OFF	OFF	ON	4.584
1st	OFF	ON	OFF	OFF	OFF	4.584
2nd	OFF	ON	ON	OFF	OFF	2.964
3rd	OFF	ON	OFF	ON	OFF	1.912
4th	OFF	ON	OFF	OFF	ON	1.446
5th	OFF	OFF	OFF	ON	ON	1
6th	OFF	OFF	ON	OFF	ON	0.746
Effective Final Drive Ratio - 6T40/45 - 3.17/3.87						
For shift solenoid 1, "ON" = Solenoid Energized (Pressurized) "OFF" = Solenoid De-energized (No						
For pressure control solenoids, "ON" = Pressurized, "OFF" = No Pressure						
Normal resistance PCS 3-5 ohms at 70f, Shift solenoid 16-20 ohms at 70f						

6T40 (RPO MH8,MHB) 6T45 (RPO MH7,MHC)

Solenoid Cleaning Process

An automated process is available that aids in cleaning debris from the solenoid assembly. Your scan tool will instruct the TCM (TEHCM) to cycle the solenoids while the system is pressurized to clean the solenoids. The transmission does not need to be disassembled to perform the cleaning process.

Simply follow the instructions on the scan tool to activate the cleaning program. This process should be completed prior to attempting to diagnose the transmission with the DT-48616 tools as described below. If the cleaning process is unsuccessful then you should diagnose the concern with DT-48616

Diagnostics

Like other GM transmissions, diagnosis is designed around the use of a quality scan tool. With the 6T40/6T45 this could not be more true as the need to access scan data is critical. Unlike other GM transmissions you have become accustomed to working with over the years, the 6T40/6T45 internal electrical components are not hard wired to the rest of the vehicle via the transmission harness. This means that the diagnostic process has changed considerably. Diagnosis is divided into 2 categories, scan diagnostics and test plate/air check diagnostics.

Solenoid and valve body diagnosis requires the following tools:

- A quality scan tool capable of communicating and commanding the TCM and its solenoids.
- Tool number DT 48616 Solenoid test plate and jumper harness DT48616-10

Remove the Control Solenoid Valve Assembly from the transmission. Install tool DT 48616 onto the Control Solenoid Valve Assembly (5Nm 44 Lb In). Apply regulated shop air (90-100 psi) to the tool. Connect the scan tool to the Control Solenoid Valve Assembly using cable DT48616-10.

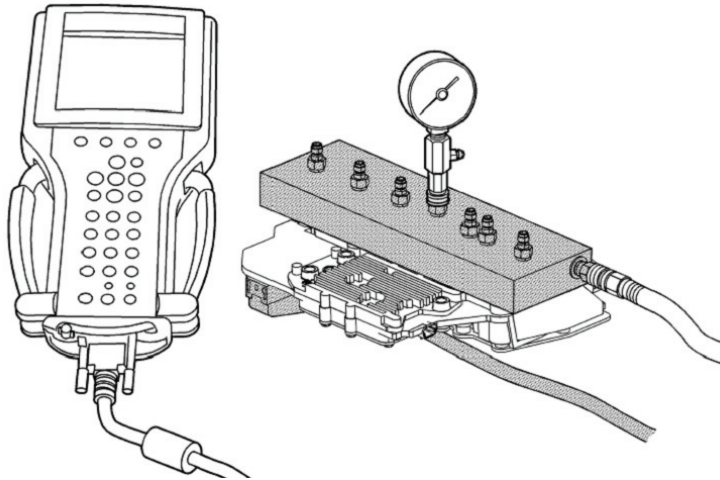
Command the solenoid ON/OFF air pressure should be present on the gauge and then it should exhaust as the solenoid is cycled. If the solenoid or valve are malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly.

If the solenoid checked OK, install the gauge on another solenoid port and command that solenoid ON/OFF with the scan to repeat the process.

6T40 (RPO MH8,MHB)

6T45 (RPO MH7,MHC)

Solenoid Cleaning Process (continued)



NOTE: If the solenoid is malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly (TEHCM)

NOTE: The TCM (TEHCM) will normally cycle several of the solenoids ON/OFF to help keep the solenoids and the valves free of debris. Therefore this cleaning function (Dither) may cause the gauge to flicker when the TCM is cleaning the solenoid you are testing.

Do not operated the solenoids for longer than 2 minutes or damage may occur.

COMPONENT	PORT ON TEST BLOCK	Key On, Engine Off (KOEO) Normal State
PC Solenoid 2, 35R	F	Full PSI flow to gage
PC Solenoid 3, R1/456	G	Full PSI flow to gage
PC Solenoid 4, 2-6	B	No PSI flow to gage
PC Solenoid 5, 1234	C	No PSI flow to gage
Shift Solenoid	D	Full PSI flow to gage
Line Pressure Control Solenoid	A	Full PSI flow to gage
TCC PC Solenoid	E	No PSI flow to gage

6T40 (RPO MH8,MHB) 6T45 (RPO MH7,MHC)

Adaptive Learning

The 6T40/45 are fully equipped with several adaptive learning strategies. As with some other GM applications you will need to erase the adaptive values and perform a “Fast Learn” prior to operating the vehicle. Adapts and fast learn procedures should be performed if any of the following occur:

- Internal Transmission repairs have been performed
- The valve body was replaced
- The Control Solenoid valve assembly was replaced
- The TCM was recalibrated or replaced
- Internal repairs were performed that could effect shift quality

NOTE: Fast learn is not required if a GM New or GM Rebuilt 6T40/6T45 is used. The transmission is fast learned prior to it being shipped from the plant.

To perform a fast learn:

- Use a scan tool capable of performing the fast learn procedure
- TFT 158-230°F (70-110°C), Move the selector in/out of gear 3 times
- Select the fast learn process from the scan tool menu
- Place the transmission in Drive with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume
- Place the transmission in Reverse with the vehicle stationary. The TCM will individually apply the clutches and calculate the clutch volume
- Shut off the engine for at least 30 seconds, open and close the door to allow “RAP” to expire or false DTC’s may set, After a minimum of 30 seconds the car can be restarted , power off the scanner
- The process is now complete

The fast learn procedure will not run if:

- DTC’s are set
- TFT is not between 158-230 °F (70-110°C)
- The brake switch is not working
- TP is 0% but engine RPM increases during the test
- P/N switch is improperly adjusted or is not functioning correctly
- Line pressure control system is malfunctioning

2ML70 (RPO M99)

2 Mode Introduction

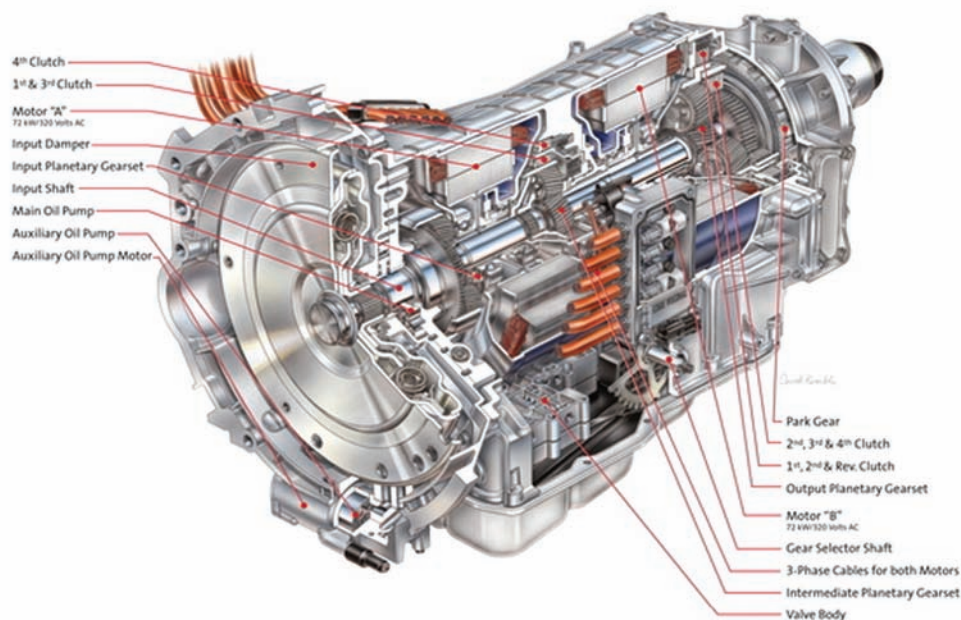
The next generation of transmissions to enter the market place has been introduced for the 2008 model year. Known as a “2 mode” design, the transmission was designated as the 2ML70 (RPO M99).

To order the 2ML70 the customer will also need to specify the 6.0L engine (RPO LFA) and the Hybrid system (RPO HP2). The 2 mode system was introduced on the Chevrolet Tahoe and GMC Yukon for the 2008 model year. It's usage will expand for the 2009 model year into other GM applications.

The “T” model transmission will be designated for rear wheel drive applications, the “C” model will be an upscale rear wheel drive application while the “F” model will be a front wheel drive application. In addition, the 2ML70 is also used by Dodge and BMW in some of their applications.

The 2 Mode design offers several advantages over conventional automatic transmissions including substantial gains in performance, fuel economy and significant reductions in emissions. Overall fuel economy gains for the C/K truck applications range between 25-40%. In addition to the common transmission functions, the 2ML70 also eliminates the need for an alternator and a starter for the vehicle.

2-Mode RWD Hybrid Transmission



2ML70 (RPO M99)

Specifications

Type 2 Mode continuous variable electric ratio hybrid transmission, four fixed gear ratios, two electric motors provide infinite variable ratios, with engine on/off operational capability

Gear Ratios

1st 3.69-1

2nd 1.70-1

3rd 1-1

4th .73-1

EVT #1 Infinity-1.70-1

EVT #2 1.70 to .5-1

Reverse Infinity to 1.70-1

- Max engine torque 380 lb-ft (515 Nm)
- Max engine power 369 bhp (275 kW)
- Two 65 kW (peak) electric motors (Drive motor #1, Drive motor #2) Y wound, 3 phase 300 volts AC, permanent magnet
- Motor cooling accomplished by a transmission fluid circulation system
- Electric motor torque 242 lb-ft (320 Nm)
- 300 volt 40 cell nickel-metal hydride battery (Located under the 2nd row seats)
- Auxiliary fluid pump
- Three planetary gear sets
- Four multiple disc clutches (2 holding, 2 driving)
- Two shift solenoids used (On/Off Design), SS1,SS2
- Six Variable bleed solenoids, PCS, PCS2, PCS3, PCS4, PCS5, TCC (TCC not used)

2ML70 (RPO M99)

Specifications (continued)

- A Bosch built 32 bit TCM (TEHCM) mounted internal to the transmission on the valve body (Referred to as the “control solenoid with body and TCM) The TEHCM incorporates the Solenoids, pressure switches, TCM and TFT and it is bolted to the valve body.
- Output speed sensor (2 Hall Effect sensors in one housing, capable of sensing both speed and direction)
- Electronic range selection
- IMS (Range position)
- Vane style oil pump (3 selective slides and rotors)
- 12 volt three phase AC powered Auxiliary fluid pump
- Three piece die cast aluminum case
- Wet weight 374 lbs (170 kg)
- Dexron VI required
- Fluid capacity, Fluid and filter 11.5 qts (10.88 liters) Overhaul 13 qts (12.30 liters)
- Torque dampener 347mm (No torque converter)
- Pressure taps- Line, Aux pump
- Driver shift control (DSC) (When in M range)
- Shifter ranges (P,R,N,D,M)
- Default actions if in 3rd or 4th= 3rd gear, if in 1st or 2nd = 2nd gear
- Manufactured in the GMPT plant, Baltimore

2ML70 (RPO M99)

Components and Functions

The 2 mode system requires several different control modules and subsystems for operation, they include:

Drive Motor Generator Control Module (DMGCM)

The DMGCM Contains the APM and PIM fastened together as an assembly. Cooling for the assembly is provided by a separate cooling system. The stand alone cooling system requires Dexcool and utilizes a heat exchanger mounted in the front of the vehicle and an electric coolant pump. The drive motor generator control module is connected to the poles of the drive motor battery. The high voltage system is controlled by a high current contactor relay mounted in the Hybrid battery assembly.

The Power Inverter Module (PIM)

The PIM converts 300 volts DC to 3 phase 300 volts AC to operate the drive motors. The Power Inverter Module (PIM) converts 3 phase 300 volts AC coming from the motor/generator to 300 volts DC to charge the hybrid battery. 6 high voltage shielded cables connect the PIM to the 2 electric drive motors mounted within the transmission. The high voltage cables are "orange" in color for easy identification. The PIM also contains the Hybrid Powertrain Control Module (HPCM) and 2 Motor Control Modules (MCM). The PIM, HPCM and the MCM are flashable.

The Accessory Power Module (APM)

The APM converts high voltage DC to low voltage DC (14 volts) and intermediate voltage DC (42 volts). The system charges the standard vehicle battery and provides power for the 42 volt power steering system. The APM is also capable of converting 12 volts to 300 volts for emergency jump starting the vehicle. The intermediate voltage cables are shielded and colored "Blue".

The Hybrid Powertrain Control Module (HPCM)

The HPCM is the main controller for the hybrid transmission system. The HPCM determines which mode/motor will operate as well as features such as "Auto Stop/Start" and "Regenerative Braking". The HPCM operates in conjunction with the Battery Energy Control Module (BECM) and the Motor Control Module (MCM) to operate the 2 transmission electric motors. The HPCM interfaces with the IMS, Auxiliary Fluid Pump, High Voltage Interlock Circuit (HVIC) and Engine RPM inputs to monitor system operation.

2ML70 (RPO M99)

Components and Functions (continued)

The Motor Control Module (MCM)

The MCM controls each of the transmission electric motors/generators. Each MCM controls its respective IGBT driver circuit to control each motor separately. The MCM output is 3 phase 300 volt AC to operate the motors. The MCM is located within the PIM.

The Battery Energy Control Module (BECM)

The BECM is located in the battery pack compartment (Located under the 2nd row seats). The BECM controls the 40 cell drive motor/generator battery. It contains 2 high voltage contactor relays, a high voltage limiter relay, a battery fan relay and the battery vent fan. The BECM monitors and controls the relays and fan as well as monitors current, voltage and battery temperature.

The Auxiliary Fluid Pump Control Module (AFPCM)

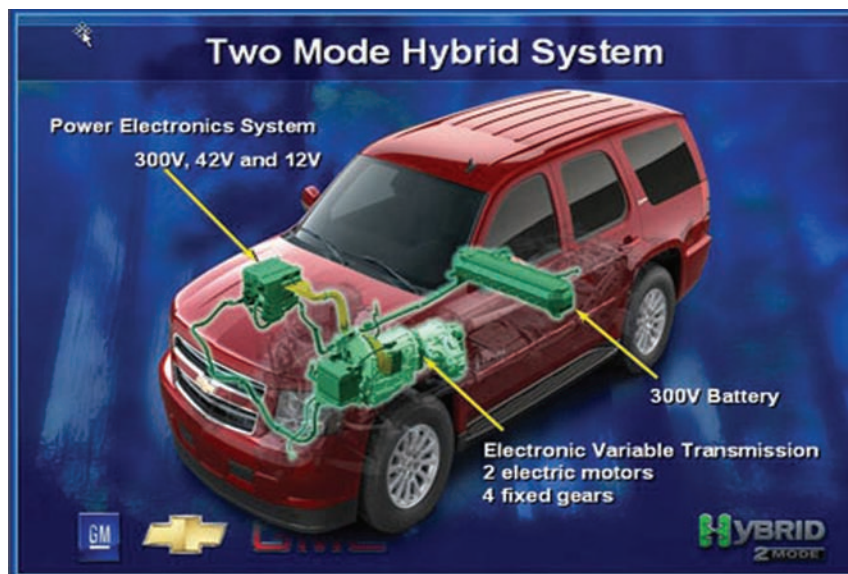
The AFPCM is mounted in the engine compartment. The AFPCM controls the auxiliary fluid pump based on commands from the Hybrid Powertrain Control Module (HPCM).

Hybrid Battery Pack

The battery pack is located under the 2nd row seat. The nickel-metal hydride battery pack consists of 40 7.2 volt cells. The combined static output of the battery is 288 volts DC. The battery pack provides current for the motors as well as other vehicle systems.

Air Conditioning Control Module (AACM)

The Air conditioning control module and compressor used to control the 300 volt AC compressor.



2ML70 (RPO M99)

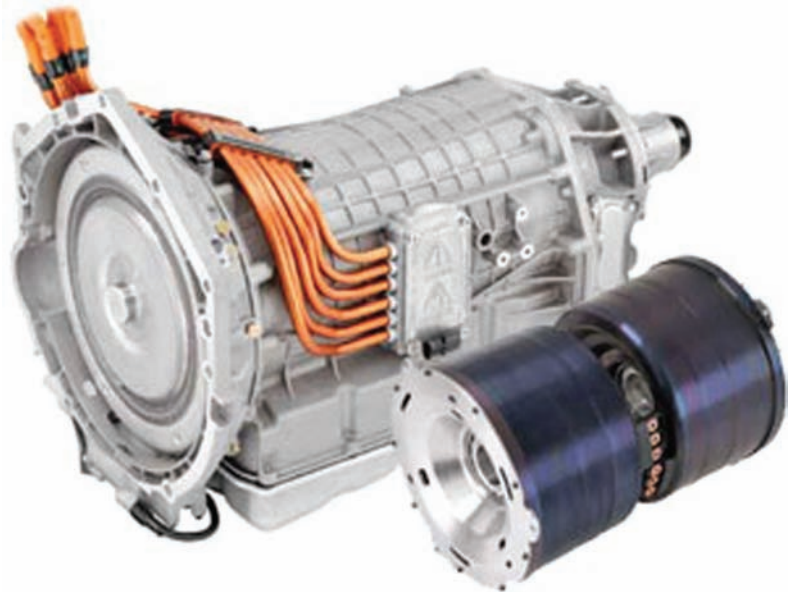
Components and Functions (continued)

Drive Motors

The 2ML70 contains two 300 volt 3 phase 60-65kW AC motor/generator assemblies. The two permanent magnet motors are mounted from each end of the transmission and supported by the shafts/bushings and a support assembly. Six high voltage (orange color) cables are attached to the transmission via rigid conduit around the transmission which then transitions to flexible cable to attach the transmission to the Drive Motor Generator Control Module (DMGCM). Transmission fluid is used for normal transmission operation as well as to cool the drive motors. The motors have a seal around each end of the assembly so transmission fluid can circulate around the motor.

The motors provide the following functions:

- Engine cranking
- Battery Charging
- Transmission Reverse operation
- 2 modes of electronic variable transmission (EVT) operation.



The front motor is used to start the engine and also reacts to torque input from the rear motor for EVT operation. The rear motor drives the vehicle when reverse is selected or when auto stop is activated and the vehicle is operating only on electrical power. Motor speed and torque are controlled by the Motor Control Module (MCM) via motor position sensors mounted in the motor assemblies.

The Motor Control Module (MCM) monitors the speed/direction and angular position via resolver position sensors. The resolver position sensor contains a drive coil, 2 driven coils, and an irregular shaped rotor assembly. The rotor is attached to the drive motor shaft. The Motor Control Module (MCM) sends a 5 volt AC 10 kHz bias signal to the resolver drive coil. The Motor Control Module (MCM) then monitors the output from the 2 driven coil assemblies. Since the rotor tooth offset varies, the Motor Control Module (MCM) can then determine the exact speed, angle and direction of each motor.

2ML70 (RPO M99)

Components and Functions (continued)

Auxiliary Fluid Pump

The gerotor auxiliary fluid pump is mounted to the front of the transmission assembly. The pump is a 12 Volt 3 phase AC motor which is directly controlled by an Auxiliary Fluid Pump Control Module via the Hybrid Powertrain Control Module (HPCM). The function of the pump is to provide pressurized fluid for lube, cooling and clutch operation when the vehicle is being operated in electric or auto stop modes.

2ML70 (RPO M99)

Components and Functions (continued)

Output Speed Sensor (OSS)

The output speed sensor is a hall effect type sensor. Internally the sensor consists of 2 hall effect circuits to make the sensor capable of sensing both speed and direction. The two sensor elements in the OSS assembly are spaced approximately 1/2 a tooth apart. When the vehicle moves forward sensor A detects the synch tooth before sensor B.

When the vehicle moves in reverse sensor B detects the synch tooth before sensor A. The sensor is connected to the TEHCM (control solenoid with body and TCM) via the wiring harness. The sensor receives a 8.3-9.3 bias voltage signal from the TEHCM.

As the output shaft rotates, the sensor output is a 8.8v square wave. The electronics in the sensor combine the two signals and output a signal with a different pulse width. This signal is interpreted by the TCM regarding speed and direction

2ML70 (RPO M99)

Components and Functions (continued)

Internal Mode Switch (IMS)

The IMS (Internal Mode Switch) operates similar to other IMS applications. The function of the IMS is to tell the TEHCM and the Hybrid Powertrain Control Module (HPCM) which range has been selected and to act as P/N safety switch.

The TEHCM sends an 8.3-9.3 bias voltage to the IMS on circuits A, B,C and P. The switch is mounted internally to the shift shaft linkage and as it rotates the contacts of the switch go to an “Open” or a “Closed” position. This creates either a HIGH or LOW signal on the circuit.

Unlike other applications the 2ML70 IMS has 5 additional outputs, R1, R2, D1, D2 and S. These inputs signal the Hybrid Powertrain Control Module (HPCM) regarding IMS direction. This information is used for P/N starting and for motor control.

IMS Circuits/Parameter	Selector Position				
	Park	Reverse	Neutral	Drive	Manual
<i>Direction Switch Operating Conditions:</i> Ignition ON, range selector in					
Direction IMS D1	HIGH	HIGH	LOW	LOW	LOW
Direction IMS D2	LOW	LOW	HIGH	HIGH	HIGH
Direction IMS R1	HIGH	LOW	LOW	HIGH	HIGH
Direction IMS R2	LOW	HIGH	HIGH	LOW	LOW
Direction IMS Start	LOW	HIGH	LOW	HIGH	HIGH
<i>Range Switch Operating Conditions</i> Ignition ON, range selector in appropriate gear					
IMS A	LOW	LOW	HI	HI	HI
IMS B	HI	LOW	LOW	LOW	HI
IMS C	HI	HI	HI	LOW	LOW
IMS P	LOW	HI	LOW	HI	LOW
Always HIGH status: Open/short to voltage condition					

2ML70 (RPO M99)

Solenoids and Fluid Pressure Switches

The TEHCM is built by Bosch and operates like the 6L80/90/50 applications. The TEHCM contains six variable bleed solenoids (only 5 are used), two On/Off solenoids, four Pressure switches, one TFT, one TCM temp sensor and a TCM all housed in one non serviceable assembly. The TEHCM is bolted to the valve body and can only be serviced by removing the bottom pan. The TEHCM controls the hydraulic shifts, shift points, and shift feel for the transmission. Like other applications the TEHCM is programmable.

Gear	Park	Reverse	Neutral	D					
	P	EVT R	N	EVT Low	1st	2nd	3rd	4th	EVT High
Shift Solenoid 1	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF
Shift Solenoid 2	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
Line PC Solenoid 1 N.H.	ON	ON/OFF*	ON	ON/OFF*	ON	ON	ON	ON	ON
PC Solenoid 2 Trim N.H.	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON
PC Solenoid 3 Trim N.H.	OFF	ON	OFF	ON	ON	ON	OFF	ON	OFF
PC Solenoid 4 Trim N.L.	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
PC Solenoid 5 N.L.	OFF	ON/OFF*	OFF	ON/OFF*	OFF	OFF	OFF	OFF	OFF
1-3 Clutch	--	--	--	--	A	--	A	--	--
4th Clutch	--	--	--	--	--	--	--	A	--
Hybrid Low 1-2 Clutch	--	A	--	A	A	A	--	--	--
Hybrid Direct 2-3-4 Clutch	--	--	--	--	--	A	A	A	A

ON = The solenoid valve is energized Hydraulically. OFF = The solenoid valve is de-energized Hydraulically.
NL= Normally Low, when the solenoid is turned OFF, the solenoid has NO output pressure. NH=
A = Applied

***When the engine is running, the line pressure control solenoid is ON (pressurized) and the pressure control solenoid 5 is OFF (no pressure). When the engine is OFF (auto stop), the line pressure control solenoid is OFF (no pressure) and the pressure control solenoid 5 is ON (pressurized).**

Gear	TFP SW 1	*TFP SW 3	TFP SW 4	TFP SW 5
M1 (48 km/h (30 mph))	Low	Low	Low	High
M2 (48 km/h (30 mph))	Low	Low	Low	High
M3 (48 km/h (30 mph))	Low	Low	Low	Low
M4 (48 km/h (30 mph))	High	High	High	High
Power OFF	Low	Low	Low	Low

High = 12V (Switch Open or Pressurized)
 Low = 0 volts (Switch Closed or No Pressure)
 Note: All TFP switches are normally closed (NC)
 *TFP switch 2 is not used

2ML70 (RPO M99)

Modes of Operation

Engine Starting

The 2 mode applications do not use a conventional starter. Instead the system relies on the transmission motor/generator to crank the engine. The 300 volt 3 phase AC motors can rotate the engine to cranking speeds that exceed 800 RPM in less than a few hundred milliseconds.

Auto Stop/Auto Start

After the engine is running the Hybrid Powertrain Control Module (HPCM) may operate the engine in the Auto Stop/Start mode. The Auto Stop feature is designed to reduce emissions output, engine wear and improve fuel economy in city type driving conditions. Engine OFF and Auto Stop modes of operation will be displayed on the tachometer. When the tachometer needle indicates OFF Auto stop will not function. If the Tachometer indicates AUTOSTOP, the engine may restart at anytime if the proper parameters are met.

Auto Stop may activate if the following conditions are present:

- Engine is running
- Hood is closed
- ECM is not requesting diagnostic information
- Gear selector is not in Reverse or Manual position
- Hybrid battery state of charge exceeds 20%
- Hybrid battery voltage, temperature and power limits are not exceeded
- Engine is warm
- Drive motor/generators have not overheated
- Power Inverter Module (PIM) temperature limits have not been exceeded
- No Hybrid system faults are present
- The Hybrid Powertrain Control Module (HPCM) has determined that engine power is not required

2ML70 (RPO M99)

Modes of Operation (continued)

The 2 mode system does not require the engine to be operational to propel the vehicle down the road. The Hybrid Powertrain Control Module (HPCM) may shut the engine off (AUTO STOP) when it determines engine power is not required. If the Hybrid Powertrain Control Module (HPCM) determines that additional power is needed, the Auto Start function will occur and drive motor #1 will be used to start the engine. It should be noted that this may occur even when the vehicle is in motion if it were operating in the electric mode.

Auto start may activate without notice if any of the following conditions occur:

- Hood is opened
- ECM requests the engine to run
- Gear selector is placed in R or M position
- Hybrid battery charge is low
- Hybrid battery voltage, temperature or power limits have been exceeded
- Engine coolant temp (ECT) is too low
- Drive motor/generator temperature limits have been exceeded
- Power Inverter Module (PIM) temperature limits have been exceeded
- The Hybrid Powertrain Control Module (HPCM) has determined that engine power is required
- A Hybrid system fault is present

2ML70 (RPO M99)

Modes of Operation (continued)

EVT Mode

Three Electronic drive modes are available, Reverse, Low and High.

High Mode #2: When High mode is selected the following occurs:

- PCS trim solenoid #3 is commanded OFF
- Shift solenoid #1 is commanded OFF
- #3 Pressure switch opens
- #1 Pressure switch opens
- #4 Pressure switch opens
- 2-3-4 clutch is applied
- Front motor#1 drives the vehicle
-

Low Mode #1 Engine OFF: When Low mode is selected the following occurs:

- PCS trim solenoid #5 is commanded ON
- Line pressure PCS is commanded OFF
- Auxiliary pump is turned ON
- 1-2 clutch is applied
- Rear motor #2 drives the vehicle
-

Low Mode #1 Engine ON: When Low mode is selected the following occurs:

- PCS #3 is commanded ON
- PCS #5 is commanded OFF
- 1-2 clutch is applied
- Front motor #1 starts the engine
- Rear motor #2 drives the vehicle if speeds are less than 25-32 mph
-

Reverse Mode: When Reverse is selected the following occurs:

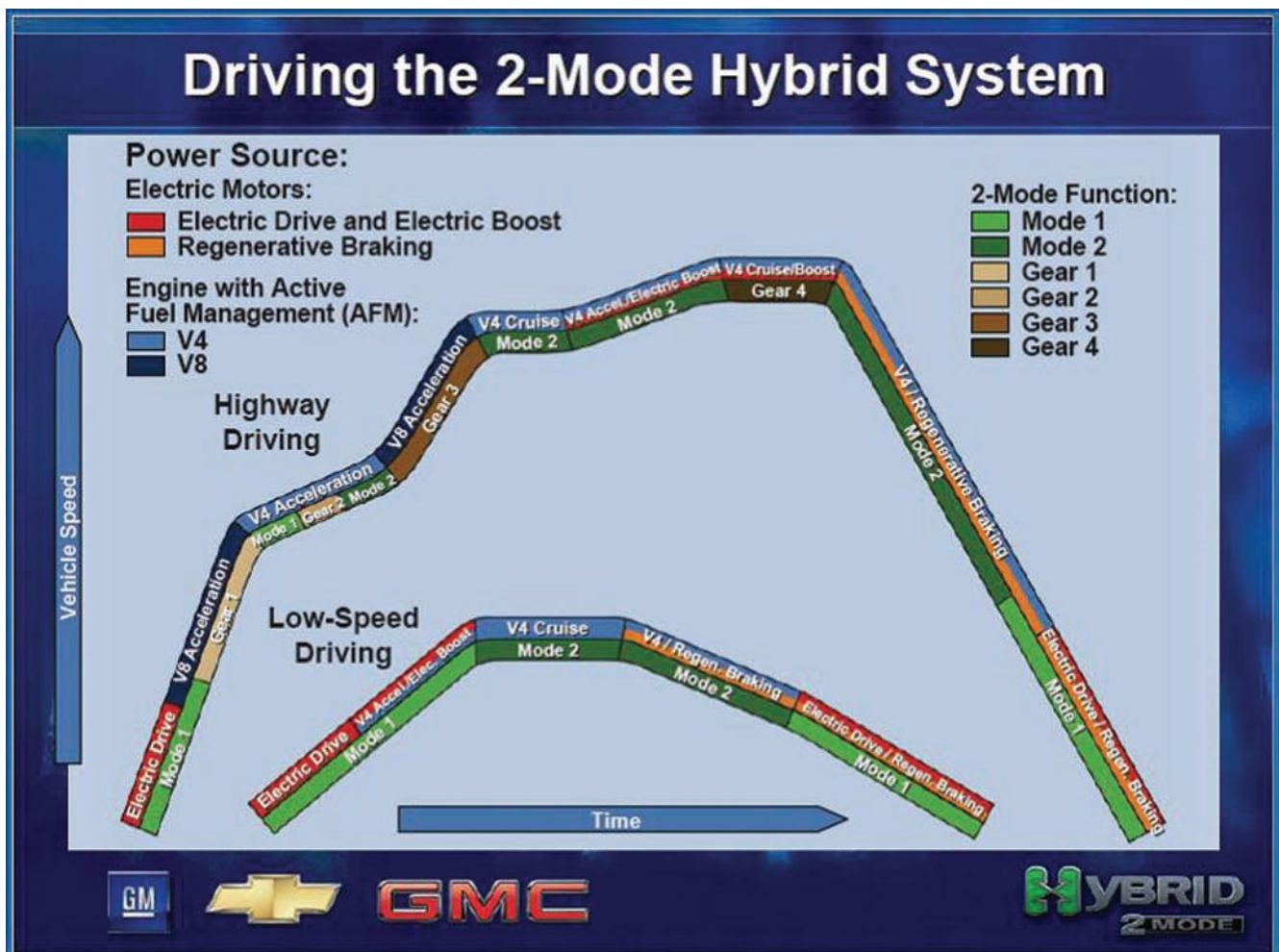
- PCS #3 is commanded ON
- 1-2 clutch is applied
- Rear motor #2 operates to drive the vehicle in reverse

2ML70 (RPO M99)

Regenerative Braking/Blended Braking

When the vehicle is decelerating or coasting the Hybrid Powertrain Control Module (HPCM) can switch the system into regeneration mode. In this mode the motors now act as generators to charge the Hybrid battery. As the motors switch to generator mode, force is exerted on the drive train which helps to slow the vehicle.

Blended braking is also available with the 2 mode system. When the brake is applied, drive motor #2 switches to generator mode leading the vehicle to slow. Communication between the Hybrid Powertrain Control Module (HPCM) and Electronic Brake Control Module (EBCM) allows the 2 mode system to transparently interface with the vehicles braking system. This feature extends brake life in city driving.



2ML70 (RPO M99)

Servicing Precautions

Service of a 2 mode vehicle, transmission and systems requires specialized training. The 2 mode system can cause injury or death if proper service procedures are not followed. Some basic service procedures include:

- Noting where the Hazard labels are located:
Hazard labels identify where potential shock hazards may occur. Areas include: Transmission, High voltage cables (Orange or Blue) Hybrid battery, DMGCM, PIM, APM, AC compressor

- Using personal protective equipment:
“Class 0” 1000 volt electrical protective gloves are required. Do not use gloves which the date code has expired. Always check the gloves for pin holes and general overall condition.

Always Wear Proper Eye Protection.

Your digital multimeter must meet or exceed category 3 or 1000 volt specifications. This also includes its leads.

- Never place both hands across vehicle components. Touching the wrong exposed terminals or leads may lead to death or injury. Use the “1 hand rule”, only use 1 hand for diagnosis and repair when possible. Keep the other hand behind your back
- Remove ALL jewelry, belt buckles, watches and other metal items before servicing these vehicles
- If High Voltage leads are disconnected insulate the ends using GM tools EL-48569 or UL listed isolation tape rated at 600 volts or more.
- ALL high voltage terminals require that they be torqued to specifications
- Never use AC powered test equipment to probe the high voltage system

2ML70 (RPO M99)

Servicing Precautions (continued)

Before servicing any of the high voltage systems including the transmission you must disable the system using the following procedure:

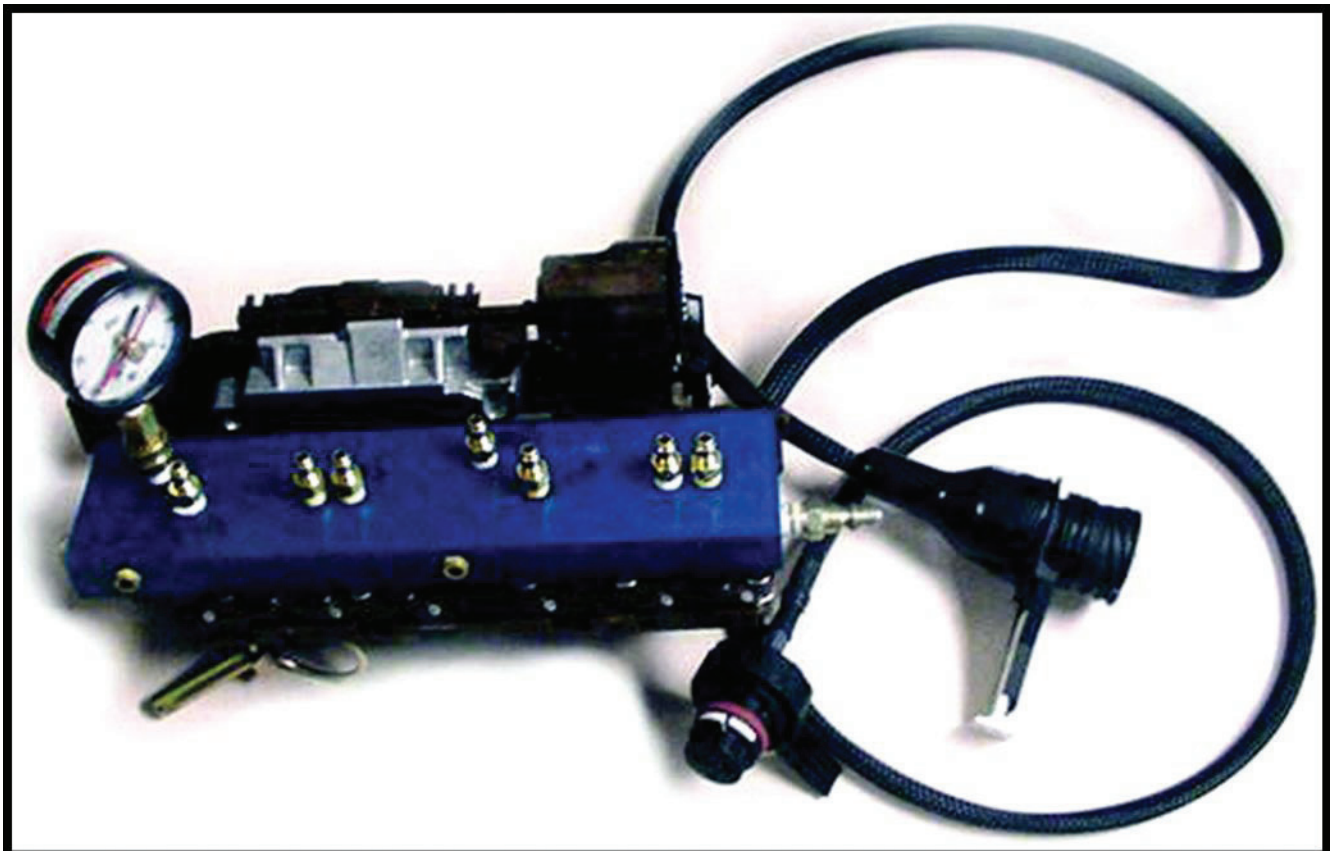
- Remove the ignition key
- Remove the cover from the passenger side of the Hybrid battery assembly.
- Remove the “high voltage manual disconnect lever”. Wait at least 5 minutes for the capacitors in the system to discharge.
- Disconnect the vehicles 12 volt battery.
- With a functioning approved digital multimeter, check the DC voltage across the high voltage DC positive (3) and negative (4) cables. The meter should read less than 3 volts. If excessive voltage is present, wait another 5 minutes and retest. If voltage is present refer to the service manual for further diagnostic procedures.
- Check for voltage between the high voltage manual disconnect terminal 1 and the high voltage DC positive cable (3)
- Check for voltage between the high voltage manual disconnect terminal 1 and the high voltage DC negative cable (4)
- Check for voltage between the high voltage manual disconnect terminal 2 and the high voltage DC positive cable (3)
- Check for voltage between the high voltage manual disconnect terminal 2 and the high voltage DC negative cable (4)
- All readings should be less than 3 volts. If voltage is present refer to the service manual for further diagnostic procedures.
- While the system may be disabled using and alternate procedure, that procedure is only valid if you are working on the transmission, cables, DMGCM, PIM or APM. The alternate method takes about the same amount of time to perform but it does not disable the complete system. Therefore ATRA is recommending you follow the above procedure to insure you and your workers stay safe.

2ML70 (RPO M99)

Solenoid Cleaning Process

An automated process is available that aids in cleaning debris from the solenoid assembly. Your scan tool will instruct the TCM (TEHCM) to cycle the solenoids while the system is pressurized to clean the solenoids. The transmission does not need to be disassembled to perform the cleaning process.

Simply follow the instructions on the scan tool to activate the cleaning program. This process should be completed prior to attempting to diagnose the transmission with DT-47825 tools as described below. If the cleaning process is unsuccessful then you should diagnose the concern with DT-47825



2ML70 (RPO M99)

Diagnostics

Like other GM transmissions, diagnosis is designed around the use of a quality scan tool. With the 2ML70 this could not be more true as the need to access scan data is critical.

Unlike other GM transmissions you have become accustomed to working with over the years, the 2ML70 internal electrical components are not hard wired to the rest of the vehicle via the transmission harness. This means that the diagnostic process has changed considerably. Diagnosis is divided into 2 categories, scan diagnostics and test plate/air check diagnostics.

Solenoid and valve body diagnosis requires the following tools:

- A quality scan tool capable of communicating and commanding the TCM and it's solenoids.
- Tool number DT 47825 Solenoid test plate and jumper harness.

Remove the Control Solenoid Valve Assembly from the transmission. Install tool DT 47825 onto the Control Solenoid Valve Assembly (5Nm 44 Lb In). Apply regulated shop air (90-100 psi) to the tool. Connect the scan tool to the Control Solenoid Valve Assembly.

Command the solenoid ON/OFF air pressure should be present on the gauge and then it should exhaust as the solenoid is cycled. If the solenoid or valve are malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly.

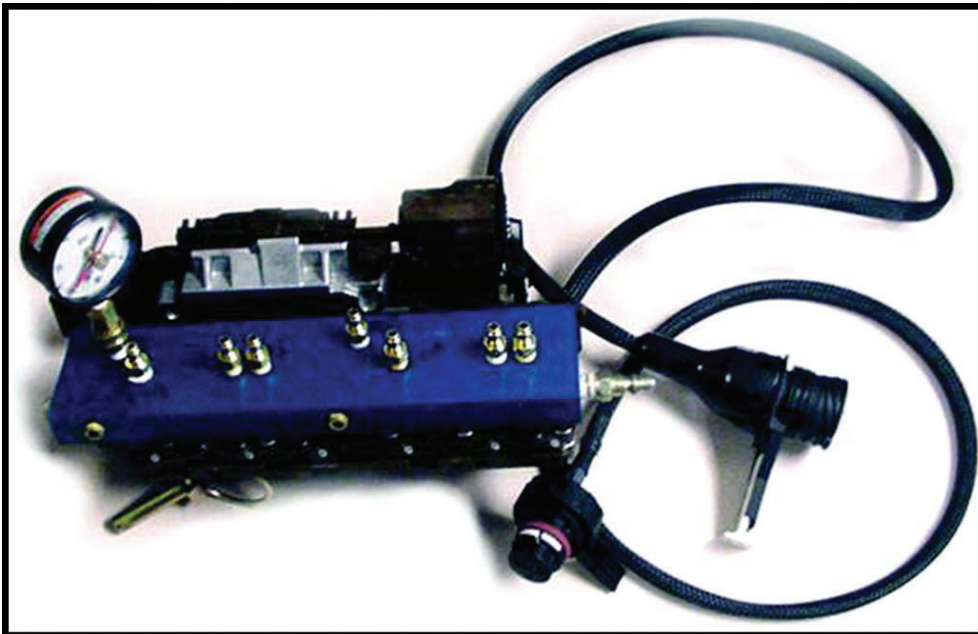
If the solenoid checked OK, install the gauge on another solenoid port and command that solenoid ON/OFF with the scan to repeat the process.

2ML70 (RPO M99)

Testing the Solenoids

If the solenoid or valve is malfunctioning the gauge pressure will not change as you cycle the solenoid. If a malfunction is determined to be present, replace the complete Control Solenoid Valve Assembly

The TCM (TEHCM) will normally cycle several of the solenoids ON/OFF to help keep the solenoids and the valves free of debris. Therefore this cleaning function (Dither) may cause the gauge to flicker when the TCM is cleaning the solenoid you are testing.



Component	Port On Test Block	Ignition ON, Engine OFF Normal State	Commanded State	
Line PC Solenoid	A	No PSI flow to gage	Increase/Decrease Approximately	
PC Solenoid 2	G	No PSI flow to gage	On - Full PSI flow to gage	Off - No PSI flow to gage
PC Solenoid 3	C	No PSI flow to gage	On - Full PSI flow to gage	Off - No PSI flow to gage
PC Solenoid 4	E	No PSI flow to gage	On - Full PSI flow to gage	Off - No PSI flow to gage
PC Solenoid 5	F	No PSI flow to gage	On - Full PSI flow to gage	Off - No PSI flow to gage
PC Solenoid 6 - Not Used	C	No PSI flow to gage	On - Full PSI flow to gage	Off - No PSI flow to gage
Shift Solenoid 1	H	No PSI flow to gage	On - Full PSI flow to gage	Off - No PSI flow to gage
Shift Solenoid 2	D	No PSI flow to gage	On - Full PSI flow to gage	Off - No PSI flow to gage

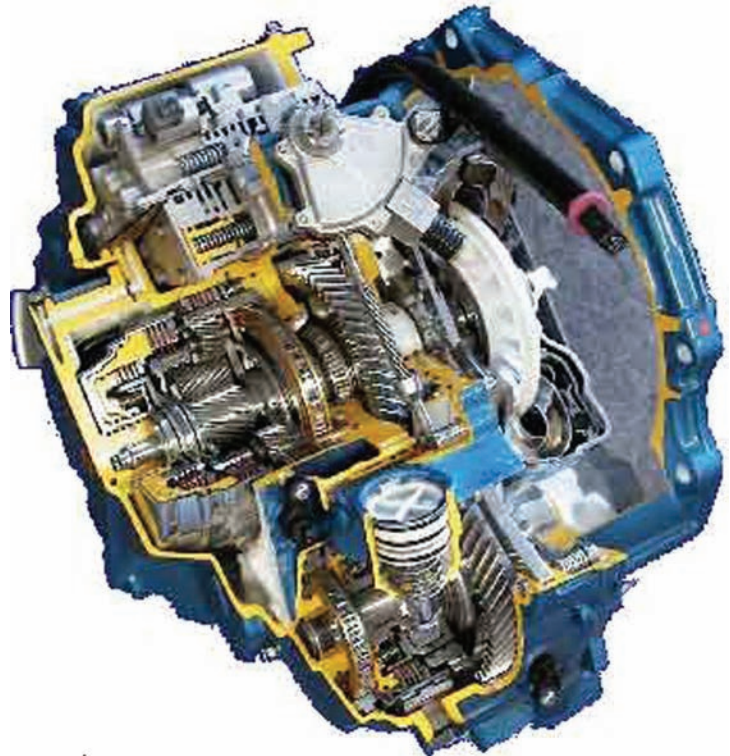
AF 17 (RPO MNF)

Introduction

The AF 17 is built by Asian Warner and is used in the Saturn Astra for the 2008 model year. RPO MNF the AF 17 is a 4 speed front wheel drive transaxle.

The AF 17 utilizes the following ratios and features:

1st	2.81-1
2nd	1.48-1
3rd	1-1
4th	.74-1
Rev	2.77-1
Final Drive	4.12-1



- Manufactured in Tahara Japan
- Approximate weight 65 kg (143 lbs)
- Torque converter Clutch
- 2 shift solenoids (S1, S2) ON/OFF type
- PCS solenoid (SLT) VBS type
- Lockup solenoid (SLU) PWM type
- Neutral switching solenoid (SN) ON/OFF type
- TFT sensor (OT) (Mounted on the VB, Part of the internal harness)
- An input speed sensor (ISS) (Lower sensor on case)
- An output speed sensor (OSS) (Top sensor on case)
- A Park/Neutral Switch (Mounted to the top of the case, external)
- TCM to control the transmission
- 2 one way clutches (F0, F1) (F0=Overrun oneway, F1=coast one way)
- 2 Brakes (B1, B2) (B1=2-4 band, B2= Low Reverse Clutch)
- 4 Clutches (C0, C1, C2, C3) (C0=OD clutch, C1= Forward Clutch, C2= Reverse Clutch, C3= Coast Clutch)

AF 17 (RPO MNF)

Features

The AF 17 is similar to other transaxles you have worked with in the past. These features include:

Winter Mode

When activated by a switch the transmission starts in 3rd gear

Economy Mode

When activated by the switch, the TCM will select a shift speed table that is designed to provide the best fuel economy for the driving conditions.

Power Mode

When activated by the switch, the TCM will select a shift speed table designed to improve the vehicles acceleration and performance.

Cold Weather Line Pressure Bias

When TFT is below 10°C (50°F) and VSS is less than 5km/h (3mph) the TCM will change the pressure control solenoid command increasing line pressure during cold operation. This feature ensures correct shift time and shift feel during cold operation.

Reverse lock out

Engine torque management for all shifts

Adaptive learning

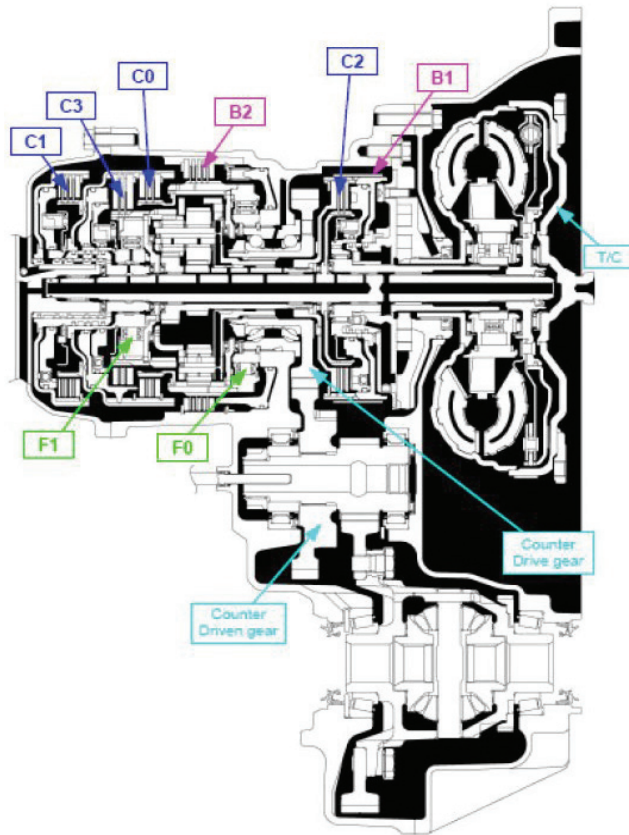
New features include:

Neutral Control

When the vehicle is stopped in “D” range with the brakes applied, the AF 17 will go to neutral by releasing the forward clutch (C1) via the neutral solenoid and the Line pressure solenoid. With the decreased load on the engine, in town fuel economy is improved. After releasing the brake the forward clutch (C1) will engage, the transmission will again be in 1st gear.

AF 17 (RPO MNF)

Cross Sectional View



Clutch & Brake		Operation
C0	Over drive clutch	Connects input shaft and front planetary ring gear when C1 operates
C1	Forward clutch	- Connects input shaft and rear planetary ring gear when F0 or / and C3 operates - Connects input shaft and front planetary ring gear when C0 operates
C2	Reverse clutch	Connects input shaft and planetary sun gear
C3	Coast clutch	Connects input shaft and rear planetary ring gear when C1 operates
B1	2nd & 4th brake	Locks rotation of planetary sun gear
B2	1st & reverse brake	Locks rotation of front planetary ring gear
F0	1 way clutch No.0	When C1 operates and the transmission is being drive by the engine, this clutch connects input shaft and rear planetary ring gear
F1	1 way clutch No.1	Locks counterclockwise rotation of front planetary ring gear

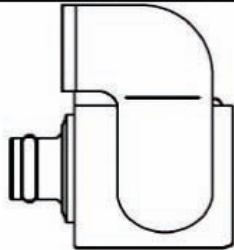
AF 17 (RPO MNF)

Solenoid Identification

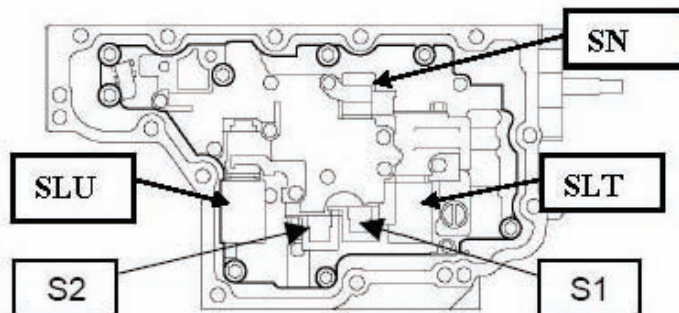
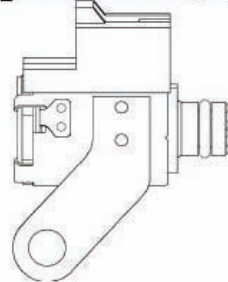
Hill Hold

If the vehicle comes to a stop on an incline the hill hold feature is activated. The TCM determines that the vehicle is stopping on an incline by monitoring how fast VSS decreases prior to the brake pedal being applied. To provide the hill hold function the TCM energizes the S2 (1-2,3-4) solenoid applying the B1 (2-4 band).

S1, S2: Normal Close



SN: Normal Open



Gear	S1	S2
1st	Off	On
2nd	On	On
3rd	On	Off
4th	Off	Off

AF33-5

Identification

The AF33-5 is a fully-automatic, five-speed, electronically-controlled transaxle. It's used in the Chevrolet Equinox, but mainly appears in the Saturn Ion sedan and the Vue.

The AF33-5 uses a line pressure control system which can adapt system line pressure to compensate for normal wear of clutch plates, seals, springs, etc. In effect, it learns the condition of the transmission, and adapts to that condition to provide the best possible operation.

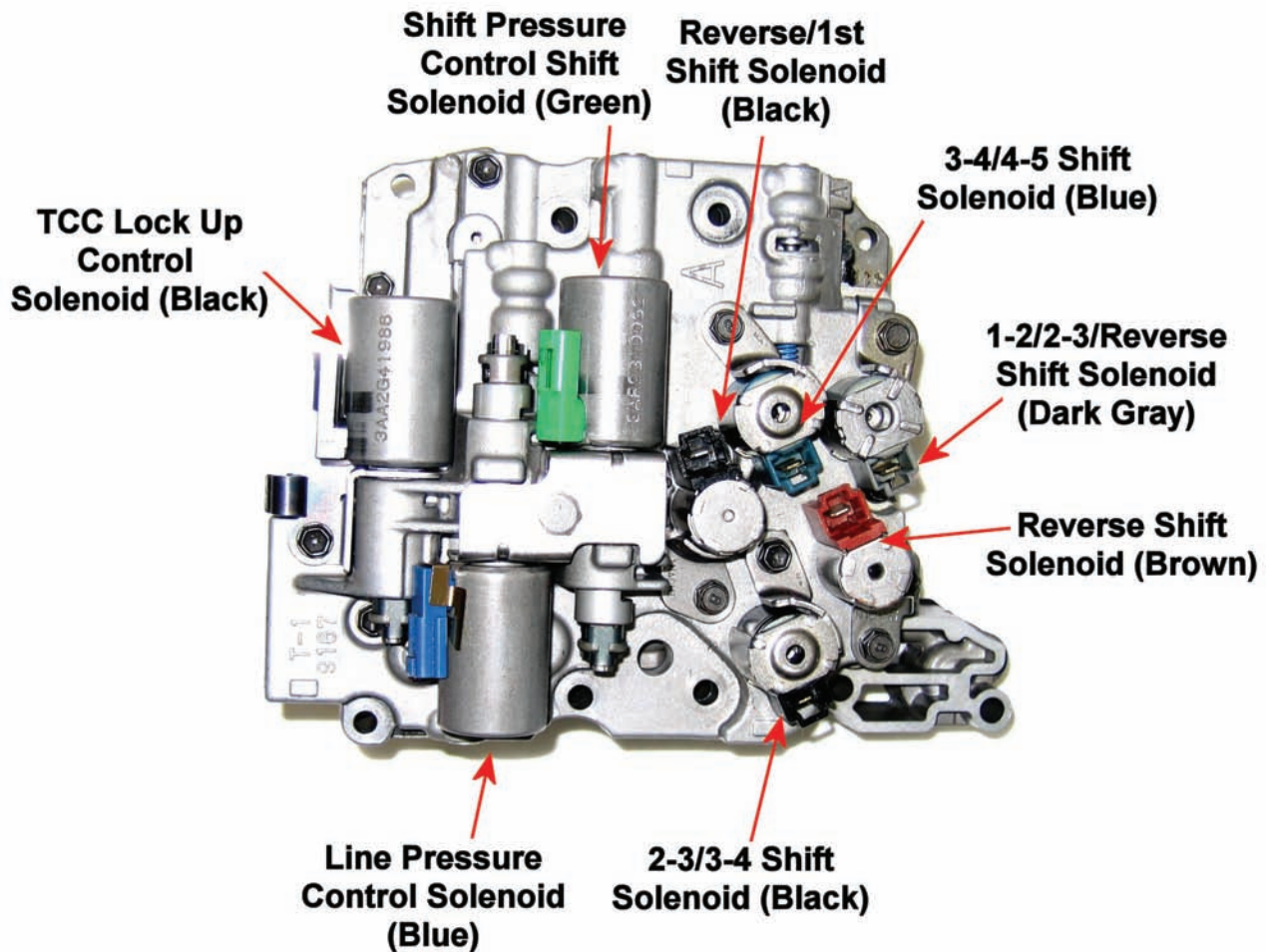


AF33-5

Solenoid Identification

The electronic shift system consists of the following components:

- TCM
- Shift Solenoids (SS1 and SS2)
- Pressure Control Solenoids (PSC)
- Lockup Solenoid (TCC)
- Input Speed Sensor (ISS)
- Output Speed Sensor (OSS)
- Transmission Fluid Temperature Sensor (TFT)
- Park/Neutral Position Switch (PNP)



AF33-5

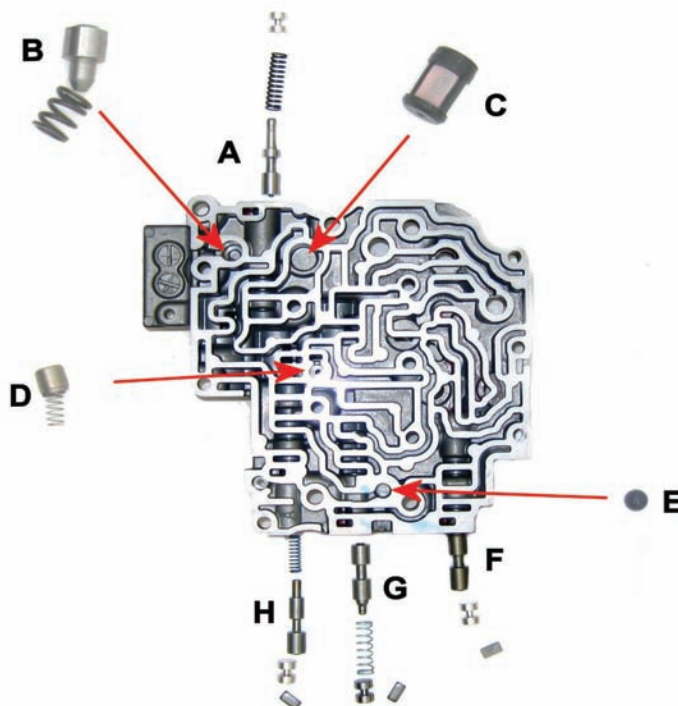
Valve Body Disassembly

The front control valve body houses all of the solenoids:

1. 1-2/2-3/Reverse Shift Solenoid (S3)(Dark Gray)
2. 3-4/4-5 Shift Solenoid (S4) (Blue)
3. Reverse Shift Solenoid (S5) (Brown)
4. 2-3/3-4 Shift Solenoid (S2) (Black)
5. Reverse/1st Shift Solenoid (S1) (Black)
6. Line Pressure Control Solenoid (SLT) (Blue)
7. TCC Solenoid (SLU) (Black)
8. Shift Pressure Control (SLS) (Green)

...and these valves and devices:

- A. Solenoid Modulator Valve
- B. Pressure Relief Valve
- C. Fluid Strainer
- D. Check Valves
- E. Checkball
- F. Forward Clutch Control Valve
- G. Neutral Relay Valve
- H. 2nd Coast Clutch Valve



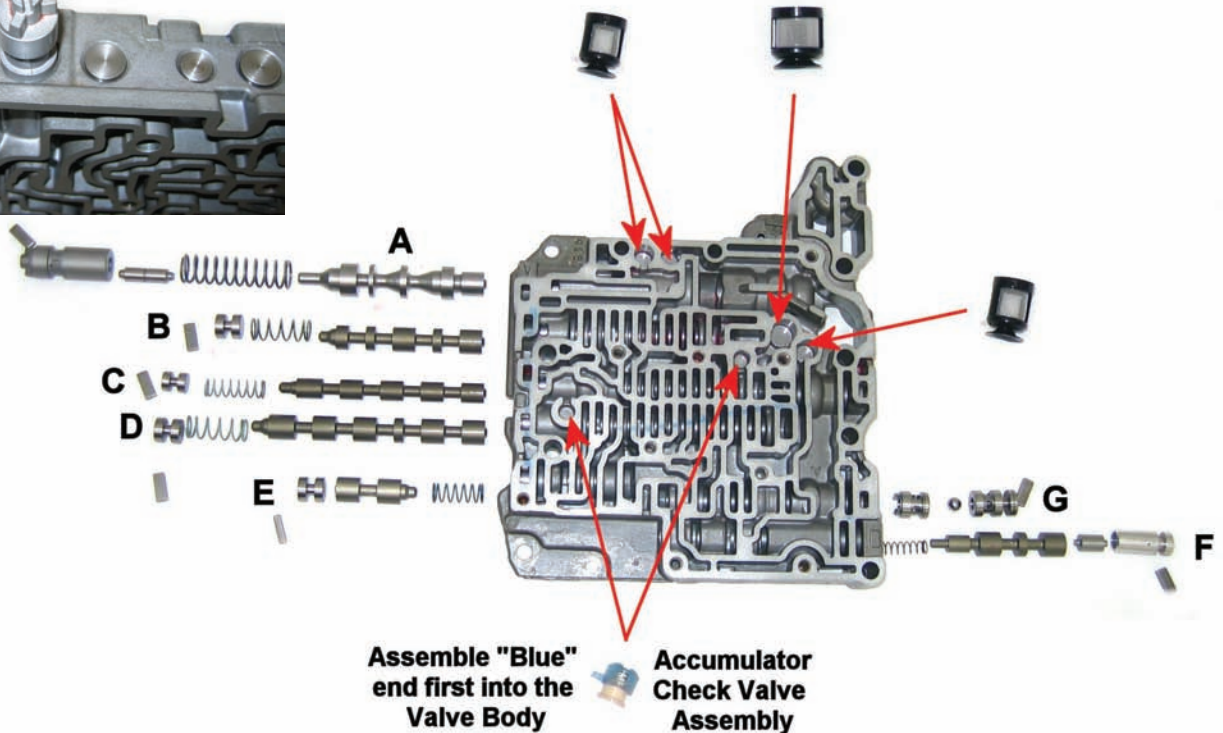
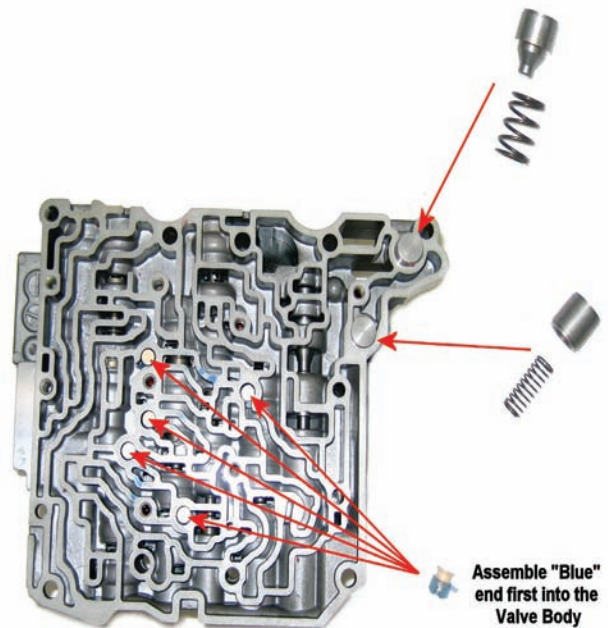
AF33-5

Valve Body Disassembly (continued)

The middle control valve body houses these valves:

- A. Primary Regulator Valve Assembly
- B. U2 Shift Valve
- C. M1 Shift Valve
- D. U1 Shift Valve
- E. 3rd Gear Band Release Valve
- F. Solenoid Relay Valve
- G. Reverse Shift Ball Check Valve

Adjustable Pressure Regulator
Step Cap (three setting are available)

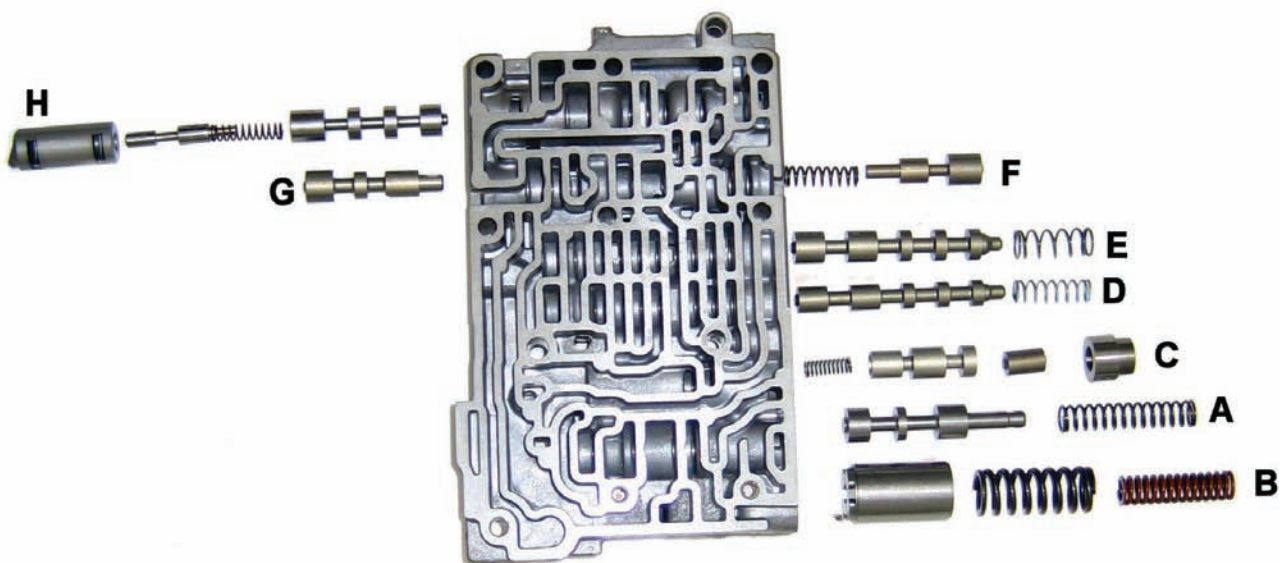


AF33-5

Valve Body Disassembly (continued)

The rear control valve body houses these valves and accumulators:

- A. Secondary Regulator Valve
- B. Line Pressure Control Accumulator Piston
- C. Shift Pressure Control Valve
- D. M2 Shift Valve
- E. Shift Pressure Relay Valve
- F. 3rd Gear Band Control Valve
- G. 1-2/Reverse Control Valve
- H. Lockup Relay Control Valve

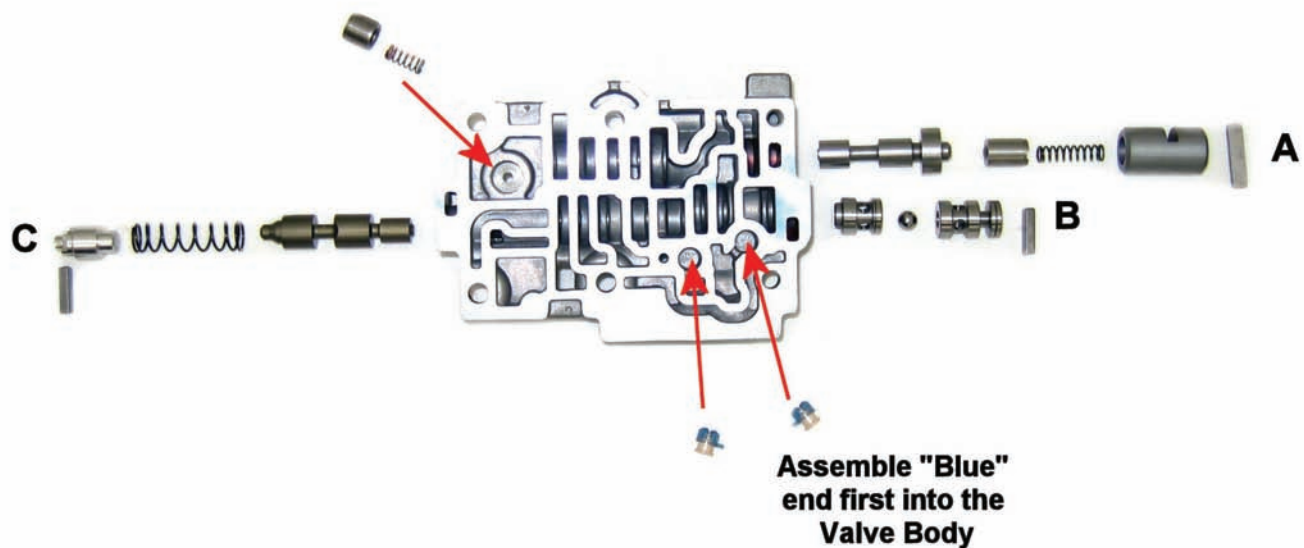


AF33-5

Valve Body Disassembly (continued)

The number 2 rear control valve body houses these valves:

- A. Lockup Control Valve
- B. Reverse Shift Restrictor Ball Check Valve
- C. Lockup Control Valve





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KIT COMPONENTS	 PREMIUM BRAND	 VALUE LINE
Photo Enhanced Sub-Kit Packaging	Yes	Yes
Metal Clad Seals	Premium Brands	Non-Premium Brands
Pan Gasket	Premium Cork and Rubber, Fiber, Molded Rubber	Non-premium Cork and Rubber, Fiber, Molded Rubber
Paper Gasket	Various U.S. Manufacturers	Various U.S. Manufacturers
Metal Sealing Rings	Premium Brands, including GoldStripe®	Non-premium Brands
Rubber Components	Parker	Parker
Aftermarket Fixes	Yes	No
Friction Plates	Raybestos®	Allomatic®

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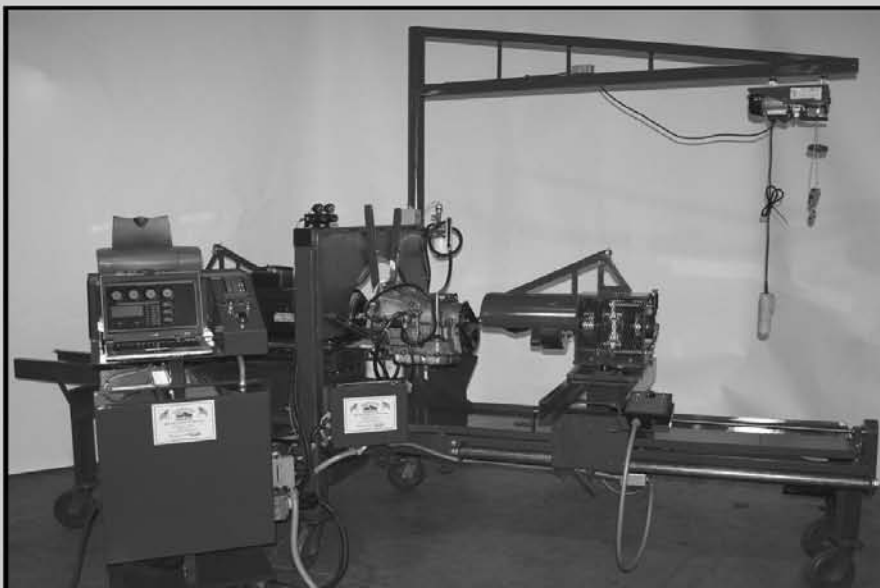
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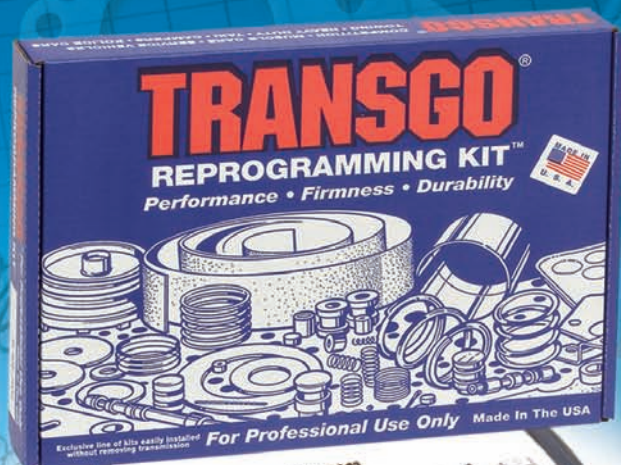
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Ford

6R60

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6R60

Application

This transmission will be taking place of the 5R55S model transmission. On 2006 and up Explorer/Mountaineer, 2007 Explorer Sport Trac with the 4.6L. The Expedition/Navigator with the 5.4L will use the 6R75.

The 6R75 is the same transmission as the 6R60 but with heavier torque capacity, this transmission will go into other applications as the current 4R75E's are phased out. The bottom line.

The transmission has Six Forward speeds, clutch to clutch (synchronous) shifting (no bands). It incorporates an internal TCM (Mechatronic Assembly). It also uses the Lapelletier Geartrain to achieve the different ratios, but never achieves a 1:1 ratio in third gear due to the planetary gearing on the pump.



6R60

Clutch Apply Chart

GEAR	SHIFTER POSITION	FORWARD CLUTCH (A)	DIRECT CLUTCH (B)	INTERMEDIATE CLUTCH (C)	LOW/REVERSE CLUTCH (D)	OVERDRIVE CLUTCH (E)
PARK	P				X	
REVERSE	R		X		X	
NEUTRAL	N				X	
1ST GEAR	D, 3, 2, 1	X			X	
2ND GEAR	D, 3, 2	X		X		
3RD GEAR	D, 3	X	X			
4TH GEAR	D	X				X
5TH GEAR	D		X			X
6TH GEAR	D			X		X

PLANETARY GEARSET COMPONENT:

- SUN GEAR #3

- SUN GEAR #2

- REAR CARRIER

6R60

Fluid Checking Procedure

With the engine at an idle and the transmission in PARK, warm the engine to between 175°F and 190°F. Fill the transmission until it is between the hatch marks.



Remove the Stick from the cap before using.



**Fill the transmission
until it is between the
hatch marks.**

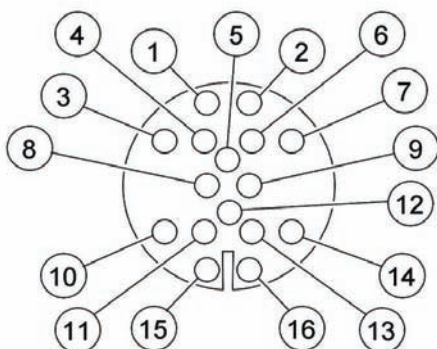
6R60

Diagnosis / Adaptive Strategies

Diagnosis is done completely through the CAN communication network. Which ever scan tool you use, it must have a CAN network interface. You must also perform the adaptive strategy after a repair.

Adaptive Strategies

1. Accelerate from rest with light throttle. The 1-2, 2-3 and 3-4 shifts must occur at engine speeds between 1300-1800 rpm
2. Continue to accelerate gently to 50 mph so that the transmission shifts into 6th gear.
3. Brake gently to a complete stop and hold foot on brake for at least 15 seconds.
4. Repeat steps 1-4 a total of five times



Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	CAN low
3	—	NOT USED
4	—	NOT USED
5	—	NOT USED
6	—	CAN high
7	—	NOT USED
8	—	NOT USED
9	—	Term 15 (Ignition)
10	—	Park/Neutral signal (to PCM TRSW-PN T-19)
11	—	NOT USED
12	—	NOT USED
13	—	Term 31 (Ground)
14	—	Term 30 (Battery voltage)
15	—	NOT USED
16	—	Terminal 31 (Ground)

6R60

Various Transmission Shift Quality Symptoms

2006-7 Explorer/ Mountaineer, 2007 Explorer Sport Trac

The TCM may need reprogramming if the transmission has any of the following complaints:

- Delayed engagement between P-D, N-D and R-D
- Delayed hesitation on 1-2 shift, 2-1 and/or 3-2 decel step in shifts
- Hoot noise during cold 1st gear launches from transmission pump
- Cold 2-1 flare under heavy braking
- Really cold temperatures harsh 1-2 and 2-3 shift -22-32°F.

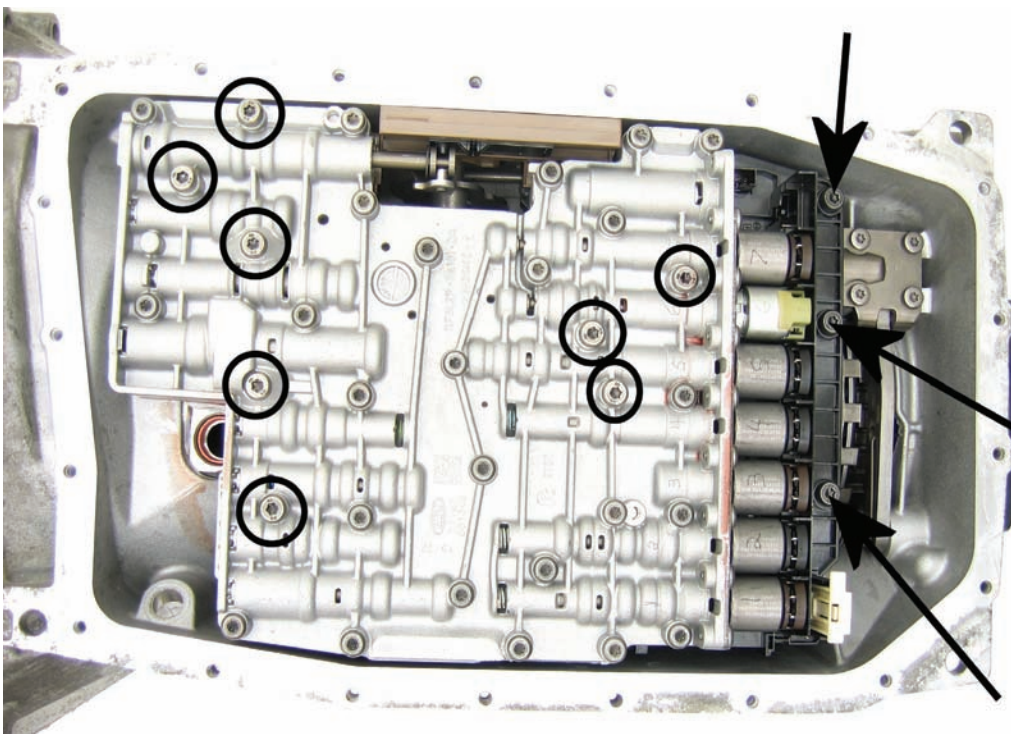
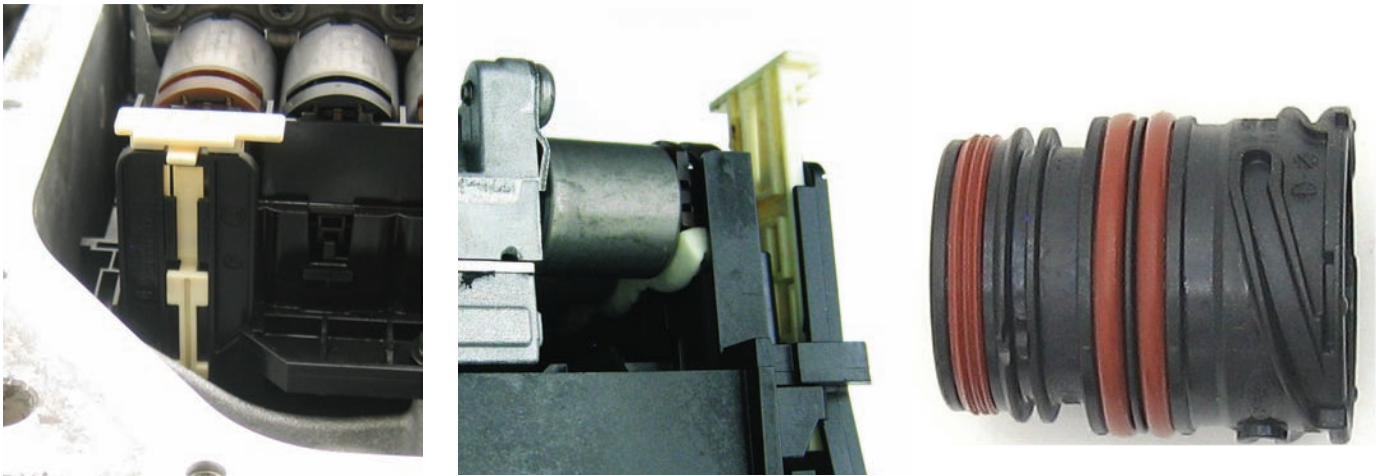
To repair the vehicle:

- Reprogram the PCM/TCM with the latest calibration.
- Reset the TCM KAM
- Perform adaptive shift strategy learn.
- Best Part: If no improvements are made, replace the Mechatronic unit (valve body/TCM and trans filter)

6R60

Case Connector and Valve Body Removal

To remove the case connector, press in on the release the tab. Lift the tab up to release the connector. Slide the connector out of the case. Remove only the (11) eleven bolts circled below. Do not remove all of the bolts, this will split the valve body halves.

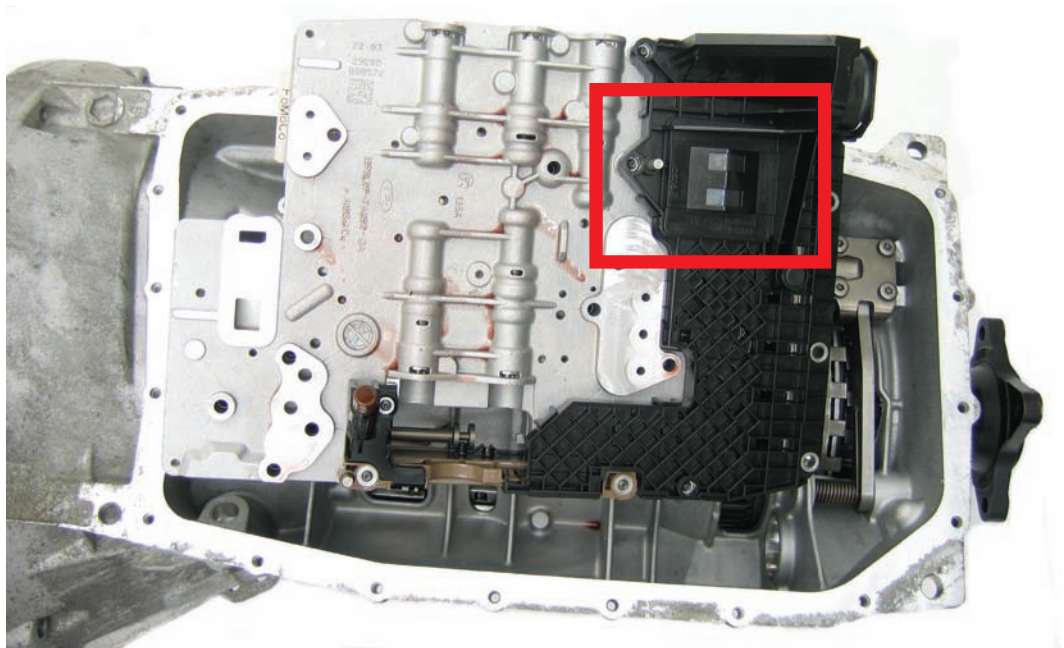
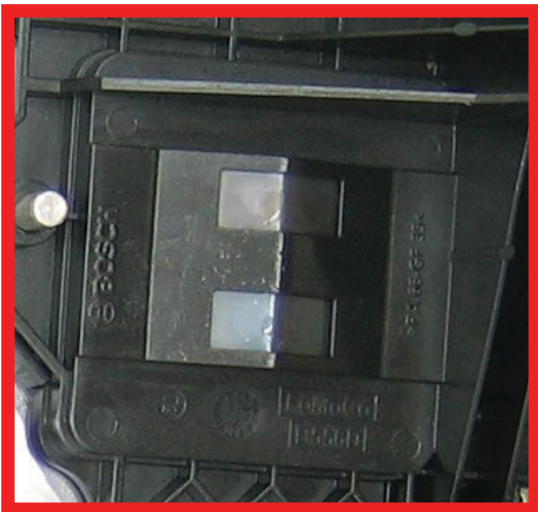


6R60

Heat Sink Element

The Heat sink is a piece of metal that is “V” bent, it acts like a return spring. Because of this, the valve body will not sit flush on the case.

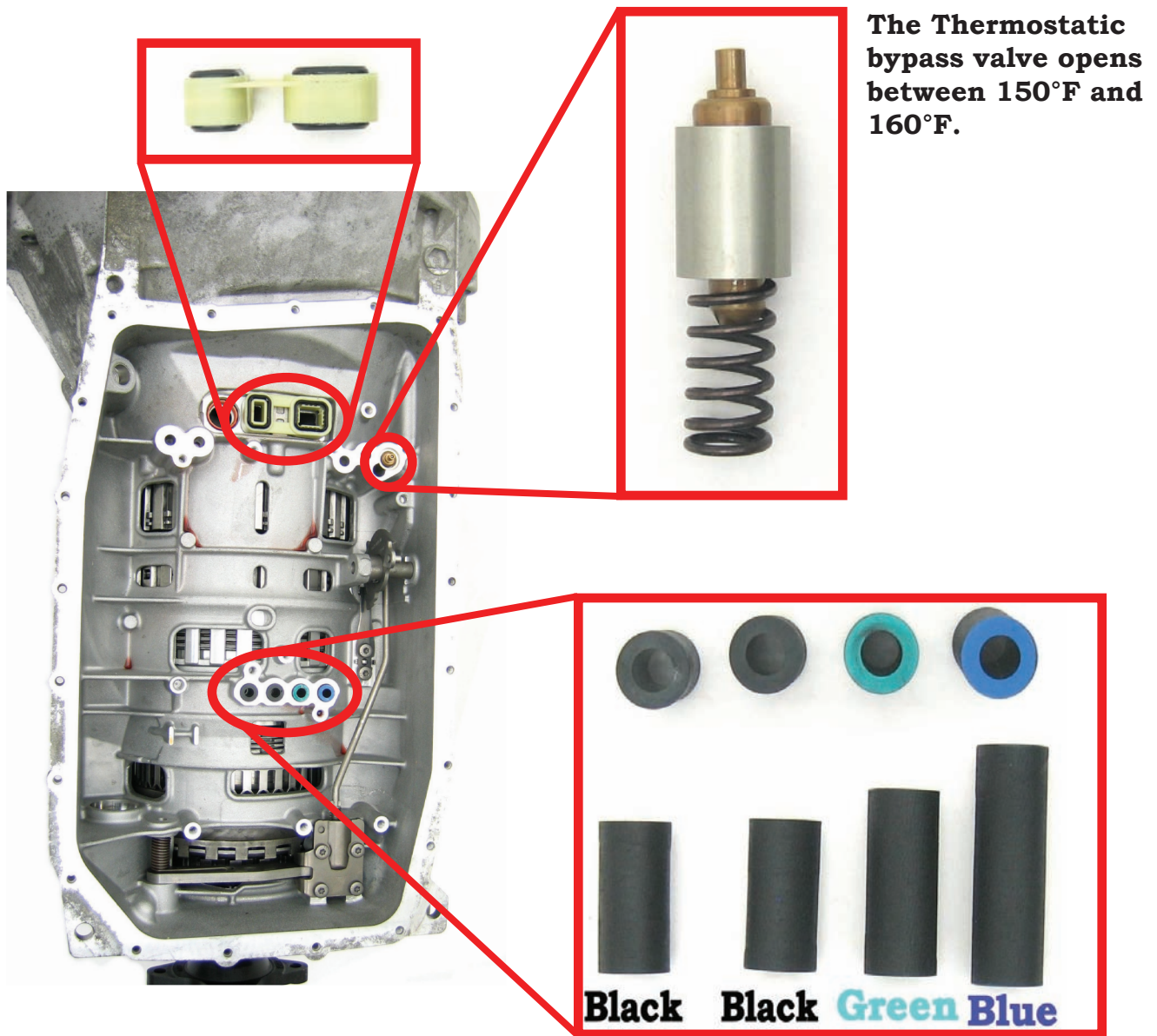
NOTE: Do not touch the electrical connector, pins, or exposed solenoid pins on the TCM. Electrostatic discharge may occur and may cause damage to the TCM.



6R60

Case Components

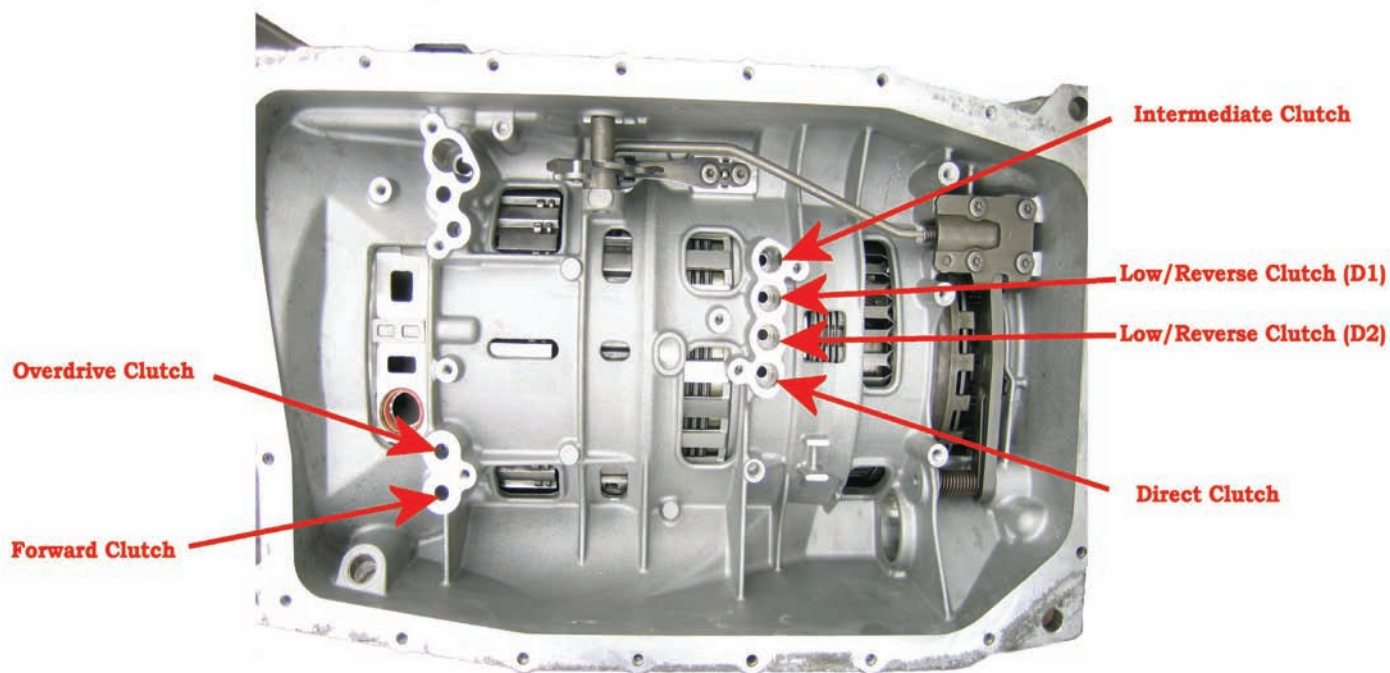
Install the case seals and components, into the casing. Make sure the clutch seals fit snug into the casing.



6R60

Air Checking the Transmission

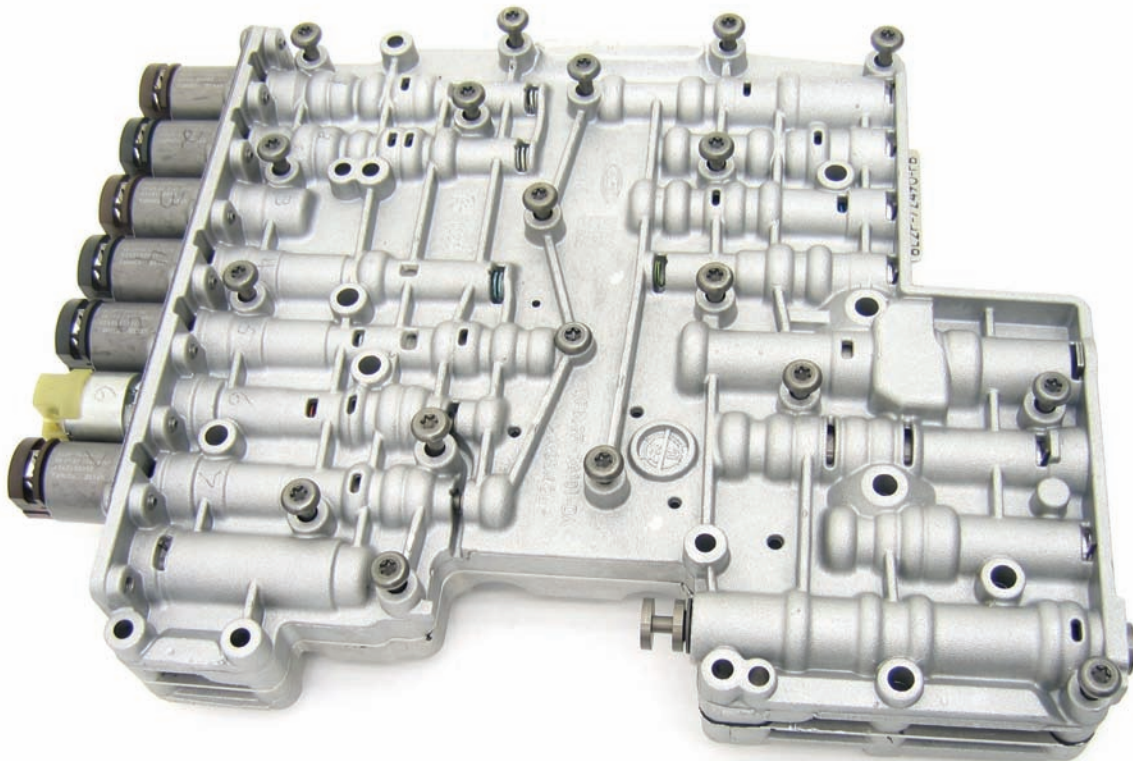
During the overhaul, after the clutches are installed into the transmission, air check the clutches for proper apply. Use approximately 10 psi of regulated shop pressure. Repeat the steps using the case seals also.



6R60

Valve Body Assembly

Split the valve body with the solenoid side (lower valve body) of the valve body facing up so we don't lose the small parts that are located in the upper valve body.

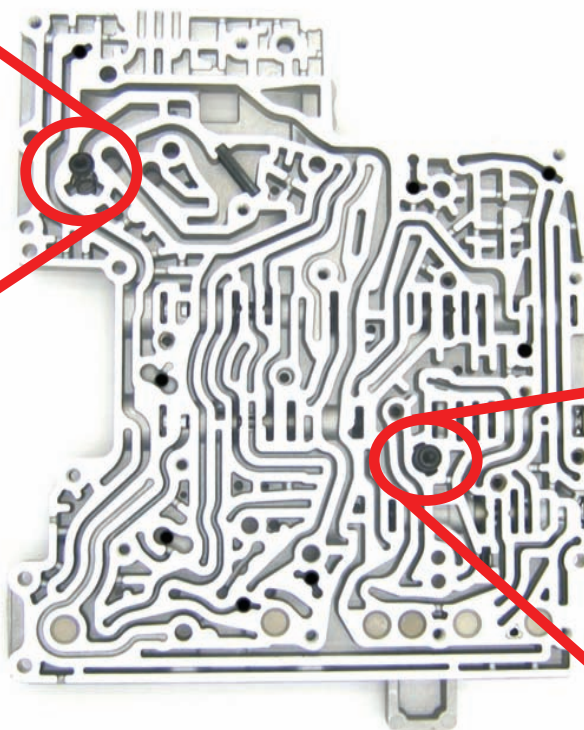


6R60

Valve Body Check Valves

Both of these valves are critical to the transmission. The drainback valve is used for converter oil control. The clutch exhaust valve is used to keep the clutches primed.

Drainback Valve

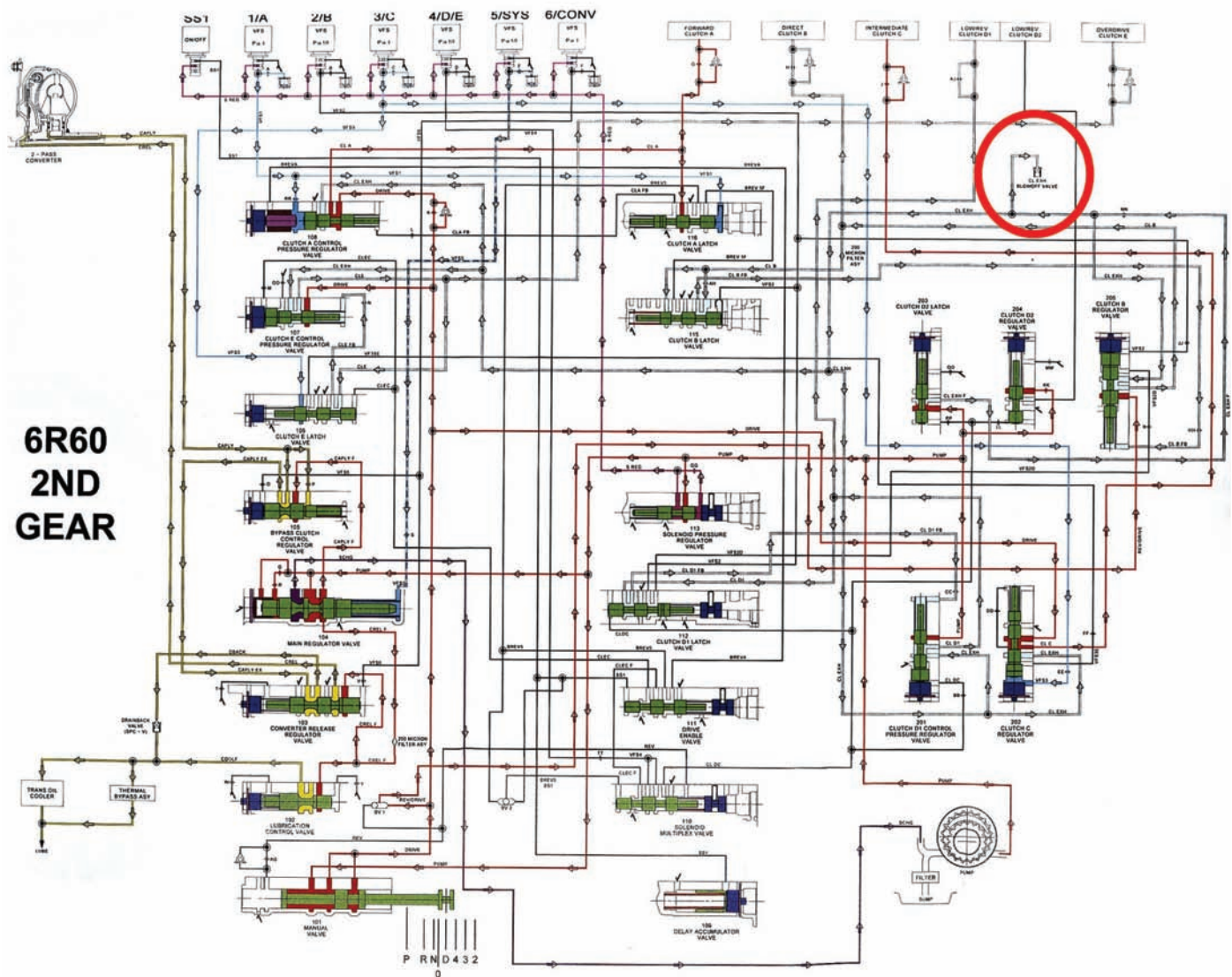


Clutch Exhaust Valve



Clutch Exhaust Valve

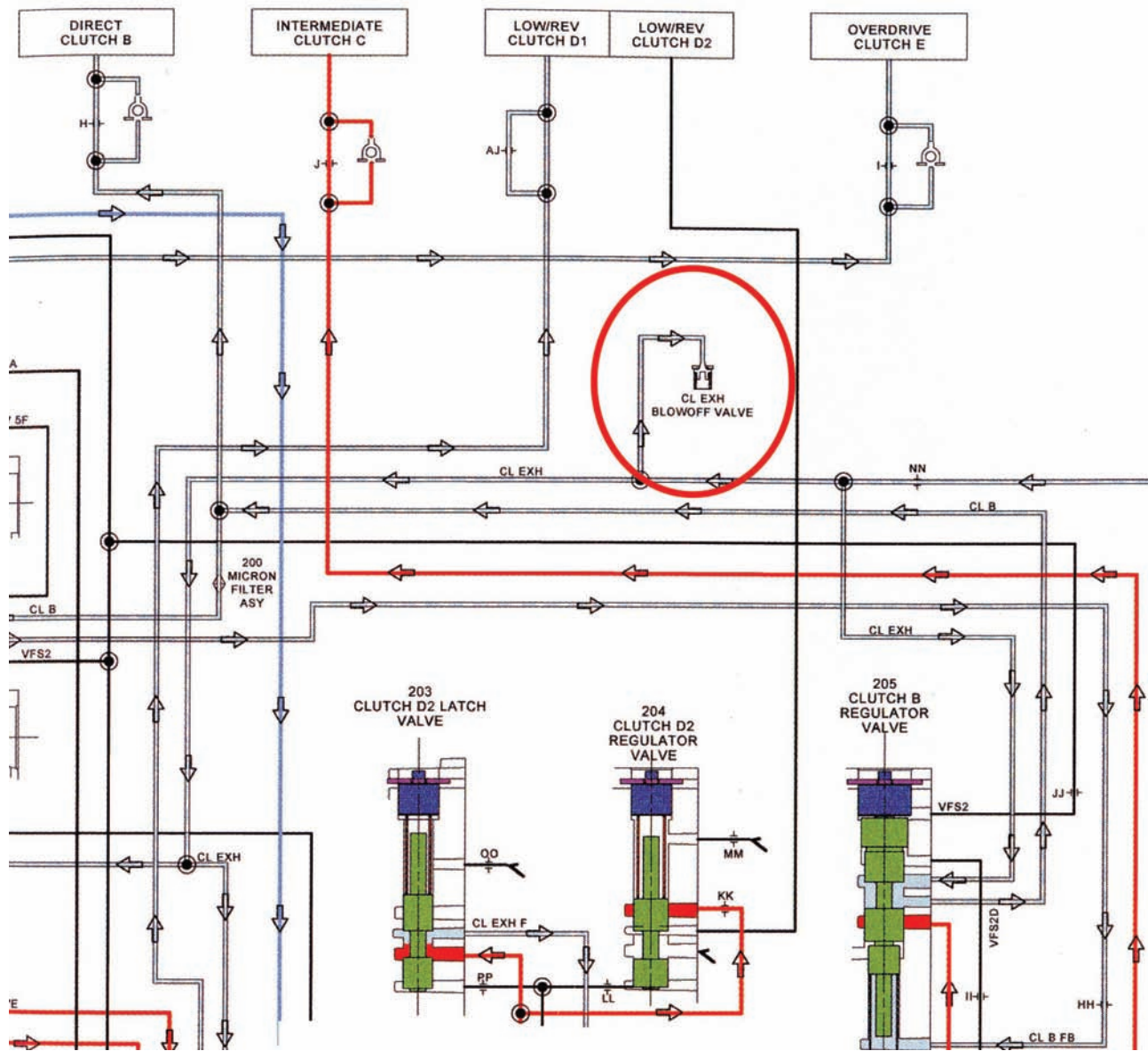
During the release of the clutch the exhaust valve drains just enough fluid pressure from the clutch. This allows the clutch piston to have just enough oil in the chamber allowing for a smoother shift.



6R60

Clutch Exhaust Valve (continued)

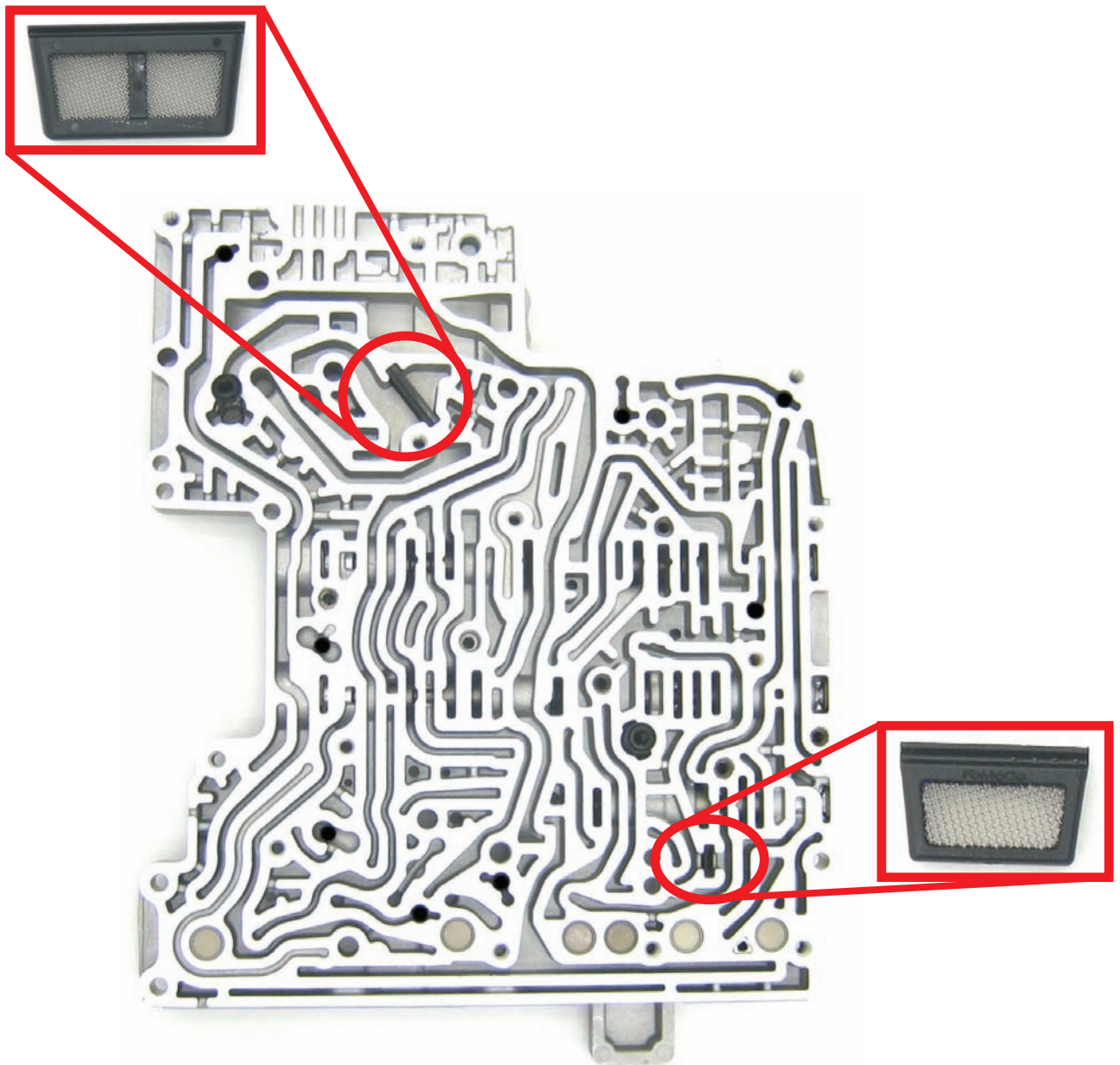
Failure to install the clutch exhaust valve into the lower valve body will result in flared or erratic shifts.



6R60

Valve Body Solenoid Filters

Solenoid filters are critical to the solenoid operation. These screens are used to filter fine particles of debris.

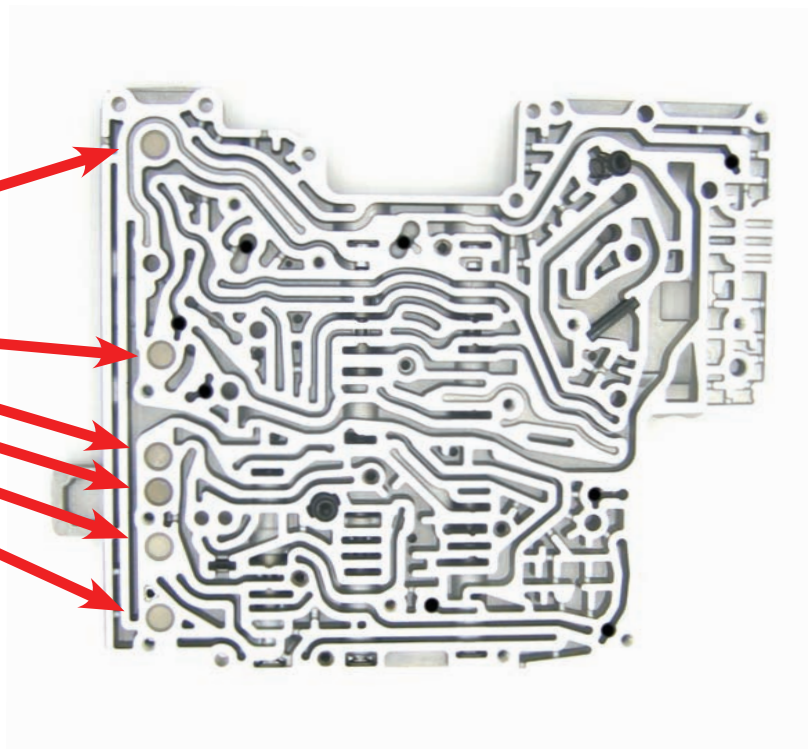


6R60

Upper Valve Body Small Parts Location

The rubber end goes INTO the valve body. These Solenoid Dampers are actually small accumulators to absorb the small pulses from the PWM solenoids.

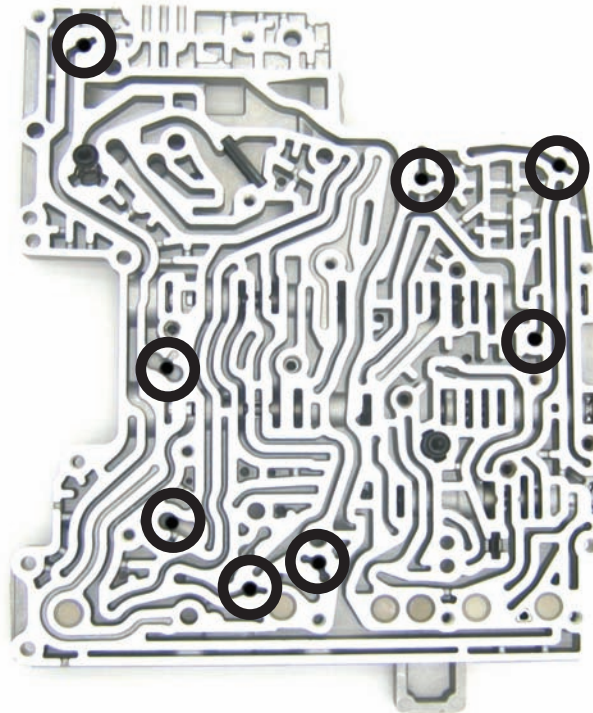
**Install the rubber end
in the valve body first**



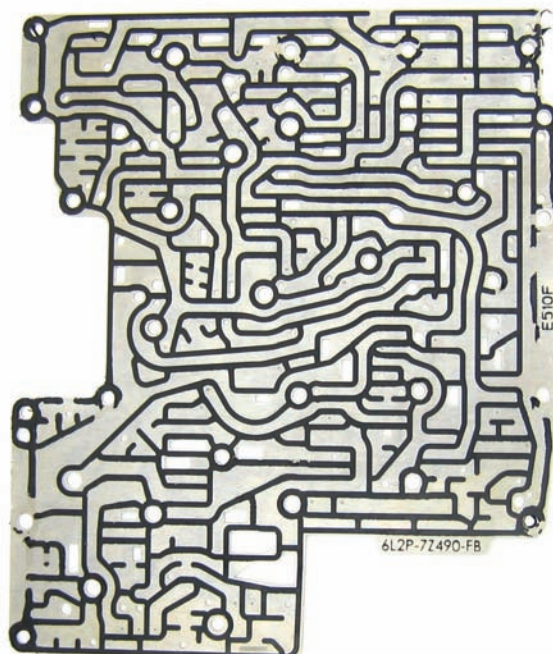
6R60

Check Ball and Separator Plate Information

There are eight (8) check balls in the Upper valve body.



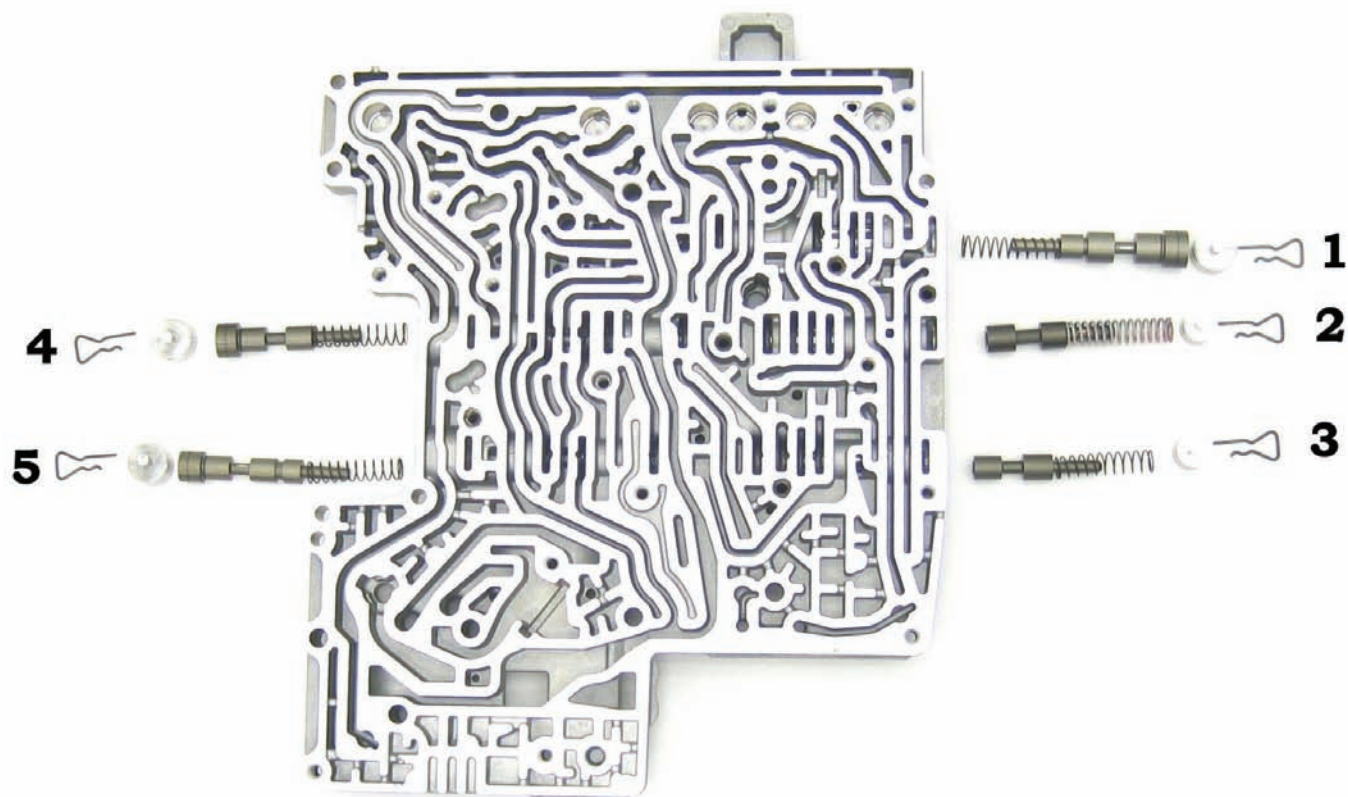
This is a one time only use separator plate. It **MUST** be replaced on every overhaul. Contact your local parts supplier for the cost.



6R60

Upper Valve Body Disassembly

The upper valve body houses five (5) valves. Each one of these valves operate multiple clutches.

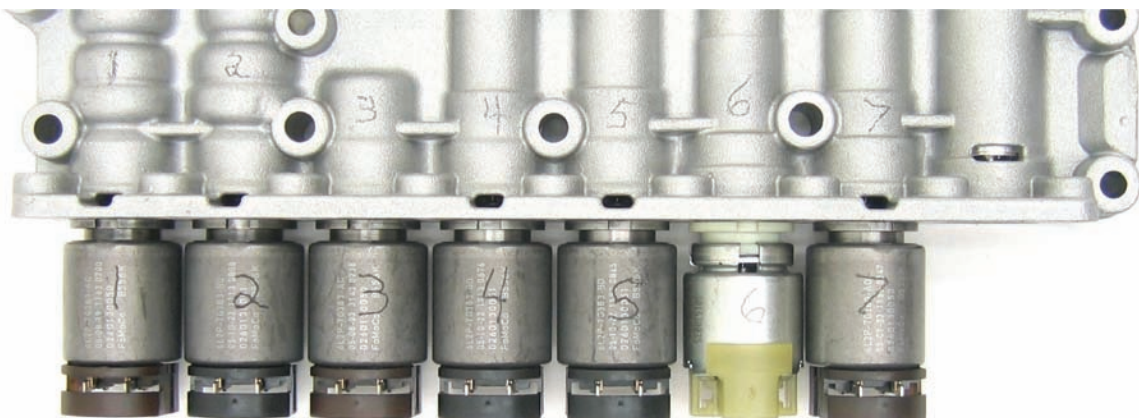


6R60 Upper Valve Body	
1	Clutch B/ Direct Regulator Valve
2	Clutch D2/ Low/Reverse Regulator Valve
3	Clutch D2/ Low/Reverse Latch Valve
4	Clutch C/Intermediate Regulator Valve
5	Clutch D1/Low Reverse Pressure Regulator Valve

6R60

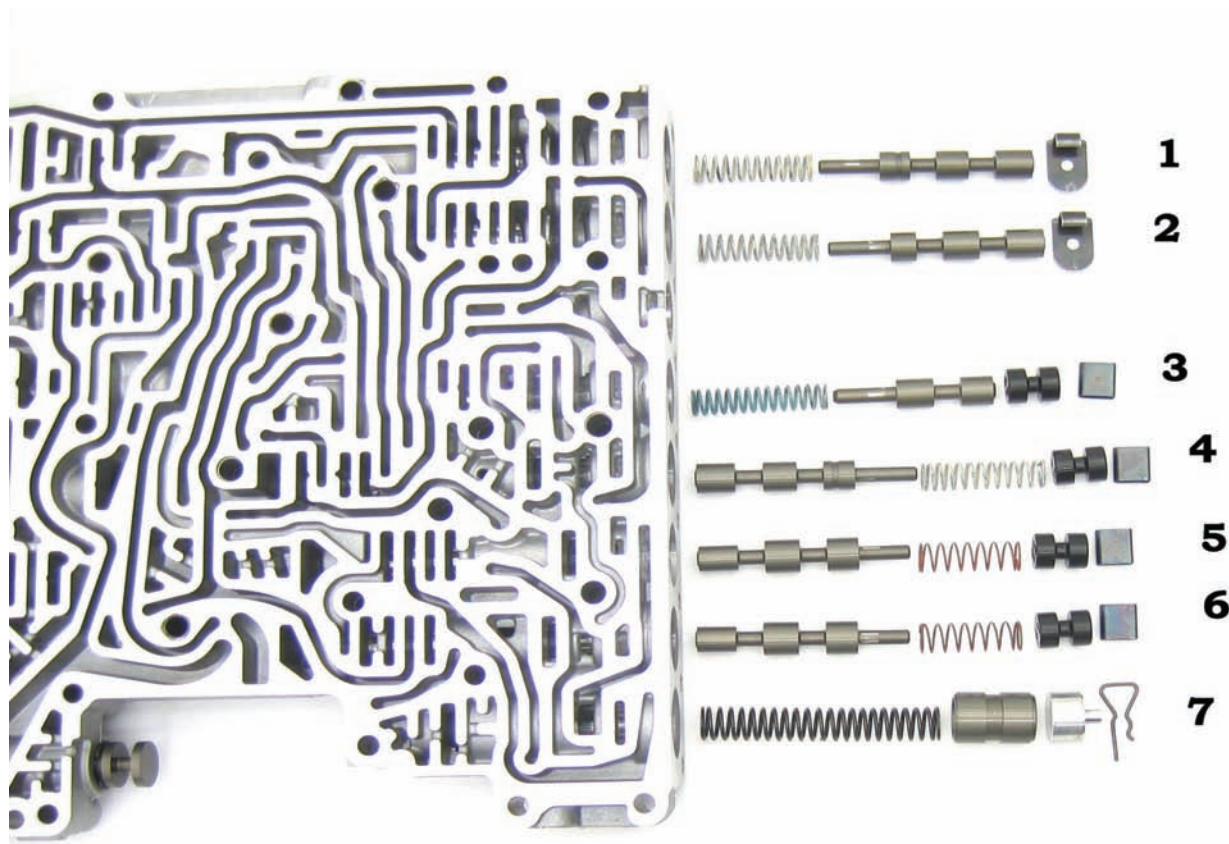
Solenoid Identification

The solenoids must be marked during the disassembly. Failure to do so may result in erratic shifts, codes, or potentially no movement. The top image was marked with a “sharpie” marker, it is effective, but may wash off during the cleaning process. The bottom image was marked with an engraving tool, a bit harder to see, but a much more effective means of identifying the casting and solenoids.



6R60

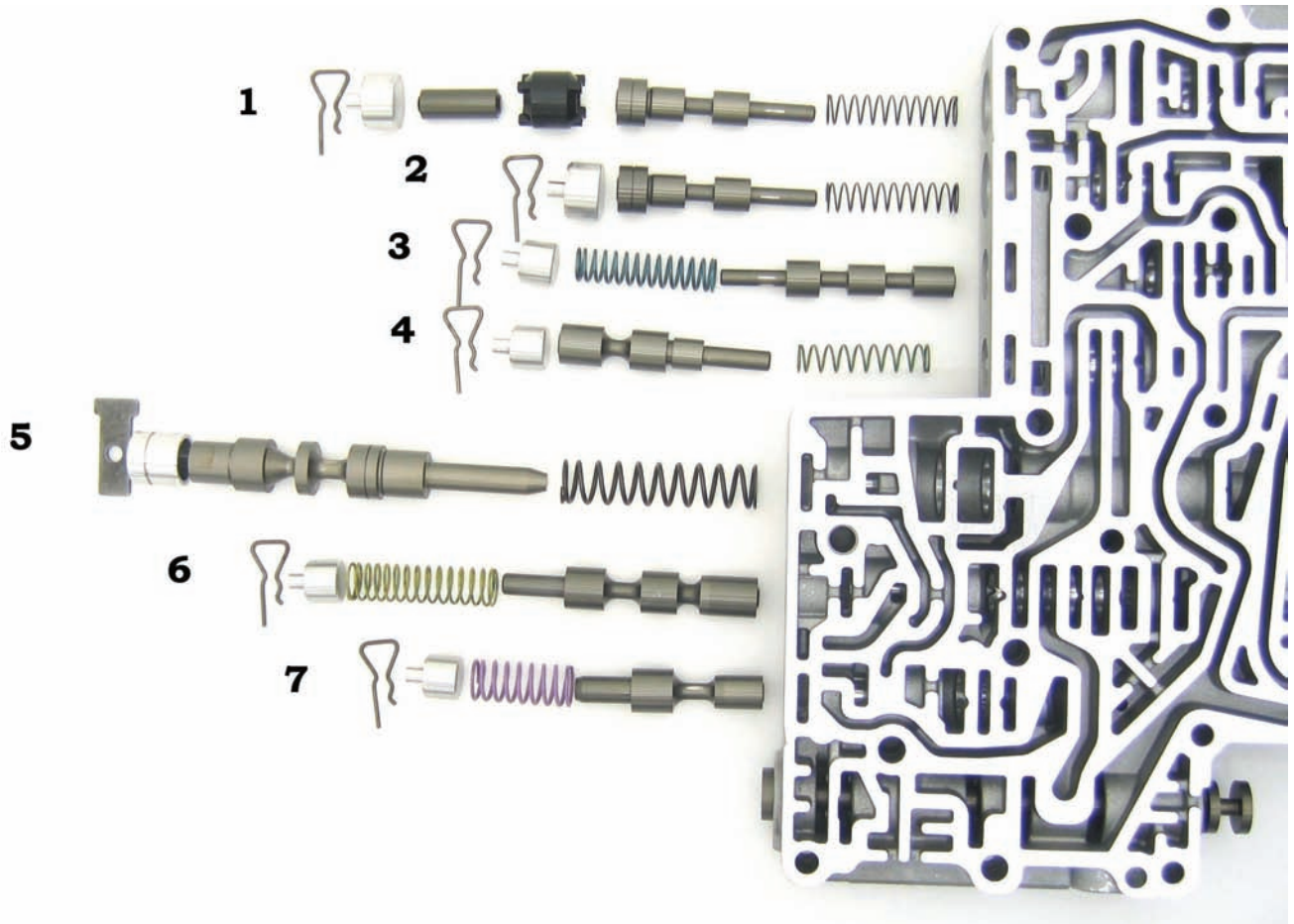
Lower Valve Body Disassembly



Lower Valve Body Right Side	
1	Clutch A/Forward Latch Valve
2	Clutch B/Direct Latch Valve
3	Solenoid Pressure Regulator Valve
4	Clutch D1/Latch Valve
5	Drive Enable Valve
6	Solenoid Multiplex Valve
7	Delay Accumulator Valve

6R60

Lower Valve Body Disassembly (continued)

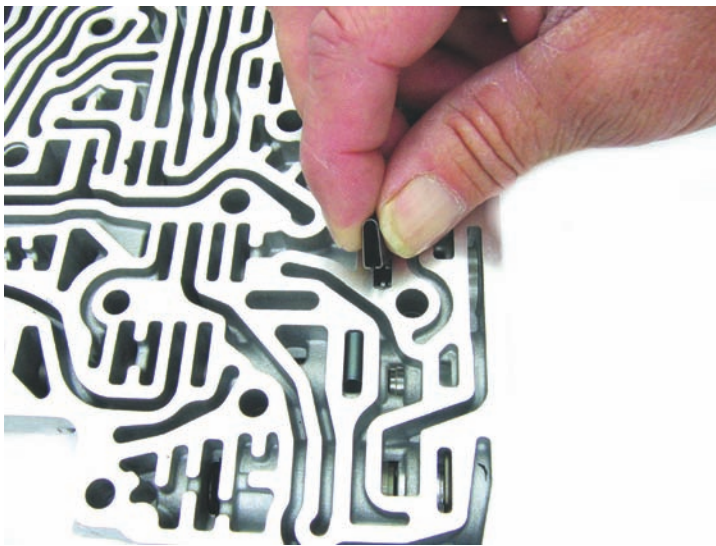


Lower Valve Body Left Side	
1	Clutch A/Forward Control Pressure Regulator Valve
2	Clutch E Control Pressure Regulator Valve
3	Clutch E/OD Clutch Latch Valve
4	Bypass Clutch Control Valve
5	Main Pressure Regulator Valve
6	Converter Release Regulator Valve
7	Lubrication Regulator Valve

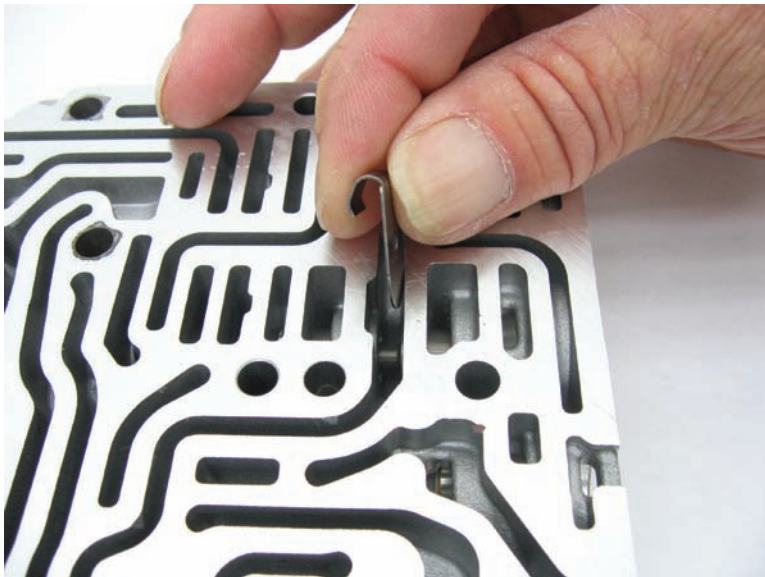
6R60

Valve Plug Retainers

There are three different types of valve and plug retainers. Two of these retainers must be positioned correctly in the valve body or the transmission may not operate correctly. The open end of the retainer is installed into the valve body first.



The Hooked end retainers face the separator plate. The Flat surfaces faces the outside of the bore.



6R60

Measuring the Endplay

Measure the depth from the case to the waved plate several places around the case, record your average measurement. Then measure the height of the Low/Reverse piston, record your average measurement.

Subtract the height of the piston from the depth of the clutch pack, your measurement should be between 0.031-0.055 in. Selective pressure plates are available.

Measure the height of the piston



Measure the depth of the clutch



6R60

The Lepelletier Geartrain

The Lapelletier geartrain, as used in this transmission, consists of:

- A front planet with the sun gear fixed to the front pump.
- A planetary gear set fixed to an input drum.
- A ring gear attached to the input shaft.

This assembly is used to drive a Ravigneaux gearset in the back of the transmission. What Mr. Lapelletier figured out was that if the planetary gearset in the back of the transmission is turned at one speed and the sun gear is turned at another speed — usually slower — the combination creates an overdrive ratio.

This overdriven ratio is slightly lower than the one created by holding the sun gear and driving the planet. The important thing to understand is that the combination of the single planet being driven faster than the sun gears, which are being driven in reduction, is what creates the different ratios.

It may take a while to get the hang of this new concept and it will be much easier with the parts on the bench in front of you so you can get a feel for how the reduction and overdrive takes place. For a complete explanation on how the Lepelletier geartrain works, check out Dennis Madden's article in the November/December 2006 issue of GEARS Magazine.

6R60

The Lepelltier Geartrain (continued)

Front Pump with the Stationary Gear



Input Planetary Gear Set



Ravigneaux Gearset



Large Sun Gear



Small Sun Gear

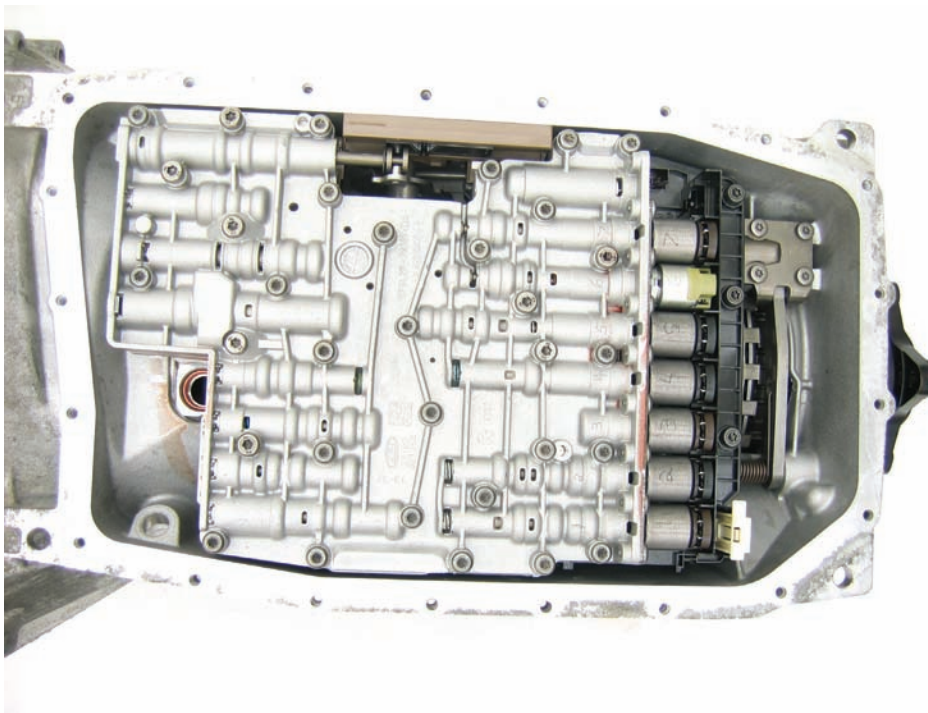


6R60

Wrench Light On, DTC P0783

2006 Explorer 4dr and Mountaineer vehicles built prior to 1/31/2006 equipped with a 6R60 transmission may exhibit the powertrain malfunction indicator lamp (Wrench Light) on with a diagnostic trouble code (DTC) P0783 (3-4 Shift Error). This may be the result of transmission fluid contamination, or a contaminated shift solenoid.

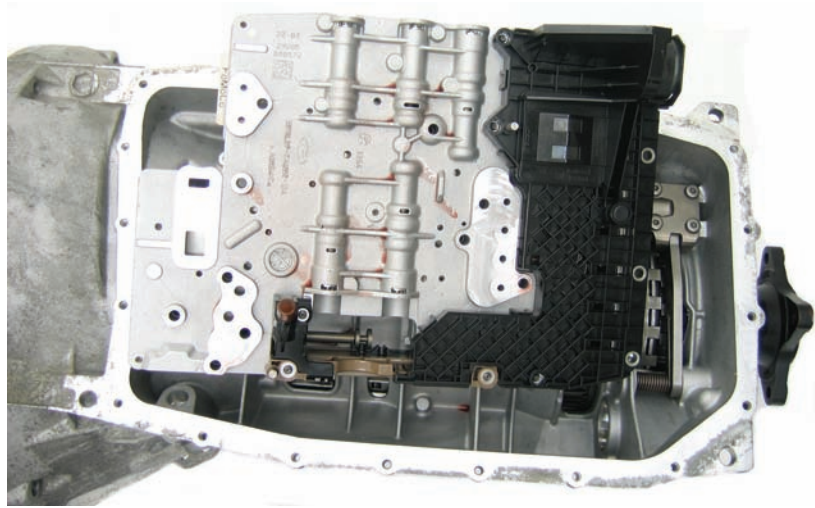
1. Check the transmission fluid for presence of water contamination by removing the transmission dipstick. If water contamination is present, repair the transmission as necessary.
2. If no obvious contamination is evident, test drive vehicle to obtain transmission shifts through all gear ranges.
3. If the transmission unsuccessfully attempts the 3-4 shift up to five (5) times, then turns on the Wrench Light and reverts to fail-safe mode, the shift solenoid is suspect.
4. Remove the mechatronic assembly and replace the shift solenoid using the following steps:
 - a. Remove the mechatronic assembly.
 - b. Once the mechatronic assembly is removed, remove the six (6) long bolts attaching the transmission control module (TCM) to the mechatronic assembly, and carefully separate the TCM from the mechatronic assembly.



6R60

Wrench Light On, DTC P0783 (continued)

5. Remove the eight (8) solenoid bracket bolts and the solenoid bracket



Replace only the white shift solenoid. Reinstall the solenoid bracket and the eight (8) bolts. Tighten to 71 lb-in (8 N-m). Carefully reinstall the TCM onto the mechatronic assembly. Reinstall the six (6) bolts and tighten in the sequence shown in to 53 lb-in (6 N-m).



**Solenoid Part Number
6L2Z-7G484-AA**

White Shift Solenoid

6R60

Multiple Symptoms

Surge, Hesitation, TCC Cycling, No Up Shift After a Forced Downshift, Poor A/C Performance

2006-2007 Explorer 4dr/Mountaineer and 2007 Sport Trac vehicles equipped with a 4.0L engine may exhibit a surge at steady speeds, transmission torque converter clutch cycling or hanging in a lower gear after a forced downshift during cruise control operation when operated in high ambient conditions.

In addition, these vehicles may exhibit a cold hesitation/surge, engine fan noise and/or varying A/C discharge temperatures “ONLY” during low vehicle speed intermittently.

Reprogram the powertrain control module (PCM) to the latest calibration using IDS release B43.16 and higher or B44.8 and higher. This new calibration is not included in the B44 CD. Calibration files may also be obtained at www.motorcraft.com.

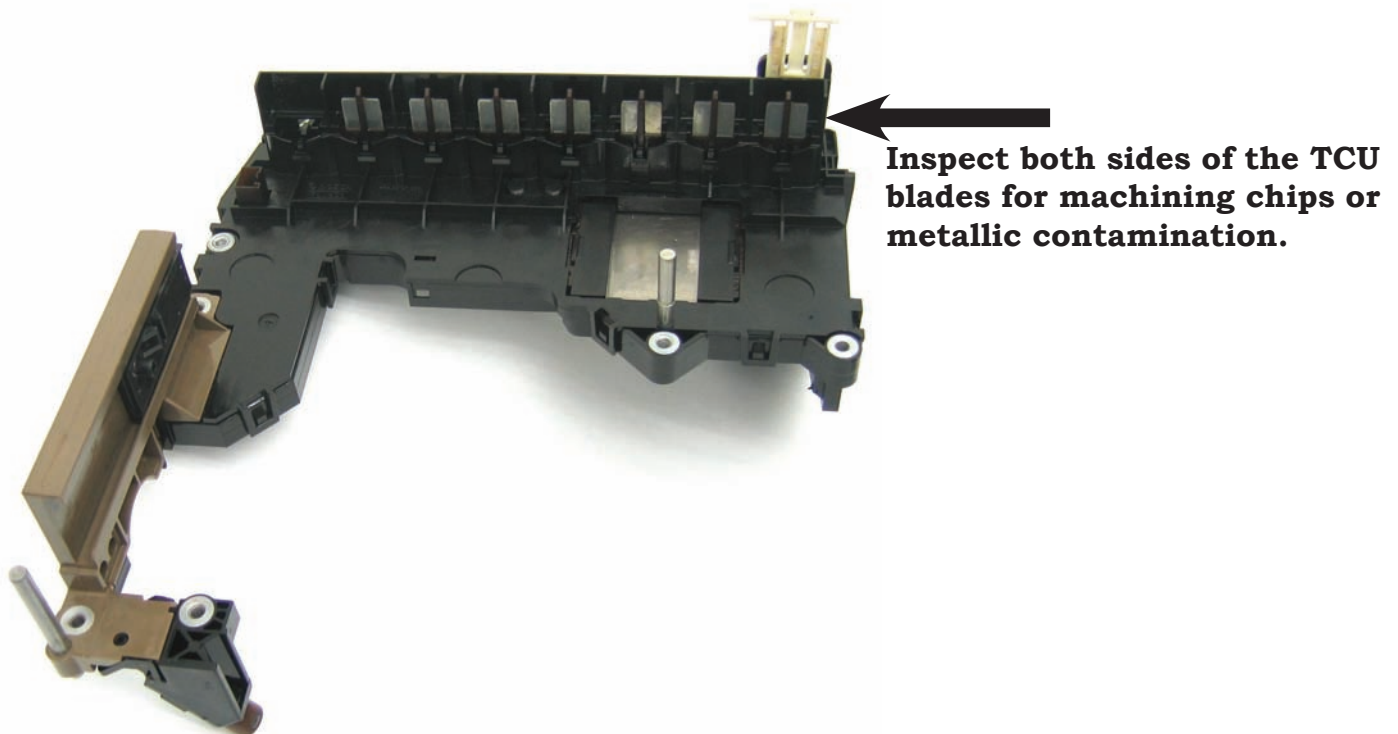
6R60

Multiple DTC's

2006-2007 Explorer and Mountaineer, 2007 Sport Trac, and 2007 Expedition vehicles may exhibit the following diagnostic trouble codes in the transmission control module (TCM) memory with or without the wrench light on. The codes include the following; P0658, P0657, P0972, P0973, P0974, P0975, P0976, P0977, P0978, P0979, P0980, P0981, P0982, P0083, P0961, P0962, P0963, P2763, P2764, P0985, P0986, P0711, P0712. The cause is contamination at the mechatronic assembly.

To repair the problem, it is necessary to remove the source of contamination from the transmission control unit (TCU)/solenoid connections and/or at the transmission fluid temperature (TFT) window. A foam barrier strip is available to prevent recurrence of the problem.

Remove mechatronic assembly. Inspect the TCM at the following locations for metal chips or other metallic contamination:

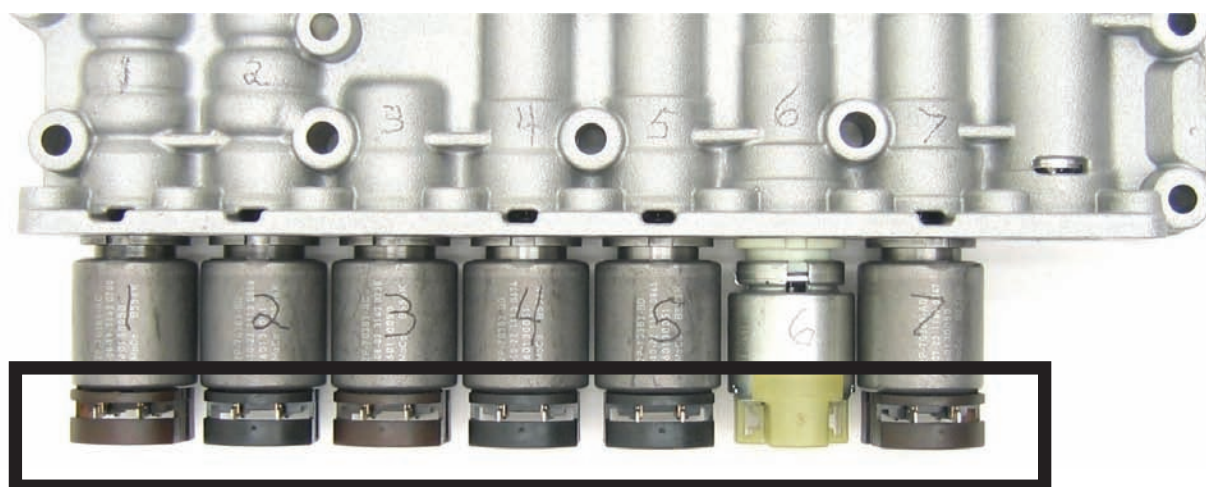


Inspect both sides of the TCU blades for machining chips or metallic contamination.

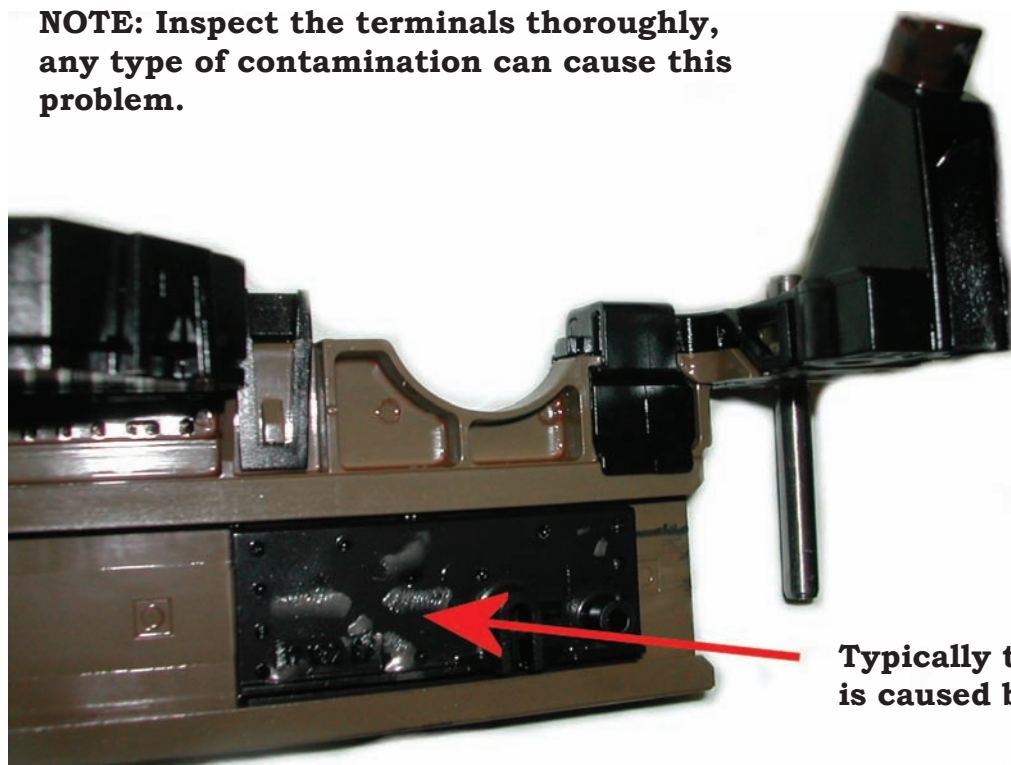
6R60

Multiple DTC's (continued)

Closely inspect all solenoid terminals for machining chips and or metallic contamination.



NOTE: Inspect the terminals thoroughly, any type of contamination can cause this problem.

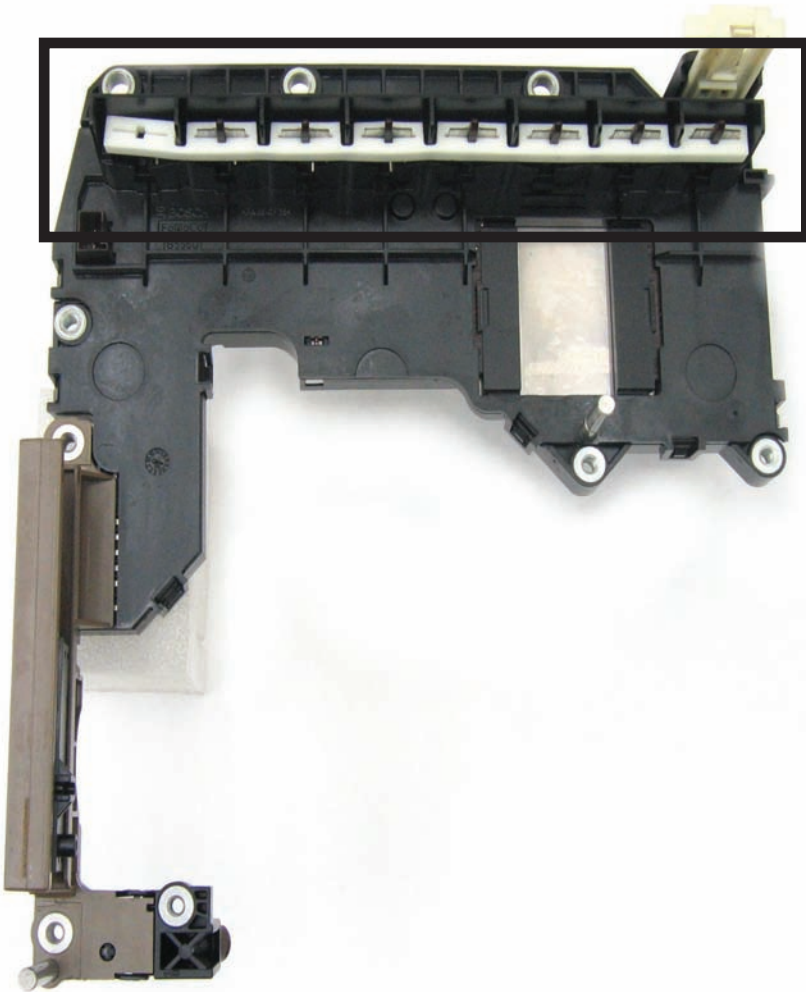


Typically the contamination is caused by clutch debris.

6R60

Multiple DTC's (continued)

Install the new foam barrier strip over the blades of the TCU, no special barrier strip is required for the TFT.



Install the foam barrier strip over the blades of the TCM as shown.

6R60

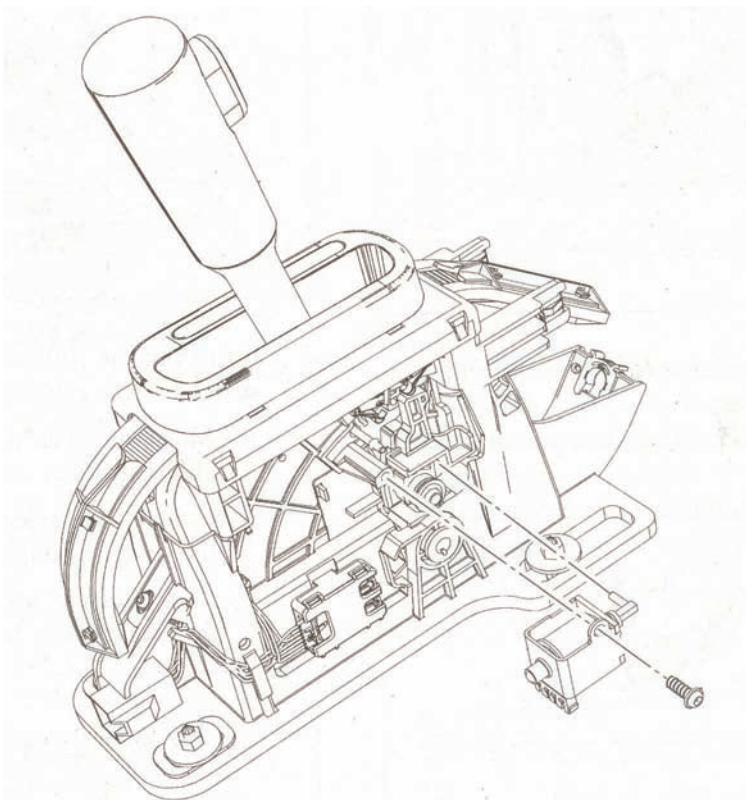
Shifter Stuck in the Park Position

2006-2007 Explorer 4dr, Mountaineer and 2007 Explorer Sport Trac vehicles built on or before 11/14/2006 may exhibit an intermittent condition where the shifter may require the use of the manual override function to get the shifter out of park.

This condition may be caused by chemicals migrating from the shifter lubricant, and being deposited on the shifter switch

1. Check the electrical system and make sure the shifter is getting power from the BOO switch (actuate brake to confirm switch signal is getting to the shifter assembly).
2. Confirm the wiring in the shifter is okay (connections are made, no cut wires).
3. If there are no issues with wiring or other electrical components, remove the Transmission Selector Lever and check it for damage. Also check Selector Lever Cable Adjustment. If they are okay replace the Transmission Selector.

PART NUMBER	PART NAME
7L2Z-7210-A	Transmission Selector Lever (6R60)
7L2Z-7210-B	Transmission Selector Lever (5R55)
7L2Z-7210-C	Transmission Selector Lever (6R60 – With Leather Rap)
7L2Z-7210-D	Transmission Selector Lever (5R55 – With Leather Rap)



6R60

Bump Feel while Braking

2006-2008 Explorer 4dr, Mountaineer and 2007-2008 Explorer Sport Trac vehicles equipped with 6R60 transmission may exhibit a bump feeling while braking to a stop less than 10 MPH (16 Km/h).

Some vehicles built prior to 5/4/2006 may exhibit the following symptoms:

- Delayed engagements into Drive from Park Neutral or Reverse.
- Hesitation upon tip-in hesitation while accelerating from a stop.

Some tip-in hesitation is normal on this transmission in order to provide smooth operation. This calibration update will help to improve the condition. The harsh bump while braking to a stop will be eliminated. Several days of driving may be required for the transmission to fully adapt.

Adaptive Strategies

1. Accelerate from rest with light throttle. The 1-2, 2-3 and 3-4 shifts must occur at engine speeds between 1300-1800 rpm
2. Continue to accelerate gently to 50 mph so that the transmission shifts into 6th gear.
3. Brake gently to a complete stop and hold foot on brake for at least 15 seconds.
4. Repeat steps 1-4 a total of five times

6R60

Bump Feel while Braking (continued)

1. Install IDS/PDS or equivalent and ID the vehicle.
2. Update the PCM and TCM calibration using IDS release 51.8 and higher or 52.1 and higher. Calibration files may also be obtained at www.motorcraft.com. Since the TCM cannot be independently reprogrammed, reprogram the PCM to ensure that engine and transmission calibrations are updated to the latest level simultaneously.
3. Clear TCM keep alive memory (KAM) and adaptive tables.
 - a. Using your scan tool:
 1. Open Toolbox.
 2. Choose Powertrain.
 3. Choose Reset KAM.
 4. Then Choose TCM.
 - b. Using your scan tool:
 1. Choose all Tests and Calibrations
 2. Scroll down the menu and Choose Reset TCM KAM.

NOTE: **Resetting the TCM Keep Alive Memory is not the same as clearing the transmission adaptive tables which is under the PCM/TCM menu tree.**

NOTE: **Unhooking the battery WILL NOT clear the TCM Keep Alive Memory.**

NOTE: **DO NOT CLEAR THE PCM KAM.**

4. Verify that the transmission fluid temperature (TFT) PID is above 175°F (80°C). If it is not at 175°F (80°C), drive unit approximately 3 miles (5 Km) to reach temperature.

NOTE: **TFT MUST BE AT 175°F (80°C) OR ABOVE BEFORE PROCEEDING TO STEP**

5. Drive unit to perform adaptive shift strategy learn.
 - a. Accelerate from rest with light throttle. The 1-2, 2-3, and 3-4 shifts must occur at engine speeds between 1300-1800 RPM.
 - b. Continue to accelerate gently to 50 MPH (80 Km/h) so that the transmission shifts into 6th gear.
 - c. Brake gently to a complete stop and hold foot on the brake for at least 15 seconds.
 - d. Repeat Steps (a-c) a total of five (5) times.

5R55N/S/W

Hard to Get Out of Park

2001 S-Type Jaguar won't come out of park, on a hill or small incline.

Disconnect the linkage and shift the trans by hand, if the shifter is hard to move by hand the problem is with the rooster comb in the transmission.

Replace the rooster comb with a ford part. The Ford part is different from the Jaguar part and will work much better.



**The Jaguar Original Rooster Comb.
The Left edge is notched.**



**The Jaguar replacement Rooster Comb.
The Left edge notched with a gradual
slope. Part number XR8P-7C494-DA**



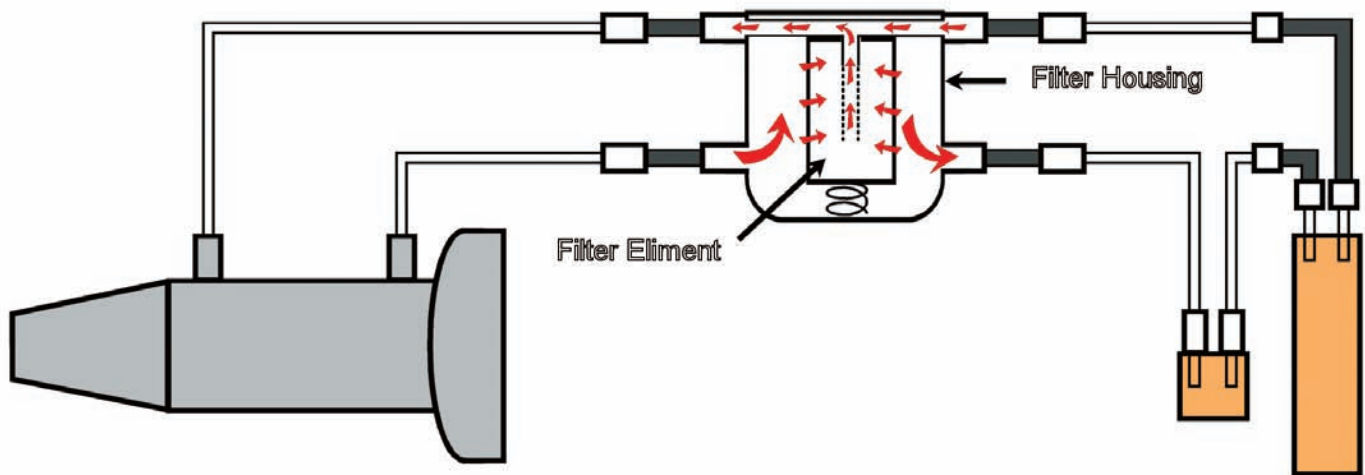
Recommended Replacement

**The Ford Rooster Comb. There is no
notch just a slope.
Part number XW4P-7C494-AC**

Torqshift

Filtration System

Ford uses a parallel filtering system in 2003 and later E and F-series trucks. The idea is pretty simple really. Both cooler lines go into the filter. The filter actually serves as a barrier, or orifice that separates the two lines. Since the cooler creates back pressure in the outgoing cooler line its pressure is higher than the return line. It's this difference in pressure that makes the system work. As the oil flows through the lines about 5% of it makes its way through the filter — bypassing the cooler and returning back to the transmission.



Torqshift

Filtration System (continued)

The benefit is the filter is really fine; capable of filtering particles 2 microns or larger. If it gets clogged — even totally clogged, it doesn't affect cooler flow because it's parallel in the system. This design allows it to provide superior filtration without risking a lack of cooler flow when it clogs. Sounds great right? Well, there's a down side. Since the filter is parallel to the cooler it's the only thing that prevents the oil from bypassing the cooler and simply returning back to the trans. That is, if you took the filter out there'd be nothing the force the oil to flow to the cooler. It is the fact that the filter is so restrictive that makes the system work.

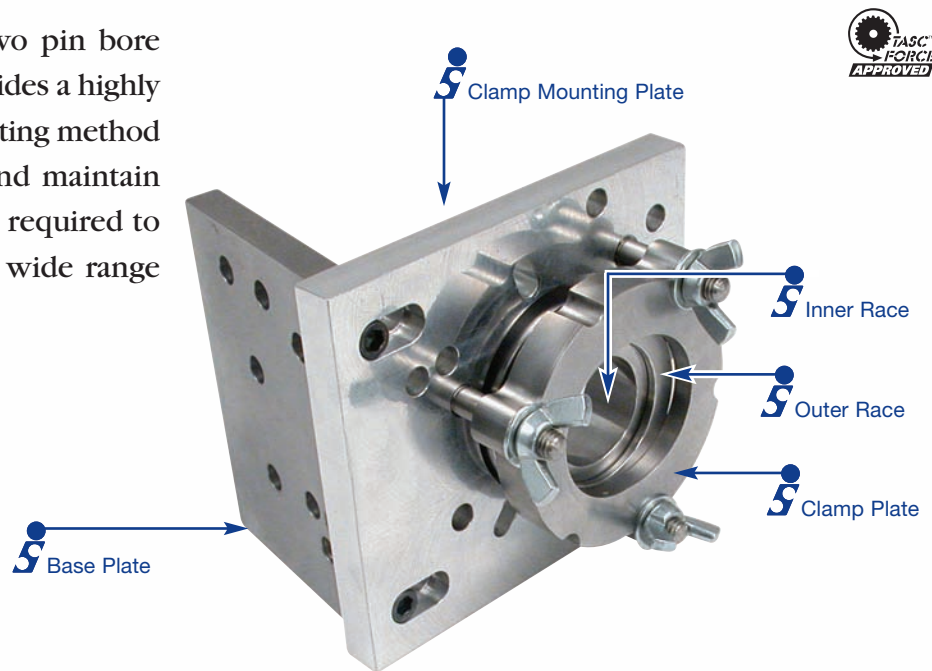
There are two considerations when you work on this system:

1. When you flush the cooler, either disconnect the lines at the remote filter and flush it from there to the cooler or leave the old filter in the housing, flush the system, then replace the filter element. If you take the filter out of the housing and then flush the cooler (from the transmission lines) you'll bypass the cooler during the flushing process.
2. If you replace the filter element be careful, not all filters are the same. If the filter you use flows more freely than the original you risk allowing too much oil to bypass the cooler. This'll cause overheating and premature transmission failure. Remember, this filter is supposed to be highly restrictive because it's the only thing separating the two cooler lines.



A revolution in servo repair!

The new Sonnax servo pin bore reaming fixture provides a highly adaptable rigid mounting method that allows you to locate and maintain the correct tool positioning required to repair servo pin bores in a wide range of transmissions.



Quit throwing away expensive cases because of wear and scoring of servo pin bores. The SERVO-FIX from Sonnax mounts to the case, and has a floating bearing guide to ensure proper pin centerline. This tool pilots off the OEM pin bore, so reaming is unaffected by irregular piston or seal concentricity issues. The SERVO-FIX has been designed to offer a variety of mounting options for a wide range of transmission cases and multiple bores. Use in conjunction with our new "S" series tool kits and associated pin bore repair sleeve kits.

Sonnax Part Number	Associated Kit Part Number	Application
SERVO-FIX	All "S" Series Tool Kits	Multiple Applications
S-56361J-TL	56361J-01K, Overdrive & Intermediate Servo Repair Sleeve Kit	5R55N/W/S
S-76890-TL24*	76890-24K, Master Servo Sleeve Kit	4R70W, AODE, 4L30-E, 180
	AODE: Overdrive or Reverse Servo Sleeve Kit	
	4L30-E: 1-2 Servo Sleeve Kit	
	180: Low Servo Sleeve Kit	
S-96872-TL*	96872-01K, Overdrive Servo Sleeve Kit	AXOD & E, AX4S & N, 4F50N

* Available 2008



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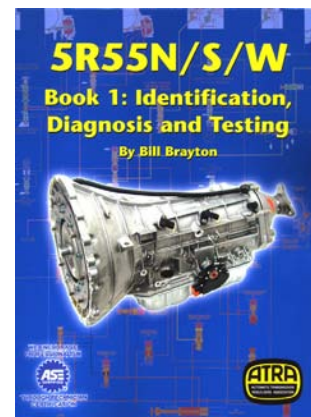
You can get them both for: **\$150**

ATRA's 5R55N/S/W Technical Manual

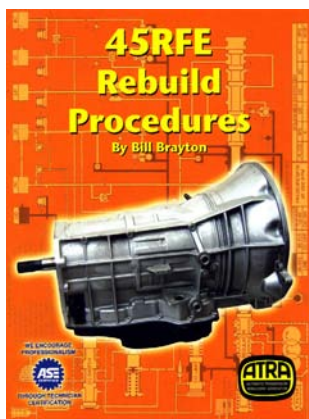
This identification, diagnosis and testing book was written by Bill Brayton. There are sections in this book on the following topics:

Transmission Identification, Diagnosis and Electrical Diagnosis, & Transmission Operation

You can purchase this for only: **\$30**



ATM-5R55N-DIAG



ATM-45RFE-REB

ATRA's 45RFE Rebuild Technical Manual

This rebuild manual is 56 pages of step by step rebuilding information with pictures for each step. Here are some of the topics that are covered:

Transmission Disassembly, Input Drum, Low/Reverse Sprag Rotation, & Solenoid Body Rebuild Procedures.

You can purchase this for only: **\$20**

This offer only available to ATRA Seminar attendees. Make sure to mention this ad when placing your order.

Expires 12/31/08



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Chrysler

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62TE

Introduction

The 62TE is the new generation of FWD/AWD Transaxles in production for Dodge/Chrysler. The concept has been around for many years but has been introduced in the 2007 Model Year.

These models include: "JS" Seabring, Seabring Convertible, and Avenger with the 3.5L V6 "CS" Pacifica with the 4.0L V6. The concept was to take a proven reliable 41TE (4 speed) and split the transfer/pinion drive with an underdrive/direct clutch to drive a double ratio to the final drive.

Although this is classified as a 6 speed fwd transaxle, there are 7 forward speeds with the addition of a 4th gear prime ratio that is used during a 6-4 kickdown. This prevents a double swap of components allowing for a smooth kickdown.



62TE

Description

The planetary gear train for the 62TE transaxle provides six forward gear ratios, including two fourth gear ratios. One reverse gear ratio is also provided.

Underdrive (UD) Compounder Assembly

- Low Clutch (LC)
- Direct Clutch (DC)
- Overrunning Clutch (ORC)
- Planetary gear set

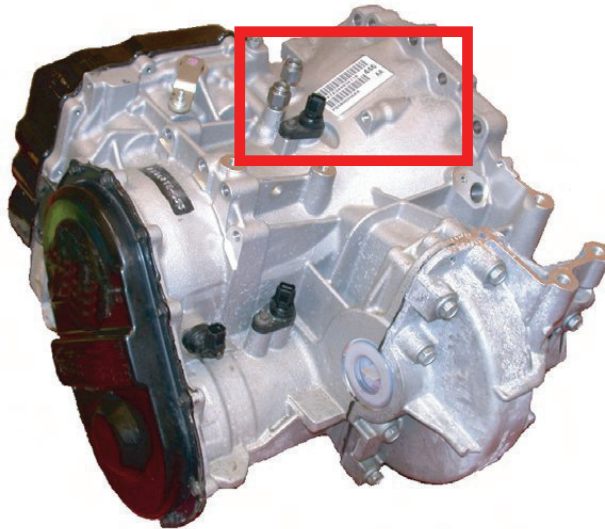
Fore-Mounted Valve Body/Solenoid/Pressure Switch Assembly

- DC solenoid
- LC solenoid
- DC pressure switch
- LC pressure switch
- Torque Converter Clutch (TC) and pressure control Solenoids
- Line Pressure Sensor (LPS)
- An additional (third) speed sensor
- A “squashed,” or flatter, torque converter
- A new cover for valve body access
- 23-way connector for the Solenoid/Pressure Switch Assembly
- A remote pinion gear
- A 2-piece, closed differential case with structural clamshell housing. The addition of the underdrive compounder assembly components improves low-end torque multiplication, enhancing low-end power capability.

62TE

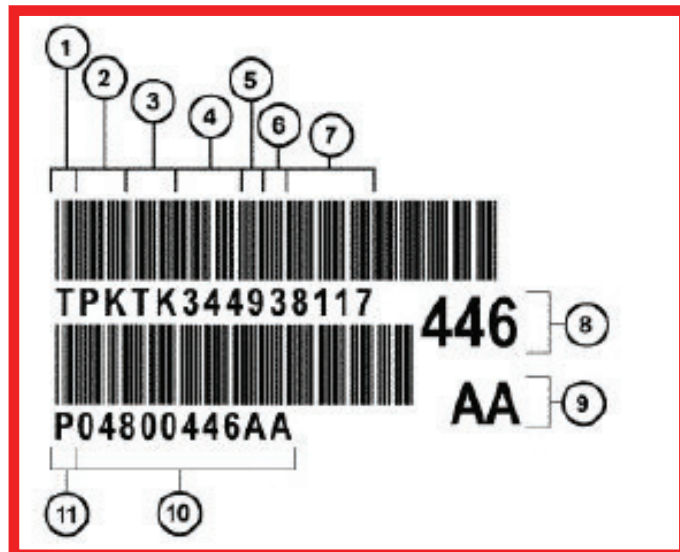
Identification

The 62TE transaxle is identified by a bar code label (1) that is fixed to the transaxle or the “PK” number (2).



The label contains a series of digits that can be translated into useful information such as transaxle part number, date of manufacture, manufacturing origin, plant shift number, build sequence number, etc. Refer to for identification label breakdown.

1. Traceability
2. Supplier Code
3. Component Code
4. Build Day (Julian Date)
5. Build Year
6. Line/Shift Code
7. Build Sequence
8. Last Three Part Number Digits
9. Revision Level
10. Transmission Part Number
11. Part Number Prefix



If the tag is not legible or missing, the “PK” number, which is stamped into the transaxle case behind the transfer gear cover, can be referred to for identification. This number differs slightly in that it contains the entire transaxle part number, rather than the last three digits.

62TE

Lubrication

The 62TE requires the use of +4 Oil. There are many different blends of oil that meet the +4 requirement (markings for +4 are clear on the labels).

During a service the 62TE fill is 5.5 qts 5.2 L

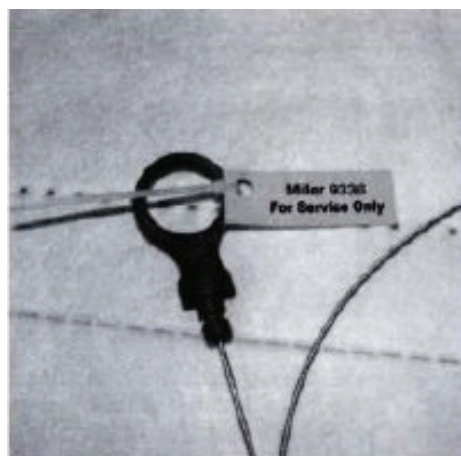
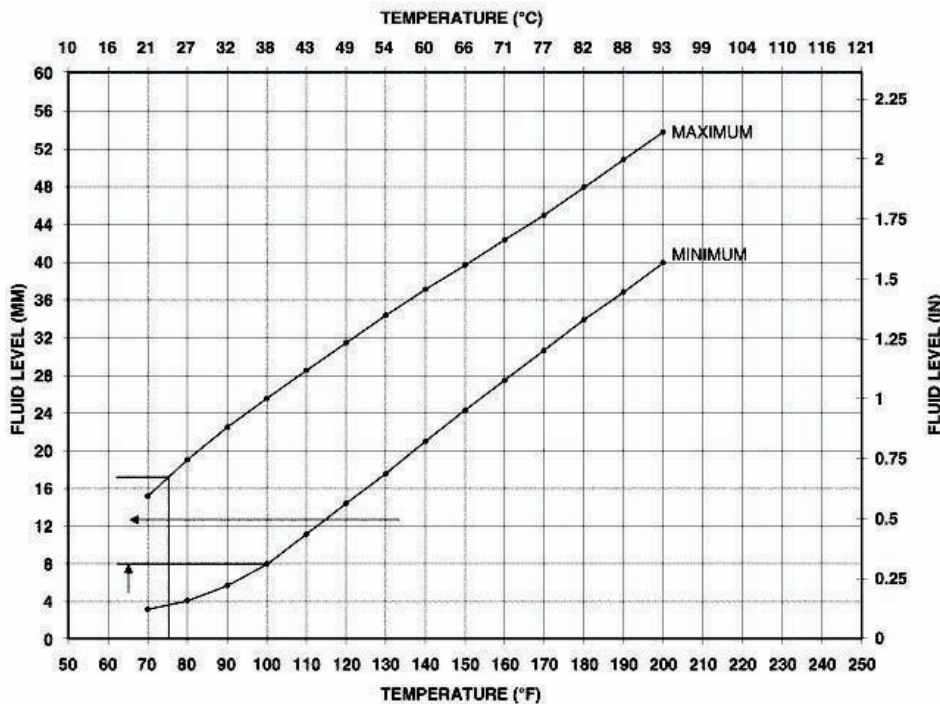
After an internal transmission repair the 62TE fill is 9.0 qts 8.5 L



62TE

Checking the Fluid Level

When checking the fluid level it is important to be on level ground and using a scan tool, verify transmission temperature. Use the chart below to properly fill the unit with Miller Tool 9336 (wire stick). Markings on the gauge bar are separated by 10mm each indicator.



**Tool 9336 Service Dipstick
(10 mm separations)**



62TE

Clutch and Ratio Chart

A = Applied
H = Holding
* = Limp-in Mode
^ = Applied in coast only

CLUTCH APPLICATION CHART									
ELEMENTS APPLIED									
GEAR	RATIO	UD	OD	R	2-4	L-R	LC	DC	ORC
1	4.127	A				A	A ^		H
2	2.842	A				A		A	
3 *	2.284	A			A		A ^		H
4	1.573	A			A			A	
4	1.452	A	A				A ^		H
5	1	A	A					A	
6	0.689		A		A			A	
R	3.215			A		A	A		

The process of elimination can be used to detect any unit which slips and to confirm proper operation of good units. Road test analysis can diagnose slipping units, but the cause of the malfunction cannot be determined. Practically any condition can be caused by leak-ing hydraulic circuits or sticking valves.

Understanding the Components Used

The use of an Underdrive Compounder assembly splits the pinion speed with two modes of operation (Direct and Reduction).

Three shifts require a double swap of clutch assemblies; 2-3, 3-2, and 4-2. This occurs when two elements are turned off while two different elements are engaged.

Clutch to clutch synchronization takes place within 40-70 milliseconds, producing a smooth shift. Up shifts require the underdrive assembly to have precise timing. If an incorrect, double bump sensations will be felt.

“Prime” gear shift is used for the 6-4 kick downshift for a smooth transition. To achieve this, the OD clutch is released and the UD clutch is applied giving a 4th gear “prime” ratio of 1.573.

Gear Ratios for 2nd, 4th, 5th, and 6th are the same as a 41TE. If the LC were to fail there will be no engine braking and no Reverse engagement.

Limp mode gear for the 62TE is 3rd gear.

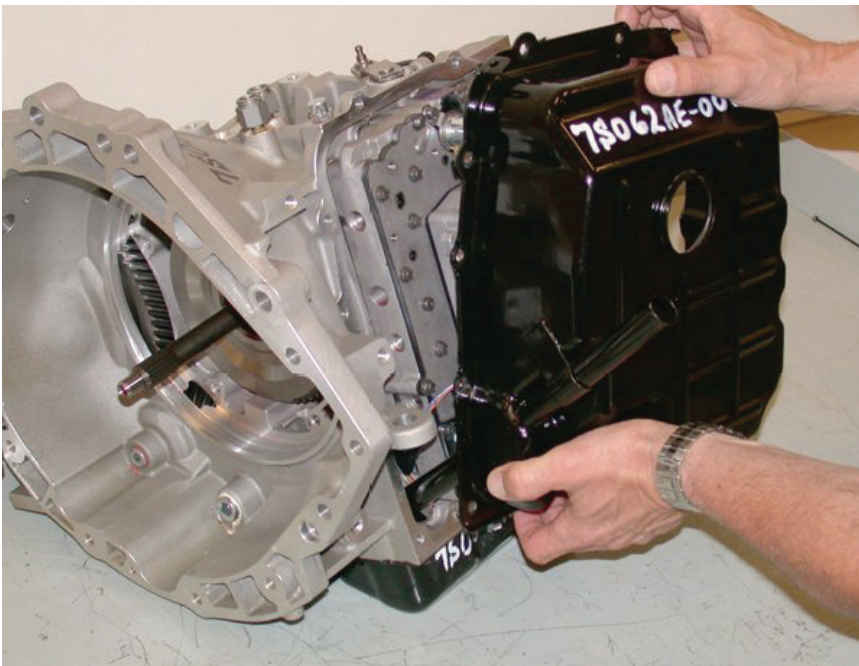
62TE

Pressure Testing

Pressure Testing is limited to one pressure tap located on the Pan Side of the transmission. Electronic control has allowed the use of a pressure control “reducing” solenoid and a transducer in providing a closed loop pressure control (desired command/perceived monitored pressure). Testing requires the use of a scan tool as well as the use of a pressure gauge and a simulator box (Miller Tool #8333 and the Electronic Transmission Adapter kit).

Using a simulator box select the “OFF” position on the “Input/Output Speed” switch. Ignition on, engine not running.

With the scan tool, monitor the Line Pressure during the following step. With the Transmission Simulator, turn the selector switch to each of the 3 Line Pressure positions.



1. With the scan tool, monitor the Line Pressure, Desired Line Pressure and the TPS degrees.
2. While firmly applying the brakes, place the shifter in reverse, then slowly press the accelerator pedal to a 15° TPS degree.
3. Compare the Line Pressure reading to the Desired Line Pressure reading on the scan tool.

NOTE: All three scan tool Line Pressure readings should be steady and $\pm 14\text{kPa}$ (2.0 psi) of the reading specified on the Transmission Simulator.

62TE

DTC's

P0122 - TPS/APP CIRCUIT LOW
P0123 - TPS/APP CIRCUIT HIGH
P0124 - TPS/APP INTERMITTENT
P0218 - HIGH TEMPERATURE OPERATION ACTIVATED
P0562 - BATTERY VOLTAGE LOW
P0604 - INTERNAL CONTROL MODULE RAM
P0613 - INTERNAL TRANSMISSION PROCESSOR
P0706 - TRANSMISSION RANGE SENSOR RATIONALITY
P0711 - TRANSMISSION TEMPERATURE SENSOR PERFORMANCE
P0712 - TRANSMISSION TEMPERATURE SENSOR LOW
P0713 - TRANSMISSION TEMPERATURE SENSOR HIGH
P0714 - TRANSMISSION TEMPERATURE SENSOR INTERMITTENT
P0716 - INPUT SPEED SENSOR 1 CIRCUIT PERFORMANCE
P0721 - OUTPUT SPEED SENSOR CIRCUIT PERFORMANCE
P0726 - ENGINE SPEED INPUT CIRCUIT RANGE/PERFORMANCE
P0729 - GEAR RATIO ERROR IN 6TH
P0731 - GEAR RATIO ERROR IN 1ST
P0732 - GEAR RATIO ERROR IN 2ND
P0733 - GEAR RATIO ERROR IN 3RD
P0734 - GEAR RATIO ERROR IN 4TH
P0735 - GEAR RATIO ERROR IN 5TH
P0736 - GEAR RATIO ERROR IN REVERSE
P0740 - TCC OUT OF RANGE
P0750 - L/R SOLENOID CIRCUIT
P0755 - 2-4 SOLENOID CIRCUIT
P075A - LC SOLENOID CIRCUIT
P0760 - OD SOLENOID CIRCUIT
P0765 - UD SOLENOID CIRCUIT
P076A - DC SOLENOID CIRCUIT
P0791 - TRANSFER SPEED SENSOR CIRCUIT
P0792 - COMPOUNDER SPEED RATIO ERROR
P083A - LC HYDRAULIC PRESSURE TEST
P083B - LC PRESSURE SWITCH RATIONALITY
P0841 - L/R PRESSURE SWITCH RATIONALITY
P0845 - 2-4 HYDRAULIC PRESSURE TEST
P0846 - 2-4 PRESSURE SWITCH RATIONALITY
P084A - DC HYDRAULIC PRESSURE TEST
P084B - DC PRESSURE SWITCH RATIONALITY
P0868 - LINE PRESSURE LOW

62TE

DTC's (continued)

P0869 - LINE PRESSURE HIGH
P0870 - OD HYDRAULIC PRESSURE TEST
P0871 - OD PRESSURE SWITCH RATIONALITY
P0882 - TCM POWER INPUT LOW
P0883 - TCM POWER INPUT HIGH
P0844 - POWER UP AT SPEED
P0888 - TRANSMISSION RELAY ALWAYS OFF
P0890 - SWITCHED BATTERY
P0891 - TRANSMISSION RELAY ALWAYS ON
P0897 - TRANSMISSION FLUID DETERIORATED
P0933 - HYDRAULIC PRESSURE SENSOR RANGE/PERFORMANCE
P0934 - LINE PRESSURE SENSOR CIRCUIT LOW
P0935 - LINE PRESSURE SENSOR CIRCUIT HIGH
P0944 - LOSS OF HYDRAULIC PUMP PRIME
P0952 - AUTOSTICK INPUT CIRCUIT LOW
P0992 - 2-4/OD HYDRAULIC PRESSURE TEST
P1684 - BATTERY WAS DISCONNECTED
P1741 - GEAR RATIO ERROR IN 4TH PRIME
P1770 - INADEQUATE ELEMENT VOLUME L/R
P1771 - INADEQUATE ELEMENT VOLUME L/R
P1775 - SOLENOID SWITCH VALVE LATCHED IN TCC POSITION
P1776 - SOLENOID SWITCH VALVE LATCHED IN L/R POSITION
P1790 - FAULT IMMEDIATELY AFTER SHIFT
P1794 - SPEED SENSOR GROUND ERROR
P1791 - MANUAL SHIFT OVERHEAT
P273A - INADEQUATE ELEMENT VOLUME LC
P273B - INADEQUATE ELEMENT VOLUME DC
P2763 - TORQUE CONVERTER CLUTCH PRESSURE CONTROL CIRCUIT HIGH
P2764 - TORQUE CONVERTER CLUTCH PRESSURE CONTROL CIRCUIT LOW
U0100 - LOST COMMUNICATION WITH ECM/PCM
U0002 - CAN C BUS OFF PERFORMANCE
U0121 - LOST COMMUNICATION WITH ABS
U0141 - LOST COMMUNICATION WITH FCM

62TE

Shift Solenoid Pressure Switches

Six solenoids are used to control the friction elements (clutches). The continuity of the solenoids circuits are periodically tested. Each solenoid is turned on or off depending on its current state. An inductive spike should be detected by the PCM during this test. If no spike is detected, the circuit is tested again to verify the failure.

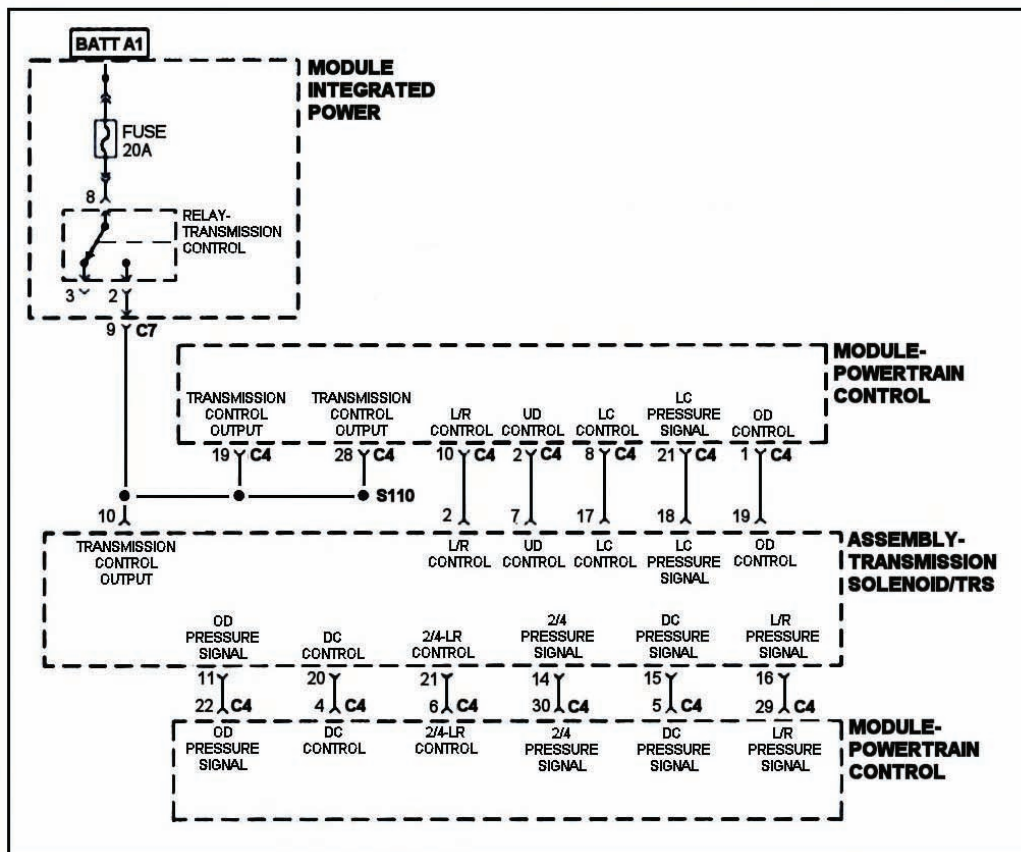
In addition to the periodic testing, the solenoid circuits are tested if a gear ratio or pressure switch error occurs. In this case, one failure will result in the appropriate DTC being set. The MIL will illuminate and the transmission goes into neutral, if the DTC is set above 35 km/h (22 mph), Limp-in mode when vehicle speed is below 35 km/h (22mph).

The Transmission system uses five pressure switches to monitor the fluid pressure in the L/R, 2/4, DC, LC, and OD elements. The pressure switches are continuously monitored for the correct states in each gear.

If a set condition is identified, 1st gear and torque converter lock-up (EMCC) will be inhibited. The vehicle will launch in 2nd gear and shift normally through the gears without allowing EMCC. If during the same key start, the set condition is no longer valid, the transmission will return to normal operation (1st and EMCC available).

Limp-in will not occur unless DTC P0841 is accompanied by a code P0706 and the MIL will illuminate after 5 minutes of substituted operation.

SOLENOID CIRCUIT



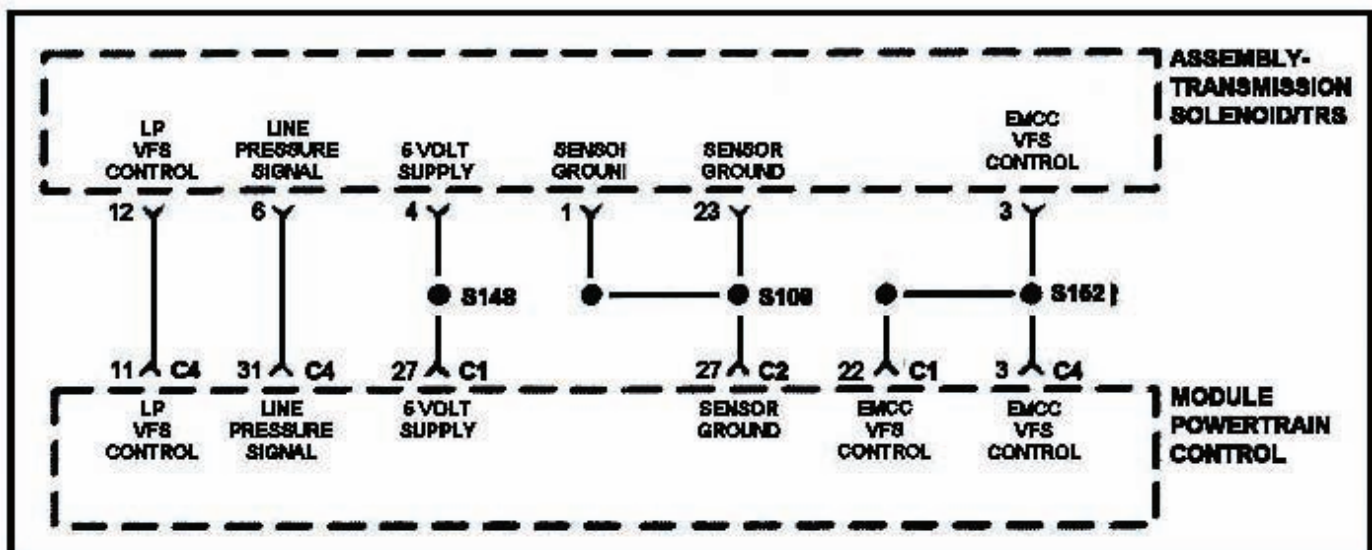
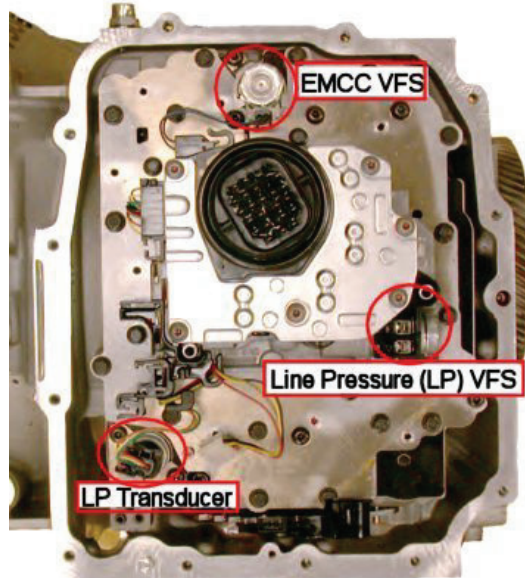
62TE

Hydraulic Line Pressure Control

Line pressure is measured by the Line Pressure Sensor (LPS) and regulation is achieved by changing the duty cycle of the Pressure Control Solenoid (PCS) controlled by the Transmission Control System. (5% duty cycle = solenoid off = Maxline pressure, 62% duty cycle = solenoid on = Min line pressure).

The Transmission Control System calculates the desired line pressure based on inputs from both the engine and transmission. The Transmission Control System calculates torque input to the transmission and uses it as the primary input to the desired line pressure calculation. This is called Torque Based Line Pressure.

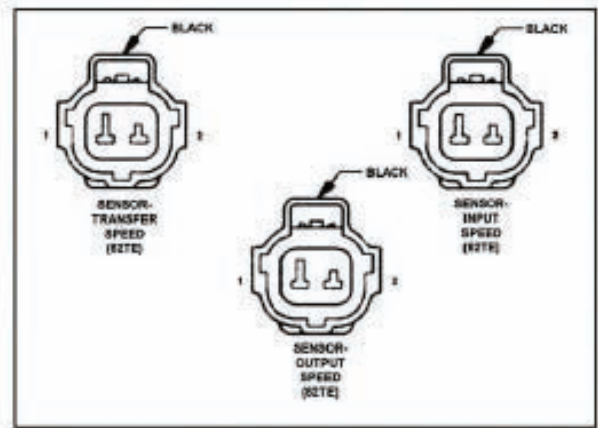
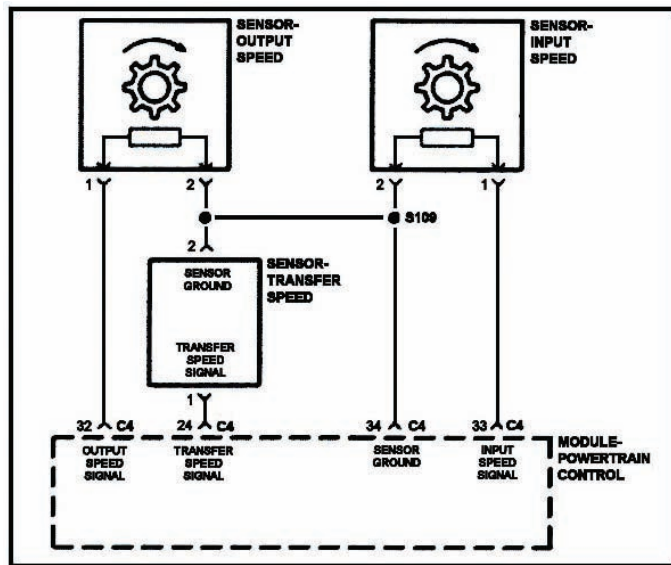
In addition, the line pressure is set to a preset level 827 or 931 kPa (120 or 135 psi) during shifts and in Park and Neutral to ensure consistent shift quality. The desired line pressure is continuously being compared to the actual line pressure. If the actual line pressure is consistently lower than the target while driving, the line pressure low DTC P0868 will set.



62TE

Speed Sensors (ISS, OSS, TSS)

The transmission control system uses three speed sensors, one to measure input rpm, one to measure Transfer Speed output rpm of the main transmission assembly, and a third to measure the final transmission output rpm. These inputs are essential for proper transmission operation. Therefore, the integrity of this data is verified through system checks.



1. ISS:

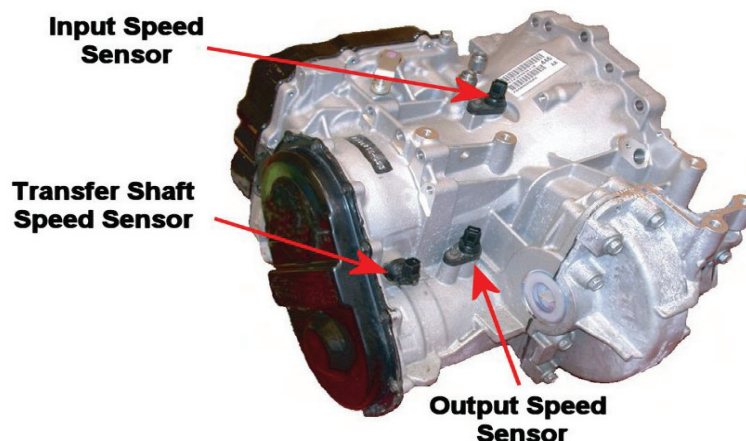
The ISS has been relocated to the top of the case, and like the 41TE, continues to read turbine speed from the input shaft.

2. TSS:

The 40/41TE OSS has been relocated to the rear of the case (backside) and renamed the TSS. It continues to read rotation of the front annulus/rear carrier assembly.

3. OSS:

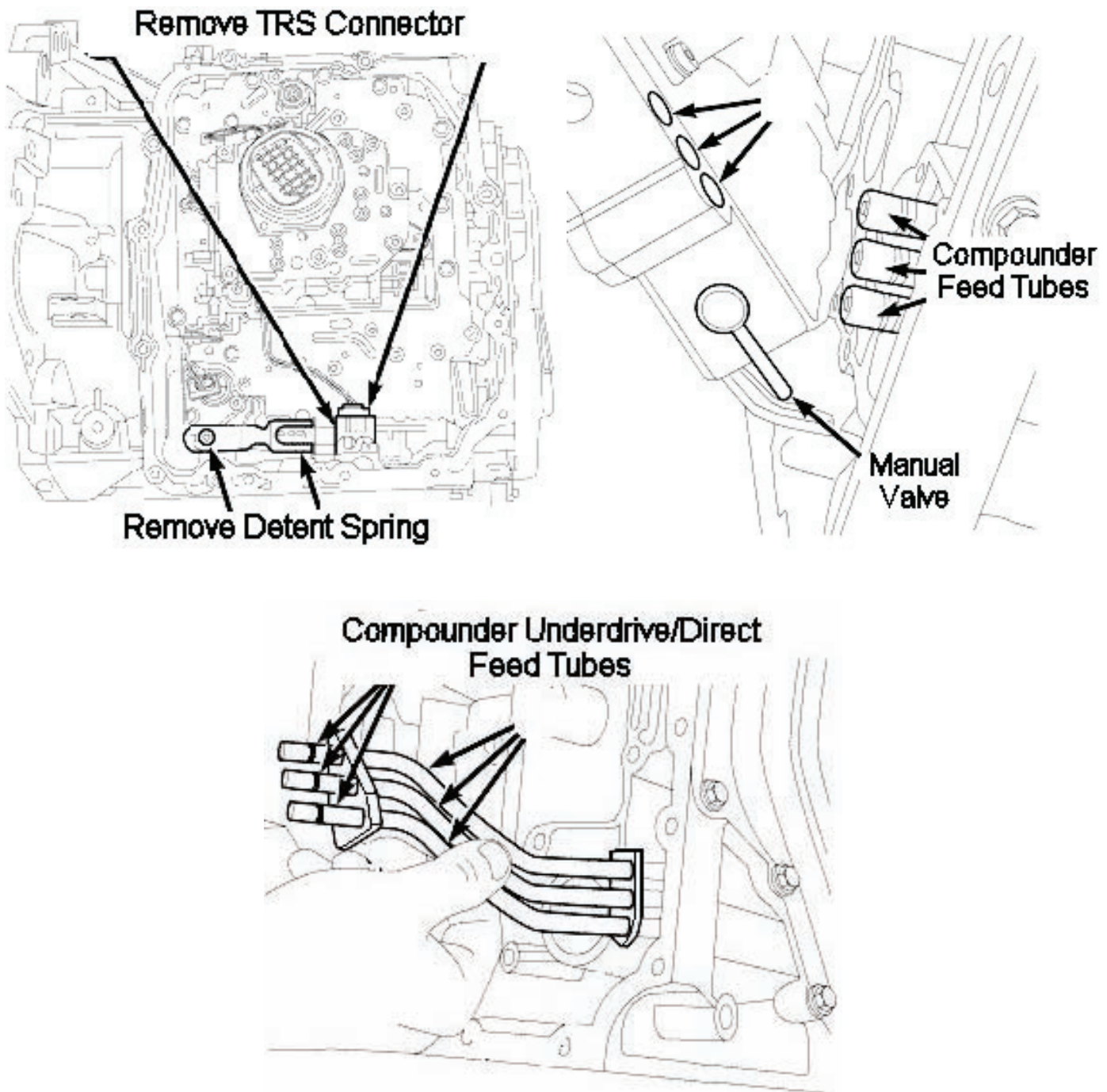
The OSS is located at the rear of the case and is unique to the 62TE. It reads the rotation of the underdrive compounder output carrier.



62TE

Valve Body and Compounder Feed Tubes

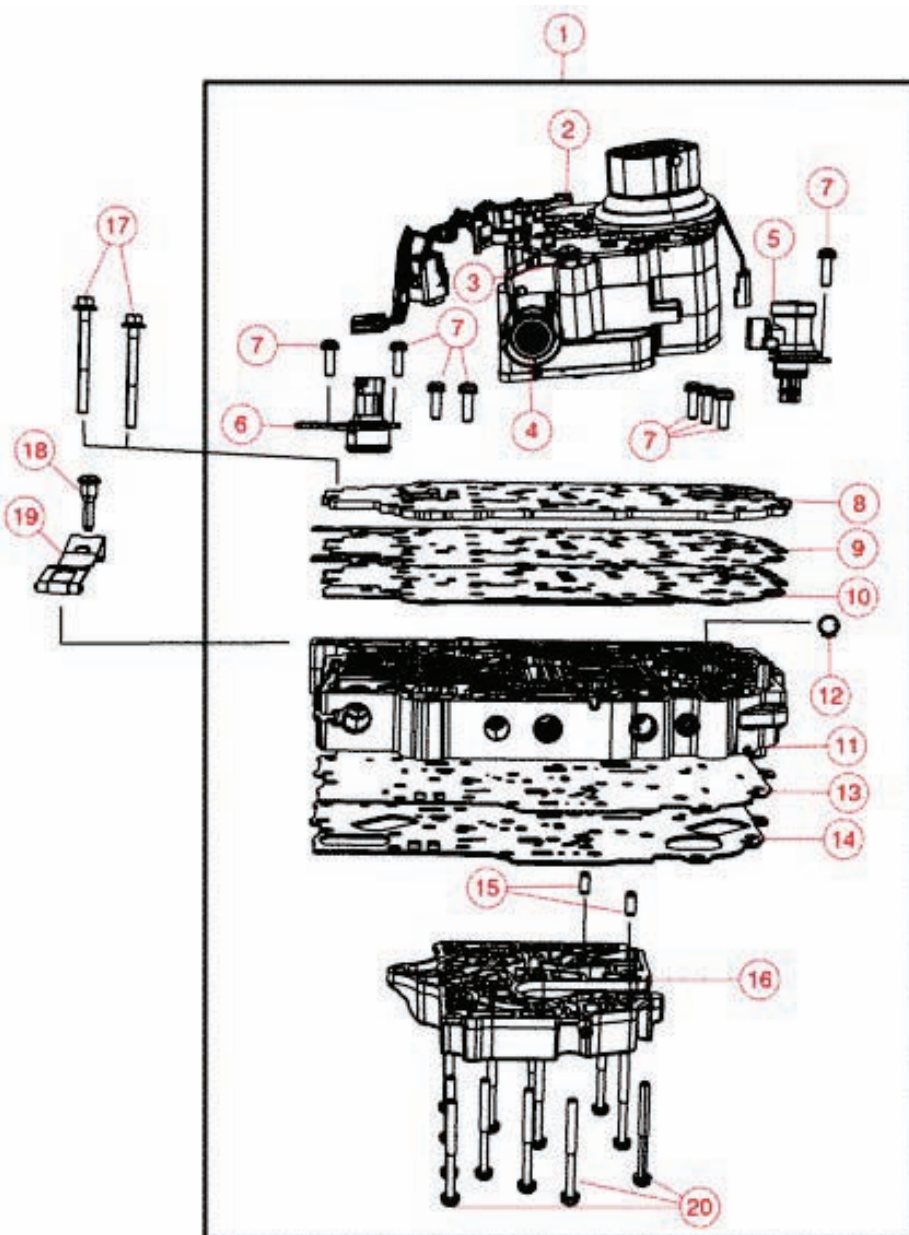
Disconnect the TRS sensor wiring, remove the rooster comb spring. Remove the 21 valve body bolts and carefully separate the VB from the Compounder Feed Tubes. Remove feed tubes. There are 6 accumulators. All six have the same spring count (2 springs). Remove the 2/4 seal from case. This must be done first before removing the compounder assembly. Assemble in reverse order after the compounder assembly is installed.



62TE

Valve Body Exploded View

- 1: Valve Body
- 2: Solenoid Module, Transmission
- 3: Screw (only serviced with solenoid module)
- 4: Sensor, Pressure, Line Pressure VFS, Only Serviced with Solenoid Module
- 5: Sensor, Trans Variable Force Solenoid 0-90 PSI
- 6: Sensor, Trans Pressure Transducer
- 7: Screw, Pan Head
- 8: Clamping Plate, Transmission valve body, Aluminum
- 9: Gasket, Valve Body
- 10: Plate, Transmission Valve Body
- 11: Valve Body, Only Serviced with Item #1
- 12: Ball, Check
- 13: Plate, Transmission Valve Body
- 14: Gasket, Valve Body
- 15: Pin, Chamfer.PT. Chamfer. PT. NO. FIN. SLOTTED M5X12.00
- 16: Transfer Plate, Aluminum Valve Body
- 17 Screw, HEAD ER. PT. REDUCD. M5X0.80X50.00, Valve Body to the Transmission Case
- 18: Screw, SPECIAL. SHOULDER. M5X0.8X31.50
- 19: Leaf, Spring Assy Trans Park Sprag
- 20: Screw,M5X0.8X55.00



62TE

Valve Body Exploded View (continued)

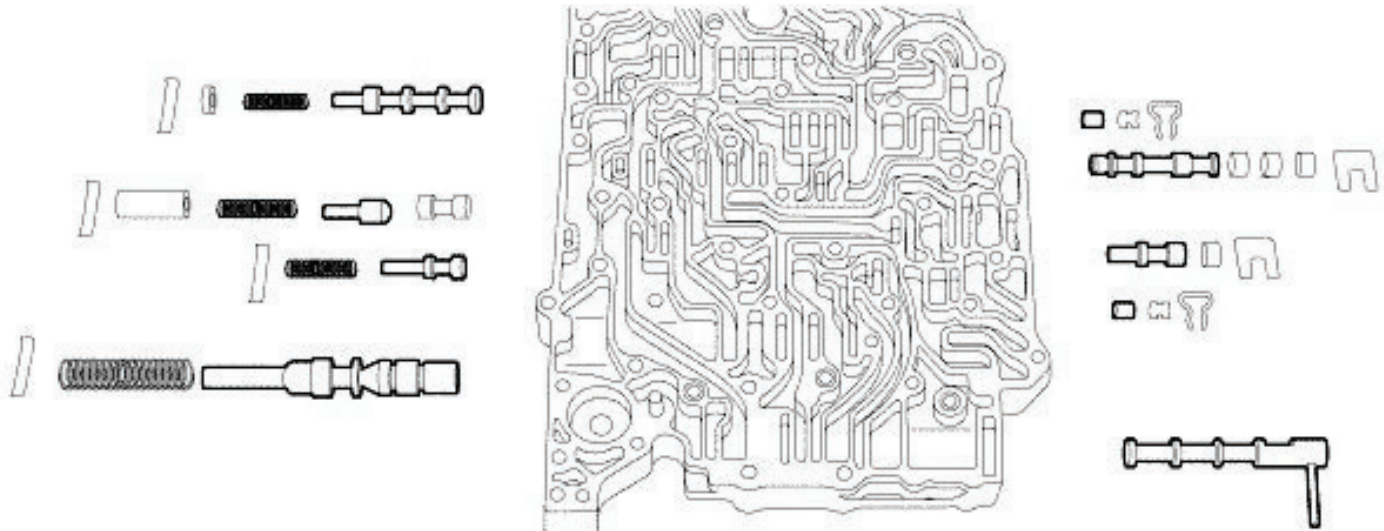
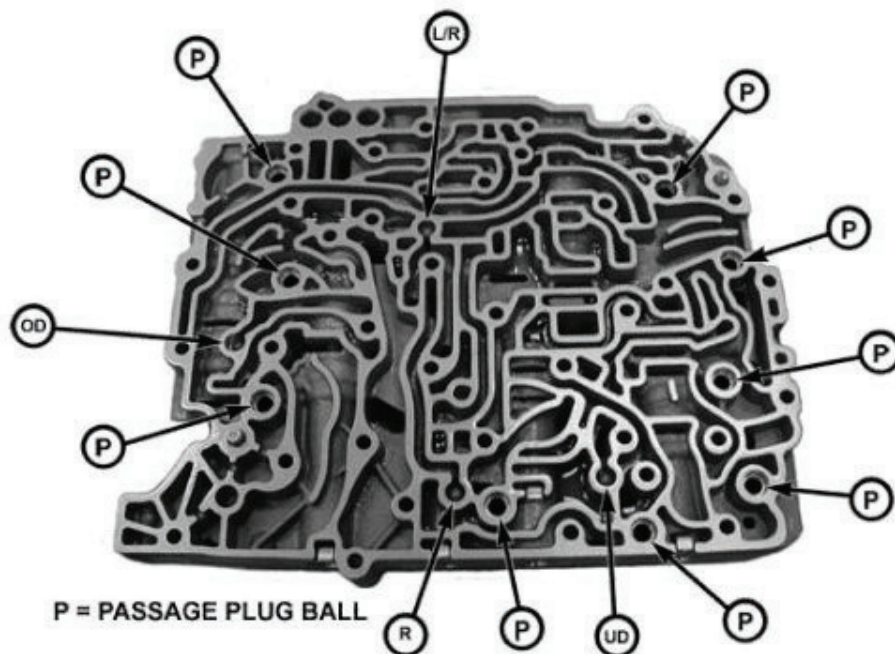
The 62TE valve body has nine (9) check balls (used for plugs) and four used in the hydraulic shift control circuit:

Ball 1: L/R clutch circuit, prevents L/R clutch application in Drive-Third gear, Fourth gear, Fifth gear, and Sixth gear.

Ball 2: UD Clutch circuit, allows an orifice to control fluid flow during UD clutch application.

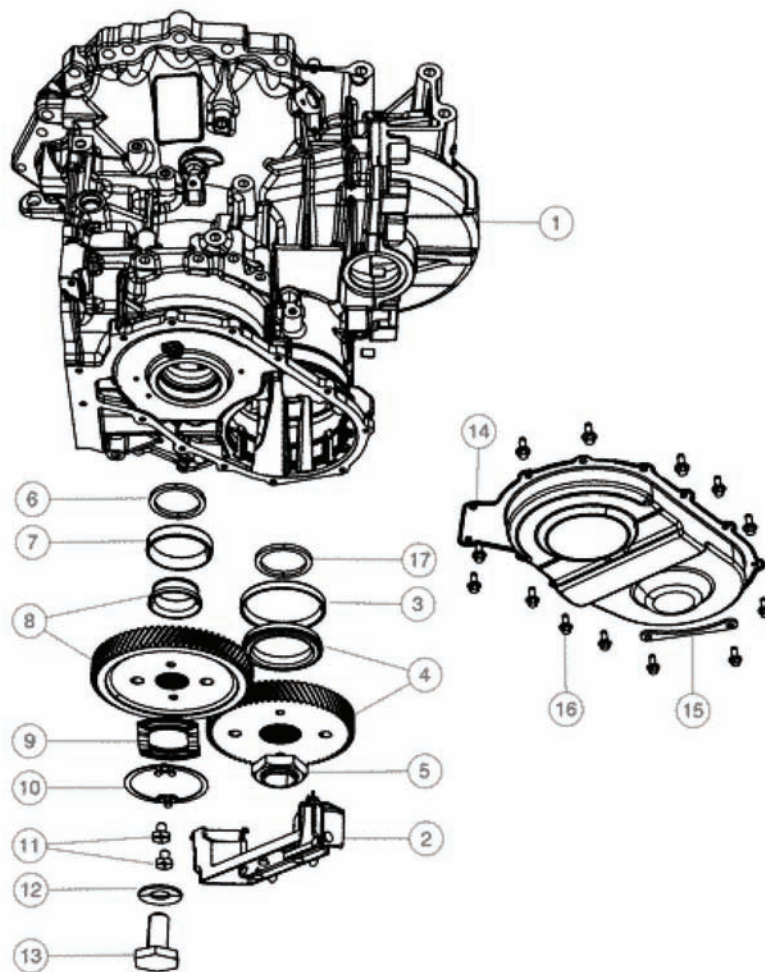
Ball 3: OD Clutch circuit, allows an orifice to control fluid flow during OD clutch application.

Ball 4: Reverse Clutch circuit, allows an orifice to control fluid flow during reverse clutch application



62TE

Transfer Gear Exploded View

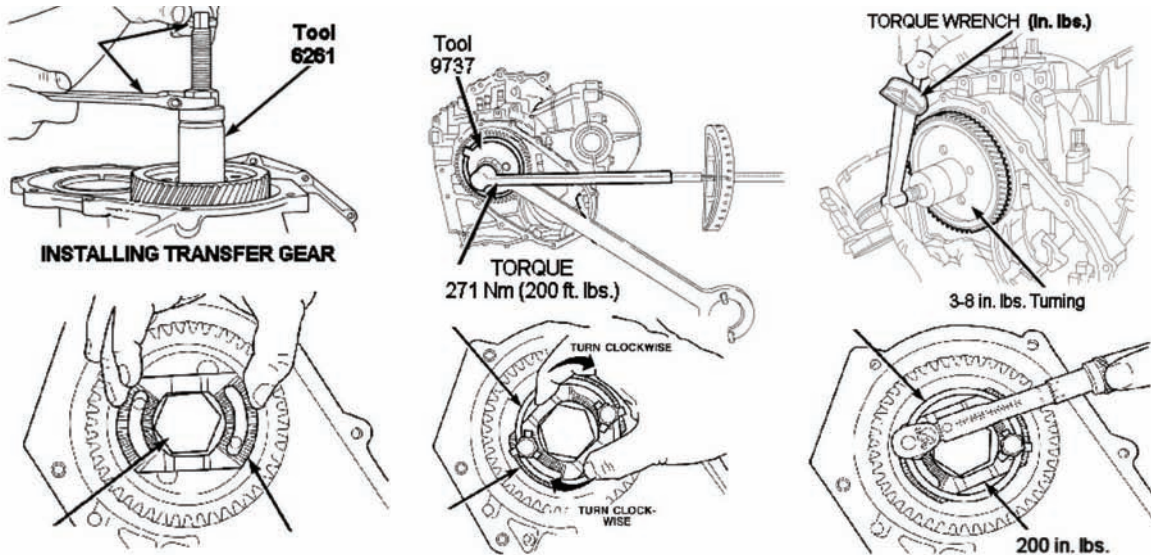


1. Case, Transaxle
2. Deflector
3. Bearing Cup, Transfer Gear (service with retainer P/N 4900387AA)
4. Gear, Transfer (70 teeth), 41 tooth spline. Includes bearing cone.
5. Nut, Hex-M33X1.50
6. Spacer, Output/Transfer Shaft
7. Bearing Cup, Output Shaft, Serviced with the Transmission Case
8. Output Gear, 74 tooth, Includes bearing cone
9. Stirrup, Retaining Nut
10. Strap, Retaining
11. Bolt, Hex Head, M8x10.00
12. Washer, Output Shaft
12. Bolt, Hex Head
13. Cover, Transmission end
14. Strap, Lower end transmission cover
15. Bolt, Hex Head, M6x1.00x14
16. Spacer, Transfer Shaft Bearing
17. Bearing Cup, Transfer Gear (service with retainer P/N 4900387AA)

62TE

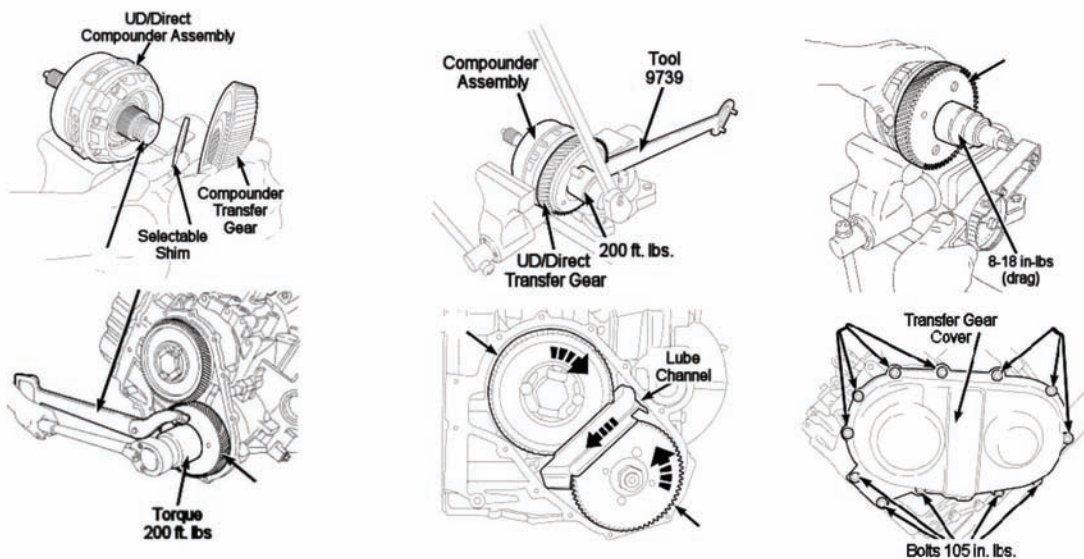
Output and Compounder Transfer Gears

The output transfer gear setting must be confirmed after the original shim selection (previous pages) to determine proper turning torque. Install the transfer gear with Tool# 6261. Torque bolt to 200 ft lbs using tool# 9739 (holder). Check to confirm that turning torque is within 3-8 in. lbs. If too tight, install thicker shim, if too loose, install thinner shim from previous chart.



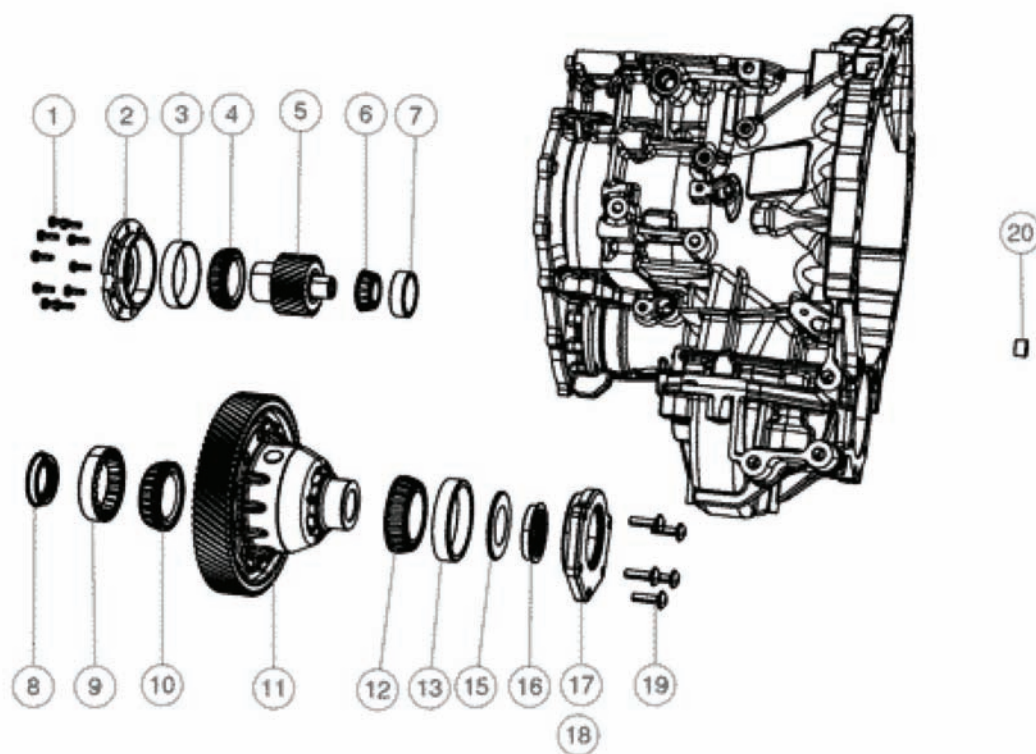
The Compounder Transfer Gears

The compounder transfer gear is set up on the bench. Desired turning pressure is 8-10 in lbs of drag. Assembly and check differential settings before assembling the compounder assembly into the case



62TE

Differential Assembly

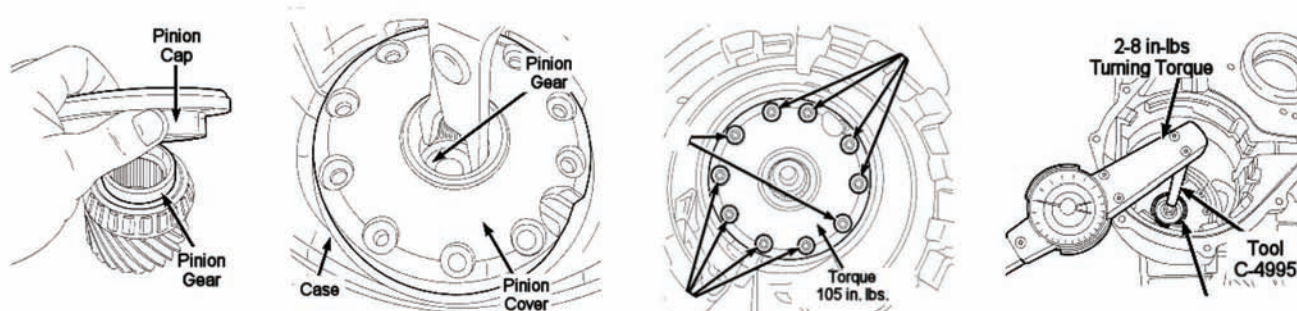


- 1: Screw, M6X1.0X20.0
- 2: Retainer, final drive pinion bearing
- 3: Cup, differential side
- 4: Bearing, differential
- 5: Pinion, final drive 23 teeth
- 6: Cone, final drive pinion
- 7: Cup, final drive pinion bearing
- 8: Seal
- 9: Cup, differential side
- 10: Bearing, differential
- 11: Differential Assy, complete
- 12: Cone, bearing tapered roller, trans right diff. bearing.
- 13: Cup, bearing tapered roller, trans right diff. bearing
- 14: Spacer
- 15: Dam
- 16: Seal
- 17: Extension Assy, transmission (series C, D, G, Z)
- 18: Extension, transmission (series E)
- 20: Plug, Hex Socket, 3/8-18NPTx.475

62TE

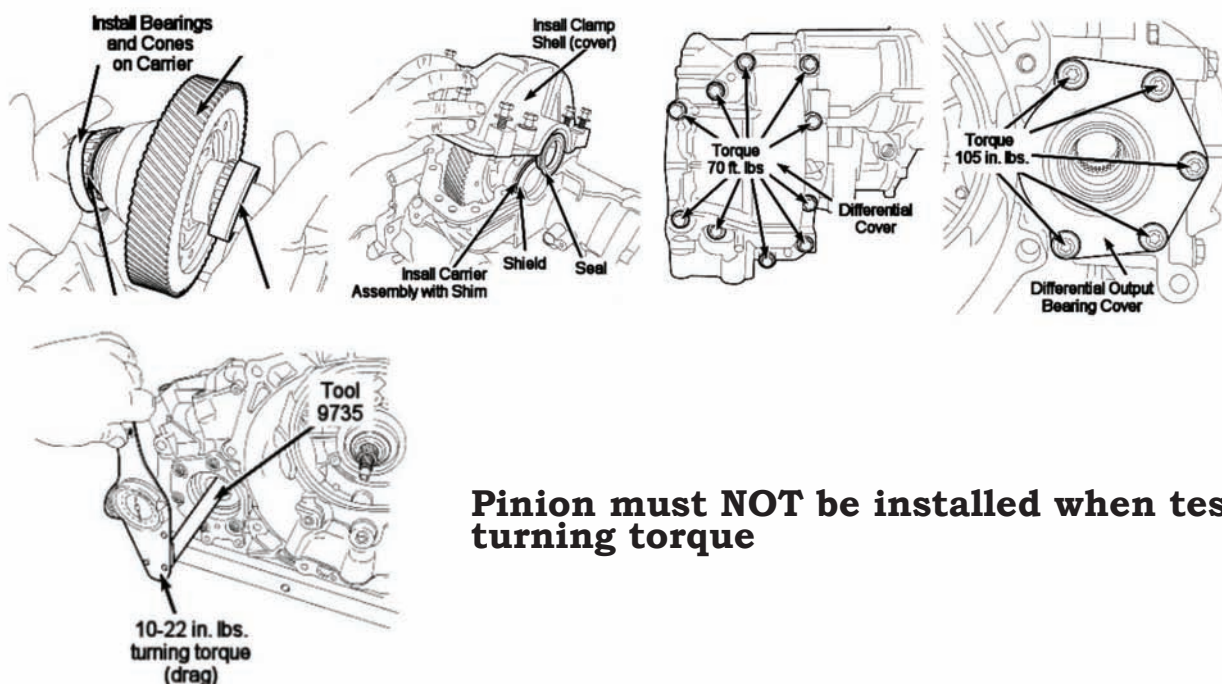
Output Pinion/Differential Set-up

Pinion Gear with bearings installed on pinion gear and cones installed in case and cap, install the pinion in the case. Torque the bearing cap to spec. Install turning torque test adapter. Turning torque needs to be set at 2 to 8 in. lbs (drag)



The Differential must not be installed during the turning torque test!

Install the differential, bearing cups, shim, seals and oil slinger into case. Install the differential cover. Install the differential cover bolts and tighten to 95 Nm (70 ft. lbs.). Install the differential output bearing cover. Install the differential output bearing cover bolts and tighten to 12 N·m (105 in. lbs.). Using the Turning Torque Tool 9735 and an inch pound torque wrench check the differential turning torque, it should be 10 to 22 in. lbs (drag).

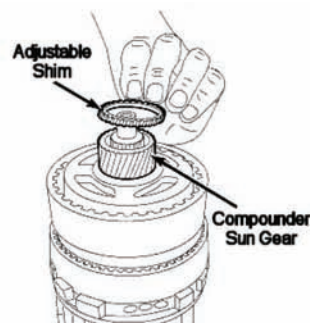
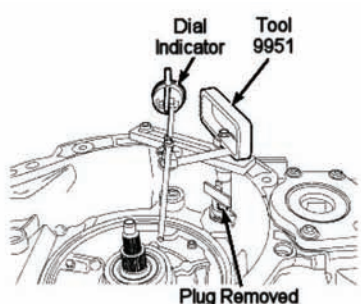


Pinion must NOT be installed when testing turning torque

62TE

Transfer Compound Endplay Adjustment

1. Remove the plug in case
2. Install compounder End Play Tool 9951 through the hole in the front case
3. Install Dial Indicator onto tool
4. Use moderate downward pressure on end play tool and zero dial indicator
5. Use moderate upward pressure on end play tool and take reading from dial indicator, adjust the shim thickness in the underdrive unit to 0.010 to 0.020”.

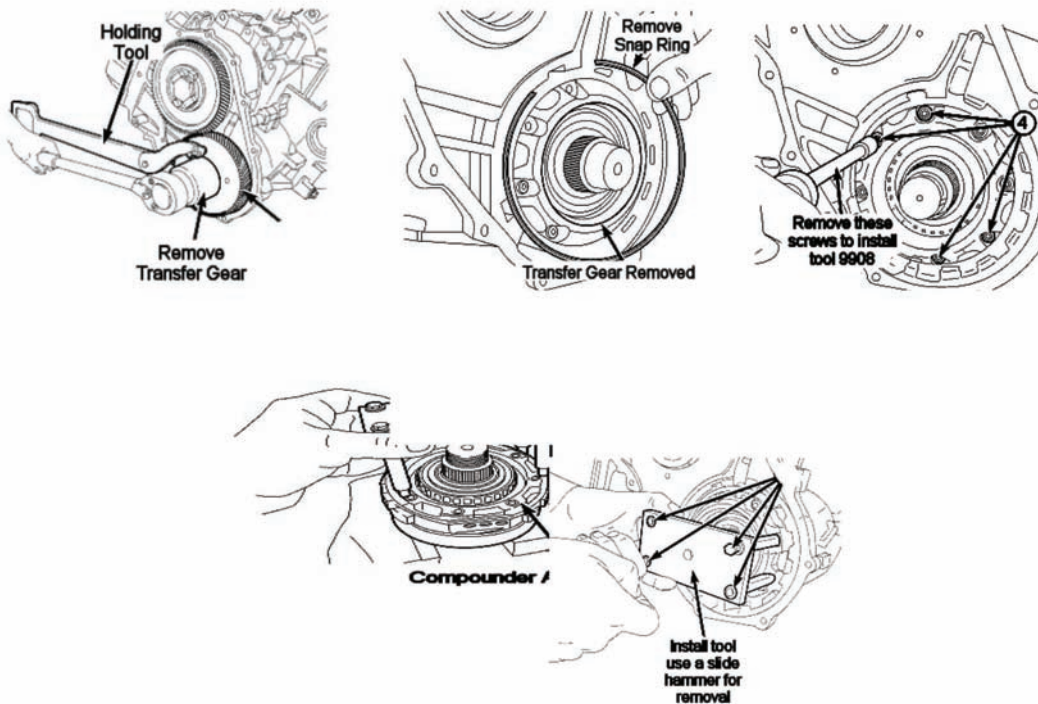


PART NUMBER	SERIES	SHIM SIZES	PART NUMBER	SERIES	SHIM SIZES
4800 487AA	C, D, G, Z	[4.16 - 4.21 mm]	4800 480AA	E	[2.76-2.81 mm]
4800 492AA	C, Z	[4.96 - 5.01 mm]	4800 490AA	E	[4.56 - 4.61 mm]
4800 490AA	C, D, G, Z	[4.56 - 4.61 mm]	4800 482AA	C, Z	[3.16-3.21 mm]
4800 488AA	C, Z	[4.36 - 4.41 mm]	4800 483AA	E	[3.36 - 3.41 mm]
4800 491AA	E	[4.76 - 4.81 mm]	4800 492AA	C, D, G, Z	[4.96 - 5.01 mm]
4800 484AA	C, Z	[3.56 - 3.61 mm]	4800 480AA	C, Z	[2.76-2.81 mm]
4800 486AA	C, D, G, Z	[3.96 - 4.01 mm]	4800 481AA	C, D, G, Z	[2.96-3.01 mm]
4800 492AA	E	[4.96 - 5.01 mm]	4800 493AA	C, D, G, Z	[5.16 - 5.21 mm]
4800 493AA	E	[5.16 - 5.21 mm]	4800 488AA	C, D, G, Z	[4.36 - 4.41 mm]
4800 482AA	E	[3.16-3.21 mm]	4800 481AA	E	[2.96-3.01 mm]
4800 487AA	C, Z	[4.16 - 4.21 mm]	4800 485AA	C, Z	[3.76 - 3.81 mm]
4800 483AA	G, Z, C, D	[3.36 - 3.41 mm]	4800 485AA	E	[3.76 - 3.81 mm]
4800 486AA	C, Z	[3.96 - 4.01 mm]	4800 490AA	C, Z	[4.56 - 4.61 mm]
4800 485AA	C, D, G, Z	[3.76 - 3.81 mm]	4800 480AA	C, D, E, G, Z	[2.76-2.81 mm]
4800 493AA	C, Z	[5.16 - 5.21 mm]	4800 481AA	C, D, E, G, Z	[2.96-3.01 mm]
4800 481AA	C, Z	[2.96-3.01 mm]	4800 482AA	E, G, Z, C, D	[3.16-3.21 mm]
4800 486AA	E	[3.96 - 4.01 mm]	4800 483AA	C, D, E, G, Z	[3.36 - 3.41 mm]
4800 488AA	E	[4.36 - 4.41 mm]	4800 484AA	C, D, E, G, Z	[3.56 - 3.61 mm]
4800 491AA	C, Z	[4.76 - 4.81 mm]	4800 485AA	C, D, E, G, Z	[3.76 - 3.81 mm]
4800 482AA	C, D, G, Z	[3.16-3.21 mm]	4800 486AA	C, D, E, G, Z	[3.96 - 4.01 mm]
4800 480AA	C, D, G, Z	[2.76-2.81 mm]	4800 487AA	C, D, E, G, Z	[4.16 - 4.21 mm]
4800 487AA	E	[4.16 - 4.21 mm]	4800 488AA	C, D, E, G, Z	[4.36 - 4.41 mm]
4800 491AA	C, D, G, Z	[4.76 - 4.81 mm]	4800 490AA	C, D, E, G, Z	[4.56 - 4.61 mm]
4800 484AA	E	[3.56 - 3.61 mm]	4800 491AA	C, D, E, G, Z	[4.76 - 4.81 mm]
4800 484AA	C, D, G, Z	[3.56 - 3.61 mm]	4800 492AA	C, D, E, G, Z	[4.96 - 5.01 mm]
4800 483AA	C, Z	[3.36 - 3.41 mm]	4800 493AA	C, D, E, G, Z	[5.16 - 5.21 mm]

62TE

UD/Direct Compounder

The underdrive compounder assembly replaces the 41TE transfer shaft. The transaxle case is modified to accommodate the additional components. The main components of the underdrive compounder assembly are the Low Clutch (LC), Direct Clutch (DC), Over-running Clutch (ORC), simple planetary gear set and bearing retainer transfer/under-drive shaft.



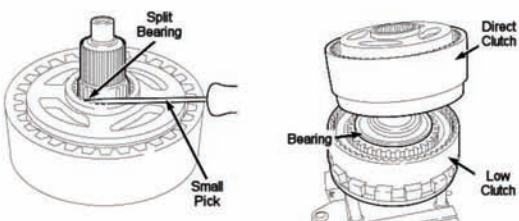
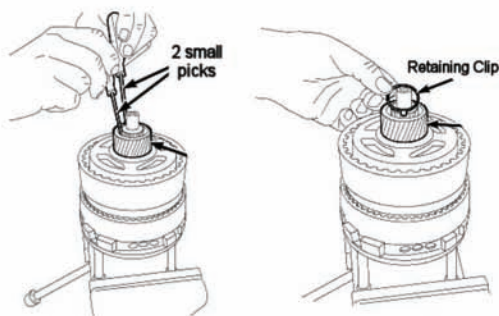
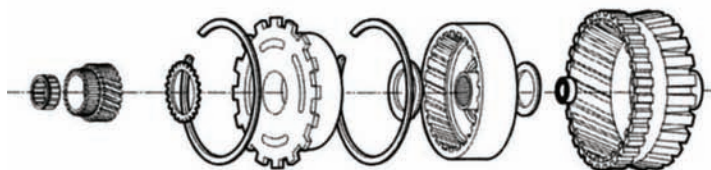
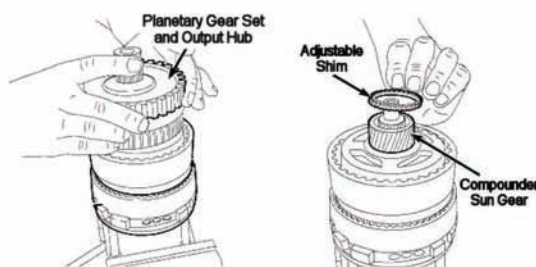
To remove the compounder assembly, first remove the valve body and feed tubes. Remove the transfer gear and snap ring holding the compounder into the case. A special tool # 9908 is needed to pull the compounder unit from the case. Install tool and use a slide hammer to remove. To install use tool 9908 for support. Torque the transfer gear nut (always replace) to 200 Ft. lbs., use staking tool 9721 to secure the gear nut.



62TE

UD Compounder Disassembly

1. Separating the Compounder Assembly:
2. Remove planetary gear set/output hub
3. Remove the Helical Shim
4. Separate the planetary assembly
5. Using two small picks, remove retaining clip from transfer/underdrive shaft, (the retaining clip must be replaced during OH)
6. Remove the split bearing using a small pick
7. Separate the Direct and Low Clutch

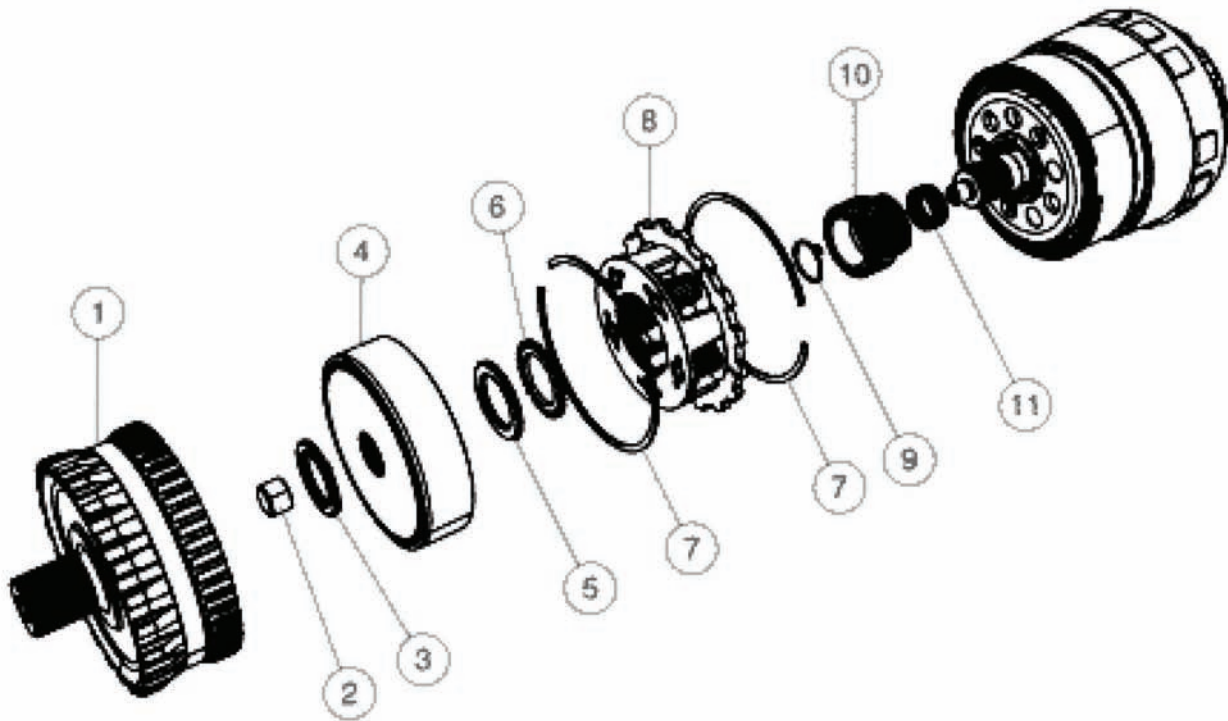


62TE

UD/Direct Compounder Planetary

Parts Description

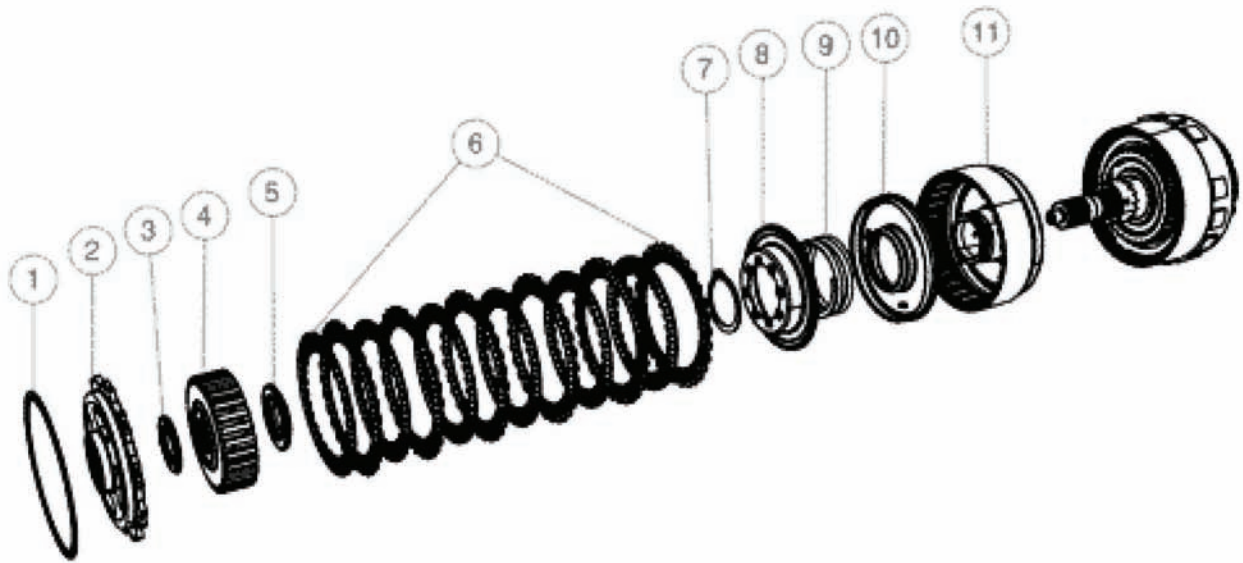
The selectable shim part numbers were covered in the end play set up. Always verify that numbers are current and correct before ordering.



1. Shaft, Output
2. Bearing, Needle roller
3. Thrust Bearing, Trans front planet pinion carrier
4. Gear, Annulus
5. Bering, Thrust needle
6. Spacer, Selectable
7. Snap Ring, Internal Carrier to output shaft
8. Planet Carrier, Complete Underdrive carrier
9. Snap Ring, External sun gear assembly
10. Sun Gear Assembly, machined
11. Bearing, Caged needle

62TE

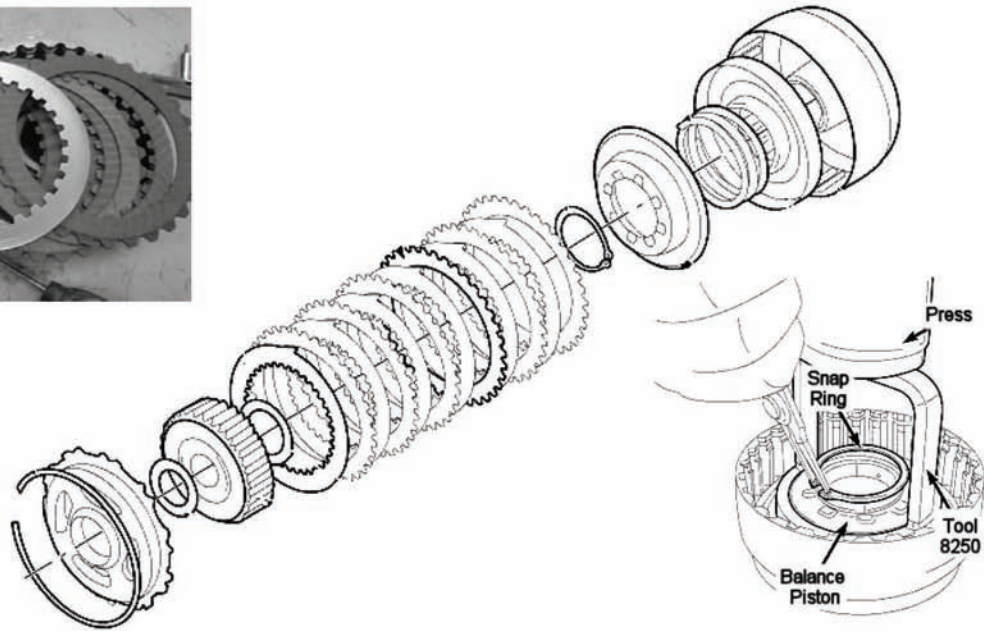
Direct Clutch Assembly



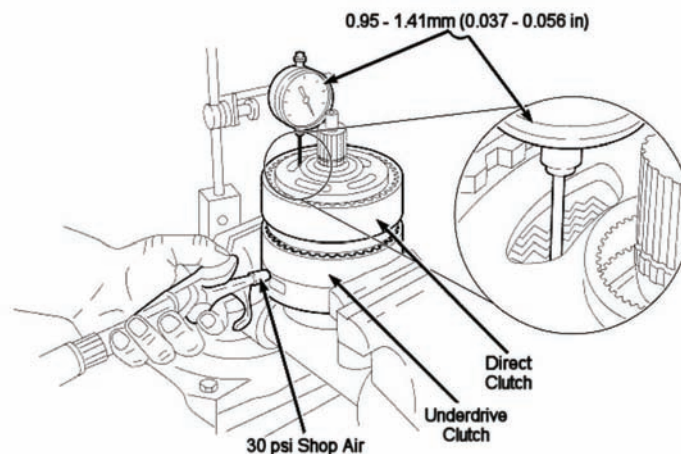
1. Snap Ring, Tapered
2. Reaction Plate Package, direct clutch, set of six
3. Thrust Bearing, trans front planet pinion carrier
4. Hub, Direct clutch
5. Needle Bearing, Thrust
6. Clutch Backage, Underdrive direct clutch
7. Snap Ring, Direct clutch piston spring retainer
8. Retainer, Direct clutch balance piston return
9. Spring, Direct clutch piston return
10. Piston, Direct clutch
11. Retainer, Direct clutch

62TE

Direct Clutch Assembly and Disassembly

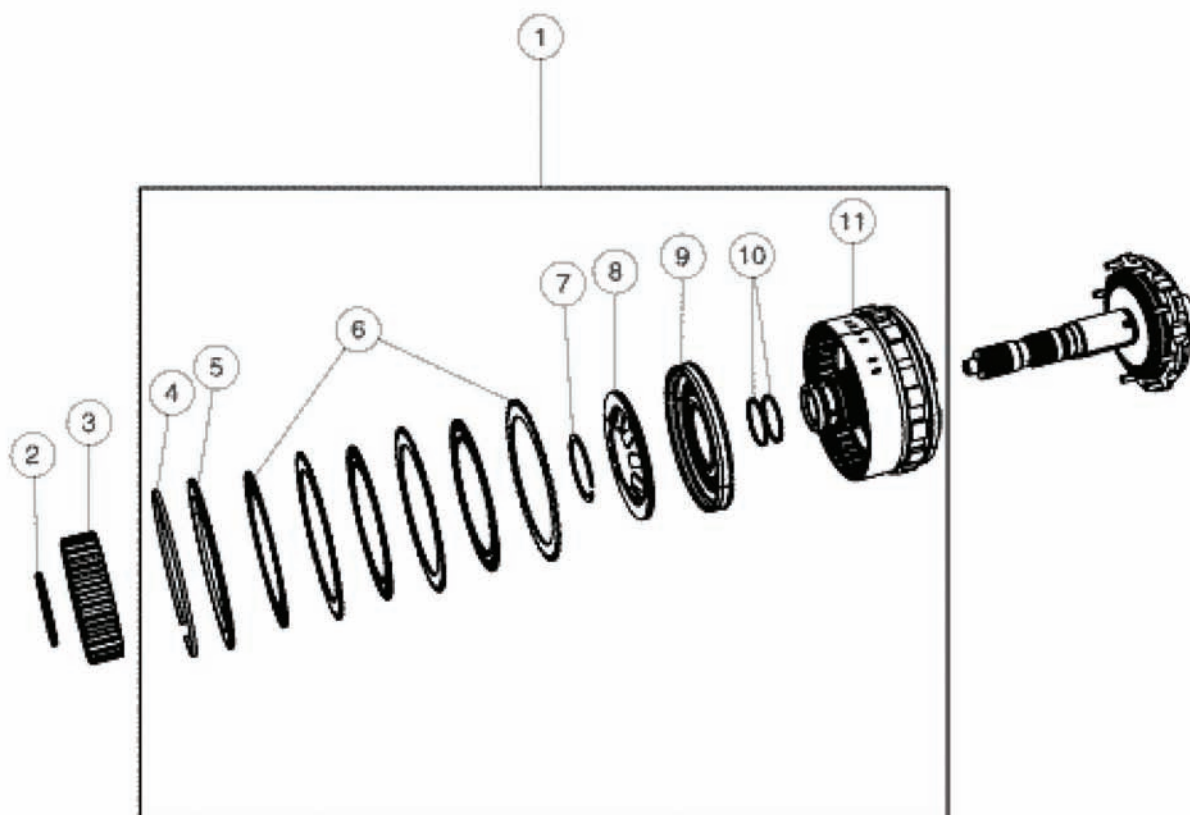


1. Remove Snap ring
2. Remove Selectable Plate (part numbers not available at this time)
3. Remove #1 thrust bearing, hub, and #2 thrust bearing
4. Remove single sided frictions
5. Compress Balance piston with tool 8250 and remove snap ring
6. Remove Piston ASSEMBLY (Reverse Procedure) assembling the entire compounder unit. Using air pressure, measure clearance of the Direct Clutch. Clearance is 0.95 - 1.41mm (0.037 - 0.056 in)



62TE

Underdrive Clutch Assembly

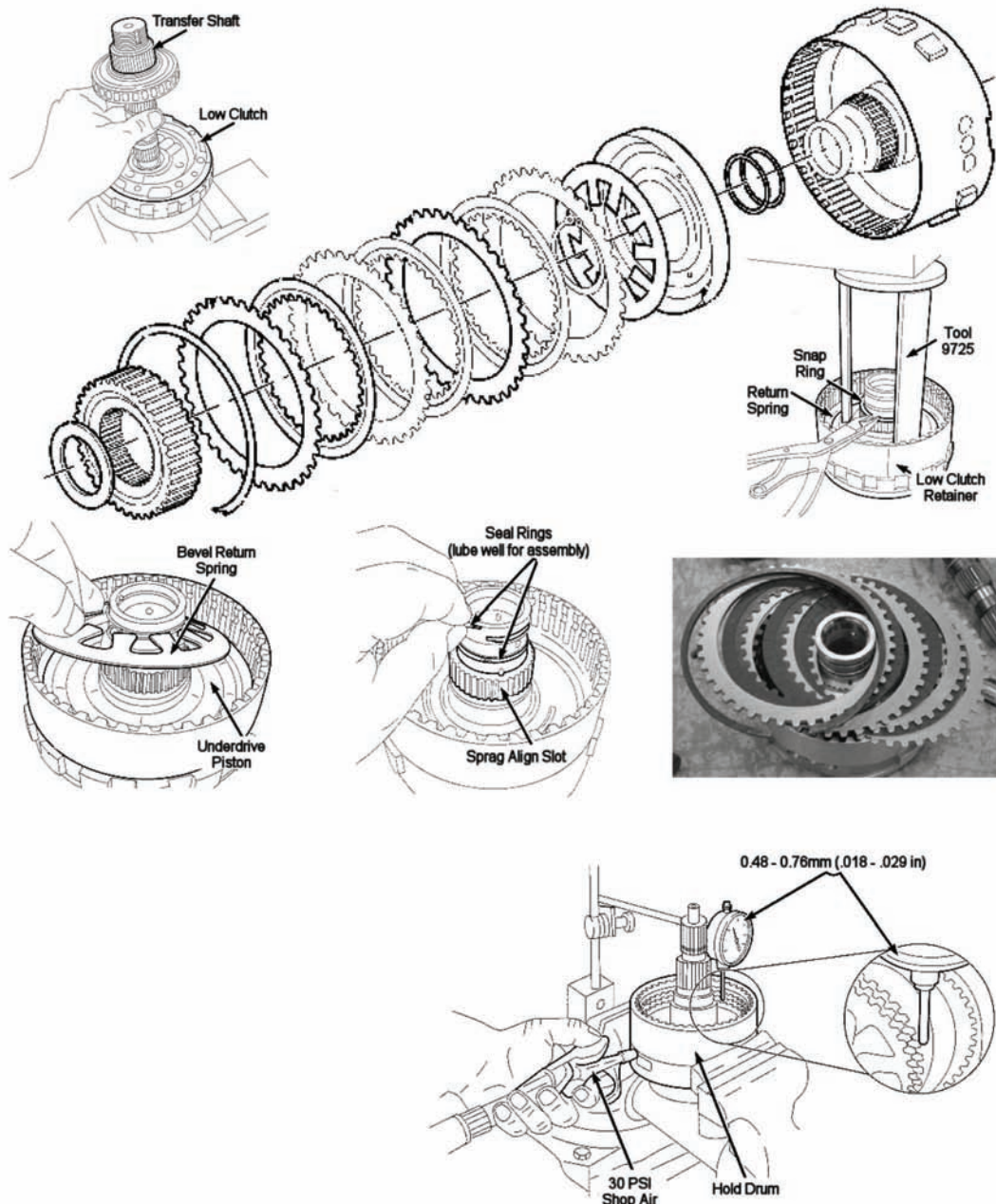


1. Retainer Assembly, L/R Clutch
2. Bearing Assembly, Thrust-Direct clutch retainer
3. Clutch Assembly, Overrunning clutch
4. Snap Ring Package, selective sizes 2.78 - 4.39 mm
5. Reaction Plate, Low clutch
6. Clutch Package, Underdrive low clutch
7. Snap Ring, Low clutch return spring
8. Spring, Low clutch retainer
9. Piston, Low clutch retainer
10. Seal Ring, Low clutch retainer
11. Retainer, Low clutch

62TE

Underdrive Clutch Assembly and Disassembly

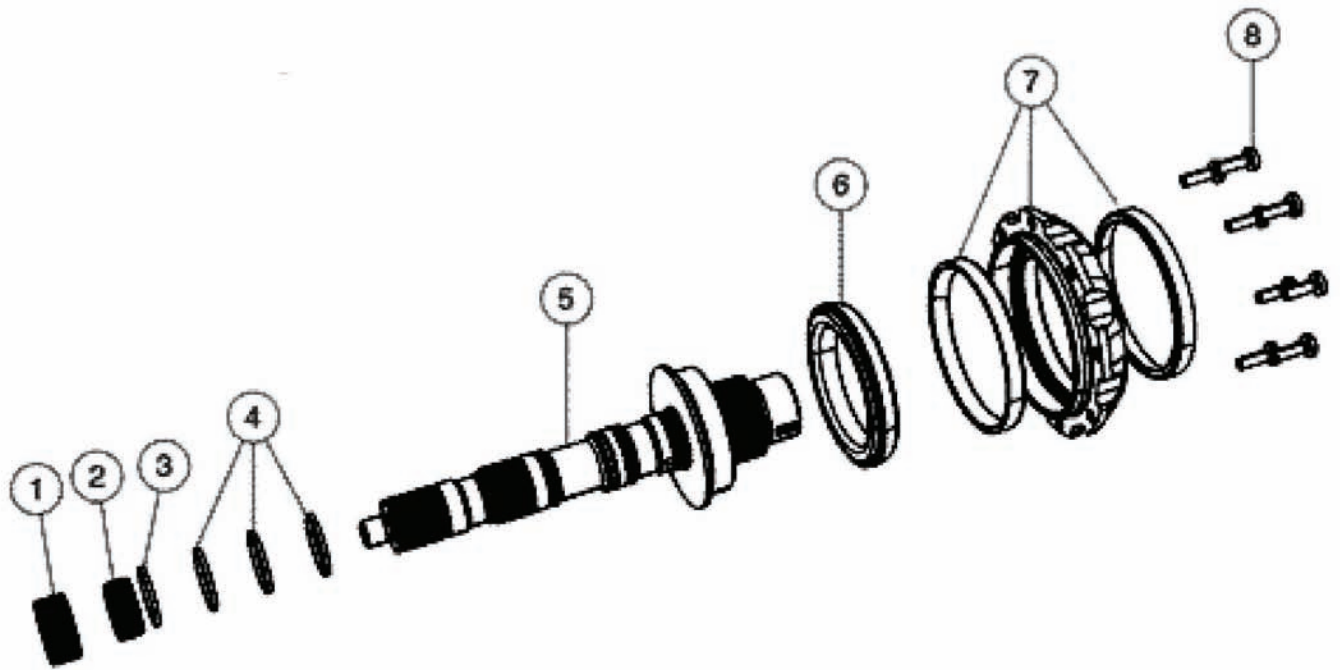
1. Remove Transfer Shaft
2. Remove Sprag, Snap Ring, Reaction Plate and Clutch Plates
3. Compress Return spring with Tool 9725
4. Remove Piston assembly Lubricate liberally! Install the piston and return spring in reverse order. Air test for clearance with 30 PSI of air pressure. Clearance should be: 0.048-0.76 mm (.018-.029 in)



62TE

Underdrive Clutch Assembly

When Assembling, use plenty of assembly lube to assure teflon rings do not expand during assembly.



1. Bearing, Caged needle
2. Bearing, Caged needle
3. Seal Ring, Teflon, Green seal
4. Seal Ring, Teflon, White seal
5. Shaft
6. Roller Bearing, Inner tapered roller, Transfer shaft/gear
7. Retainer, Transfer gear bearing, Underdrive assembly
8. Screw, M6X1.0X20.0

62TE

Specifications

DESCRIPTION	SPECIFICATION
Output Shaft Gear Drag Torque	3 to 8 in. lbs.
Low/Reverse Clutch Pack Clearance	0.89-1.47 mm (0.035-0.058 in.)
Reverse Clutch (Select Snap Ring)	0.89-1.37 mm 0.035-0.054 in.
Overdrive Clutch (No Selection)	0.54-2.39 mm 0.00054-0.00239 in.
Underdrive Clutch (Select Pressure Plate)	0.94-1.50 mm 0.037-0.059 in.
2/4 Clutch Clearance	0.76-2.64 mm (0.030-0.104 in.)
Input Shaft End Play	0.005 to 0.025 inch
Final Drive Remote Pinion Drag Torque	2 to 8 in-lbs (drag)
Differential Turning Torque	10 to 20 in-lbs (drag)
Low Clutch Clearance	0.48 - 0.76 mm (.018 - .029 in.)
Direct Clutch Pack Clearance	0.95 - 1.41 (0.037- 0.056

Description	Metric	Standard
Front Sun Gear Bushings	29.55 - 29.60 mm	1.163 -1.165 in.
Rear Carrier Bushing	29.75 - 30.00 mm	1.171 - 1.181 in.
Overdrive Hub / Shaft Bushing	21.52 - 21.58 mm	0.847 - 0.850 in.
Oil Pump Reaction Support Sleeve	45.27 - 45.31 mm	1.782 - 1.784 in.
Oil Pump Outer Gear to Pump Pocket	0.089-0.202 mm	0.0035-0.0079 in.
Oil Pump Outer Gear to Crescent	0.060-0.298 mm	0.0023 - 0.0117 in.
Oil Pump Inner Gear to Crescent	0.093 - 0.385 mm	0.0036 - 0.0151 in.
Oil Pump Between Both Gear end Faces and the Reaction Shaft Support	0.020-0.046 mm	0.0008-0.0018 in.
Front / Rear Carrier Pinion end Play	0.15 - 0.61 mm	0.006 - 0.024 in.
Torque Converter Hub Bushing	38.019 - 38.11	1.499 - 1.501 in.
Output Carrier Pinion End Play	0.15 - 0.76	0.006 - 0.030
Direct Clutch Retainer Bushing	39.71 - 39.75	1.563 - 1.565
Low Clutch Retainer Bushing (Steel)	28.22 - 28.26	1.111 - 1.113
Low Clutch Retainer Bushing (Brass)	30.01 - 30.03	1.181 - 1.182

62TE

Air Pressure Test

The clutches may be tested by applying air pressure to their respective passages using Air Pressure Test Plate 9741. The valve body and oil filter must be removed and Air Pressure Test Plate 9741 installed. To make air pressure tests, proceed as follows:

NOTE: The compressed air supply must be free of all dirt and moisture. Use a pressure of 30 psi.

Remove the oil pan and the valve body. Install the Test Plate, part #9741 and tighten the bolts to 50 in. lbs. When your testing is finished install valve body and tighten bolts to 50 in. lbs. Install the oil pan bolts and tighten to 50 in. lbs. and fill transmission.

Overdrive Clutch

Apply air pressure to the overdrive clutch feed hole located on the test plate marked OD and watch for the push/pull piston to move forward. The piston should return to its starting position when the air pressure is removed.

Reverse Clutch

Apply air pressure to the reverse clutch feed hole located on the test plate marked REV and watch for the push/pull piston to move rearward. The piston should return to its starting position when the air pressure is removed.

2/4 Clutch

Apply air pressure to the feed hole located on the test plate marked 2/4 clutch. Look in the area where the 2/4 piston contacts the first separator plate and watch carefully for the 2/4 piston to move rearward. The piston should return to its original position after the air pressure is removed.

Low/Reverse Clutch

Apply air pressure to the low/reverse clutch feed hole located on the test plate marked LR. Then, look in the area where the low/reverse piston contacts the first separator plate. Watch carefully for the piston to move forward. The piston should return to its original position after the air pressure is removed.

62TE

Air Pressure Test (continued)

Underdrive Clutch

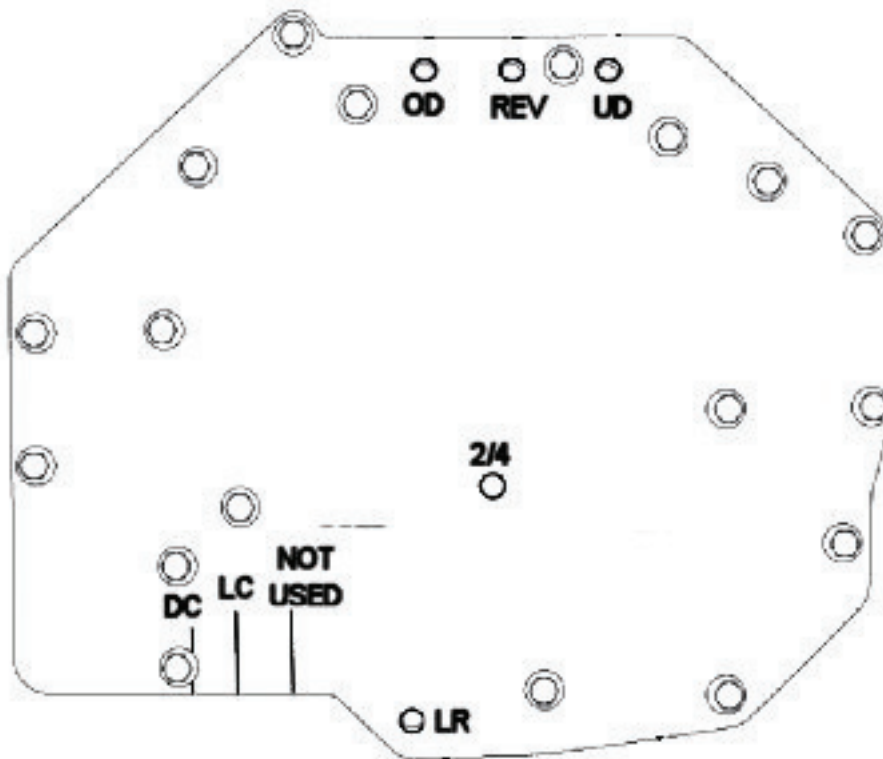
Because this clutch piston cannot be seen, its operation is checked by function. Air pressure is applied to the feed hole located on the test plate marked UD. This locks the output shaft. Use a piece of rubber hose wrapped around the input shaft and a pair of clamp-on pliers to turn the input shaft. Next apply air pressure to the underdrive clutch. The input shaft should not rotate with hand torque. Release the air pressure and confirm that the input shaft will rotate.

Direct Clutch

Apply air pressure to the feed hole located on the test plate marked DC, listen for an audible thud.

Low Clutch

Apply air pressure to the feed hole located on the test plate marked LC, listen for an audible thud.



45RFE

Input Clutch Retainer Kit

When using input clutch retainer kit 68009648AA (or later) in 1999-2007 MY 45RFE or 545RFE transmissions, you **MUST ALSO** replace the OD clutch discs with the latest friction material. Order input clutch kit 05013090AF (or later) to get the latest OD clutch disc material.

Part Numbers:

- 68009648A\$

545RFE

New Filter Kit

If the sump filter is being replaced due to a split in the side of the filter along the crimp, this Tech Tip applies.

It has been discovered that the 4799662AB cooler return filter allows the torque converter to drainback. When the vehicle is started, the air in the T/C is compressed and after passing through the cooler can be directed to the sump filter.

The compressed air has the ability to split the filter. The cooler filter must be replaced as well as the sump filter. Do not reinstall a 4799662AB filter.

Cooler Filters P.N. 4799662 and 4799662AC are acceptable.

1. If the filter was P.N. 4799662AB replace both filters.
2. If a split sump filter is discovered and the cooler filter was not P.N. 4799662AB, replace the sump filter.

Part Numbers:

- 05013470A\$
- 05015267A\$

RFE

Transmission Pump and Pump Cover

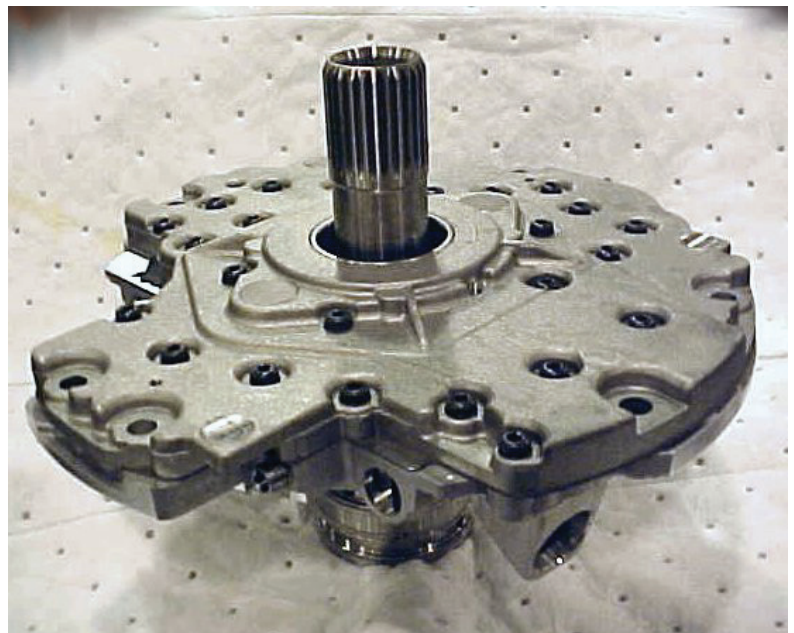
The pump cover is retained by two snap rings (inner and outer). Vehicles which have had the transmission or pump replaced may now contain a revised cover design. The revised cover is steel and is retained by only one (outer) snap ring. The two cover designs are NOT interchangeable. The pump housing was revised to accommodate the new cover design.

If ordering a pump cover for 1999-2006 vehicle which had the transmission or pump replaced after July 2006, verify which design is present and order accordingly. The original (aluminum) cover is 04799609 (service kit 68009609AA). The revised steel cover is service kit 68009859AA.

NOTE: The RFE service pump kit includes a new pump cover. If you are replacing the pump, the cover does NOT need to be ordered separately.

Part Numbers:

- 04799609
- 68004735A\$
- 68009609A\$
- 68009879A\$



722.6

K1 Clutch Retainer and F1 Sprag Update

There was a change to the K1 Retainer 52108541AA and F1 Overrunning Clutch 52108342AA during the 2005 model year. The height of the F1 ORC was increasing from 22.7mm to 24.7mm. The distance between the snap ring grooves in the K1 Retainer was also increased.

There is a number stamped on the end of the F1 ORC

P.N. 52108342AA – “A 722 270 00 31” which is the 22.7mm max. F1 ORC

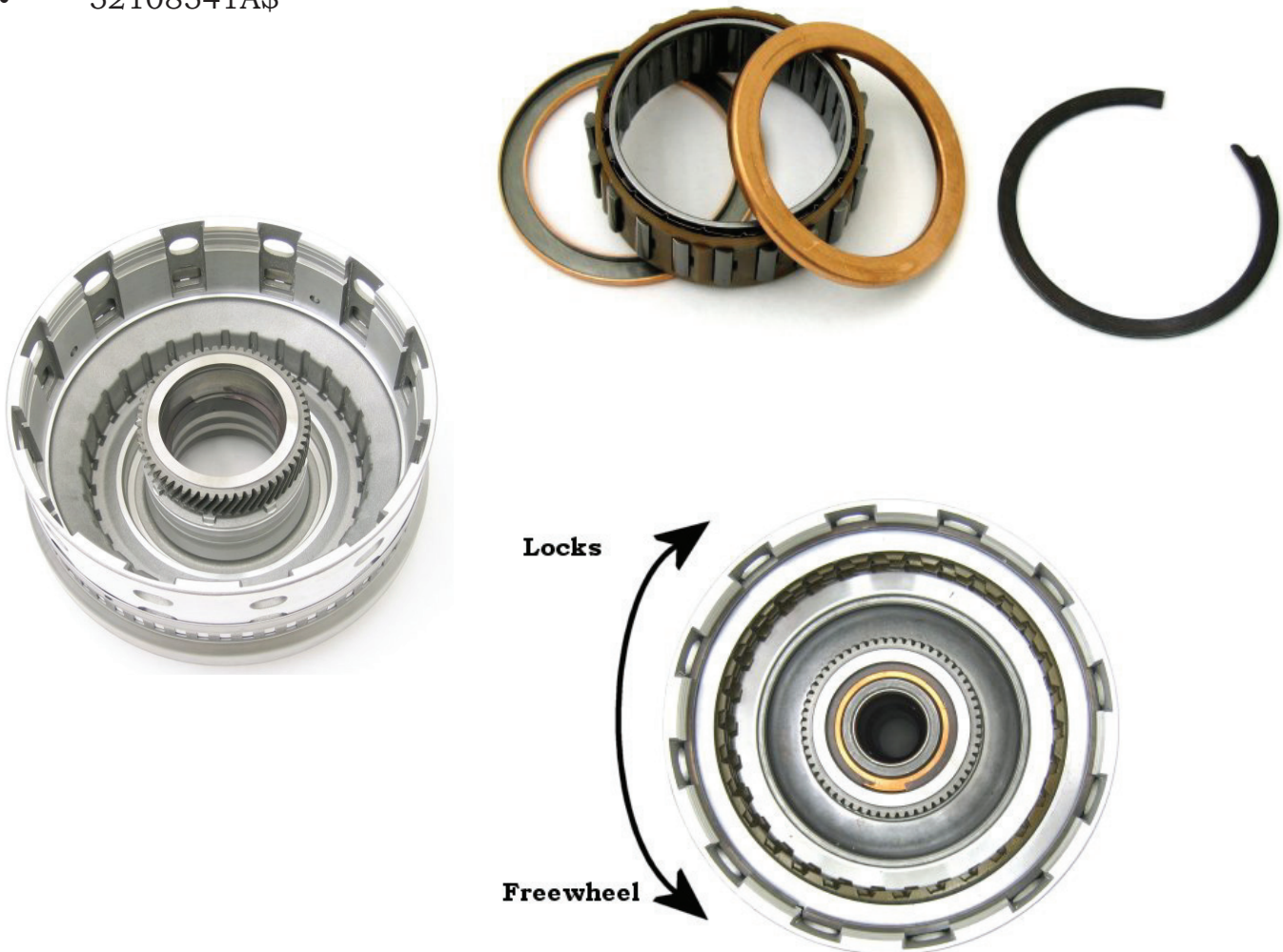
P.N. 52108342AB – “A 722 270 02 31” which is the 24.7mm max. F1 ORC

When replacing the K1 Retainer and the F1 ORC is 22.7mm (A 722 270 00 31), order part number 52108541AA.

If the F1 ORC is 24.7mm (A 722 270 02 31) order part number 52108541AB. If replacing both the K1 Retainer and F1 ORC order the AB revision level of both.

Part Numbers:

- 52108541A\$



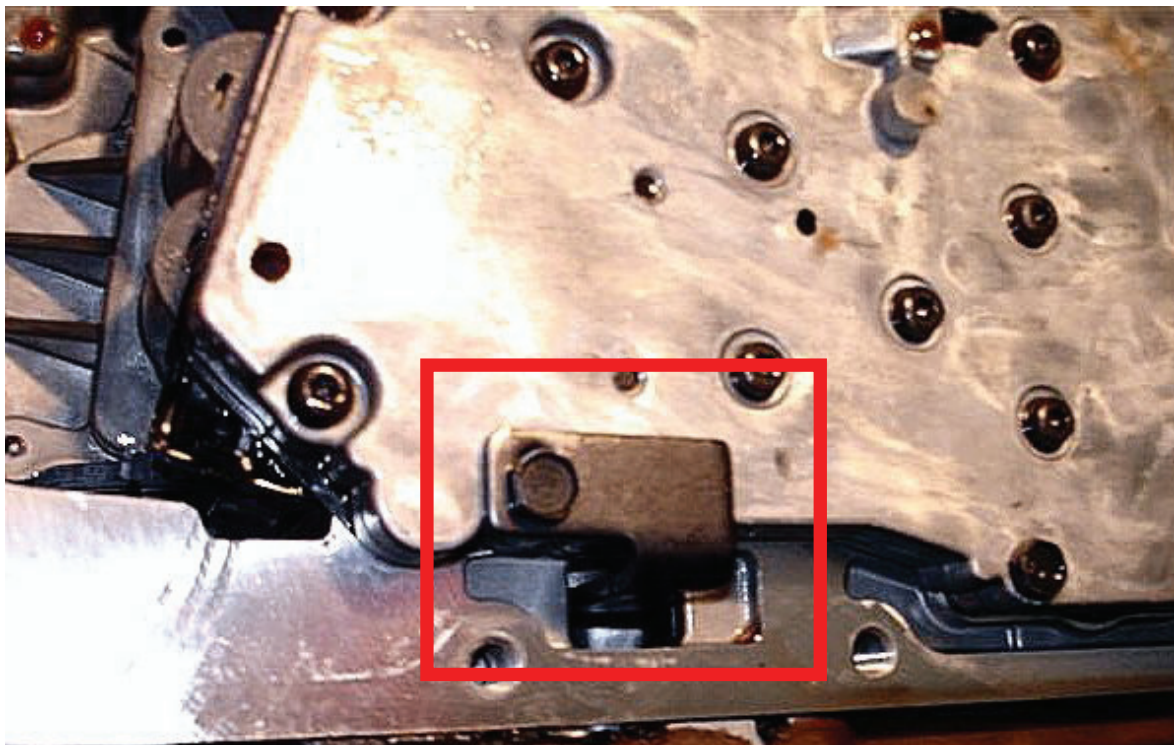
42RLE

Loss of Park

The cup plug used in retaining the park pawl anchor shaft in the 42RLE transmission can fall out of place causing a loss of park due to the anchor shaft falling out.

There was a Safety Recall E14 pertaining to the 2005 and 2006 model year Dodge Durango, Dakota, Charger and Magnum as well as the Jeep Liberty and Wrangler and the Chrysler 300 series vehicles with the 42RLE.

As a safety, during any routine service as well as major repair it is recommended to install the safety bracket that prevents this anchor pin from backing out in the case. The bracket can be purchased from Dodge; OE Part number CBP1E140. Use this when servicing any year 42RLE to assure this does not happen after your repair.



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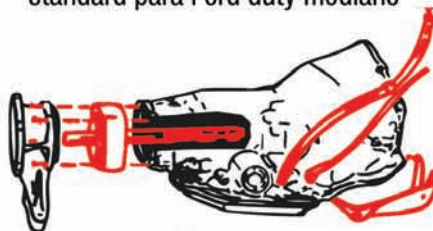
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- Gasket Sets
- Gears & Shafts

Clutch Parts

- Sach's Clutch Kits (New)
- Forks
- Pilot Bushings & Bearings
- Clutch Alignment Tools

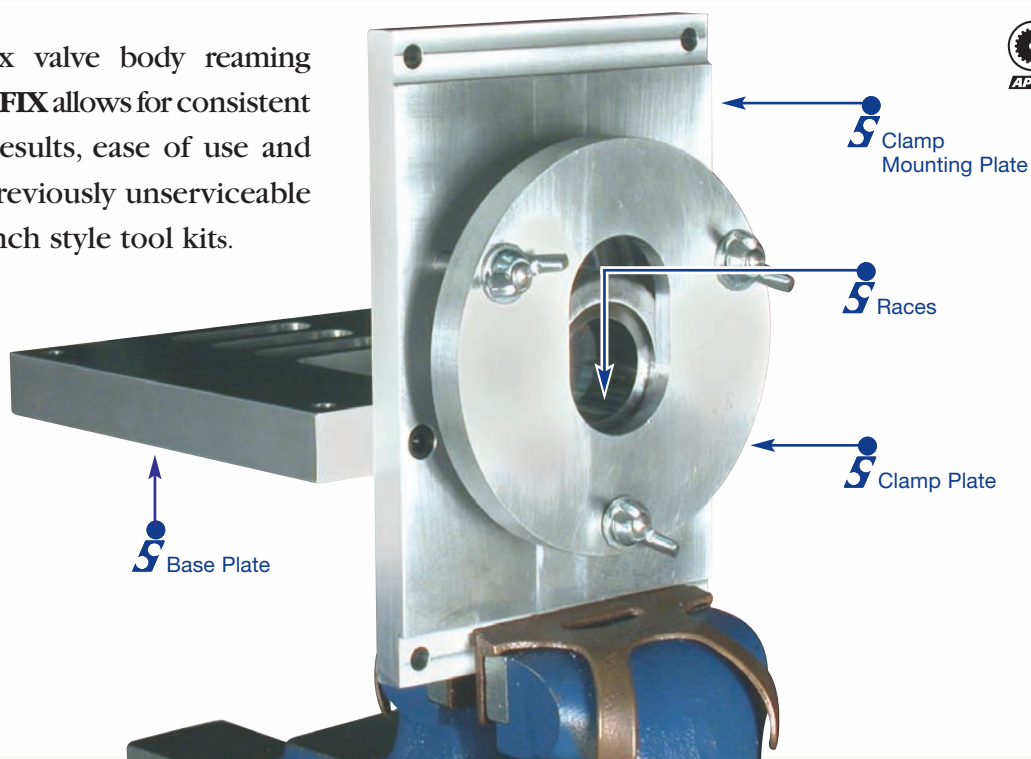
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F-77754-SERV	77754-03K, -04K (GM SERV), TCC Regulator Valve Kits	4L60-E
F-34200-TL16	34200-16K, Actuator Feed Limit Valve Kit	4L80-E
F-55211-TL	55211-01K, Actuator Feed Limit Valve & Sleeve Kit	5L40-E
F-55211-TL4	55211-04K, TCC Regulator Valve & Sleeve Kit	5L40-E
F-33000-TL	33000-03, TCC Control Valve	4T40-E, 4T45-E
F-84596-TL	84596-02K, Actuator Feed Limit Valve Kit	4T65-E
F-56947J-TL2	56947J-05K, TCC Control Valve Kit	5R55N/W/S
F-56947J-TL15	56947J-15K, TCC Modulator Valve Kit	5R55N/W/S
F-73840-TL	73840-RK, Pressure Regulator Valve Kit	CD4E
F-92835-TL	92835-21, Solenoid Switch Valve	41TE, 42LE, 42RLE, 45RFE, 545RFE
F-22771-TL	22771-02K, Throttle Valve Kit	42-46-47RH/RE, 31-32RH, A727, A904
F-22771A-TL7	22771A-07K, Pressure Regulator Valve Kit	RWD Chrysler, '78 & Up
F-119940-TL3	119940-03K, Main Regulator Valve Kit	VW/Audi 01M, 01N, 01P
F-119940-TL5	119940-05K, Boost Regulator Valve Kit	VW/Audi 01M, 01N, 01P
F-119940-TL6	119940-06K, Solenoid Regulator Valve Kit	VW/Audi 096/097/098, 01M, 01N, 01P
F-119940-TL7	119940-07K, Boost Regulator Valve Kit	VW/Audi 096, 097, 098
F-119940-TL8	119940-08K, Main Regulator Valve Kit	VW/Audi 096, 097, 098



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Ford

GEM Codes

DIAGNOSTIC TROUBLE CODE INDEX

DTC	Description
B1342	GEM/CTM Defective
B1483	Brake Pedal Input Circuit Failure
B1485	Brake Pedal Input Circuit Short To Power
B2105	Throttle Position Input Out Of Range Low
B2106	Throttle Position Input Out Of Range High
P0500	VSS Signal Circuit
P1804	4WD High Indicator Open/Short To Gnd
P1806	4WD High Indicator Short To Power
P1808	4WD Low Indicator Open/Short To Gnd
P1810	4WD Low Indicator Short To Power
P1812	4WD Mode Select Switch Open/Short To Gnd
P1815	4WD Mode Select Switch Short To Power
P1820	T/C LO To HI Shift Relay Open/Short To Gnd
P1822	T/C LO To HI Shift Relay Coil Short To Power
P1824	4WD Clutch Relay Circuit Failure
P1826	4WD Clutch Relay Short To Power
P1828	T/C Shift Relay Circuit Failure
P1830	T/C Shift Relay Coil Short To Power
P1836	Front Drive Shaft Speed Sensor Circuit
P1837	Rear Drive Shaft Speed Sensor Circuit
P1838	T/C Shift Motor Circuit Failure
P1846	T/C Contact Plate "A" Open Circuit
P1850	T/C Contact Plate "B" Open Circuit
P1854	T/C Contact Plate "C" Open Circuit
P1858	T/C Contact Plate "D" Open Circuit
P1866	T/C System Concern
P1867	T/C Contact Plate General Circuit Failure
P1874	Hall Effect Sensor Power Circuit Failure
P1875	Hall Effect Sensor Power Circuit Short
P1891	T/C Contact Plate Ground Return Open Circuit

General Motors

TCCM Codes

DIAGNOSTIC TROUBLE CODE DEFINITIONS

DTC	Description
B0768	Service Indicator Circuit High
B2725	Select Switch Circuit Malfunction
C0300	Rear Speed Sensor Malfunction
C0305	Front Speed Sensor Malfunction
C0308	Motor A/B Circuit Low
C0309	Motor A/B Circuit High
C0310	Motor A/B Circuit Open
C0315	Motor Ground Circuit Open
C0323	Transfer Case Lock Circuit Low
C0324	Transfer Case Lock Circuit High
C0327	Encoder Circuit Malfunction
C0357	Park/Neutral Switch Circuit High
C0362	4L Discrete Output Circuit High
C0367	Front Axle Control Circuit High
C0374	General System Malfunction
C0376	Front/Rear Drive Shaft Speed Mismatch
C0387	Unable To Perform Shift
C0550	ECU Malfunction
C0611	VIN Information Error

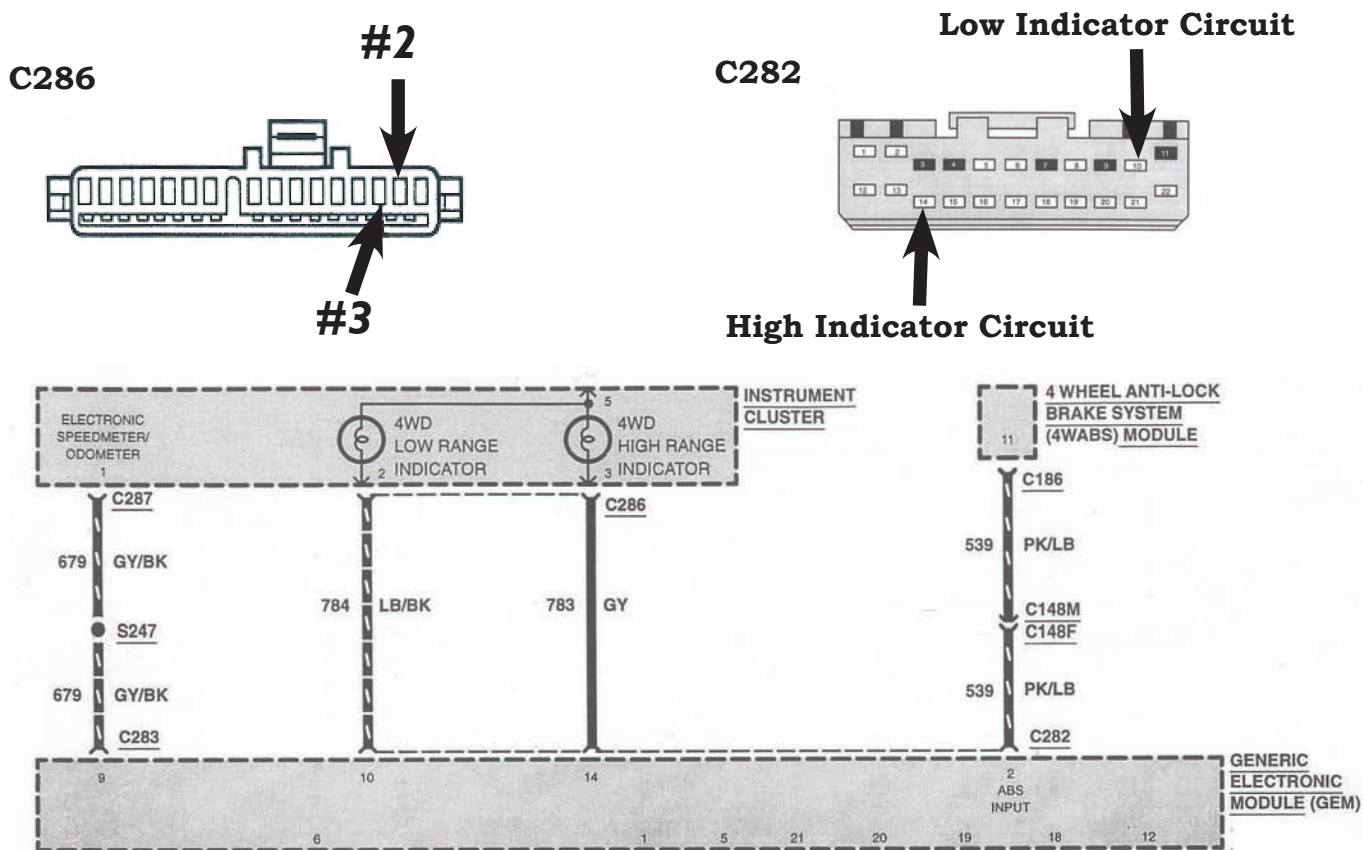
Ford DTC's

P1804, P1806, P1808 and P1810

Indicates that the GEM has encountered a fault in the 4WD indicator system. Check indicator system wiring, connections.

Check circuit # 783 (high range indicator) and circuit #784 (low range indicator) for a battery voltage signal when each indicator is commanded on. You can check for this signal at the GEM C282 connector terminals # 14 (high range indicator) and #10 (low range indicator) or you can check for this signal at the instrument cluster C286 connector at terminals #3 (high range) and #2 (low range).

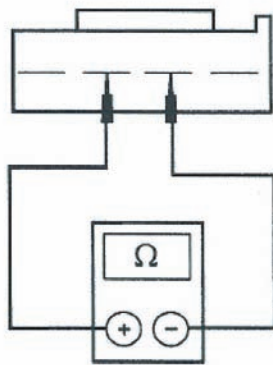
If you have this signal at the instrument cluster connector, you may have an instrument cluster printed circuit problem or a faulty bulb. If you do not have the signal at the instrument cluster connector but you have a signal at the GEM connector, a circuit test would be recommended. If you are not getting a signal coming out of the GEM, check the GEM connector, terminals, power and grounds. You may have a faulty GEM module.



Ford DTC's

P1812 and P1815

Indicates that the GEM has encountered a fault in the mode switch circuits. Check mode switch circuit pins 2 and 3, wiring, and connections. Mode switch failures are common, replacing the switch usually repairs the problem.



Switch Position	Ohms
2WD	3700-4100
4WD High	1050-1150
4WD Low	340-380



Ford DTC's

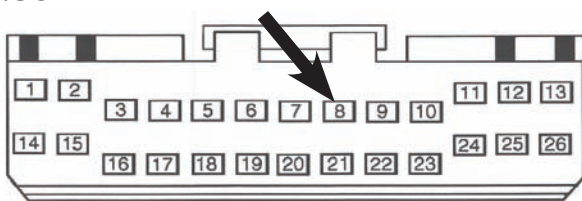
P1812 and P1815 (continued)

You can check the mode switch circuit by back probing into the GEM C280 connector terminal # 8 and the C282 connector terminal #21 and check the resistance of the mode switch and circuits. Refer to mode switch resistance chart for the correct resistance in each range.

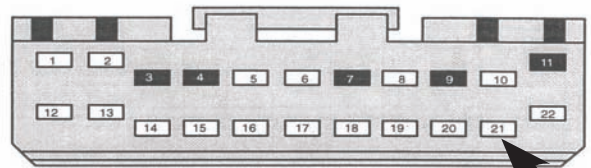
If the resistance is within specifications, you may have an intermittent problem in the circuits, the mode switch or you may have a faulty GEM module. If the resistance is not within specifications, you can check the mode switch itself by probing into the mode switch connector terminals #2 & #3. Replace the mode switch if it is not within the specified ranges. If the mode switch is within specifications, a circuit check would be recommended.

C280

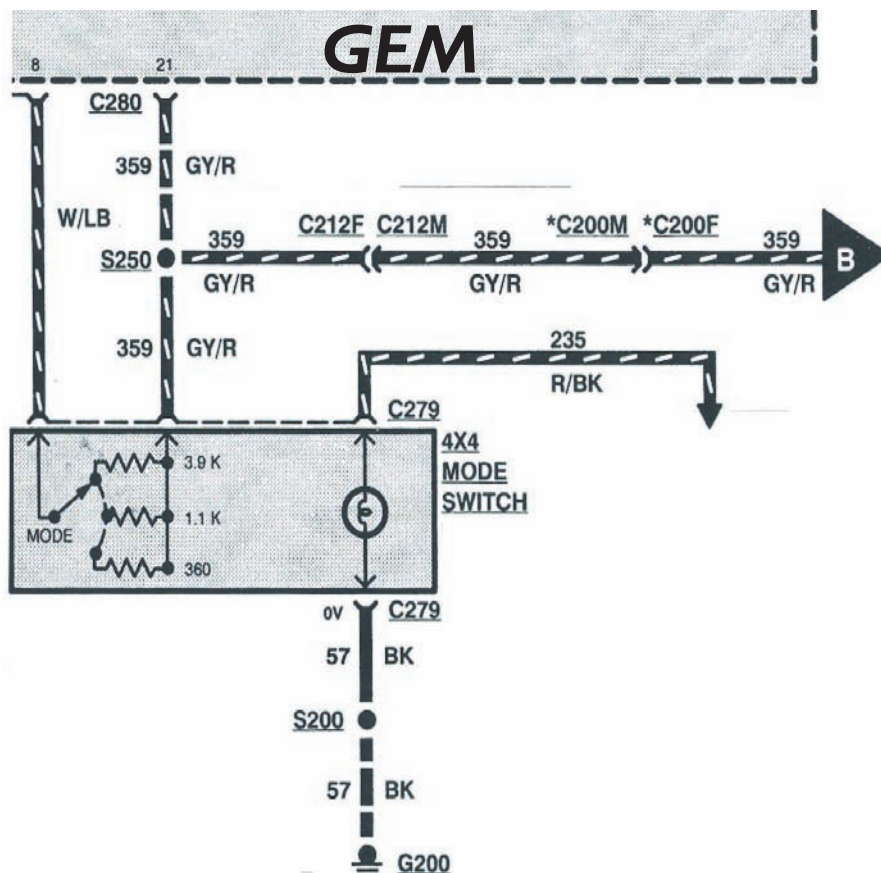
Pin 8



C282



Pin 21



Ford DTC's

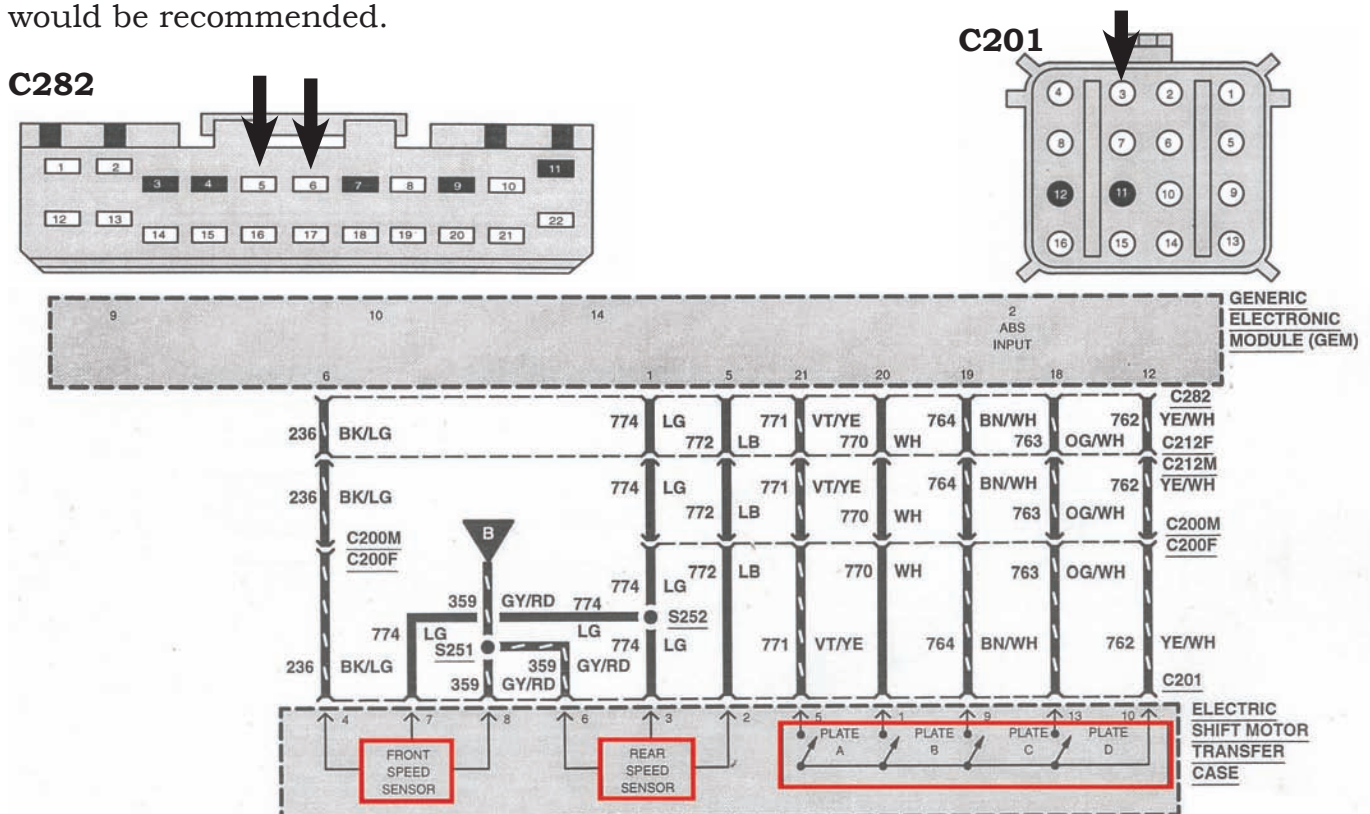
P1836, P1837, P1874 and P1875

Indicates that the GEM has encountered a fault in the drive shaft speed sensor circuits or hall effect power feed circuits.

Check the front and rear speed sensor signals by back probing into GEM connector C282 terminals # 5 (rear speed sensor) and #6 (front speed sensor). If the signals are good, you may have an intermittent problem or a faulty GEM module. If you have an erratic speed sensor signal, a circuit test would be recommended. If your circuits check out okay, suspect a faulty speed sensor. If you have no speed sensor signal at all, start by checking the speed sensor power circuit (774) at GEM C282 connector terminal #1.

If you have battery voltage at terminal #1, the next step is to check for battery voltage at the transfer case connector C201 terminals # 3 (rear speed sensor) and #7 (front speed sensor). If you do not have battery voltage at the C201 connector, a circuit test would be recommended. If you have battery voltage at the C201 connector, the next step is to check the sensor ground circuit (359) at the C201 connector terminals #6 (rear speed sensor) and #8 (front speed sensor).

You can check circuit #359 by performing a continuity check between the C201 connector and the GEM C280 connector terminal #21. If you have continuity, suspect a faulty speed sensor. If you do not have continuity or excessive resistance, a circuit check would be recommended.



Ford DTC's

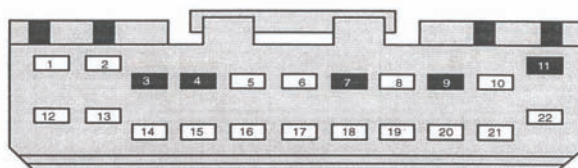
P1838

Indicates that the GEM has encountered a circuit problem in the motor circuit.

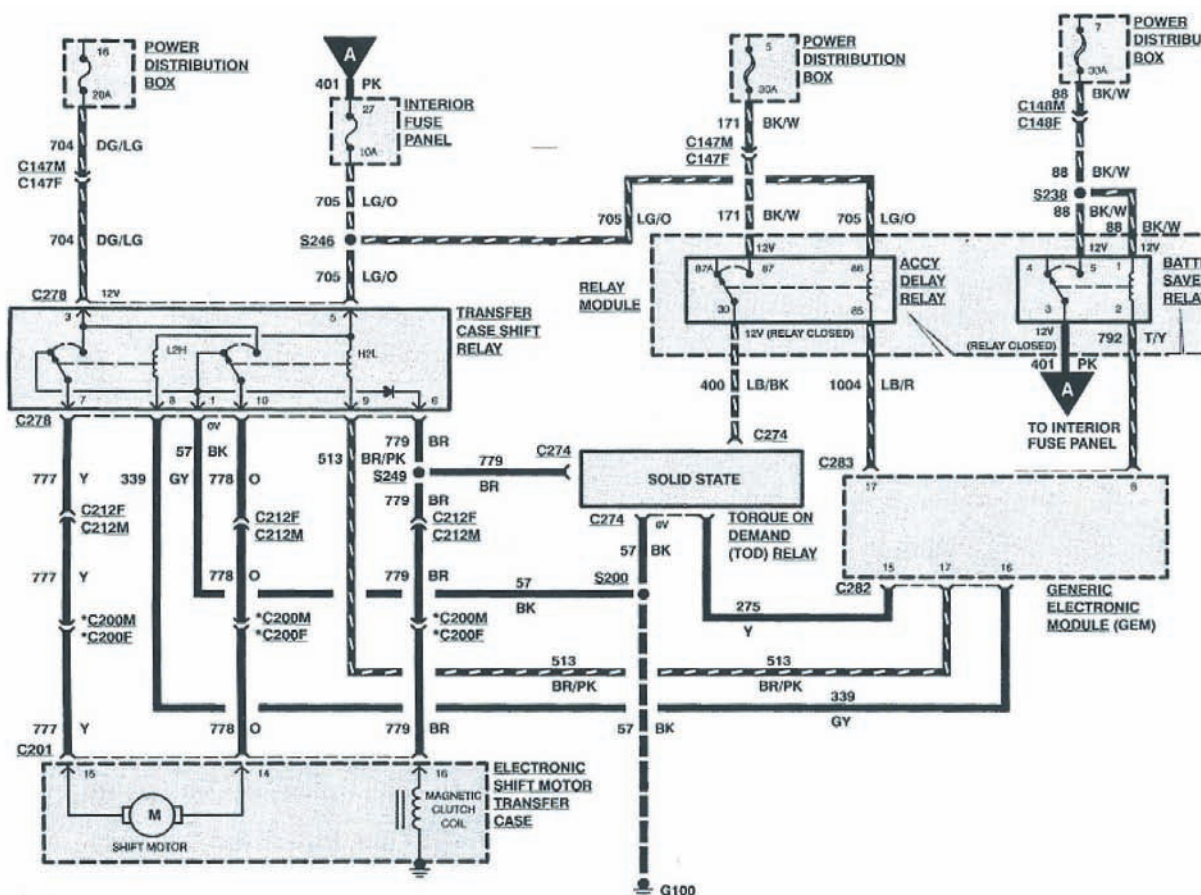
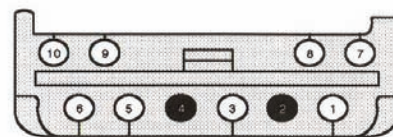
You can perform checks on the motor circuits by performing continuity checks on each of the circuits. The first step would be to check the motor circuits from the transfer case shift relay C278 connector terminals #7 & #10 to the encoder motor C201 connector terminals #14 & #15.

The next step is to check the continuity of transfer case relay control circuit from the transfer case relay C278 connector terminal #8 to the GEM C282 connector terminal #16 and from the transfer case relay C278 connector terminal #9 to the GEM C282 connector terminal #17. If all circuits check out okay, suspect a transfer case relay or encoder motor failure. Connection problems and encoder motor failures are common.

C282



C278



Ford DTC's

P1846, P1850, P1854, P1858, P1867 and P1891

Indicates that the GEM has encountered a fault in the encoder plate circuits.

You can check the encoder plate circuits by monitoring the encoder plate PID inputs to the GEM with your scanner.

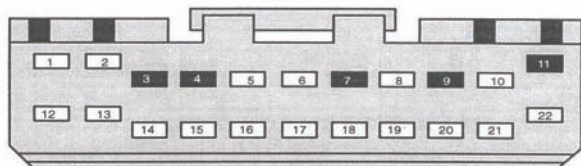
The PID's should match the 4wd encoder plate PID chart for your specific vehicle application. If the PID's do match the 4wd encoder plate PID chart, you may have an intermittent circuit problem or a faulty GEM module.

If the PID's do not match your specific 4wd encoder plate PID chart, a circuit test of the encoder circuits between the GEM C282 connector and the transfer case C201 connector is recommended. If the circuits check out good, suspect a faulty encoder motor assembly. Connection problems and encoder motor failures are common.

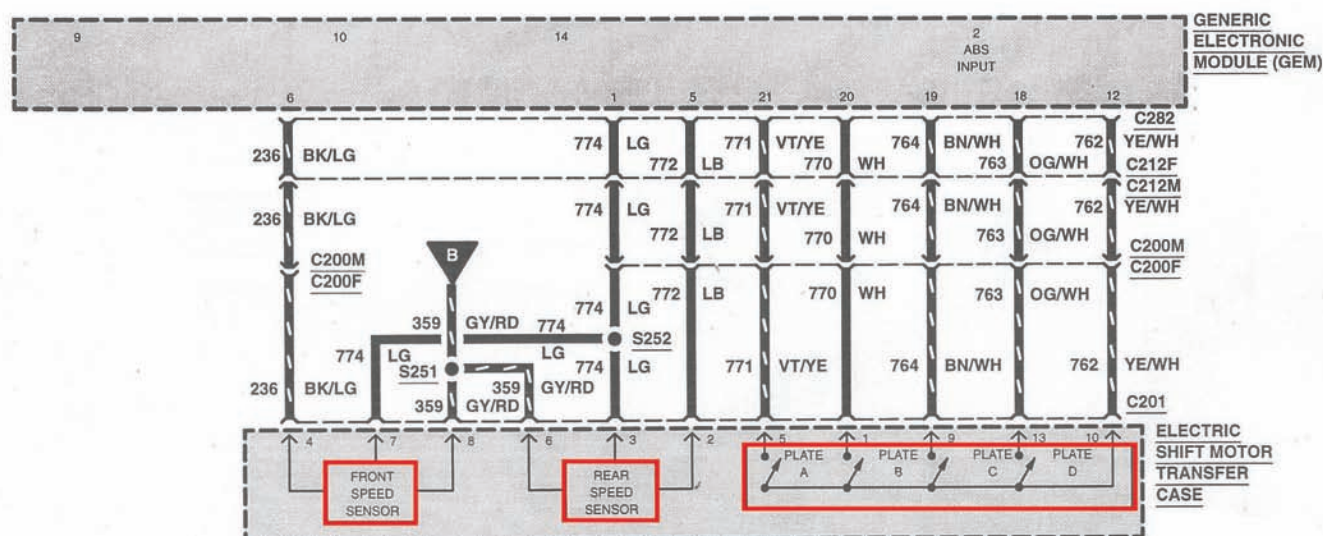
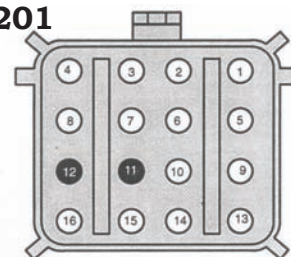
4WD MODE SWITCH PID OUTPUT

CONTACT PLATE	2H	4H
PLATE_A	CLOSED	OPEN
PLATE_B	OPEN	CLOSED
PLATE_C	CLOSED	CLOSED
PLATE_D	CLOSED	OPEN

C282

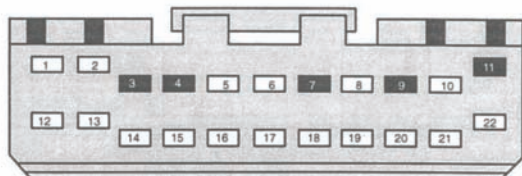


C201



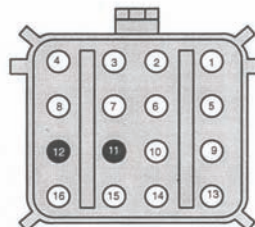
Ford

GEM and Transfer Case Connector ID's



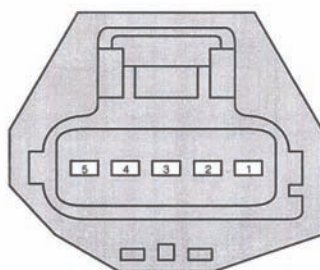
C282
GENERIC ELECTRONIC MODULE (GEM)

PIN	CIRCUIT	CIRCUIT FUNCTION
1	774 (LG)	Speed Sensor Power
2	539 (PK/LB)	Anti-Lock Brake Input
3	—	NOT USED
4	—	NOT USED
5	772 (LB)	Rear Speed Sensor Input
6	236 (BK/LG)	Front Speed Sensor Input
7	—	NOT USED
8	465 (WH/LB)	4WD Mode Switch Input
9	—	NOT USED
10	784 (LB/BK)	4WD Low Range Indicator Control
11	—	NOT USED
12	762 (YE/WH)	4WD Contact Plate Signal Return
13	810 (RD/LG)	Brake Pedal Position Input
14	783 (GY)	4x4 High Range Indicator Control
15	275 (YE)	Torque On Demand Clutch Relay Output
16	339 (GY)	4 Low to 4 High (L2H Relay Control)
17	513 (BN/PK)	4 High to 4 Low (H2L Relay Control)
18	763 (OG/WH)	Contact Plate D
19	764 (BN/WH)	Contact Plate C
20	770 (WH)	Contact Plate B
21	771 (VT/YE)	Contact Plate A
22	463 (RD/WH)	Neutral Sense Input



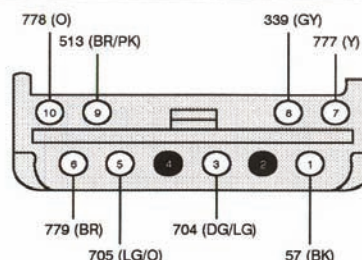
C201 (BLACK)
ELECTRIC SHIFT MOTOR TRANSFER CASE

PIN	CIRCUIT	CIRCUIT FUNCTION
1	770 (WH)	Motor Position #4
2	772 (LB)	Rear Speed Sensor Coil
3	774 (LG)	Speed Sensor Power
4	236 (BK/LG)	Front Speed Sensor Coil
5	771 (VT/YE)	Motor Position #5
6	359 (GY/RD)	Sensor Signal Return
7	774 (LG)	Speed Sensor Power
8	359 (GY/YE)	Speed Sensor Return
9	764 (BN/WH)	Motor Position #3
10	762 (YE/WH)	Motor Position #1
11	—	NOT USED
12	—	NOT USED
13	763 (OG/WH)	Motor Position #2
14	778 (OG)	Shift Relay to Motor H2L
15	777 (YE)	Shift Relay to Motor L2H
16	779 (BN)	Shift Relay to Electronic Clutch



C274
TORQUE ON DEMAND (TOD) RELAY

PIN	CIRCUIT	CIRCUIT FUNCTION
1	400 (LB/BK)	Safety Relay Load Terminal to Window Regulator Switch Feed
2	779 (BN)	Electrical Shift 4X4 Module to Electric Clutch
3	275 (YE)	Switch on to Relay
4	57 (BK)	Ground
5	400 (LB/BK)	Safety Relay Load Terminal to Window Regulator Switch Feed



C278 (BLACK)
TRANSFER CASE SHIFT RELAY

PIN	CIRCUIT	CIRCUIT FUNCTION
1	57 (BK)	Ground
2	—	NOT USED
3	704 (DG/LG)	Power (Hot at All Times)
4	—	NOT USED
5	705 (LG/O)	Power (Hot at All Times)
6	779 (BR)	Shift Relay to Electronic Clutch
7	777 (Y)	Shift Relay to Motor L2H
8	339 (GY)	Relay Coil to GEM (L2H)
9	513 (BR/PK)	Relay Coil to GEM (H2L)
10	778 (O)	Shift Relay to Motor H2L

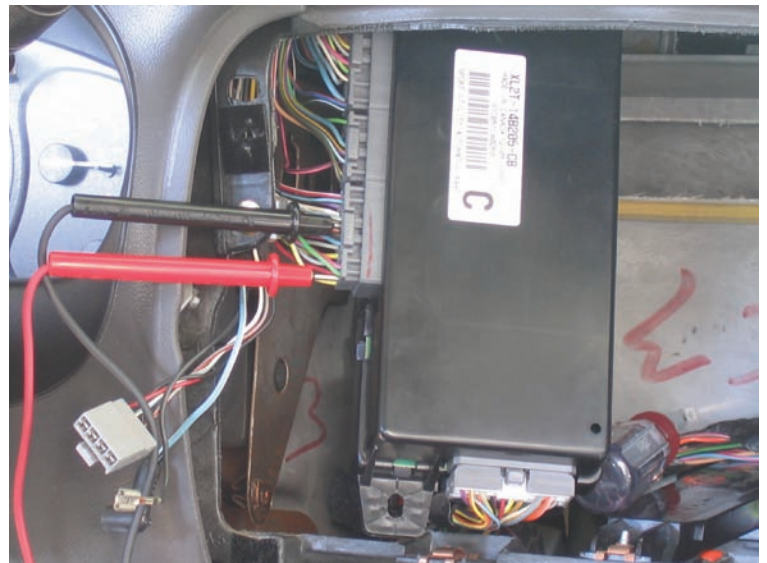
Ford

Ease of Diagnosis

Pinpoint tests on the GEM system can easily be accomplished at the encoder Motor connector terminals or at the GEM connector it self. Refer to the connector terminal ID on the previous page.

GEM modules are typically located in two different areas depending on the model.

F-Series vehicles are location on top of the fuse block on the left under side of the dash.
Ford small SUV's are located behind the stereo.



GM DTC's

B2725

Indicates the TCCM has encountered an intermittent fault in the transfer case control switch circuits. Check for proper operation of the control switch by performing the following tests.

- Verify proper voltage to switch
- Check resistance of all switch states
- Check for short to voltage in switch signal circuit
- Check for open/short to ground in signal circuit
- Check for short to 8 volt circuit
- Verify 8 volt regulated circuit is at specified voltage
- Check 8 volt regulated circuit for short to voltage
- Check 8 volt regulated circuit for short/open to ground

You can check the transfer case control switch circuits by first verifying that the transfer case control switch is getting the correct voltage to the switch. The NVG233 system uses a 12 volt reference voltage at terminal # C of the transfer case control switch C2 connector.

The NVG236 & 246 systems use an 8 volt reference voltage to its control switch system at terminal #A of the transfer case control switch C1 connector. Refer to the 4x4 system wiring schematic for your specific vehicle. If you do not have the correct reference voltage at the control switch, a circuit check would be recommended. If you have the correct reference voltage to the control switch, the next step is to check the resistance of the transfer case control switch.

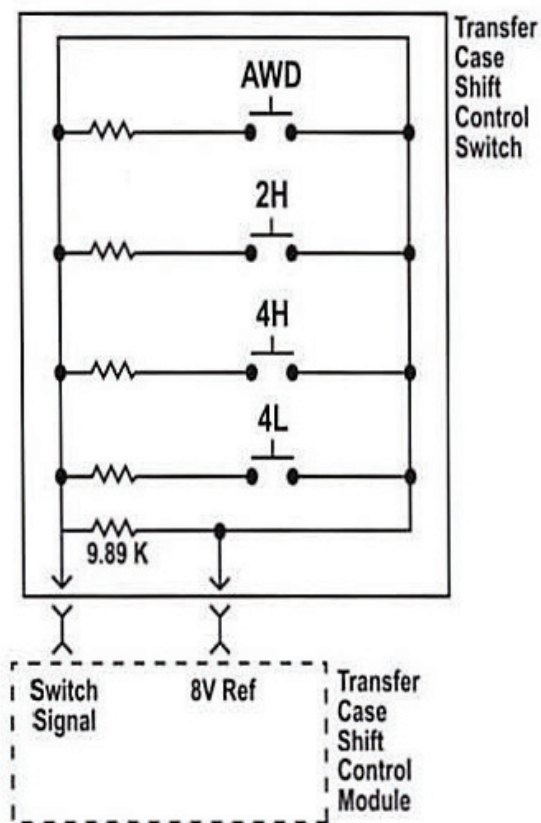
This can be done by checking the resistance across the C1 connector terminals # A & #B. Resistance should be as specified. G.M. has not released the specifications for the NVG233 control switch, but the specifications for the NVG236 and 246 controls switch are as follows:

Auto 4WD	=	61.7-68.1 ohms
4HI	=	656-760 ohms
2HI	=	1.50-1.53 K ohms
4LO	=	2.32-2.37 K ohms
Neutral	=	1.015-1.035 K ohms

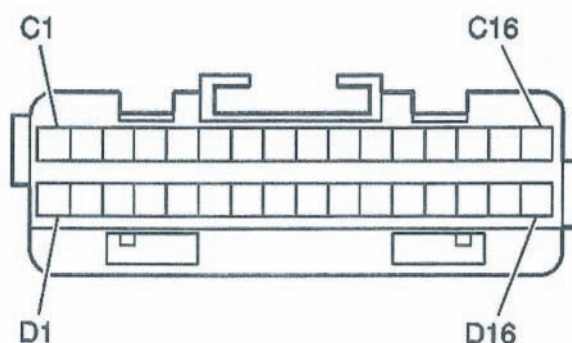
GM DTC's

B2725 (continued)

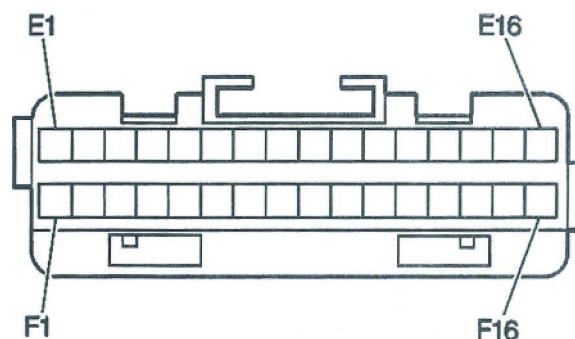
Use the following connector illustrations to diagnose your concern.



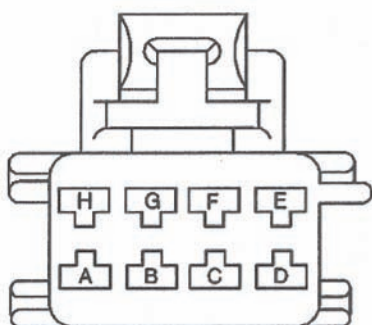
NVG 233 TCCM Connector



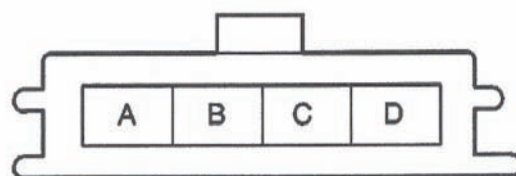
NVG 236/246 TCCM Connector



NVG 236/246 Selector Switch C1



NVG 236/246 Selector Switch C2



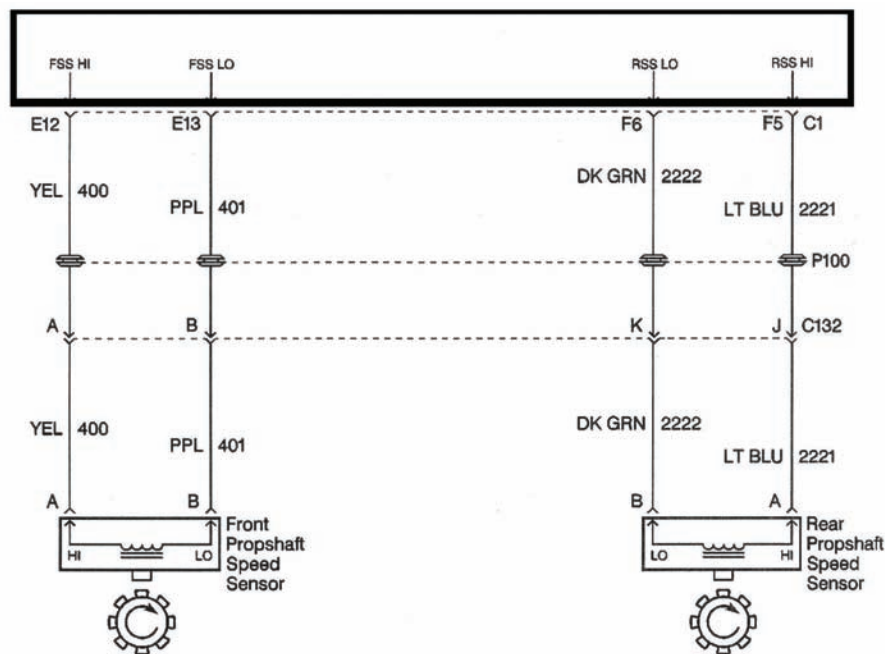
GM DTC's

C0300 and C0305

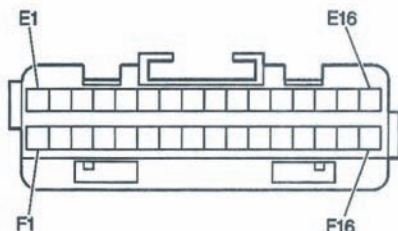
Indicates that the TCCM has received an erratic rear or front output shaft speed sensor signal. Check the front and rear output shaft speed sensor signals at the TCCM. Check wiring, connections, speed sensors. Check connector for oil contamination.

You can check the speed sensor circuits by back probing into the TCCM C1 connector terminals #E12 and #E13 (front speed sensor), terminals # F5 and #F6 (rear speed sensor) to monitor each of the speed sensor signals. The speed sensors should be producing a 3.25 VAC signal at approximately 5 mph and climb as speed increases. If the signal is correct, you may have an intermittent circuit problem or a faulty TCCM. If the speed sensor signal is erratic or there is no signal at the TCCM, a circuit test would be recommended. If the circuits check out okay, check the suspected speed sensor resistance. The resistance should be between 1300-2700 ohms.

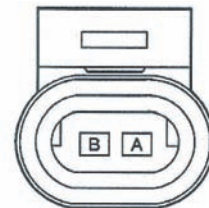
If the resistance is within specifications or your codes are intermittent, suspect connection problems.



236 and 246 TCCM Connector C1



Speed Sensor Connector



GM DTC's

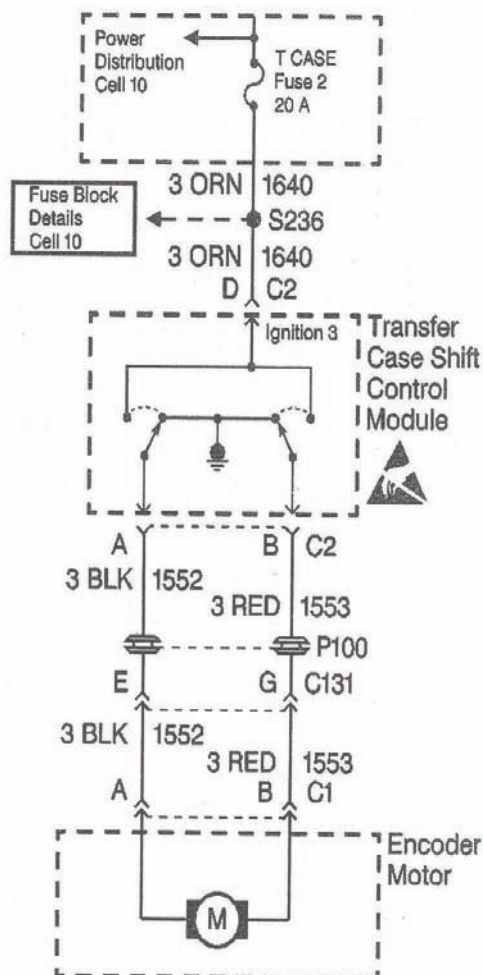
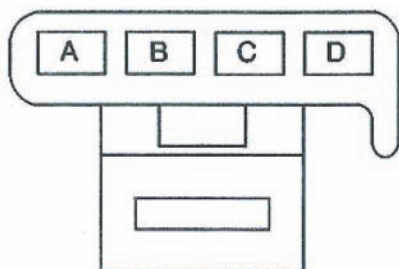
C0308, C0309 and C0310

Indicates that the TCCM has encountered a problem in the A/B motor circuit. Check the A/B motor circuit for continuity. Check wiring, harnesses and connections. Connections and encoder/motor faults are common.

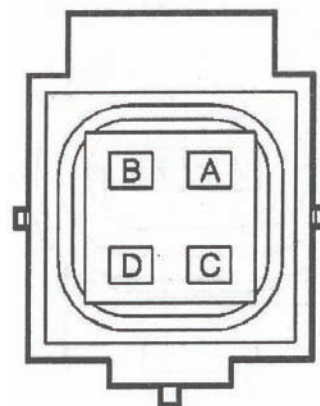
You can check the A/B motor circuit by back-probing into the TCCM C2 connector terminals # A & B and performing a continuity test through the motor circuit. The resistance of the A/B motor circuit should be 5-35 ohms. If the resistance at the TCCM C2 connector is correct, suspect a faulty TCCM. If the resistance is not correct, a circuit test between the TCCM C2 connector terminals #A & #B to the encoder motor C1 connector terminals #A & #B would be recommended.

If the circuits check out okay, check the resistance of the motor at encoder motor C1 connector. Resistance should be between 5-35 ohms. If the resistance is not within specifications, replace the encoder motor assembly.

TCCM C2 Connector



Encoder Motor Circuit C1



GM DTC's

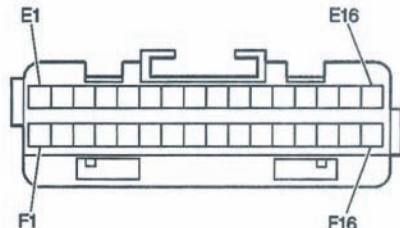
C0323 and C0324

Indicate that the TCCM has encountered a problem in the transfer case motor lock circuit. Check lock circuit wiring, harness & connections. Encoder/motor problems are common. This is typically an encoder motor failure. Make sure all of your wiring is check before replacing the motor.

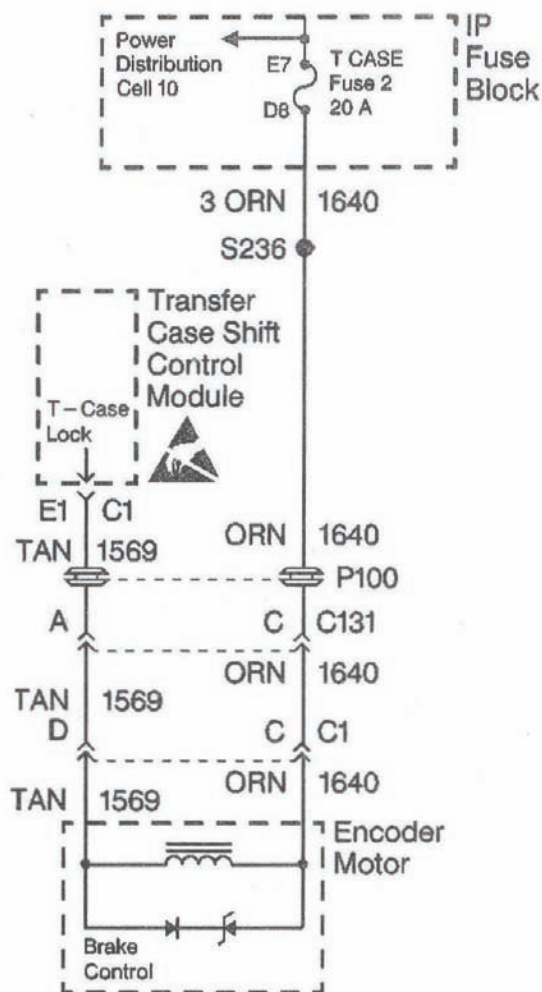
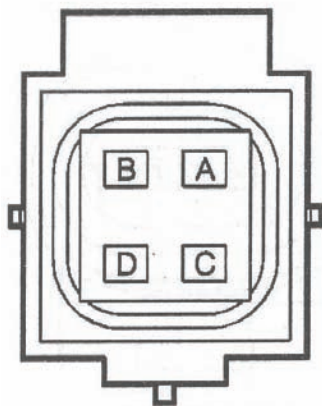
You can check the encoder lock circuit by first checking for battery voltage at the encoder motor C1 connector terminal #C. The next step is to check the resistance of the encoder lock circuit, inside the encoder motor assembly. Perform a continuity check between encoder motor C1 connector terminals #C & #D. The resistance should be between 20-80 ohms. If the resistance is not within specification, replace the encoder motor assembly. If the lock circuit resistance is within specification, a circuit check of the lock control circuit would be recommended.

The lock control circuit test can be performed between the encoder motor C1 connector terminal #D and the TCCM C1 connector terminal #E1. If the circuit tests are within specifications, suspect a faulty TCCM. Remember...encoder motor connections and internal problems are common.

236 and 246 TCCM Connector C1



Encoder Motor Circuit C1



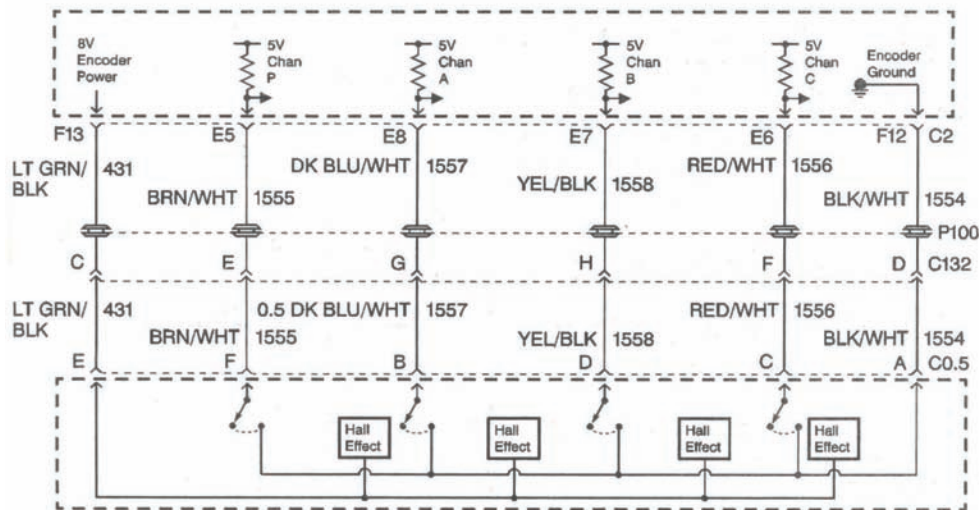
New Venture I36/233/236/246

C0327

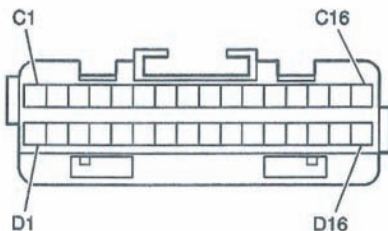
Is usually a connection problem at the encoder/motor or an internal encoder circuit problem. Replacing the encoder/motor will usually repair this code.

You can check the encoder circuits by performing circuit tests (continuity test) between the TCCM connector and the encoder motor connector. The next step is to verify that the encoder motor is receiving an 8 volt reference signal at the #E terminal of the encoder motor connector. If you have the 8v reference signal at terminal #E, the next step is to check the encoder ground circuit from the encoder connector terminal #A to the TCCM connector terminal #F12.

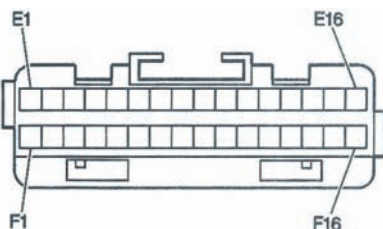
If you have good power and ground circuits and the encoder circuits check out okay, replace the encoder motor assembly. Encoder motor assembly problems are common.



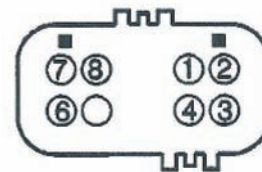
233 TCCM Connector



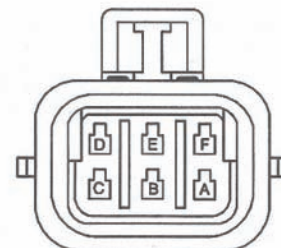
236/246 TCCM Connector



233 Encoder Connector



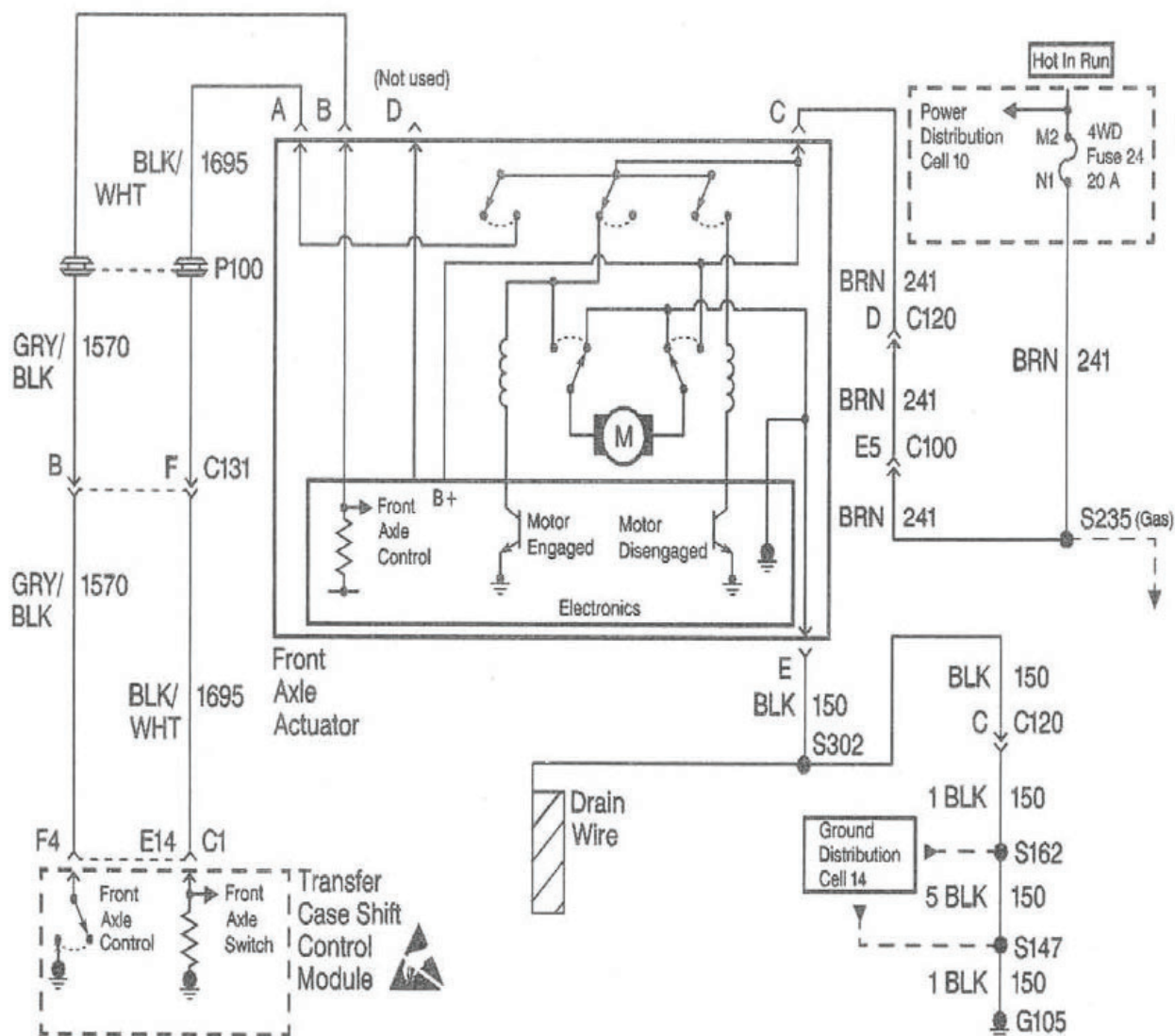
236/246 Encoder Connector



New Venture I36/233/236/246

C0367

Code C0367 indicated the TCCM has encountered a problem in the front axle actuator circuit. Check the front axle actuator harness, wiring, and connections. Connections and front axle actuator concerns are common.



New Venture I36/233/236/246

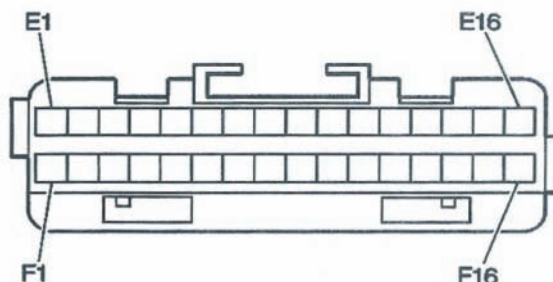
C0367 (continued)

On the NVG246 system, check for battery voltage at the front axle actuator connector terminal #C.

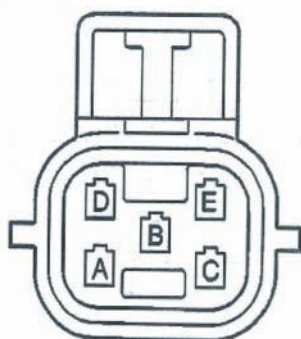
The next step is to check the ground circuit on terminal #E of the actuator connector. Once the power and ground circuits have been verified, the next step is to perform a circuit test on the front axle switch and the front axle control circuits from the TCCM C1 connector terminal #E14 and the front axle actuator connector terminal #A (front axle switch) and between TCCM C1 connector terminal #F4 and the front axle actuator connector terminal #B (front axle control). On the NVG236 system, check for battery voltage at terminal #A of the 4wd indicator switch and the front axle clutch solenoid.

The next step is to perform a circuit test from the #B terminal of the 4wd indicator switch connector to the TCCM C1 connector terminal #E14 and from the #B terminal of the front axle clutch solenoid to the TCCM C1 connector terminal #F4. If the circuits check out okay, suspect an intermittent connection problem or a faulty front axle actuator. G.M recommends replacing the front axle actuator to correct this concern.

236/246 TCCM Connector C1

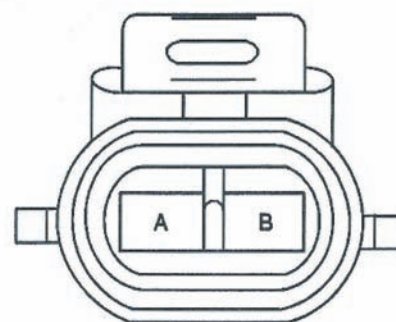
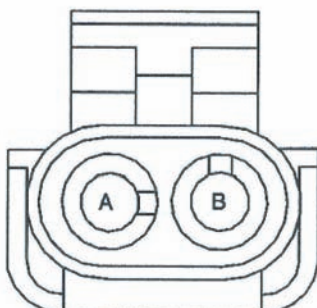


246 Front Axle Connector



236 Front Axle Connector

236 Front Axle Connector



New Venture I36/233/236/246 C0374 and C0387

These codes are usually set because the TCCM was unable to perform the shift as requested. This is usually a mechanical problem in the transfer case or the encoder motor problem.

Remove the encoder motor and attempt to shift the transfer case manually. If the transfer case can be manually shift through all ranges, replace the encoder motor assembly. If the transfer case cannot be manually shift through all ranges, remove, disassemble and repair the transfer case.

New Venture I36/233/236/246

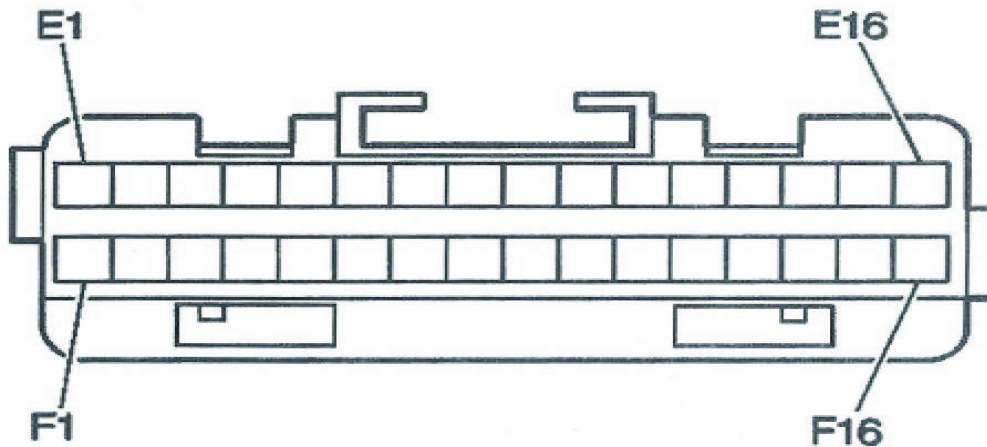
C0550 and C0611

These codes are set because the TCCM suspects an internal failure (C0550) or the TCCM has a VIN recognition problem.

After checking the power and ground circuits going to the TCCM (refer to the TCCM connector terminal identification for your specific vehicle), if code C0550 returns, G.M. recommends replacing the TCCM.

If code C0611 returns, the VIN must be entered into the TCCM for your specific vehicle. If C0611 returns, G.M. recommends replacing the TCCM and re-entering the vehicle's VIN number.

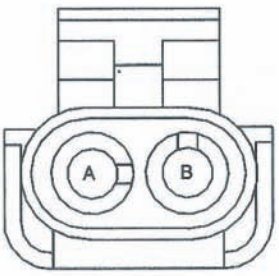
236/246 TCCM Connector C1



New Venture 233

4X4 System Connector Terminal Identification

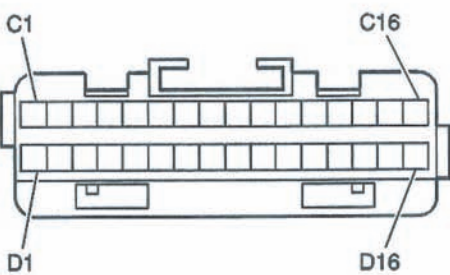
Front Axle Switch Connector



38552

Connector Part Information		• 12103584 • 2 Way F Weather Pack Connector (BRN)	
Pin	Wire Color	Circuit No.	Function
A	BRN	241	Fuse Output - Ignition 3 - Type III Fuse
B	BLK/WHT	1695	Four Wheel Drive Front Wheel Lock Telltale

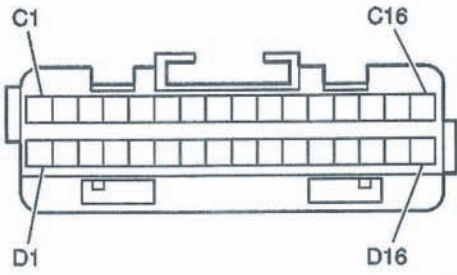
Transfer Case Shift Control Module Connector



581541

Connector Part Information		• 12041476 • 32 Way F Micro-Pack 100 Series (BLU)	
Pin	Wire Color	Circuit No.	Function
C1	GRY/BLK	1694	4WD Drive Switch Signal - Low
C2	—	—	Not Used
C3	DK GRN/ WHT	1559	4 "LO" Select Switch Output
C4	DK GRN/ WHT	1562	2 "HI" Select Switch Output
C5	GRA/BLK	1564	4 "HI" Select Switch Output
C6	ORN	40	Fuse Output - Battery

Transfer Case Shift Control Module Connector (cont'd)



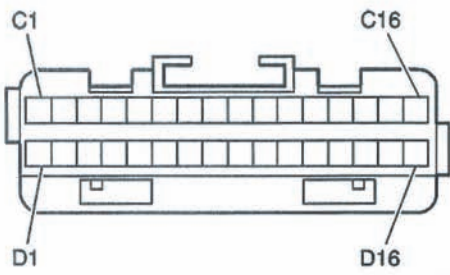
581541

Connector Part Information		• 12041476 • 32 Way F Micro-Pack 100 Series (BLU)	
Pin	Wire Color	Circuit No.	Function
C7	—	—	Not Used
C8	BRN	241	Fuse Output - Ignition 3
C9	BLK/WHT	1554	Transfer Case Encoder Signal Return
C10	BLK	1050	Ground
C11	LT GRN/ BLK	1563	2 "HI" Indicator Lamp Output
C12	TAN/BLK	1566	4 "HI" Indicator Lamp Output
C13	—	—	Not Used
C14	PPL/WHT	1565	4 "LO" Indicator Lamp Output
C15	—	—	Not Used
C16	BLK	1552	Transfer Case Motor Feed - CW
D1	RED	1553	Transfer Case Motor Feed - CCW
D2	LT GRN/ BLK	584	Fuse Output - Brake Transmission Shift Interlock
D3	ORN	1568	Diagnostic Signal - Transfer Case Control Module
D4	BRN/WHT	1555	Transfer Position Switch Encoder Signal - Channel P
D5	RED/WHT	1556	Transfer Position Switch Encoder Signal - Channel C
D6	DK BLU/ WHT	1557	Transfer Position Switch Encoder Signal - Channel A
D7	YEL/BLK	1558	Transfer Position Switch Encoder Signal - Channel B
D8	DK GRN/ WHT	817	Vehicle Speed Signal - 4000 Pulses Per Mile

New Venture 233

4X4 System Connector Terminal Identification (continued)

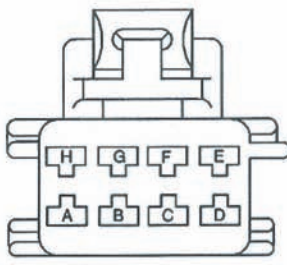
Transfer Case Shift Control Module
Connector (cont'd)



581541

Connector Part Information		• 12041476 • 32 Way F Micro-Pack 100 Series (BLU)	
Pin	Wire Color	Circuit No.	Function
D9-D11	—	—	Not Used
D12	BLK	1050	Ground
D13	BLK	1050	Ground
D14	ORN	1640	Fuse Output - Battery
D15	ORN	1640	Fuse Output - Battery
D16	PPL	806	Fuse Output - Crank

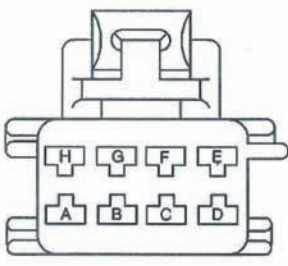
Transfer Case Shift Select Switch
Connector C1 (cont'd)



62463

Connector Part Information		• 12064766 • 8 Way F Metri-Pack 150 Series (BLU)	
Pin	Wire Color	Circuit No.	Function
E	LT GRN/ BLK	1563	2 "HI" Indicator Lamp
F	DK GRN/ WHT	1559	4 "LO" Select Switch Output
G	BLK	1050	Ground
H	GRA	1220	Fuse Output - Instrument Panel Lamps

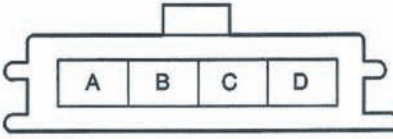
Transfer Case Shift Select Switch
Connector C1



62463

Connector Part Information		• 12064766 • 8 Way F Metri-Pack 150 Series (BLU)	
Pin	Wire Color	Circuit No.	Function
A	GRA/BLK	1564	4 "HI" Select Switch Output
B	DK GRN/ WHT	1562	2 "HI" Select Switch Output
C	PPL/WHT	1565	4 "LO" Indicator Lamp Output
D	TAN/BLK	1566	4 "HI" Indicator Lamp Output

Transfer Case Select Switch Connector C2



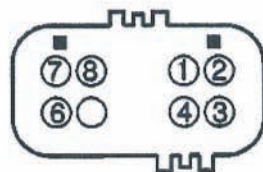
130635

Connector Part Information		• 12045013 • 4 Way F Metri-Pack 150 Series (NAT)	
Pin	Wire Color	Circuit No.	Function
A	—	—	Not Used
B	PPL/WHT	1382	LED Dimming Signal
C	BRN	241	Fuse Output - Ignition 3
D	—	—	Not Used

New Venture 233

4X4 System Connector Terminal Identification (continued)

Electric Shift Transfer Case Connector



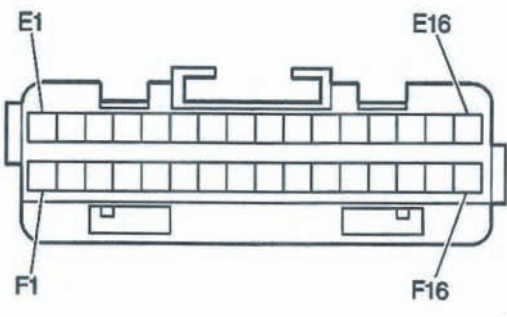
95786

Connector Part Information		• 12124051 • 8 Way F (BLK)	
Pin	Wire Color	Circuit No.	Function
1	YEL/BLK	1558	Transfer Case Position Switch Encoder Signal - Channel B
2	DK BLU/WHT	1557	Transfer Case Position Switch Encoder Signal - Channel A
3	BLK/WHT	1554	Transfer Case Encoder Signal Return
4	BRN/WHT	1555	Transfer Case Position Switch Encoder Signal - Channel P
5	—	—	Not Used
6	RED	1553	Transfer Case Motor Feed - CCW
7	BLK	1552	Transfer Case Motor Feed - CW
8	RED/WHT	1556	Transfer Case Position Switch Encoder Signal - Channel C

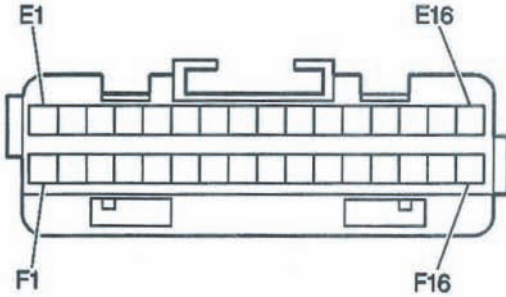
New Venture 236 and 246

4X4 System Connector Terminal Identification

Transfer Case Control Connector
End Views

Transfer Case Shift Control Module Connector C1			
			
Connector Part Information		• 12052107 • 16 Way F Micro-Pack 100 Series (ORN)	
Pin	Wire Color	Circuit No.	Function
E1	Tan	1569	Transfer Case Lock Solenoid Output
E2	—	—	Not Used
E3	PNK	1561	AWD/4WD Indicator Lamp Output
E4	Lt GRN/ BLK	1563	2 HI Indicator Lamp Output
E5	BRN/WHT	1555	Transfer Case Position Switch Encoder Signal
E6	RED/WHT	1556	Transfer Case Position Switch Encoder Signal
E7	YEL/BLK	1558	Transfer Case Position Switch Encoder Signal
E8	DK BLU/ WHT	1557	Transfer Case Position Switch Encoder Signal
E9	DK GRN/ WHT	1133	Class 2 Serial Data Signal
E10	BRN	241	Fuse Output - Ignition 3 - Type III Fuse
E11	PPL	806	Fuse Output - Crank - Type III Fuse
E12	YEL	400	Vehicle Speed Sensor Signal
E13	PPL	401	Vehicle Speed Sensor Return
E14	BLK/WHT	1695	Four Wheel Drive Front Wheel Lock Telltale

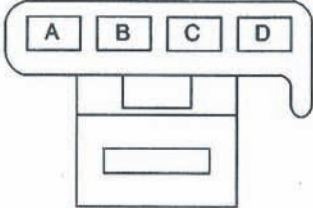
Transfer Case Shift Control Module
Connector C1 (cont'd)

Transfer Case Shift Control Module Connector C1 (cont'd)			
			
Connector Part Information		• 12052107 • 16 Way F Micro-Pack 100 Series (ORN)	
Pin	Wire Color	Circuit No.	Function
E15	—	—	Not Used
E16	BLK/WHT	451	Engine Control Module Ground
F1	PPL/WHT	1565	4 LO Indicator Lamp Output
F2	TAN/BLK	1566	4 HI Indicator Lamp Output
F3	BRN	1560	Neutral Indicator Lamp Output
F4	GRA/BLK	1570	Front Axle Actuator Output
F5	LT BLU	2221	Vehicle Speed Sensor Signal
F6	DK GRN	2222	Vehicle Speed Sensor Return
F7	GRA/BLK	1694	Four Wheel Drive Switch Signal - Low
F8 - F11	—	—	Not Used
F12	BLK/WHT	1554	Transfer Case Encoder Signal Return
F13	LT GRN/ BLK	431	Reference Voltage Feed - 8 Volt Reference
F14	LT GRN/ BLK	431	Reference Voltage Feed - 8 Volt Reference
F15	—	—	Not Used
F16	LT BLU	1693	Four Wheel Drive Switch Signal

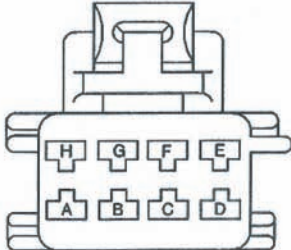
New Venture 236 and 246

4X4 System Connector Terminal Identification (continued)

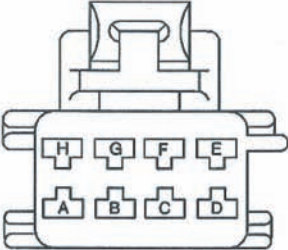
Transfer Case Shift Control Module
Connector C2

		• 12052856 • 4 Way F Metri-Pack 280 Series (BLK)	
Pin	Wire Color	Circuit No.	Function
A	BLK	1552	Transfer Case Motor Feed - Clockwise
B	RED	1553	Transfer Case Motor Feed - Counterclockwise
C	BLK	1050	Ground
D	ORG	1640	Fuse Output - Battery - Type III Fuse

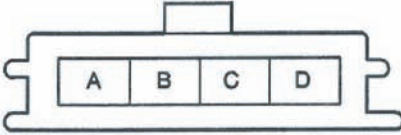
Transfer Case Select Switch Connector C1
(cont'd)

		• 12064766 • 8 Way F Metri-Pack 150 Series (BLU)	
Pin	Wire Color	Circuit No.	Function
E	LT GRN/ BLK	1563	2 HI Indicator Lamp Output
F	PNK	1561	AWD/4WD Indicator Lamp Output
G	BLK	1050	Ground
H	GRA	1220	Fuse Output - IP Lamps - Type III

Transfer Case Select Switch Connector C1

		• 12064766 • 8 Way F Metri-Pack 150 Series (BLU)	
Pin	Wire Color	Circuit No.	Function
A	LT GRN/ BLK	431	Reference Voltage Feed - 8 Volt Reference
B	LT BLU	1693	Four Wheel Drive Switch Signal
C	PPL/WHT	1565	4 LO Indicator Lamp Output
D	TAN/BLK	1566	4 HI Indicator Lamp Output

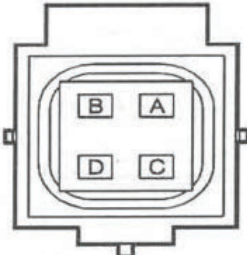
Transfer Case Select Switch Connector C2

		• 12045813 • 4 Way F Metri-Pack 150 Series (NAT)	
Pin	Wire Color	Circuit No.	Function
A	—	—	Not Used
B	PPL/WHT	1382	LED Dimming Signal
C	BRN	241	Fuse Output - Ignition 3 - Type III Fuse
D	BRN	1560	Neutral Indicator Lamp Output

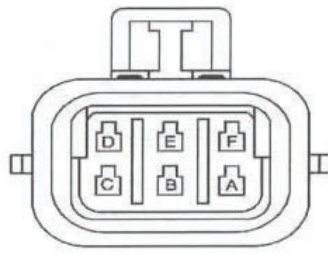
New Venture 236 and 246

4X4 System Connector Terminal Identification (continued)

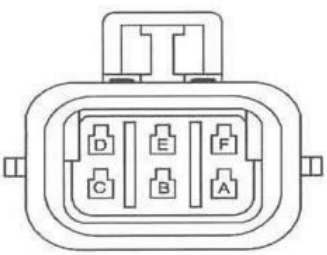
Transfer Case Encoder Motor Connector C1

			
365977			
Connector Part Information		• 12191399 • 4F Metri-Pack 280 Series, Flexlock, Sealed (BLK)	
Pin	Wire Color	Circuit No.	Function
A	BLK	1552	Transfer Case Motor Feed - Clockwise
B	RED	1553	Transfer Case Motor Feed - Counterclockwise
C	ORG	1640	Fuse Output - Battery - Type III Fuse
D	TAN	1569	Transfer Case Lock Solenoid Output

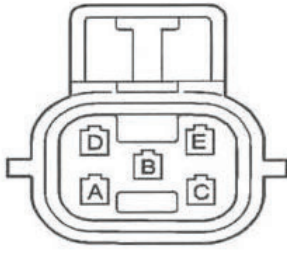
Transfer Case Encoder Motor Connector C2 (cont'd)

			
62449			
Connector Part Information		• 12052848 • 6 Way F Metri-Pack 150 Series, Sealed (BLK)	
Pin	Wire Color	Circuit No.	Function
D	YEL/BLK	1558	Transfer Case Position Switch Encoder Signal
E	LT GRN/BLK	431	Reference Voltage Feed - 8 Volt Reference
F	BRN/WHT	1555	Transfer Case Position Switch Encoder Signal

Transfer Case Encoder Motor Connector C2

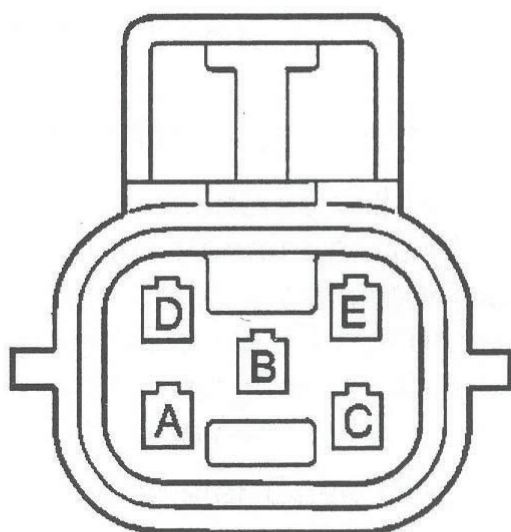
			
62449			
Connector Part Information		• 12052848 • 6 Way F Metri-Pack 150 Series, Sealed (BLK)	
Pin	Wire Color	Circuit No.	Function
A	BLK/WHT	1554	Transfer Case Encoder Signal Return
B	DK BLU/WHT	1557	Transfer Case Position Switch Encoder Signal
C	RED/WHT	1556	Transfer Case Position Switch Encoder Signal

Front Axle Actuator

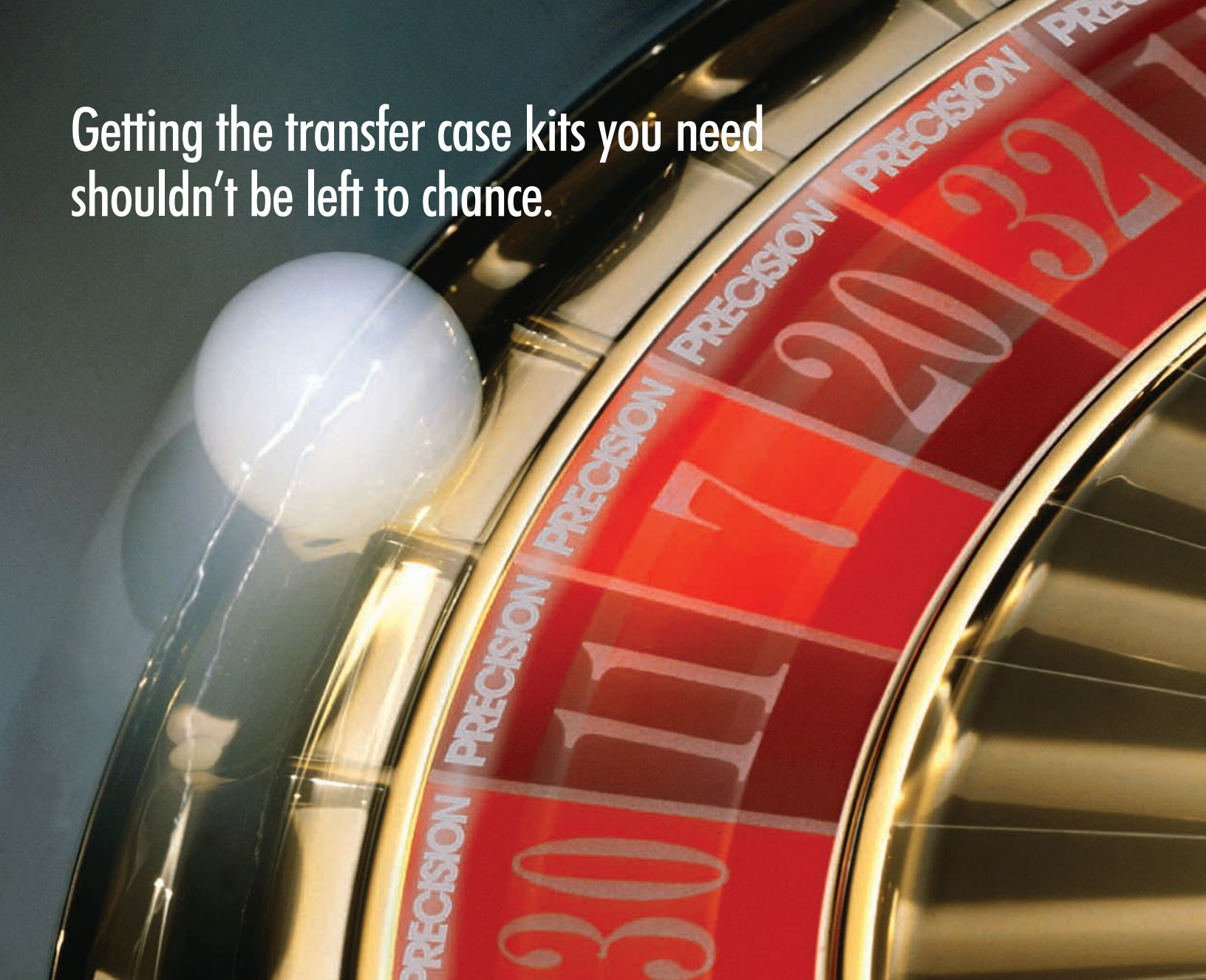
			
365944			
Connector Part Information		• 12077591 • ASM 5F M/P 150 (BLK)	
Pin	Wire Color	Circuit No.	Function
A	BLK/WHT	1695	4WD Front Wheel Lock Telltale Feed
B	GRY/BLK	1570	Front Axle Actuator Output
C	BRN	241	Fuse Output - Ignition 3 - Type II Output
D	—	—	Not Used
E	BLK	150	Ground

New Venture 246

4X4 System Connector Terminal Identification (continued)



Connector Part Information		• 12077591 • ASM 5F M/P 150 (BLK)	
Pin	Wire Color	Circuit No.	Function
A	BLK/WHT	1695	4WD Front Wheel Lock Telltale Feed
B	GRY/BLK	1570	Front Axle Actuator Output
C	BRN	241	Fuse Output - Ignition 3 - Type II Output
D	—	—	Not Used
E	BLK	150	Ground



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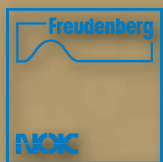
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A761

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A340

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A761

Introduction

The A761E transmission is Toyota's first six speed automatic. It is said to be lightest six speed automatic speed automatic transmission in the world, weighing in at 187 pounds wet. This transmission is used in the 2004 and the 2004 and later Lexus LS430



A76I

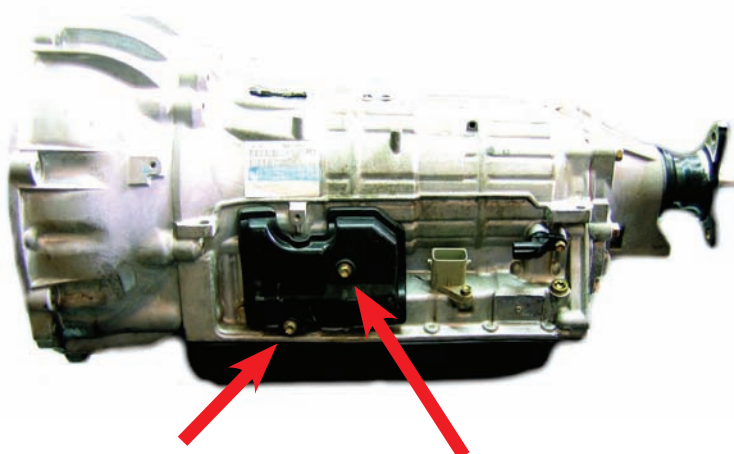
Fluid Fill Procedure

Before the Transmission is Filled

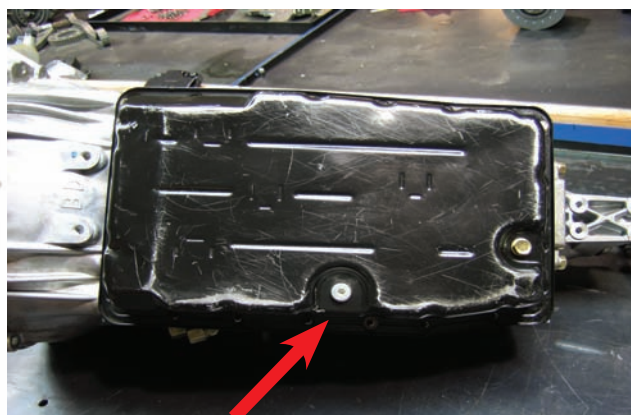
This transmission requires genuine Toyota ATF WS. In order to refill the transmission with the correct amount of fluid. The vehicle must remain level while adjusting fluid level.

SST Part # 00002-111-02

Transmission Pan Fill



1. Remove the two bolts and case cover from the side of transmission.



2. Remove the refill plug and the overflow plug.
4. Reinstall the overflow plug after the transmission full.



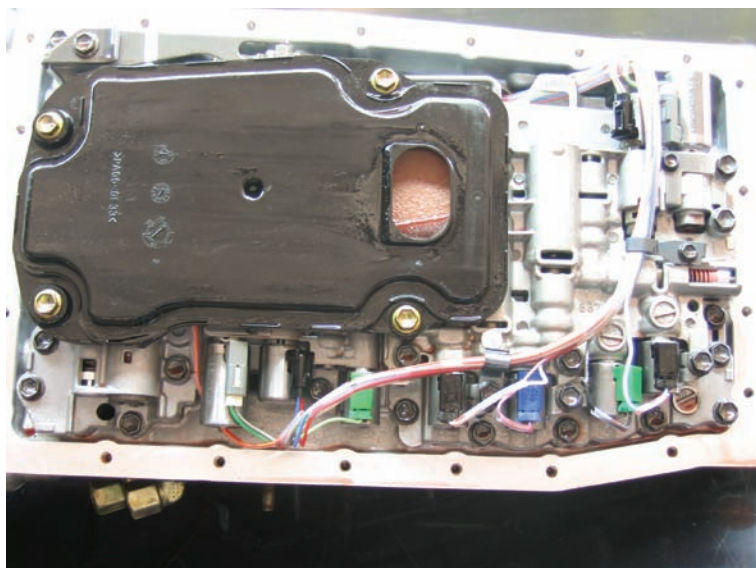
3. Fill the transmission through the refill hole until fluid begins to trickle out.

A76I

Contamination

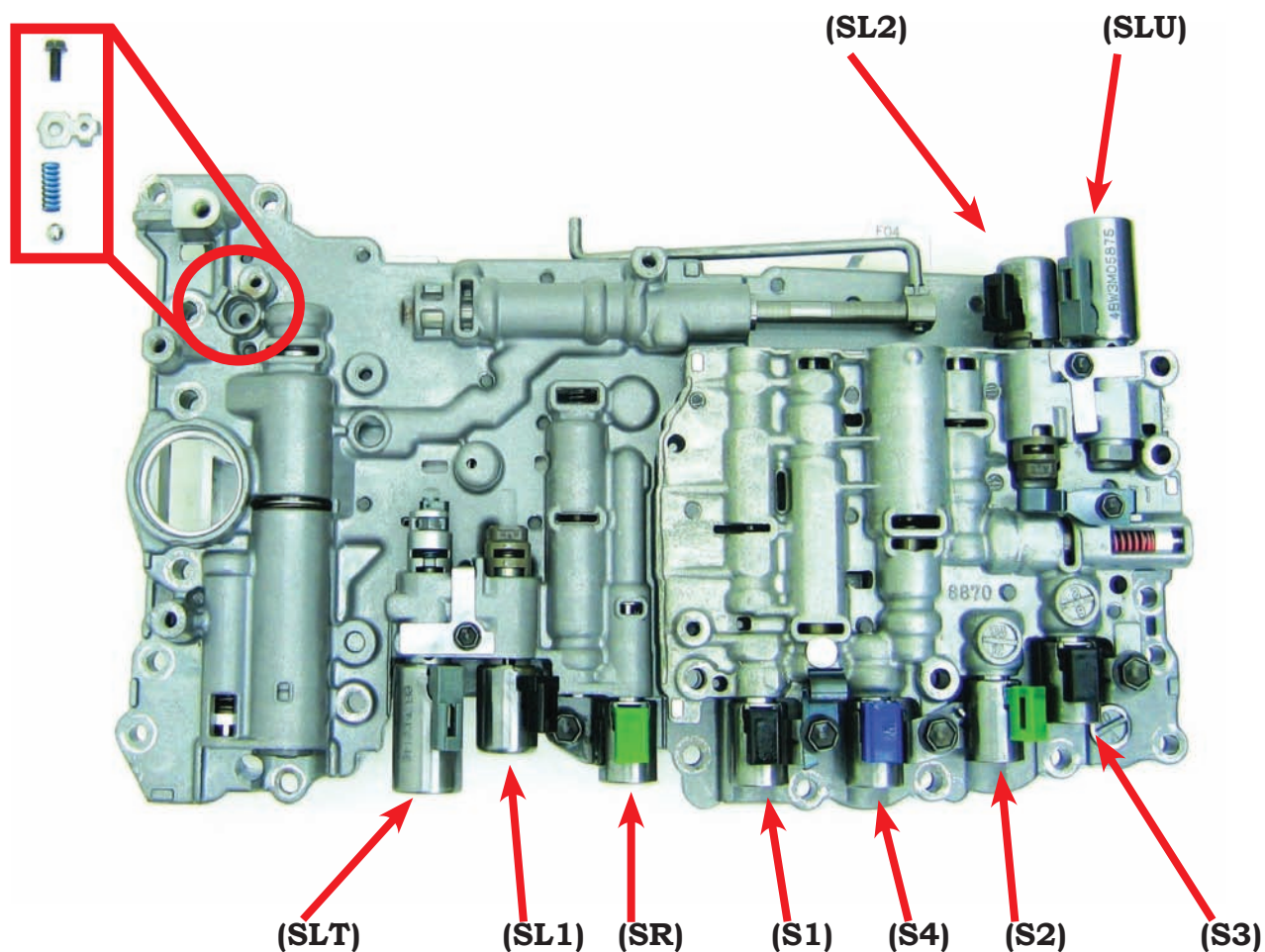
Do not turn the transmission over before the oil pan is removed as this will contaminate the valve body with foreign matter, there is no magnet in the bottom of the pan to catch any debris that can reach the valve body when rolled over.

Install the transmission case on the overhaul attachment. Remove the 20 bolts from oil pan, carefully look at the foreign matter and particles in the pan. This will help to anticipate the type of wear you will find in the transmission



A76I

Solenoid Identification



Solenoid

S1
S2
S3
S4
SR
SL1
SL2
SLU
SLT
TFT

Wire Color

Pin 8 WHT
Pin 15 BLK
Pin 7 Lt BLU
Pin 14 PPL
Pin 6 Lt GRN
Pin 11 RED
Pin 10 YEL
Pin 12 Lt GRN
Pin 13 GRN
Pin 9 ORN

Case Connector

Ground
Ground
Ground
Ground
Ground
Pin 3 BLU
Pin 2 PPL
Pin 4 BRN
Pin 5 GRY
Pin 1 ORN

Resistance

11-15
11-15
11-15
11-15
11-15
5-5.6
5-5.6
5-5.6
5-5.6
79K-156K

A76I

Connector Pin Identification

Using the illustration and specifications below will help you diagnose an internal wiring and solenoid concern.

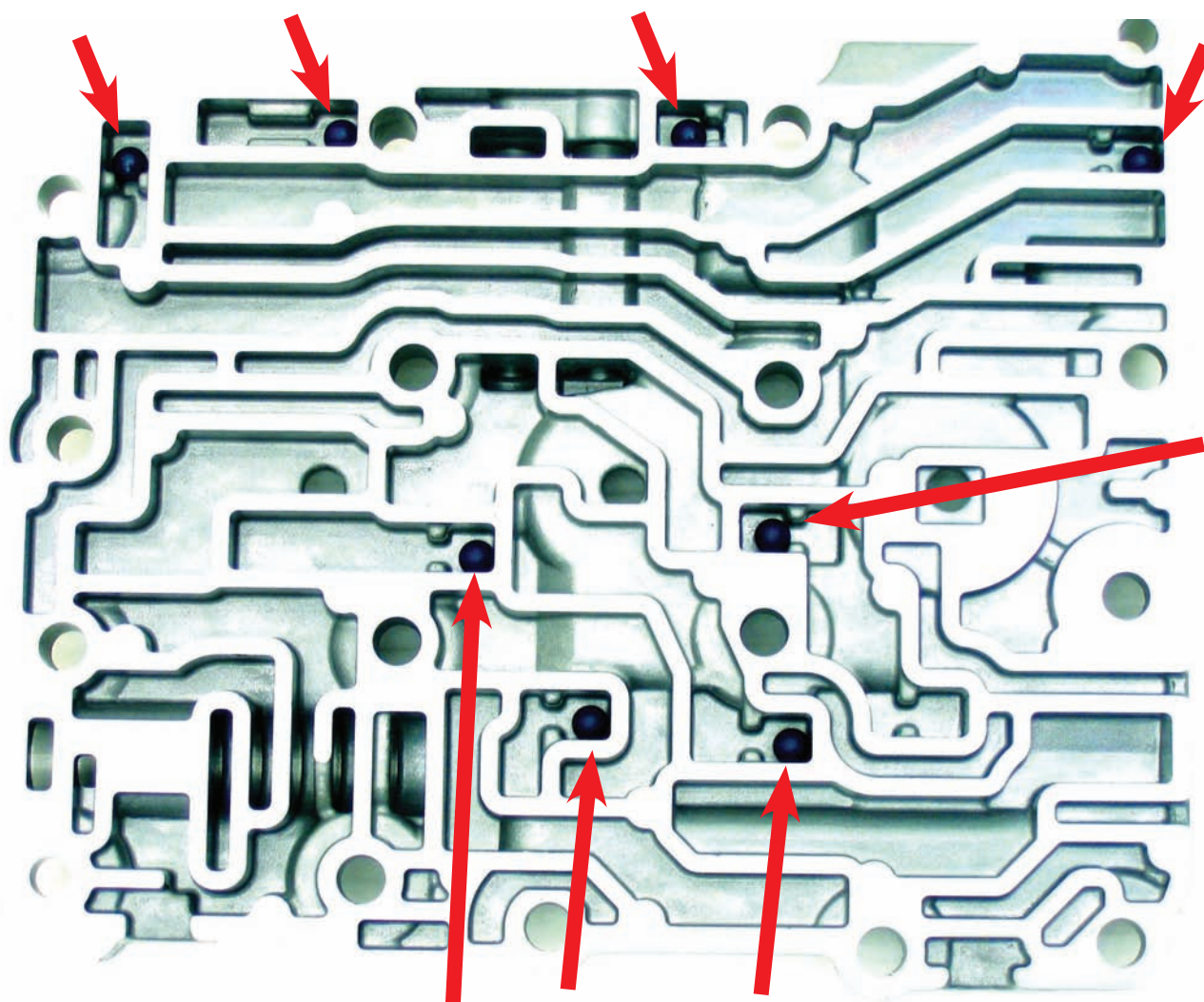


Solenoid	Wire Color	Case Connector	Resistance
S1	Pin 8 WHT	Ground	11-15
S2	Pin 15 BLK	Ground	11-15
S3	Pin 7 Lt BLU	Ground	11-15
S4	Pin 14 PPL	Ground	11-15
SR	Pin 6 Lt GRN	Ground	11-15
SL1	Pin 11 RED	Pin 3 BLU	5-5.6
SL2	Pin 10 YEL	Pin 2 PPL	5-5.6
SLU	Pin 12 Lt GRN	Pin 4 BRN	5-5.6
SLT	Pin 13 GRN	Pin 5 GRY	5-5.6
TFT	Pin 9 ORN	Pin 1 ORN	79K-156K

A76I

Upper Valve Body Check Ball Locations

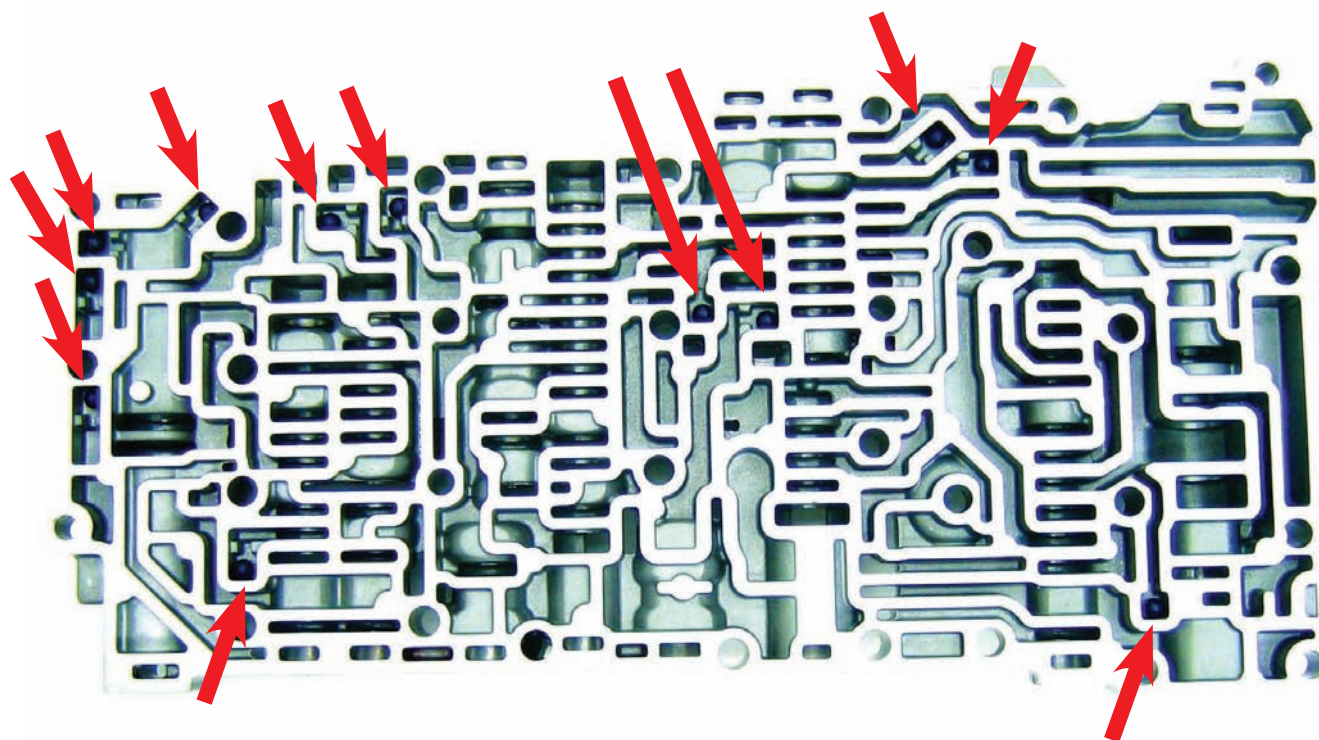
There are eight (8) check balls in the Upper Valve Body. All of the check balls are composite, make sure during the rebuild that the check balls seat on the valve body separator plate and are not decomposed.



A76I

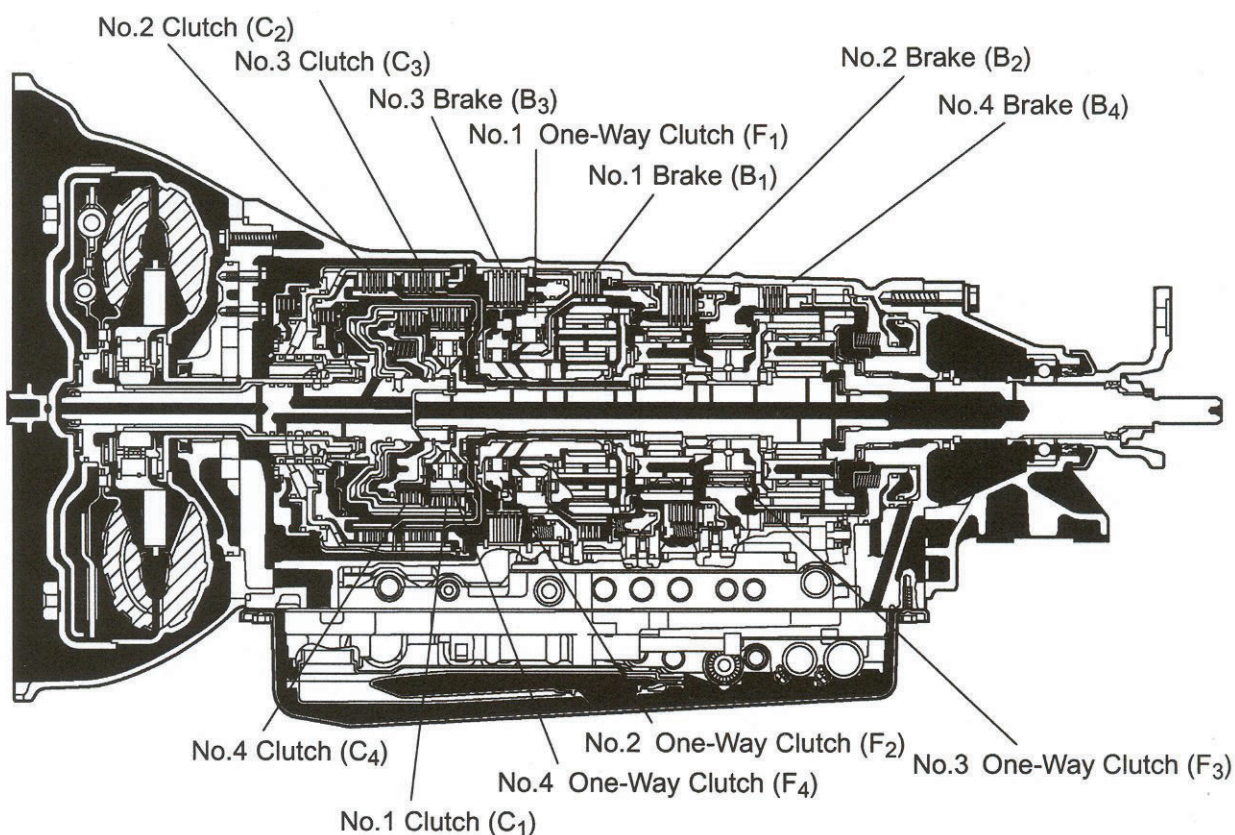
Main Valve Body Check Ball Locations

There are twelve (12) check balls in the Main Valve Body. All of the check balls are composite, make sure during the rebuild that the check balls seat on the valve body separator plate and are not decomposed.



A761

Clutch and Band Application Chart



Shift Lever Position	Solenoid Valve								Clutch				Brake				One-way Clutch			
	S1	S2	S3	S4	SR	SL1	SL2	SLU	C ₁	C ₂	C ₃	C ₄	B ₁	B ₂	B ₃	B ₄	F ₁	F ₂	F ₃	F ₄
P		ON	ON		ON		ON													
R*		ON	ON		ON		ON				○		○			○	○			
N		ON	ON		ON		ON													
D, S (6)	1st		ON	ON		ON		ON	○			○							○	○
	2nd	ON	ON	ON		ON		ON	○			○			○		○	○		○
	3rd	ON		ON		ON		ON	○		○	○			●		○			○
	4th	ON				ON		ON	○	○	●	○			●					○
	5th	ON			ON		ON		●	○	○		○		●					
	6th	ON	ON		ON		ON		●	○			●	○	●					

A761

Codes and Definitions

- *1 : ● ... MIL (Malfunction Indicator Lamp) light up
- *2 : "○" mark means ECM memorizes the malfunction code if the ECM detects the DTC detection condition.
- This DTC may be output when the clutch, brake and gear components etc. inside the automatic transmission are damaged.

DTC No. (See Page)	Detection Item	Trouble Area	MIL *1	Memory *2
P0500 (05-228)	Vehicle Speed Sensor "A"	• Open or short in speed sensor (SP2) circuit • Speed sensor (SP2) • ECM	●	○
P0705 (05-615)	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	• Open or short in park/neutral position switch circuit • Park/neutral position switch • ECM	●	○
P0710 (05-622)	Transmission Fluid Temperature Sensor "A" Circuit	• Open or short in ATF temperature sensor circuit • Transmission wire (ATF temperature sensor) • ECM	●	○
P0711 (05-627)	Transmission Fluid Temperature Sensor "A" Performance	• Open or short in ATF temperature sensor circuit • Transmission wire (ATF temperature sensor) • ECM	●	○
P0712 (05-622)	Transmission Fluid Temperature Sensor "A" Circuit Low Input	• Short in ATF temperature sensor circuit • Transmission wire (ATF temperature sensor) • ECM	●	○
P0713 (05-622)	Transmission Fluid Temperature Sensor "A" Circuit High Input	• Open in ATF temperature sensor circuit • Transmission wire (ATF temperature sensor) • ECM	●	○
P0717 (05-630)	Turbine Speed Sensor Circuit No Signal	• Open or short in speed sensor (NT) circuit • Speed sensor (NT) • ECM • Automatic transmission (clutch, brake or gear, etc.)	●	○
P0724 (05-634)	Brake Switch "B" Circuit High	• Short in stop light switch signal circuit • Stop light switch • ECM	●	○
P0729 (05-636)	Gear 6 Incorrect Ratio	• Valve body is blocked up or stuck (reverse sequence valve) • Automatic transmission (clutch, brake or gear, etc.) • ECM	●	○
P0748 (05-641)	Pressure Control Solenoid "A" Electrical (Shift Solenoid Valve SL1)	• Open or short in shift solenoid valve SL1 circuit • Shift solenoid valve SL1 • ECM	●	○
P0751 (05-644)	Shift Solenoid "A" Performance (Shift Solenoid Valve S1)	• Shift solenoid valve S1 remains open or closed • Valve body is blocked • No.2 brake malfunction (Driving is difficult.) • Automatic transmission (clutch, brake or gear, etc.) • ECM	●	○
P0756 (05-650)	Shift Solenoid "B" Performance (Shift Solenoid Valve S2)	• Shift solenoid valve S2 remains open or closed • Valve body is blocked • Automatic transmission (clutch, brake or gear, etc.) • ECM	●	○

A76I

Codes and Definitions (continued)

P0761 (05-655)	Shift Solenoid "C" Performance (Shift Solenoid Valve S3)	• Shift solenoid valve S3 remains open or closed • Valve body is blocked • Automatic transmission (clutch, brake or gear, etc.) • ECM	●	○
P0766 (05-661)	Shift Solenoid "D" Performance (Shift Solenoid Valve S4)	• Shift solenoid valve S4 remains open or closed • Shift solenoid valve SL2 remains open or closed • Valve body is blocked (Brake control valve) • Automatic transmission (clutch, brake or gear, etc.) • ECM	●	○
P0778 (05-666)	Pressure Control Solenoid "B" Electrical (Shift Solenoid Valve SL2)	• Open or short in shift solenoid valve SL2 circuit • Shift solenoid valve SL2 • ECM	●	○
P0781 (05-669)	1-2 Shift (1 -2 Shift Valve)	• Valve body is blocked up or stuck (1-2 shift valve) • Automatic transmission (clutch, brake or gear, etc.) • ECM	●	○
P0850 (05-615)	Park/Neutral Switch Input Circuit	• Short in park/neutral position switch circuit • Park/neutral position switch • ECM	●	○
P0973 (05-674)	Shift Solenoid "A" Control Circuit Low (Shift Solenoid Valve S1)	• Short in shift solenoid valve S1 circuit • Shift solenoid valve S1 • ECM	●	○
P0974 (05-674)	Shift Solenoid "A" Control Circuit High (Shift Solenoid Valve S1)	• Open in shift solenoid valve S1 circuit • Shift solenoid valve S1 • ECM	●	○
P0976 (05-677)	Shift Solenoid "B" Control Circuit Low (Shift Solenoid Valve S2)	• Short in shift solenoid valve S2 circuit • Shift solenoid valve S2 • ECM	●	○
P0977 (05-677)	Shift Solenoid "B" Control Circuit High (Shift Solenoid Valve S2)	• Open in shift solenoid valve S2 circuit • Shift solenoid valve S2 • ECM	●	○
P0979 (05-680)	Shift Solenoid "C" Control Circuit Low (Shift Solenoid Valve S3)	• Short in shift solenoid valve S3 circuit • Shift solenoid valve S3 • ECM	●	○
P0980 (05-680)	Shift Solenoid "C" Control Circuit High (Shift Solenoid Valve S3)	• Open in shift solenoid valve S3 circuit • Shift solenoid valve S3 • ECM	●	○
P0982 (05-683)	Shift Solenoid "D" Control Circuit Low (Shift Solenoid Valve S4)	• Short in shift solenoid valve S4 circuit • Shift solenoid valve S4 • ECM	●	○
P0983 (05-683)	Shift Solenoid "D" Control Circuit High (Shift Solenoid Valve S4)	• Open in shift solenoid valve S4 circuit • Shift solenoid valve S4 • ECM	●	○
P0985 (05-686)	Shift Solenoid "E" Control Circuit Low (Shift Solenoid Valve SR)	• Short in shift solenoid valve SR circuit • Shift solenoid valve SR • ECM	●	○
P0986 (05-686)	Shift Solenoid "E" Control Circuit High (Shift Solenoid Valve SR)	• Open in shift solenoid valve SR circuit • Shift solenoid valve SR • ECM	●	○
P2714 (05-689)	Pressure Control Solenoid "D" Performance (Shift Solenoid Valve SLT)	• Shift solenoid valve SLT remains open or closed • Valve body is blocked • Automatic transmission (clutch, brake or gear, etc.) • ECM	●	○

A76I

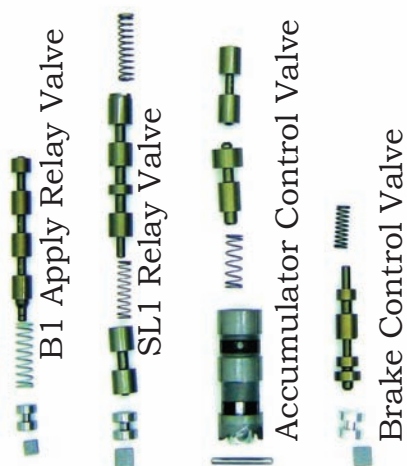
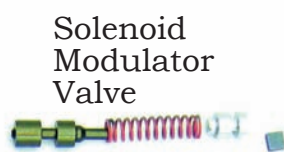
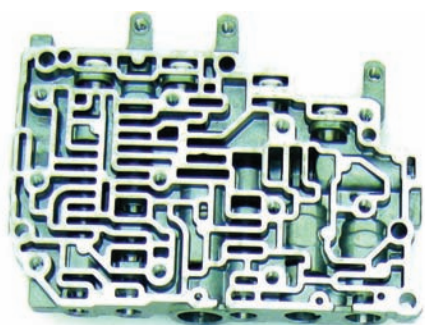
Codes and Definitions (continued)

P2716 (05-694)	Pressure Control Solenoid "D" Electrical (Shift Solenoid Valve SLT)	• Open or short in shift solenoid valve SLT circuit • Shift solenoid valve SLT • ECM	●	○
P2757 (05-697)	Torque Converter Clutch Pressure Control Solenoid Performance (Shift Solenoid Valve SLU)	• Shift solenoid valve SLU remains open or closed • Valve body is blocked • Shift solenoid valve SLU • Torque converter clutch • Automatic transmission (clutch, brake or gear, etc.) • Line pressure is too low • ECM	●	○
P2759 (05-703)	Torque Converter Clutch Pressure Control Solenoid Control Circuit Electrical (Shift Solenoid Valve SLU)	• Open or short in shift solenoid valve SLU circuit • Shift solenoid valve SLU • ECM	●	○

A76I

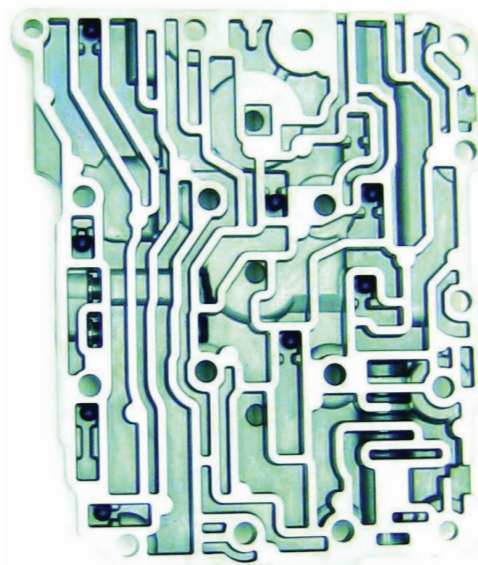
Valve Body Exploded View

Lower #2 Valve Body



**Mark the setting before
you remove the Pressure
boost valve.**

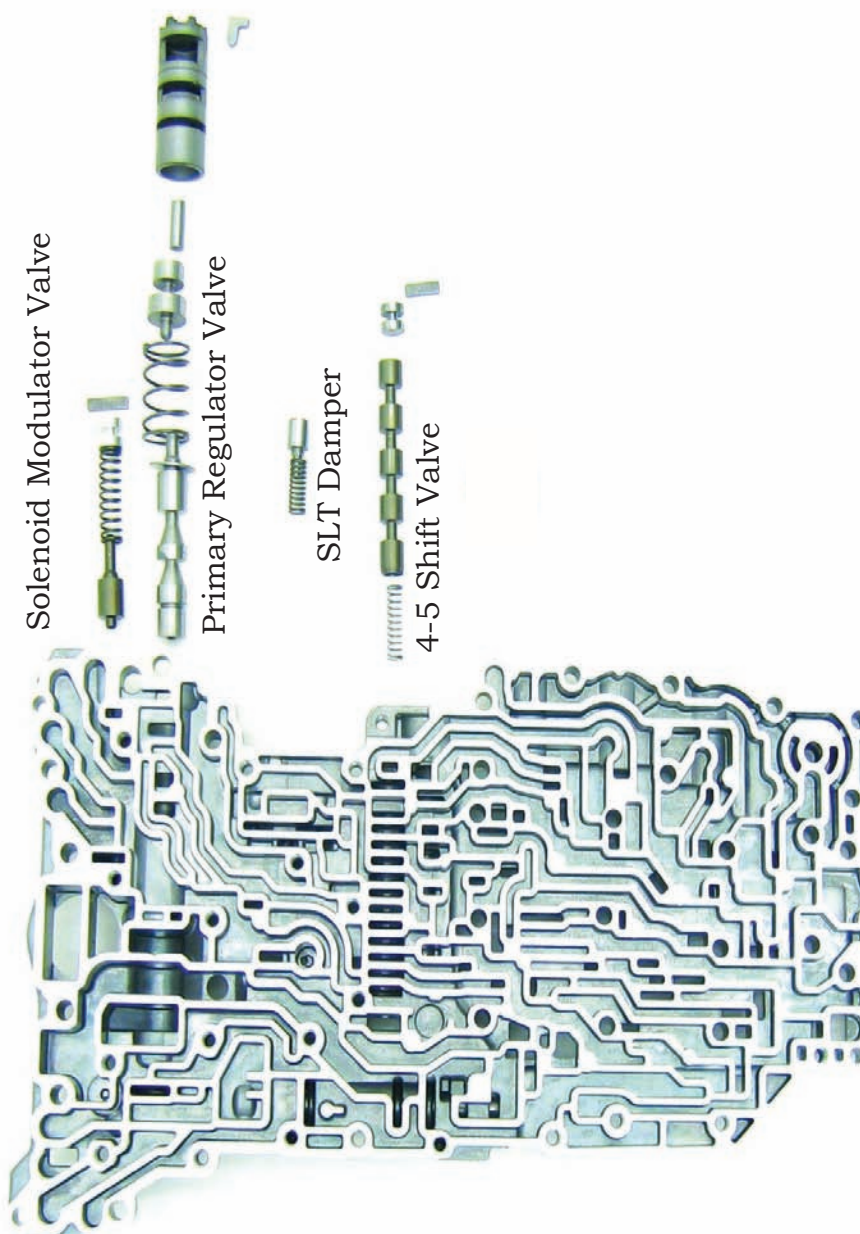
Upper #2 Valve Body



A76I

Valve Body Exploded View (continued)

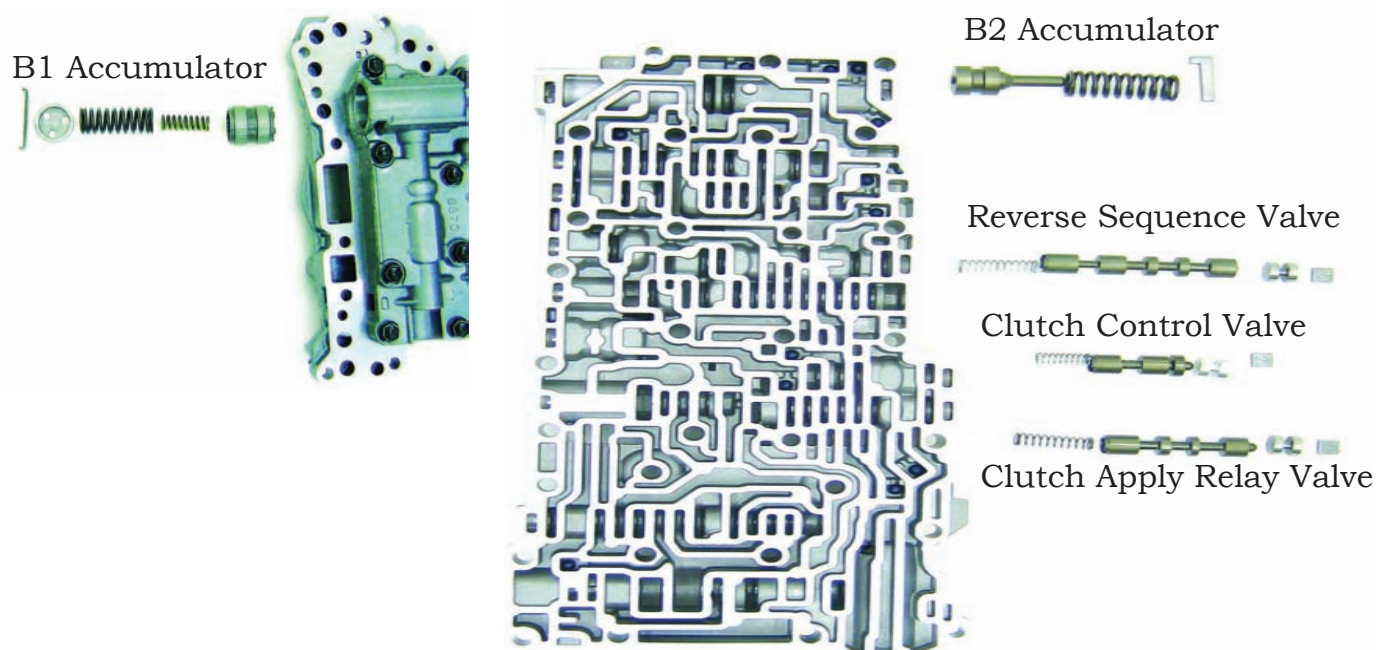
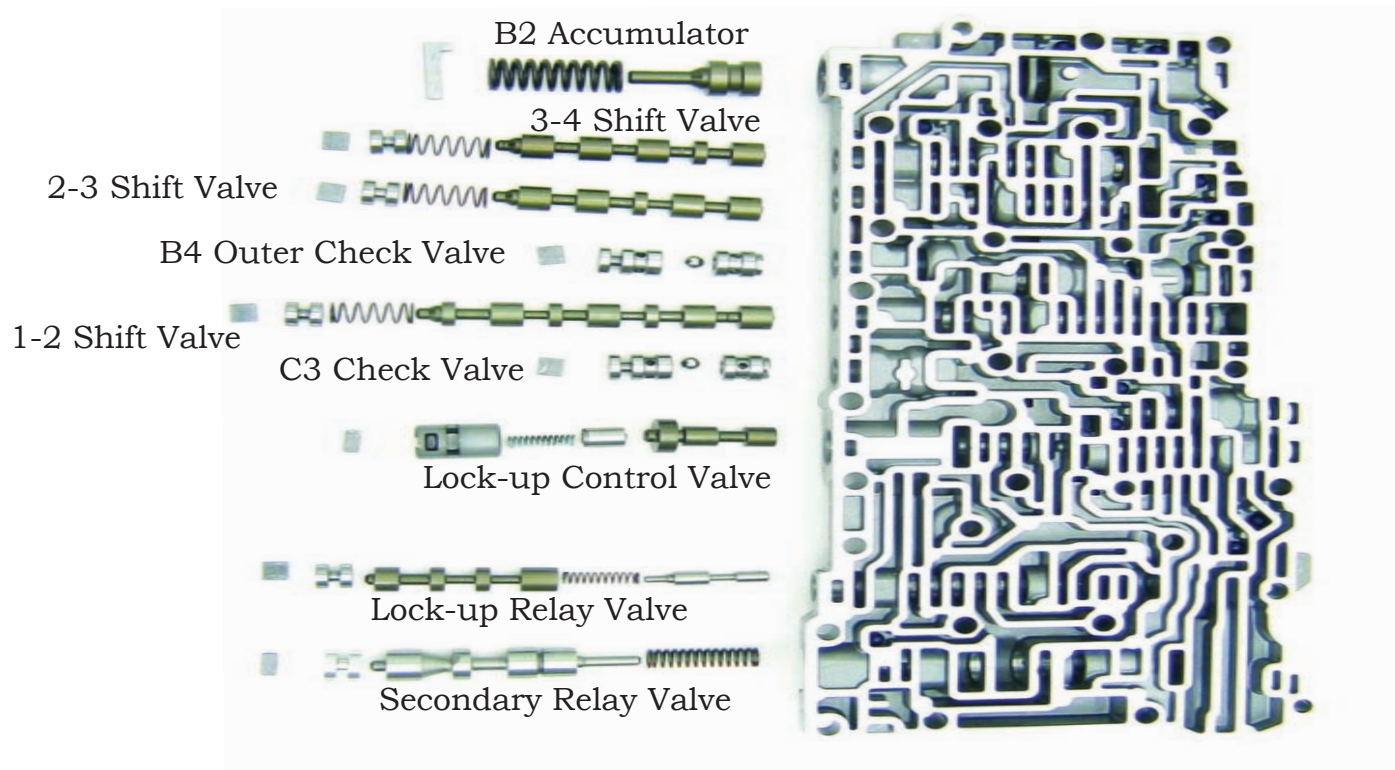
Lower #1 Valve Body



A76I

Valve Body Exploded View (continued)

Upper #1 Valve Body

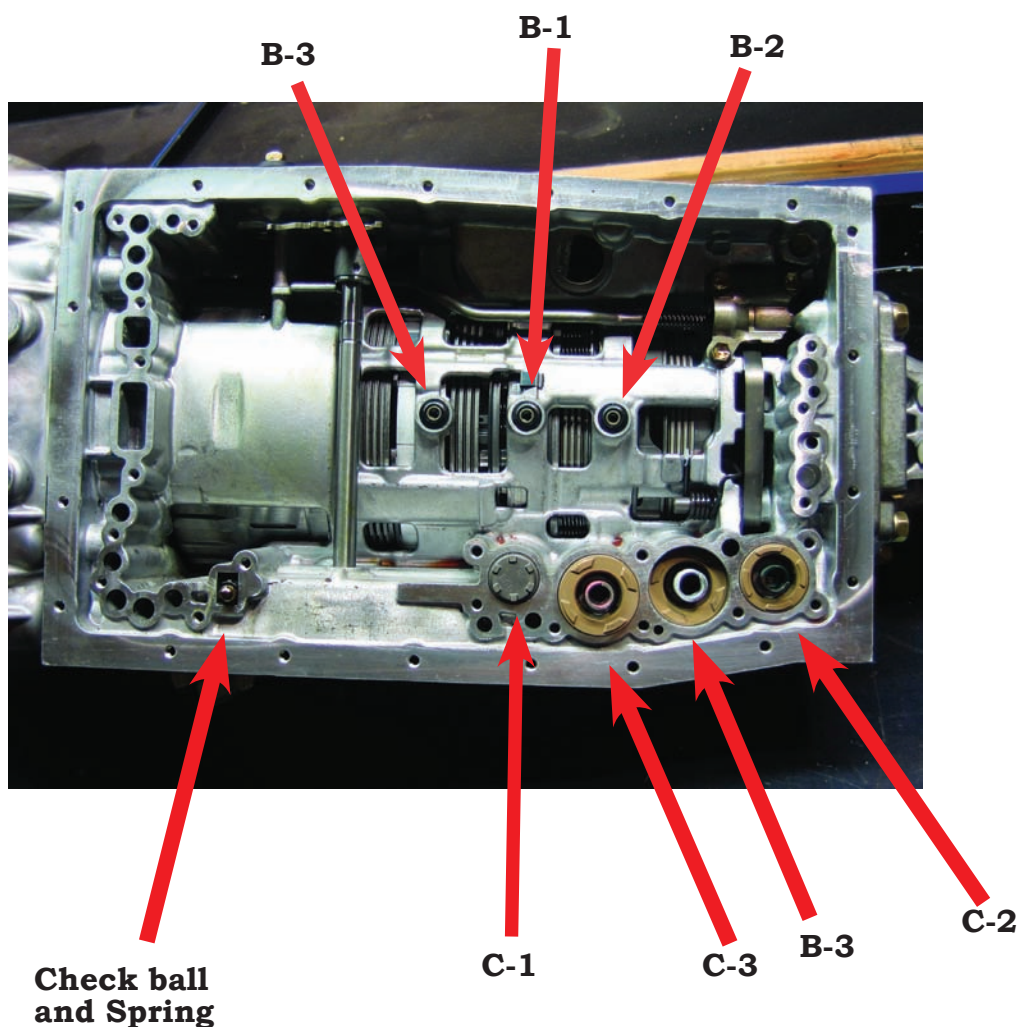


A76I

Accumulator Piston Identification

During disassembly inspect the accumulator pistons, springs and bores for wear or damage.

During reassembly always replace the valve body to case seals in the case for the B-1, B-2, and B-3 applications.



A76I

Accumulator Identification (continued)

C1 Accumulator Piston and Spring



**Inner Spring
Free Length**
44.98 mm

Outer Diameter
11.30 mm

Color
Natural

**Outer Spring
Free Length**
46.36 mm

Outer Diameter
17.10 mm

Color
Natural

C3 Accumulator Piston and Spring



**Inner Spring
Free Length**
44.0 mm

Outer Diameter
14.0 mm

Color
Yellow

**Outer Spring
Free Length**
76.65 mm

Outer Diameter
20.10 mm

Color
Natural

**Small Balance Spring
Free Length**
22.06 mm

Outer Diameter
14.05 mm

Color
Pink

A76I

Accumulator Identification (continued)

B3 Accumulator Piston and Spring



**Inner Spring
Free Length**
65.5 mm

Outer Diameter
19.5 mm

Color
Orange/Red

**Balance Spring
Free Length**
29.75 mm

Outer Diameter
16.15 mm

Color
White

C2 Accumulator Piston and Spring



**Inner Spring
Free Length**
63.14 mm

Outer Diameter
16.0 mm

Color
Gray/White

**Balance Spring
Free Length**
17.57 mm

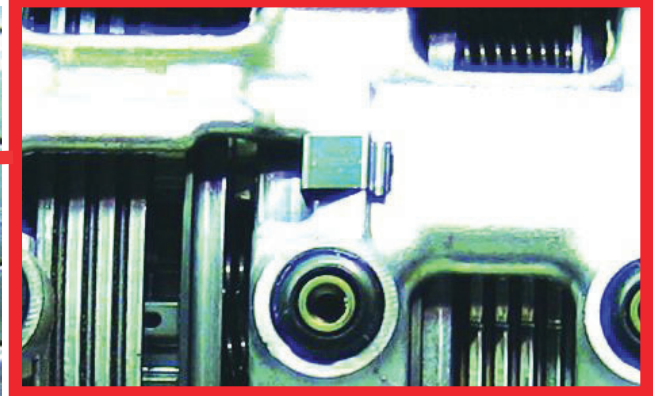
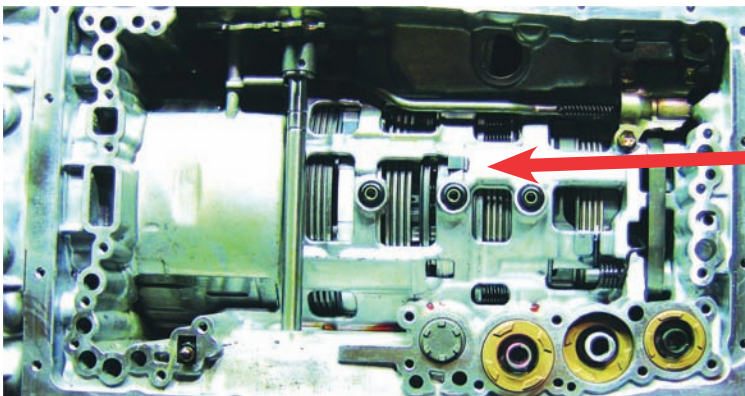
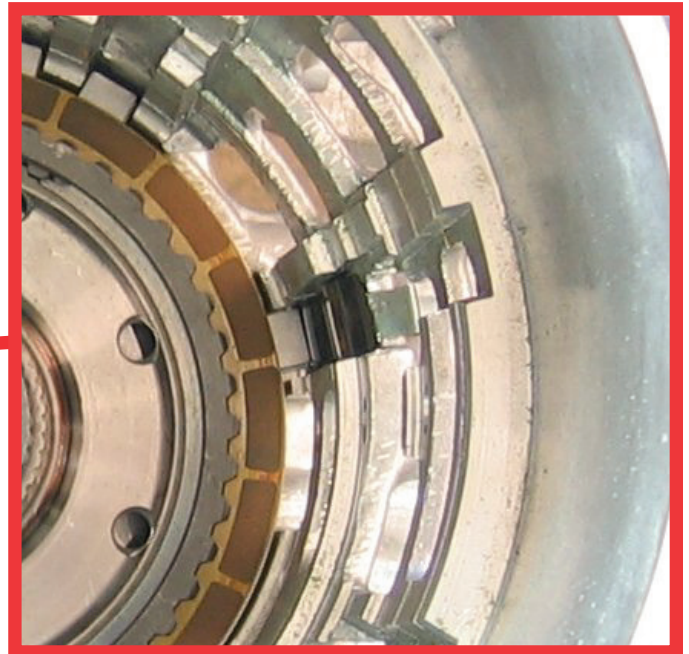
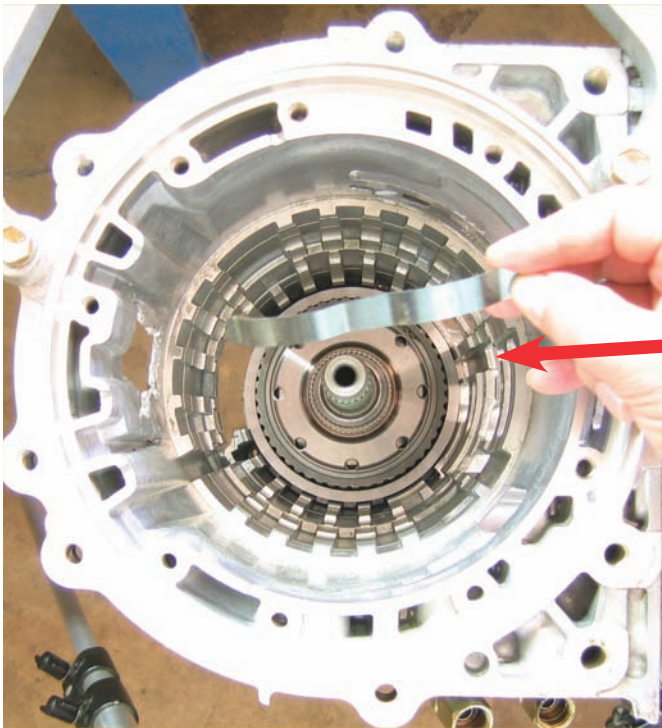
Outer Diameter
14.04 mm

Color
Green

A761

Brake Plate Stopper

Install the brake plate stopper anti-rattle spring into the case. the spring clips on to the case and should be installed as shown. The brake plate stopper anti-rattle spring is used to prevent the rattling of the B4, B2, and B1 steel plates. If left out the steel clutch plates would rattle in Park, Neutral, 1st, 2nd and 3rd gears.

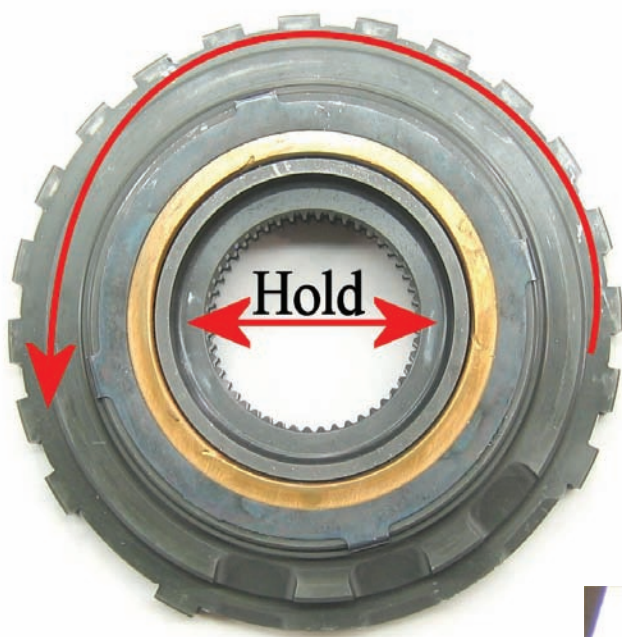


A761

Low/Reverse Sprag Assembly

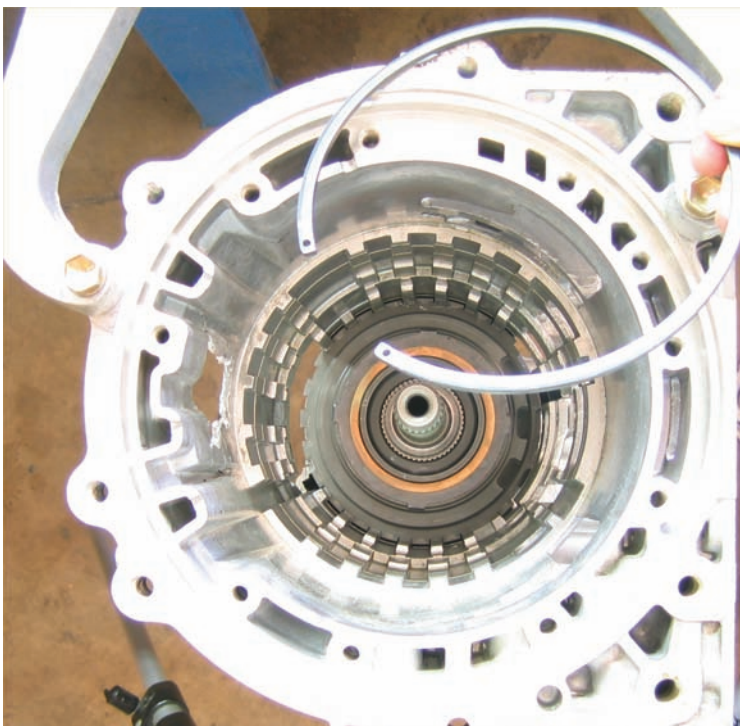
The Low/Reverse sprag freewheels counter clockwise and locks clockwise while holding the inner race.

If the sprag is installed incorrect a no forward gear in drive and/or a bind on the 1-2 shift.



Hold the inter race. The Outside flange will turn freely counter clockwise and lock clockwise.

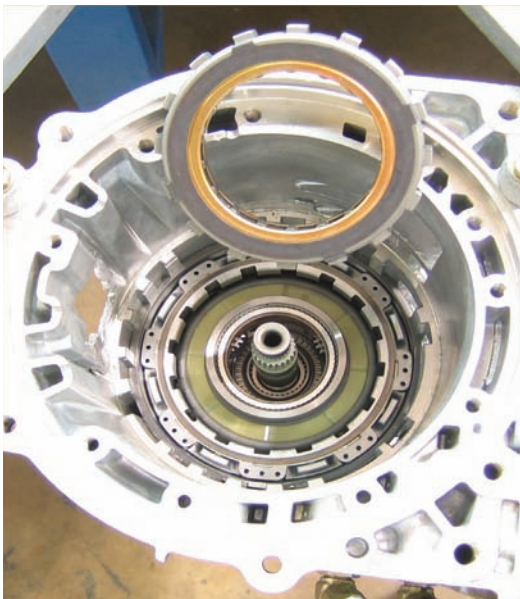
After installing the sprag into the case. Install the snap ring on top of the Low/Reverse sprag assembly.



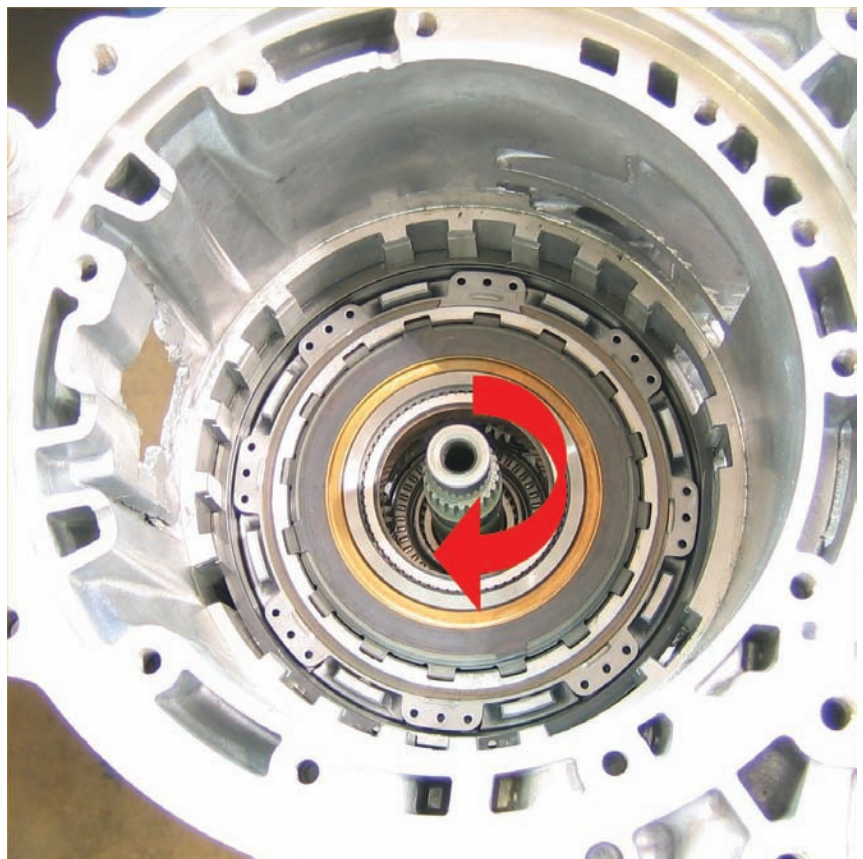
A76I

No. 3 Sprag Assembly

Install the 3rd brake cylinder and snap ring into the case. Check the oil pressure apply hole, make sure it lines up. Cylinder #3 aligns with the oil pressure apply hole of the transmission case. Install the No. 3 Sprag assembly into the case as shown. All four tabs must be up! The inner race should rotate freely in a clockwise rotation.



All four tabs must be up! The inner race should rotate freely in a clockwise rotation.

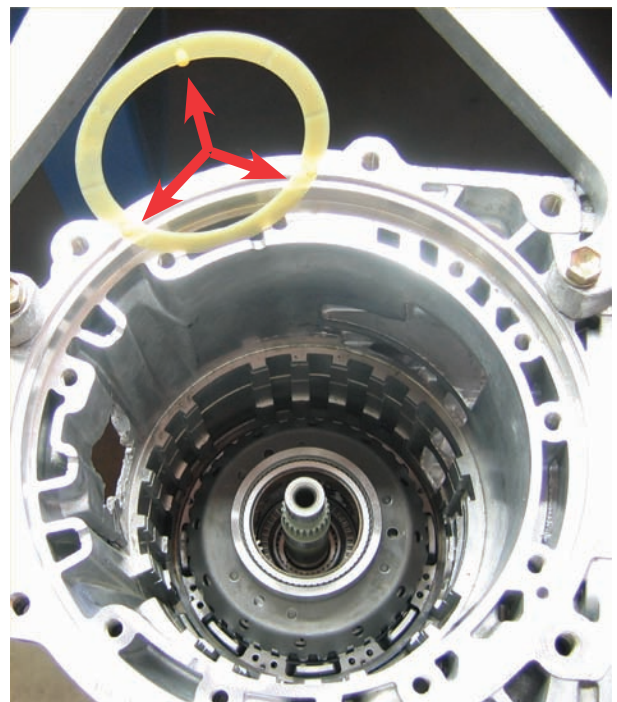
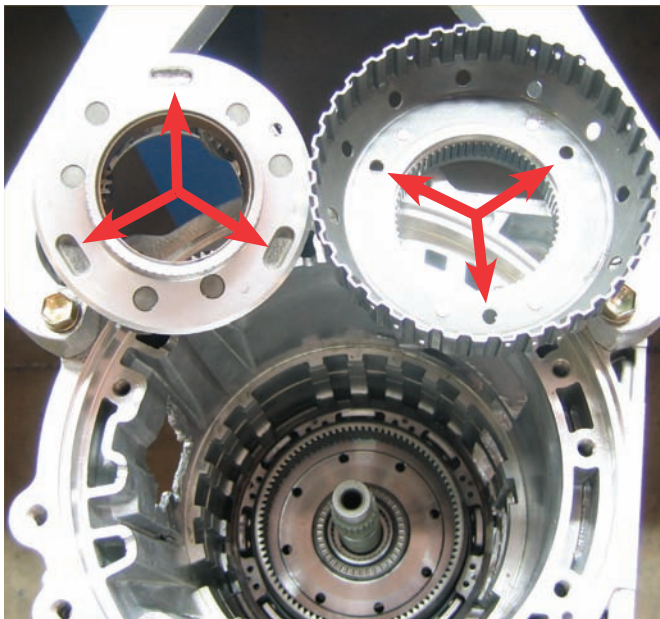


A76I

Front Planetary Assembly

When installing the one way clutch inner race onto the front planetary make sure that the holes line up with the slots. On the planetary for the tabs on the thrust washer.

If this is not in place you'll end up with no end play and wipe the thrust washer out, then the transmission.



A76I

No. 2 Sprag Assembly

Install the No. 2 sprag assembly and thrust washers. The No. 2 sprag assembly rotates freely clockwise and locks counterclockwise. If installed wrong a no 2nd gear and/or bind on the 2-3 shift.

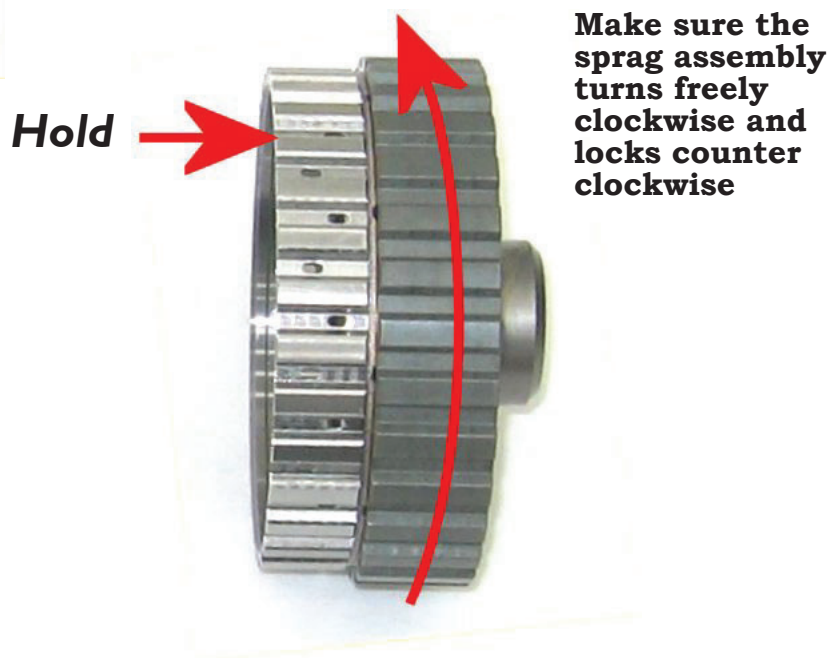


Make sure the sprag assembly turns freely clockwise and locks counter clockwise

A76I

No. 4 Sprag Assembly

Install the input shaft assembly into the direct and the reverse clutch drum. Install the No. 4 sprag assembly into the input clutch drum. With the sprag installed hold the coast clutch hub, the sprag assembly should turn freely clockwise and locks counter clockwise



Make sure the sprag assembly turns freely clockwise and locks counter clockwise

A76I

Reverse Clutch Reaction Sleeve

Install reverse clutch reaction sleeve and snap ring. During the assembly make sure the cushion plate is installed as shown. If the cushion plate is installed upside down, the clutch clearance will be too loose, potentially causing shift concerns.

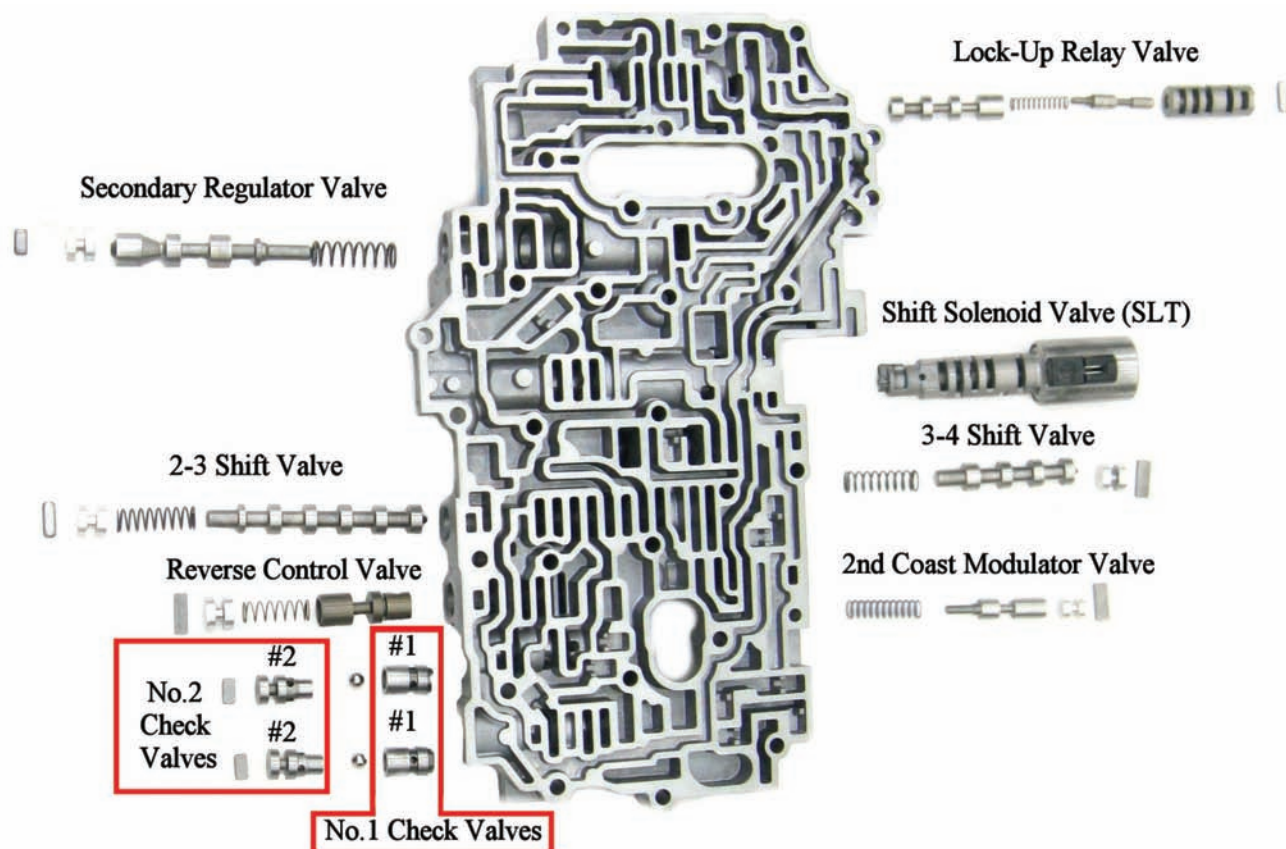


Cushion Plate

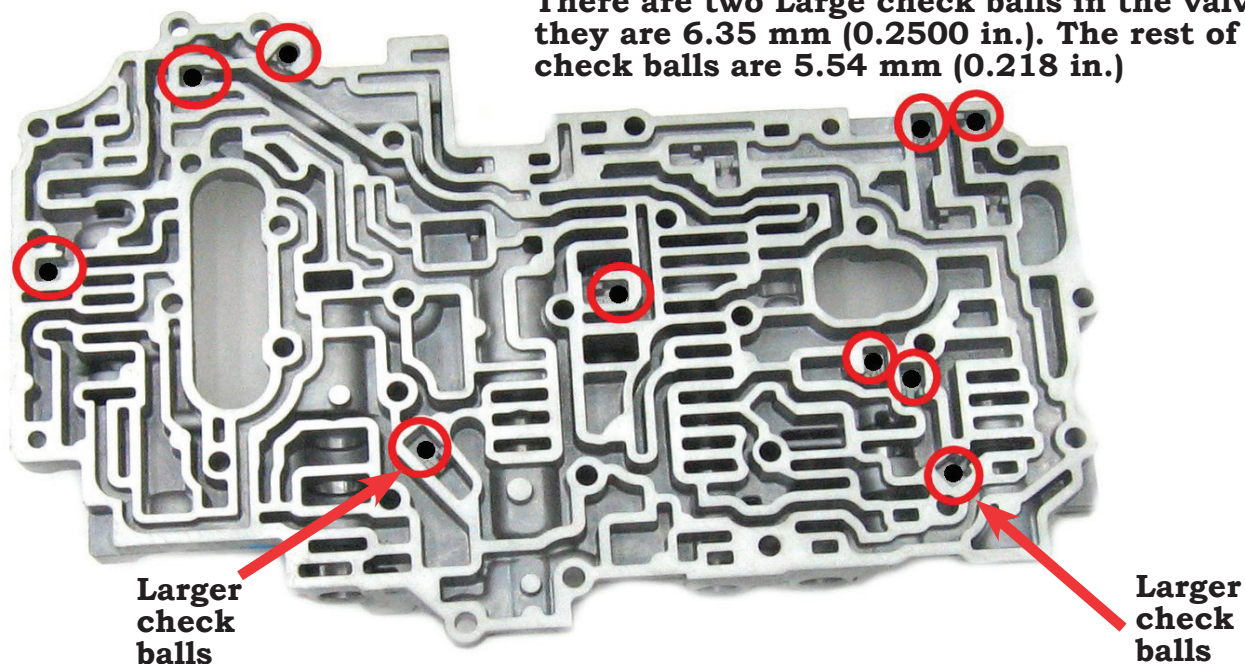


A340

Upper Valve Body Exploded View

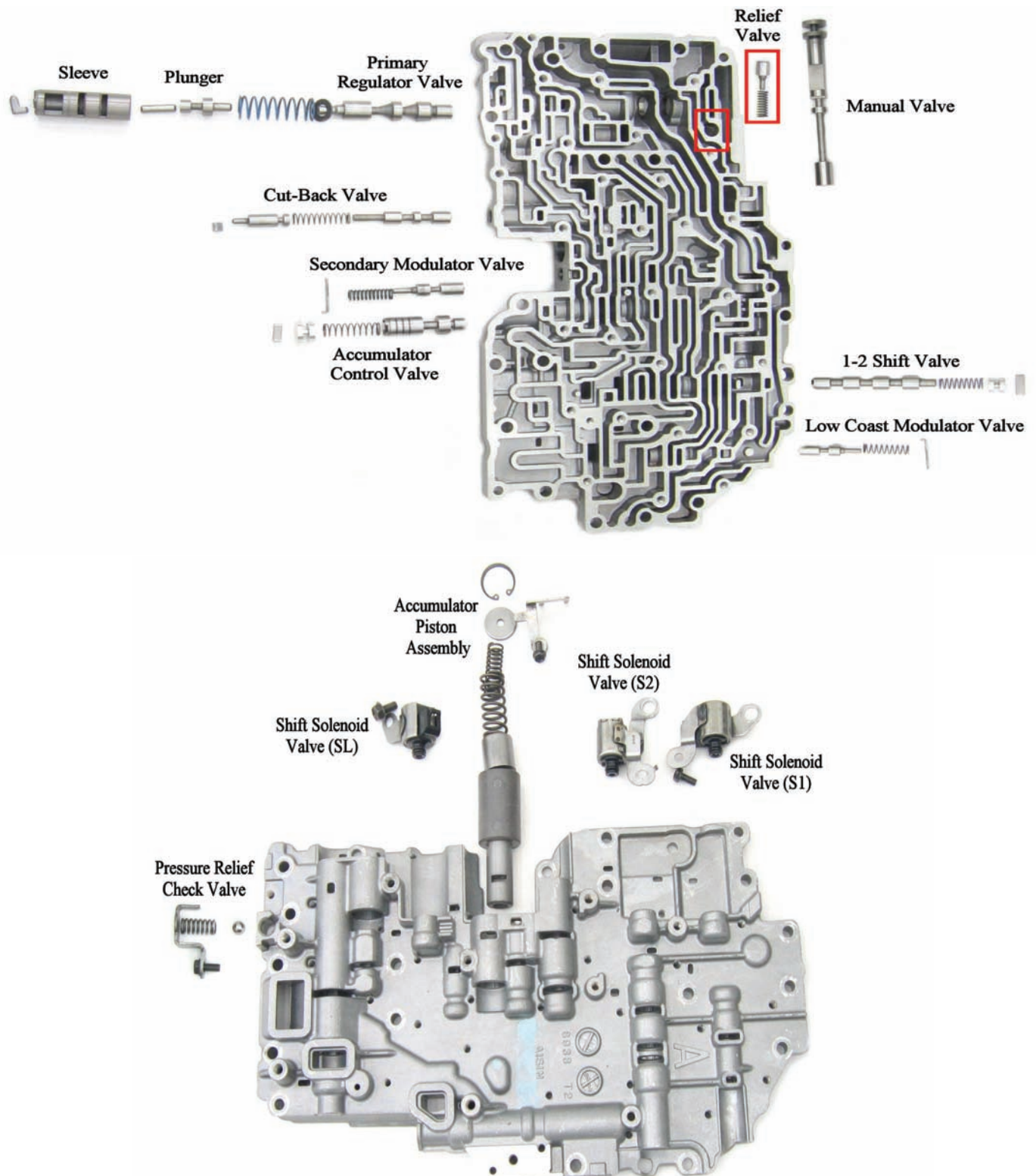


There are two Large check balls in the valve body, they are 6.35 mm (0.2500 in.). The rest of the check balls are 5.54 mm (0.218 in.)



A340

Lower Valve Body Exploded View



A340

Separator Plate Oil Strainers

During the installation, always install the strainers into the valve body separator plate. The strainers have a lip on one side of the element, this lip should snap into the separator plate.

A no reverse or no upshift concern could occur if the strainers are installed into the valve body channel casting and not the separator plate.

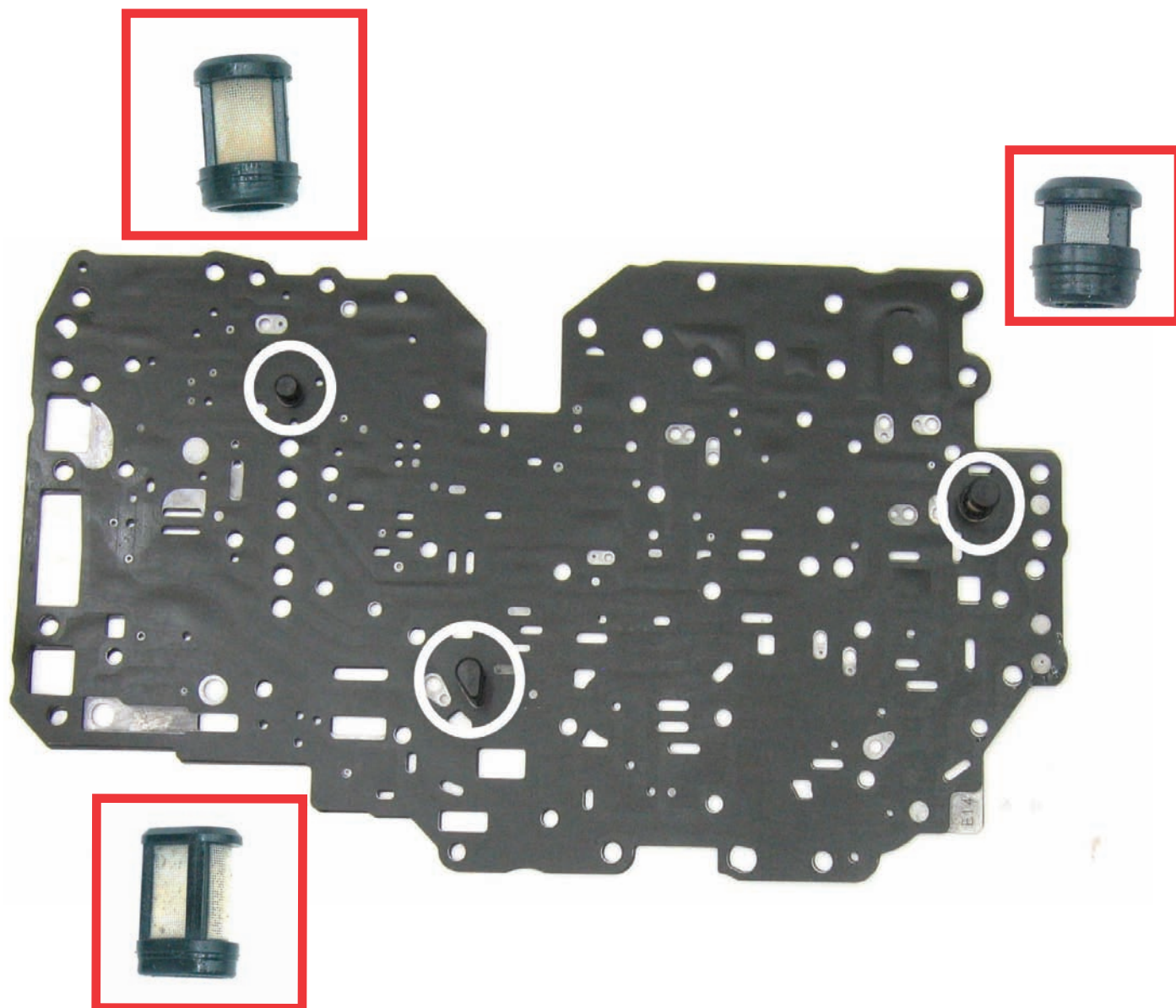


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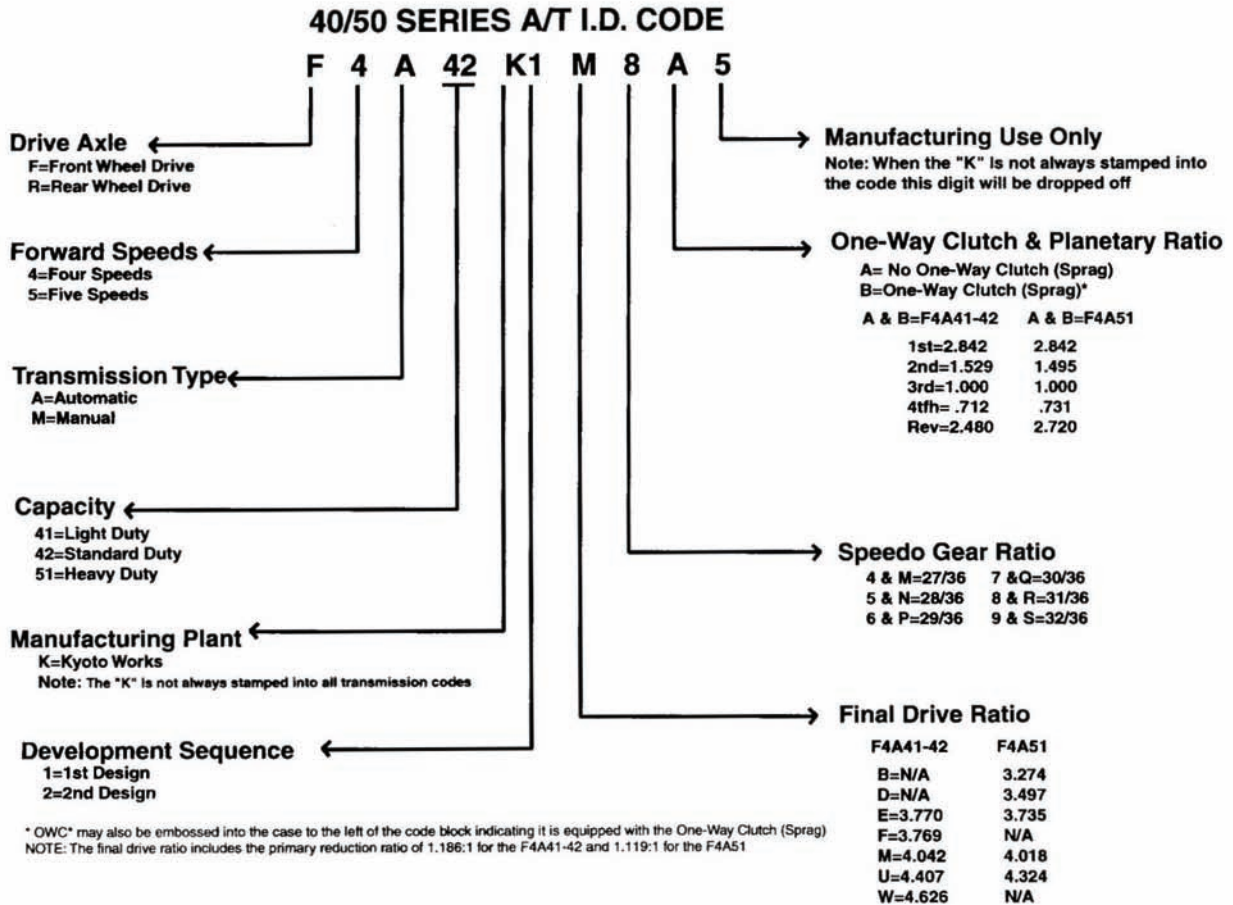
Applications

YEAR	MODEL	ENGINE SIZE	TRANSMISSION	SPRAG
1997	Diamante	3.5 Liter Sohc	F4A51-2-D5A	No
1998-99	Diamante	3.5 Liter Sohc	F4A51-2-D5B	Yes
2000-04	Diamante	3.5 Liter Sohc	F4A51-2-CZB	Yes
2000	Eclipse	2.4 Liter Sohc	F4A42-2-M6B	Yes
2001	Eclipse	2.4 Liter Sohc	F4A42-2-J6B	Yes
2002-05	Eclipse	2.4 Liter Sohc	F4A51-2-JZB	Yes
2000-01	Eclipse	3.0 Liter Sohc	F4A51-2-E5B	Yes
2002-05	Eclipse	3.0 Liter Sohc	F4A51-2-FZB	Yes
2004-05	Eclipse	3.0 Liter Sohc (VIC)	F4A51-2-LZP	Yes
2006-07	Eclipse	2.4 Liter Sohc (MIVEC)	F4A4B-4-L3Z	Yes
2006-07	Eclipse	3.8 Liter Sohc (MIVEC)	F5A5A-4-C1Z	Yes
2004-06	Endeavor	3.8 Liter Sohc	F4A5A-4-L1Z	Yes
2004-06	Endeavor	3.8 Liter Sohc	W4A5A-4-T1ZE	Yes
1999-00	Galant	2.4 Liter Sohc	F4A42-2-M6B	Yes
2001	Galant	2.4 Liter Sohc	F4A42-2-J6B	Yes
2002-03	Galant	2.4 Liter Sohc	F4A42-2-JZB	Yes
1999	Galant	3.0 Liter Sohc	F4A51-2-D6B	Yes
2000-01	Galant	3.0 Liter Sohc	F4A51-2-E6B	Yes
2002-03	Galant	3.0 Liter Sohc	F4A51-2-FZB	Yes
2004-06	Galant	2.4 Liter Sohc (MIVEC)	F4A4B-4-L1Z	Yes
2004	Galant	3.8 Liter Sohc	F4A5A-4-F2Z	Yes
2005-06	Galant	3.8 Liter Sohc	F4A5A-4-F1Z	Yes
2007	Galant Ralli-Art	3.8 Liter Sohc (MIVEC)	F5A5A-4-C1Z	Yes

YEAR	MODEL	ENGINE SIZE	TRANSMISSION	SPRAG
1997-99	Mirage	1.5 Liter Sohc	F4A41-1-M8A	No
2000	Mirage	1.5 Liter Sohc	F4A41-1-M8B	Yes
2001	Mirage	1.5 Liter Sohc	F4A41-1-J8B	Yes
1997-99	Mirage	1.8 Liter Sohc	F4A42-1-M8A	No
2000-01	Mirage	1.8 Liter Sohc	F4A42-1-M8B	Yes
2001-03	Mirage	1.8 Liter Sohc	F4A42-1-J8B	Yes
2003	Lancer	2.0 Liter Sohc	F4A42-1-JZB	Yes
2004	Lancer	2.0 Liter Sohc	F4A4B-1-J1Z	Yes
2004-07	Lancer	2.4 Liter Sohc (MIVEC)	F4A4B-4-L2Z	Yes
2003	Outlander	2.4 Liter Sohc	F4A42-2-NZB	Yes
2003	Outlander	2.4 Liter Sohc	W4A42-2-RZD	Yes
2004-06	Outlander	2.4 Liter Sohc (MIVEC)	F4A4B-4-N1Z	Yes
2004-06	Outlander	2.4 Liter Sohc (MIVEC)	WA44B-4-R1Z	Yes

F4A42/51

Identification Codes



TRANSAXLE I.D. CODES

Final Drive Ratio:

F4A41-42	F4A51
A = N/A	A = 3.269
B = N/A	B = 3.274
C = N/A	C = 3.491
D = N/A	D = 3.497
E = 3.770	E = 3.735
F = 3.769	F = 3.728
J = 4.041	J = N/A
L = 4.212	L = 4.011
M = 4.042	M = 4.018
N = 4.406	N = N/A
R = 4.625	R = 4.520
U = 4.407	T = 4.316
W = 4.626	U = 4.324
	W = N/A

Planetary Ratio:

A & B = F4A41-42	A & B = F4A51
1st = 2.842	2.842
2nd = 1.529	1.495
3rd = 1.000	1.000
4th = .712	.731
Rev = 2.480	2.720

Speedo Gear Ratio:

F4A41-42	F4A51
4 & M = 27/36	5 & N = 28/36
6 & P = 29/36	7 & Q = 30/36
8 & R = 31/36	9 & S = 32/36

Z = No vehicle speed sensor, vehicle speed is calculated using the output speed sensor

NOTE: The final drive ratios above include the primary reduction ratio of 1.186 for the F4A41-42 and 1.119 for the F4A51

F4A/F5A Series

Clutch and Band Application Charts

Mitsubishi

OPERATING ELEMENT		ENGINE START	PARKING MECHANISM	UNDER DRIVE CLUTCH (UD)	REVERSE CLUTCH (REV)	OVER-DRIVE CLUTCH (OD)	DIRECT CLUTCH (DIR)	LOW-REVERSE BRAKE (LR)	SECOND BRAKE (2ND)	REDUCTION BRAKE (RED)	ONE-WAY CLUTCH (OWC-L)	ONE-WAY CLUTCH (OWC-D)
P	Parking	OK	x	—	—	—	—	x	—	x	—	—
R	Reverse	—	—	—	x	—	—	x	—	x	—	—
N	Neutral	OK	—	—	—	—	—	x	—	x	—	—
D	Sport mode	1st	—	—	x	—	—	x*	—	x	x	x
		2nd	—	—	x	—	—	—	x	x	—	x
		3rd	—	—	x	—	x	—	—	x	—	x
		4th	—	—	x	—	x	x	—	—	—	—
		5th	—	—	—	—	x	x	—	x	—	—

x: Function element —: Not applicable

NOTE: * operates only when the vehicle is stationary [at approximately 10 km/h (6.2 mph) or less].

Kia/Hyundai

ITEM	UD	OD	2ND	LR	REV	RED	DIR	OWC2	OWC1
P	-	-	-	O	-	O	-	-	-
R	-	-	-	O	O	O	-	-	-
N	-	-	-	O	-	O	-	-	-
D	1	O	-	O	-	O	-	O	O
	2	O	-	O	-	O	-	O	O
	3	O	O	-	-	O	-	O	-
	4	-	O	O	-	O	-	O	-
	5	-	O	O	-	-	O	-	-

F4A/F5A Series

Pressure Specifications

4-Speed

STANDARD HYDRAULIC PRESSURE TEST

MEASUREMENT CONDITION			STANDARD HYDRAULIC PRESSURE kPa					
SELEC-TOR LEVER POSI-TION	SHIFT POSI-TION	ENGINE SPEED (r/min)	UNDER-DRIVE CLUTCH PRESSURE [UD]	REVERSE CLUTCH PRESSURE [RV]	OVER-DRIVE CLUTCH PRESSURE [OD]	LOW AND REVERSE BRAKE PRESSURE [LR]	SECOND BRAKE PRESSURE [2ND]	TORQUE CONVERT-ER PRESSURE [DR]
P	-	2,500	-	-	-	310 - 390 (46 - 57)	-	250 - 390 (37 - 57)
R	Reverse	2,500	-	1,270 1,770 (185 - 256)	-	1,270 1,770 (185 - 256)	-	500 - 700 (73 - 101)
N	-	2,500	-	-	-	310 - 390 (46 - 57)	-	250 - 390 (37 - 57)
D	1st gear	2,500	1,010 1,050 (147 - 152)	-	-	1,010 1,050 (147 - 152)	-	500 - 700 (73 - 101)
	2nd gear	2,500	1,010 1,050 (147 - 152)	-	-	-	1,010 1,050 (147 - 152)	500 - 700 (73 - 101)
	3rd gear	2,500	590 - 690 (85 - 100)	-	590 - 690 (85 - 100)	-	-	450 - 650 (65 - 94)
	4th gear	2,500	-	-	590 - 690 (85 - 100)	-	590 - 690 (85 - 100)	450 - 650 (65 - 94)

5-Speed

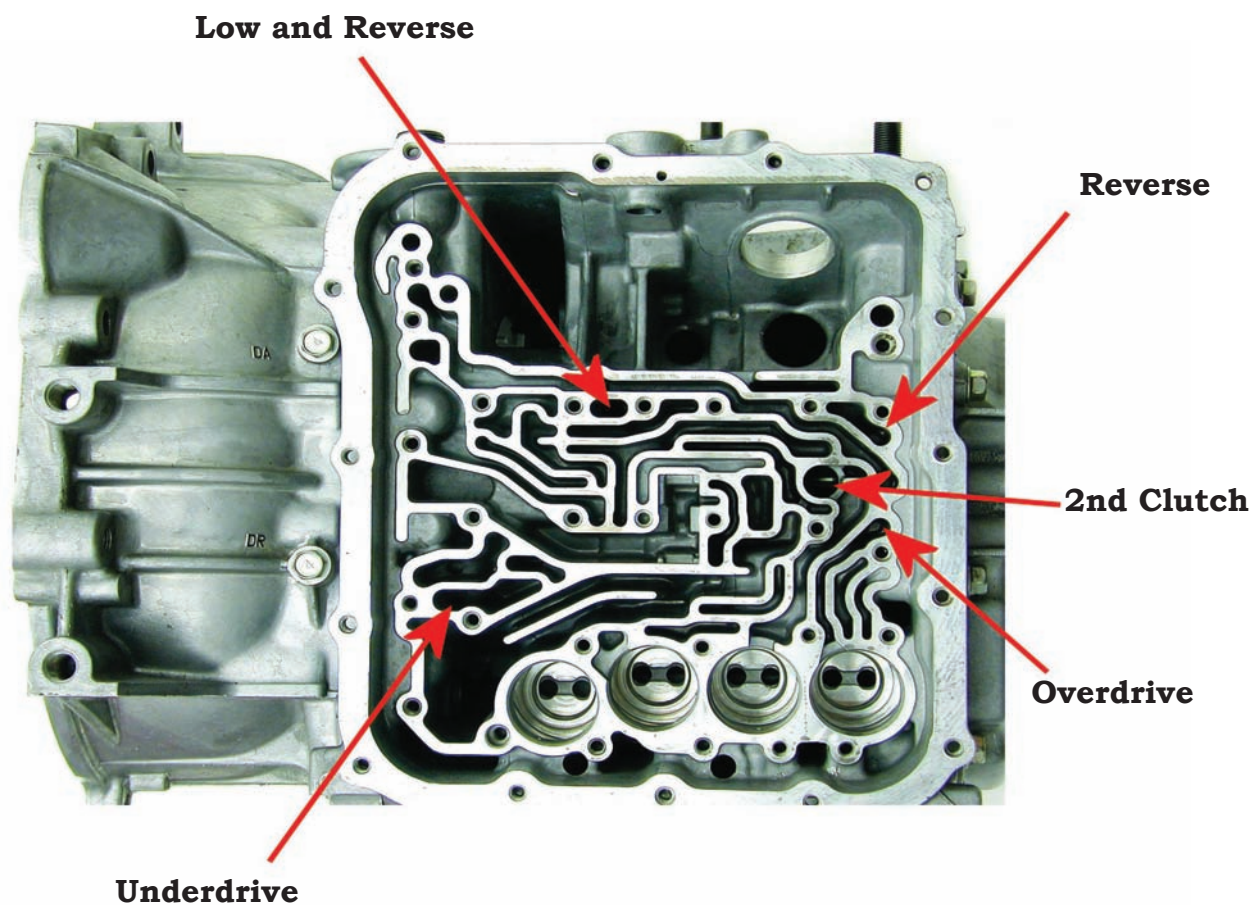
MEASUREMENT CONDITION			STANDARD HYDRAULIC PRESSURE MPa (psi)							
TRANSMISSION RANGE	SHIFT POSITION	ENGINE SPEED (r/min)	UNDERDRIVE CLUTCH PRESSURE [UD]	REVERSE CLUTCH PRESSURE [RV]	OVERDRIVE CLUTCH PRESSURE [OD]	DIRECT CLUTCH PRESSURE [DIR]	LOW-REVERSE BRAKE PRESSURE [LR]	SECOND BRAKE PRESSURE [2ND]	REDUCTION BRAKE PRESSURE [RED]	TORQUE CONVERTER CLUTCH PRESSURE [DR]
P	-	2,500	-	-	-	-	0.31 - 0.39 (44 - 56)	-	0.31 - 0.39 (44 - 56)	0.22 - 0.36 (32 - 52)
R	Reverse	2,500	-	1.27 - 1.77 (185 - 256)	-	-	1.27 - 1.77 (185 - 256)	-	1.27 - 1.77 (185 - 256)	0.50 - 0.73 (73 - 106)
N	-	2,500	-	-	-	-	0.31 - 0.39 (44 - 56)	-	0.31 - 0.39 (44 - 56)	0.22 - 0.36 (32 - 52)
Sport mode	1st gear	2,500	0.95 - 1.06 (137 - 153)	-	-	-	0.95 - 1.06 (137 - 153)	-	0.95 - 1.06 (137 - 153)	0.50 - 0.73 (73 - 106)
	2nd gear	2,500	0.95 - 1.06 (137 - 153)	-	-	-	-	0.95 - 1.06 (137 - 153)	0.95 - 1.06 (137 - 153)	0.50 - 0.73 (73 - 106)
	3rd gear	2,500	0.78 - 0.90 (113 - 131)	-	0.78 - 0.90 (113 - 131)	-	-	-	0.78 - 0.88 (113 - 128)	0.45 - 0.72 (65 - 104)
	4th gear	2,500	0.78 - 0.90 (113 - 131)	-	0.78 - 0.90 (113 - 131)	0.78 - 0.88 (113 - 128)	-	-	-	-
	5th gear	2,500	-	-	0.78 - 0.90 (113 - 131)	0.78 - 0.88 (113 - 128)	-	0.78 - 0.88 (113 - 128)	-	-

NOTE: When the torque converter pressure is measured, the engine speed should be 1,500 r/min or less.

F4A Series

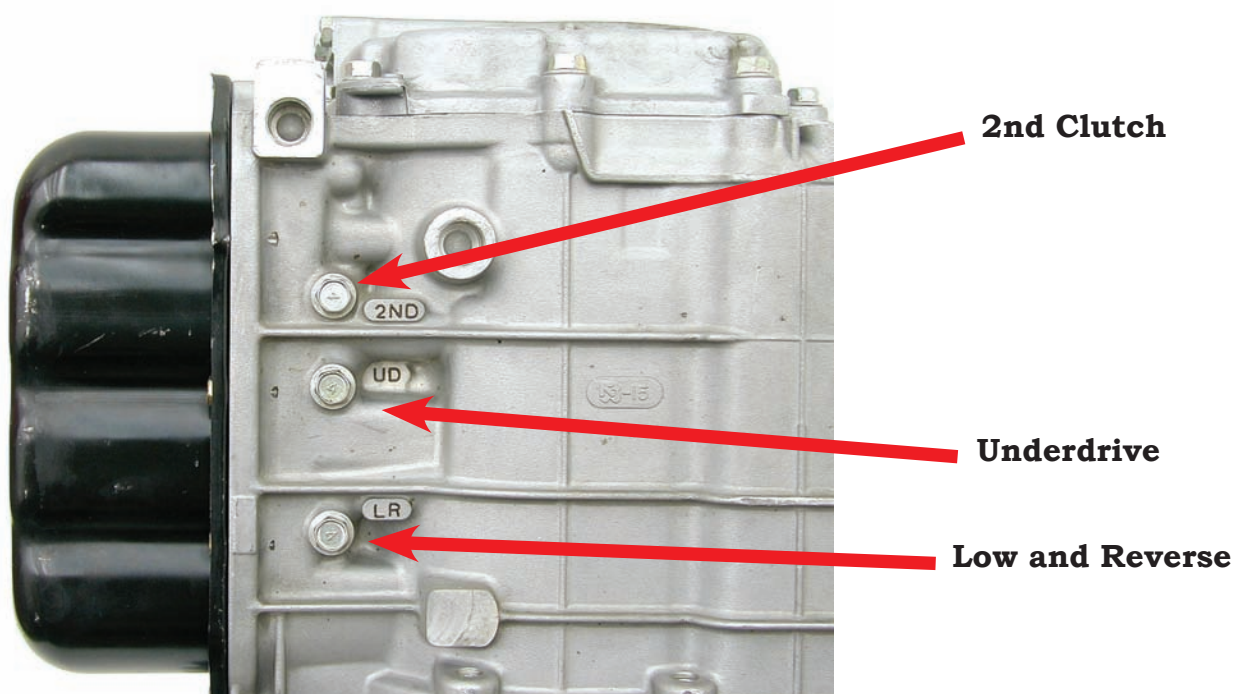
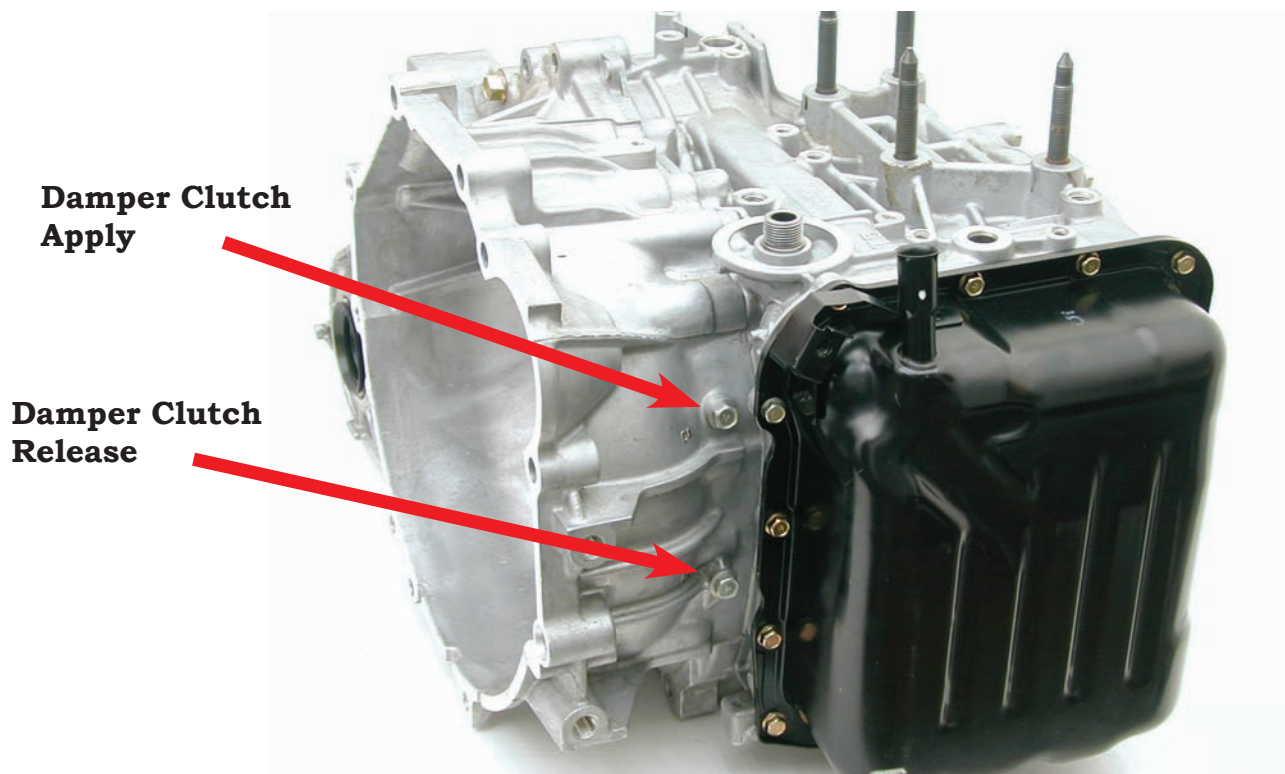
Air Checking the Transmission

Always use regulated clean shop air before you perform the air test.



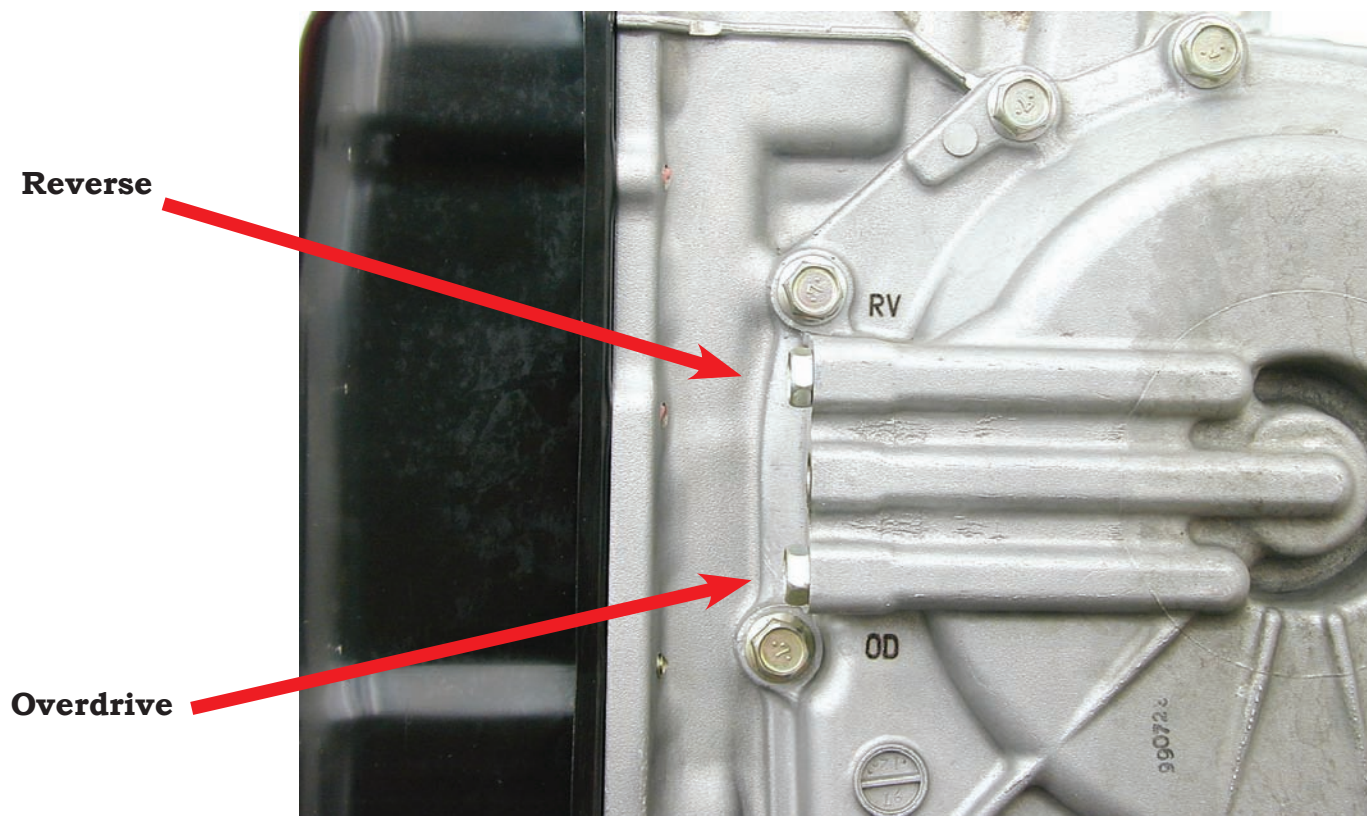
F4A/F5A Series

Pressure Tap Locations



F4A/F5A Series

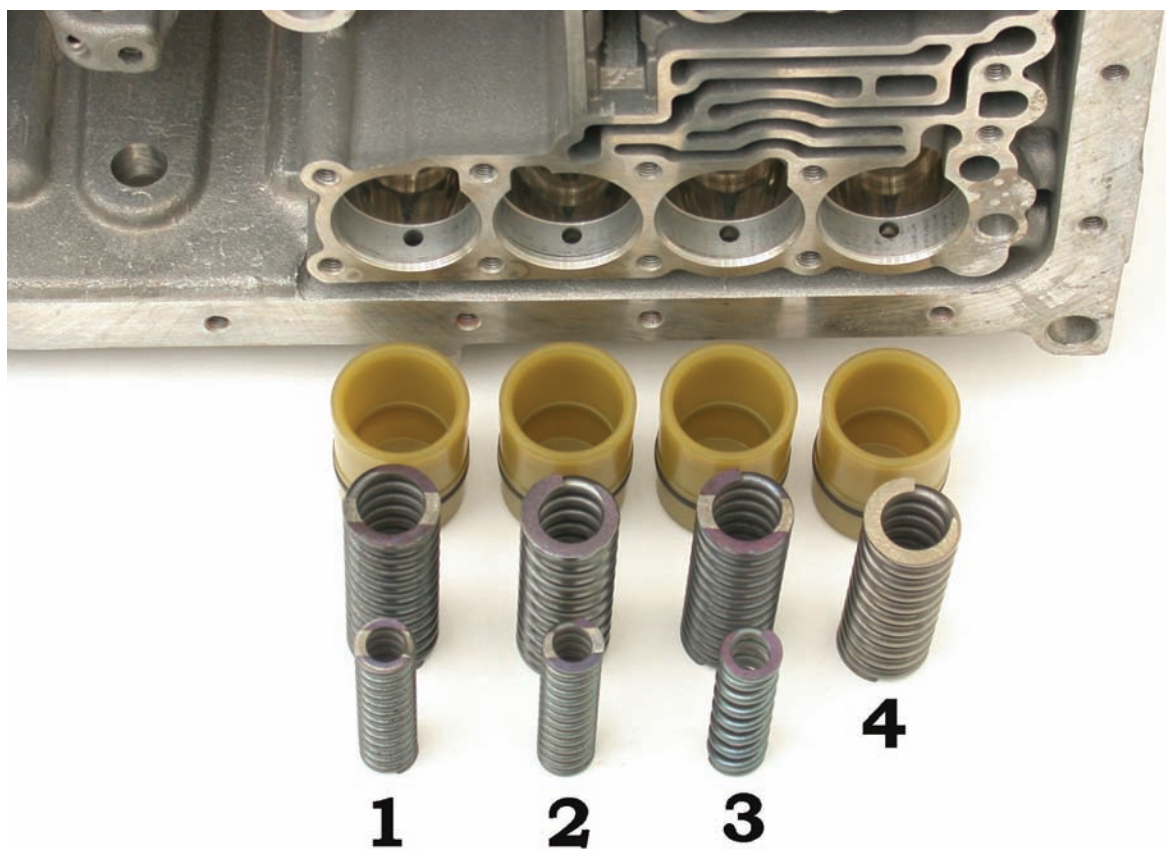
Pressure Tap Locations (continued)



F4A/F5A Series

Accumulator Piston Positions

During reassembly install the springs first then the pistons.



Accumulator Piston

- 1. LR Brake**
- 2. UD Clutch**
- 3. 2nd Brake**
- 4. OD Clutch**

I.D. Color

- Colorless**
- Yellow**
- White**
- Colorless**

Outer

- 2.60 in**
- 2.60 in**
- 2.53 in**
- 2.50 in**

Inner

- 2.25 in**
- 2.30 in**
- 2.12 in**

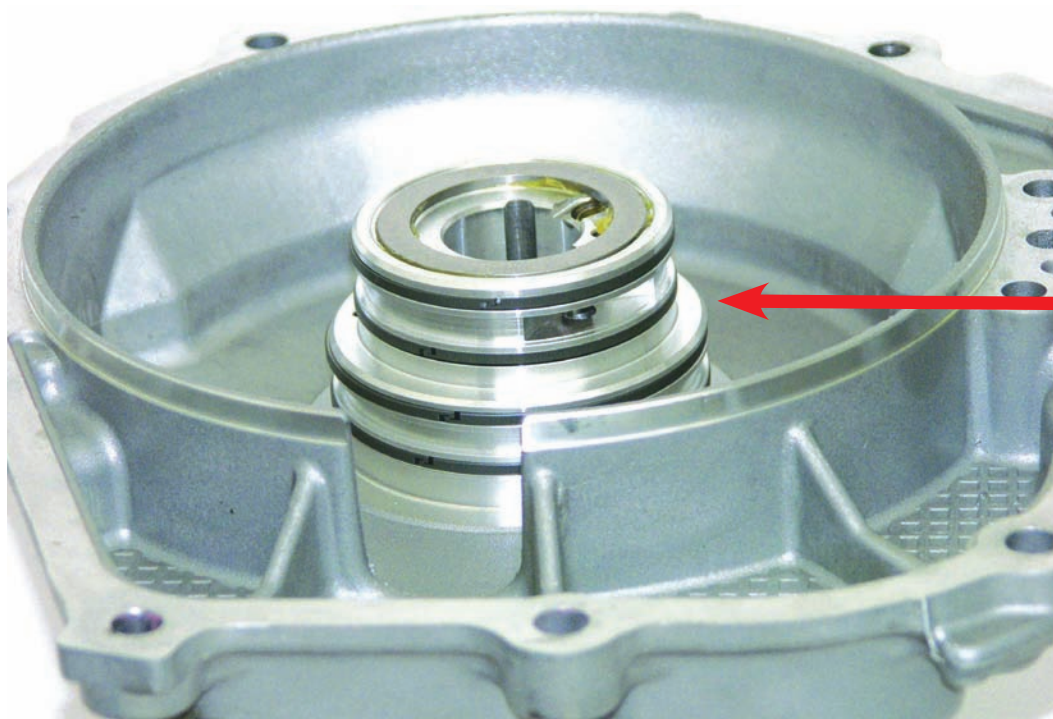
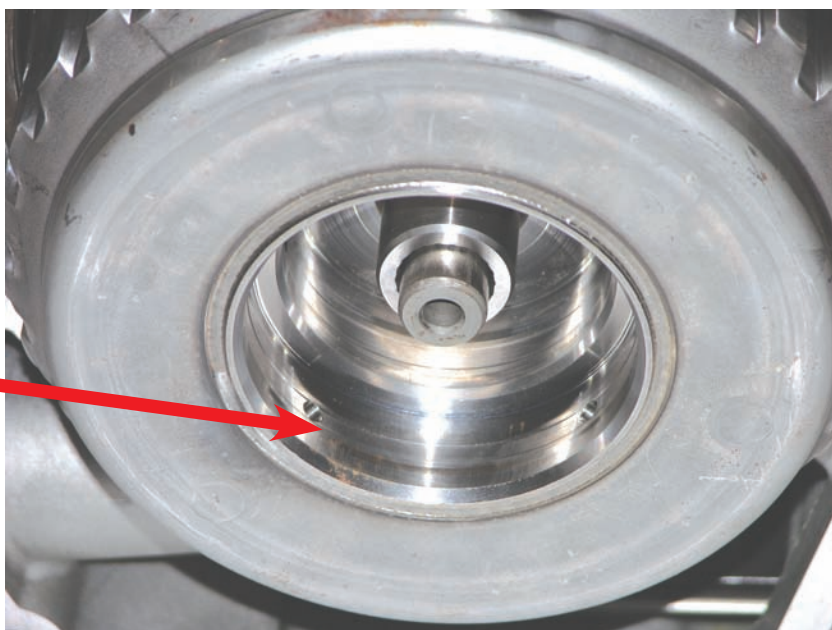
F4A/F5A Series

2-3 Shift Flare

A 2-3 Shift Flare, Soft, or Bumpy shift can be caused by the rear cover seal rings and ring tower for wear or damage. Check ring seal surfaces in drum assembly.

Inspect the end cover and ring grooves for wear. This area is a HIGH failure rate.

**Check the drum ring
land surface for damage**



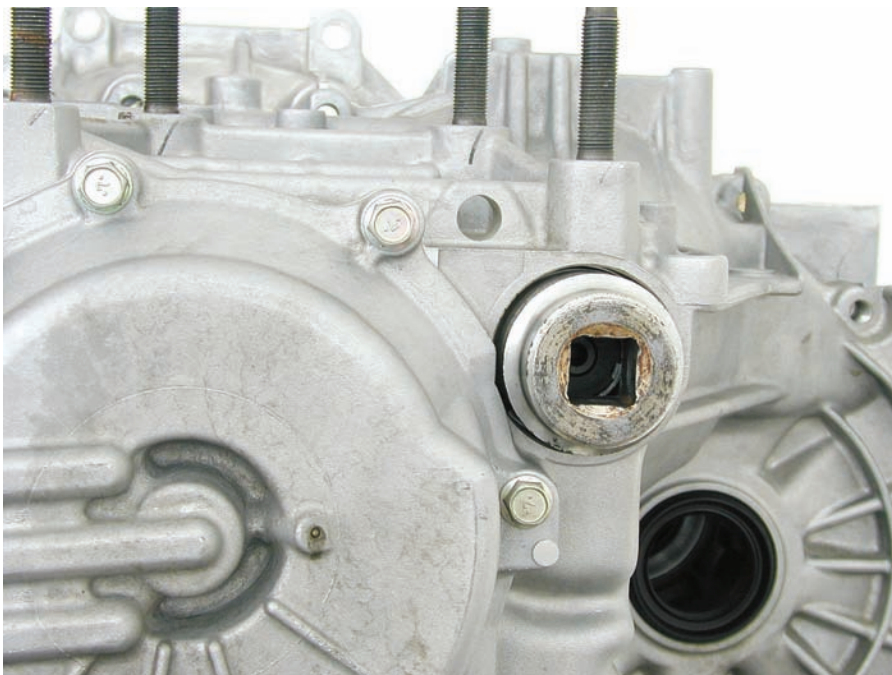
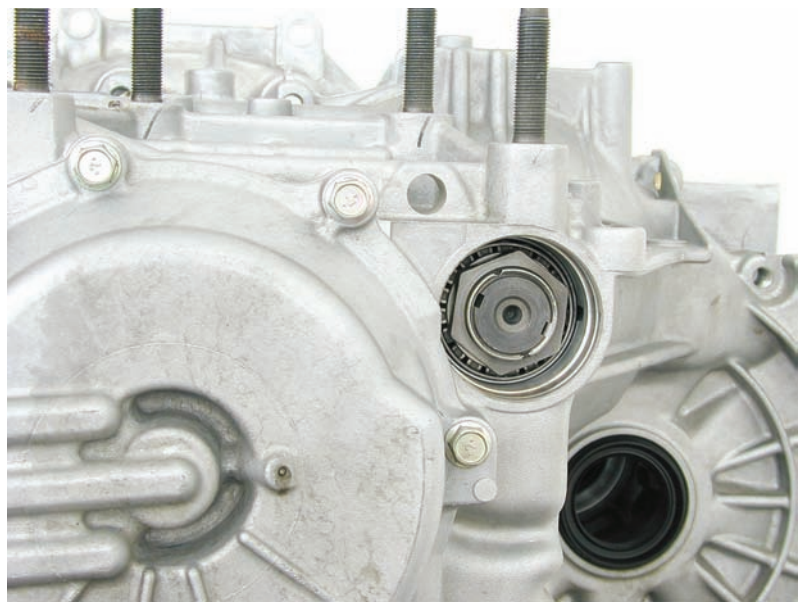
**Check the
end cover
ring lands
for damage**

F4A/F5A Series

Transfer Gear Lock Nut

The Lock Nut is Left hand thread. Use a punch or equivalent tool to release the locking tab on the nut flange.

During the installation torque the Transfer Gear nut to 133-155 ft lbs.



F4A/F5A Series

Low Sprag

The Low Sprag holds in First gear and freewheels in all other forward gears. The sprag rotates freely in a counter clockwise rotation and locks in a clockwise rotation.

If the sprag were installed incorrectly a no forward in the drive position and a bind in 2nd gear.



The sprag rotates freely in a counter clockwise rotation and locks in a clockwise rotation.

F4A/F5A Series

2nd Clutch

The 2C clutch clearance can be check two different ways. One method of checking it is without the wave spring and applying pressure down to the clutch packs to obtain the clearance. Your measurement will be 0.035-0.050 in.

The second method is using the factory tools with the wave spring installed and not applying pressure to the clutch pack. Your measurement will be between 0.043-0.061 in.

The broken wave spring is a common failure, when this happens it can damage the pump, stick valves and destroy other components. Make sure to thoroughly clean the unit if this happens.



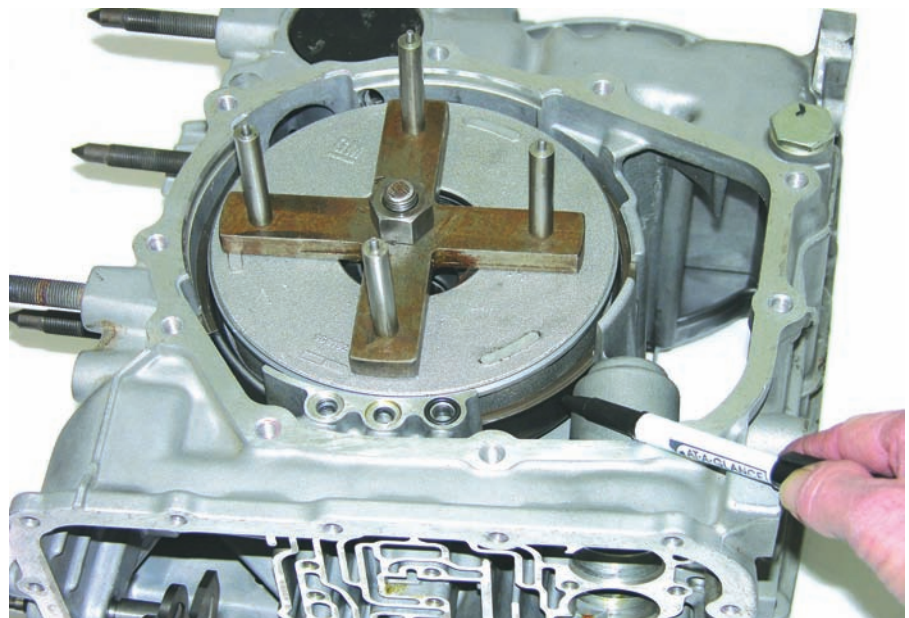
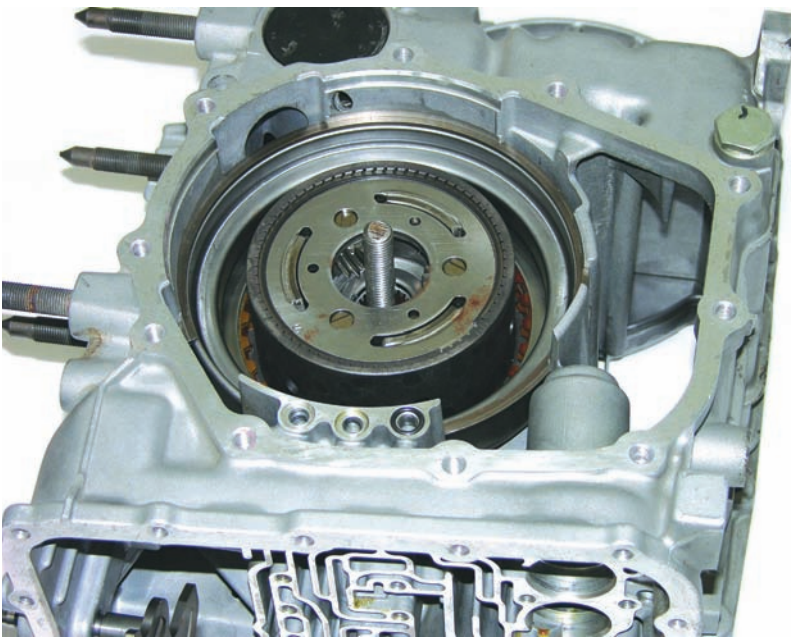
This spring is used on F4A51 models w/V6 always replace the wave spring with an updated thicker wave spring.

F4A/F5A Series

Installing the C2 Piston

When installing the C2 piston, install thick snap ring, then install the retainer plate with the step facing down. Then install the thicker snap ring.

You will need to use a tool to compress the 2C clutch piston housing in order to install the snap ring in to the case. You can use a 4L30E reverse piston and standard compressor tools.



F4A/F5A Series

Installing the Overdrive and Reverse Clutch

During the reassembly of the overdrive and reverse clutch packs. Check the Overdrive clutches with even force around the clutch pack. The average clearance is between 0.040-0.047 in. Use the same procedure for the Reverse clutch packs. The average clearance is between 0.059-0.067 in.

To ease installation of the Overdrive and Reverse drums into the case, spline the sun shell into clutch packs. Then install the sun shell and drum assembly into the case and install the end cover last.

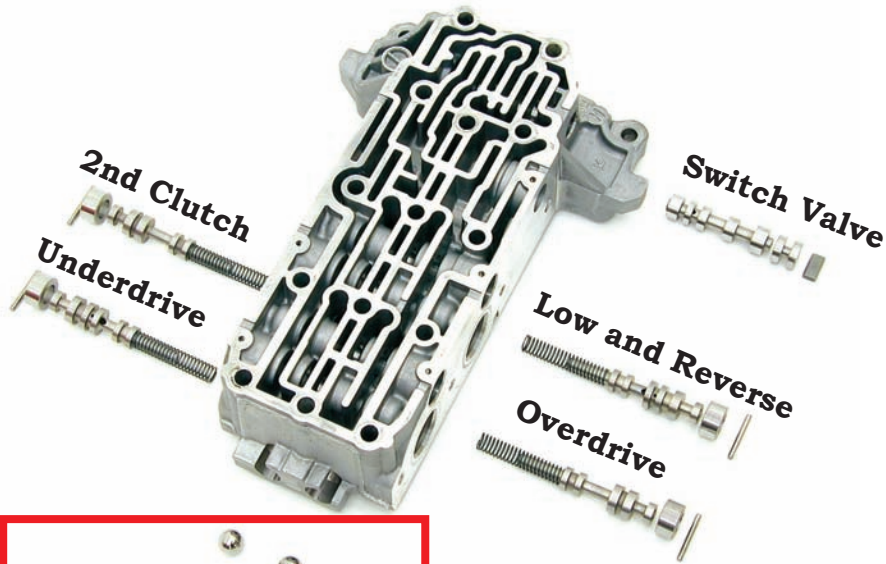


**Air check the clutches
Through the end cover**

F4A Series

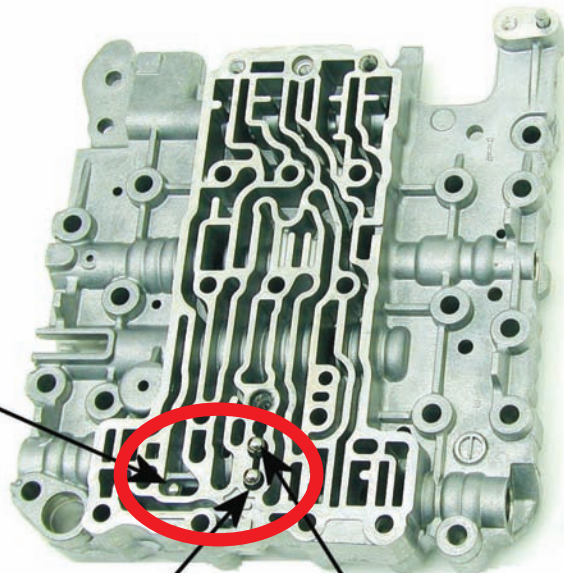
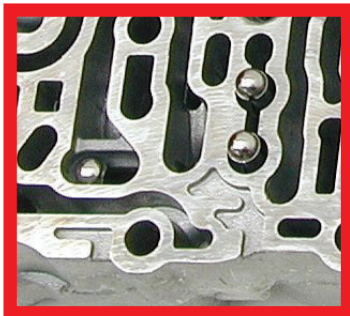
Valve Body (4 Speed)

There are two check balls in the auxiliary valve body that are used to bleed air out of the clutch exhaust circuits. These two check balls are held against the case with no springs.



These Check Balls are used to bleed air out of the clutch exhaust circuits.

Check Ball with out spring



Two Check Balls with springs

TCC Regulator Valve



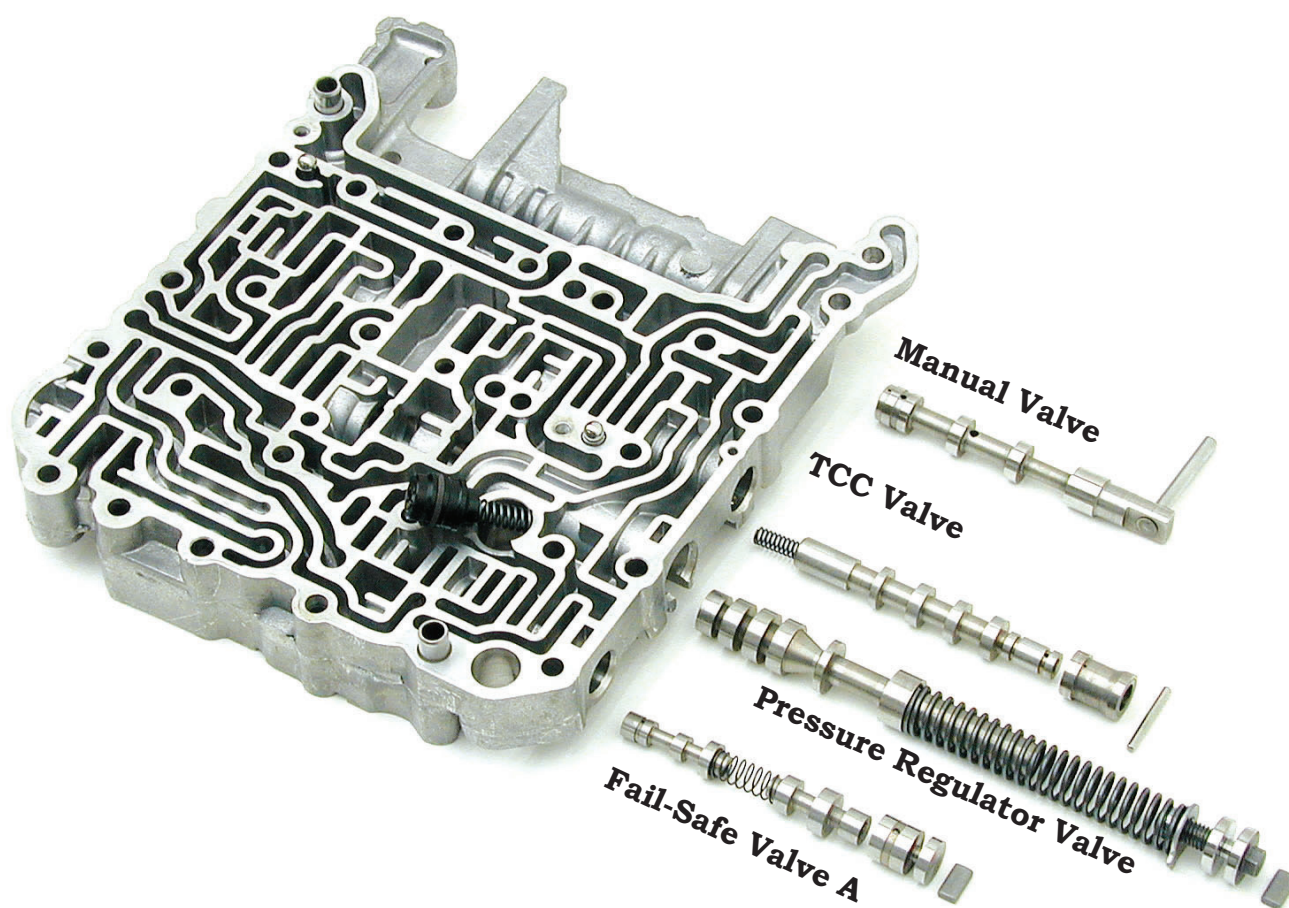
Fail-Safe Valve



F4A Series

Valve Body (4 Speed) (Continued)

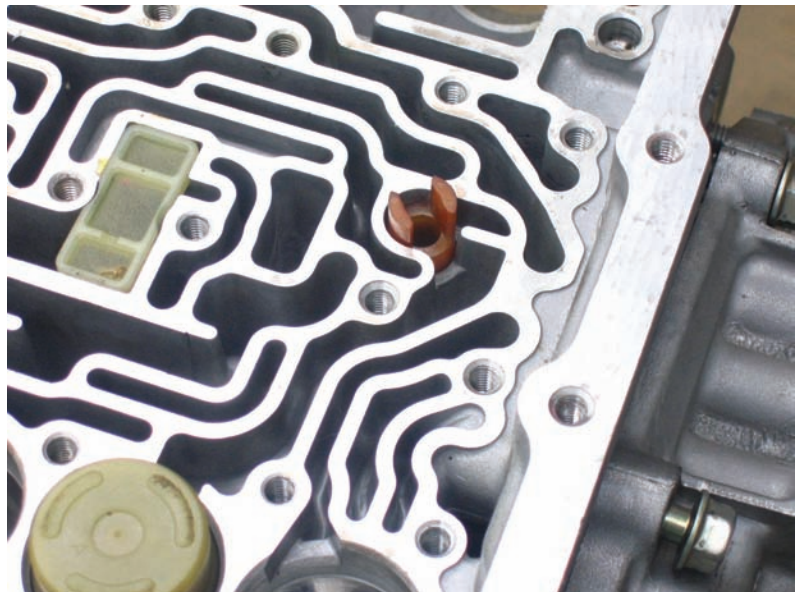
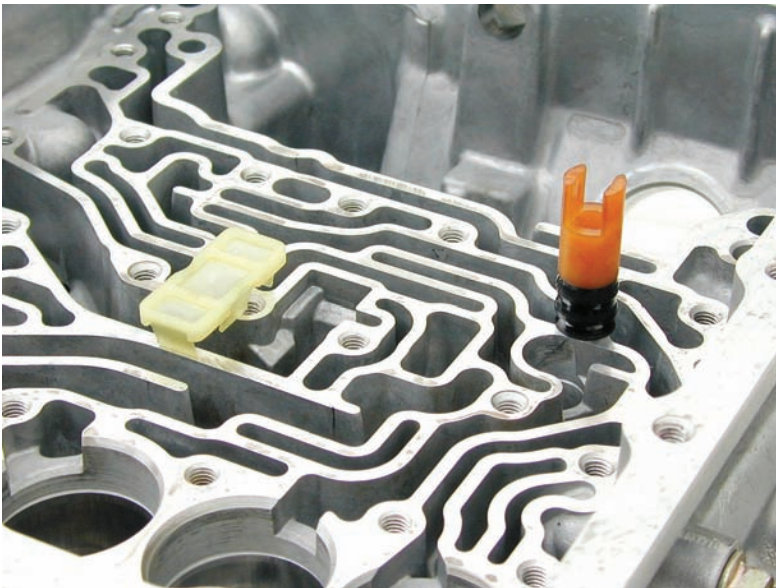
The Pressure Regulator valve is adjustable, but it is also a high wear item. The valve and bore must be checked during a rebuild.



F4A/F5A Series

2C Transfer Tube

The 2C Transfer Tube completes the hydraulic circuit between the valve body and the 2C clutch/accumulator. Make sure the support legs DO NOT sit across the case passage. If the legs sit across the case passage the unit will bind up during the 2-3 shift.



F4A/F5A Series

Troubleshooting

SOLENOID VALVE OPERATING ELEMENTS OF EACH SHIFT RANGE

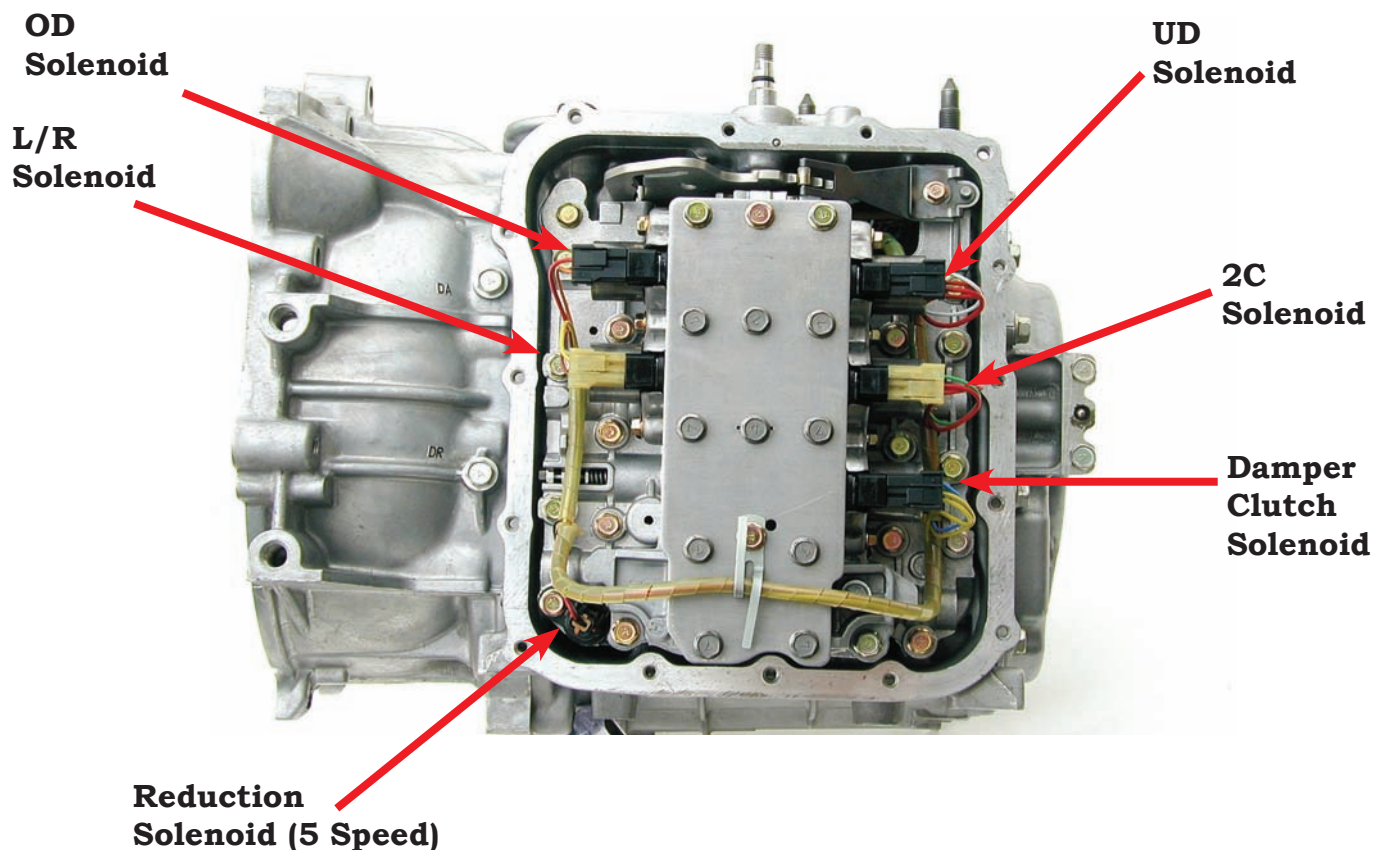
Item	Solenoid valve					
	LR (DIR)	2ND	UD	OD	RED	DCC (reference)
Shift range	LR (DIR)	2ND	UD	OD	RED	DCC (reference)
First speed	OFF (LR)	ON	OFF	ON	OFF	OFF
Second speed	ON (LR)	OFF	OFF	ON	OFF	OFF
Third speed	ON (DIR)	ON	OFF	OFF	OFF	OFF
Fourth speed	ON (DIR)	OFF	ON	OFF	OFF	ON
Fifth speed	OFF (DIR)	OFF	ON	OFF	ON	ON
Reverse	OFF (LR)	ON	ON	ON	OFF	OFF
Neutral, parking	OFF (LR)	ON	ON	ON	OFF	OFF

NOTE: The solenoids are normally open and applying the clutch when they are in the OFF (de-energized) mode . When their energized the solenoid closes and the clutch is released

Solenoid Operation and Testing

<5A/T>

DRIVING CONDITION	DATA LIST ITEM				
	DIR-L/R	UD	2C	OD	REDU
Driving at constant speed of 10 km/h (6.2 mph) in 1st gear	0%	0%	100%	100%	0%
Driving at constant speed of 30 km/h (19 mph) in 2nd gear	100%	0%	0%	100%	0%
Driving at constant speed of 50 km/h (31 mph) in 3rd gear	100%	0%	100%	0%	0%
Driving at constant speed of 50 km/h (31 mph) in 4th gear	0%	0%	100%	0%	100%
Driving at constant speed of 70 km/h (36 mph) in 5th gear	0%	100%	0%	0%	100%

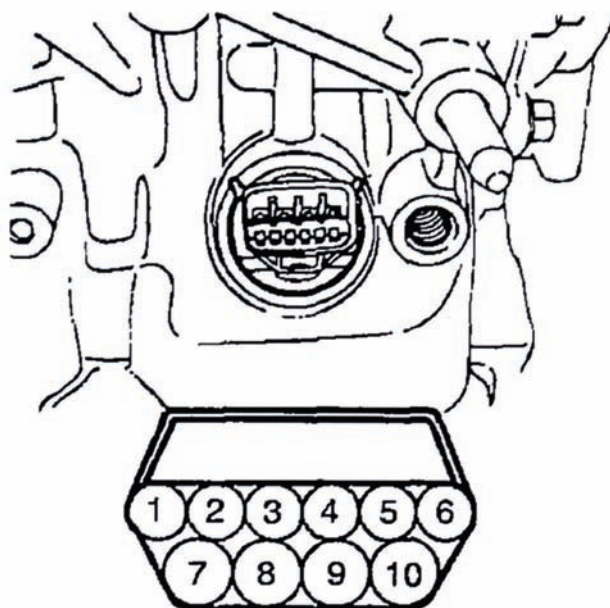


F5A Series

Solenoid Specifications

Early models use a metal body solenoid. Late models, after the 2000 model year, use a solenoid made of plastic. The Metal and the Plastic solenoids are not interchangeable with each other.

Connector View at the Transmission



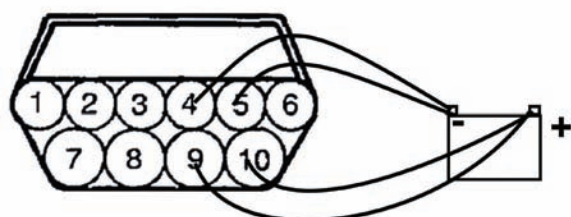
Solenoid Duty Cycle and Pressure Valves

SOLENOID VALVE CHART

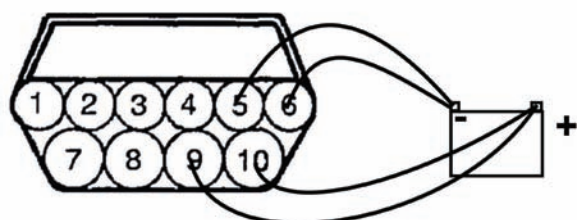
Solenoid Valve	DUTY (%)			
	0%	50%	75%	100%
UD, OD, LR, 2ND, RED (61.27 Hz)	10.5 +/- 0.1 kg/m ²	6.4 +/- 0.25kg/m ²	3.6 +/- 0.25kg/m ²	Below 0.1kg/m ²
DCCSV (30.64 Hz)	10.5 +/- 0.1 kg/m ²	5.9 +/- 0.3kg/m ²	3.2 +/- 0.3kg/m ²	Below 0.1 kg/m ²

F5A Series

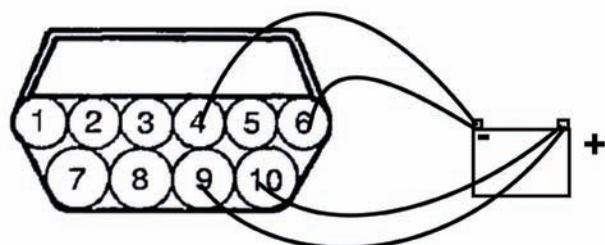
Forcing the Shifts on the 5-Speed



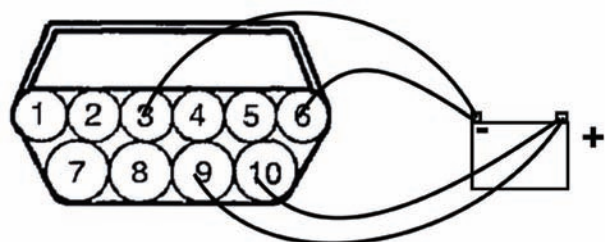
1st Gear



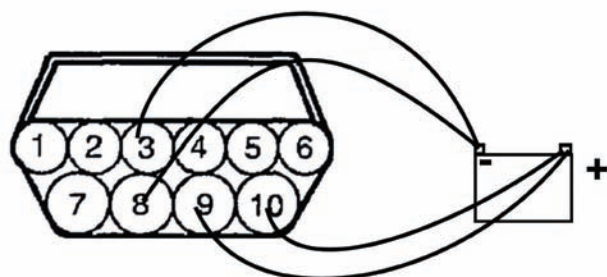
2nd Gear



3rd Gear



4th Gear

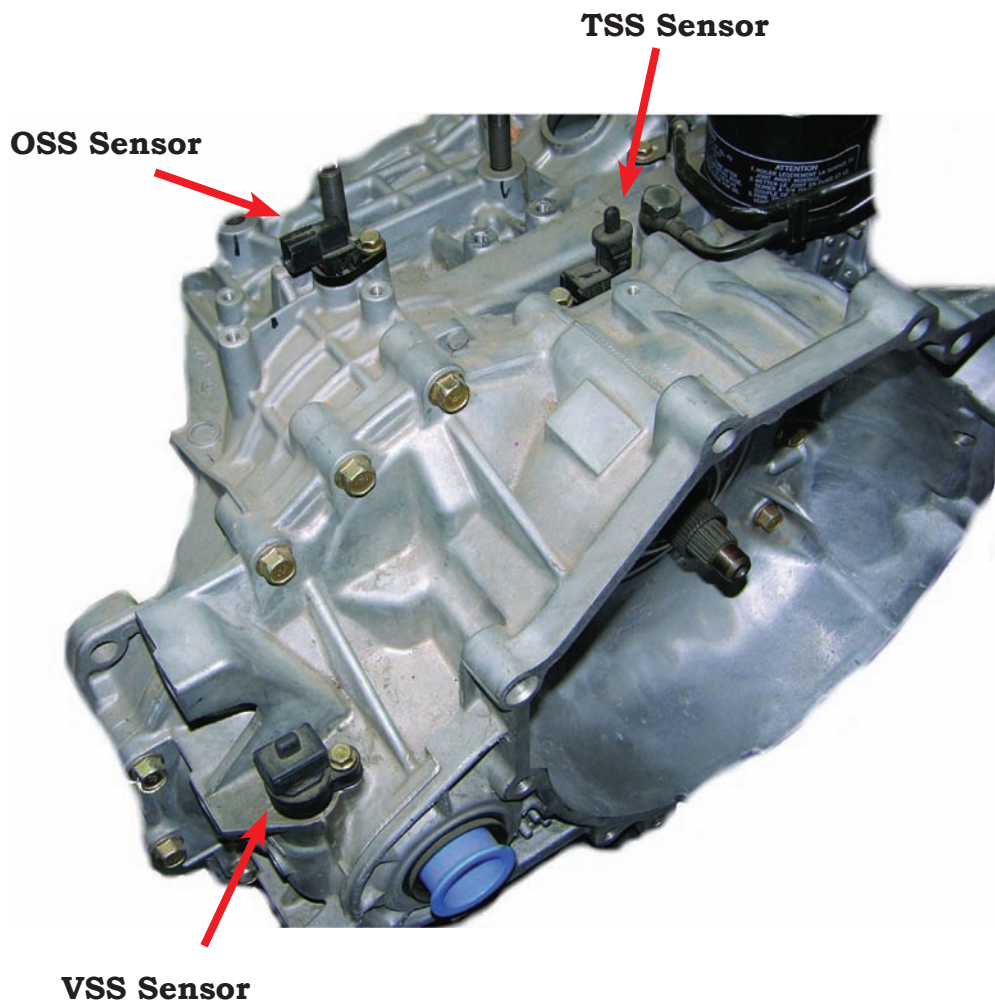


5th Gear

F4A/F5A Series

OSS and TSS

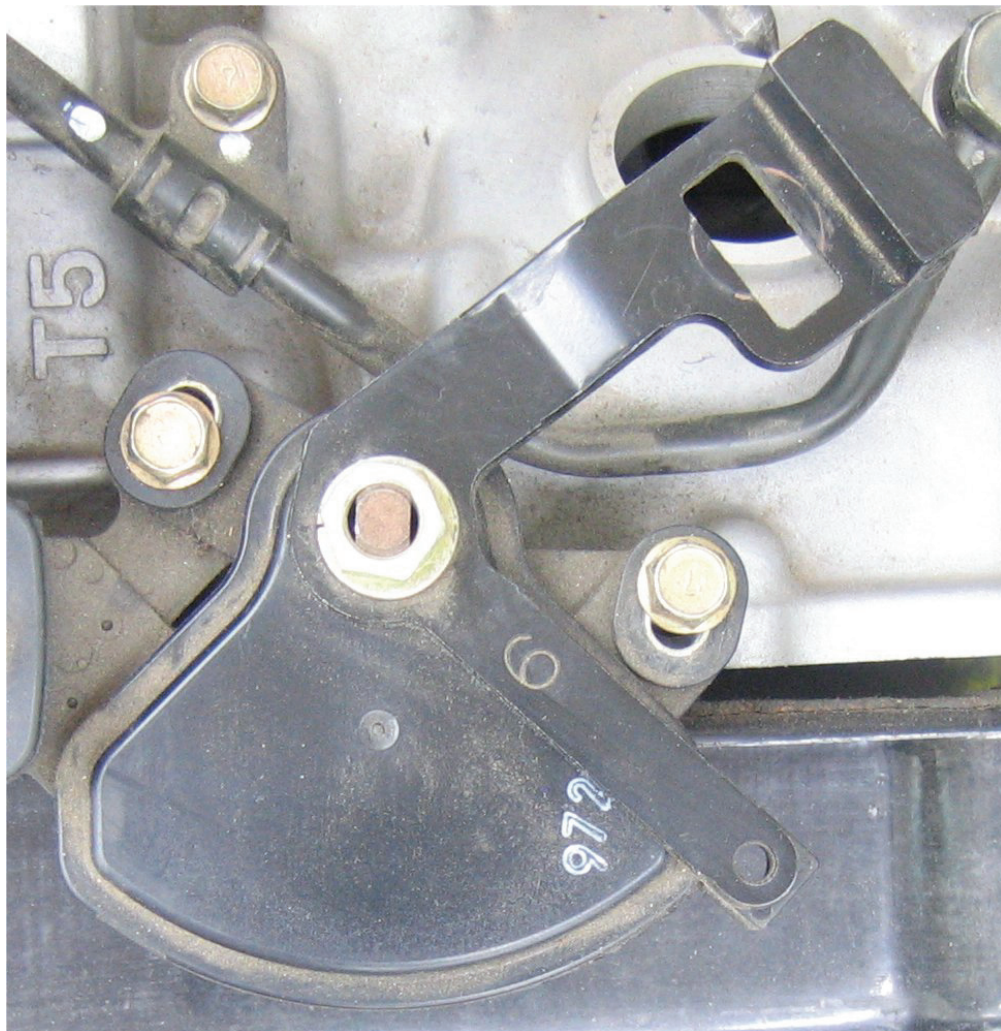
Unlike the KM units these two speed sensors can not be installed incorrectly. However they do have problems with corrosion and sensor damage. Codes P0715, P0717, P0720, P0721, P0722 may be set. Check the sensors for intermittent or no signal at the TCM and at the sensor.



F5A Series

P0707 and P0708

Codes P0707 & P0708 may be set due to the range switch being out of adjustment. With the selector in Neutral, make sure the alignment arm is directly over the alignment tab on the range switch.



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RE5R05A

Introduction

Starting in mid-2002, JATCO introduced the RE5R05A: a rear-wheel drive, 5-speed automatic transmission used in the Infiniti Q45. Since then, this unit has appeared in Infiniti and Nissan drivetrains. Infiniti uses it in CX25, FX35, FX45, G35, M35/35x, Q45, and QX56 vehicles. Nissan uses it in the 350Z, Z, Frontier, Pathfinder, Armada, Titan, and Xterra.



RE5R05A

Applications

INFINITI

Model	Geartrain	Year	Engine
FX35	RWD/AWD	2003-06	3.5L V6
FX45	AWD	2003-06	4.5L V8
G35	RWD/AWD	2003-06	3.5L V6
M35	RWD/AWD	2006	3.5L V6
M45	RWD	2003-06	4.5L V8
Q45	RWD	2002-06	4.5L V8
QX56	RWD/4X4	2004-06	4.5L V8

NISSAN

Model	Geartrain	Year	Engine
350Z	RWD	2003-06	3.5L V6
Frontier	RWD/4X4	2005-06	2.5L L4 / 3.5L V6
Pathfinder	RWD/4X4	2004-06	5.6L V8
Armada	RWD/4X4	2004-06	5.6L V8
Pathfinder	RWD/4X4	2004-06	4.0L V6
Titan	RWD/4X4	2004-06	5.6L V8
Xterra XE	RWD/4X4	2005-06	4.0L V6

RE5R05A

Computer System

There are two separate controller systems that are used for the RE5R05A transmission applications. The TCM and the ECM are separate controllers that share information through a multiplex type system.

The TCM is located in the transmission on the later vehicles and on the right kick panel on earlier model vehicles. The TCM includes all of the Transmission electronics, the TCM, Solenoids, TRS, ISS, OSS and Pressure switch circuit board. This makes diagnosing the RE5R05A difficult if you don't have the correct scan tool or the proper adapters for the scan tool.

TCM Function

The Function of the TCM is to:

- Receive information from the input signals sent from the various switches and sensors mounted on the transmission and share information from the ECM.
- Determine required pressures, shift points, lock-up operation, and engine breaking operation based on the various switches and sensors.

The TCM is constantly learning, this is called adaptive strategy. During this process the TCM is constantly monitoring the driving conditions and driver behavior.

Adaptive Strategy allows the customer to feel a flawless shift until the transmission is not capable of that shift. Typically this is at about the 75,000-100,000 mile marker. During and up until that time of repair the TCM is constantly raising and lowering pressures. This could cause you problems after an overhaul, if the computer is not reset.

NOTE: It is always recommended to reset the adaptive strategies before test driving the vehicle after overhaul.

RE5R05A

Adaptive Strategies

Before the transmission can start its adaptive learning process, the TCM must first relearn some very important parameters. The vehicle must be cleared of codes and at normal operating temperature. The following Relearn procedures **MUST** be done if the Battery, Sensor connector, TCM or ECM is disconnected!

All of these relearns can be done using the Consult 2 or manually. Be aware that all of the manual relearn procedures are done using time specifications.

NOTE: The technician must use a clock to determine the time sequences.

1. Accelerator Pedal Released Position Learning:

This is an operation to learn the fully released position of the Accelerator Pedal Position by monitoring the output signal.

Operation Procedure:

1. Make sure the accelerator pedal is fully released.
2. Turn the ignition switch to the ON position, wait at least 2 seconds.
3. Turn the ignition switch to the OFF position, wait at least 10 seconds.
4. Turn the ignition switch to the ON position, wait at least 2 seconds.
5. Turn the ignition switch to the OFF position, wait at least 10 seconds.

2. Throttle Valve Closed Position Learning:

This is an operation to learn the fully closed position of the Throttle Valve Position by monitoring the output signal.

Operation Procedure:

1. Make sure the accelerator pedal is fully released.
2. Turn the ignition switch to the ON position.
3. Turn the ignition switch to the OFF position, wait at least 10 seconds. (make sure the throttle valve moves during the 10 seconds in the OFF position by confirming the operating sound.)

RE5R05A

Adaptive Strategies (continued)

Preparation:

Before performing Idle Air Volume Learning, make sure the following conditions are met. The learning procedure will stop if any of the following are not met prior to starting the procedure.

1. Battery Charging Voltage: More than 12.9V
2. Engine Coolant: (70 - 100°C) 158 - 212°F
3. PNP Switch: ON:
4. Electrical Loads: OFF (A/C, Head lamps, Rear Window Defogger) **NOTE: On vehicles equipped with daytime running light systems, apply the parking brake BEFORE you turn the ignition switch to the on position, this will keep the lights OFF.**
5. Steering Wheel: Neutral (Straight-ahead position)
6. Vehicle Speed: Stopped
7. Transmission: Operation temperature

Operation Procedure:

1. Perform the Accelerator Pedal Released Position Relearn procedure.
2. Perform the Throttle Valve Closed Position Relearning procedure.
3. Start the engine and run it until it reaches operation temperature.
4. Once the engine is at operating temperature, turn the ignition OFF and wait for 10 seconds.
5. Confirm the Accelerator Pedal is fully released, turn the ignition ON and wait for 3 seconds.
6. Repeat the following procedures below QUICKLY five times within five seconds.
7. Fully depress the accelerator pedal.
8. Fully release the accelerator pedal..
9. Wait 7 seconds, fully depress the accelerator pedal and keep it there for approximately 20 seconds until the MIL stops blinking and turned ON.
10. Fully release the accelerator pedal within 3 seconds after the MIL light goes OUT.
11. Start the engine and let it idle.
12. Wait 20 seconds
13. Rev the engine two or three times and make sure the idle speed and ignition timing are within the specifications. **(In the P or N position Idle 650 RPM +/- 50, 15 BTDC)**
14. If the engine is not idling properly, the relearn procedure did not take or there is a problem with other engine related components.

RE5R05A

Inputs and Outputs

Input/Output Signal of TCM

Control item		Line pressure control	Vehicle speed control	Shift control	Lock-up control	Engine brake control	Fail-safe function (*3)	Self-diagnosis function
Input	Accelerator pedal position signal (*4)	X	X	X	X	X	X	X
	Vehicle speed sensor A/T (revolution sensor)	X	X	X	X		X	X
	Vehicle speed sensor MTR(*1) (*4)	X	X	X	X			X
	Closed throttle position signal(*4)	(*2) X	(*2) X		X	(*2) X		X
	Wide open throttle position signal(*4)	(*2) X	(*2) X			(*2) X		X
	Turbine revolution sensor 1	X	X		X		X	X
	Turbine revolution sensor 2 (for 4th speed only)	X	X		X		X	X
	Engine speed signals(*4)				X			X
	PNP switch	X	X	X	X	X	X	X
	A/T fluid temperature sensors 1, 2	X	X	X	X	X	X	X
	ASCD	Operation signal(*4)		X	X	X		
		Overdrive cancel signal(*4)		X	X	X		
	TCM power supply voltage signal	X	X	X	X	X		X
Output	Direct clutch solenoid (ATF pressure switch 5)		X	X			X	X
	Input clutch solenoid (ATF pressure switch 3)		X	X			X	X
	High & low reverse clutch solenoid (ATF pressure switch 6)		X	X			X	X
	Front brake solenoid (ATF pressure switch 1)		X	X			X	X
	Low coast brake solenoid (ATF pressure switch 2)		X	X		X	X	X
	Line pressure solenoid	X	X	X	X	X	X	X
	TCC solenoid				X		X	X
	Self-diagnostics table(*4)							X
	Starter relay						X	X

*1: Spare for vehicle speed sensor-A/T (revolution sensor)

*2: Spare for accelerator pedal position signal

*3: If these input and output signals are different, the TCM triggers the fail-safe function.

*4: CAN communications

RE5R05A

Clutch and Band Chart

Floor Shift Models

Shifter Position		I/C	HLR/C	D/C	R/B	FR/B	LC/B	Fwd/B	1st OWC	Fwd OWC	3rd OWC
P											
R			A		A	A			*		*
N											
D	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
	5th	A	A			A			oo		oo
4	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
3	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
2	1st		a*				a**	A	*	*	*
	2nd			A		A	A	A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
1	1st		A			A	A	A	*	*	*
	2nd			A		A	A	A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		

A = Applied

a* = Operates under priming conditions

a** = Operates under priming conditions

* = Operates during progressive acceleration

oo = Operates and effects power while coasting

I/C: Intermediate Clutch

HLR/C: High and Low Reverse Clutch

D/C: Direct Clutch

R/B: Reverse Brake

FR/B: Front Brake

LC/B: Low Clutch Brake

Fwd/B: Forward Brake

1st OWC: 1st One-Way Clutch

Fwd OWC: Forward One-Way Clutch

3rd OWC: 3rd Onw-Way Clutch

RE5R05A

Clutch and Band Chart (continued)

Column Shift Models

Shifter Position	I/C	HLR/C	D/C	R/B	FR/B	LC/B	Fwd/B	1st OWC	Fwd OWC	3rd OWC
P										
R		A		A	A			*		*
N										
D	1st	a*				a**	A	*	*	*
	2nd		A				A		*	*
	3rd	A	A		A			∞		*
	4th	A	A	A				∞		
	5th	A	A		A			∞		∞
M5	1st	a*				a**	A	*	*	*
	2nd		A				A		*	*
	3rd	A	A		A			∞		*
	4th	A	A	A				∞		
	5th	A	A		A			∞		∞
M4	1st	a*				a**	A	*	*	*
	2nd		A				A		*	*
	3rd	A	A		A			∞		*
	4th	A	A	A				∞		
M3	1st	a*				a**	A	*	*	*
	2nd		A				A		*	*
	3rd	A	A		A			∞		*
M2	1st	a*				a**	A	*	*	*
	2nd		A		A	A	A		*	*
M1	1st	A			A	A	A	*	*	*
	2nd		A		A	A	A		*	*

A = Applied

a* = Operates under priming conditions

a** = Operates under priming conditions

* = Operates during progressive acceleration

∞ = Operates and effects power while coasting

I/C: Intermediate Clutch

HLR/C: High and Low Reverse Clutch

D/C: Direct Clutch

R/B: Reverse Brake

FR/B: Front Brake

LC/B: Low Clutch Brake

Fwd/B: Forward Brake

1st OWC: 1st One-Way Clutch

Fwd OWC: Forward One-Way Clutch

3rd OWC: 3rd One-Way Clutch

RE5R05A

DTC's

DTC		Items (Consult-II Screen Terms)
OBD-II	Except OBD-II	
Consult-II GST (*1)	Consult-II only "A/T"	
N/A	P0615	Starter Relay Circuit
P0700	P0700	TCM
P0705	P0705	PNP Switch Circuit
P0710	P1710	ATF Temperature Sensor Circuit
P0717	P0717	Turbine Revolution Speed Sensor
P0720	P0720	Vehicle Speed Sensor Circuit A/T
N/A	P0725	Engine Speed Signal
P0740	P0740	TCC Solenoid Circuit
P0744	P0744	A/T TCC Solenoid Voltage Function
P0745	P0745	Line Pressure Solenoid Circuit
N/A	P1705	Throttle Position Sensor Circuit Meter
N/A	P1721	Vehicle Speed Sensor Circuit Meter
P1730	P1730	A/T Interlock
N/A	P1731	A/T 1st Braking
P1752	P1752	I/C Solenoid Circuit
P1754 (*2)	P1754	I/C Solenoid Function
P1757	P1757	FR/B Solenoid Circuit
P1759 (*2)	P1759	FR/B Solenoid Function
P1762	P1762	D/C Solenoid Circuit
P1764 (*2)	P1764	D/C Solenoid Function
P1767	P1767	HLR/C Solenoid Circuit
P1769	P1769	HLR/C Solenoid Function
P1772	P1772	LC/B Solenoid Circuit
P1774	P1774	LC/B Solenoid Function
N/A	P1815	Manual Mode Switch Circuit
N/A	P1841	ATF Pressure Switch #1 Circuit
N/A	P1843	ATF Pressure Switch #3 Circuit
N/A	P1845	ATF Pressure Switch #5 Circuit
N/A	P1846	ATF Pressure Switch #6 Circuit
U1000	U1000	CAN Communication Circuit
*1: These Numbers are prescribed by SAE J2012		
*2: These malfunctions cannot be displayed MIL if another malfunction is assigned to MIL		

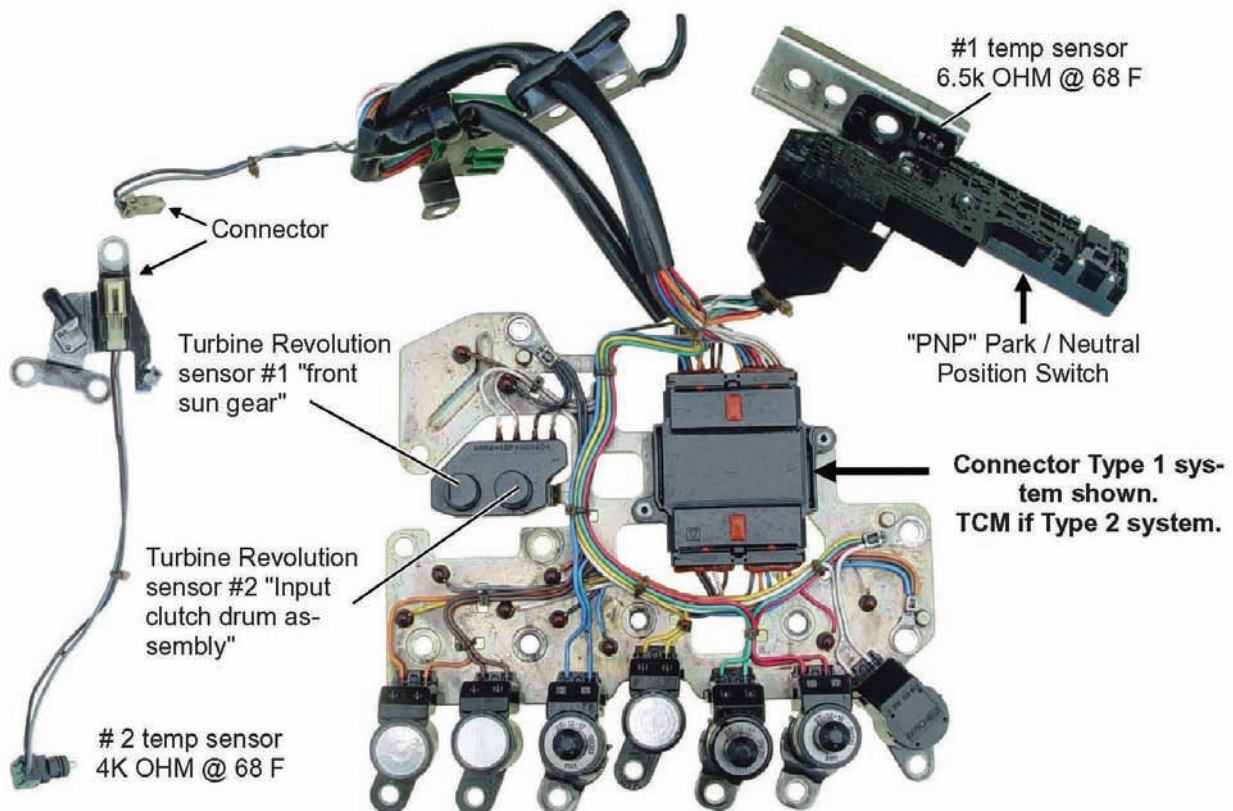
RE5R05A

Fail Safe and Sensor Locations

The Fail-Safe mode for this transmission is fixed in 2nd, 4th, or 5th (depending on the failed position). The customer will fill a “slipping” or “poor acceleration”.

Even when the electronic circuits are normal, under special conditions (like wheel spin or drastically stopping the tire rotation), the transmission can go into fail-safe mode. If this happens, switch “OFF” the ignition switch for 10 seconds, then switch it “On” again to return to the normal shift pattern.

Gear Position		ATF Pressure Switch Output					Fail-safe Function	Clutch Pressure Output Pattern After Fail-safe Function					
		SW3 (I/C)	SW6 (HLR/C)	SW5 (D/C)	SW1 (FR/B)	SW2 (LC/B)		I/C	HLR/C	D/C	FR/B	LC/B	L/U
A/T Interlock Coupling Pattern	3rd	NG	X	X	NG		Held in 2nd Gear	OFF	OFF	ON	OFF	OFF	OFF
	4th	NG	X	X	NG		Held in 2nd Gear	OFF	OFF	ON	OFF	OFF	OFF
	5th	X	NG	NG	X		Held in 2nd Gear	OFF	OFF	ON	OFF	OFF	OFF
NG= NO Good													
X= OK													

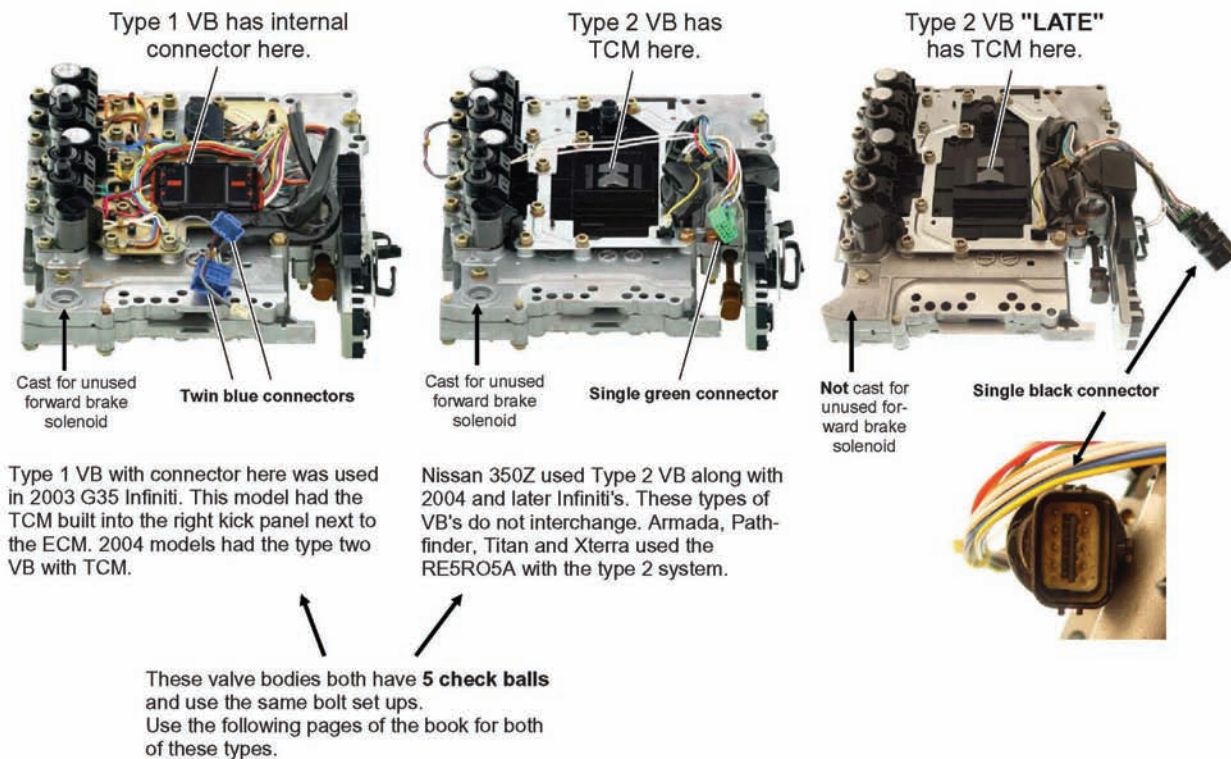


RE5R05A

Computer and Wiring

The TCM on the Type 2 is actually the complete transmission computer system; that is, it combines the TCM, pressure switches, input speed sensors and the TR sensor connector and Solenoid connector, and bolts onto the valve body. This is becoming a common practice: almost all manufacturers seem to be heading in this direction.

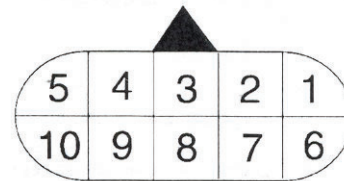
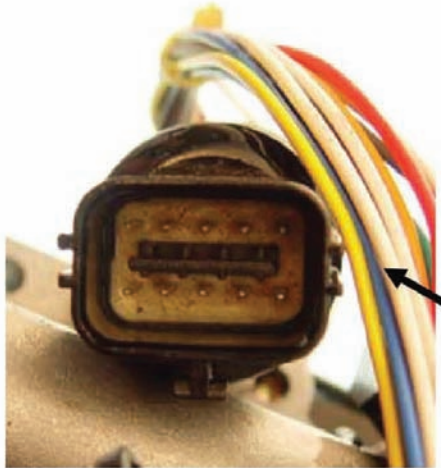
Type 1 & 2 Valve Bodies



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RE5R05A

TCM Pins



TCM INSPECTION TABLE

Data are reference value and are measured between each terminal and ground.

Terminal No.	Wire color	Item	Condition		Data (Approx.)
1	P	Power supply (Memory back-up)	Always		Battery voltage
2	P	Power supply (Memory back-up)	Always		Battery voltage
3	L	CAN-H	-		-
4	V	K-line (CONSULT-II signal)	The terminal is connected to the data link connector for CONSULT-II.		-
5	B	Ground	Always		0V
6	BR *1 Y/R *2	Power supply		-	Battery voltage
				-	0V
7	R	Back-up lamp relay		Selector lever in "R" position.	0V
				Selector lever in other positions.	Battery voltage
8	P	CAN-L	-		-
Terminal No.	Wire color	Item	Condition		Data (Approx.)
9	B/R	Starter relay		Selector lever in "N", "P" positions.	Battery voltage
				Selector lever in other positions.	0V
10	B	Ground	Always		0V

*1: Column shift

*2: Floor shift

RE5R05A

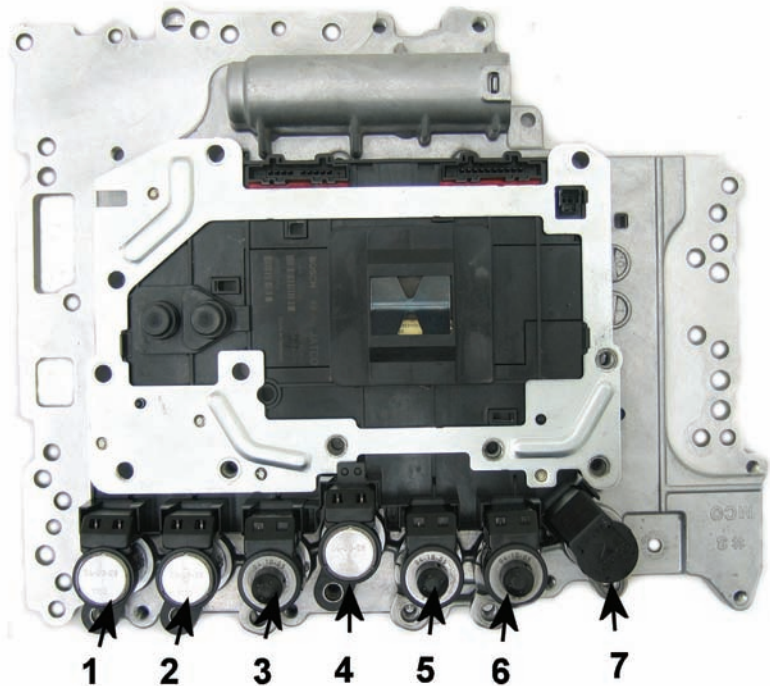
Solenoids

There are seven (7) solenoids on the valve body:

1. Line Pressure Solenoid
2. TCC Solenoid
3. High and Low Solenoid
4. Front Brake Control Solenoid
5. Input Clutch Control Solenoid
6. Direct Clutch Control Solenoid
7. Low Coast Brake Solenoid

All of the solenoids operate and connect directly to the TCM. All of the solenoids except the TCC solenoid have 3.3 ohms resistance. The TCC solenoid has 23 ohms resistance. The TCM controls all of them using a duty cycled signal.

When checking solenoid operation you'll need a CAN adapter for your scan tool or an interface adapter that checks the solenoid operation.



When checking the solenoid operation via your scan tool the data will read in amps. All of the solenoids operate between 0.0-0.8 amps. Something interesting to look at is the operating range for these solenoids. For example, the TCC solenoid will run at 0.2-0.4 amps during slip and 0.4-0.7 amps when it's fully locked up.

The input clutch, front brake, direct clutch, and high and low clutch solenoids operate at 0.6-0.8 amps while disengaging the clutches (solenoids energized), and 0.0-0.05 amps when the clutches are engaged (solenoids de-energized).

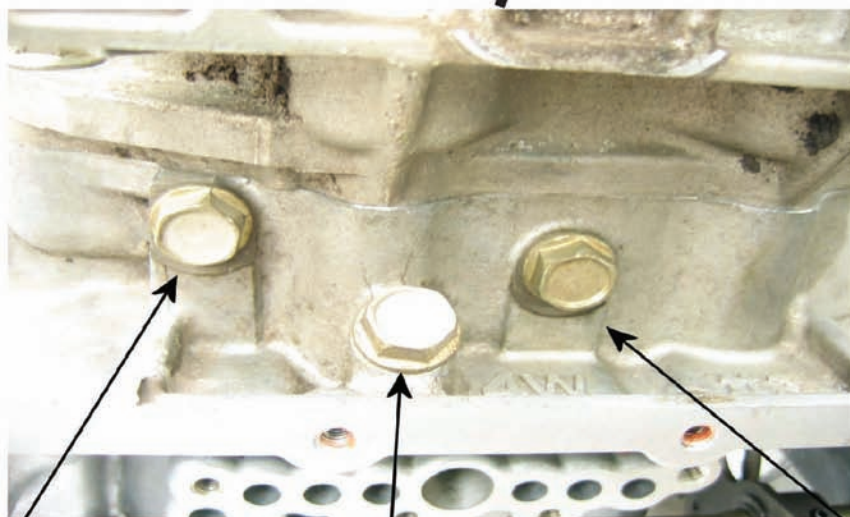
RE5R05A

Pressure Specifications

Engine Speed	Line Pressure Specifications	
	Reverse Position	Drive Position
At Idle Speed	62-67 psi	55-62 psi
At Stall Speed	233-283 psi	190-218 psi



Main Line Tap



Forward Brake Pressure

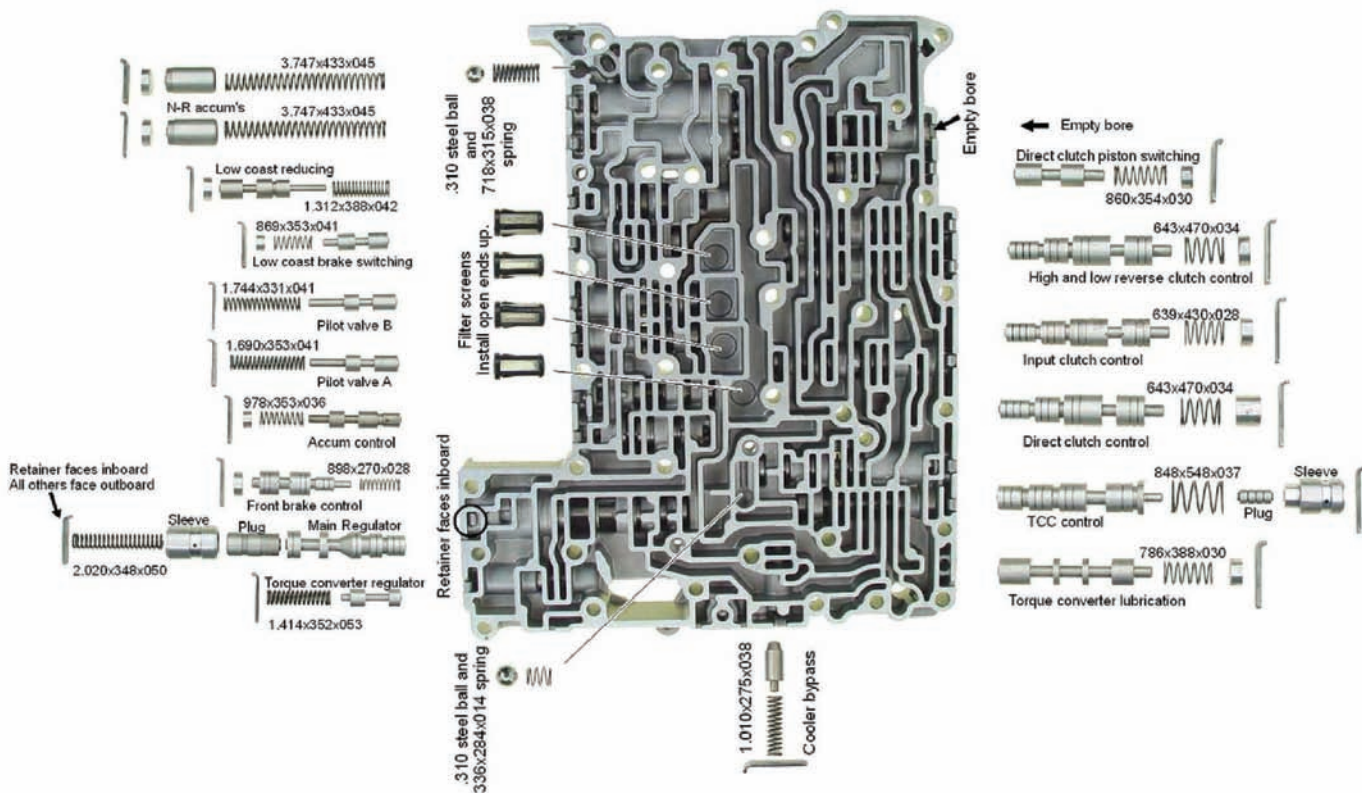
Direct Clutch Pressure

Low Coast Brake Pressure

RE5R05A

Lower Valve Body

The valve bodies are not interchangeable. If you are replacing the valve body or using some parts for interchange, make sure you identify the year of the valve body. Earlier models are assembled with the accumulator pistons next to the pucks towards the outside of the valve body housing and have an empty bore opposite of the accumulators.

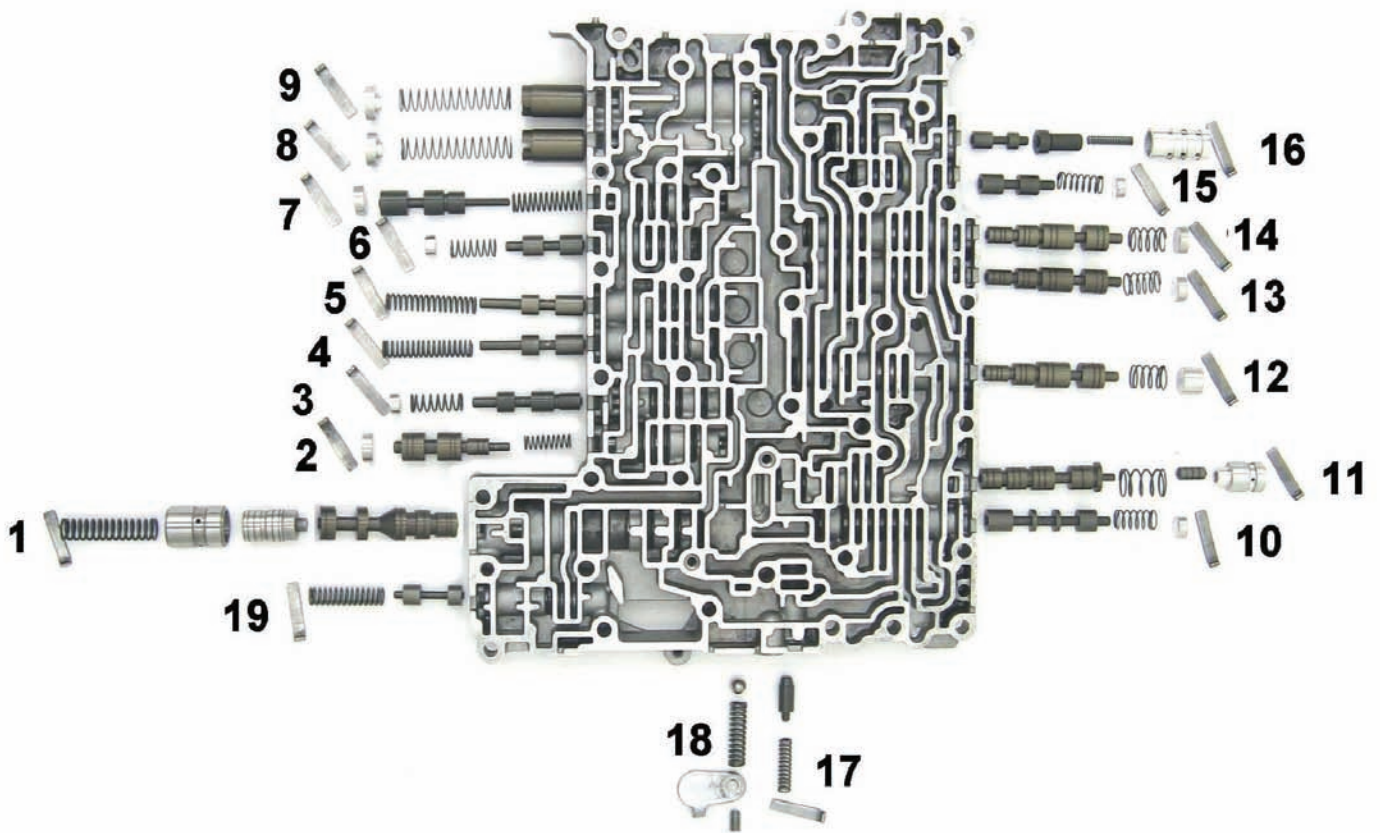


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RE5R05A

Lower Valve Body (continued)

Later model valve bodies assemble the accumulators with the pistons towards the inside of the valve body away from the pucks. They also have a valve that is opposite of the accumulator setup.



RE5R05A

Valve Descriptions

1. (a) Pressure Regulator Valve, (b) Pressure Regulator Plug, (c) Pressure Regulator Sleeve: Adjusts the oil discharged from the oil pump to the optimum levels (line pressure) for normal operation.
2. Front Brake Control Valve: When the front brake is applied, this valve adjusts line pressure to optimum levels (front brake pressure) and supplies it to the front brake. (In 1st, 2nd, 3rd, and 5th gears, it adjusts the clutch pressure.
3. Accumulator Control Valve: Adjusts the pressure (accumulator control pressure) acting on the accumulator piston and low coast reducing valve for normal operation.
4. Pilot Valve A: Adjusts the line pressure and produces the constant pressure (pilot pressure) required for line pressure, shifting, and lockup control.
5. Pilot Valve B: Adjusts the line pressure and produces the constant pressure (pilot pressure) required for shifting.
6. Low Coast Brake Switching Valve: During engine braking, this valve supplies the line pressure to the low coast brake reducing valve.
7. Low Coast Brake Reducing Valve: When the low coast brake is applied, this valve adjusts the line pressure to optimum levels (low coast brake pressure) and supplies it to the low coast brake.
8. N-R Accumulator: Produces stabilizing pressure for N-R ranges.
9. N-D Accumulator: Produces stabilizing pressure in N-D ranges.
10. Torque Converter Lubrication Valve: Operates during lockup to switch the torque converter, cooling and lubrication systems' oil paths.

RE5R05A

Valve Descriptions (continued)

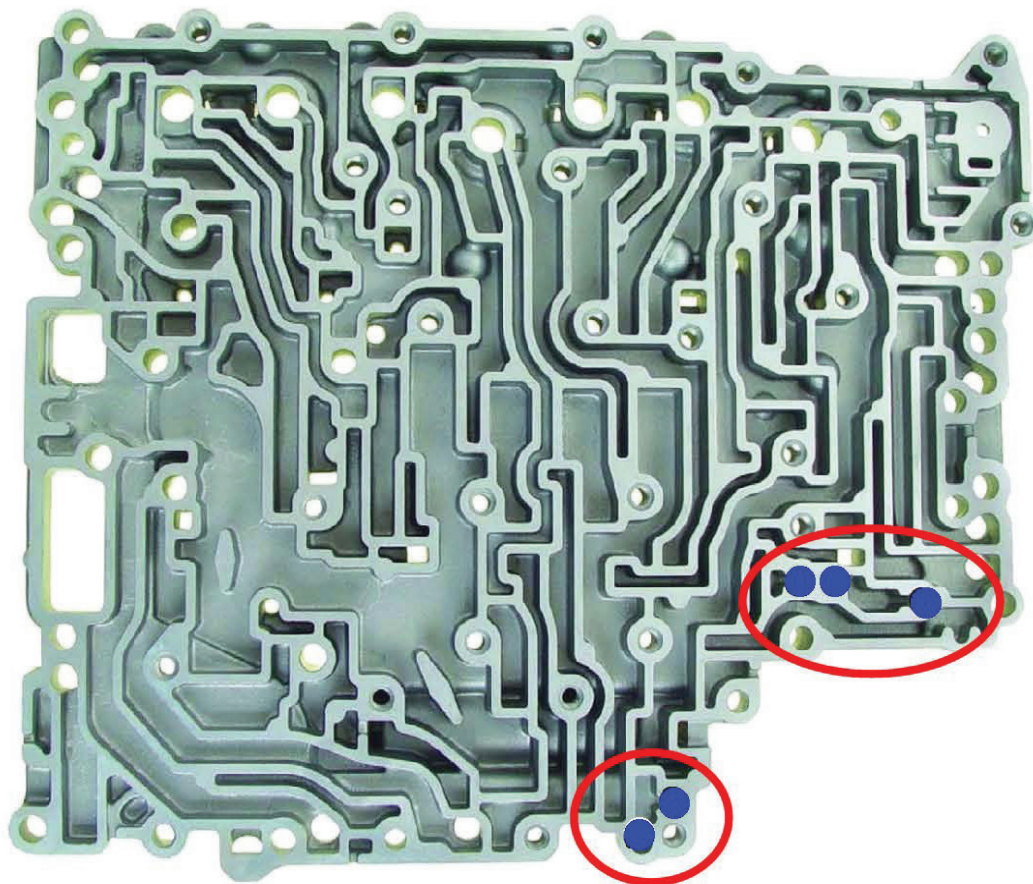
11. Torque Converter Regulator Valve: (a) TCC Control Valve, (b) TCC Control Plug, (c) TCC Control Sleeve: Applies or releases the converter clutch. By performing the lock-up operation transiently, it provides a smooth converter clutch apply.
12. Direct Clutch Control Valve: When the direct clutch is applied, this valve adjusts line pressure to optimum levels (direct clutch pressure) and supplies it to the direct clutch. (In 2nd, 3rd, and 4th gears, it adjusts the clutch pressure.)
13. Input Clutch Control Valve: When the input clutch is applied, this valve adjusts line pressure to optimum levels (input clutch pressure) and supplies it to the input clutch. (In 4th and 5th gears, it adjusts the clutch pressure.)
14. High and Low Reverse Clutch Control Valve: When the high and low reverse clutch is applied, this valve adjusts line pressure to optimum levels (high and low reverse clutch pressure) and supplies it to the high and low reverse clutch. (In 1st, 3rd, 4th and 5th gears, it adjusts the clutch pressure.)
15. Direct Clutch Piston Switching Valve: Operates in 4th gear and switches the direct clutch coupling capacity.
16. Direct Clutch Regulating Valve
17. Cooler Bypass Valve: Allows excess oil to bypass cooler circuit without being fed into it.
18. Line Pressure Relief Valve: Discharges excess oil from line pressure circuit.
19. To prevent too much pressure from reaching the torque converter, line pressure is adjusted to optimum levels; this is called torque converter operating pressure.
20. Manual Valve: Sends line pressure to each circuit according to the selector position.

RE5R05A

Upper Valve Body Check Ball Locations

2003

There is a distinct difference between the valve body casings. The locations of the check balls are also different between the years.



Install .217 steel balls at the "B" locations.

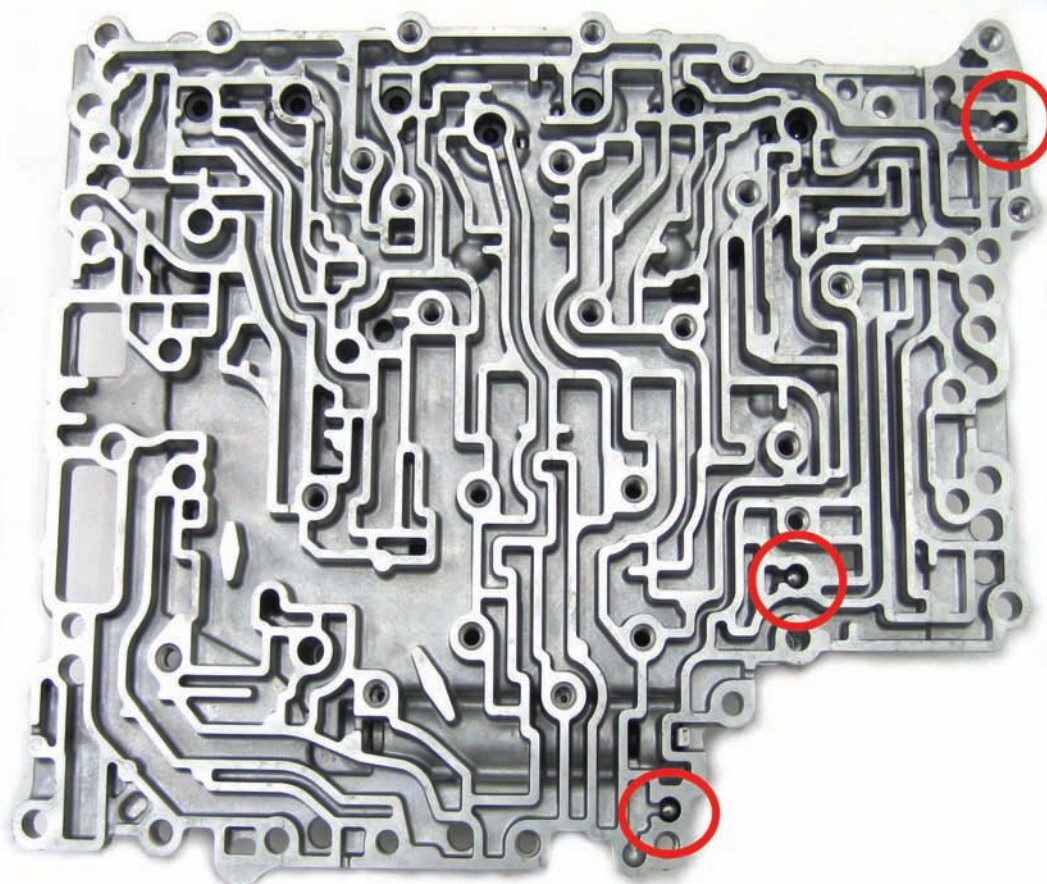
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RE5R05A

Upper Valve Body Check Ball Locations

2004 and up

There is a distinct difference between the valve body casings. The locations of the check balls are also different between the years.



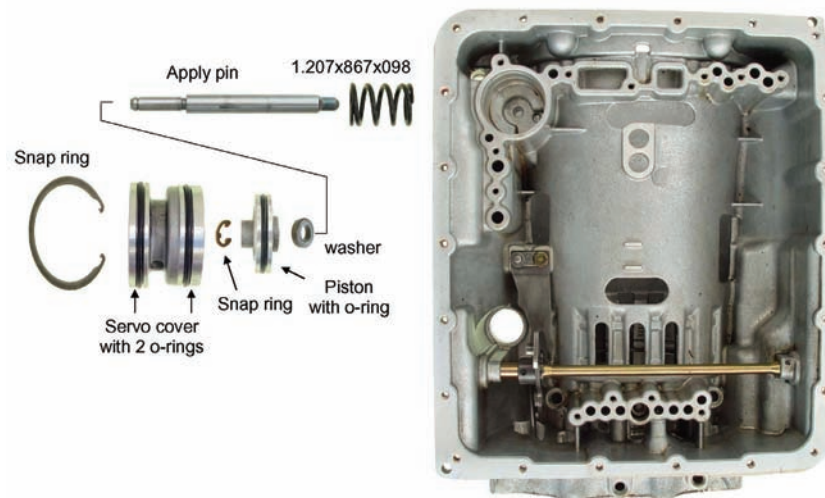
RE5R05A

Front Brake Servo and Band

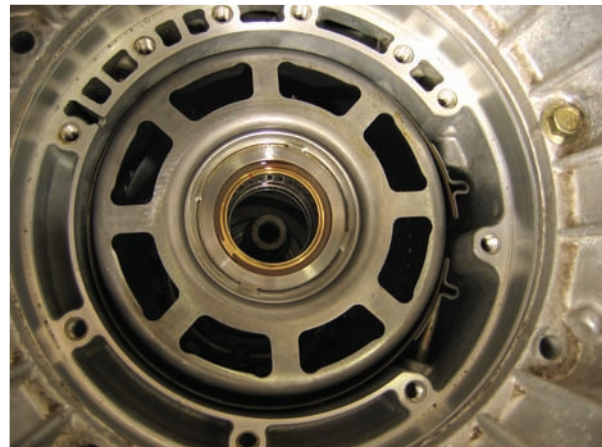
Install the anchor pin and the servo assembly into the case. Install the band assembly into the case, install the front sun gear assembly to the front carrier assembly. The front sun shell is where the band rides. Adjusting the band is pretty straightforward:

1. Use a brake band clip or equivalent to make sure the band contacts the shell assembly.
2. Loosen the anchor locknut and tighten the anchor end pin to 44 in-lbs.
3. Mark the anchor pin with a marker.
4. Back off the anchor end pin exactly three turns.
5. Hold the pin in place and tighten the locknut.

This will be your last and only chance to adjust the band, because once the transmission is in the vehicle.



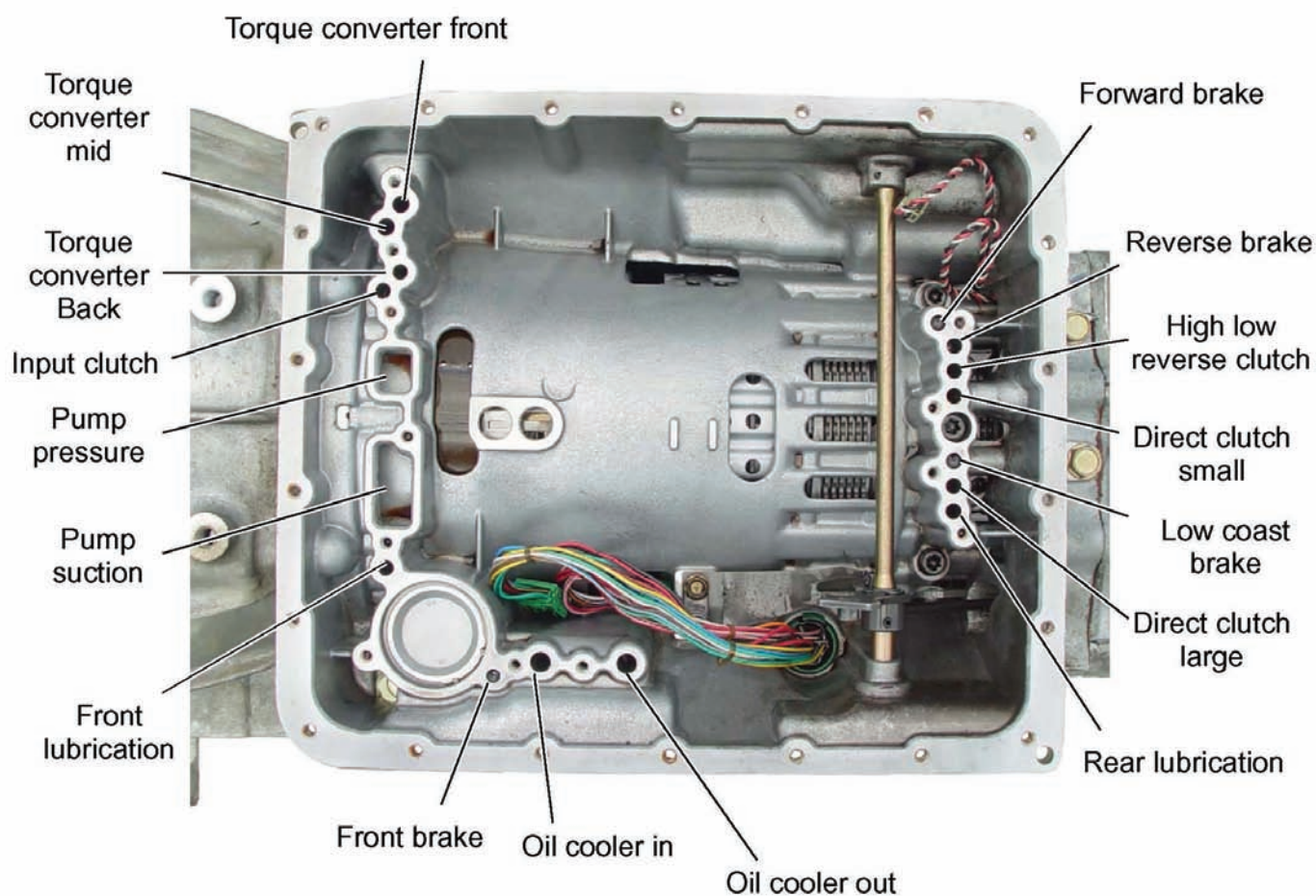
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RE5R05A

Air Checks

Air checking the clutches is pretty straight forward, use controlled shop air to make your tests. The last thing you want to do is blow a seal or damage a hard part.



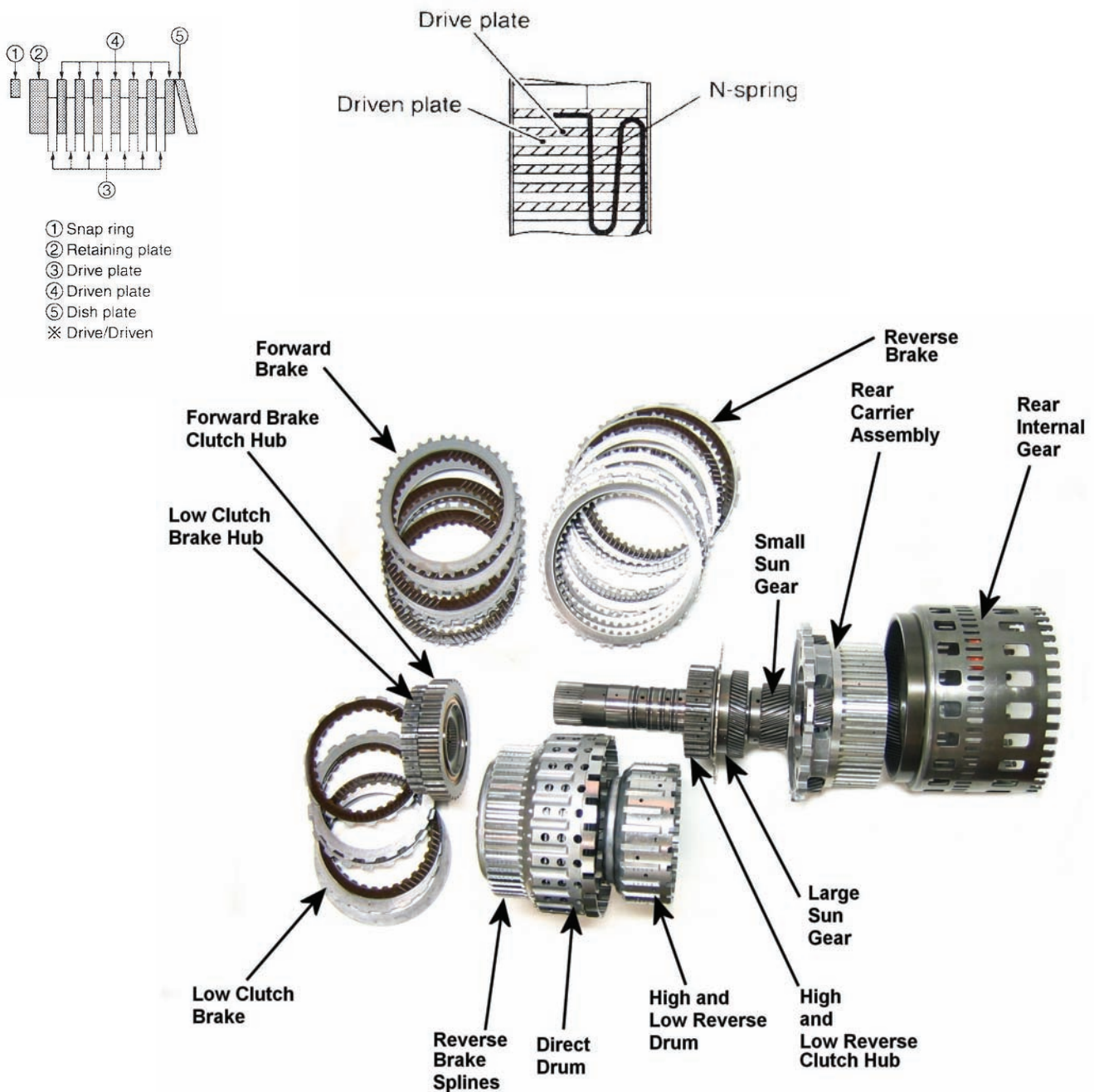
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RE5R05A

Clutch Drum and Hard Part ID

This is the lower half of the transmission. During the rebuild it is very important to get the Low Clutch Brake hub splined properly to the clutches.

Install the Reverse Brake Clutches, install the cushion plate as illustrated. Before installing the retaining plate, install the "N-spring" as shown.

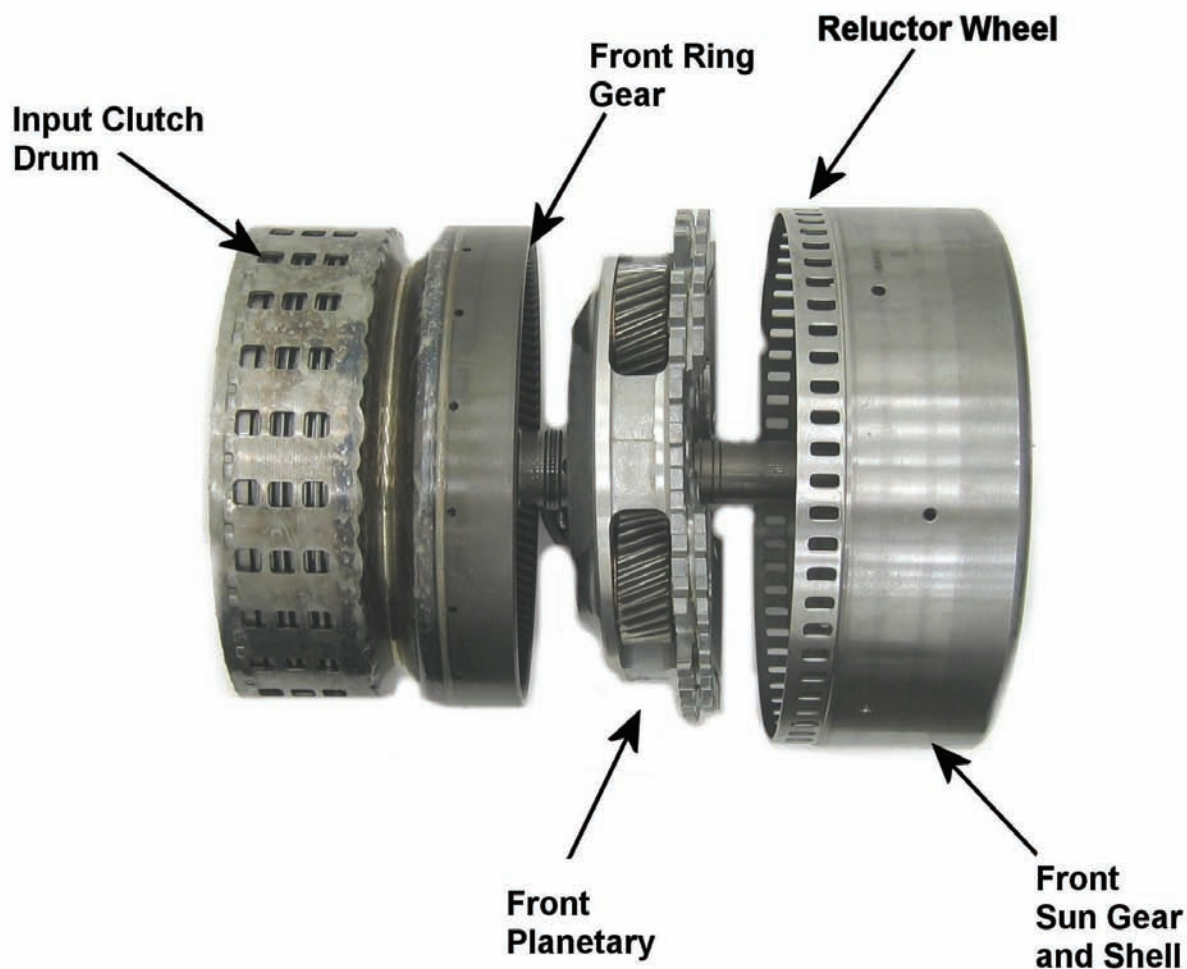


RE5R05A

Clutch Drum and Hard Part ID (continued)

The Jatco RE5R05A, accomplished a similar style of the Lepelletier geartrain. They used a sun gear and shell assembly just like the GM and Ford units, except this sun gear isn't splined to the stator support, it's mounted using a sprag so it can freewheel in one direction.

It also uses a band to prevent the sun gear from freewheeling when needed. The sun shell assembly sits on the stator support, the front planetary splines to the sun gear, and the ring gear that's attached to the input drum splines to the planetary. And unlike the gear train used by GM and Ford, this design allows for a 1:1 ratio.

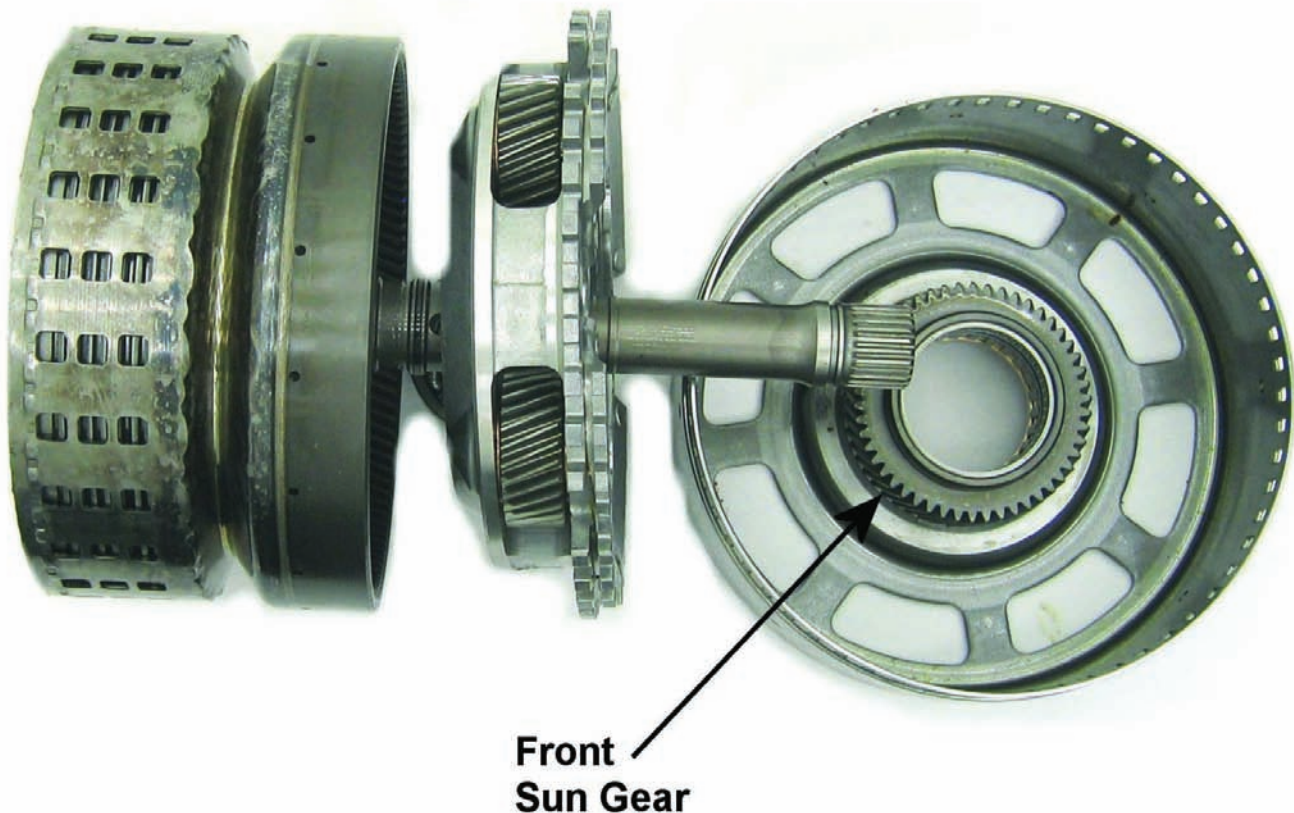


RE5R05A

Clutch Drum and Hard Part ID (continued)

The clutch-and-band application chart says that the band is on in first, second, third and fifth. It isn't on in fourth: If the band applied in fourth it'd create a bind-up. And it has to come back on in fifth because without it the transmission would shift to neutral.

More important is when the band comes on; this provides the input shaft with that all-important reduction we're looking for. Without that reduction we would have that super overdrive that would not be practical, so reducing the input shaft speed gives you a high enough ratio to improve gas mileage, while still providing adequate power.

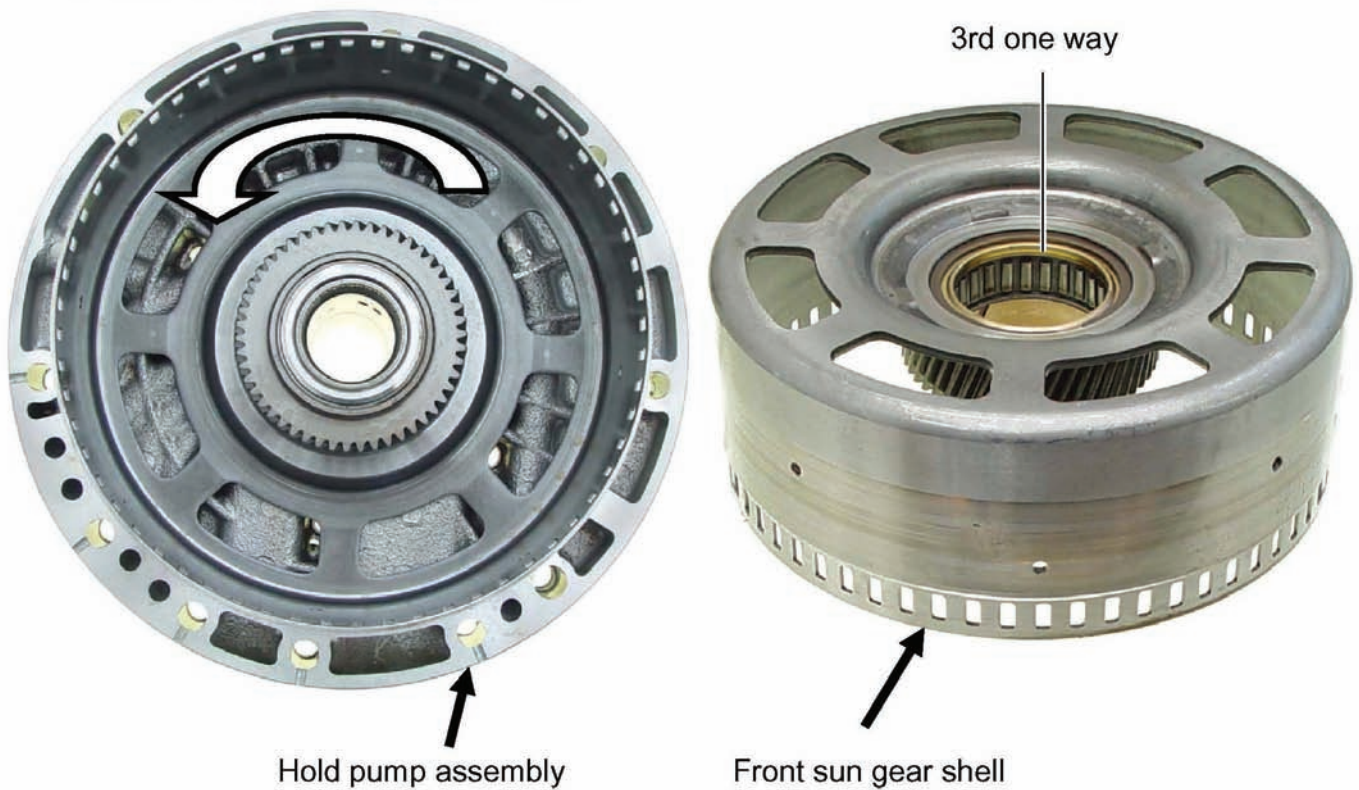


RE5R05A

3rd Sprag Assembly

The 3rd One-way sprag allows the front sun gear to turn freely in the forward direction but fastens it for reverse rotation.

Hold pump, Front sun gear shell should freewheel in the direction of the arrow.



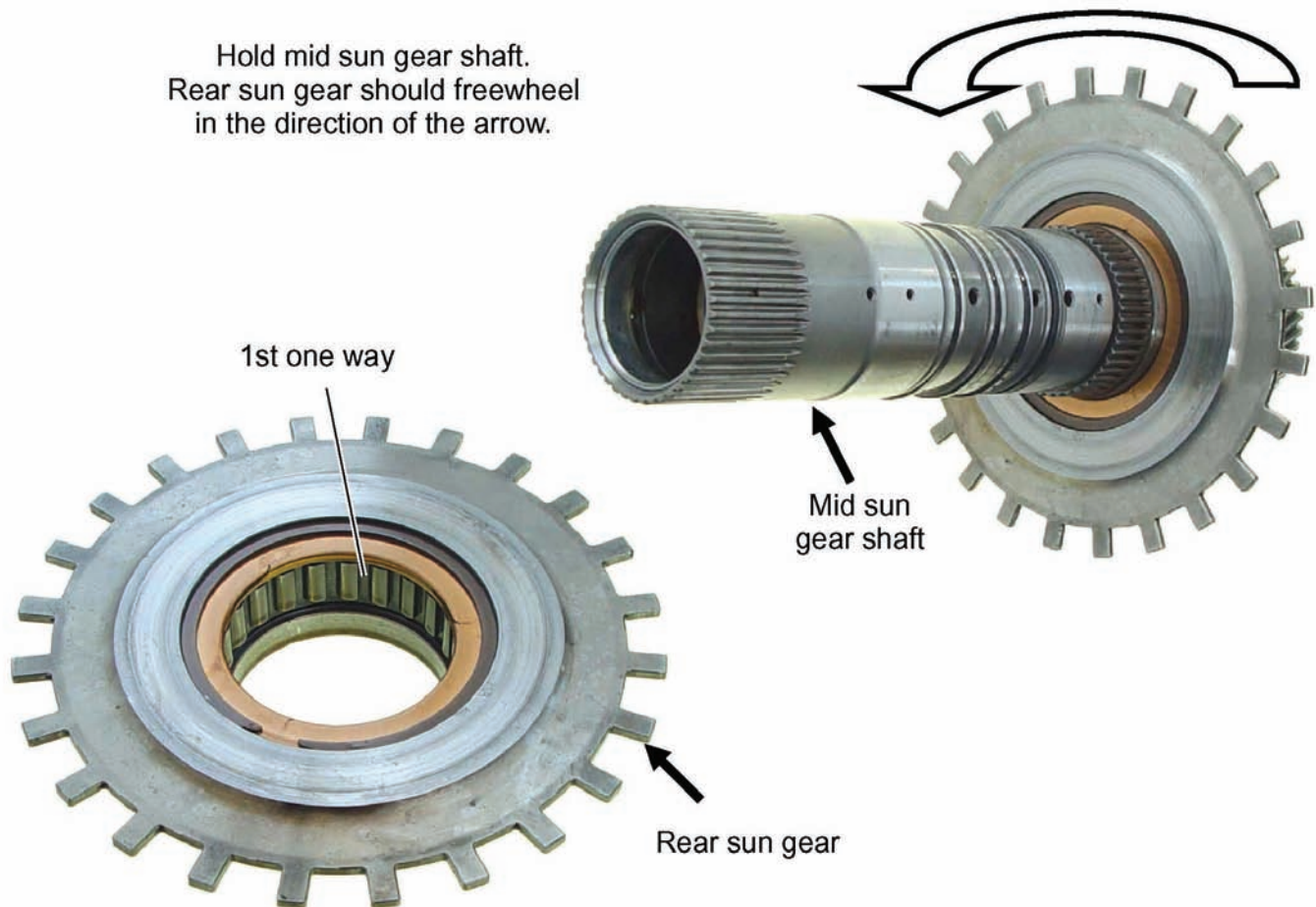
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RE5R05A

1st Sprag Assembly

Allows the mid-sun gear to turn freely forward relative to the mid-sun gear but fastens it for reverse rotation.

Hold mid sun gear shaft.
Rear sun gear should freewheel
in the direction of the arrow.

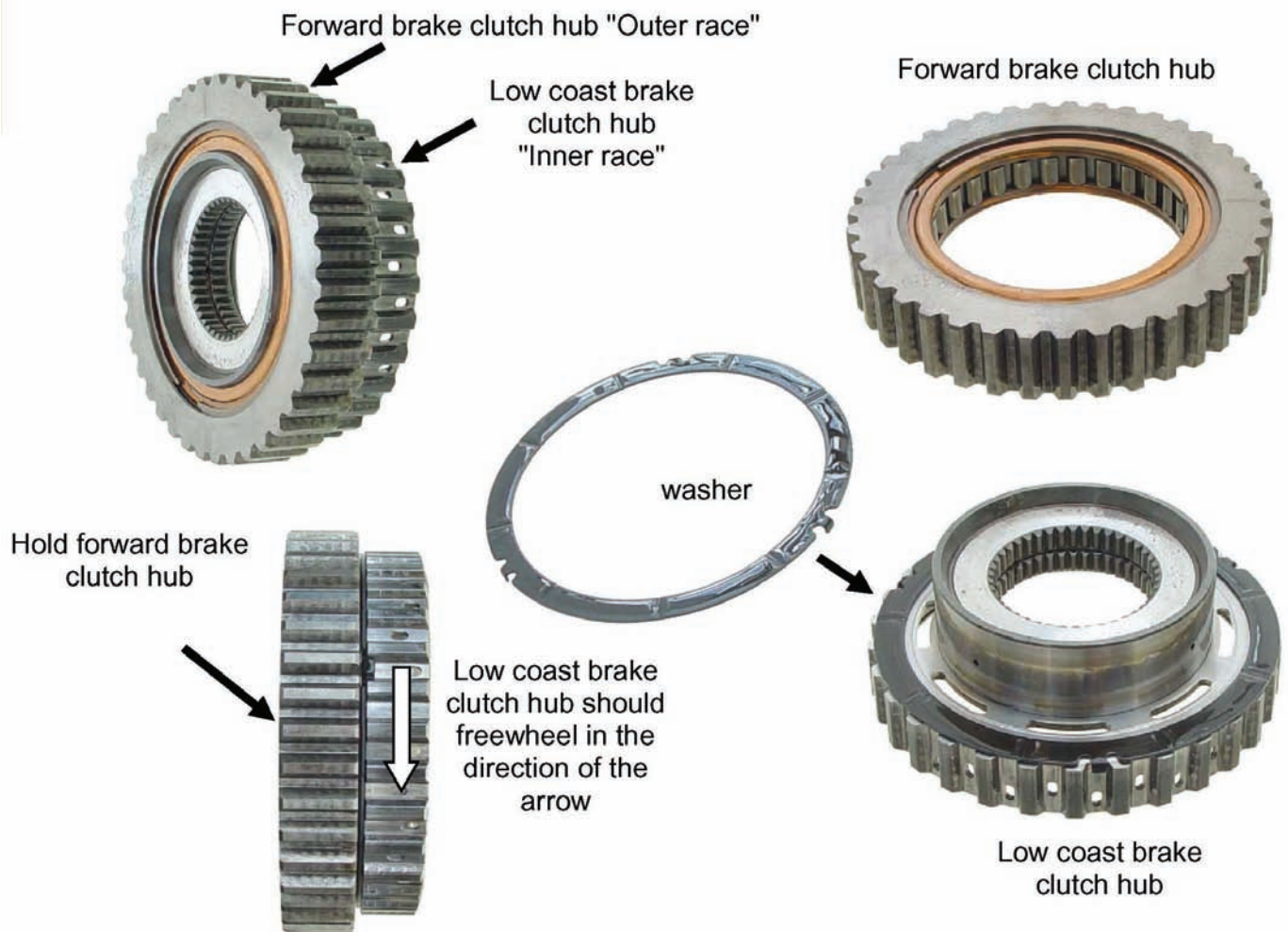


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Forward Sprag Assembly

Allows the mid-sun gear to turn freely in the forward direction but fastens it for the reverse direction.



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Dennis Madden

Chief Executive Officer

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That's important — we can't stay in business without customers. But bringing 'em in the door is only half the job: It doesn't mean a thing unless you have the skills and training to get 'em back out again.

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So, on behalf of the ATRA staff and the ATRA Chapters that have worked so hard to put this program together, I'd like to welcome you, and thank you for doing your part to keep our industry strong. We hope you have a wonderful day, and a terrific learning experience.

A handwritten signature in black ink, appearing to read "D. Madden". The signature is fluid and stylized, with a long horizontal stroke at the end.

Dennis Madden,
ATRA, CEO



Lance Wiggins
Technical Director



The ATRA technical department is proud to be celebrating another year serving the automatic transmission repair industry. Many changes have taken place over the years, technical training has become an integral part of today's transmission repair industry. To that end, ATRA is pleased to present its 2009 Technical Seminar. Packed with countless hours of research, this year's seminar will stand out as one of the most demanding and useful technical training programs ever developed for this industry.

With over 240 pages of up-to-the-minute technical information, the 2009 Technical Seminar Manual will remain a valuable resource long after the seminar is just a memory.

We're confident that you'll find this year's seminar presentation and technical manual both informative and profitable. In fact, we're so sure you'll be satisfied with what you learn in this program, we guarantee it!

On behalf of the entire ATRA staff, the international board of directors, and all of the ATRA members worldwide, we'd like to thank you for your continued support.

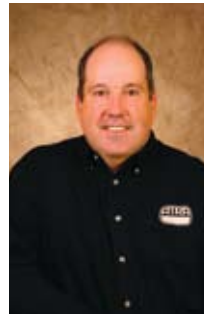
A handwritten signature in black ink that reads "Lance Wiggins". The signature is stylized with a large, sweeping initial "L" and a long, horizontal stroke at the end.

Lance Wiggins
ATRA Technical Director

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4T45E

TCC Surge

Some A Body cars (Cobalt, Ion and G5) customers may experience a TCC surge or Chuggle when the transmission is in 3rd or 4th gear.

A new calibration has been released to address this concern on 2007 and 2008 applications.

[SPS Info](#)

 **Service and Parts Operations**

To obtain the latest electronic controller calibration information for your vehicle, enter the vehicle's 17 character Vehicle Identification Number (VIN) and select 'Get CAL ID'.

To obtain the Calibration Verification Number (CVN) for any calibration part number, enter the part number of the calibration ID and select 'Get CVN.'

VIN: Get CAL ID

Part Number: Get CVN

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4T40/45E

Updates

2008 Reverse Input Clutch Wave Plate:

The reverse input clutch wave plate changed from 8 teeth to 16 teeth. The change is designed to help prevent the wave plate from moving and cutting into the drum.

Increasing the number of teeth reduces the stress on the drum splines. This update will back service previous year applications. The updated part number for the wave plate is 24243005.



4T40/45E

Updates (continued)

Intermediate/4th Servo Cushion Spring:

A 3rd design updated servo cushion spring is now available. The update is a single spring design and will back service previous applications with the 1st design single spring or the 2nd design two piece spring assemblies. The new spring has a larger outside diameter. The spring is available in Kit 24245771.



4T40/45E

Updates (continued)

Direct Clutch Material

A change occurred to the material that comprises the direct clutch friction plates. The “High Energy” material is designed to significantly improve direct clutch life. The update is only for 2008 applications. The update includes the following changes:

- Direct clutch friction discs: The discs are made of a different material and can be identified by the metallic specks imprinted into the friction lining.
- The spacer plate was changed: The orifice feed for the clutch was changed from 2.45mm to 2.15mm.
- The plate can be identified by the notch pattern and part number on the plate.
- TCM Calibration: An updated calibration was required for this change

For 2008 applications the parts are available in kits.

Non Hybrid: 24247457

Hybrid (BAS):24247456

If the kit is installed the updated calibration is also required

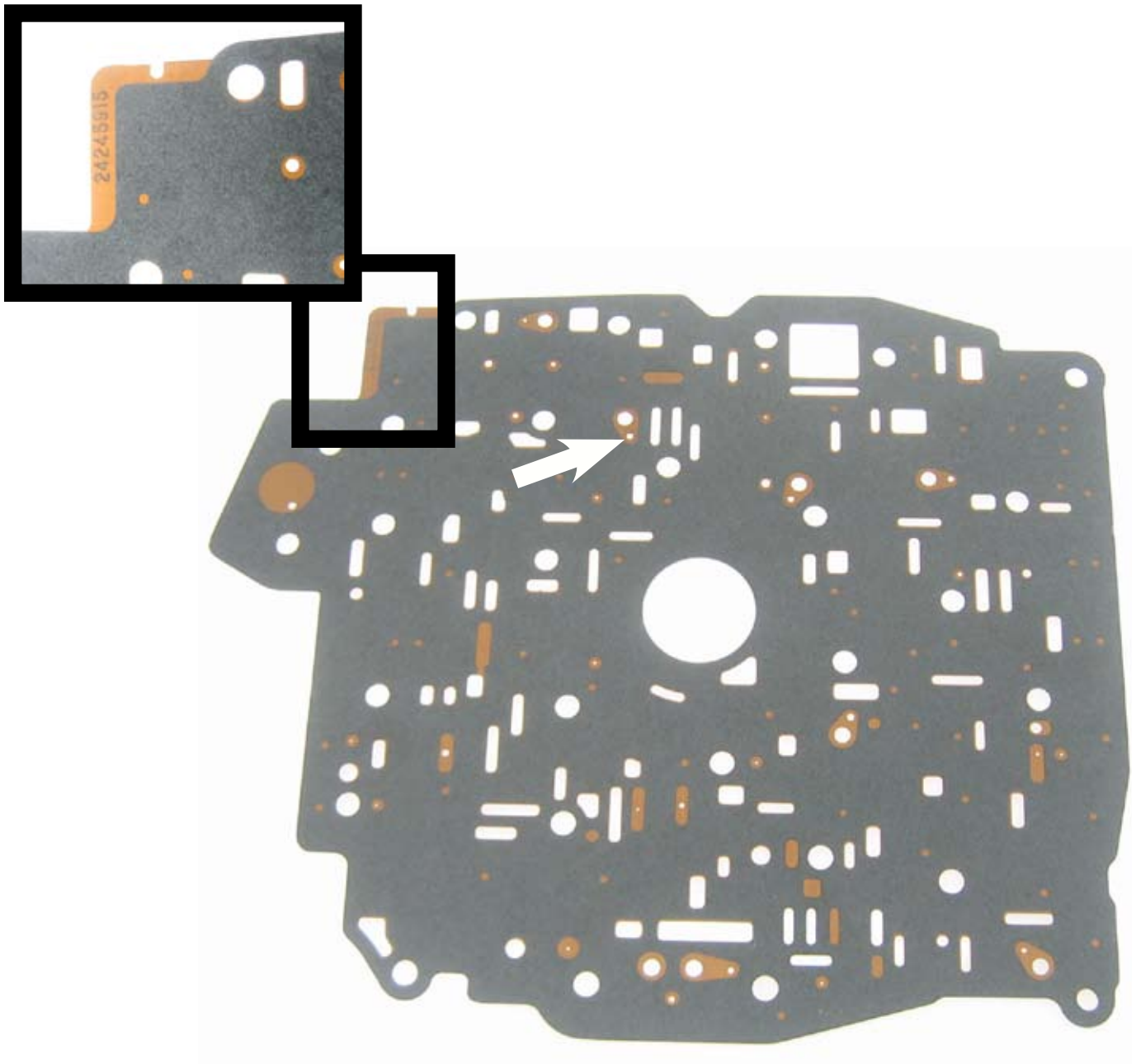


4T40/45E

Updates (continued)

Spacer Plate

The spacer plate was changed: The orifice feed for the clutch was changed from 2.45mm to 2.15mm. The plate can be identified by the notch pattern and part number on the plate.

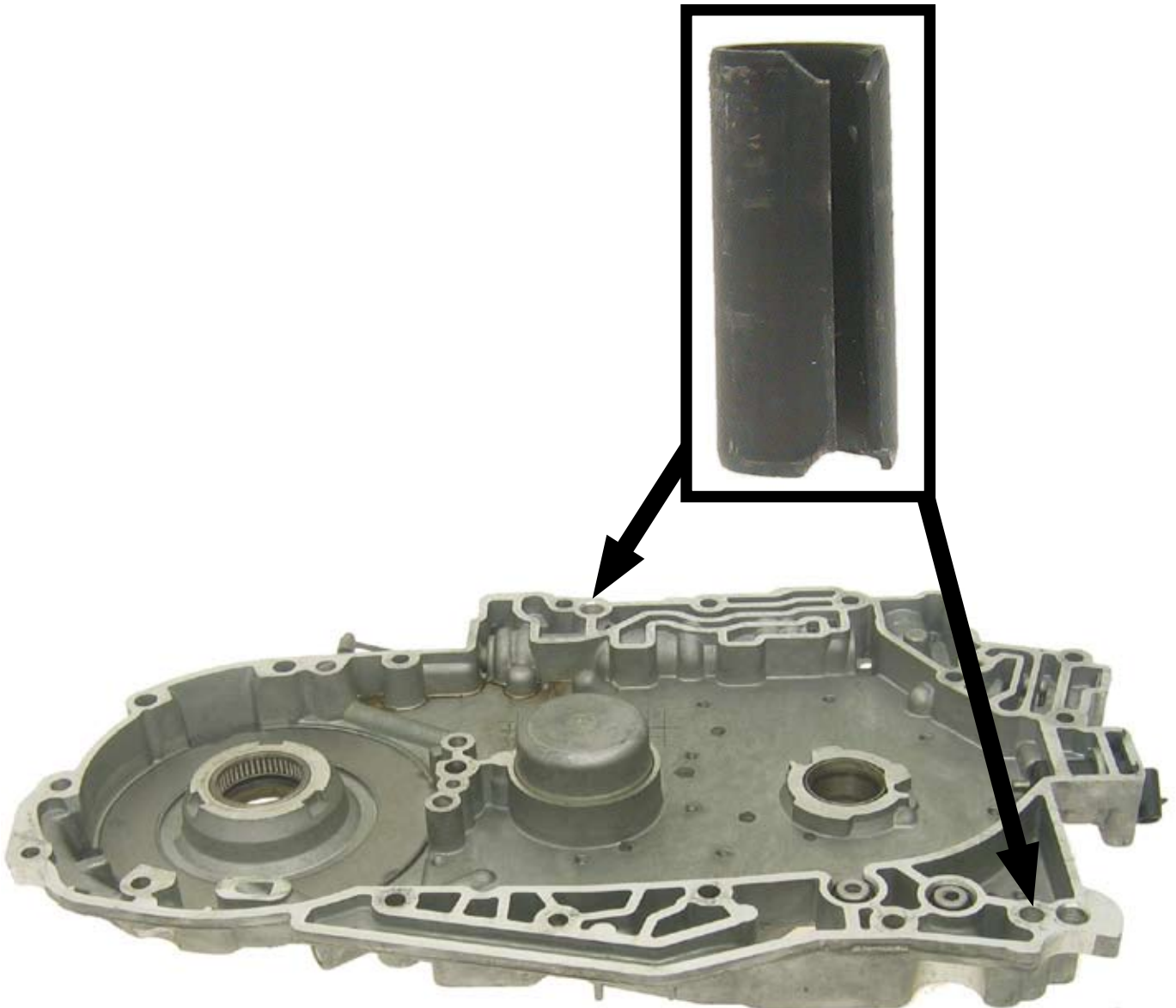


4T65E

Updates

Case Cover Dowels (Channel Plate)

The dowels on the channel plate were updated to spring pin design. If a replacement channel plate is ordered it will come with the updated design dowel pins. The new pins are press fit into the case and should not fall out during overhaul or service.



4T65E

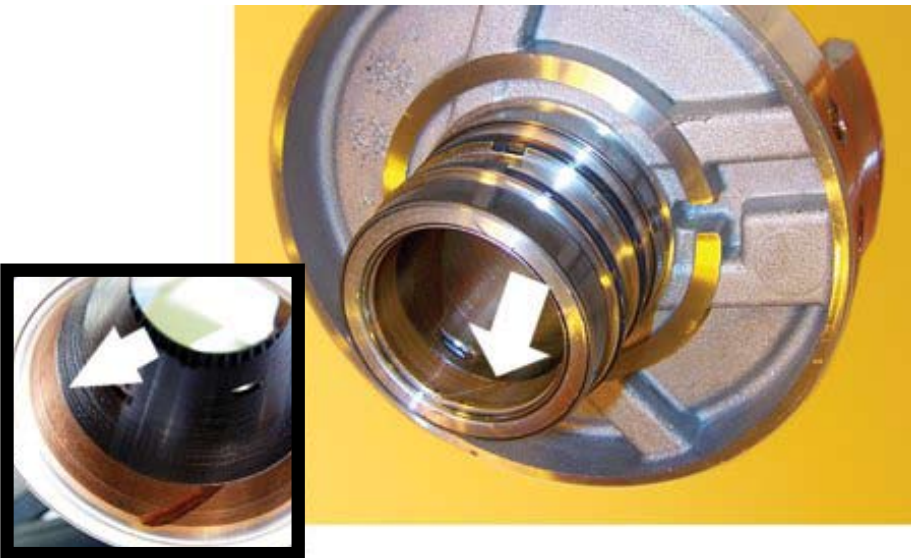
Sprocket Support

Some technicians have inquired regarding the finish on the inside diameter of the driven sprocket support (P/N 24209098). It appears that the cross hatch is rough and concerns have been raised regarding the life expectancy for the input housing seals.

GM Powertrain engineering has stated that the cross hatch seen in the picture below is normal and should not raise durability concerns for the seals.

In addition many technicians have inquired regarding the proper position for the 4th clutch piston in the driven sprocket support housing.

Engineering had the vendor for the piston stamp a “V” mark in the piston so it could be properly oriented in the housing. The piston should be placed in the housing as shown.



4T80E

TCC Buzz Noise

Some Cadillac DTS (K Body) customers may comment that they hear a TICK or BUZZ type noise coming from the dash area. Generally this noise will be present when TCC is applied and will diminish or disappear completely when TCC is released.

Use your scan tool to verify that the noise is present when TCC is applied. The cause of the noise is the TCC solenoid pressure pulsations that are being transmitted into the passenger compartment via the shifter cable.

The pressure pulsations are considered NORMAL. The best way quiet the noise is to install a cable dampener on the shift cable. The cable dampener is sold under part number 20778626.

IMPORTANT: Install damper onto the shifter cable next to the adjuster if possible. Make certain the dampener does not come into contact with the body, shifter, or any other vehicle components or it will be unable to dampen the noise successfully.



6T40/45E

No and/or Hard Shifts

Some customers with Z body (Malibu, G6, Aura) 6T40 applications may experience any or all of the following conditions:

- SES light on
- Engine may/may not start
- Transmission may exhibit hard shifts
- Transmission may not shift
- I/P cluster may not operate or may operate intermittently
- Scan tool may or may not be able to communicate with the Transmission Control Module
- DTC's may be set, these may include any or all of the following in any combination. P150C, U0073, U0100, U0100-7F, U0100-75, U0101, U2106, C0561 (Communication Error DTC's) or P0700 (Transmission DTC set)
- You may find that in addition to communication problems, the TEHCM (TCM) may not function correctly or it may fail to function at all. Diagnosis will lead you replace the TEHCM (TCM)

Several items may cause the concern including:

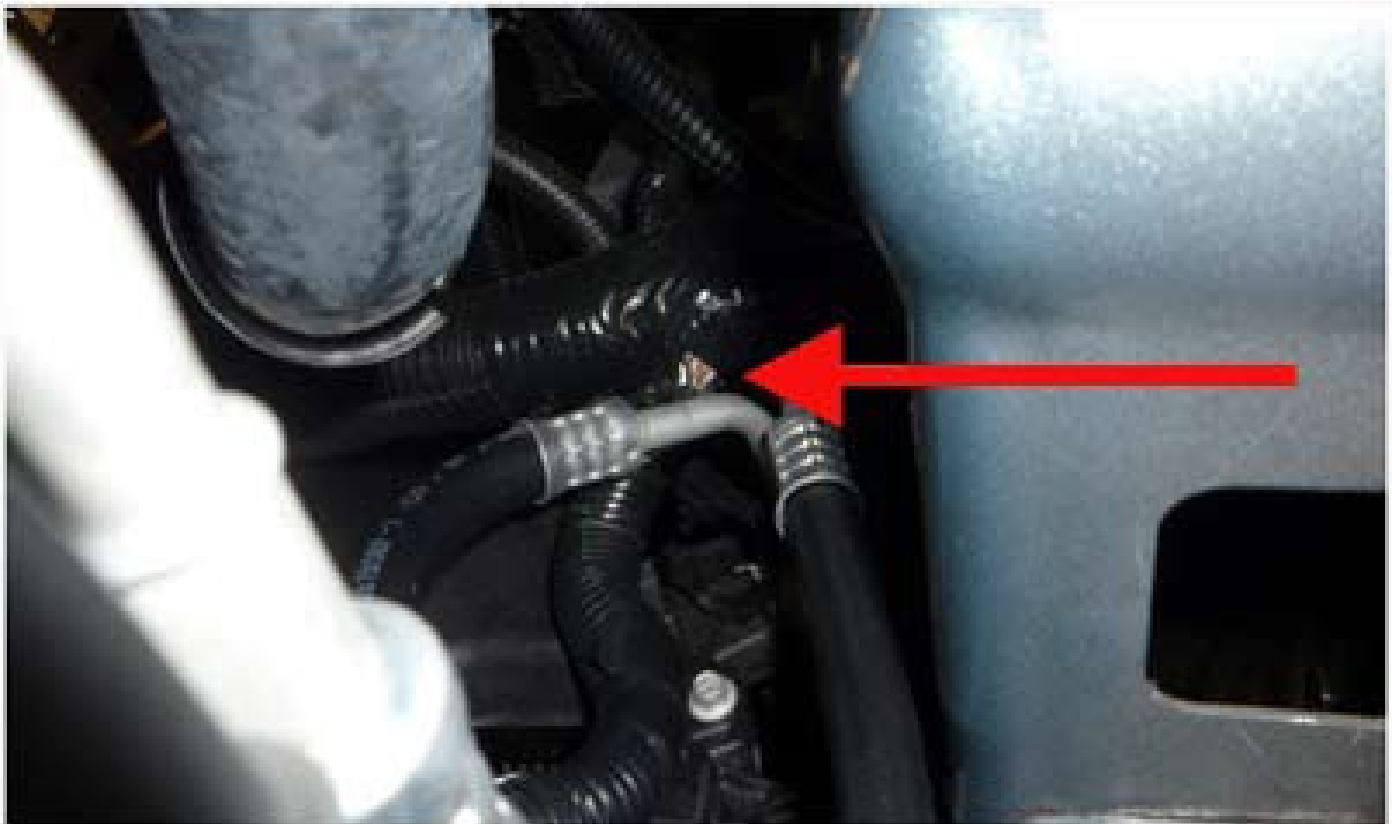
- The high speed LAN circuits may be shorted to ground
- The cooling fan may be developing a voltage spike

6T40/45E

No and/or Hard Shifts (continued)

Inspect the ECM/PCM harness (Circuits 2500,2501,5060) for damage. Typically the harness is rubbing at the strut tower area. Repair the harness and tie the harness back so it can no longer rub.

If the TEHCM (TCM) is not functioning it may have been damaged by a voltage spike from the engine cooling fan. Replace the TEHCM (TCM). The updated GM TEHCM (TCM) utilizes a de-spiking circuit to prevent damage to the controller.



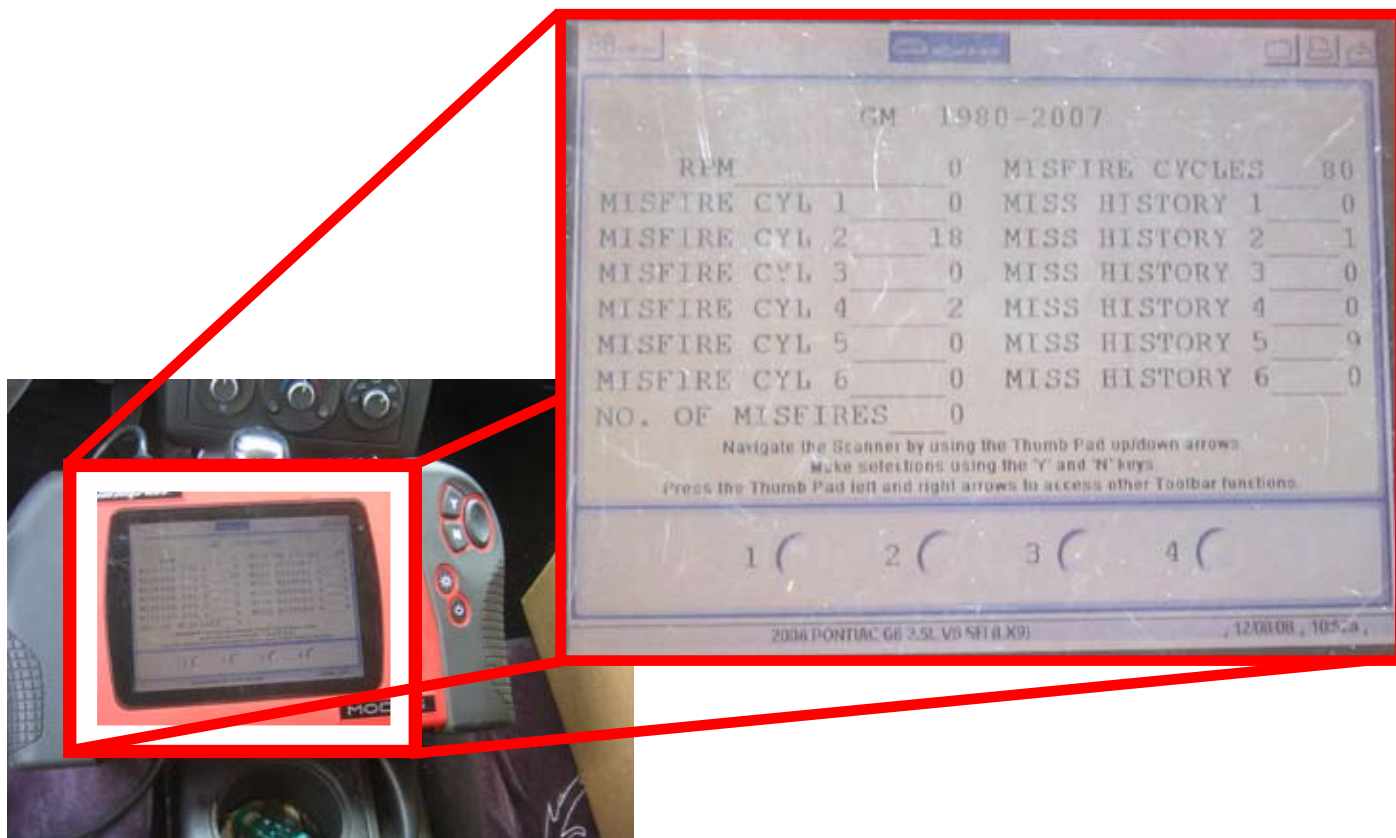
4L60E

Erratic TCC Surge, Cycling

2006-07 S/T truck applications (Rainier, Colorado, Trailblazer, Canyon, Envoy, H3, or 9.7X) may experience a condition where the engine tends to surge while at cruising speeds with the throttle held steady. This condition may be worse on rough roads.

Upon inspection the technician will typically be unable to find a cause for the condition. No DTC's will be set and the condition may be difficult to duplicate. If the technician is able to duplicate the concern, he/she should monitor the TCC command status and the engine misfire counters. He/She will notice the misfire counters when the TCC is being commanded OFF. If this condition is present attempt to isolate the cause of the misfire. If the cause cannot be isolated, an updated PCM program is available to address the concern. The updated program changes the misfire diagnostic programming.

NOTE: Remember ALL GM vehicles will inhibit TCC when a MISFIRE is PRESENT. So if the engine has tune-up concerns, the TCC WILL NOT WORK PROPERLY. This applies to 1996-current model vehicles.



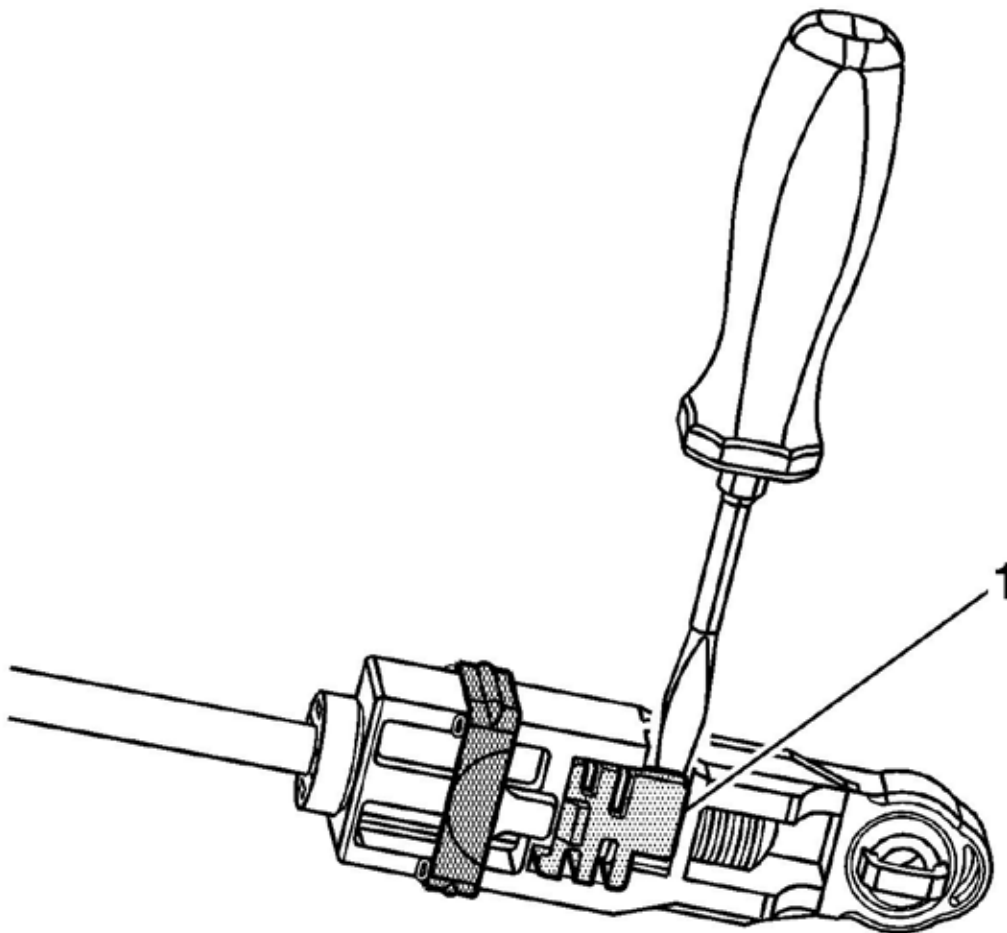
5L50/6L50

Shift to Park Message

Some 2004 and later Cadillac XLR and XLR-V models may display a “Shift to Park” message on the Driver Information Center (DIC) even though the vehicle is actually in the park position. In addition the auto door lock feature may not function and the ignition key may not move all the way to the off position.

Several items can cause this concern including:

- **Shifter Cable Adjustment:** The cable should be adjusted with the shifter in the park position. Verify the shifter is in park, and that the parking pawl is engaged. Release the cable adjuster lock and allow the cable to relax. Re-seat the cable adjuster lock.
- **Secondary Park Switch:** Verify the transmission IMS operation with your scan tool. If the IMS is operating correctly inspect the secondary park switch. The secondary park switch is located on the right side of the shifter and is an input to the BCM so you will need to monitor BCM data to check the operation of the switch.



6L50

TCC Noise and/or Vibration

Some customers may notice a boom, vibration, or noise when TCC is applied in Cadillac DTS application.

The cause of the concern is engine firing pulses that are being transmitted through the drivetrain. To correct the condition an updated calibration has been released that raises the TCC apply speed approximately 10 mph.

NOTE: If the updated calibration is installed, the customer will notice a decrease in the vehicle fuel economy.

[SPS Info](#)

 **Service and Parts Operations**

To obtain the latest electronic controller calibration information for your vehicle, enter the vehicle's 17 character Vehicle Identification Number (VIN) and select 'Get CAL ID'.

To obtain the Calibration Verification Number (CVN) for any calibration part number, enter the part number of the calibration ID and select 'Get CVN.'

VIN: Get CAL ID

Part Number: Get CVN

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6L80

No Forward Movement

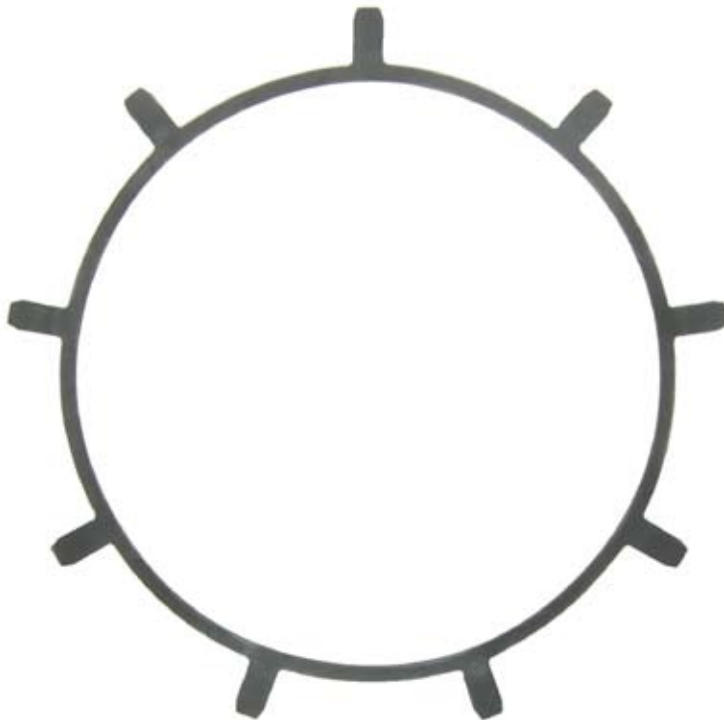
1-2-3-4/3-5-R Clutch Housing

The clutch housing was updated to address a NO Forward condition. This concern could happen without notice. Upon inspection, the technician will notice the snap ring has popped out of the housing. To address the concern the housing was updated.

In addition, the 3-5R waved plate and the 1-2-3-4 wave plate were updated. The 3-5 R wave plate changed from 12-18 teeth. The 1-2-3-4 wave plate changed from 9-18 teeth. This update was implemented for the mid 2007 model year as an interim 07 change. Service for the updated housing require that clutch travel be checked.

- 3-5-R wave plate # 24239828
- 1-2-3-4 wave plate # 24239615
- Selective snap rings #2440194 – 24240201
- Clutch housing kit, Housing and selective snap rings # 24241232
-

The updated housing, wave plates and snap rings will back service previous model applications.



6L80

Clutch Shudder Condition

Low/Reverse Clutch Plates

An update occurred to the Low/Reverse clutch friction plates to address a clutch shudder concern. The material was changed and it is being sold as part # 24235460. If the updated clutch discs are installed, a calibration update is required for 2006-2007 applications.

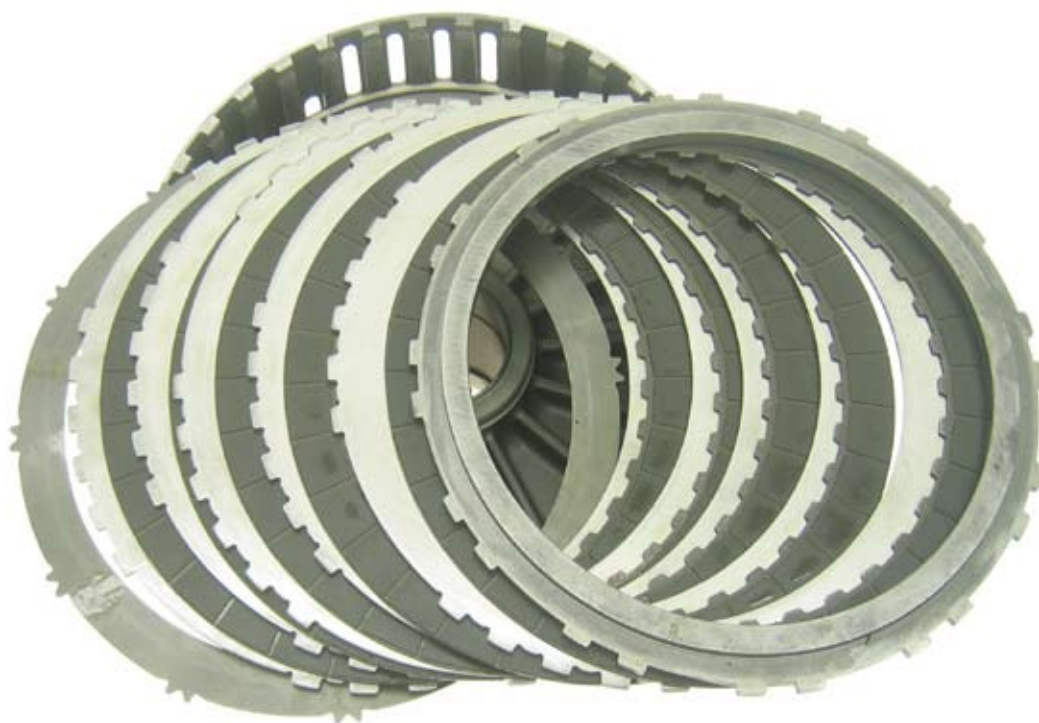


6L80

Ticking and/or Rattling Noise

2-6 Clutch Friction Material

The 2-6 friction discs were updated to address a Ticking/Rattling Noise issue. The groove pattern changed from an X shaped pattern to radial grooves in the material. The updated parts will back service previous model year applications. The updated discs are available under part #24240221

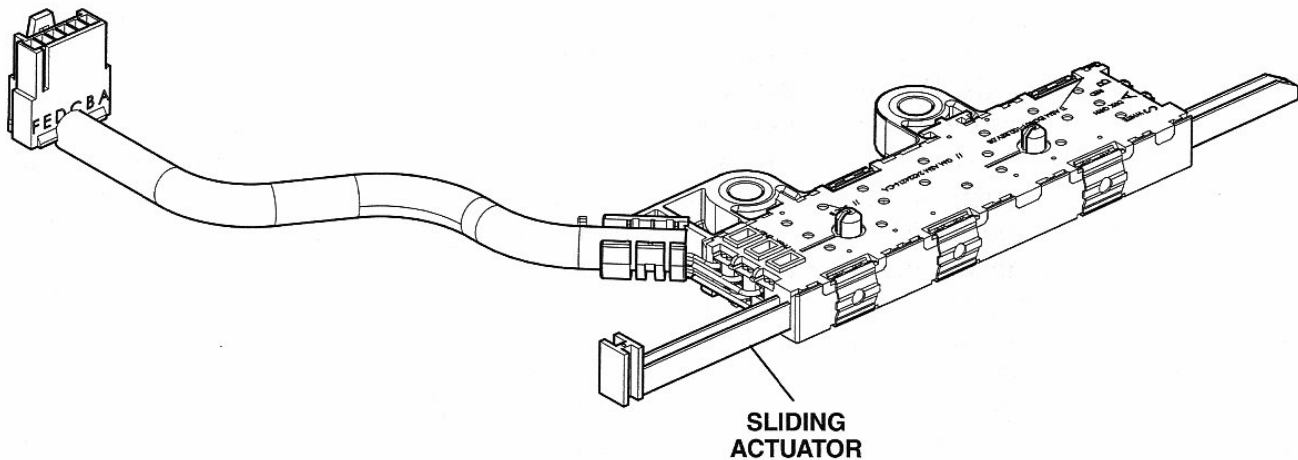


6L80

P1875

IMS Out of Range

The IMS update was completed as a mid 2007, interim 2007 update. Oxidation was forming on the contacts, leading to contact resistance, which may result in a P1875 DTC. The updated IMS added additional nickel plating to the contacts and changed the lead frame to stainless steel to reduce the contact resistance. The updated IMS will back service previous applications and is available under part # 24246427



6L80

Low Sprag Update

The low sprag was updated as a mid 2007, interim 2007 change. The update design changed the number of sprag elements from 30 to 38. The updated design will back service early 2007 and all 2006 applications. The updated sprag is available as a kit under part #24248957



6L80

Delayed Engagement, Reverse Drain Down, N-R, P-R Delay

3-5 Reverse Clutch Piston Capacity Reduction

This update occurred at start of production (SOP) for the 2008 model year. Clutch piston capacity was reduced by 20% for the 1-2-3-4/3-5 Reverse clutches. This updated piston is designed to limit the amount of oil volume required to stroke the piston. The update also required a calibration change so it will not currently back service 2006-07 applications.

The piston and the seals were updated and communized between cars and trucks for this concern.

Parts are available under the following part numbers:

- 2006-07 3-5 Reverse Clutch Piston #24234213
- 2008-09 3-5 Reverse Clutch Piston #24238696
- 2008-09 1-2-3-4 Clutch Piston # 24238700
- 2008-09 Seal kit for 1-2-3-4/3-5 Reverse drum #24243898
- 2006-07 Seal kit for 1-2-3-4/3-5 Reverse drum (CAR) #24248576
- 2006-07 Seal kit for 1-2-3-4/3-5 Reverse drum (TRUCK) #24248578



6L80

Spacer Plate and Valve Body Spring Updates

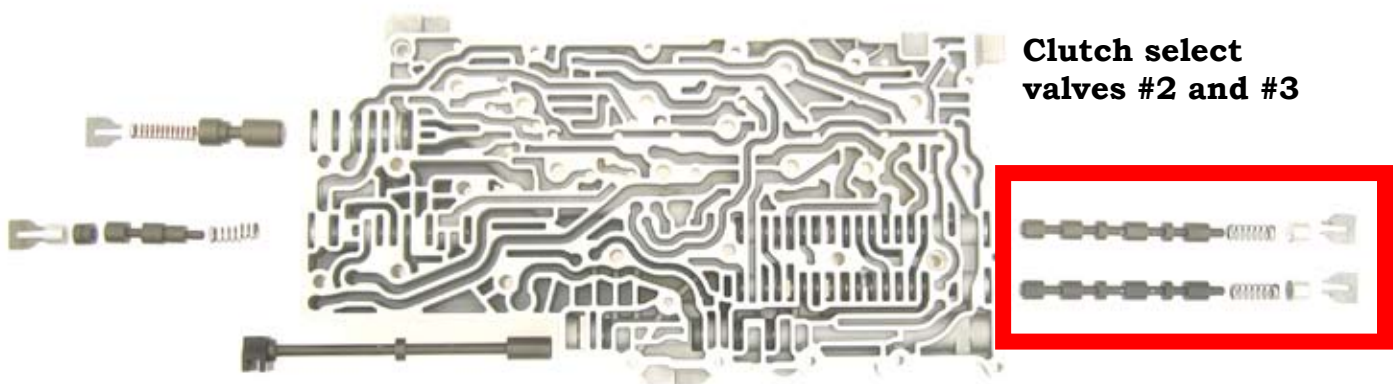
The spacer plate has undergone multiple changes for this application. The 1st major change occurred in mid 2007 as a 2007 interim change. The spacer plate added an exhaust and a parallel path for a lube circuit bleed. The plate can be interchanged between the 6L50/80/90 applications. The part number used at the time was 24246916.

Additional updates were performed to the plate as a mid 2008, interim 2008 change. These changes were designed to address the P0751 DTC that commonly sets. In addition to the plate upgrade, a 2009 update occurred in July 08 to the lower valve body springs as the second part of the update to address the P0751. The spring load on the clutch select valves #2 and #3 were lowered. This allowed the select valves to move at a lower pressure reducing the tendency of the P0751 to set. The clutch select valves springs are not available individually.

The updated valve body and spacer plates will back service previous model year applications if used together.

Updated part number:

- Spacer plate #24245720
- Lower valve body with spring updates # 24250384



6L50/80/90

P1825, P182E, P1915

Mode Switch Codes

Some customers with Chevrolet, Cadillac, GMC, Hummer, and Pontiac vehicles equipped with the 6L50, 6L80, or 6L90 transmissions may note any or all of the following DTC's, P1825, P182E and/or P1915 are set upon inspection with a scan tool. In addition the PRNDL display may not function.

The DTC's will set if the following conditions occur:

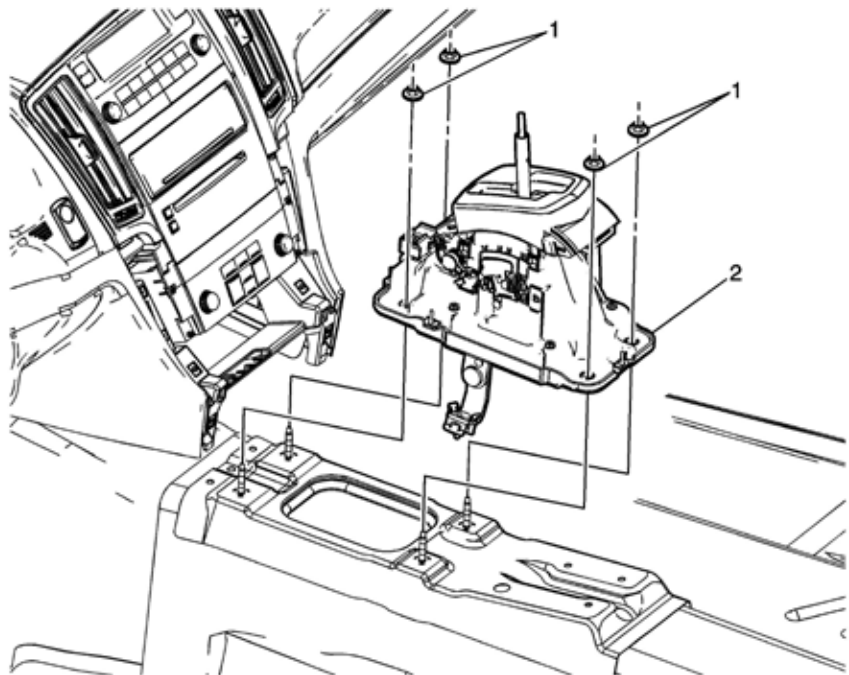
P1825 will set if:

- IMS range A is Low while in D6 range for more than 8 seconds
- IMS range C is High while in D6 range for more than 8 seconds
- IMS range A, B, P are low while in Park range for more than 1 second
- P/N switch indicates park/neutral but the IMS shows a range other than P/N
- IMS indicates a INVALID range for more than 3.25 seconds
- VSS greater than 10 mph
- P0722 or P0723 not set

P1915 will set if:

- The engine speed is greater than 525 RPM for more than 3.25 seconds
- The transmission input shaft speed is greater than 250 RPM
- Transmission output speed less than 90 RPM
- As the shifter is moved the IMS voltage sequence does not follow the designed state. In other words the IMS range sequence does not correspond in the correct order to the designated range sequence.

P1915 generally indicates the wrong range was indicated at one time or another.



6L50/80/90

P1825, P182E, P1915 (continued)

Mode Switch Codes

If a P1825, P1915 or P182E sets the TCM will:

- Command max line pressure
- Turn off all solenoids, resulting in 3rd or 6th gear default depending on the gear the transmission was in at the time the DTC set
- Freeze shift adapts

If you have any combination of the DTC's set inspect the IMS scan values, the scan values should match the IMS status chart. If the scan values fail to match the IMS status chart inspect the circuit wiring. If the status stays HIGH inspect the circuit/IMS for being open. If the status stays LOW inspect the circuit/IMS for being shorted to ground. P1825 generally indicates an Invalid range sequence was monitored at one timer or another.

If the values match the chart or if the concern is intermittent proceed as follows:

- Inspect the shifter cable for damage, kinks, bends and for a binding condition
- Check shifter cable adjustment
- Inspect the shift lever mechanism
- Inspect the rooster comb and detent assembly within the transmission
- Inspect the TCM calibration file for updates. An update was released for 2006-2007 applications for this concern. Install the calibration update.
- Replace the IMS. The IMS internal contacts were updated for this concern in March 2007. This update applies to 2006- 2007 models. Install the updated IMS.

Gear Position Selected	Scan Value	IMS Position	P/N Switch	PRNDL
PARK	L/H/H/L	PARK	P/N	PARK
PARK/REVERSE	L/L/H/L	-----	IN GEAR	BLANK
REVERSE	L/L/H/H	REVERSE	IN GEAR	REVERSE
REVERSE/NEUTRAL	H/L/H/L	-----	IN GEAR	BLANK
NEUTRAL	H/L/H/L	NEUTRAL	P/N	NEUTRAL
NEUTRAL/D6	H/L/L/H	-----	IN GEAR	BLANK
D6	H/L/L/H	D6	IN GEAR	DRIVE
D6/D4	L/L/L/H	-----	IN GEAR	BLANK
D4	L/L/L/L	D4	IN GEAR	MANUAL
D4/D3	L/H/L/L	-----	IN GEAR	BLANK
D3	L/H/L/H	D3	IN GEAR	D3
D3/D2	H/H/L/H	-----	IN GEAR	BLANK
D2	H/H/L/L	D2	IN GEAR	D2
INVALID	H/H/H/L	INVALID	IN GEAR	BLANK
INVALID	L/H/H/H	INVALID	IN GEAR	BLANK
INVALID	H/H/H/H	INVALID	IN GEAR	BLANK

6L50/80/90

P0751

SSI Solenoid Performance, Stuck Off

P0751 will set if:

- No DTCs P0716, P0717, P0722, P0723, P1915 or P1825 are set
- First gear is commanded.
- Commanded gear slip is equal to or less than 75 RPM for 2 seconds during decel or commanded gear is 1st and the gear ratio indicates 4th or slip exceeds 35 RPM for .5-1.05 seconds.

When in first gear engine braking, if first gear ratio is not achieved in a predetermined period of time and the closest gear ratio detected is fourth, the TCM commands second gear and if second gear ratio is attained this indicates a stuck OFF SS valve 1 and the DTC P0751 will set.

Several items may cause the P0751 to set. To diagnose the P0751 proceed as follows:

- Inspect the pan for excessive debris
- Inspect the filter for evidence of cracks or holes in the seams and seal area where air may leak in
- Remove the valve body and inspect the separator plate for debris and for proper check ball operation. Inspect the separator plate gasket for evidence of cross leaks
- Inspect the clutch select valve 2 bore plug in the valve body for proper size (11.502mm +/- .004 mm)
- Inspect the CBR1/C456 regulator valve for freedom of movement
- Check the TEHCM solenoid operation using the DT47825 as outlined in previous ATRA seminars.
- Check to see if an updated calibration is available to address the P0751 for your application. As outlined in previous ATRA seminars updated calibrations are available for 2006-07 applications that exhibit this concern
- Install the updated spacer plate designed to address this concern.

Models:

2007-08 MYD, 2008 MYB, MYC, #24245720

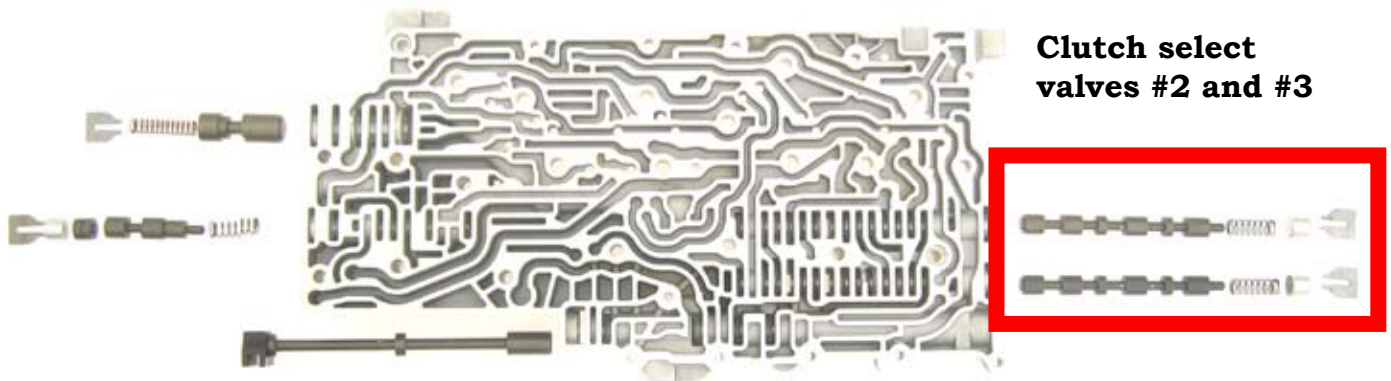
2006-07 MYC #24246916

2007 MYB #24246917

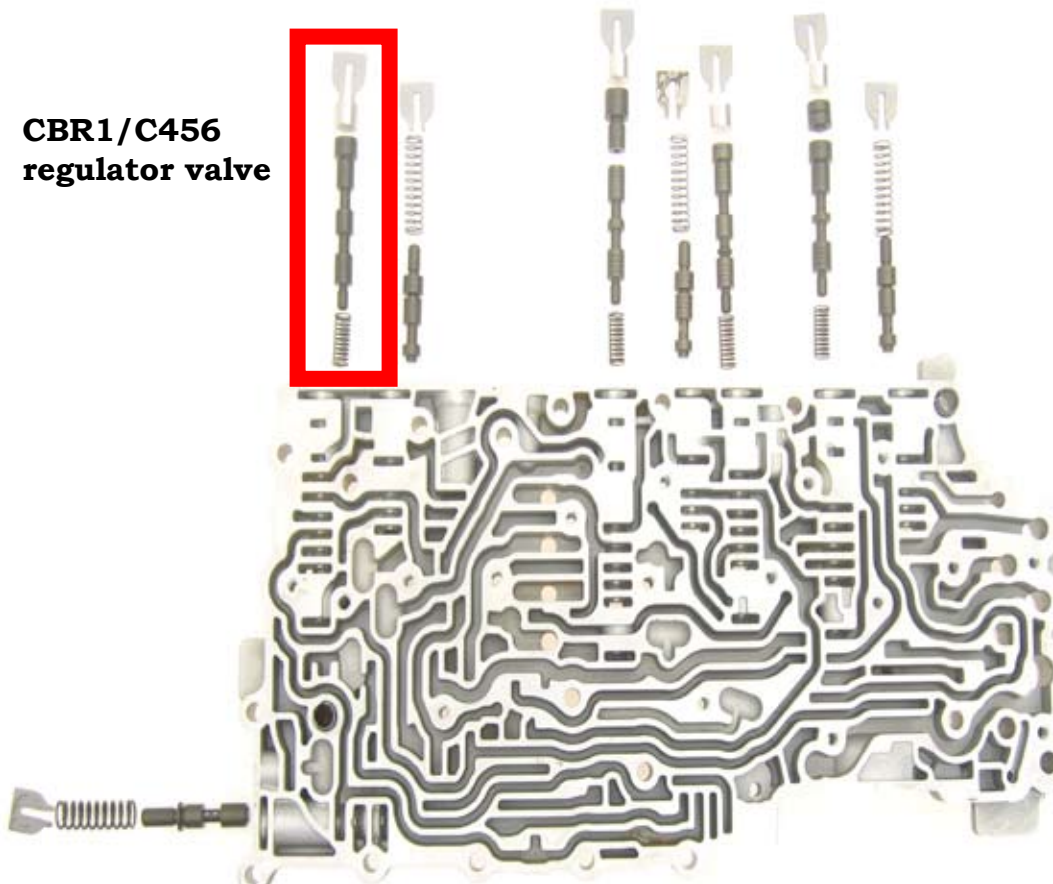
6L50/80/90

P075I (continued)

SSI Solenoid Performance, Stuck Off (continued)



CBR1/C456
regulator valve



6L80

2-3 Shift Concerns

1234/3-5 Reverse Clutch Pump Cover Seal Update

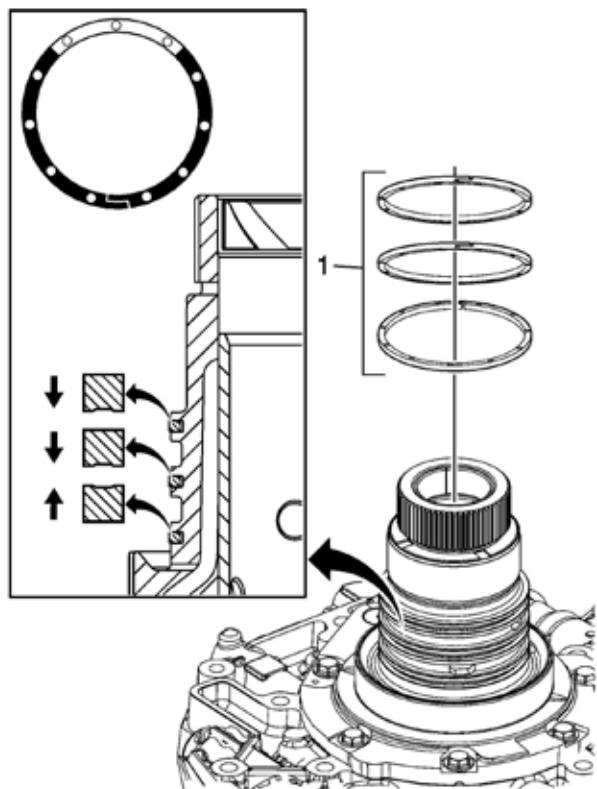
A major design change has occurred as a mid 2009, interim 2009 change. The update includes the grooves and seals that are located on the back of the pump cover. This update was designed to address 2-3 shift complaints.

A redesign to the pump cover seals and the addition of O-Ring type backup rings were added to mid production 2009 and later 6L80 applications. The new O-rings fit into updated grooves in the pump cover. The updated seals now utilize anti-rotational tabs. This updated seals design can only be used in the updated pump cover design.

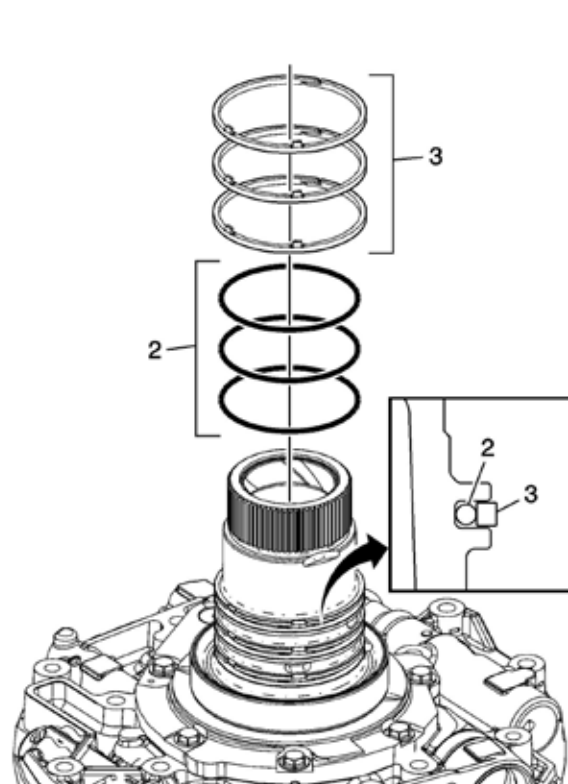
The seals will not back service unless the pump cover is also changed. Do not intermix seal and pump cover designs. The parts are available under the following part numbers:

- Seal kit for old design pump cover and seals # 2428581
- Seal kit for updated design pump cover with o-ring backup #24248559
- Updated pump cover and seal kit #24248573

2007-2008



2009-on



LCT 1000

Fluid Leaks from the Vent

Fluid leaks from the transmission vent when the vehicle is allowed to set overnight or for extended periods of time. This condition may get worse if the engine is allowed to idle for extended periods of time before being driven. This condition may also be more pronounced at ambient temperatures lower than 0°F (-18°C). This concern was prevalent on 2001-2003 applications.

Lube oil is not draining back into the sump properly. This leads to pressure build up in the case and pump.

A new vented dipstick has been released to address this concern. GM part #15115171 should be used.



This notch was added to help prevent pressure build up.

LCT 1000

Fluid Leaks from the Bell Housing Area

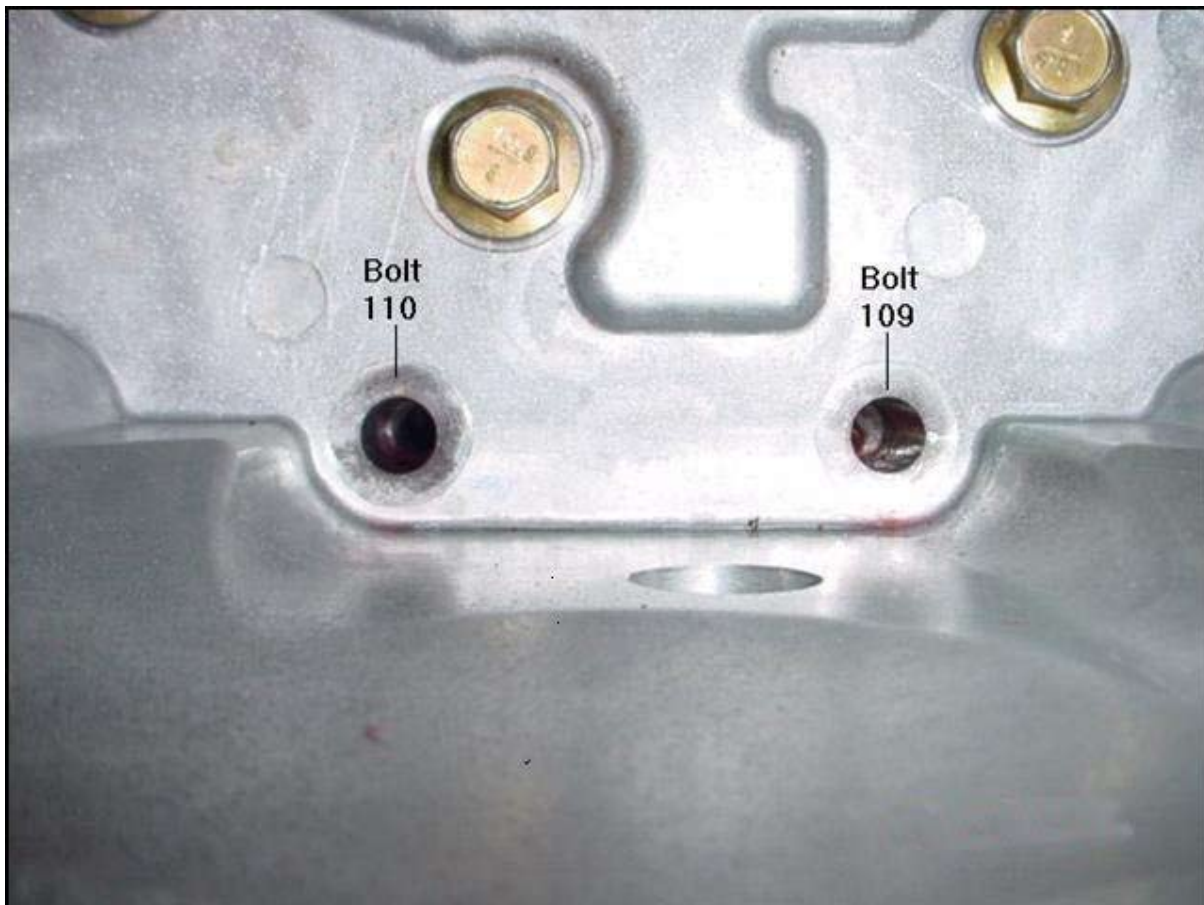
Fluid leaking from converter/bell housing area

Fluid may be leaking from two areas:

- Torque converter lugs as outline in previous ATRA seminars
- The lower bolts on the bell housing, bolt #109,110.

Inspect the area for the source of the leak

- Replace the converter if the leak is converter related
- Install sealer or copper washers on the bottom bell housing bolts



LCT 1000

P0872, P1711

Pressure Switch #3 Circuit

Some LCT 1000 applications may set a DTC P0872 and/or P1711. In many instances the DTC's may not have been set prior to transmission repair.

To set a P0872 or a P1711 the following must occur

P0872

- Engine speed greater than 200 but less than 7500 RPM
- Shift solenoid "E" is commanded into the "OFF" or un-stroked position while pressure switch E status remains ON for 2-20 seconds. The amount of time required to set the DTC depends on the transmission fluid temperature. At 0°C the timer is set at 2 seconds while the timer will increment to 20 seconds at -40°C.

P1711 (This DTC was not used on later model applications)

- Shift solenoid "E" is commanded from the "ON" position to the "OFF" position.
- Pressure switch E does not reflect the change in solenoid/shift valve position
- The amount of time required to set the DTC depends on the transmission fluid temperature. At 0°C the timer is set at 2 seconds while the timer will increment to 10.5 seconds at -40°C.

Several items can cause the DTC's to set they include:

- A crack in the 4WD adapter housing. This allows sand and debris to enter the transmission leading to the stuck shift valve
- Dirt or sand enters the transmission during service or overhaul
- Faulty pressure switch manifold or wiring
- Faulty shift solenoid "E"
- Shift valve bore or shift valve are worn or stuck (Check C and E shift valves/bores). Inspect C shift valve for cross leaks into E shift valve circuit.
- Improper Valve Body torquing

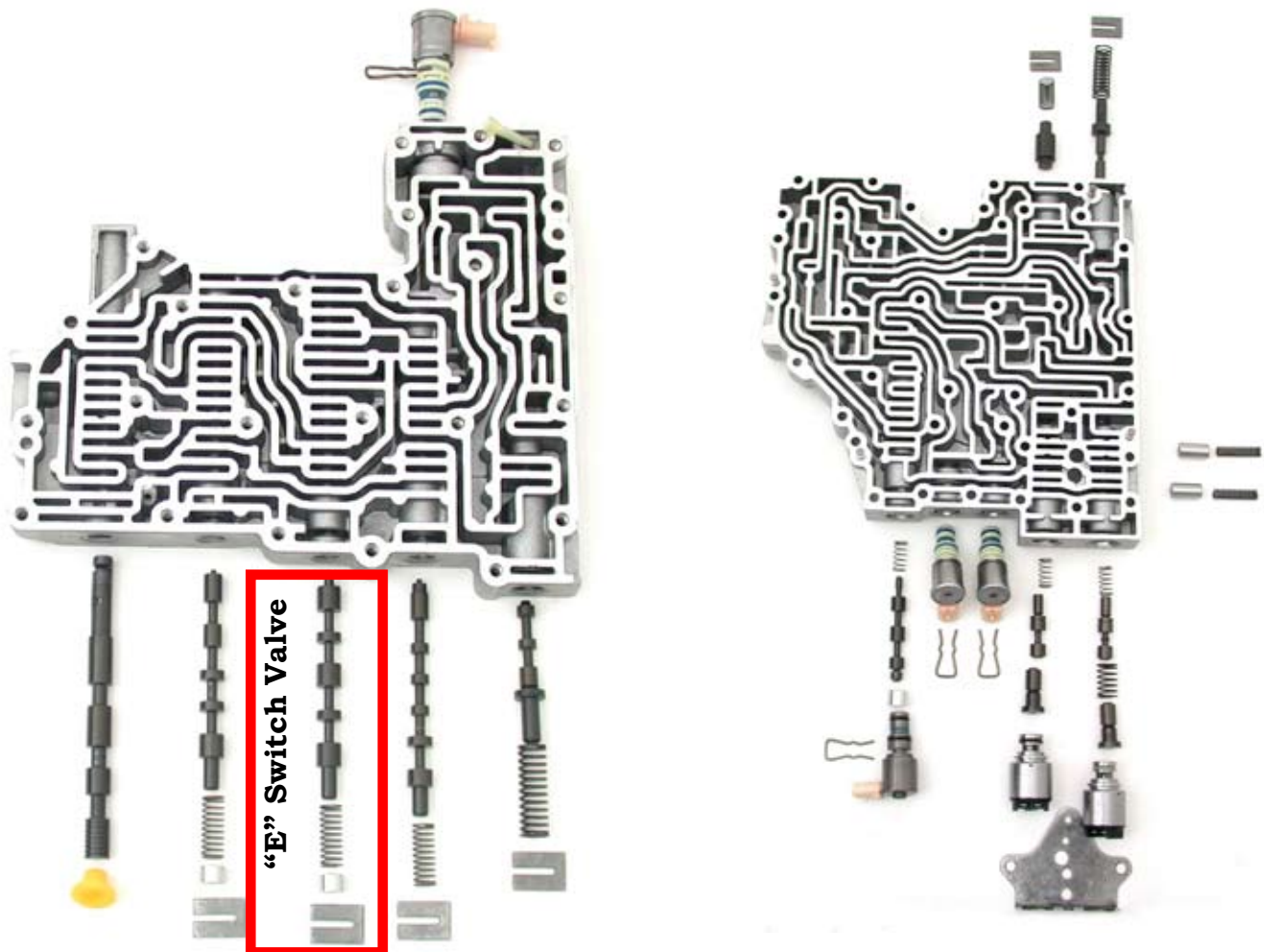
LCT 1000

P0872, P1711 (continued)

Pressure Switch #3 Circuit (continued)

Repair:

- Replace the 4WD adapter housing if cracked. Diagnosis and repair for this concern was covered in earlier ATRA seminars
- Replace the fluid/filters and flush the cooler lines
- With your scan tool, monitor the pressure switch manifold (TFP) switch status. With the key ON engine OFF TFP switches "C,D, and E" should read OFF. Start the engine TFP switches "C, D and E" should read ON. If the switches read as indicated the TFP and its wiring are functioning properly. Operate the vehicle in 1st gear, steady state, TFP switch "C" should read OFF and TFP switch "D" should read ON. TFP switch "E" should change to OFF. If it does not change when steady state 1st gear is achieved inspect shift valve E for being stuck, shift solenoid E for proper operation and shift valve C for a cross leak into shift valve E condition.



LCT 1000

Shift Concerns, Erratic Operation

Some LCT 1000 and 2000 series may experience problems with mainline pressure not operating as designed. As covered in the 2005 ATRA seminar a modulated main line solenoid (Solenoid G) was added to the transmission for the 2004 model year.

Some transmissions may experience a condition that can cause solenoid G function improperly or not to function at all, without setting a DTC. This may result in shift feel concerns. The problem may vary in intensity based on:

- System Voltage
- Temperature
- TCM build variations
- Solenoid build variations

Inspect the TCM calibration level. Calibrations that were created between March 2006 and September 2007 (CC level 44 or 48) could indicate that solenoid G is being commanded to respond correctly to load, but in fact the main line pressure is not following the command. This may indicate a possible problem with the calibration software. It has been found that the TCM may lack the proper “Pull In” solenoid driver current to properly operate solenoid G.

Verify the base line pressure as well as pressure boost.

Specifications:

- G solenoid On = 85 to 105 psi (590 – 720 kpa)
- G solenoid Off = 105 to 220 psi (721 – 1480 kpa)



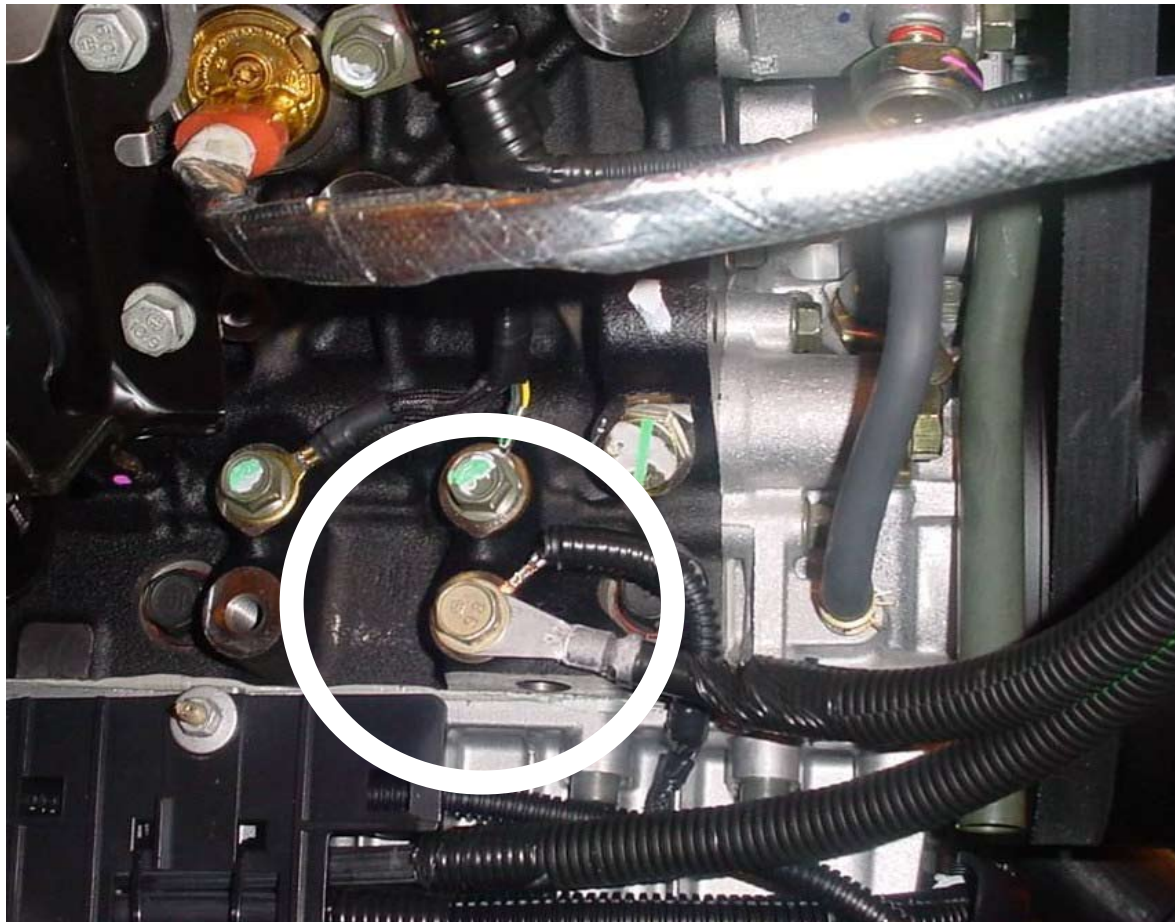
If the line pressure does not vary (Locked High) with No DTC's set, inspect the calibration level. Recalibrate the TCM as necessary. Install a new TCM if you are unable to repair the fixed high line pressure concern with a calibration update.

LCT 1000

Multiple DTC's, Erratic Operation, Bad TCM

The LCT 1000 TCM may exhibit various DTC's and/or operational symptoms (neutral only, shifting, shift feel, erratic operation). This may include non transmission symptoms such as speedometer operation that is intermittent, Drivability concerns and/or Communication concerns.

As discussed in several ATRA seminars in the past, proper ground for the TCM is imperative. In this instance you may diagnose the cause of the concern as a faulty TCM. Before replacing ANY TCM always clean and secure the controller grounds. Bad grounds on the Allison application can cause controller circuit board failure. Solder joint failure on the circuit board have been traced back to a faulty ground on many TCM's returned for warranty or as cores.



LCT 1000

Neutrals while Driving, No Reverse, P0877, P2723

Some LCT 1000 and 2000 series transmission may exhibit any/all the following conditions:

- Intermittent or No Reverse operation
- Possible P0877 and/or P2723 set
- Problem may have occurred after a transmission service

P0877 will set if:

- Battery voltage is between 9-18 Volts
- The engine is running
- TFT is greater than 32°F (0°C)

P0708 or P0878 are not set

- Park/Neutral or a forward range is selected
- Pressure switch #4 (PS4) remains ON (Closed mechanically or Electrically ON) for more than 1 second

P2723 will set if:

- Battery voltage is between 9-18 volts
- Turbine speed exceeds 60 RPM
- Output speed is greater than 125 RPM
- TFT is greater than 32°F (0°C)
- Ratio calculation indicates the oncoming clutch that is commanded at the time has failed to fully apply. This indicates the clutch that is being controlled by Pressure control solenoid 1 (PCS1) may be stuck off.
- P0716, P0717, P0721, P0722, P0877, P0878 are not set

If a P0877 or P2723 are set the TCM will:

- Freeze the shift adapts
- Inhibit TCC
- Illuminate the MIL
- Default to Neutral after the shifter has been moved if other parameters are met (Forward gears possible until the parameters are met)
- Default to Neutral (No reverse) after the shifter has been moved

LCT 1000

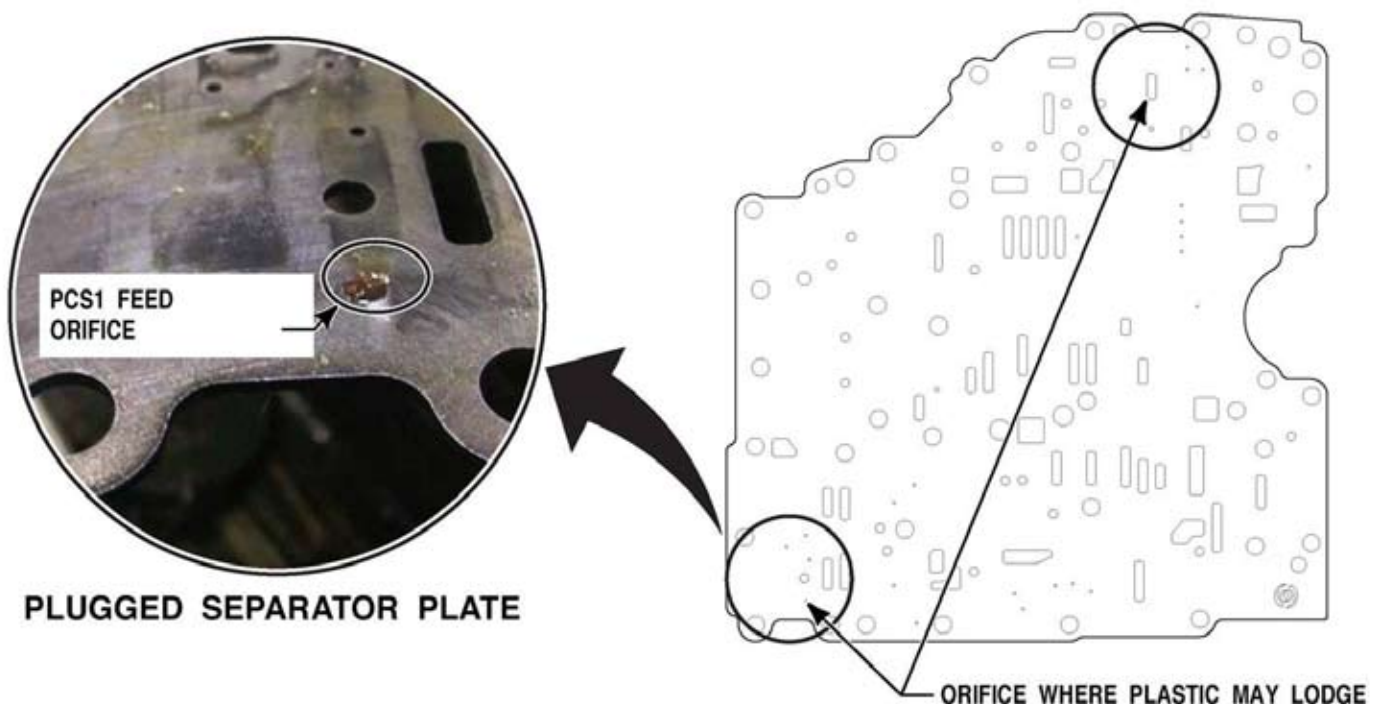
Neutrals while Driving, No Reverse, P0877, P2723 (continued)

The root cause of this problem may be the PCS #1 feed orifice in the spacer plate may be plugged. This has been noted when aftermarket spin on filters have been used. Some filters are wrapped in plastic shrink wrap.

When the filters are wrapped by the equipment at the manufacture, the machine melts the ends of the wrap together. In some cases pieces of plastic will drop into the filter. Another cause for this concern is the technician unwrapping the filter. In many cases the technician will poke his/her finger through the plastic and into the hole in the filter. Pieces of plastic can drop into the filter which may lead to the concern.

If you suspect this may be the cause for your concern, inspect the spacer plate orifices for contamination. To avoid this concern consider using a filter that is not wrapped in plastic or check for plastic remnants prior to installing a new filter.

In addition, avoid poking holes in the plastic over the open end of the filter. Allison filter # 29539579



LCT 1000

P0658, P2670, Transmission Stuck in Neutral, No Reverse

Some LCT 1000 applications may set a P0658 and/or a P2670 DTC.

The TCM provides voltage to the shift solenoids via a pair of High Side Drivers (HSD)

The HSD has current limiting protection as well a diagnostic routine which is used to set the following DTC's, P0658, P0659 (HSD1), and P2670, P2672 (HSD2). HSD2 controls the voltage for SS1, SS2 and SS3. HSD1 controls the voltage for the modulated main solenoid (G solenoid) PCS1 and the TCC solenoid.

P0658 will set if:

- The High Side Driver #1 (HSD1) is commanded ON
- Battery Voltage is between 9-18 volts
- The engine is running
- The TCM detects that the HSD1 voltage is LESS than 6 volts for more than 75 ms (Indicates a short to Ground)

If a P0658 sets the TCM will:

- Command the transmission to Neutral or 3rd gear after the shift selector is moved and other conditions are present
- Inhibit TCC
- Illuminate the MIL

P2670 will set if:

- The High Side Driver #2 (HSD2) is commanded ON
- Battery Voltage is between 9-18 volts
- The engine is running
- The TCM detects that the HSD2 voltage is LESS than 6 volts for more than 75 ms (Indicates a short to Ground)

If a P2670 is set the TCM will:

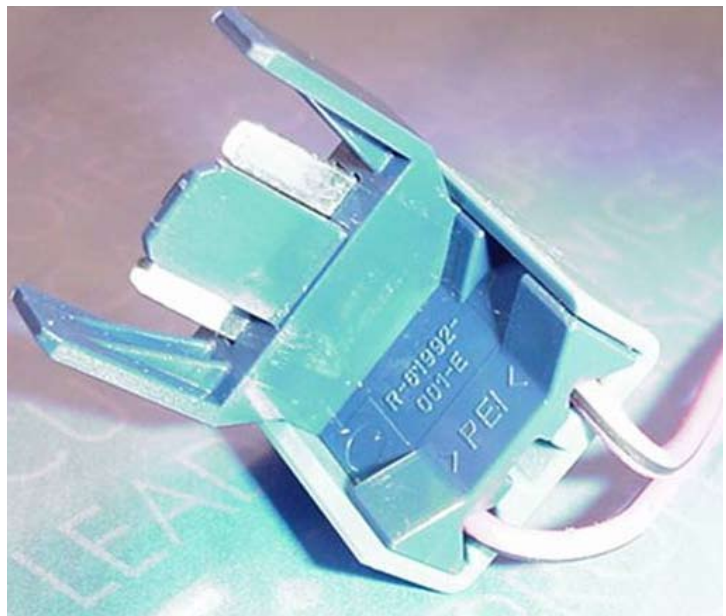
- Command the transmission to neutral after the shift selector is moved and other conditions are present
- Inhibit modulated main operation
- Freeze adapts
- Inhibit TCC
- Illuminate the MIL

LCT 1000

P0658, P2670, Transmission Stuck in Neutral, No Reverse (continued)

The most common cause of these DTC's is metal contamination. One source of the contamination is the Torrington bearing (T3 bearing) on the P1 sun gear. The bearing fails due to sun gear machining issues leading to metal contamination. The contamination may bridge the solenoid terminal to ground on the solenoid frame leading to the DTC. Inspect the solenoid electrical terminals for metal particulate.

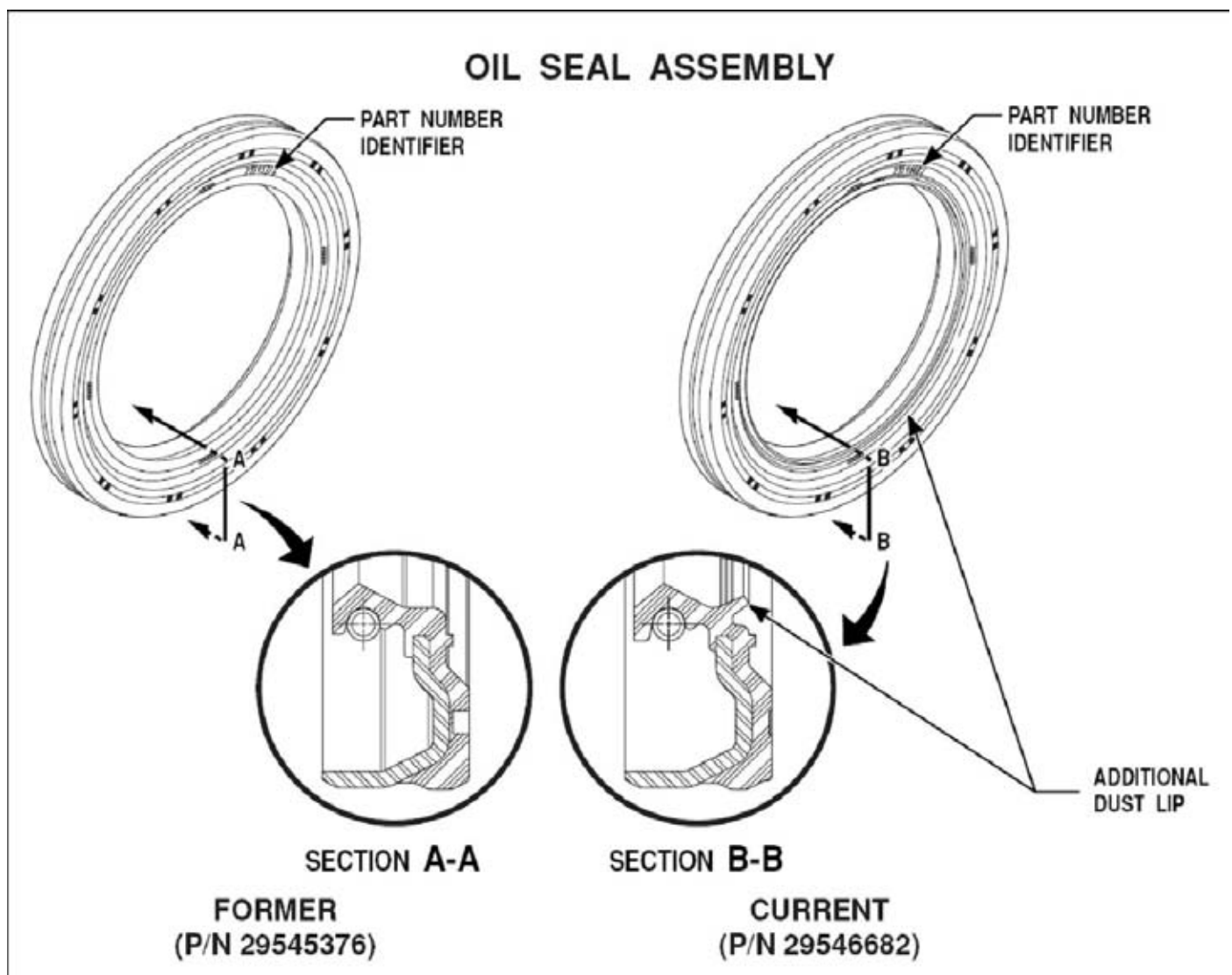
If you find metal, locate the source of the contamination. In addition you should consider updating the internal wiring harness. The updated harness has particulate dams built into the solenoid connectors to prevent bridging concerns from happening. The updated harness part number remained the same as the previous harness.



LCT 1000

Pump Seal

The pump seal was updated on all LCT 1000 and 2000 applications starting with serial number 6310831532 transmissions. The updated seal includes an additional dust lip to prevent foreign material from getting into the interior lip of the seal. The updated seal is coated with a dry wax for protection. The seal is available under part number 29546682 and will back service earlier applications.



LCT 1000

T1, T2, T3 and T6 Torrington Bearing

Starting with mid 2008 models the T1,T2, T3 and T6 Torrington bearings were updated for durability reasons. The updated “hardened race” bearings can be identified by the “BLUE” stripe on the bearing race. The following part numbers are for the updated bearings

T1 & T6	29539501
T2	29531090
T3	29531095



LCT 1000

DTC'S for 2009 Model Year

Six new trouble codes were added for the 2009 model year. As with other DTC's they are application specific.

The following DTC's were added:

P0897: Transmission Fluid Deteriorated

P088B: Transmission Fluid Very Deteriorated

P2789: Maximum Adaptive Pressure Limit Reached

P0657: Actuator Supply Voltage 1 Open (Modulated Main High Side Driver 1)

P2669: Actuator Supply Voltage 2 Open (SS1, SS2 SS3, PCS2 High Side Driver 2)

P2772: 4WD Low Switch Performance Problem

SUPERIOR's New Bench Buddy™ & Accumulator Buddy™ May be the Best Friends Transmission Builders Ever Had

Remove Small Burrs and Polish Bores – FAST!

Save time and money with the latest patent pending Simple Solutions from Superior Transmission Parts. Impregnated with a special super fine abrasive, Bench Buddy™ and Accumulator Buddy™ brushes easily remove small burrs and polish the inside of a valve/accumulator bore with virtually no enlargement of the bore diameter itself.

- Improves the surface finish of a bore by up to 50%
- Restore smooth valve operation in seconds
- Services bores from a 1/4" to 2"

With these brushes you can use valve bodies and accumulator bores that in the past may have been questionable. No workbench should be without the New Bench Buddy™ or Accumulator Buddy™.

NOW AVAILABLE

The New Superior 4F27E Kit!

This shift correction package features new 1-2 and neutral/drive accumulator pistons with sealing rings and a new patent pending Accumulator Buddy™ brush to smooth out the case accumulator bores.



Works on 4F27E Ford, FN4A-EL Mazda and J39A Export Vehicles.

PART # K4F27E



▲ PART # AB100
Covers bore sizes
from 1" to 2"

▲ PART # BB100
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- J2534 Compatible - can Reprogram GM, Ford, Chrysler & Toyota controllers - with ONE INTERFACE
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- Updates are inexpensive, and a breeze with reprogrammable hardware



Don't Miss Out!!

Over 100 million cars on the road today support Flash Reprogramming. Auto Manufacturers are constantly updating controller software to solve problems such as false DTCs, hesitation, rough idle, emissions problems, hard starting, poor fuel economy and others. These problems plague many 5 to 8 year old cars that are no longer under warranty. Your competitors are making thousands of dollars repairing these cars by Flash Reprogramming. You should be too!!

Vehicles Supported *

General Motors and Saturn

On-Board Programming (In Vehicle):

- 1993 and newer GM Powertrain/Body/Chassis flash reprogrammable controllers
- 1996 and newer Saturn Powertrain/Body/Chassis flash reprogrammable controllers

Off-Board Programming:

- 1993 and newer GM Powertrain flash reprogrammable controllers
- 1996 and newer Saturn Powertrain flash reprogrammable controllers

Ford, Lincoln and Mercury

On-Board Programming (In Vehicle):

- 1996 and newer Powertrain/Body/Chassis flash reprogrammable controllers

Off-Board Programming:

- 1996 and newer Powertrain flash reprogrammable controllers

Chrysler, Dodge, Plymouth and Jeep

On-Board Programming (In Vehicle):

- 1996 and newer Powertrain flash reprogrammable controllers

Off-Board Programming:

- 1996 and newer Powertrain flash reprogrammable controllers

Toyota, Scion and Lexus

On-Board Programming (In Vehicle):

- 2001 and newer Powertrain flash reprogrammable controllers

*Hardware supports listed vehicles.
Manufacturer Reprogramming
Data Subscription(s) Required.



WHAT DO YOU NEED TO GET STARTED?

J2534-ON-KIT-A-C



J2534 On-Board Reprogramming Kit - Cabled

This kit allows you to reprogram controllers in the vehicle.
OEM data subscriptions not included.

Includes:

- Universal Reprogrammer Unit- Cabled
- EASE Flash Wizard
- OBD II Cables
- GM OBD I Cable
- Power Transformer
- Cigarette Plug Power Cable
- USB Cable
- Carrying Case

Go Wireless! The J2534 On-Board Reprogramming Kit Package above can be ordered with a Wireless Universal Reprogrammer Unit in place of the Cabled Universal Reprogrammer Unit.

Order: **J2534-ON-KIT-A-W** J2534 On-Board Reprogramming Kit - Wireless

- ADD-ONS -

J2534-GFC-CBL-PT

GM, Ford & Chrysler Powertrain Off-Board Cable Set (11 Cables)

These cables allow you to reprogram most GM, Ford and Chrysler controllers out of the vehicle.

Requires: J2534-ON-KIT-A-C or J2534-ON-KIT-A-W

Includes: GM Powertrain Off-board Cable Set (7 cables); Ford Powertrain Off-board Cable (1 cable); Chrysler Powertrain Off-board Cables (3 cables)



J2534-GFC-CBL-R

GM, Ford & Chrysler Powertrain Advanced Universal Off-Board Cable Set (6 Cables)

EASE developed a set of Advanced "Universal" off-board cables that can be connected to virtually any GM, Ford and Chrysler PCM that can be reflashed. These Universal cables require you to manually connect to the PCM pins, however, detailed wiring diagrams are included to show you how to do this in the EASE Flash Wizard software.

Requires: J2534-ON-KIT-A-C or J2534-ON-KIT-A-W

Includes: GM Powertrain Advanced Universal Off-board Cables (3 cables); Ford Powertrain Advanced Universal Off-board Cable (1 cable); Chrysler Powertrain Advanced Universal Off-board Cables (2 cables)

System Requirements

To ensure maximum performance and proper operation, a PC is needed with the following minimum requirements:
Windows 2000, XP or Vista, Pentium III 600 MHz processor, 256 MB RAM, 20 GB HDD, 16X CD-ROM drive, two unused USB ports, 1024 x 768 256 Color Graphics Card, Internet Connectivity, Email Account

Contact Bob Sorenson
(507) 359-1197

or

Email

barefootbob@myclearwave.net

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Ford



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6F50

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ALL Ford's

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A better way of shifting gears. SM

Valve Body Kits

Easy to Install - Low Cost - Great Results

Fix Code 1870 Fast

RT™ 4L60E

Improves: Shift firmness - **Fix** TCC Slip Code 1870 - Eliminates the need to replace TCC Regulator and Isolator valves - No reaming. Restores pressure regulator booster valve function. Includes **"Booster Recovery System™"** Patent Pending Eliminates the need to replace TCC PWM solenoid due to sticky valve. TCC will have full apply even if solenoid has failed - saves \$\$.

Adjust 1-2 shift firmness without removing VB.

For **Hot Rods** use kit # **RT-4L60E-HD**
Includes Pan and Valve Body Gaskets.



Provides 20% more torque for Lockup.
Has parts that stabilize line pressure reducing TCC shudder, booster valve wear and bump 1-2 shift.



RT™ AX4S

Also fits
AXODE

Both kits include a bypass
booster valve sleeve assembly
and the **Patent Pending**
"Booster Recovery System™"
restoring pressure regulator
valve function.
Improve shift firmness.
Billet retainers your gonna love!



RT™ 4F50N

Also fits
AX4N



RT™ E40D/4R Kit fits E40D and 4R100

Comes with 3 high tech
regulator valves for the
"stick free" accumulator
body. Improves TCC
torque capacity. Provides
adjustable shift firmness.



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Product Highlight...

Product Highlight...

AW55-50 Valve Body

What is the valve body called?

The transaxle is manufactured by Asian Warner but is used by many car makers.

Volvo calls it an **AW55-50**, Nissan & Infinity call it an **RE5F22A**,

GM (Chevy, Saab, Saturn & Pontiac) calls it an **AF33-5**.

What do we do to our AW55-50 Valve Bodies?

Install **Sonnax** updates including the oversized pressure regulator valve & boost valve assembly. Seal leaking end plugs, increase lube volume & flat sand entire valve body to eliminate cross leaks. Vacuum test known wear areas that don't have current fixes to assure worn valve bodies are weeded out.

Flush & test all solenoids, fully test the valve body & adjust the SLS, SLT & TCC solenoids.

What if the transmission has shift concerns?

Each manufacturer has their own shift adapt relearn procedures & they are posted on our web site.

Our product support department is ready and available to help.

How do I identify the valve body?

Look for a letter that is cast into the valve body to the right of the S4 solenoid hold down bolt.

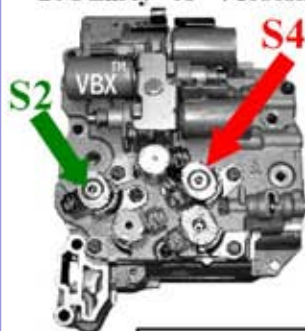
"No Letter/Blank Space" & valve bodies cast with a letter **"A"** are considered **early**.

Valve bodies cast with a letter **"B"** or **"C"** are considered **late**.

Nissan, Infinity & Volvo use one shift solenoid configuration.. Others use a different configuration. If vehicle type is not known, ask customer to describe the S2 solenoid. A domed top on the S2 is a GM.

A flat top with four ribs radiating from the hole in the center of the S2 is a Nissan/Volvo.

GM Early "A" Version



GM Late "B" Version



Volvo Early "No Letter" Version



Volvo Late "B" Version



Transtar #	VBX #	Casting	Vehicle Type
P89740-1	AW55GE	None or A	GM/Saab/Saturn Early
P89740-2	AW55GL	B or C	GM/Saab/Saturn Late
P89740-3	AW55VE	None or A	Volvo/Nissan Early
P89740-4	AW55VL	B or C	Volvo/Nissan Late

AWF-21B

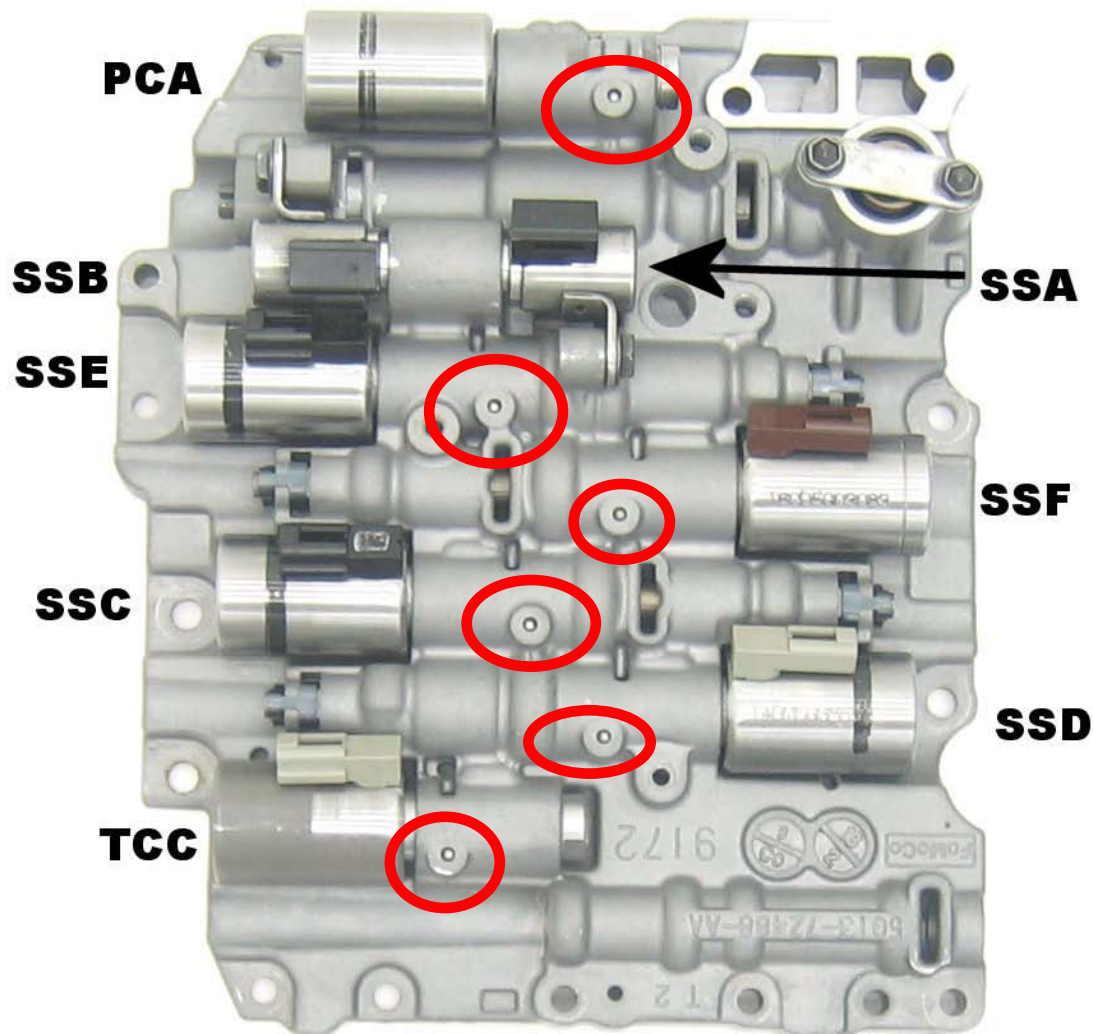
Solenoid Identification and Locations

The Solenoid identifications and locations are important. If the Solenoids are installed into the wrong location, shifting problems, codes, and ratio error will occur.

- SSA and SSB = 11-15 ohms
- SSC, SSD, SSE, TCC and PCA = 5-7 ohms

CAUTION: There are “keepers” throughout this valve body. Pay close attention to your disassembly process and use the following pages for reference. If a pin is lost during your rebuild, a replacement can be made using a needle bearing.

Pin Measurement size 0.932 x 0.118

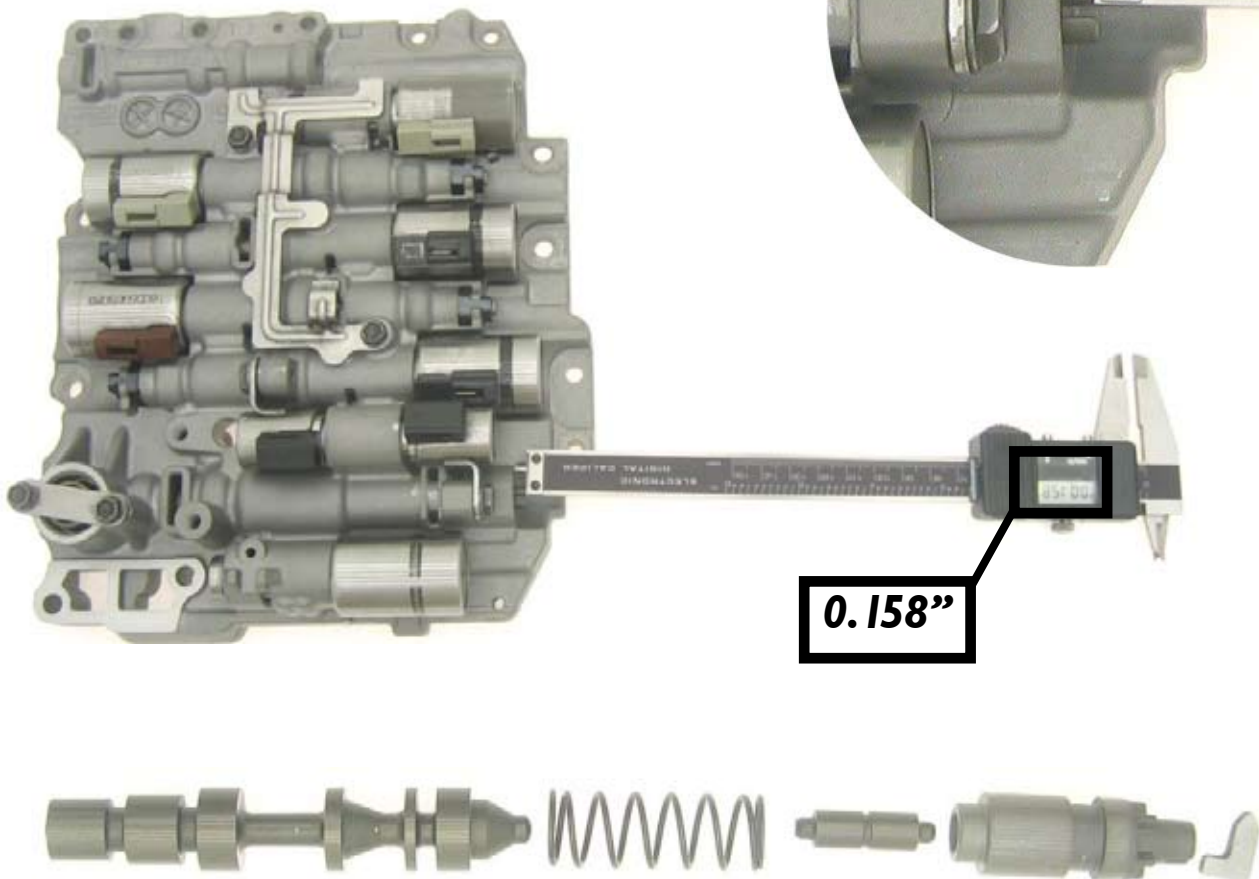


AWF-21B

Pressure Regulator Valve Adjustment

This pressure regulator valve has a stepped sleeve. Always measure the distance from the tip of the sleeve to the valve body for proper installation.

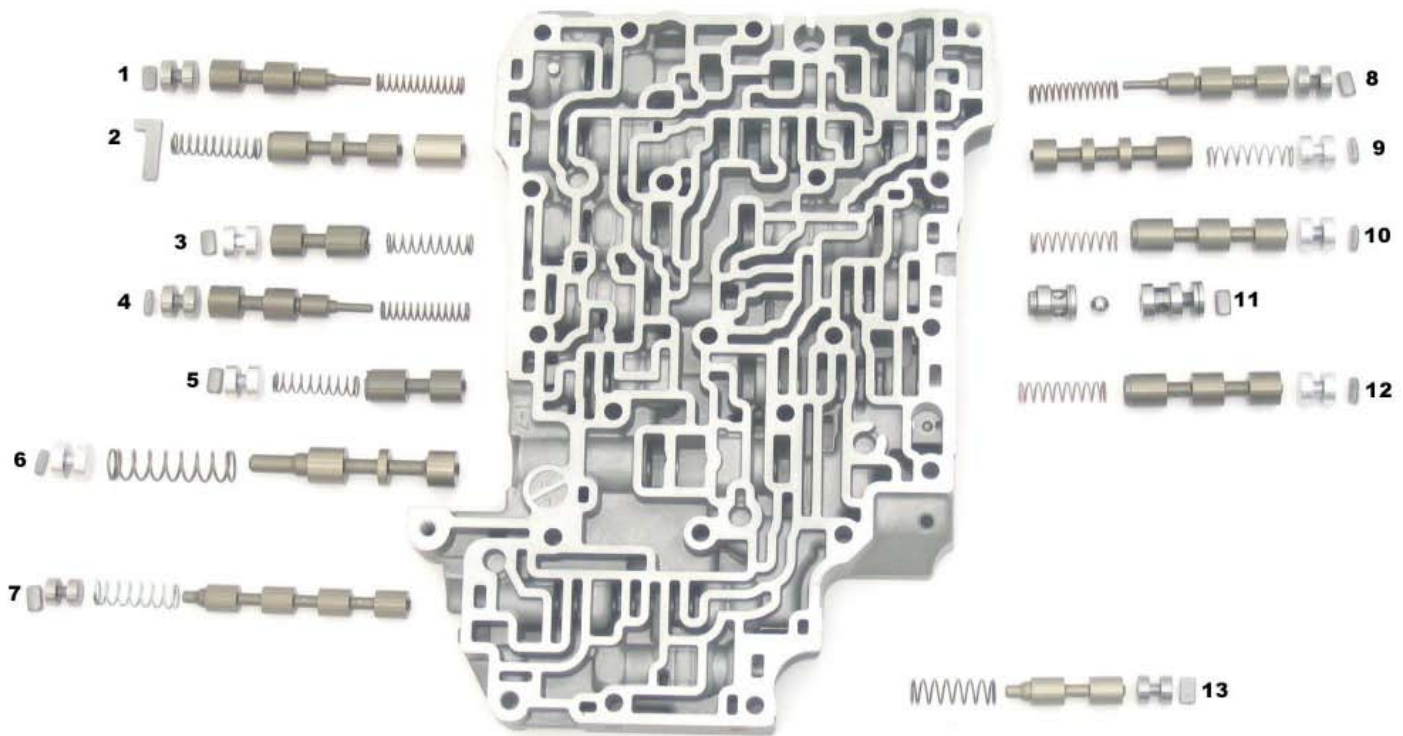
Always measure the distance from the tip of the sleeve to the valve body for proper installation.



AWF-21B

Upper Valve Body Valve Description

Use the following illustrations for reference during your rebuild.

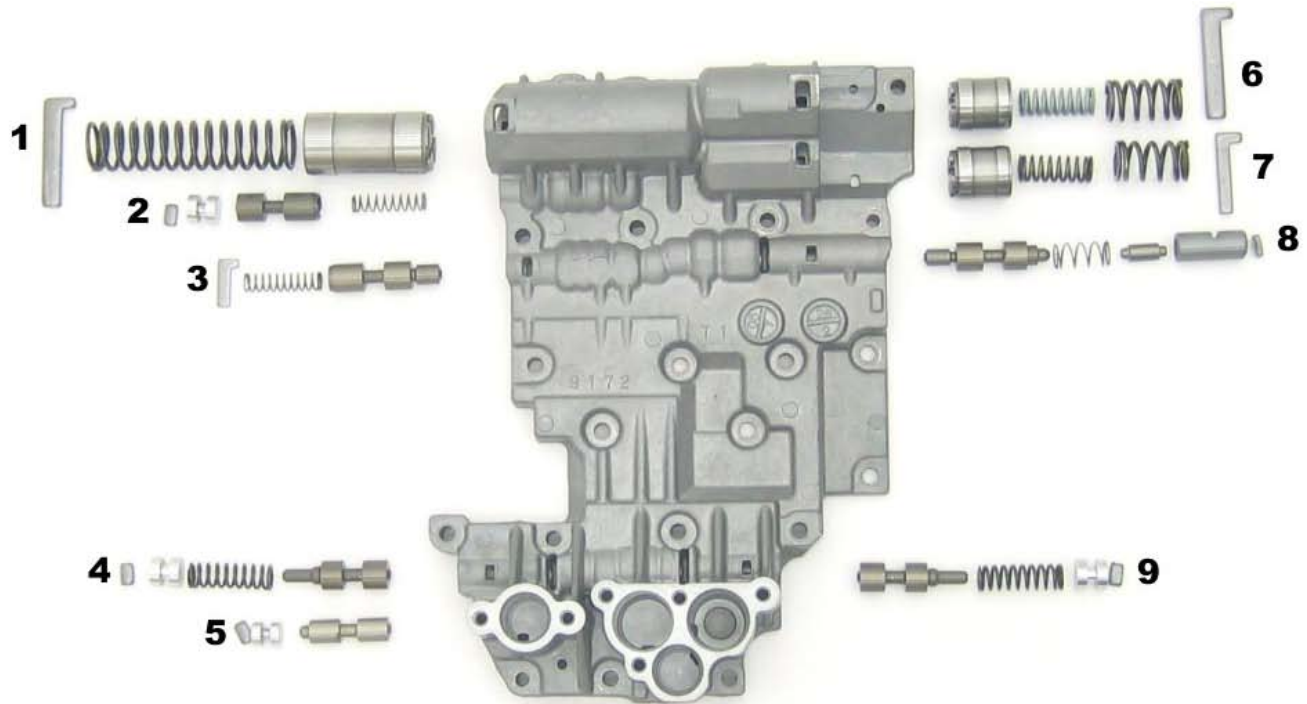


1. **Blank**
2. **C2 Control Valve**
3. **Blank**
4. **Blank**
5. **Blank**
6. **Secondary Regulator Valve**
7. **B2 Control Valve**
8. **Blank**
9. **Lock-Up Control Valve**
10. **C1 Control Valve**
11. **Blank**
12. **Servo Control Valve**
13. **PCA Regulator Valve**

AWF-21B

Lower Valve Body Valve Description

Use the following illustrations for reference during your rebuild.



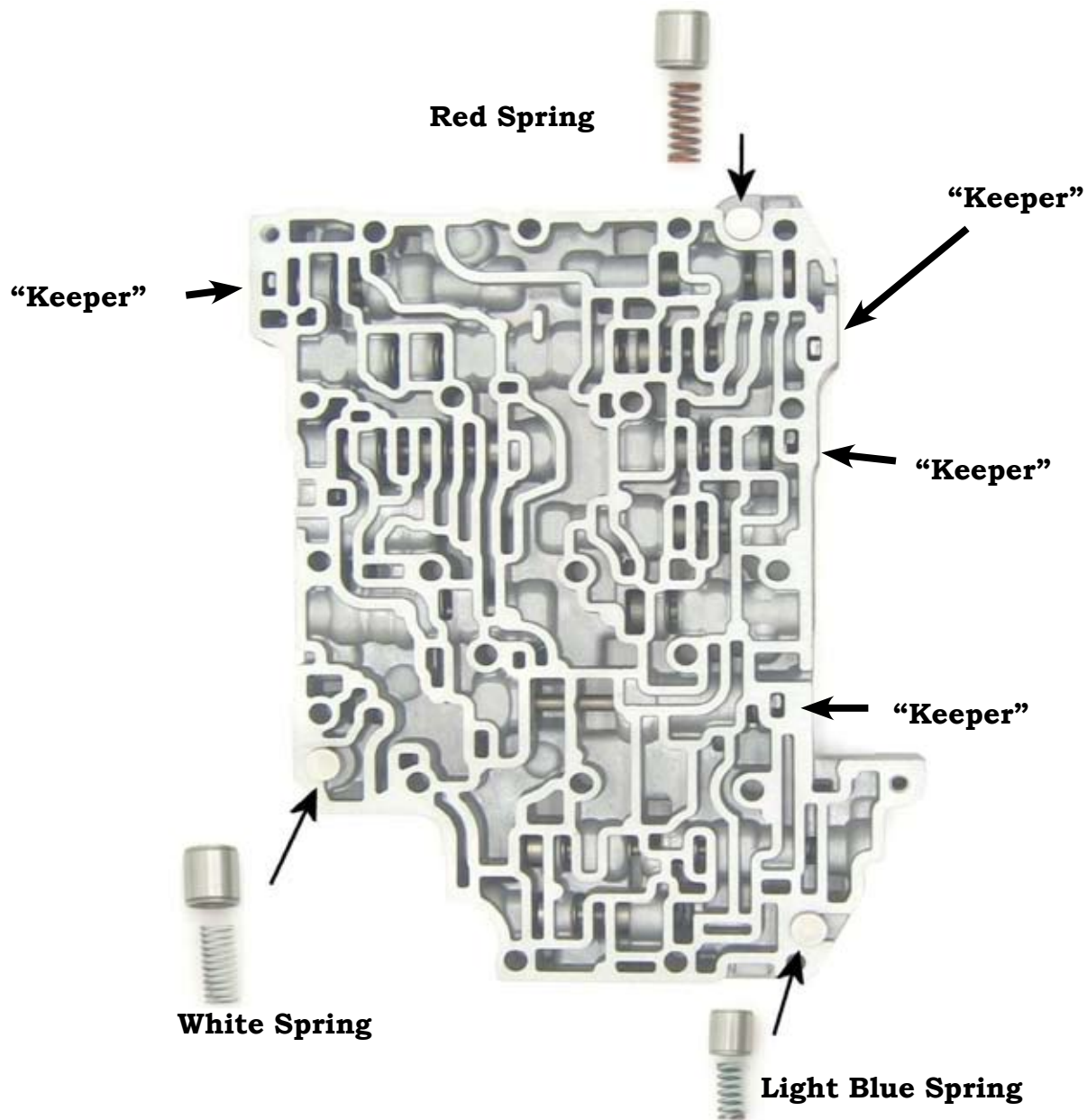
1. Blank
2. Blank
3. Blank
4. Solenoid Regulator Valve
5. Blank
6. Blank
7. Blank
8. Torque Converter Regulator Valve
9. Solenoid Regulator Valve

AWF-21B

Middle Valve Body

Check Valve and Spring Locations ‘Upper Side’

Use the following illustrations for reference during your rebuild.

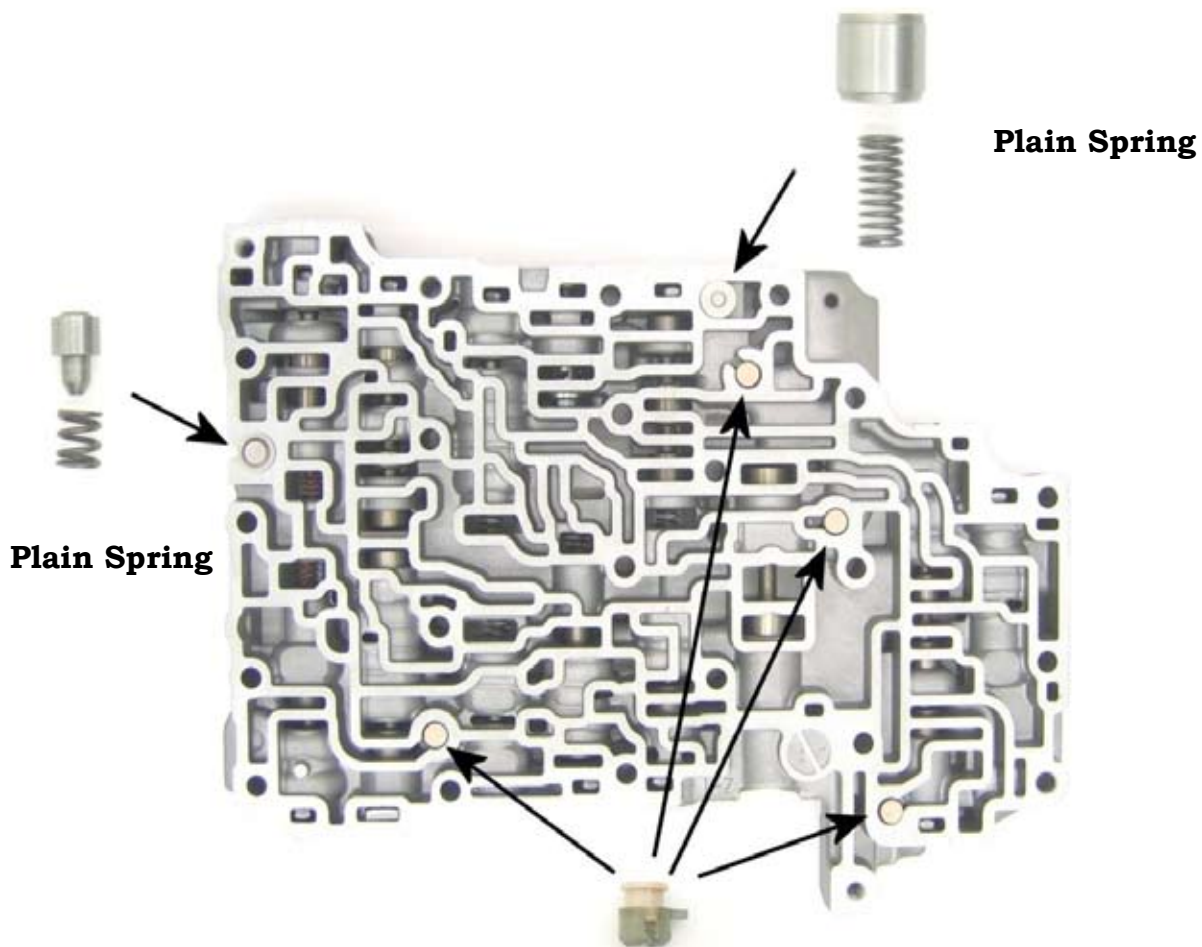


AWF-21B

Middle Valve Body (continued)

Check Valve and Spring Locations 'Lower Side'

Use the following illustrations for reference during your rebuild.

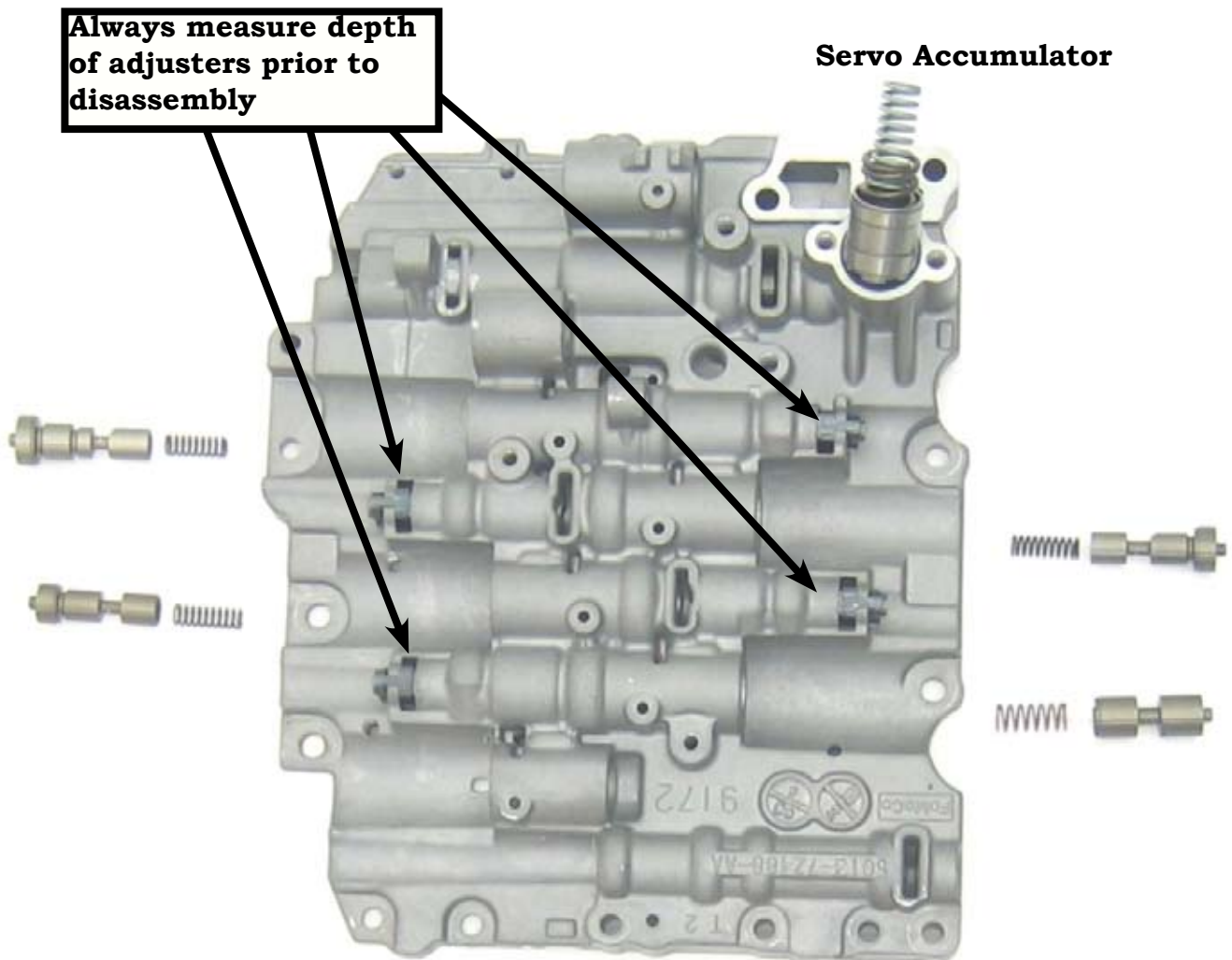


The accumulator check valves are installed with the blue side facing down into the valve body slot.

AWF-21B

Upper Valve Body Top Side

There are no manufacturer specifications for the spring tensioner depths. There are four (4) different valves with this type of layout. Always measure the depth of the tension adjusters prior to disassembly.

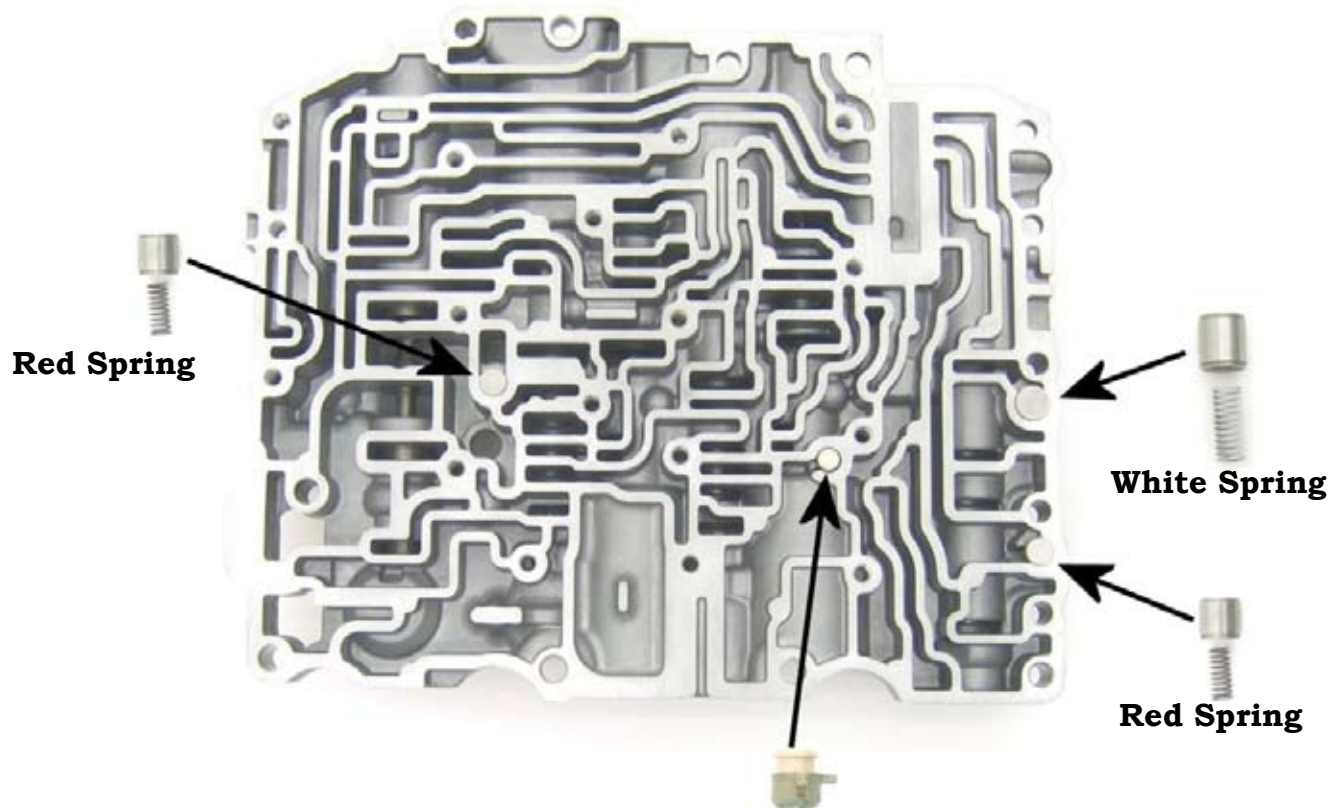


AWF-21B

Upper Valve Body

Check Valve Locations

Use the following illustration for check valves with spring and piston locations. New check valves come in the rebuild kit and should be replaced with every rebuild.



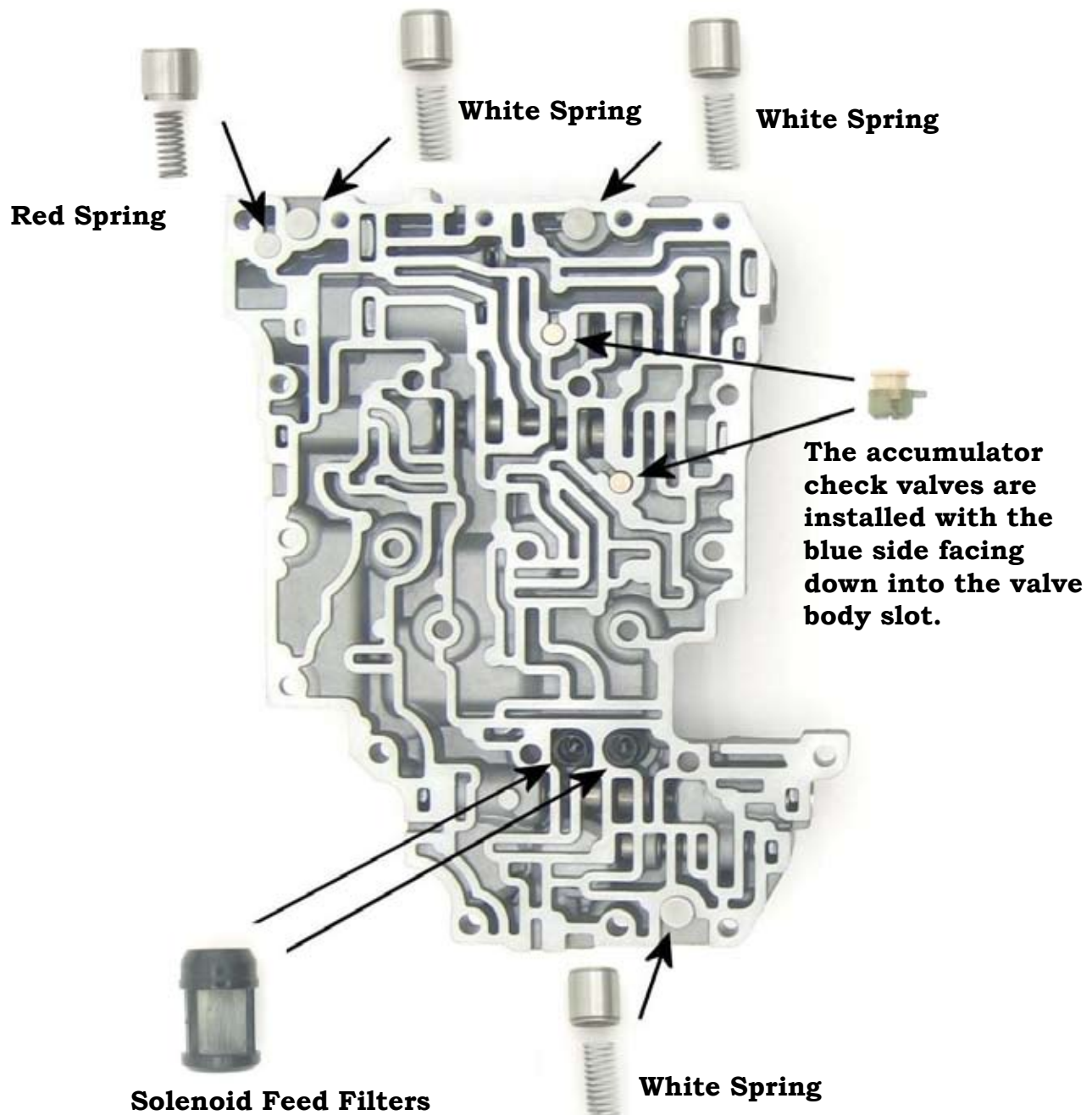
The accumulator check valves are installed with the blue side facing down into the valve body slot.

AWF-21B

Lower Valve Body

Check Valve Locations

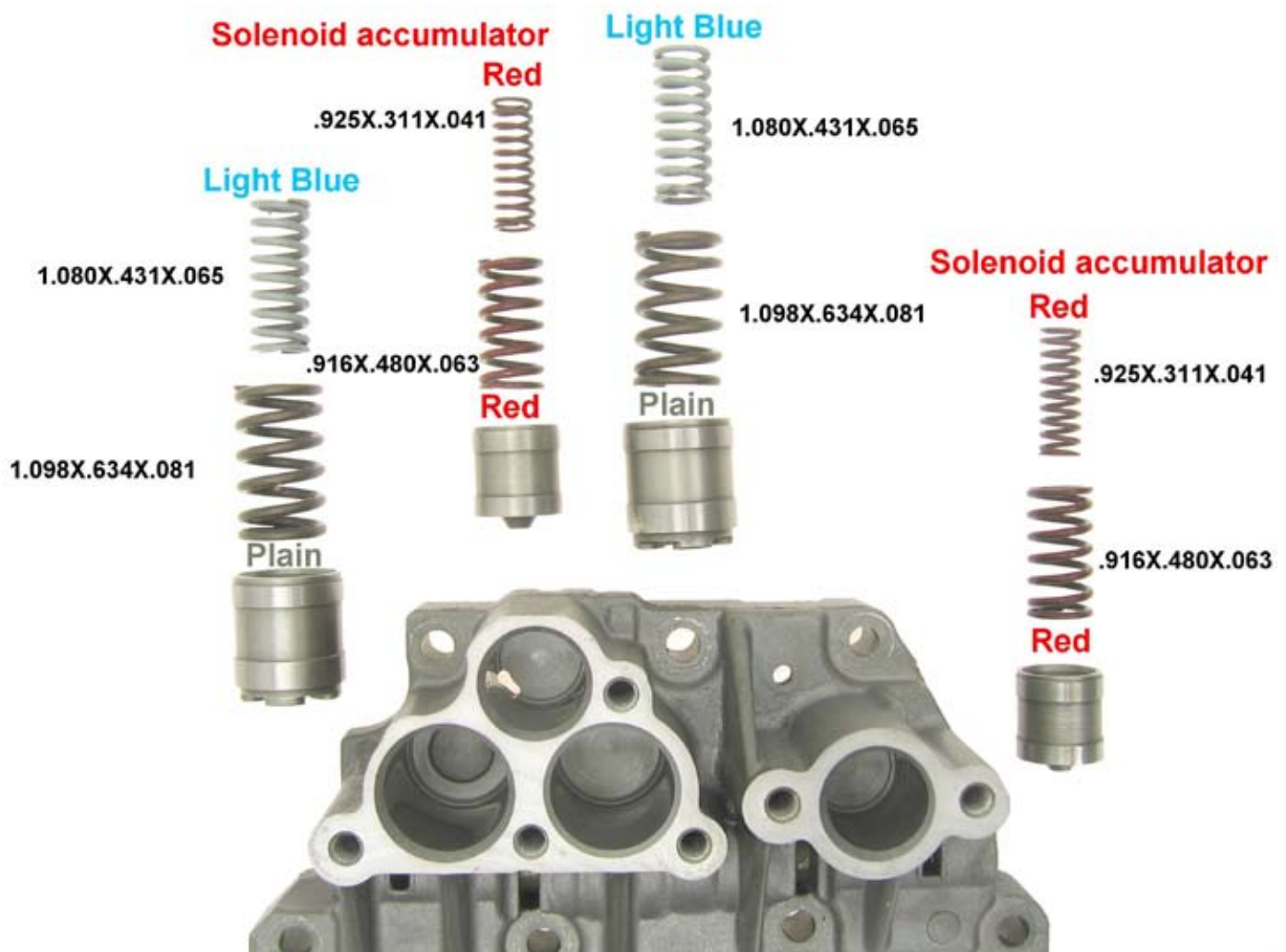
Use the following illustration for check valve with spring and piston locations. New check valves come in the rebuild kit and should be replaced with every rebuild.



AWF-21B

Accumulator Piston and Spring Location

Use the following illustration for accumulator valve and spring locations.



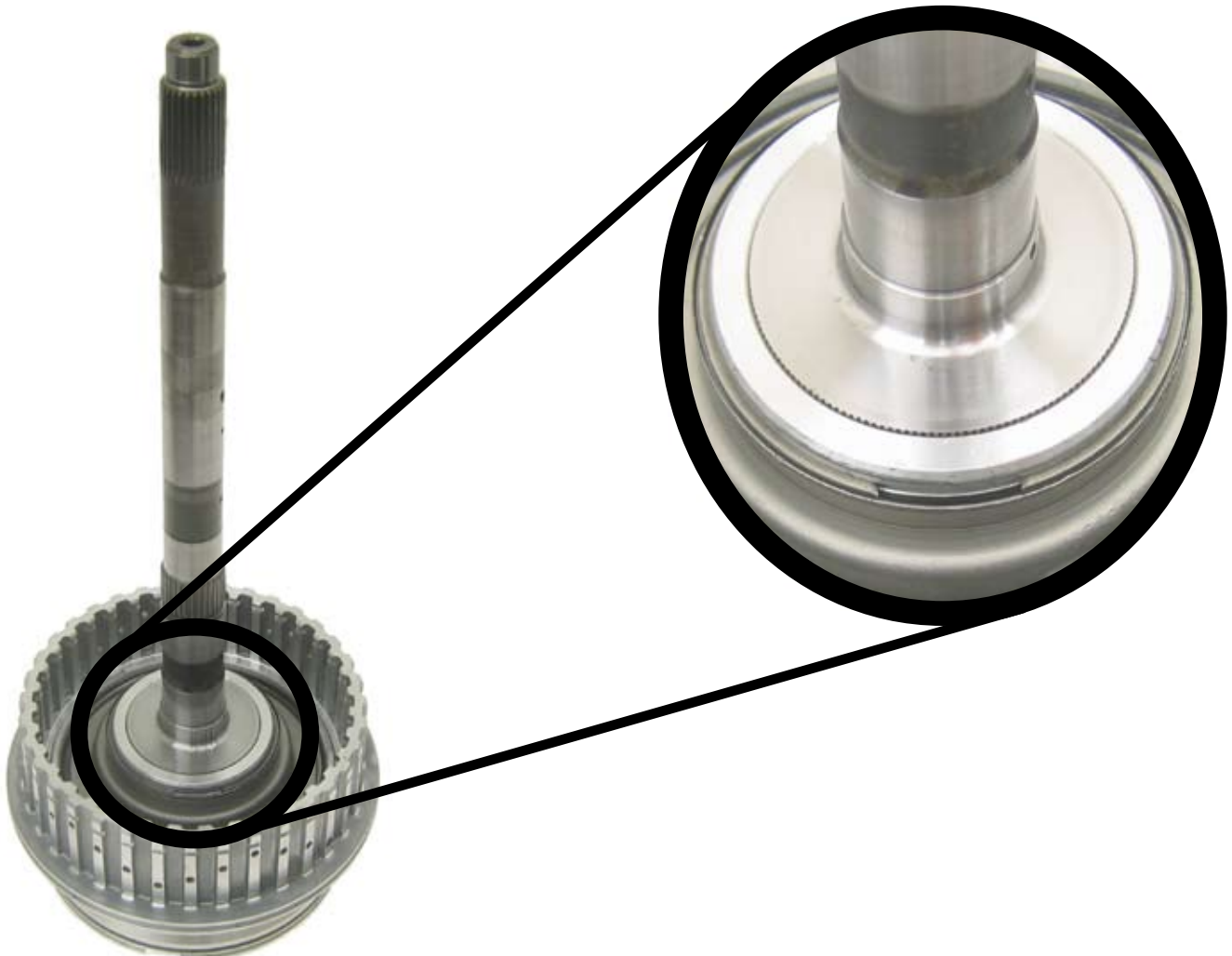
6F50

O/D Piston Return Snap Ring Removal

We used parts from around the shop to take the place of the special tools needed to disassemble and reassemble the 6F50N. To remove the retaining snap ring from the OD clutch piston return spring assembly, you'll need some parts from other transmissions:

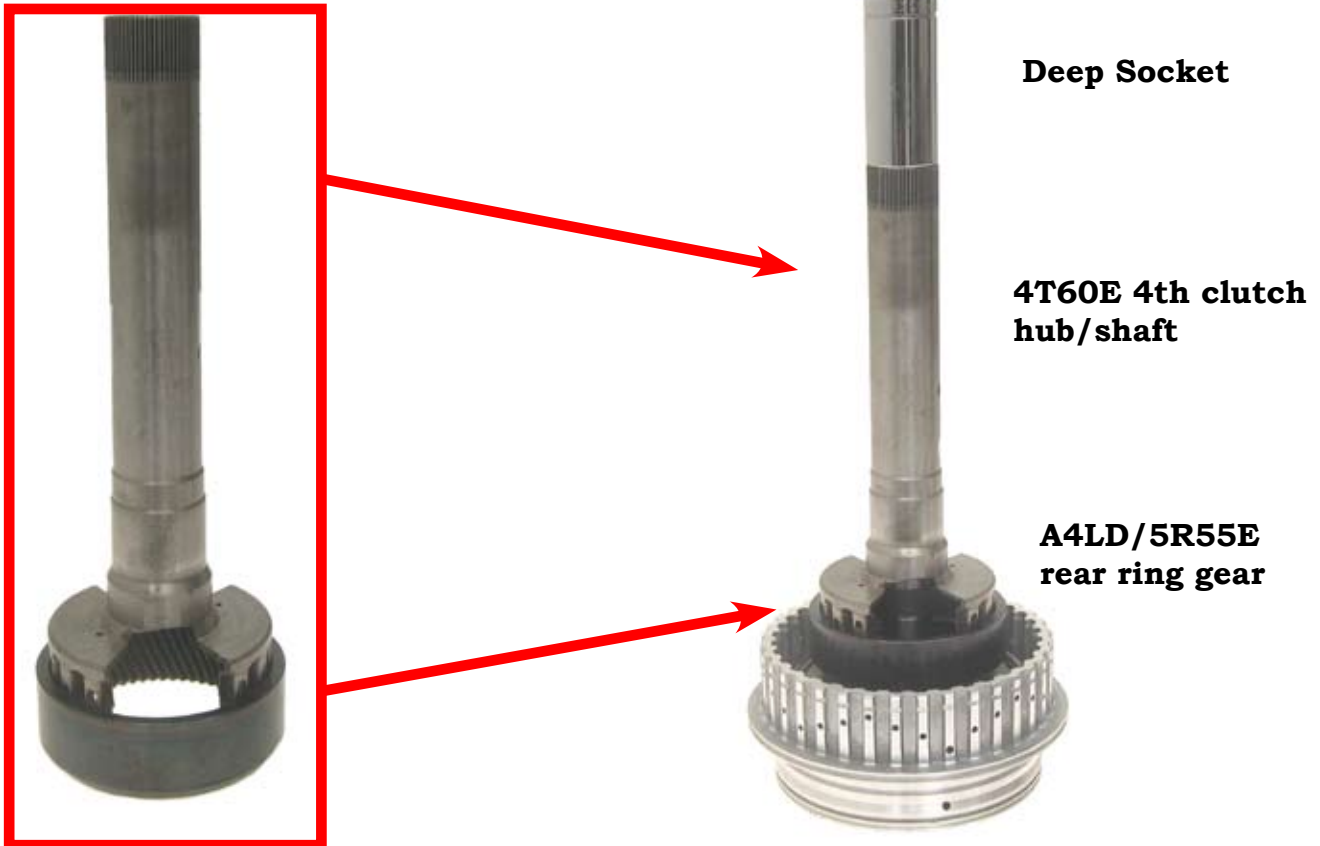
- an A4LD/5R55E rear ring gear (for the low/reverse planet)
- a worn out OD clutch hub/shaft from a 4T60E
- a large deep socket
- a suitable press.

Use a cutting wheel to cut large slots out of the 4th clutch hub/shaft. Place the ring gear on the clutch retainer and slide the 4th clutch hub down onto the ring gear. Use the deep socket as an extension of the hub to be pressed down to remove the ring.

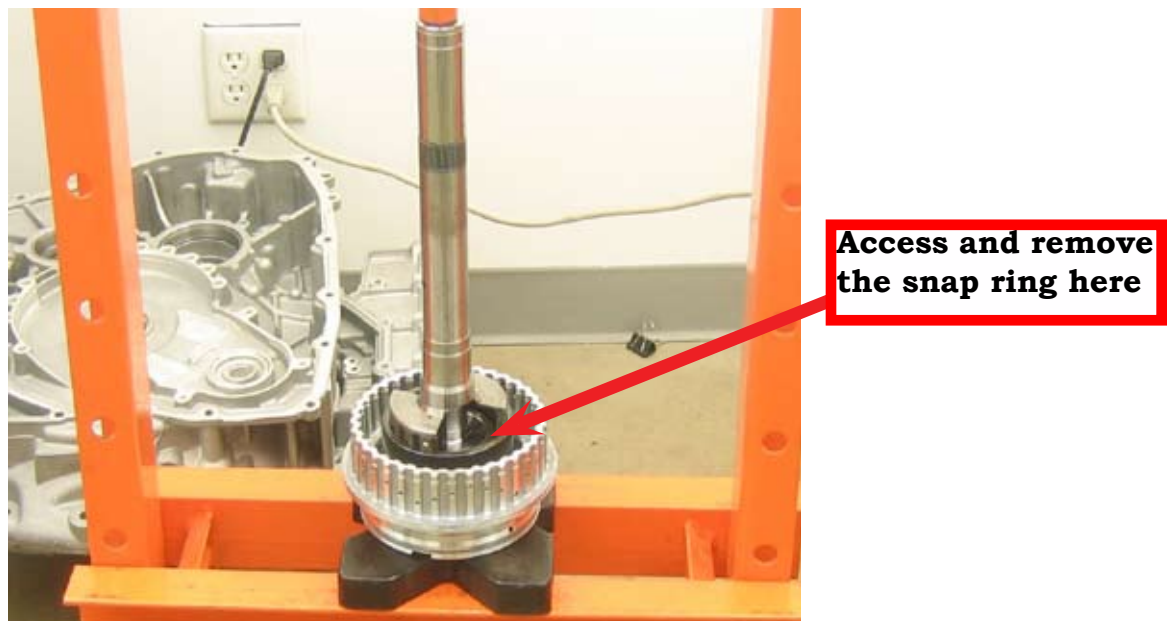


6F50

O/D Piston Return Snap Ring Removal (continued)



Press down on the retainer just enough to access the snap ring



6F50

Direct Clutch Return Snap Ring Removal

To remove and install the direct clutch piston return spring without breaking the tab, use a:

- low/reverse piston from an AW50-42LE or a 4L30E reverse clutch piston
- a bar or 12 inch 3/8 extension.

The 4L30E reverse piston will have to be modified with a cutting wheel to gain access to the snap ring but it is the correct diameter to fit the direct clutch piston.



4L30E Reverse Piston
before cut outs have
been made



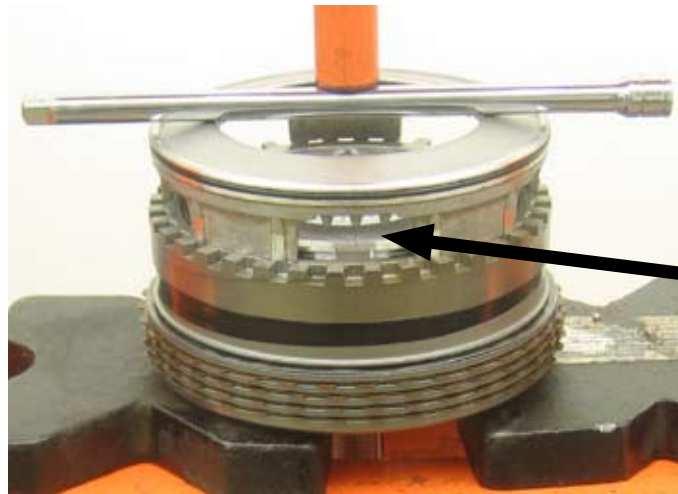
AW50-42LE low/reverse
piston-no modification
necessary

6F50

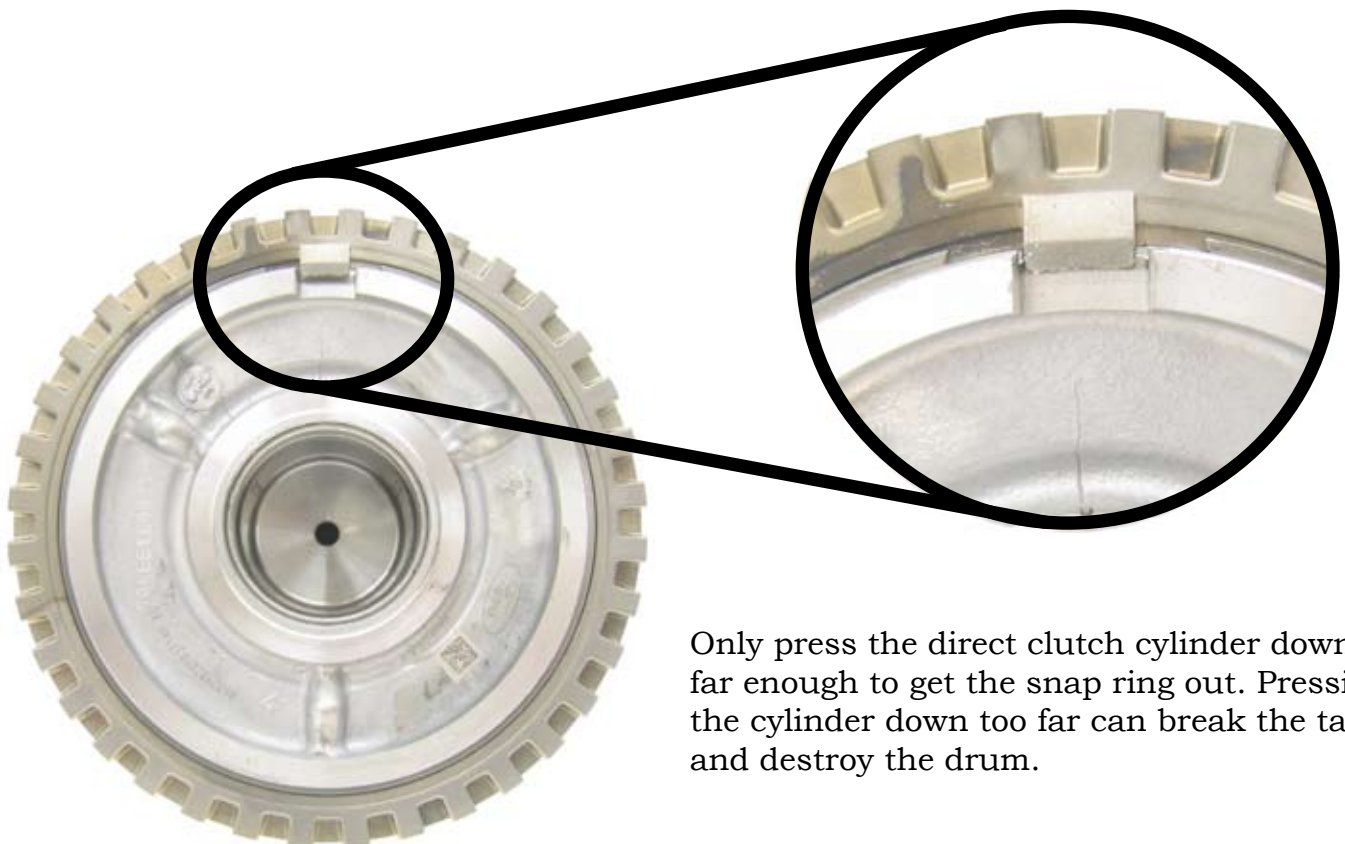
Direct Clutch Return Snap Ring Removal (continued)

The drum is placed in the press and with the bar or extension across the piston to push the piston down evenly.

CAUTION!! Only press the direct clutch cylinder down far enough to get the snap ring out of its groove. Pressing the cylinder down too far can break the tab and the cylinder.



Access the
snap ring
here



Only press the direct clutch cylinder down far enough to get the snap ring out. Pressing the cylinder down too far can break the tab and destroy the drum.

6F50

Intermediate Piston Return Snap Ring Removal

To compress the intermediate clutch spring to remove and install the retaining snap ring, use:

- an E40D/4R100 Sun Shell or RE5R05A Sun Shell (cut two slots opposite of each other)
- a bar to use in the press

Use a cutting wheel or a torch, (much faster) to cut large notches out of the sun shell. These slots allow access to the snap ring. The slots should not be any wider than 4 inches. Any larger and the return springs may get distorted when compressing the spring.



6F50

Reverse Piston Return Snap Ring Removal

To remove or install the reverse clutch return spring use:

- A pair of C clamp vice grips.

Use the C clamp to compress the return spring. Use a screwdriver with a twisting motion to securely hold the snap ring in place. Move around the end cover in this way until the retaining ring is completely seated in the groove.



6F50

Specifications

Material

Item	Specification	Fill Capacity
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V	9.5L (10 qt)
Ultra Silicone Sealant TA-29	—	—

General Specifications

Item	Specification
6F50 Transaxle Weight	100 kg (220 lb)

Solenoid Operation Chart

Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (CB 1,2,3,4)	SSB (VFS) NH (3,5,R)	SSC (VFS) NL (CB 2,6)	SSD (VFS) NH (CB L,R/4,5,6)	SSE (On/Off) NC	
P	P	Off	On	Off	Off	On	Off
R	R	Off	Off	Off	Off	On	Off
N	N	Off	On	Off	Off ^a	On*	Off
D	1	On	On	Off	Off ^b	On ^c	Off
	2	On	On	On	On	Off	Off
	3	On	Off	Off	On	Off	Off
	4	On	On	Off	Off	Off	On/Off
	5	Off	Off	Off	Off	Off	On/Off
	6	Off	On	On	Off	Off	On/Off
	L	On	On	Off	Off ^b	On ^c	Off

a. Solenoid state will change if vehicle is moving forward with the selector lever in the NEUTRAL position.

b. Turns on above 5 km/h (3 mph).

c. Turns off above 5 km/h (3 mph).

CB = Clutch brake

NC = Normally closed

NH = Normally high

NL = Normally low

Clutch Application Chart

Gear	Direct (C 3,5,R)	Overdrive (C 4,5,6)	Forward (CB 1,2,3,4)	Low/Reverse (CB L,R)	Inter-mediate (CB 2,6)	One-Way
1st			X	X		X
2nd			X		X	O/R
3rd	X		X			O/R
4th		X	X			O/R
5th	X	X				O/R

6F50

Specifications (continued)

Clutch Application Chart (Continued)

Gear	Direct (C 3,5,R)	Overdrive (C 4,5,6)	Forward (CB 1,2,3,4)	Low/Reverse (CB L,R)	Inter-mediate (CB 2,6)	One-Way
6th		X			X	O/R
Reverse	X			X		

CB = Clutch brake

O/R = Overrunning

Line Pressure Chart

Gear	Line
Pressures at Idle^a	
P	372-413 kPa (54-60 psi)
R	689-724 kPa (100-105 psi)
N	372-413 kPa (54-60 psi)
D	579-600 kPa (84-87 psi)
L	579-600 kPa (84-87 psi)
Pressure at Wide Open Throttle (WOT) Stall^a	
P	372-413 kPa (54-60 psi)
R	1,724-2,068 kPa (250-300 psi)
N	372-413 kPa (54-60 psi)
D	1,655-1,724 kPa (240-250 psi)
L	1,655-1,724 kPa (240-250 psi)

a All pressures are approximate.

Stall Speed Chart

Engine	Stall Speed
3,5L	2,350-2,650

Shift Speeds

Throttle Position	Range	Shift	km/h	mph
Light Throttle	D	1-2	14-19	9-12
	D	2-3	24-31	15-19
	D	3-4	32-40	20-25
	D	4-5	45-56	28-35
	D	5-6	63-80	39-50
Medium Throttle	D	1-2	37-47	23-29
	D	2-3	58-71	36-44
	D	3-4	74-93	46-58
	D	4-5	108-135	67-84
	D	5-6	169-211	105-131
Heavy Throttle	D	1-2	55-69	34-43
	D	2-3	84-105	52-65
	D	3-4	127-158	79-98
	D	4-5	167-208	104-129
	D	5-6	179-222	111-138

Differential Bearing Preload Shim Selection Chart

Part Number	Shim Thickness
7T4Z-4067-A	0.55 mm (0.022 in)
7T4Z-4067-B	0.575 mm (0.023 in)
7T4Z-4067-C	0.6 mm (0.024 in)
7T4Z-4067-D	0.625 mm (0.025 in)
7T4Z-4067-E	0.65 mm (0.026 in)
7T4Z-4067-F	0.675 mm (0.027 in)
7T4Z-4067-G	0.7 mm (0.028 in)
7T4Z-4067-H	0.725 mm (0.029 in)
7T4Z-4067-J	0.75 mm (0.030 in)
7T4Z-4067-K	0.775 mm (0.031 in)
7T4Z-4067-L	0.8 mm (0.032 in)
7T4Z-4067-M	0.825 mm (0.033 in)
7T4Z-4067-N	0.85 mm (0.034 in)
7T4Z-4067-P	0.875 mm (0.034 in)
7T4Z-4067-Q	0.9 mm (0.035 in)
7T4Z-4067-R	0.925 mm (0.036 in)
7T4Z-4067-S	0.95 mm (0.037 in)
7T4Z-4067-T	0.975 mm (0.038 in)

4R70W/4R70/75E

Interchange Information

Anti-Rattle Spring

Ford has come up with a better designed anti rattle spring. The updated spring is a “V” shaped strip of spring steel that won’t eat into the case or center support. This spring will retrofit back all the way to the AOD transmission and is a great case saver for severely worn cases. The part number for the updated spring is 2L3Z-7F277-AA.

Discard



Updated Spring

Part # 2L3Z-7F277-AA



4R70W/4R75E

Interchange Information (continued)

Center Support

To make room for the turbine speed sensor, the 4R70E/75E center support has an extra notch cut out. If you install a 4R70W support in a 4R70E/75E case, the turbine speed sensor will not install all the way into the case.

If you are in a pinch, grinding a notch into the support to make room for the sensor will not pose a problem.

4R70W



4R70E/75E



NOTCH FOR
TURBINE SPEED SENSOR

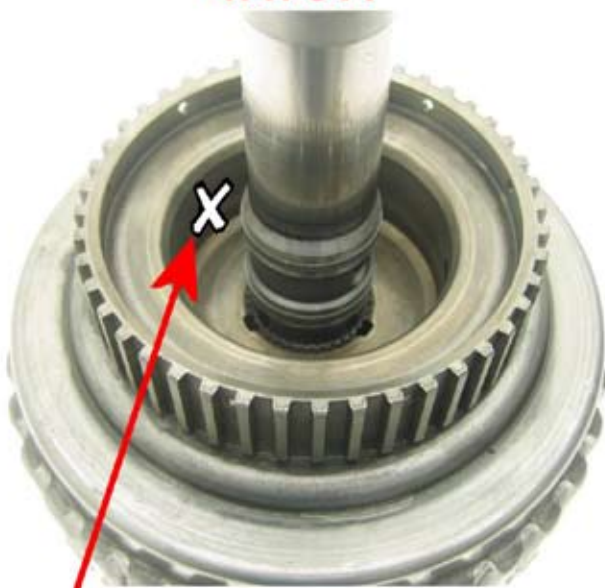
4R70W/4R75E

Interchange Information (continued)

Forward Drum

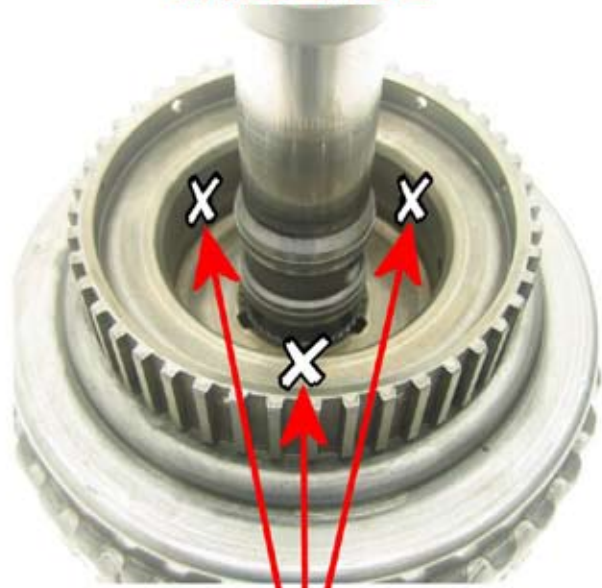
2004-on, forward drums have three clutch apply holes, 120° apart, verses the earlier version having only one. This design change is cosmetic and will not affect forward clutch apply if interchanged. The 4R70/75E drum will fit on all year models.

4R70W



Pre-2004 only has one apply hole

4R70E/75E



2004-on, forward drums have three clutch apply holes

4R70W/4R75E

Interchange Information (continued)

Intermediate Mechanical Diode Sprag

In 2007, Ford introduced a new design mechanical diode. They increased the number of ratchet teeth in the diode which should increase holding strength. At the time of printing this manual, there have been no reports of premature failure.

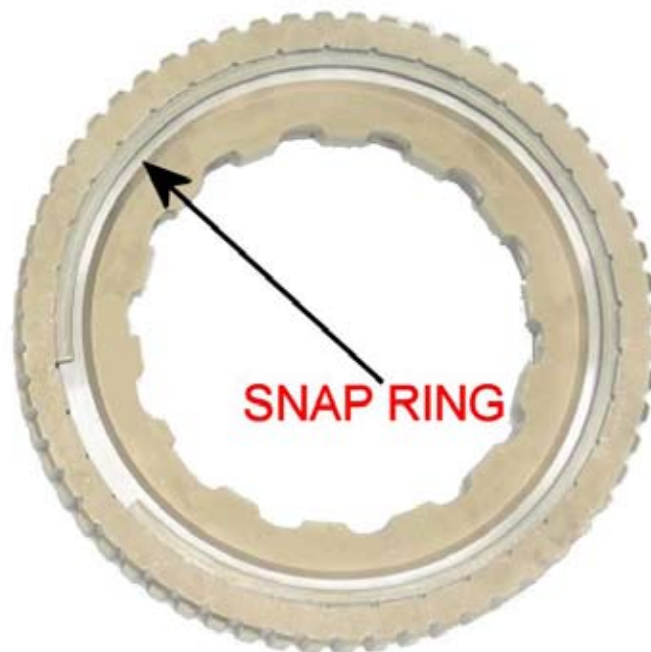
The new diode has a snap ring that holds the element retainer in place instead of the earlier pressed design. Height dimensions have changed slightly where the snap ring rides on the reverse input/OD drum.

The new design diode supersedes the previous design, and when used on any diode-style drum, will increase the clearance between the inner race and the snap ring by about 0.020", this is a normal clearance by design. An aftermarket-designed spiral snap ring should be used in place of the stock snap ring to prevent snap ring failure.

1998-2006



2007-ON



4R70W/4R75E

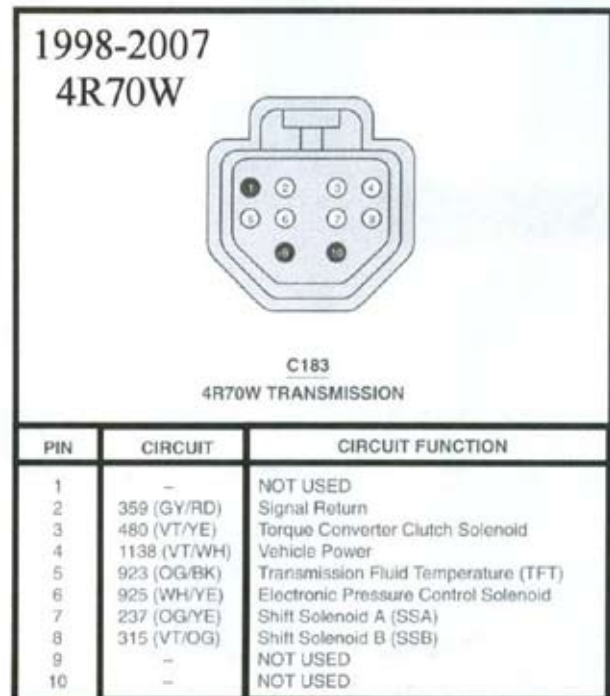
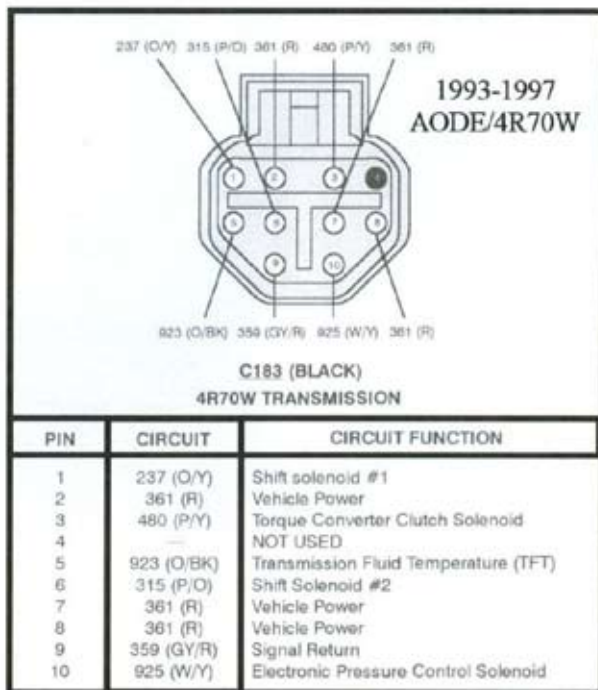
Interchange Information (continued)

Harness Connector Changes

Use the diagrams to make sure you are using the correct connector for your application. The diagrams shown are the vehicle side of the harness. From 1993-1997, the transmission connector is white with soft wiring built into the connector.

From 1998-on, the connector is black in color and uses the separate hard plastic harness. Solenoids will not interchange due to connection differences.

NOTE: Installing the wrong wiring harness can create multiple codes and erratic shifts.



4R70W/4R75E

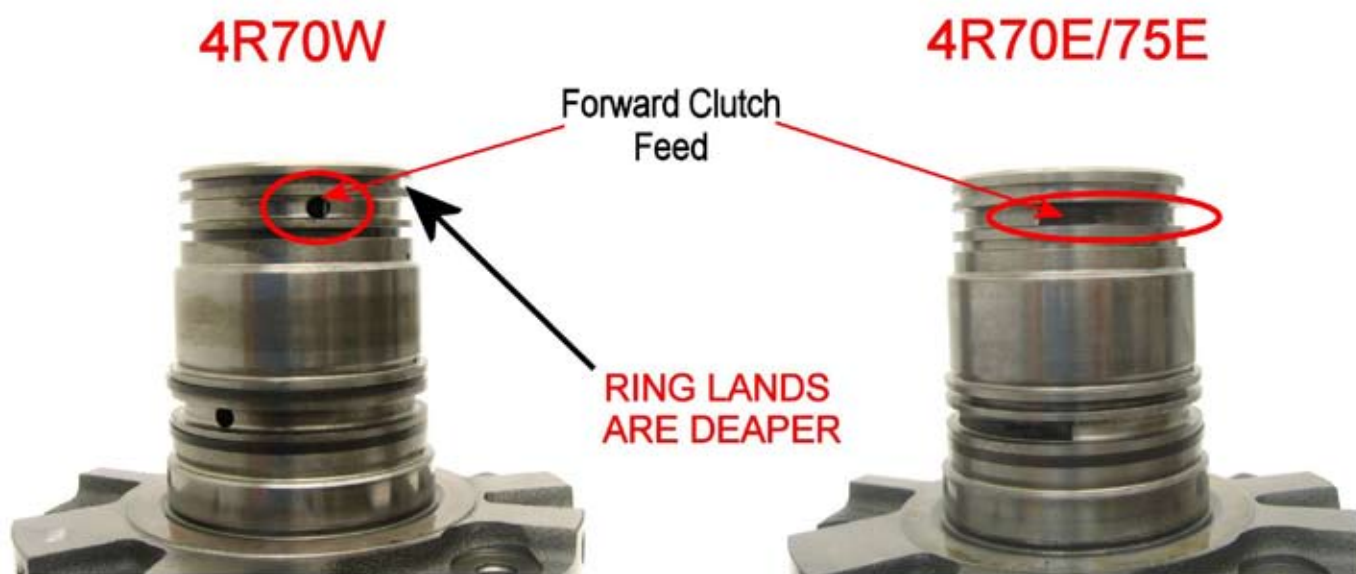
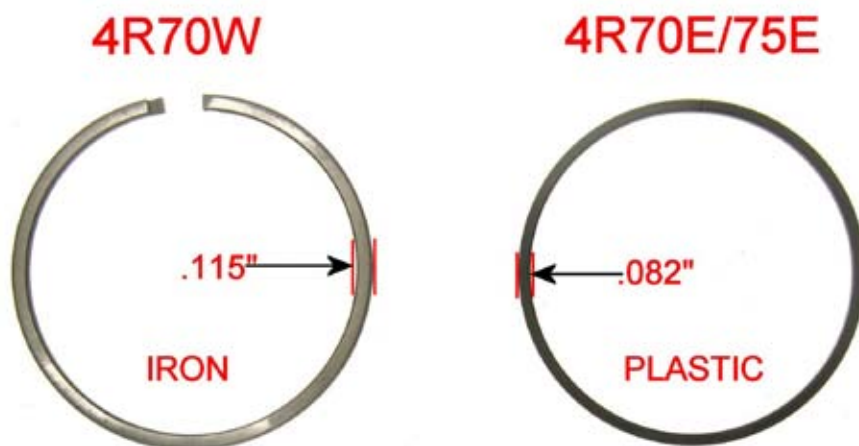
Interchange Information (continued)

Stator Support

The stator supports are identical in hydraulic design but there is an important difference in the forward sealing ring lands. The 4R70E/75E uses a plastic ring that is much thinner than the 4R70W cast iron design.

The outer dimensions of the two rings are identical so as long as the correct rings are used, the stator supports can be interchanged.

The other difference is the forward clutch feed hole. Ford changed the machining process for the forward clutch apply hole and turned it into a slot instead of a round hole. This is strictly cosmetic and will have no effect on forward clutch apply if interchanged.



4R70W/4R75E

Interchange Information (continued)

Planetary

The planetary gear set is the same ratio and dimensions between the two units. The only difference is how the rear cover is attached. The 4R70E/75E uses a welded design as the older versions use rivets to connect the bottom cover to the top portion of the gear set. That area has never had a real issue and the change is due to an easier manufacturing process. Interchange between years will not pose a problem.

4R70W



4R70E/75E



4R70W/4R75E

Interchange Information (continued)

Sun Shell and Forward Sun Gear

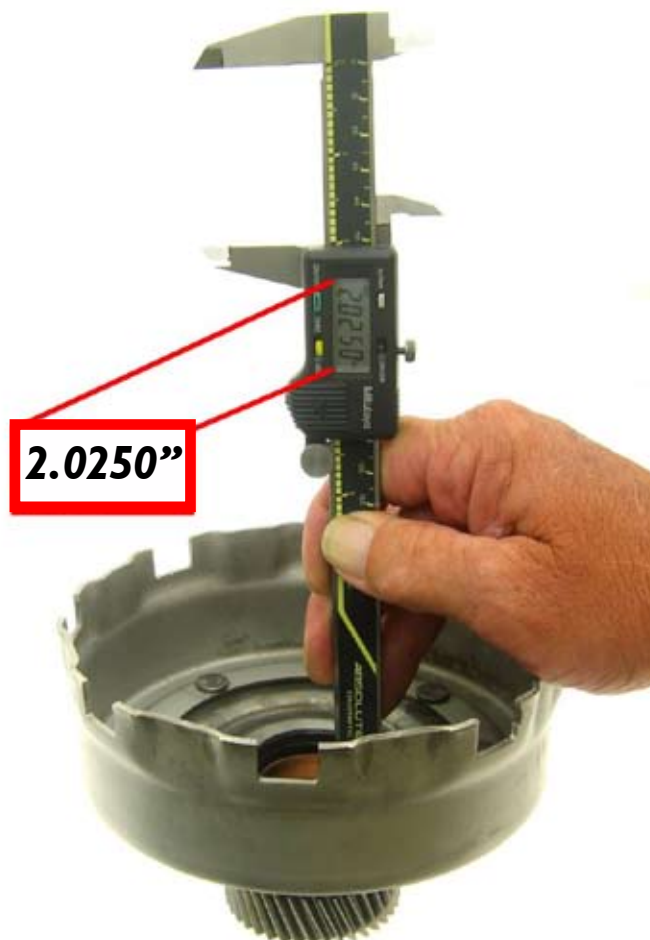
2004 & up sun shells are designed with added strength by utilizing a two piece riveted or a one piece design in the later applications. On both designs, the metal is thicker along the chamfer at the base of the gear which will reduce cracking. Height dimensions from the bottom of the sun gear to the area where the bearing rides has been reduced by .030" to make room for the thicker two piece bearing.

The sun shell, bearing, and forward sun gear must be changed as a set if changing over to a 4R70W or the end play will be incorrect. Ford sells this complete service kit under part # 4L3Z-7D234-AA.

4R70W



4R70E/75E



4R70W/4R75E

Interchange Information (continued)

Sun Shell and Forward Sun Gear (continued)

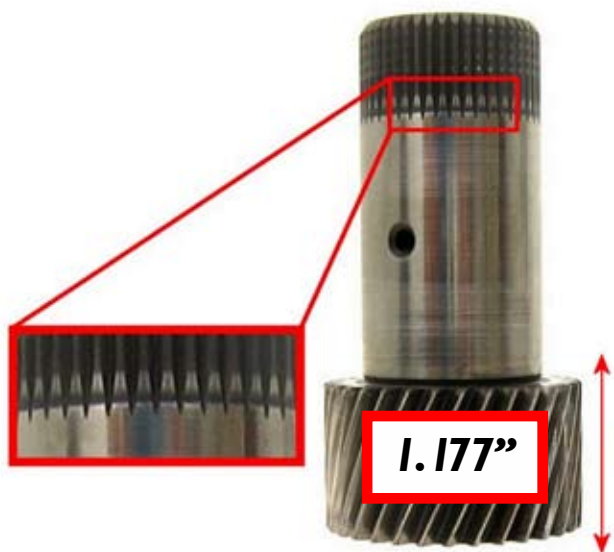
The sun shell, bearing, and forward sun gear must be changed as a set if changing over to a 4R70W or the end play will be incorrect. Ford sells this complete service kit under part # 4L3Z-7D234-AA.

Thicker two piece bearing.

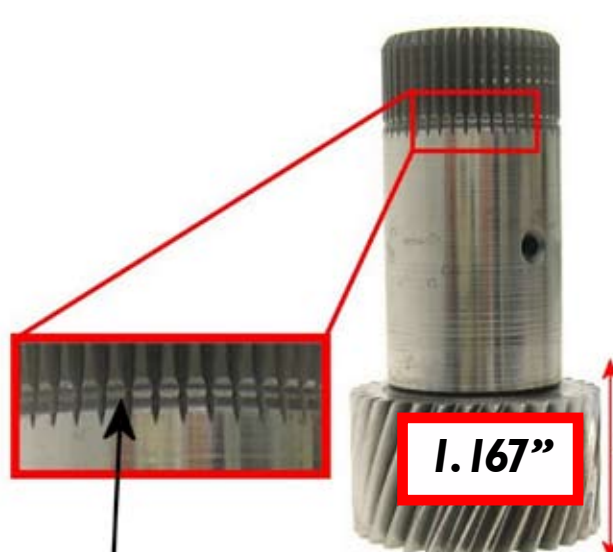


4R70W

4R70E/75E



1.177"



1.167"

ID Groove

4R70W/4R75E

Interchange Information (continued)

Sun Shell and Forward Sun Gear (continued)

The single most important change with the 4R70E/75E sun shell is something you can not see with the naked eye, but will prevent the transmission from leaving your shop. That is the 4R70E/75E sun shell is non-magnetic. In order for the input speed sensor that the 4R70E/75E's now incorporate to work, the sun shell must be non magnetic so that the sensor can pick up the signal from the stamping on the forward drum. Failure to use a non magnetic sun shell will result in harsh or no shifting with possible ratio and input speed sensor codes.

4R70W



4R70E/75E

2004-2005



2006-On



4R70W/4R75E

Interchange Information (continued)

Pump Body

The pump bodies are identical except for the intermediate piston design. The 4R70E/75E uses a bonded rubber piston that is larger in size and will produce more holding power than the aluminum piston design.

A wave style piston return spring in 04-05 models and a one piece in the 06 and up models is utilized on the molded style and cannot retrofit back. The wave style spring requires a seat that sits in the case so that the wave spring does not eat into the aluminum. The later one piece style has a notch that indexes at 12 o'clock in the case and is placed with the springs facing up towards you.

The two different designed pumps can be interchanged from one another without any issues, but as a complete set. You cannot interchange intermediate pistons or springs with one another. If you choose to use a 4R75E pump in place of the early 4R70W, make sure to install the wave spring retainer into the early case or damage to the case will occur. If using the 06-up one piece design spring, no retainer is needed.



4R70W/4R75E

Interchange Information (continued)

Ring Gear

A new designed output speed sensor was incorporated for the 2004 model year. The new sensor uses the exciter ring from the 24 extended parking pawl lugs as where the old sensor uses six (6) holes that are machined around the ring gear.

Mismatching an early ring gear in a late transmission will result in a 75% reduction in the output speed sensor signal and will not let the trans shift out of first gear. Using a late ring gear in an early transmission will produce an output speed signal 400% faster and shift the transmission into fourth gear by the time you hit 10 MPH. No interchange possible.

4R70W



6 RELUCTOR HOLES

4R70E/75E



24 RELUCTOR LUGS

4R70W/4R75E

Interchange Information (continued)

Output Speed Sensor

The Output Speed Sensor changed from the oval connector to the square in 2001. The length is the same as the earlier version up to 2004 when the ring gear changed. Installing the shorter late sensor in 01-03 models could create a weak signal and intermittent OSS codes. Installing the early sensor in an 04 and up will cause damage to the sensor.



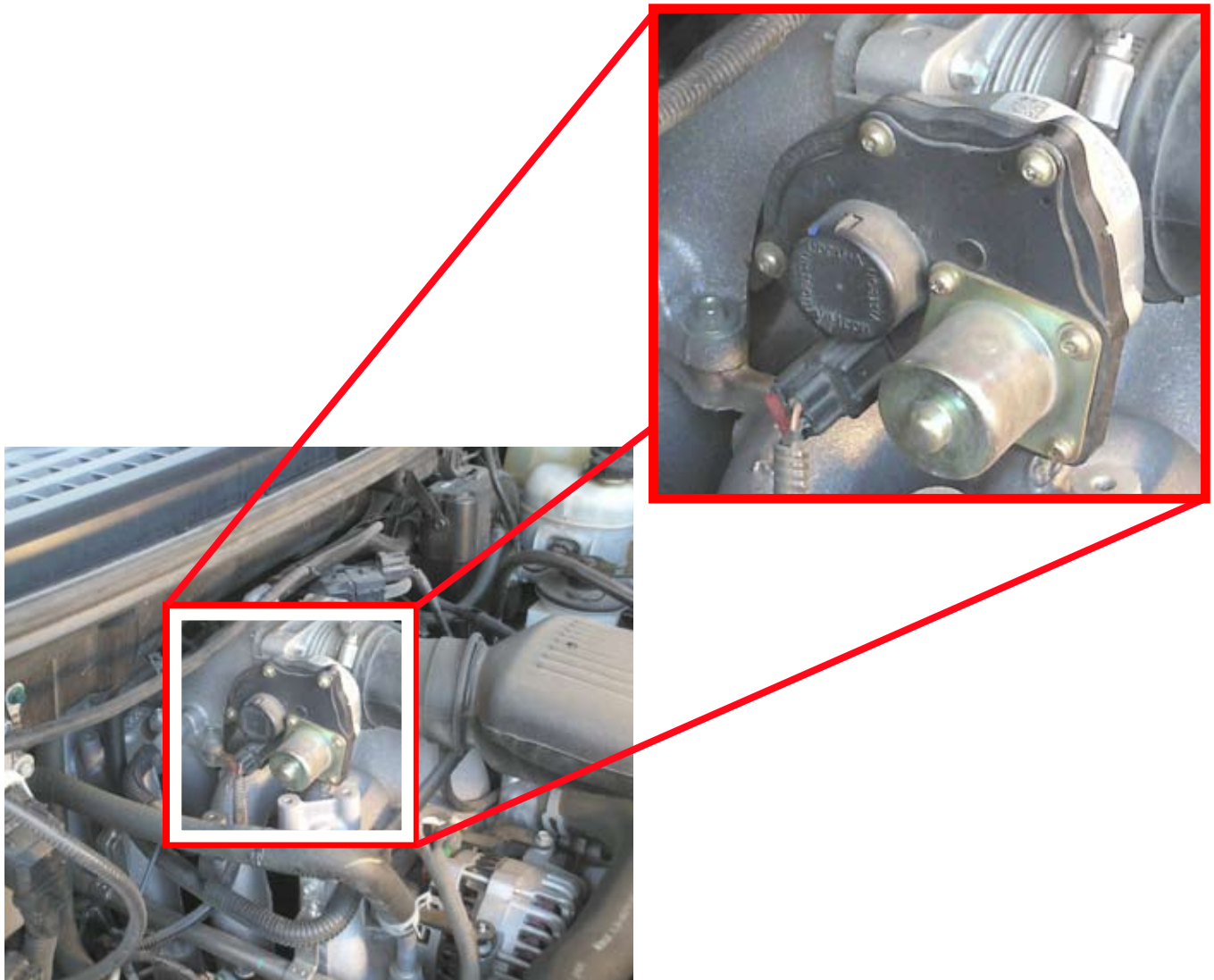
4R70W/4R75E

DTC P2106

Throttle Actuator Control (TAC) System-Forced limited Power

The Torque Based Throttle Control system is a “Drive by Wire” throttle system that uses the Mass Air Flow (MAF), Accelerator Pedal Position Sensor (APPS), Crank Position Sensor (CKP), Turbine Speed Sensor (TSS), and Output Speed Sensor (OSS) to calculate load and determine the correct throttle opening for the condition in which the vehicle is driving in.

If the incorrect sun shell is installed or if there is a Turbine Speed Sensor failure, P2106 will set. Keep in mind that a malfunction with any other of the above mentioned sensors along with a mechanically stuck throttle or throttle actuator can set this code as well.



Torqshift

Low/Reverse Planetary Gear Set Interchange

Starting in late 2008 Ford introduced a new planetary gear set. This planet has the Low/Reverse sprag and the Low/Reverse clutches built onto the planet assembly.

On late model units 2008 and up, if the Low/Reverse clutches are burnt or worn out the whole planet assembly must be replaced. The planet can be purchased from the dealer as an assembly.

The alternative is to use the earlier Low/Reverse clutches and steels, Planetary, and Sprag assembly. The early Low/Reverse clutch pack only has a five (5) clutch pack stack-up. You must use six (6) clutch fibers and six (6) steels to complete the interchange.

Early Pre-2008 Low/Reverse planet with separate clutches and sprag assembly



Late 2008-up Low/Reverse planet with integral clutches and sprag assembly

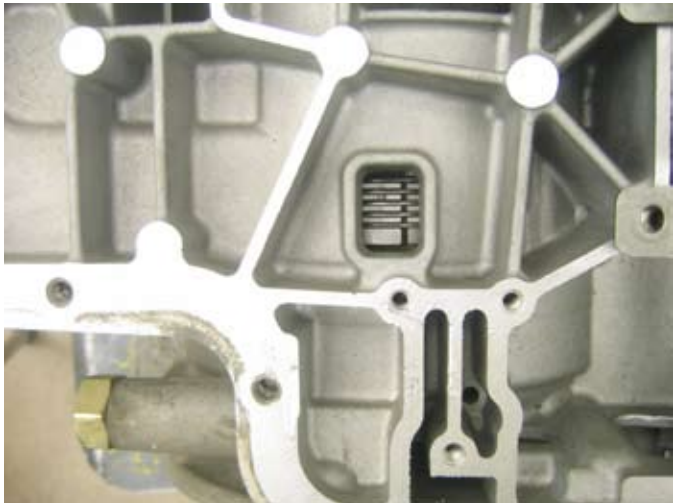


Torqshift

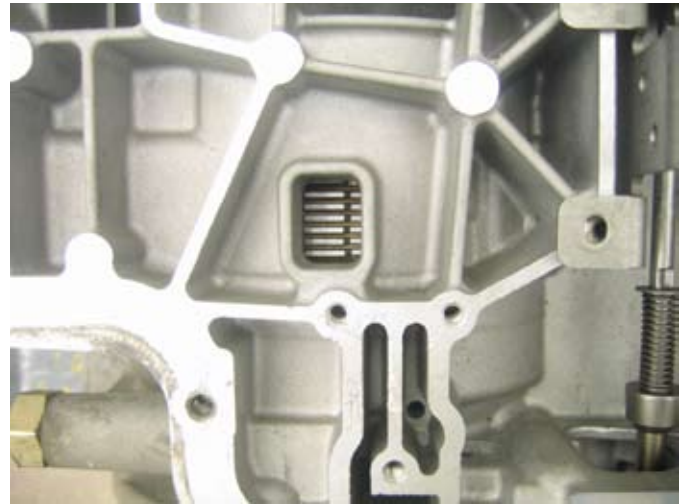
Low/Reverse Planetary Gear Set Interchange (continued)

The clutches have been stacked up and the planets placed in the same case. The late and the early planet/clutch assemblies have the exact same clearance and can be interchanged between years.

**Early pre-2008 planet with 5 frictions.
May be upgraded to 6 frictions**



**Late 2008-up planet with 6 frictions
can be interchanged with earlier pre-2008 parts**



Early pre-2008 planet assembled in the case



Late Planet 2008-up assembled in the case



Ford All

Erratic Speedometer Reading while Sitting Still

Speedometer reading while sitting still, possible speedometer codes P0500, P0503 VSS intermittent.

These symptoms and codes can be very difficult and time consuming to diagnose. Often times the cause is EMI. The top causes of EMI are:

1. Bad alternator (disconnect)
2. Defective grounds on the controller
3. Erratic TSS or ISS signals (due to bad grounds)
4. High power electrical devices (after market amplifiers-boom boxes)
5. Check ignition wave form for irregularities.
6. Added resistance from faulty spark plugs

Isolate the conditions in both KOEO or KEOR?

Disconnect devices one at a time, disconnecting all devices at the same time may work but won't isolate the issue.



Disconnect the alternator as a quick check for EMI.

Ford All

Erratic Speedometer Reading while Sitting Still (continued)

Loose grounds contribute to EMI inside the controller. When diagnosing erratic speed sensor readings, check and verified all grounds are clean and tight before any other tests are done.

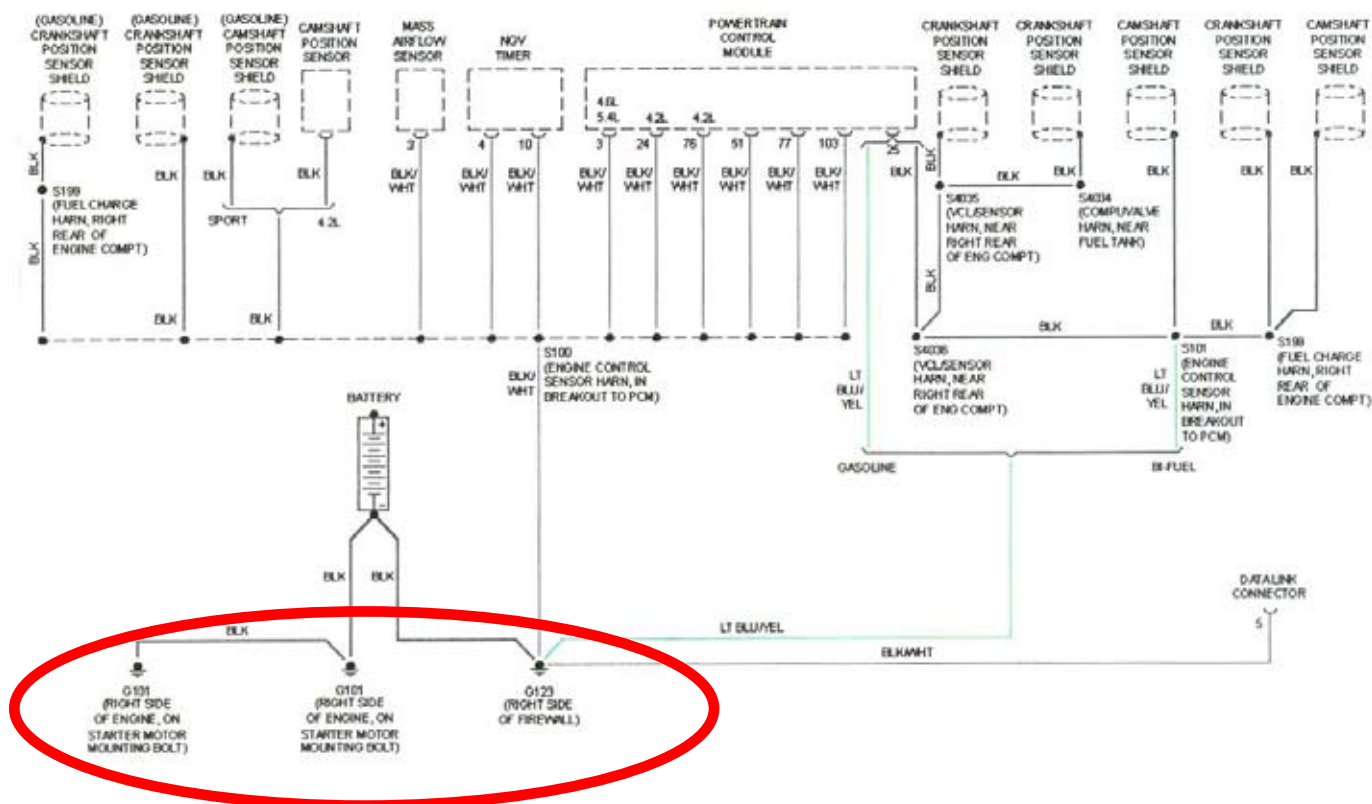
Check those grounds!



Ford All

Erratic Speedometer Reading while Sitting Still (continued)

F-150 Schematic



Main computer grounds

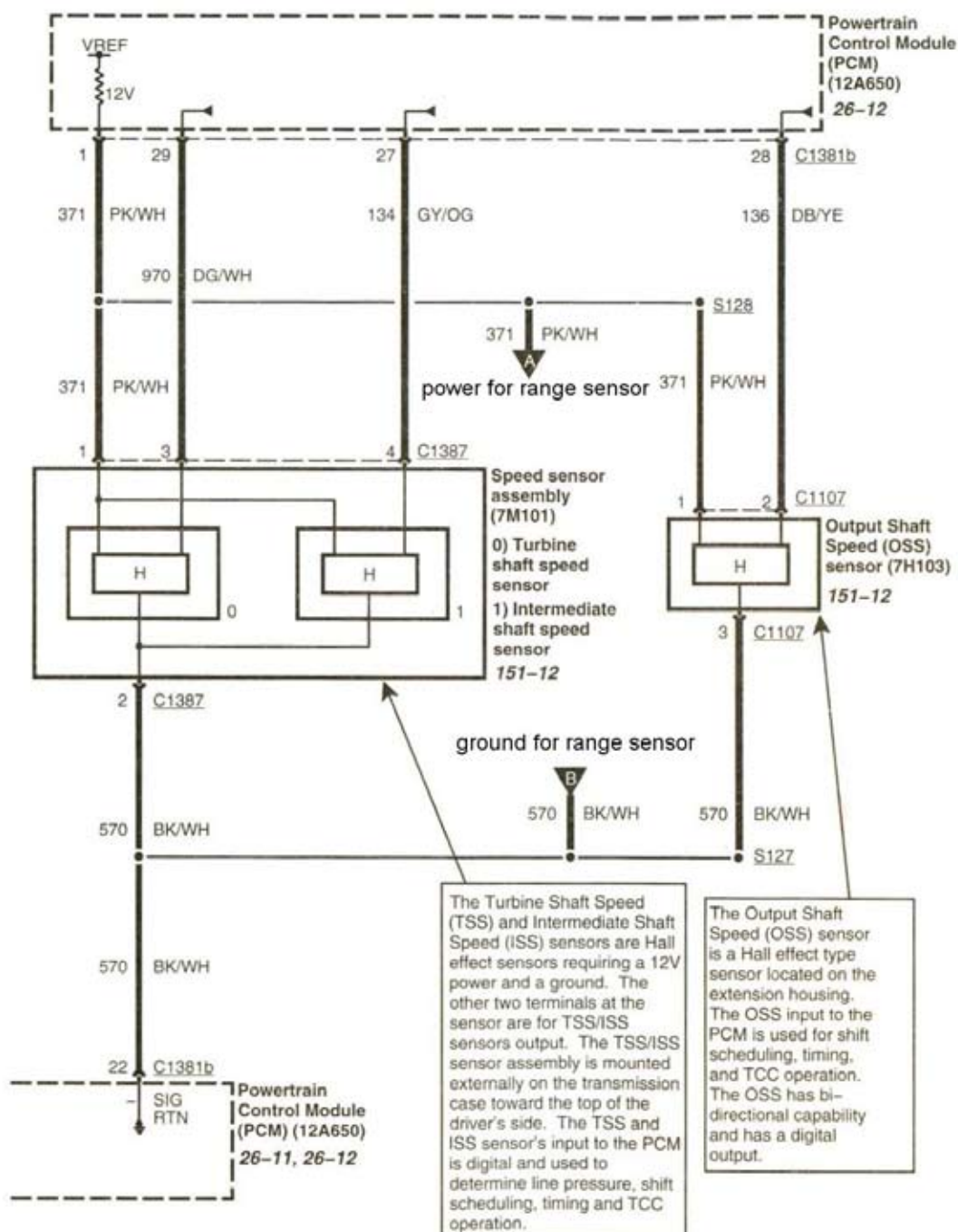


Ford All

Erratic Speedometer Reading while Sitting Still (continued)

Erratic VSS signals to the PCM can be caused by EMI getting into the PCM. When erratic speedometer concerns are present always inspect the TSS or ISS wiring.

2004 F-250 5.4L



Ford All

Erratic Speedometer Reading while Sitting Still (continued)

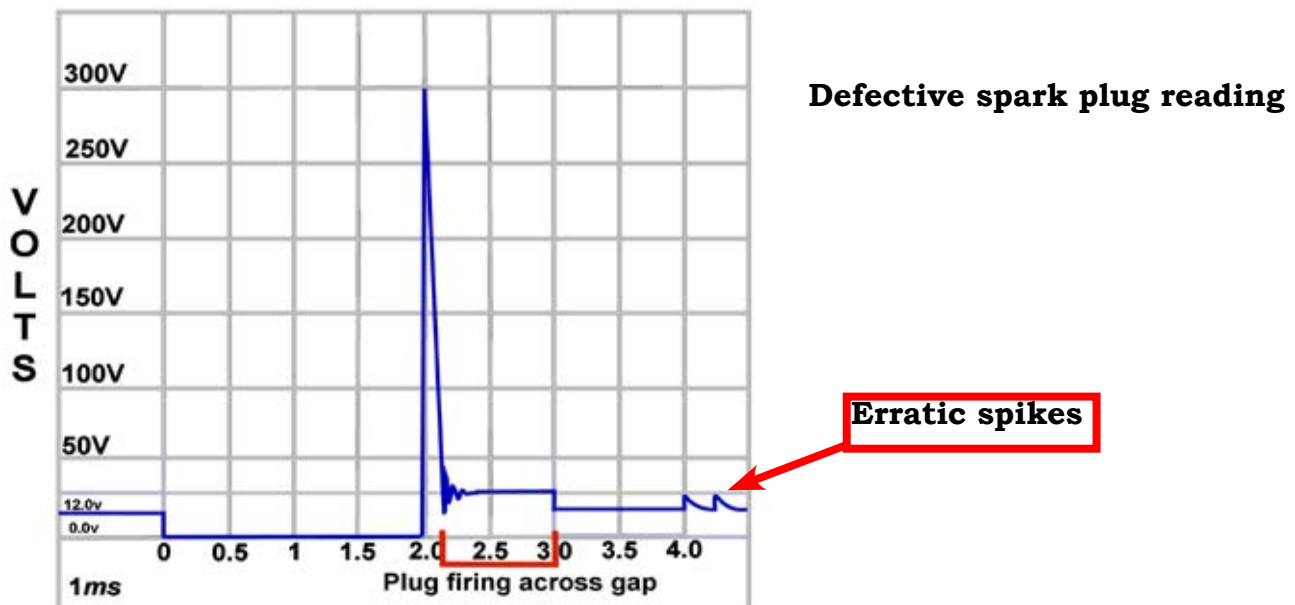
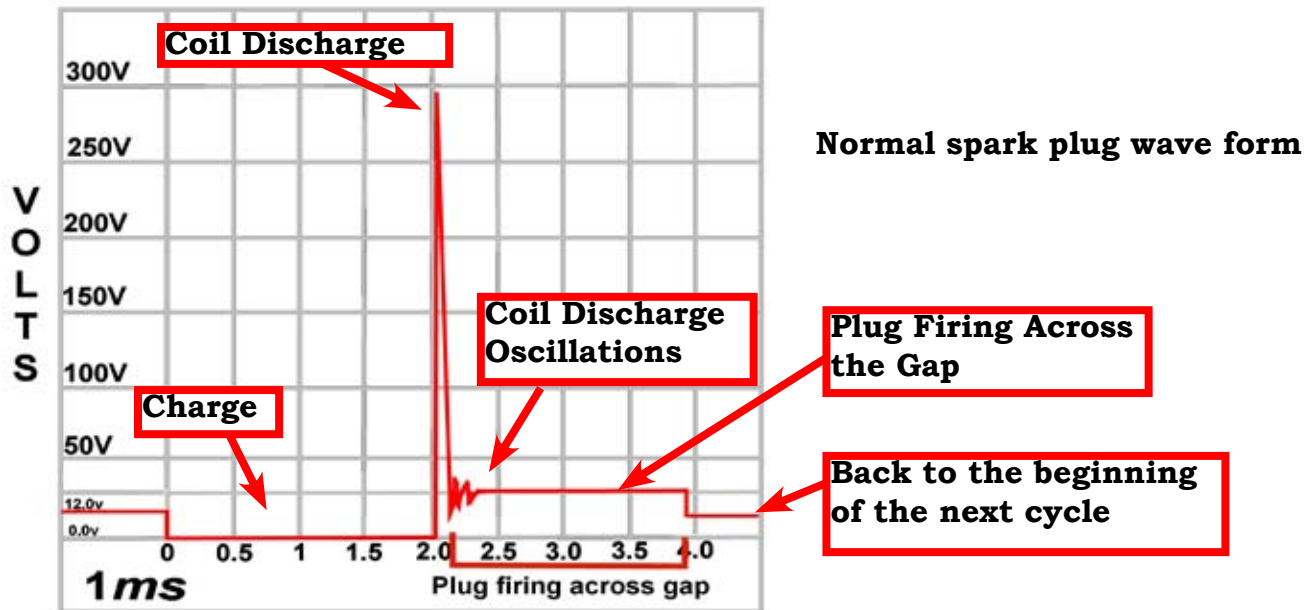
Improperly installed stereo amps, stereo heads, speakers, or other accessories can be a source of EMI. Simply power down the device in question and retest.



Ford All

Erratic Speedometer Reading while Sitting Still (continued)

Ignition wave forms can also be a good way to track down EMI. Ford's Coil Over Plug (COP) coils are controlled directly by the PCM. If there is excessive inductive voltage from the spark plug firing it could cause EMI. This can interfere with other signals inside the PCM including the VSS.



Ford All

Erratic Speedometer Reading while Sitting Still (continued)

Worn plugs from a 2004 Ford F250 with approximately 39,000 miles, typically these plugs are recommended for replacement at or around the 60,000 mile mark.

“ A special Thank You to Roger Perry at Lake Sumter Transmissions for the spark plugs”



Ford All

Erratic Speedometer Reading while Sitting Still (continued)

This is a schematic of a 2004 F250 with ABS. Testing for EMI can be done at pin 58. The wire will have to be cut as close to the computer as possible and still make a complete connection after we are done testing.

After the wire is cut check for DC Hz on both ends of the wire. Typically if the problem is worn spark plugs there will be DC Hz coming OUT of the PCM and nothing going into the PCM while the engine is running and the transmission is in park,

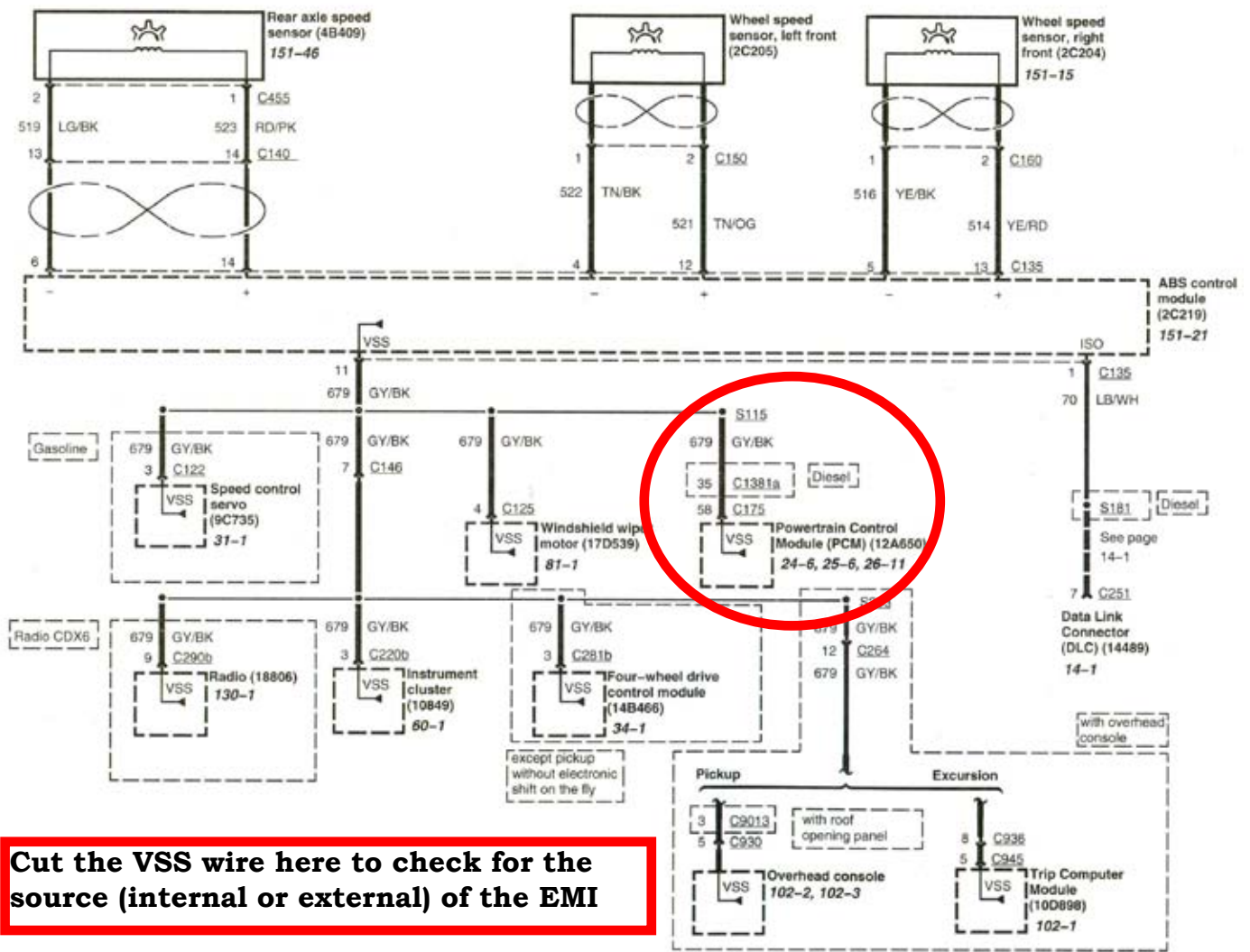


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68RFE

Introduction

The 68RFE offers full electronic control of all automatic up and downshifts.

Features:

- Real-time adaptive closed-loop shift and pressure control
- Electronic shift and torque converter clutch controls (help protect the transmission from damage due to high temperatures, which can occur under severe operating conditions). By altering shift schedules, line pressure, and converter clutch control, these controls reduce heat generation and increase transmission cooling.

To help reduce parasitic losses, the transmissions includes a dual-stage transmission fluid pump with electronic output pressure control. Under most driving conditions, pump output capacity greatly exceeds that which is needed to keep the clutches applied. The 68RFE pump-pressure control system monitors input torque and adjusts the pump pressure accordingly.

The primary stage of the pump works continuously; the second stage is bypassed when demand is low. The control system also monitors input and output speed and, clutch slip is observed, the pressure control solenoid duty cycle is varied, increasing pressure in proportion to demand.

A high-travel torque converter damper assembly allows earlier torque converter clutch engagement to reduce slippage. Needle-type thrust bearings reduce internal friction. The 68RFE is packaged in a one-piece die-cast aluminum case. To reduce NVH, the case has high lateral, vertical and torsional stiffness. Dual filters protect the pump and other components.

A cooler return filter is added to the main sump filter. Independent lubrication and cooler circuits assure ample pressure for normal transmission operation even if the cooler is obstructed or the fluid cannot flow due to extremely low temperatures.

The hydraulic control system design (without electronic assist) provides the transmission with PARK, REVERSE, NEUTRAL, and FOURTH gears, based solely on driver shift lever selection. This design allows the vehicle to be driven (in “limp-in” mode) in the event of a electronic control system failure, or a situation that the Transmission Control Module (TCM) recognizes as potentially damaging to the transmission.

68RFE

Clutch Operation

The 68RFE has a design change that allowed for the full time 6 speed as well as the increase in torque ratios. The 4C on the 45/545RFE held an annulus as the planet was driven by a sun gear. On the 68RFE the 4C holds a sun gear causing the annulus to be driven by the planetary.

Shift Lever	Gear			Applied Input Clutch	Applied Holding Clutch	Gear Ratios		
	45RFE	545RFE	68RFE			45RFE	545RFE	68RFE
P	Park	Park	Park		L/R			
R	Reverse	Reverse	Reverse	Reverse	L/R	3.000	3.000	4.444
N	Neutral	Neutral	Neutral		L/R			
D	1	1	1	UD	L/R & ORC	3.000	3.000	3.231
	2	2	2	UD	2C	1.667	1.667	1.837
	2 nd Prime	2 nd Prime	3	UD	4C	1.500	1.500	1.410
	3	3	4	UD/OD		1.000	1.000	1.000
	4	4	5	OD	4C	0.750	0.750	0.816
		5	6	OD	2C		0.667	0.625

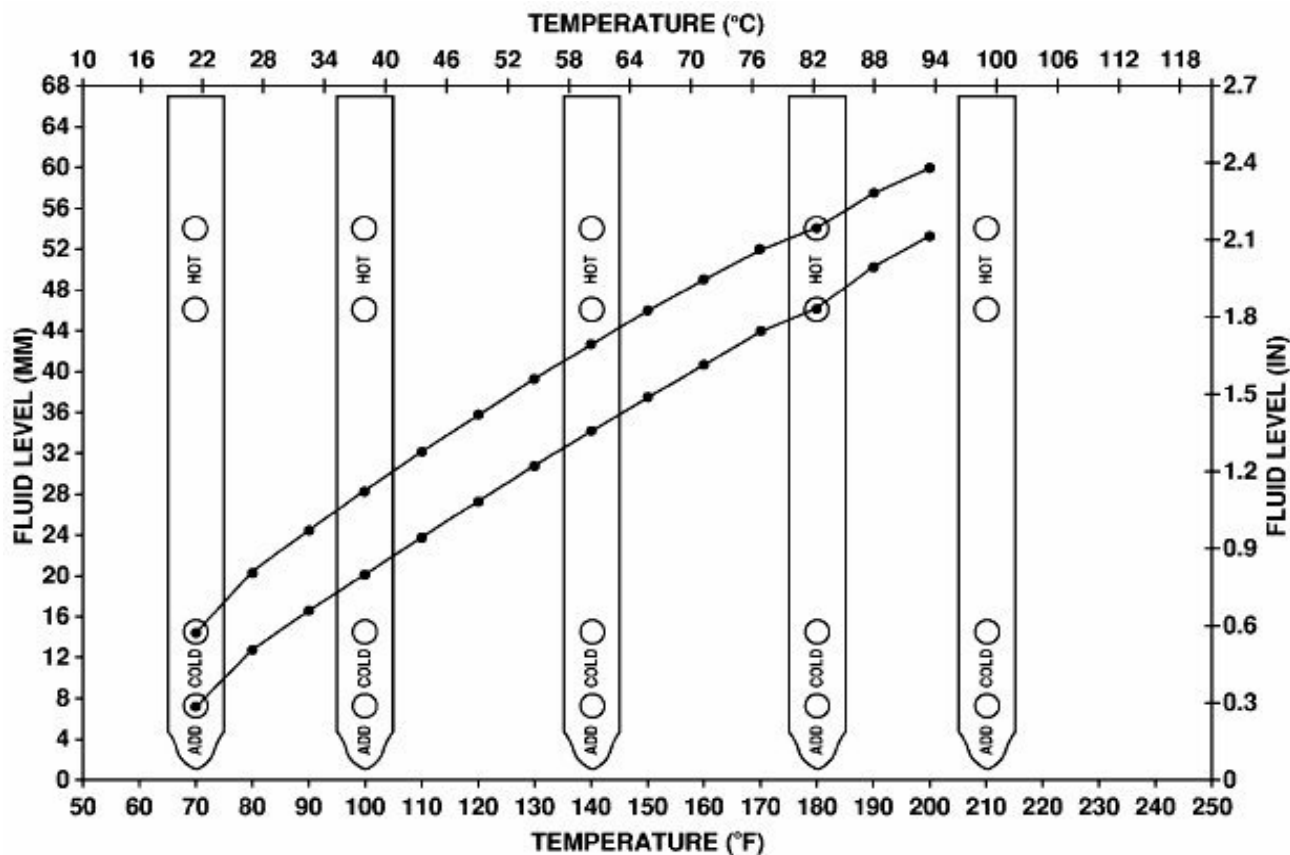
* When output speed is greater than 150 rpm the L/R clutch is released and the ORC is the holding element before the 1-2 shift.

** Failsafe is 3rd gear on the 45/545RFE and 4th gear on the 68RFE (Vehicles that have ERS (Electronic Range Select) will not have a manual low "2nd" gear while in failsafe).

68RFE

Oil Level

When servicing and/or testing for proper oil level it is important to note that the fill is based off of oil temperature. Proper fill does require the use of a scan tool to verify actual transmission temperature.



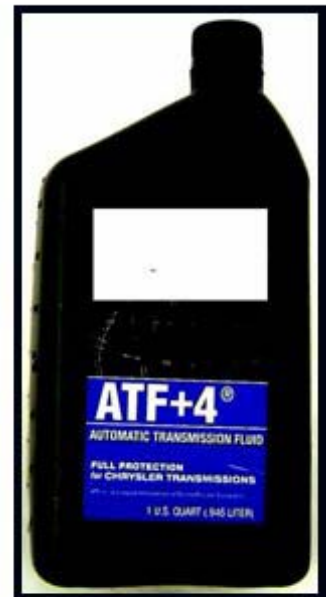
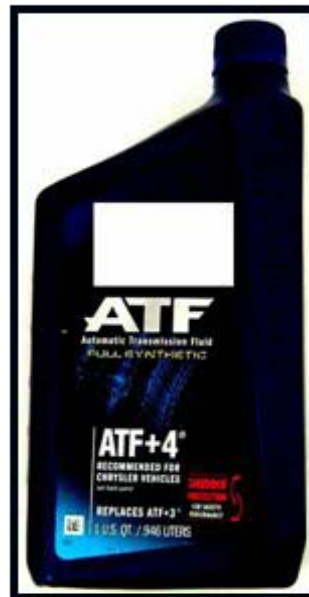
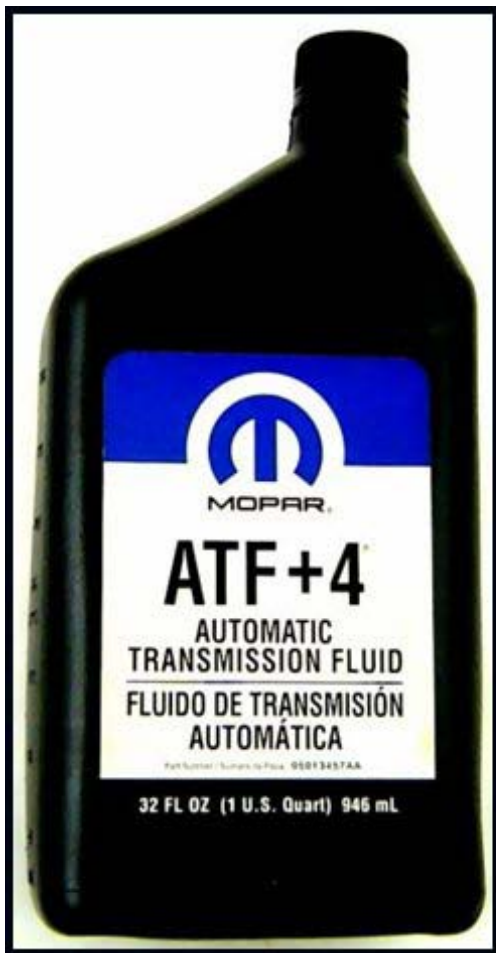
To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

1. Remove dipstick and insert clean funnel in transmission fill tube.
2. Add following initial quantity of Mopar® ATF +4 to transmission:
 - a. If only fluid and filter were changed, add 10 pints (5 quarts) of ATF +4 to transmission.
 - b. If transmission was completely overhauled and the torque converter was replaced or drained, add 24 pints (12 quarts) of ATF +4 to transmission.

68RFE

Mopar +4

The only recommended fluid for the 68RFE is MOPAR +4 oil. There are many different blends of oil that claim +4 rating. The only way to assure that you are using +4 blend is to use MOPAR brand. Using a blend that is not recommended may result in shift concerns that can only be fixed by using the proper oil.



68RFE

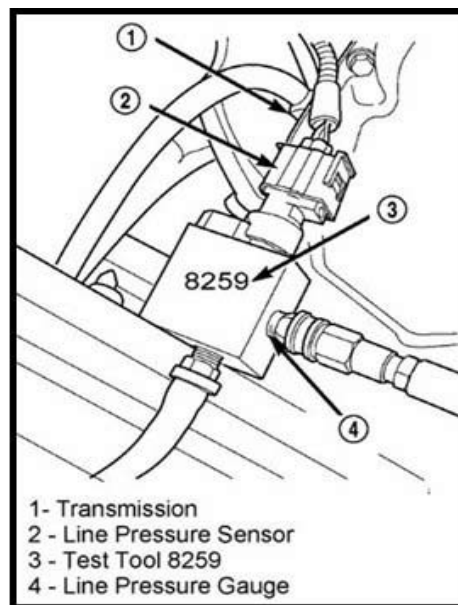
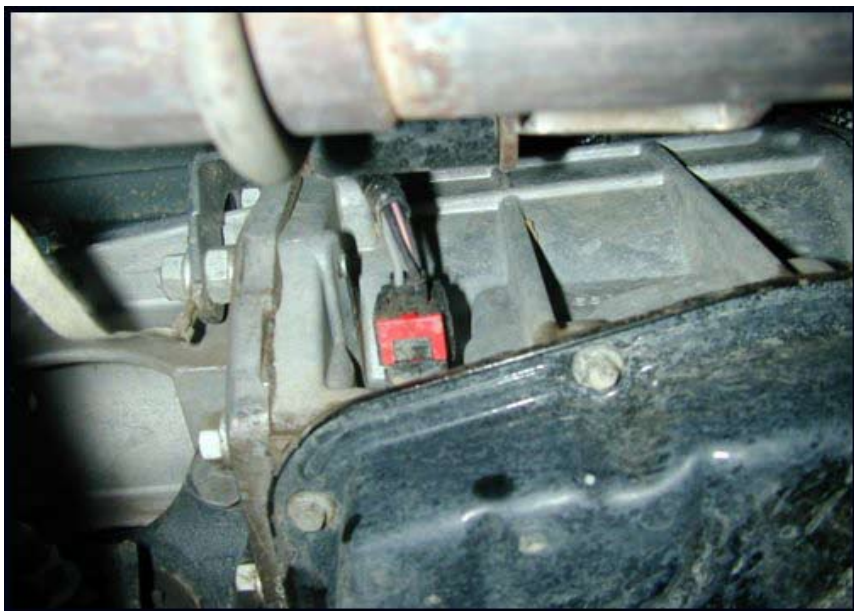
Pressure Testing Ports

Accurate tachometer and pressure test gauges are required. Test gauges must have a 300 psi range and is used at all locations where pressures exceed 100 psi.

Pressure Test Port Locations

The torque converter clutch apply (3) and release (1) ports are located on the right side of the transmission case .

There are two (2) methods of testing line pressure. The 1st method requires the use of a scan tool and adapter that allows you to monitor perceived pressure (scan data) vs. actual pressure (pressure gauge). The 2nd method (not available on all applications because of mounting issues) is the use of a special adapter oil pan that allows you to tap into each clutch pressure port located on the valve body.



Method #1

The scan tool can be used to read line pressure from the line pressure sensor. The second method is to install Line Pressure Adapter 8259 (3) into the transmission case and then install the pressure gauge and the original sensor (2) into the adapter.

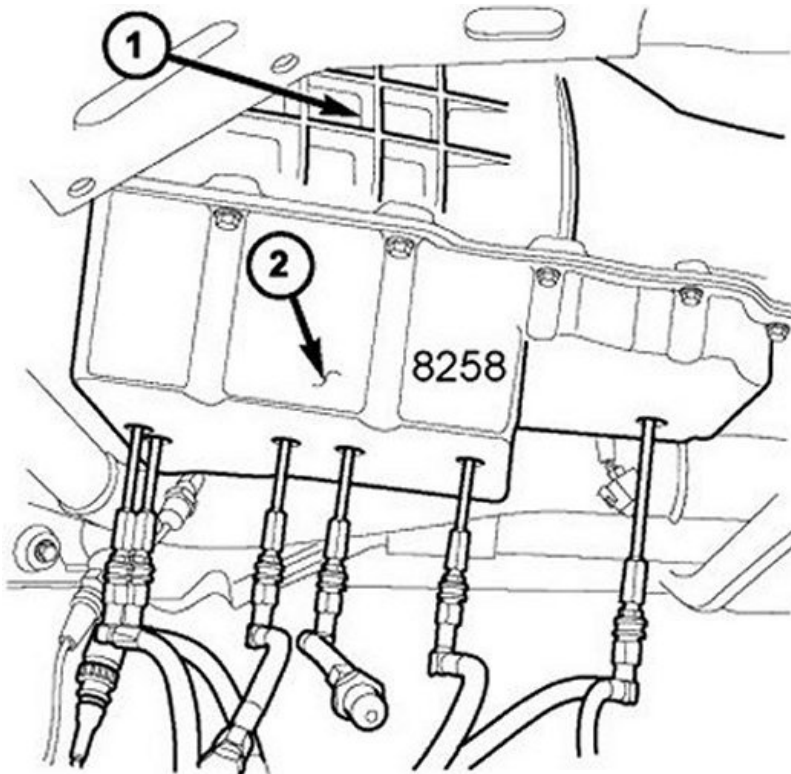
This will allow a comparison of the scan tool readings and the gauge reading to determine the accuracy of the line pressure sensor. The scan tool line pressure reading should match the gauge reading within ± 10 psi.

68RFE

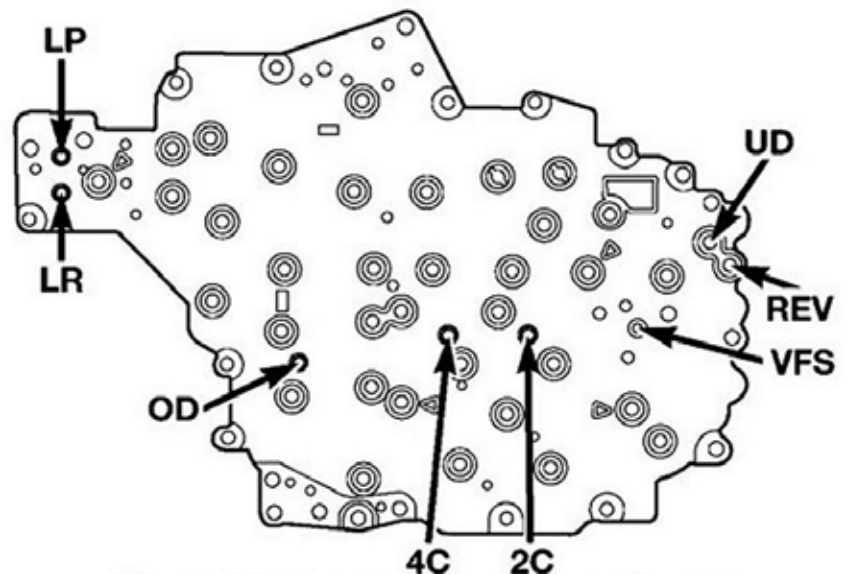
Pressure Testing Ports (continued)

Method #2

Another method of testing hydraulic line pressure involves removing the valve body pressure test ports and installing the parts of the valve body pressure tap adapter and one or more 300 psi pressure gauges (Miller Special Tool #8258-A and #C-3293SP).



- 1 - Transmission
- 2 - Special Tool 8258



Clutch Pressure Port Locations

68RFE

Pressure Specifications

With method #1 or #2 the proper procedure is as follows when testing:

- Check the transmission fluid level and condition (this condition can only be tested when the oil pan is removed).
- Check the shift cable adjustment.
- Raise the vehicle on a hoist, install a tachometer and the pressure gauge with adapter (s).
- Check line pressure while operating the transmission at 1500 engine rpm in Park, Reverse and Drive. Compare the scan tool line pressure reading with the desired line pressure and gauge reading. All three readings should agree. If the gauge reading does not match the scan tool reading, there is a line pressure sensor problem. If the scan tool reading does not match the desired line pressure, there is a pressure control problem (oil level, filter, pump regulator valve, PCS solenoid, etc.)

UPSHIFT PRESSURE								
545RFE								
ENGINE	1-2	2-3	2prime-3	3-4	2prime-4	2-5	3-5	4-5
5.7L	150	125	125	135	135	135	135	135
68RFE								
ENGINE	1-2	2-3	3-4	4-5	5-6	2-4	3-5	4-6
6.7L	160	150	150	160	160	150	150	150

DOWNSHIFT PRESSURES										
545RFE										
ENGINE	5-4	5-3		5-2	4-3	4-2prime	3-2	3-2prime	2prime-1	2-1
5.7L	135	135		135	135	135	135	135	135	135
68RFE										
ENGINE	6-5	6-4	5-4	5-3	4-3	4-2	3-2	3-1	2-1	-
6.7L	150	150	150	160	150	160	150	160	160	-

IN-GEAR PRESSURES									
545RFE									
ENGINE	1	2	2prime	3	4	5	NEUTRAL	REVERSE	
5.7L	160	135	135	135	135	135	120	250	
68RFE									
ENGINE	1	2	3	4	5	6	NEUTRAL	REVERSE	
6.7L	160	150	150	160	160	160	125	250	

Actual line-pressure while in-gear will vary based upon minimum learned line-pressure. Minimum line-pressure starts at 40 psi and learns up to the minimum pressure to hold the clutches in a applied state.

68RFE

Diagnostic Specifications

NOTE: This vehicle uses an NGC4 Control Module (which only controls Transmission operation) and an Engine Control Module (ECM) that controls the Diesel engine. In these procedures, the NGC4 Control Module is referred to as the Powertrain Control Module (PCM).

Perform the following before attempting any diagnostic procedures:

1. With the scan tool, check pinion factor (if equipped) for proper tire identification and program or reprogram if necessary.
2. Check the transmission fluid level. If the fluid level is low, locate and repair any leaks and fill the transmission to the proper level. Refer to the appropriate Service Information for procedures. Many transmission symptoms can be caused by a low fluid level.
3. Check the battery. To avoid false diagnosis, testing should only be performed with the battery fully charged.
4. With the scan tool, read Engine (ECM) DTCs. If DTCs are present, refer to the Drivability Category and perform to the appropriate diagnostic procedure(s) before proceeding.
5. With the scan tool, read Transmission (PCM) DTCs. Record all Stored, Active, and Pending DTC information. Diagnose any Pending DTC as a matured DTC.
6. With the scan tool, read and record the Event Data. Use this data to identify the conditions in which the DTC was set.
7. **NOTE: DTC Event Data may exist even if no DTCs are stored. DTC Event Data is only erased by a Battery Disconnect, reflash, or QuickLearn procedure. Clearing DTCs does NOT erase the DTC Event Data. Some DTCs require two “bad trips” before they are stored (and the MIL illuminates). The transmission may enter “limp-in” mode during the first “bad trip,” but if the fault condition is not present after the vehicle is restarted, the pending DTC may be cleared without lighting the MIL. Nevertheless, the DTC Event Data for the pending DTC will remain stored and can still be retrieved with the scan tool. If the customer reports a “limp-in” event but no DTCs are present, check the DTC Event Data.**

68RFE

Diagnostic Specifications (continued)

Perform the following before attempting any diagnostic procedures: (continued...)

8. Performing a Battery Disconnect will clear all Event Data and reset all learned Transmission values to the default values, which may temporarily result in erratic shift schedules.
9. With the scan tool, perform the Shift Lever Position Test. If the test fails with an error code, refer to the diagnostic procedure for P0706 Transmission Range Sensor Rationality. If the test fails without an error code, adjust the shift linkage in accordance with the Service Information.
10. For Gear Ratio Error DTCs or shift quality complaints, use the scan tool to view CVI Monitor data. Read and record the Clutch Volume Index information.
11. Use the wiring diagram as a guide. Inspect the wiring and connectors related to this circuit. Repair as necessary.
12. Refer to the When Monitored and Set Conditions for this DTC. DTCs can set at ignition on, at start up, after driving under specific conditions and after diagnostic monitors have been run.
13. Refer to applicable Technical Service Bulletins (TSBs) for controller software update information. Some conditions can be corrected by upgrading the Engine (ECM) or Transmission (PCM) controller software.
14. Refer to any Service Information Tune Ups or Technical Service Bulletins that apply.

Were there any repairs made that fixed the vehicle?

Yes - Testing complete. Perform 68RFE TRANSMISSION VERIFICATION TEST.

No - Refer to DTC Based Diagnostics and perform the application.

68RFE

Verification Process

Perform the following after completion of a diagnostic repair:

1. Connect the scan tool to the Data Link Connector (DLC).
 2. With the scan tool check pinion factor (if equipped) for proper tire identification and program or reprogram if necessary.
 3. Reconnect any disconnected components.
 4. If the PCM has been replaced or updated (flashed), or the transmission has been repaired or replaced, using the scan tool, perform a Quick Learn Procedure.
 5. With the scan tool, erase all Transmission and Engine DTCs.
 6. With the scan tool, perform a BATTERY DISCONNECT, this will clear the Event Data
 7. With the scan tool, display Transmission Temperature. Start and run the engine until the Transmission Temperature is HOT.
 8. Check the Transmission fluid level and adjust if necessary. Refer to the Service Information for the Fluid Fill procedure.
 9. Road test the vehicle.
 10. Perform the following shifts from a standing start with a constant throttle opening of 20 to 25 degrees to the speeds of 97 km/h (60 mph); make fifteen to twenty 1 to 2, 2 to 3, 3 to 4, 4 to 5, 5 to 6 upshifts.
 11. Perform the following shifts with speeds below 40 km/h (25 mph); make five to eight wide open throttle kickdowns to 2nd gear. Allow at least 5 seconds each in 3rd and 4th gear between each kickdown.
 12. Check for DTCs during and after the road test.
 13. If after performing the road test, if any shift concerns are noted, perform the drive learn procedure for those affected shifts.
 14. Use the OBDII task manager to run Good Trip time in each gear, this will confirm the repair and to ensure that the DTC does not re-mature
- Were there any Diagnostic Trouble Codes (DTCs) set during the road test?
- Yes - Refer to DTC Based Diagnostics and perform the appropriate diagnostic procedure.
- No - Repair is complete.

68RFE

Scan Tool Acronyms

DESCRIPTION		DESCRIPTION	
2C	2 nd Clutch or Solenoid	4C	4 th Clutch or Solenoid
2/4	2/4 Clutch	2-4	2-4 Solenoid
41/42	41TE/AE, 42LE, 42RLE	APPS	Accelerator Pedal Position Signal
AWD	All-Wheel Drive	BCM	Body Control Module
BTS	Battery Temperature Sensor	CARB	California Air Resources Board
CC	Converter Clutch	CKP	Crank Shaft Position (Sensor)
CPU	Central Processing Unit	CVI	Clutch Volume Index
DRBIII®	Diagnostic Readout Box	DLC	Data Link Connector
DTC	Diagnostic Trouble Code	EATX	Electronic Automatic Transmission/Transaxle
EC	Error Counter	ECT	Engine Coolant Temperature Sensor
EF	Error Flag	EMCC	Electronically-Modulated Converter Clutch
FEMCC	Full Electronically-Modulated Converter Clutch	F/S	Fail Safe
FWD	Front-Wheel Drive	IAC	Idle Air Control (MOTOR)
ICS	Ignition Control Module	LPS	Line Pressure Solenoid
L / R	Low Reverse Clutch	LR/CC	Low Reverse / Converter Clutch Solenoid
MAP	Manifold Absolute Pressure (SENSOR)	MIL	Malfunction Indicator Lamp
MS	Multi-Select Solenoid	NGC	Next Generation Controller
NTC	Negative Temperature Coefficient	OBDII	On Board Diagnostics Level II
OD	Overdrive Clutch or Solenoid	ORC	Overrunning Clutch
OSS	Output Speed Sensor	OTGR	Overall Top Gear Ratio
PCI	Programmable Communication Interface	PCS	Pressure Control Solenoid (closed loop)
PCD	Power Distribution Center	PEMCC	Partially Electronically-Modulated Converter Clutch
PWM	Pulse Width Modulated	REV	Reverse or Reverse Clutch
RFE	45RFE/545RFE, 68RFE	RWD	Rear Wheel Drive
SLP	Shift Lever Position	SSV	Solenoid Switch Valve
TCC	Torque Converter Clutch	TCM	Transmission Control Module
TCR	Transmission Control Relay	TIPM	Totally Integrated Power Module
TPS	Throttle Position Sensor	TRD	Torque Reduction Link
TRS	Transmission Range Sensor	TSB	Technical Service Bulletin
TSS	Turbine Speed Sensor	TTS	Transmission Temperature Sensor
UD	Underdrive Clutch or Solenoid	VPWM	Variable Pulse Width Modulated
VSS	Vehicle Speed Sensor	TOT	Transmission Oil Temperature
VFS	Variable Force Solenoid (same as PCS)	ERS	Electronic Range Select
VLP	Variable Line Pressure		

This is not a complete list. Just the most common terms that are used when looking at diagnostic information. Always keep notes of NEW ACRONYMS.

68RFE

Quick Learn Procedures

The quick learn procedure requires the use of the scan tool.

This program allows the electronic transmission system to recalibrate itself. This will provide the proper transmission operation. The quick learn procedure should be performed if any of the following procedures are performed:

- Transmission Assembly Replacement.
- Transmission Control Module Replacement.
- Solenoid Pack Replacement.
- Clutch Plate and/or Seal Replacement.
- Valve Body Replacement or Recondition.

To perform the Quick Learn Procedure, the following conditions must be met:

1. The brakes must be applied.
2. The engine speed must be above 500 rpm.
3. The throttle angle (TPS) must be less than 3 degrees.
4. The shift lever position must stay in PARK until prompted to shift to overdrive.
5. The shift lever position must stay in overdrive after the Shift to Overdrive prompt until the scan tool indicates the procedure is complete.
6. The calculated oil temperature must be above 60°F and below 200°F.

68RFE

Drive Learn Procedures

When a transmission is repaired and a Quick Learn procedure has been performed on the Transmission Control Module (TCM), the following Drive Learn procedure can be performed to fine tune any shifts which are particularly objectionable.

NOTE: It is not necessary to perform the complete Drive Learn procedure every time the TCM is Quick Learned. Perform only the portions which target the objectionable shift.

Learn a Smooth 1st Neutral to Drive Shift

Perform this procedure only if the complaint is for a delayed or harsh shift the first time the transmission is put into gear after the vehicle is allowed to set with the engine not running for at least 10 minutes. Use the following steps to have the TCM learn the 1st N-D UD CVI.

NOTE: The transmission oil temperature must be between 80° - 110°F (27° - 43°C).

1. Start the engine only when the engine and ignition have been off for at least ten (10) minutes.
2. With the vehicle at a stop and the service brake applied, record the 1st N-D UD CVI while performing a Neutral to Drive shift. The 1st N-D UD CVI accounts for air entrapment in the UD clutch that may occur after the engine has been off for a period of time.
3. Repeat Step #1 and Step #2 until the recorded 1st N-D UD CVI value stabilizes.

NOTE: It's important that this procedure be performed when the transmission temperature is between 80° - 110°F (27° - 43°C). If this procedure takes too long to complete fully for the allowed transmission oil temperature, the vehicle may be returned to the customer with an explanation that the shift will improve daily during normal vehicle usage.

The TCM also learns at higher oil temperatures, but these values (line pressure correction values) are not available for viewing on the scan tool.

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Drive Learn Procedures (continued)

Learn a Smooth Neutral to Drive Garage Shift

Perform this procedure if the complaint is for a delayed or harsh shift when the transmission is put into gear after the vehicle has had its first shift. Use the following steps to have the TCM learn the Norm N-D UD CVI.

NOTE: The transmission oil temperature must be between 80 - 110°F (27 - 43°C) to learn the UD CVI. Additional learning occurs at temperatures as low as 0°F and as high as 200°F. This procedure may be performed at any temperature that experiences poor shift quality. Although the UD CVI may not change, shift quality should improve.

Learn a Smooth Neutral to Drive Garage Shift

1. Start the vehicle engine and shift to drive.
2. Move the vehicle forward to a speed of at least 16 km/h (10 MPH) and come to a stop. This ensures no air is present in the UD hydraulic circuit.
3. Perform repeated N-D shifts at a stop while pausing in Neutral for at least 2-3 seconds and monitor Norm N-D UD CVI value until the value stabilizes. The value will change during the N-D shift. This is normal since the UD value is different for the N-D shift then the normal value shown which is used for 4-3 coastdown and kickdowns. Perform repeated shifts in this temperature range until the Norm N-D UD CVI value stabilizes and the N-D shifts become smooth.

Learn the 1st 2-3 Shift After Restart or Shift Reverse

Use the following steps to have the TCM learn the 1st 2-3 shift OD CVI.

NOTE: The transmission oil temperature must be above 80°F (27°C).

1. With the vehicle engine running, select reverse gear for over 2 seconds.
2. Shift the transmission to Drive and accelerate the vehicle from a stop at a steady 15 degree throttle opening and perform a 2-3 shift while noting the 1st 2-3 OD CVI.
3. Repeat Step #1 and Step #2 until the 1st 2-3 upshift becomes smooth and the 1st 2-3 OD CVI stabilizes.

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Drive Learn Procedures (continued)

Learn a Smooth 2-3 and 3-4 Upshift

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the OD and 4C CVI's.

1. Accelerate the vehicle from a stop at a steady 15 degree throttle opening and perform multiple 1-2, 2-3, and 3-4 upshifts. The 2nd 2-3 shift following a restart or shift to reverse will be shown during the shift as a value between the 1st 2-3 OD CVI and the normal OD CVI. Updates to the normal OD CVI will occur after the 2nd shift into 3rd gear, following a restart or shift to reverse.
2. Repeat Step #1 until the 2-3 and 3-4 shifts become smooth and the OD and 4C CVI become stable.

Learn a Smooth 4-3 Coastdown and Part Throttle 4-3 Kickdown Shift

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the UD shift volume.

1. At a vehicle speed between 64-97 km/h (40-60 MPH), perform repeated 4-3 kickdown shifts.
2. Repeat Step #1 until the UD volume becomes somewhat stable and the shift becomes smooth.

Learn a Smooth 1-2 Upshift and 3-2 Kickdown

Use the following steps to have the TCM learn the 2C shift volume.

NOTE: The transmission oil temperature must be above 110°F (43°C).

1. With a vehicle speed below 48 km/h (30 MPH) and the transmission in 3rd gear, perform multiple 3-2 kickdowns.
2. Repeat Step #1 until the 3-2 kickdowns become smooth and the 2C CVI becomes stable.

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Drive Learn Procedures (continued)

Learn a Smooth Manual 2-1 Pulldown Shift as well as a Neutral to Reverse Shift

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the LR volume.

1. With the vehicle speed around 40-48 km/h (25-30 MPH) in Manual 2nd, perform manual pulldowns to Low or 1st gear at closed throttle.
2. Repeat Step #1 until the LR CVI becomes stable and the manual 2-1 becomes smooth.

Learn a Smooth Neutral to Reverse Shift

NOTE: The transmission oil temperature must be above 110°F (43°C).

1. With the vehicle at a stop, perform Neutral to Reverse shifts until the shift is smooth. An unlearned Neutral to Reverse shift may be harsh or exhibit a double bump.
2. If any of the shifts are still not smooth after the clutch volume stabilizes, an internal transmission problem may be present.

Learn a Smooth 4-5 Upshift

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the Alt 2C CVI.

1. Accelerate the vehicle through 88 km/h (55mph) at a steady 10-15 degree throttle opening and perform multiple 4-5 upshifts.
2. Repeat Step #1 until the 4-5 shift become smooth and the Alt 2C CVI become stable. There is a separate 2C volume used and learned for 4-5 shifts, 2CA. It is independent of the 2C CVI learned on 3-2 kickdowns.

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Test Tools

Simulator Box

The simulator box values are specific and when used in conjunction with a scan tool, all parameters can be checked for the true preset values. The box will test range sensor, pressure switches, speed sensors, etc. It helps to eliminate wiring and module from diagnosis.



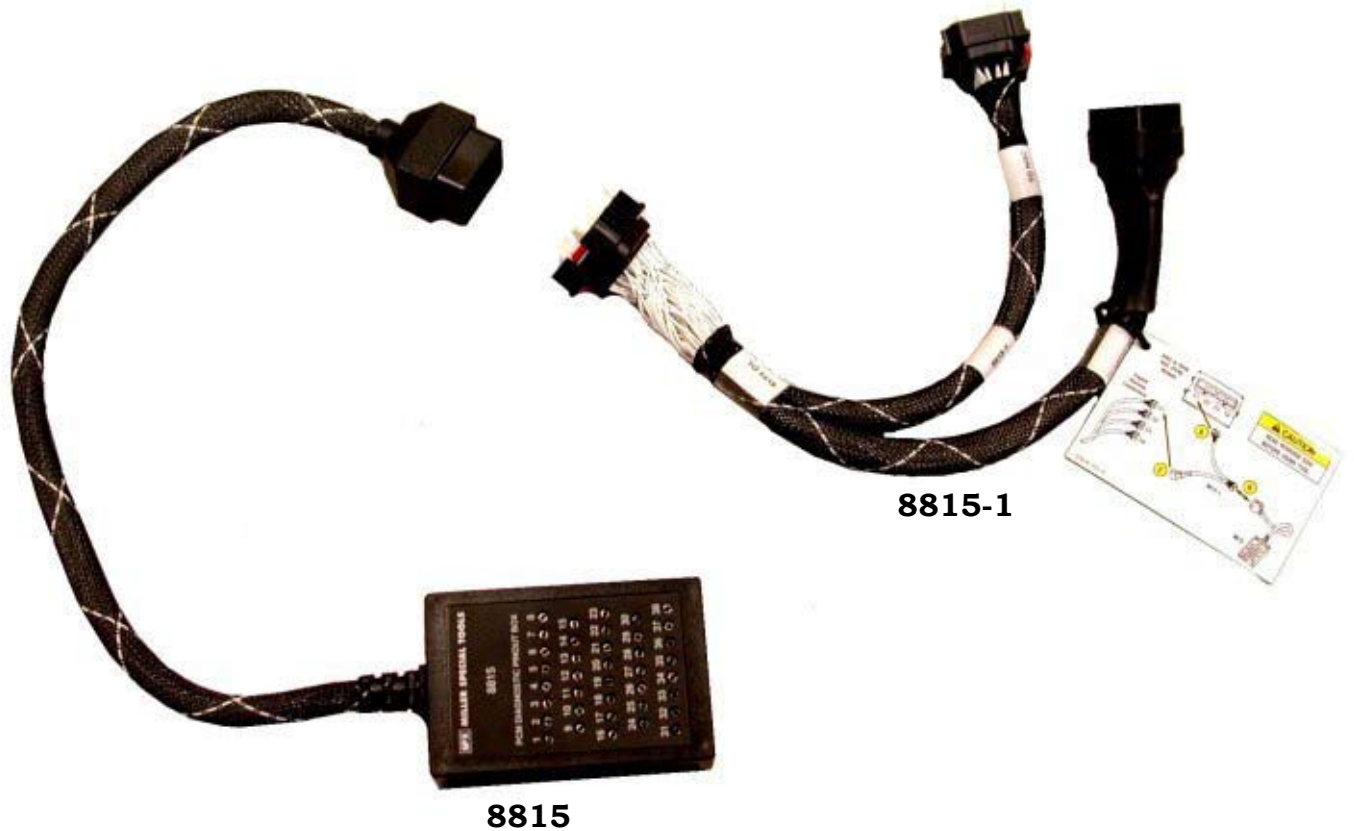
68RFE

Test Tools (continued)

Breakout Box

The breakout box allows you to do voltage testing with the NGC (Next Gen. Controller) without doing damage to the pins. The module pins are very easily damaged when testing if the box is not used.

Miller Tool 8815 & 8815-1



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Code Descriptions

With computer strategy changing to allow for a full time six (6) speed, diagnostic codes also had to be added to allow for the different ratios. Typically when dealing with codes for ratio errors they start off with P0731 for a 1st gear ratio followed by P0732 for 2nd and so on. Because the P0736 was already established for “REVERSE” on the 45/545RFE the ratio code for 6th gear does not follow the rule of which gear that is having the ratio issues. The code for 6th gear ratio is P0729.

Code List is as follows:

P0218 – HIGH TEMPERATURE OPERATION ACTIVATED
P0602 – CONTROL MODULE PROGRAMMING ERROR/NOT PROGRAMMED
P0604 – INTERNAL CONTROL MODULE RAM
P0605 – INTERNAL CONTROL MODULE ROM
P0613 – INTERNAL TCM
P0706 – TRANSMISSION RANGE SENSOR RATIONALITY
P0711 – TRANSMISSION TEMPERATURE SENSOR PERFORMANCE
P0712 – TRANSMISSION TEMPERATURE SENSOR LOW
P0713 – TRANSMISSION TEMPERATURE SENSOR HIGH
P0714 – TRANSMISSION TEMPERATURE SENSOR INTERMITTENT
P0716 – INPUT SPEED SENSOR 1 CIRCUIT PERFORMANCE
P0721 – OUTPUT SPEED SENSOR CIRCUIT PERFORMANCE
P0729 – GEAR RATIO ERROR IN 6TH
P0731 – GEAR RATIO ERROR IN 1ST
P0732 – GEAR RATIO ERROR IN 2ND
P0733 – GEAR RATIO ERROR IN 3RD
P0734 – GEAR RATIO ERROR IN 4TH
P0735 – GEAR RATIO ERROR IN 5TH
P0736 – GEAR RATIO ERROR IN REVERSE
P0740 – TCC OUT OF RANGE
P0750– L/R SOLENOID CIRCUIT
P0755– 2C SOLENOID CIRCUIT
P0760– OD SOLENOID CIRCUIT
P0765– UD SOLENOID CIRCUIT
P0770– 4C SOLENOID CIRCUIT
P0841– L/R PRESSURE SWITCH RATIONALITY
P0845– 2C HYDRAULIC PRESSURE TEST
P0846– 2C PRESSURE SWITCH RATIONALITY
P0868– LINE PRESSURE LOW
P0869– LINE PRESSURE HIGH
P0870– OD HYDRAULIC PRESSURE TEST

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Code Descriptions (continued)

Code List is as follows:

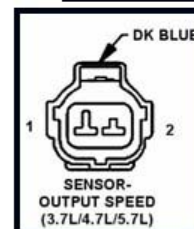
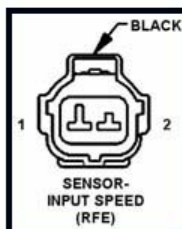
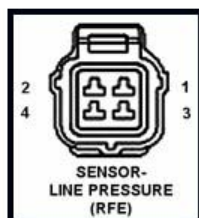
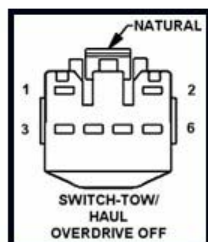
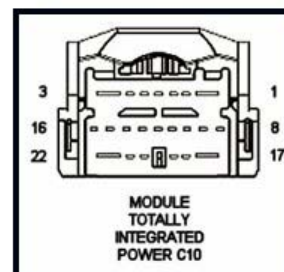
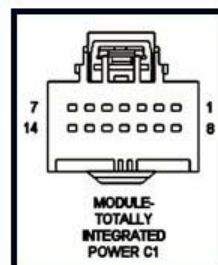
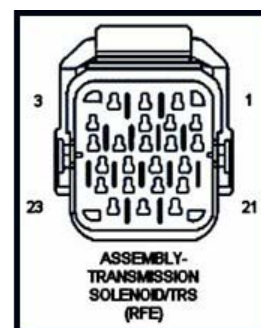
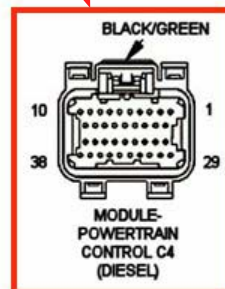
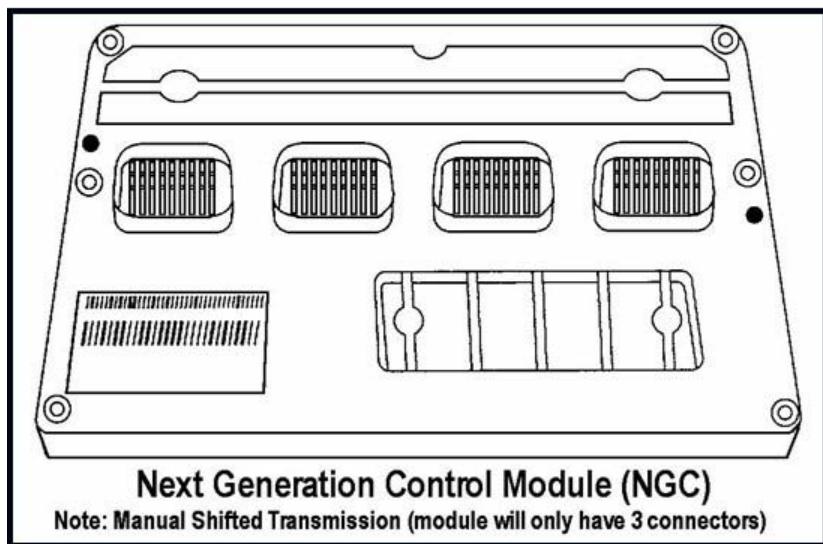
P0871- OD PRESSURE SWITCH RATIONALITY
P0875- UD HYDRAULIC PRESSURE TEST
P0876- UD PRESSURE SWITCH RATIONALITY
P0882- TCM POWER INPUT LOW
P0883- TCM POWER INPUT HIGH
P0884- POWER UP AT SPEED
P0890- SWITCHED BATTERY
P0933- HYDRAULIC PRESSURE SENSOR RANGE/PERFORMANCE
P0934- LINE PRESSURE SENSOR CIRCUIT LOW
P0935- LINE PRESSURE SENSOR CIRCUIT LOW
P0944- LOSS OF HYDRAULIC PUMP PRIME
P0957- AUTO STICK CIRCUIT LOW (ERS)
P0958- AUTO STICK CIRCUIT HIGH (ERS)
P0987- 4C HYDRAULIC PRESSURE TEST
P0988- 4C PRESSURE SWITCH RATIONALITY
P1684- BATTERY WAS DISCONNECTED
P1715- RESTRICTED MANUAL VALVE IN T3 RANGE
P1775- SOLENOID SWITCH VALVE LATCHED IN TCC POSITION
P1776- SOLENOID SWITCH VALVE LATCHED IN L/R POSITION
P1794- SPEED SENSOR GROUND ERROR
P2700- INADEQUATE ELEMENT VOLUME L/R
P2701- INADEQUATE ELEMENT VOLUME 2C
P2702- INADEQUATE ELEMENT VOLUME OD
P2703- INADEQUATE ELEMENT VOLUME UD
P2704- INADEQUATE ELEMENT VOLUME 4C
P2706- MS SOLENOID CIRCUIT
U0002- CAN C BUS OFF PERFORMANCE
U0100- NO COMMUNICATION WITH THE ECM/PCM
U0121- LOST COMMUNICATION WITH ABS
U0141- LOST COMMUNICATION WITH FCM

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Module and Connectors

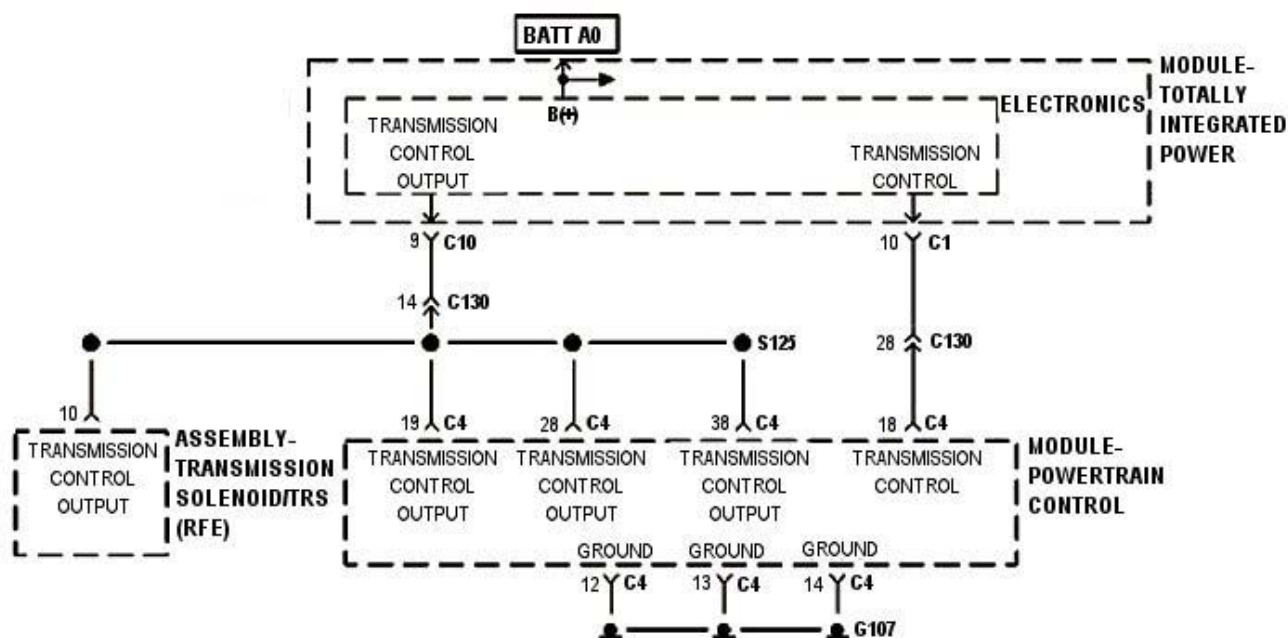
Understanding pin positions and connector make the diagnosis procedures a breeze. The Next Generation module has four connectors. The Black/Green connector is the C4 which houses most all the transmission controls.

The Black/Green connector is the C4 which houses most all the transmission controls.



Power and Ground Circuits

Powertrain Control Module grounds must have no voltage present.



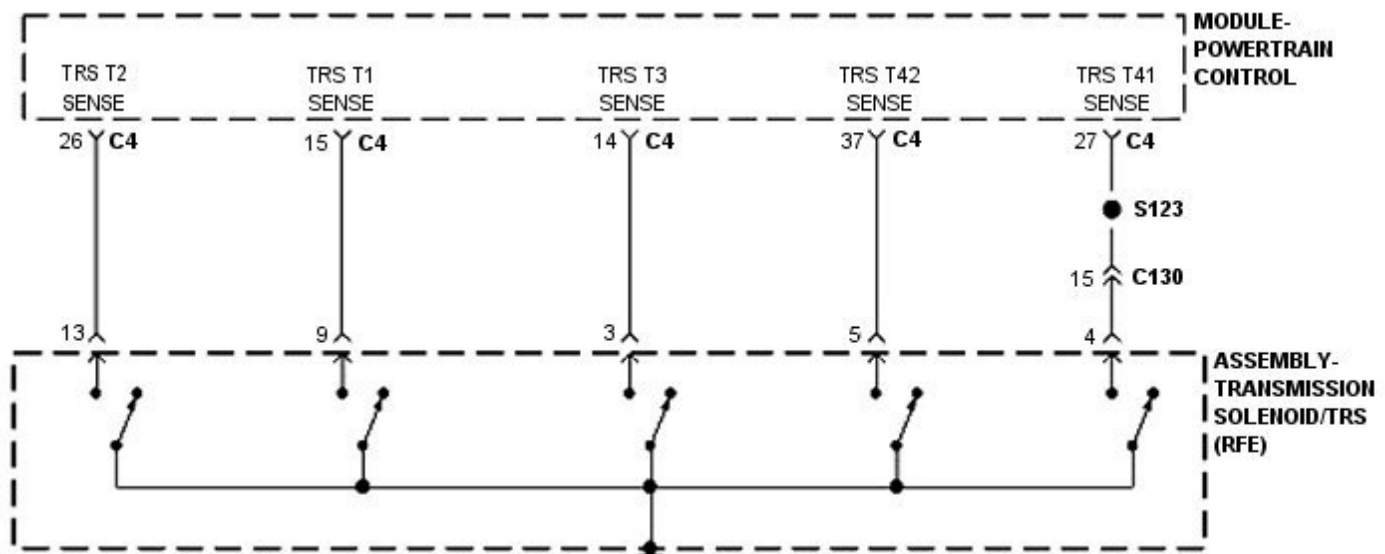
With Diesels (two batteries), both batteries need to be at the same surface voltages. If one is lower than the other this will cause the charging system to compensate for the battery that is undercharged. Remember, step one in any diagnosis after documenting and clearing trouble codes is to clean the batteries, even if they look clean and retest for codes.

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Range Sensor

Because of this being a electronically controlled transmission, the range sensor inputs are very critical in order for the transmission module to function properly. When reading on scan data the “PID” names are C1-C2-C3-C4-C5. There are transition ranges so that the module knows the direction the driver is selecting while moving the shifter.

These transitions are referred to as TMP 1-TMP 2-TMP 3. Remember that the manual valve only has three positions that change oil flow. This means that in order to control shift schedules this input is imperative.



TRS SWITCH STATES

	PARK	TMP 1	REV	TMP 2	N1	N2	TMP 3	D	TMP 4	MAN 2	TMP 5	MAN 1
T41 (C1)	CL	OP	OP	OP	CL	CL	OP	OP	OP	OP	OP	OP
T42 (C2)	CL	CL	CL	CL	CL	CL	CL	OP	OP	OP	OP	OP
T3 (C3)	OP	OP	OP	CL	CL	CL	CL	CL	OP	OP	OP	CL
T1 (C4)	OP	OP	OP	OP	OP	CL	CL	CL	CL	CL	OP	OP
T2 (C5)	CL	CL	OP	OP	OP	OP	OP	OP	OP	CL	CL	CL

SHIFT LEVER ERROR CODES

ERROR CODE	SWITCH STUCK	POSITION	ERROR CODE	SWITCH STUCK	POSITION
1	T41 (C1)	OPEN	7	T1 (C4)	OPEN
2	T41 (C1)	CLOSED	8	T1 (C4)	CLOSED
3	T42 (C2)	OPEN	9	T2 (C5)	OPEN
4	T42 (C2)	CLOSED	10	T2 (C5)	CLOSED
5	T3 (C2)	OPEN	11	TOW/HAUL	OPEN
6	T3 (C2)	CLOSED	12	TOW/HAUL	CLOSED

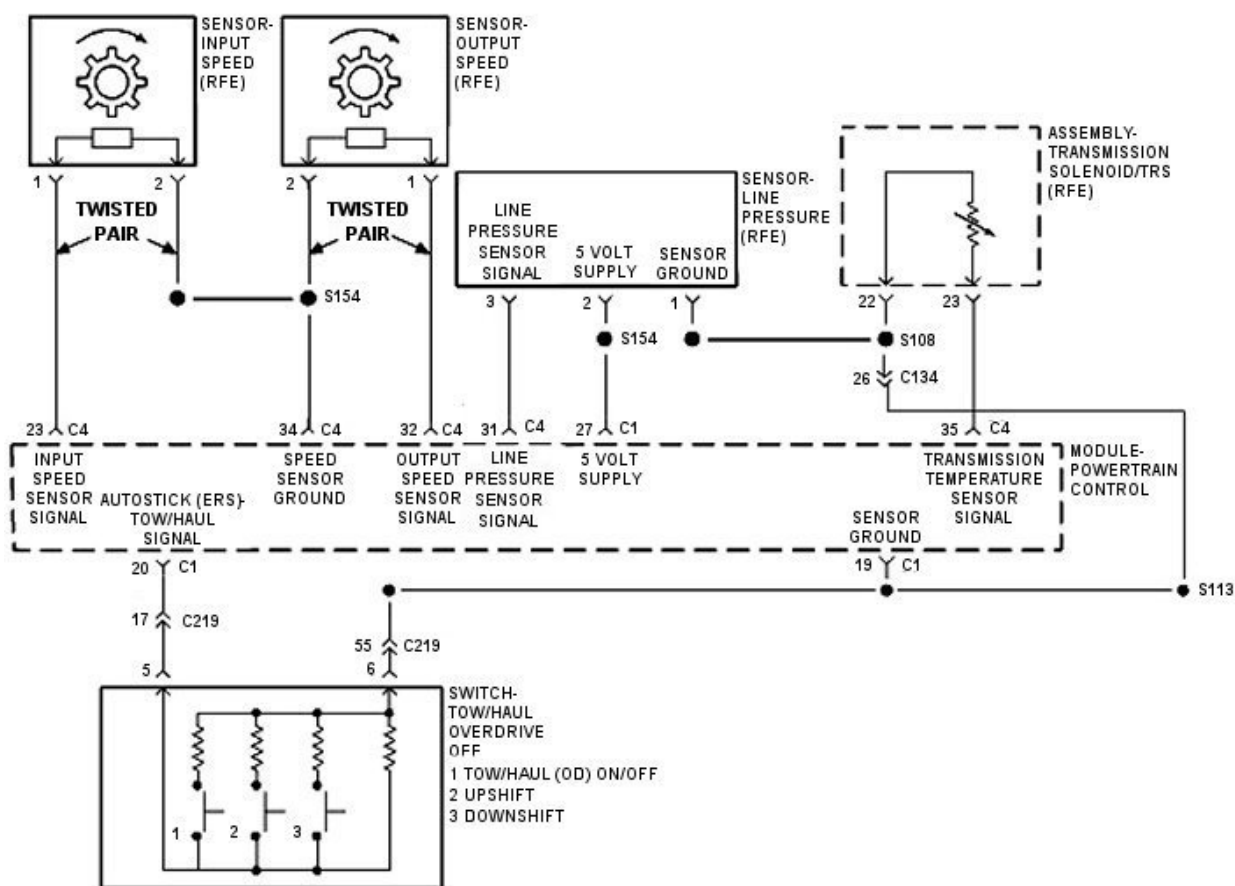
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Sensor Circuits

Speed Sensors, Pressure Sensor, Temperature Sensor and OD Cancel-TOW/HAUL

Essential to transmission operation is the use of sensors (inputs). There are two speed sensors (input and output) that measure rpm. These sensors register the speed of shift transitions and are used to determine the CVI (clutch volume index) values. In addition to these sensors there is; line pressure sensor (feeds a signal voltage informing the module what line pressure is doing).

This is a feed back/closed loop for a command on line pressure given from the module), Temperature sensor (used so the module can control shift timing and feel through all the temperature ranges), OD cancel/Tow/haul switch that allows the module to know if the driver is towing and or requesting that OD is canceled.



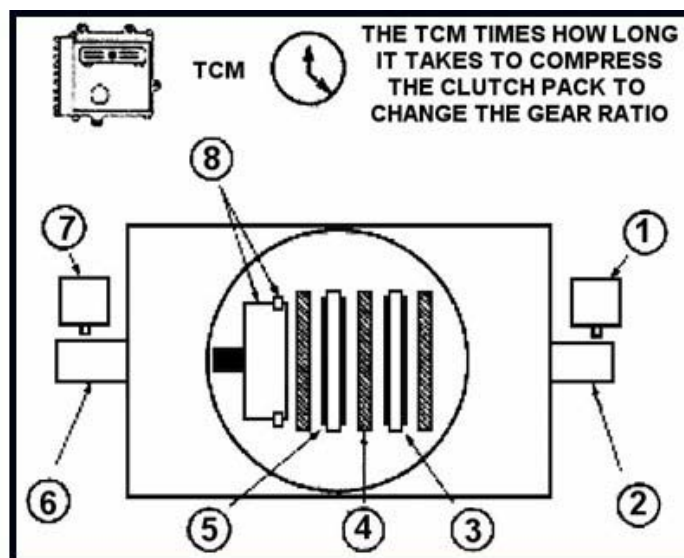
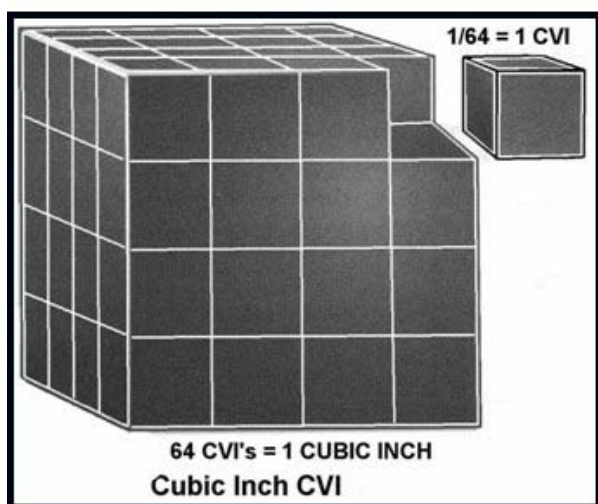
Note: Remember when OD is canceled this is a 4 speed unit (5th and 6th gear are both OD ranges)

68RFE

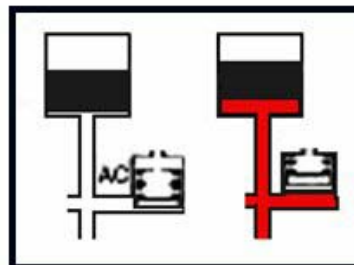
Understanding Clutch Volume Index (CVI)

CVI is the measurement of the physical amount of fluid required to fill the clutch and stroke the piston. CVIs are in general updated when a clutch is applied. These measurements require the use of speed sensing devices (input and output speed sensors).

Note: 1 (one) CVI is equal to 1/64 of a cubic inch of transmission fluid (64 CVIs would equal one square inch of oil). Gear Ratios are determined by monitoring change in speed rotations of input signals from the Input and Output speed sensors. By comparing the two inputs, the TCM determines not only which gear you are in but also the CVI monitor value. These values are based on how long it takes to complete a gear change.



1	OUTPUT SPEED SENSOR	5	FRICTION DISCS
2	OUTPUT SHAFT	6	INPUT SHAFT
3	CLUTCH PACK	7	INPUT SPEED SENSOR
4	SEPARATOR PLATE	8	PISTON AND SEAL



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Understanding Clutch Volume Index (CVI) (continued)

Electronically, the upshifts are performed by timing the venting of the releasing clutch to the filling of the applying clutch. The releasing clutch must lose its holding capacity at the same time the applying clutch gains holding capacity. Proper CVI values are critical to properly perform upshifts.

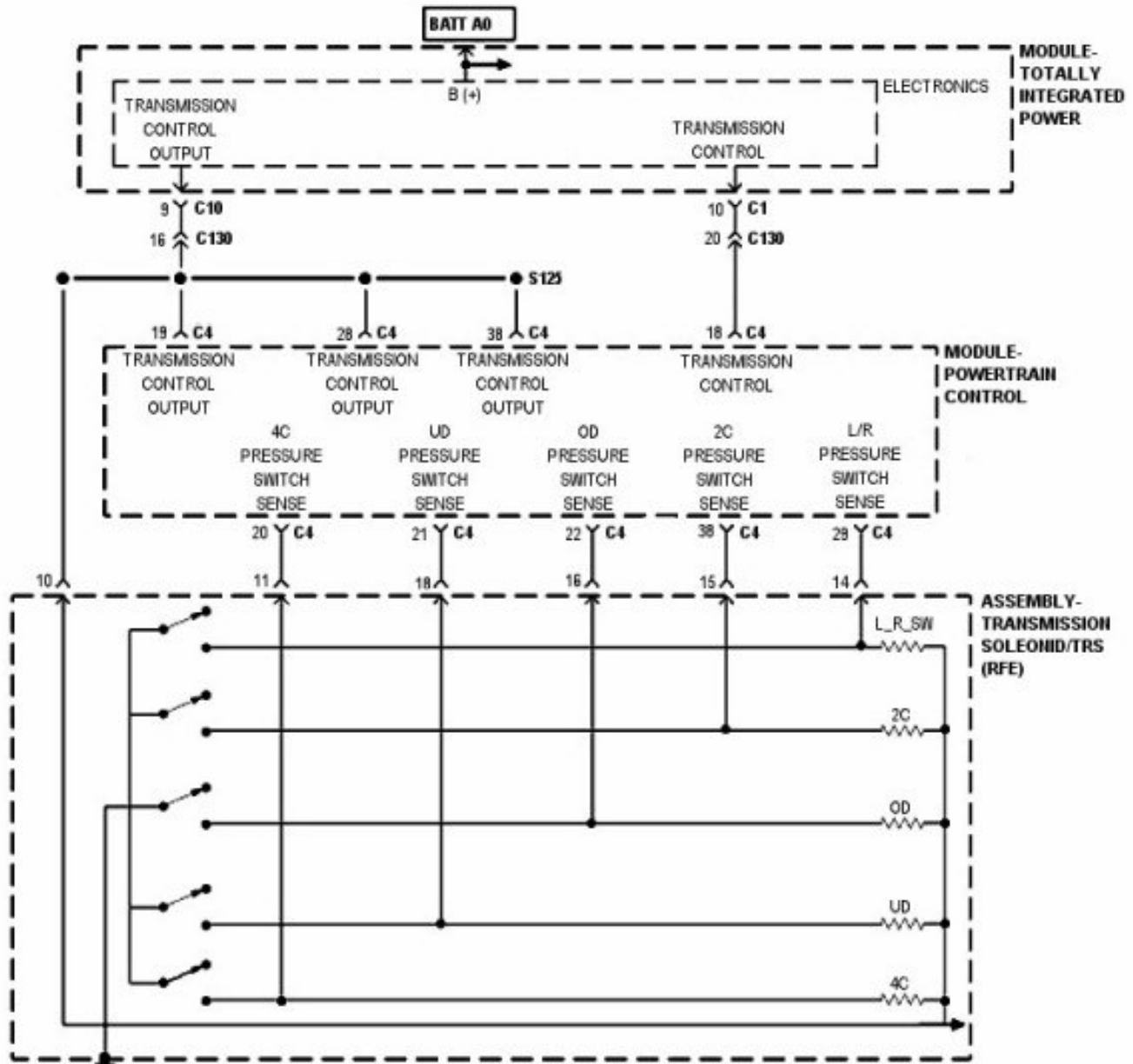
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CLUTCH VOLUMES		
Clutch	When Updated	Proper Clutch Volume
L/R	2-1, 3-1 or 4-1 downshift.	45 to 134
2C	4-3 or 3-2 downshift.	25 to 85
2C Alternate	5-6 upshift	25 to 85
OD	3-4 upshift	30 to 100
4C	4-5 upshift	30 to 85
4C Alternate	2-3 upshift	30 to 85
UD	5-4 or 6-4 kickdown shift	30 to 100

Each accumulator has the holding value of 64 CVIs. If the measurement of oil passing through the valve passageways and applying the holding clutch element was an additional 64 CVIs that would give a value of 128 CVIs (Too High). The accumulator CVIs are not taken into consideration when the scan data is shown, only the clutch volume (applying oil) is which would be 64.

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Pressure Switch Wiring



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Pressure Switch Specifications

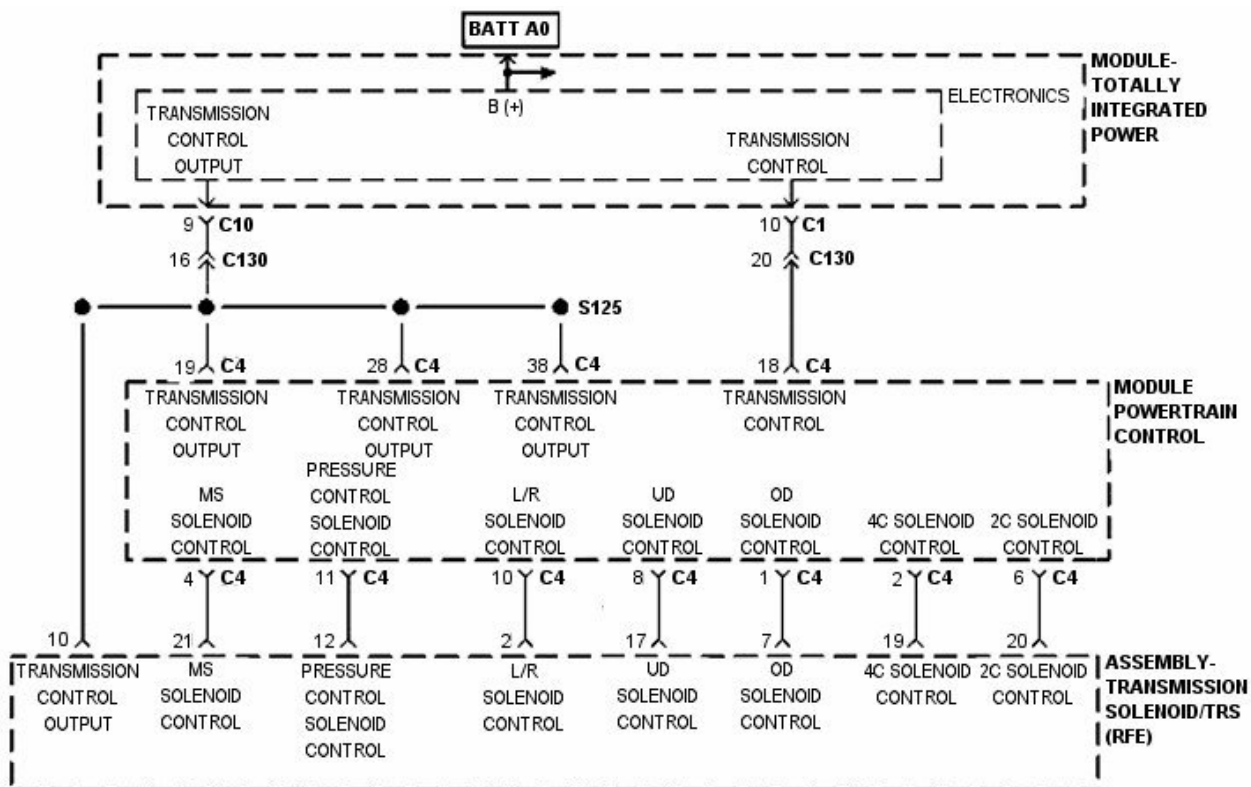
The Transmission System uses five (5) pressure switches to monitor the fluid pressure in the L/R, 2C, 4C, UD, and OD clutch circuits. These switches are continuously monitored for the correct states in each gear as shown.

PRESSURE SWITCH STATES					
GEAR	L/R	2C	4C	UD	OD
REVERSE	OPEN	OPEN	OPEN	OPEN	OPEN
P/N	CLOSED**	OPEN	OPEN	OPEN	OPEN
1ST	CLOSED*	OPEN	OPEN	CLOSED	OPEN
2ND	OPEN	CLOSED	OPEN	CLOSED	OPEN
3RD	OPEN	OPEN	CLOSED	CLOSED	OPEN
4TH	OPEN	OPEN	OPEN	CLOSED	CLOSED
5TH	OPEN	OPEN	CLOSED	OPEN	CLOSED
6TH	OPEN	CLOSED	OPEN	OPEN	CLOSED
* = L/R is closed if output speed is below 100 rpm in Drive. L/R is closed in Manual (ERS) 1 st					
** = May be open when rolling in Neutral or at low oil temperatures					

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Shift Solenoid Control

There are six (6) solenoids used to control hydraulic fluid direction in this transmission and one (1) solenoid used to control (reduce) line pressure. The continuity of each solenoid circuit is periodically tested. Each inactive solenoid is turned on for a few milliseconds, then off. Each active solenoid is turned off for a few milliseconds, then on. This pulsing of voltage to the solenoid causes an inductive spike which can be sensed by the Transmission Control System. If this spike is out of range a solenoid code will set.



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Shift Solenoid Control (continued)

When hydraulic diagrams are required for shift concerns, use the 545RFE diagrams for your reference. 1st gear is the same, 2nd gear is the same, 2nd gear prime is now 3rd gear, 3rd gear will be now 4th, 4th will be used as 5th, and what was the 5th gear will now be 6th. Changes in how the 4th clutch holds when locking onto the clutch hub (originally holding a ring gear/annulus but with the 68RFE holding a sun gear) have allowed for the full time 6 speed. Oil flow through the shift solenoids and valve body has remained the same other than the computer strategy for gear command.

Solenoid Resistance values:

Line Pressure = 4.3 ohms

All Others = 1.9 ohms

SOLENOID APPLICATION CHART							
SHIFTER POSITION	GEAR	UD (NA)	OD (NV)	4C (NV)	2C (NV)	L/R (NV)	MS (NA)
P/N	P/N	OFF	OFF	OFF	OFF	ON ##	ON
R	R	OFF	OFF	OFF	OFF	OFF	OFF ++
OD	1 ST	OFF	OFF	OFF	OFF	ON **	ON
OD	2 ND	OFF	OFF	OFF	ON	OFF ^^	ON
OD	3 RD	OFF	OFF	ON	OFF	OFF ^^	ON
OD	4 TH >>	OFF	OFF	OFF	OFF	OFF ^^	OFF
OD	5 TH	ON	OFF	ON	OFF	OFF ^^	OFF
OD	6 TH	ON	ON	OFF	ON	OFF ^^	ON
Manual Low or autostick 1st	1st	OFF	OFF	OFF	OFF	ON	ON
Manual 2nd	2 nd >>	OFF	OFF	OFF	OFF	OFF	OFF
>> = Failsafe is 4 th gear, all solenoids off in OD range. Failsafe is 2 nd gear if shifter is moved to manual 2-1 range							
** = On only from Neutral or Coast Down or in Manual 1. Off with Output RPM above 100. Off with kickdown to 1 st . Off during extreme cold shift schedule.							
## = Off if speed is over 8 mph (prevents engagement)							
++ = On only if shift to Reverse is above 8 mph.							
^^ = Modulates for Convert Clutch EMCC							

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Oil Pump Valve Description

Converter Clutch Switch Valve

The converter clutch switch valve is used to control the direction of oil flow to the torque converter. When the converter clutch is released (CC switch valve downshifted), hydraulic pressure is supplied to the front (OFF) side of the torque converter clutch. When the converter clutch is applied (CC switch valve upshifted), regulated oil pressure is supplied to the back (ON) side of the converter clutch.

Converter Clutch Regulator Control Valve and Accumulator

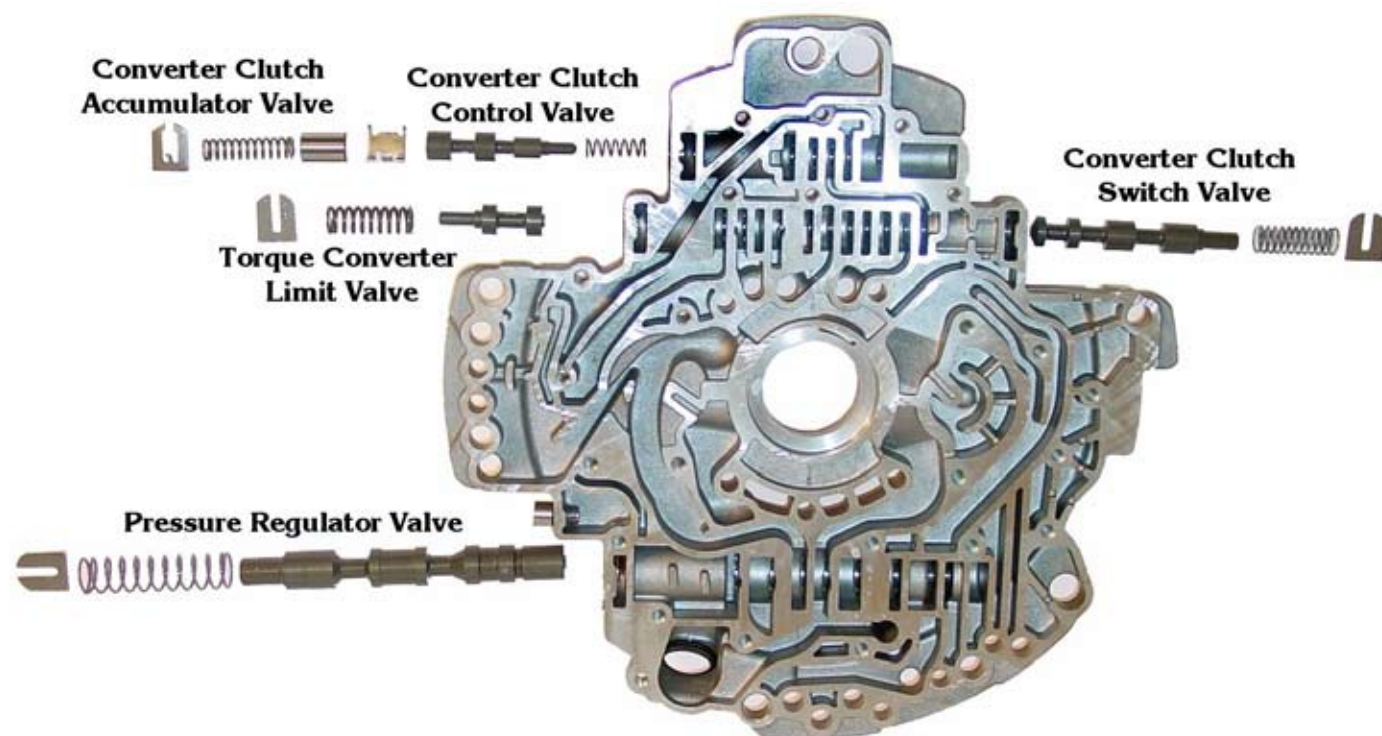
The converter clutch regulator valve is used to control the hydraulic pressure supplied to the back (ON) side of the torque converter clutch.

Torque Converter Limit Valve

The torque converter limit valve serves to limit the maximum pressure supplied to the front side of the torque converter clutch.

Pressure Regulator Valve

The pressure regulator valve controls the line pressure in the transmission. It is a balanced dump valve to maintain a fixed line value. With the use of the Line Pressure Solenoid the pressure can be lowered to a working value.



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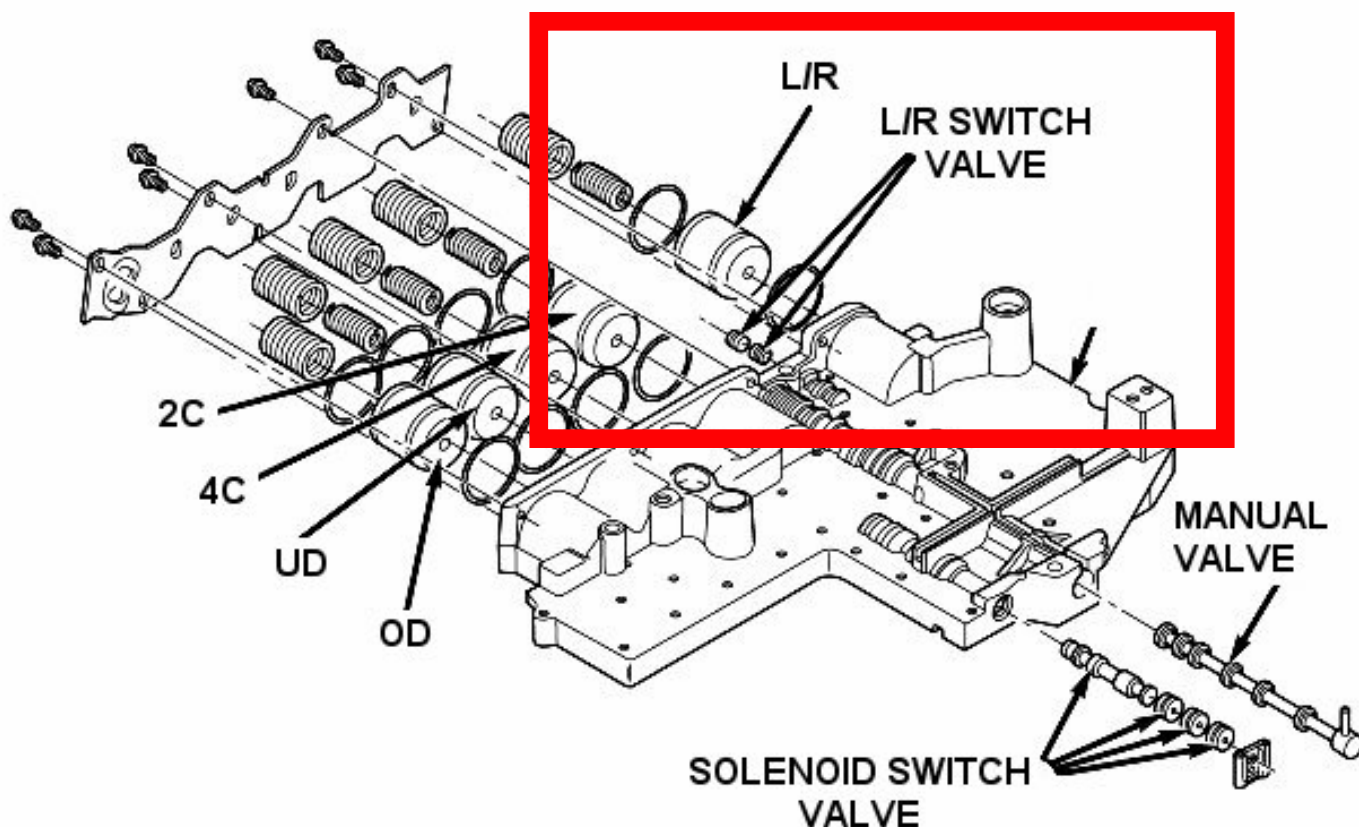
Upper Valve Body

The Solenoid Switch Valve (SSV) controls the direction of the transmission fluid when the L/R-TCC solenoid is energized. The Solenoid Switch Valve controls line pressure from the LR-TCC solenoid.

In 1st gear, the SSV will be in the downshifted position directing fluid to the L/R clutch circuit. In all other gears, the solenoid switch valve will be in the upshifted position and directs fluid into the torque converter clutch (TCC) circuit.

When shifting into 1st gear, a special hydraulic sequence is performed to ensure SSV movement into the downshifted position. The L/R pressure switch is monitored to confirm SSV movement.

If the movement is not confirmed (the L/R pressure switch does not close), 2nd gear is substituted for 1st. A DTC will be set after three unsuccessful attempts are made to get into 1st gear in one given key start.



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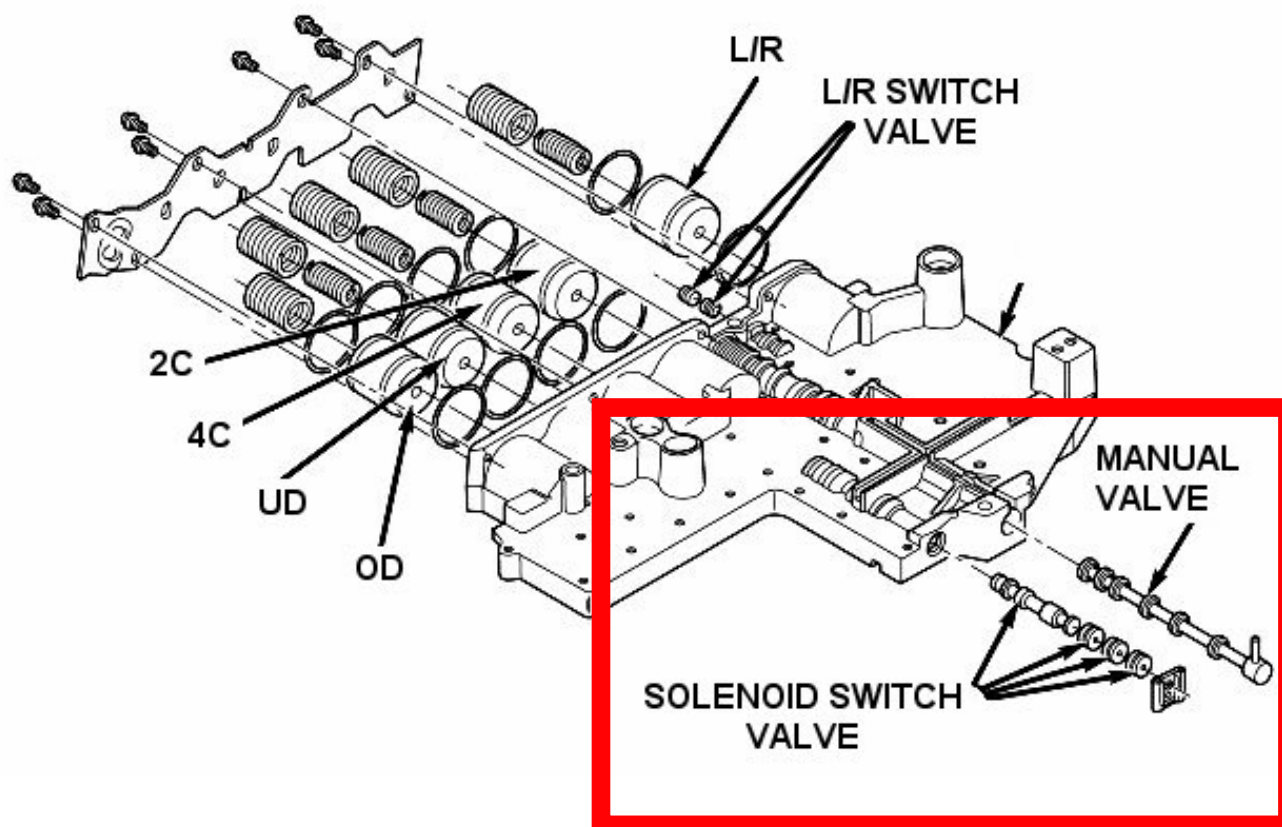
Upper Valve Body (continued)

Manual Valve

The manual valve is a relay valve. The purpose of the manual valve is to direct fluid to the correct circuit needed for a specific gear or driving range. The manual valve, as the name implies, is manually operated by the driver with a lever located on the top of the valve body. The valve is connected mechanically to the gearshift mechanism. The valve is held in each of its positions by a roller detent spring that engages the rooster comb of the TRS selector plate.

Low/Reverse Switch Valve

The low/reverse switch valve allows the low/reverse clutch to be operated by either the LR/CC solenoid or the MS solenoid.



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Lower Valve Body

Check Ball and Functions

There are 7 check balls located in the lower valve body. It is important when doing repairs to the valve body that new check balls be installed.

Ball #1: Used in 2nd gear. Neutral to 8 mph. If left out will energize the L/R clutch. In 2nd, 3rd, and kickdown to 1500 RPM, three elements apply.

Ball #2: Used in 5th gear. If the ball is left out energizes the UD clutches in 5th, three elements apply.

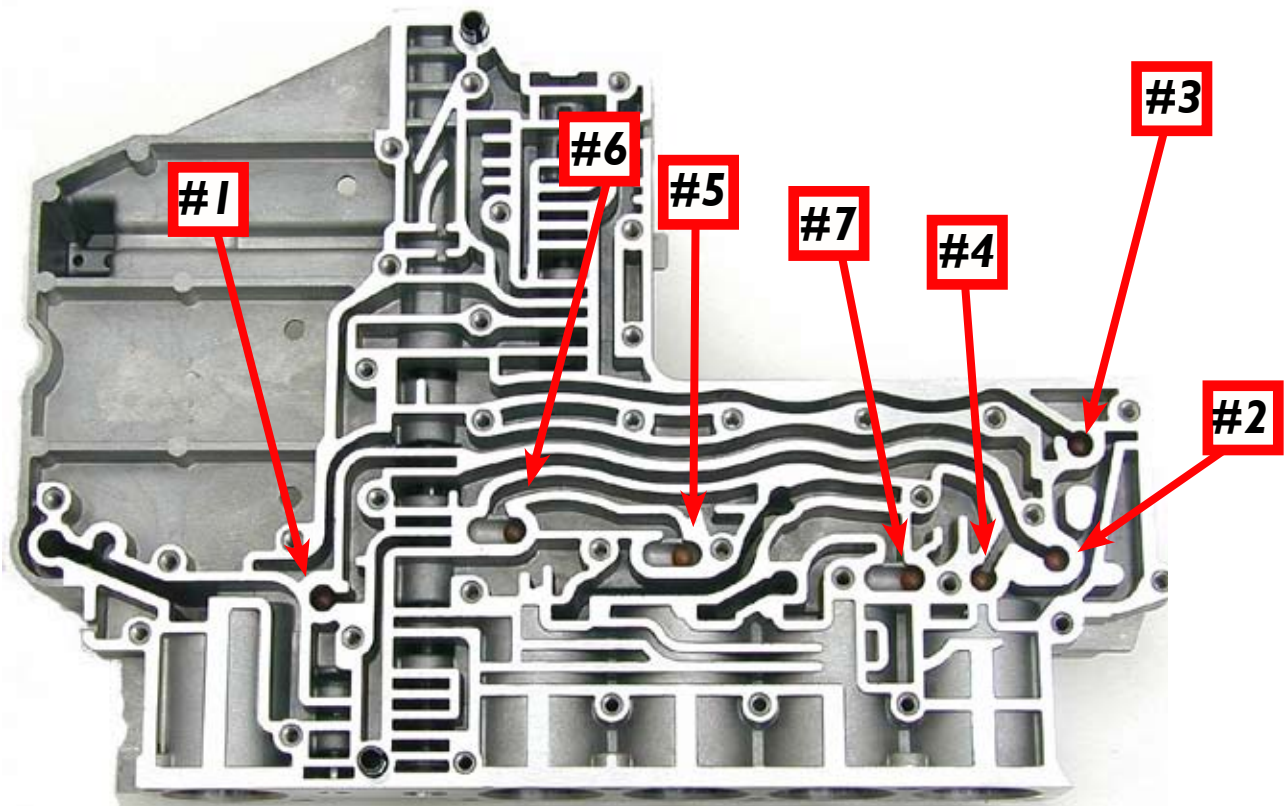
Ball #3: Used in Reverse. If the ball is left out it allows bypass of R-1

Ball #4: Used in 1st and 2nd gear. If ball is left out the OD clutches apply, three elements apply.

Ball #5: Used in 3rd and 4th gear. If the ball is left out, three elements apply

Ball #6: Used in 4th gear. If left out the OD clutch vents apply oil

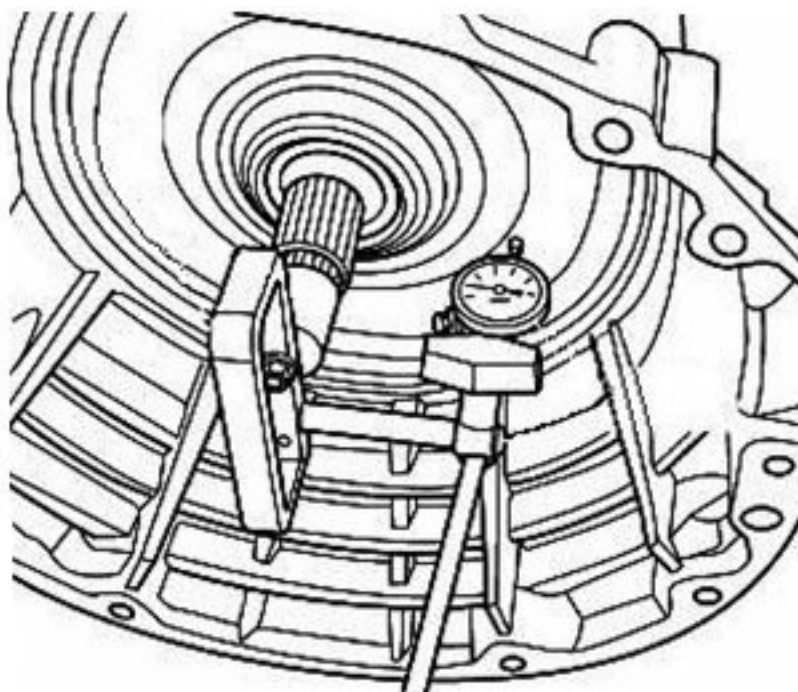
Ball #7: Used in 2nd and 3rd. If left out it vents 2nd clutch oil.



68RFE

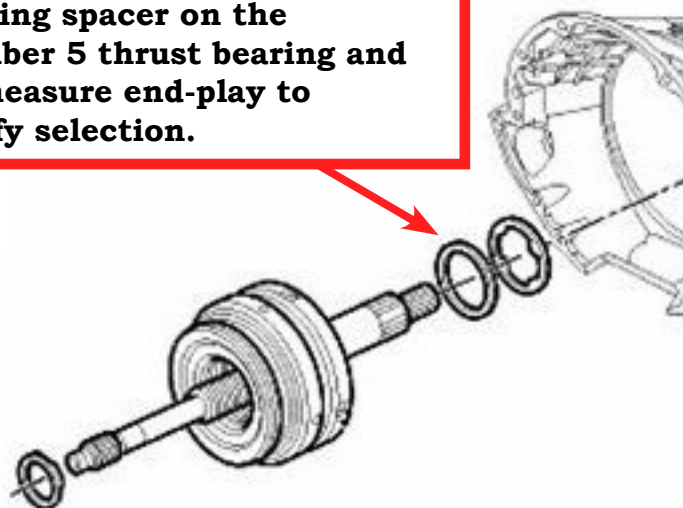
Front and Rear Endplay

Using Adapter 8266-17 from End-Play Tool Set 8266 (1) and Dial Indicator C-3339 (2), measure and record the input shaft end-play. The correct end-play is 0.52-0.74 mm (0.020-0.029 in.). Adjust as necessary.



27	= 1.57 mm (0.062 in.)
28	= 1.71 mm (0.067 in.)
29	= 1.85 mm (0.073 in.)
30	= 1.99 mm (0.078 in.)
31	= 2.13 mm (0.084 in.)
32	= 2.27 mm (0.089 in.)
33	= 2.41 mm (0.095 in.)
34	= 2.55 mm (0.100 in.)
35	= 2.69 mm (0.106 in.)
36	= 2.83 mm (0.111 in.)
37	= 2.97 mm (0.117 in.)
38	= 3.11 mm (0.122 in.)
39	= 3.25 mm (0.128 in.)
40	= 3.39 mm (0.133 in.)
41	= 3.67 mm (0.144 in.)

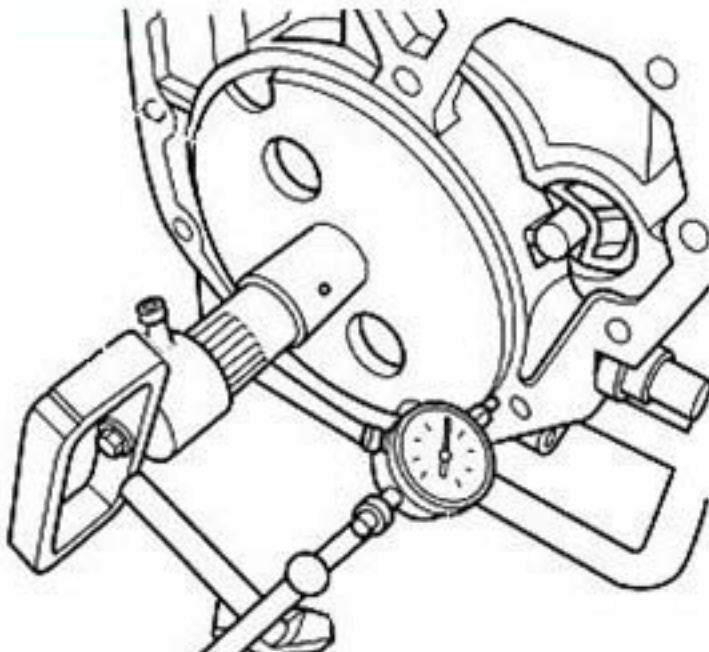
Install the chosen selectable bearing spacer on the number 5 thrust bearing and re-measure end-play to verify selection.



68RFE

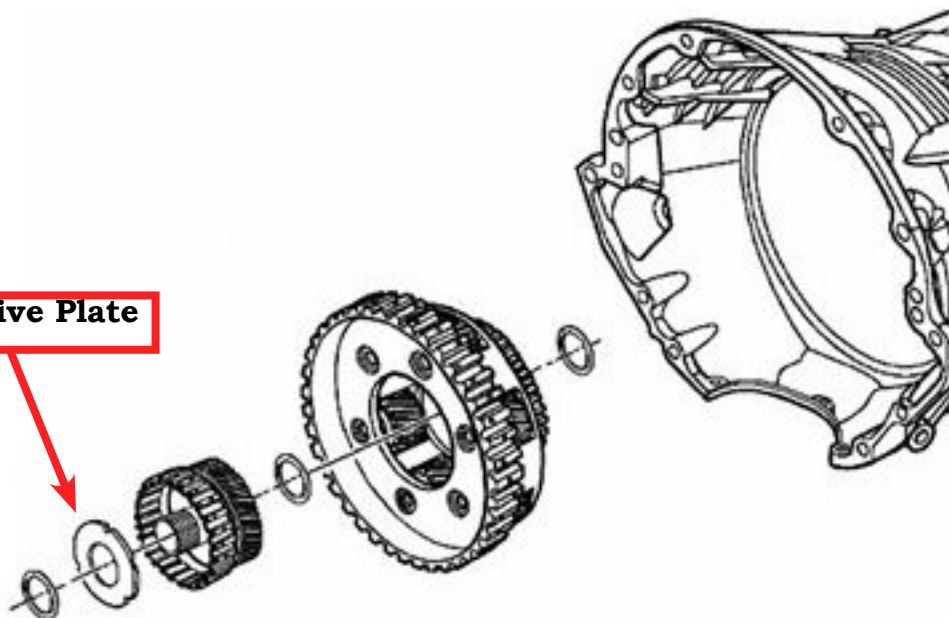
Measuring Output Shaft Endplay

Using an alignment plate, output shaft endplay Socket 8266-20, handle from End-Play Tool Set 8266 (2) and Dial Indicator C-3339 (3), measure and record the output shaft end-play. The correct output shaft end-play is 0.25-0.52 mm (0.010-0.020 in.). Adjust as necessary. Install the chosen output shaft selective bearing spacer and re-measure end-play to verify selection.



09	=	2.18 mm	(0.086 in.)
10	=	2.33 mm	(0.092 in.)
11	=	2.48 mm	(0.098 in.)
12	=	2.63 mm	(0.103 in.)
13	=	2.78 mm	(0.109 in.)
14	=	2.69 mm	(0.115 in.)
43	=	3.08 mm	(0.121 in.)
16	=	3.23 mm	(0.127 in.)
17	=	3.38 mm	(0.133 in.)
18	=	3.53 mm	(0.139 in.)
19	=	3.68 mm	(0.145 in.)

Selective Plate

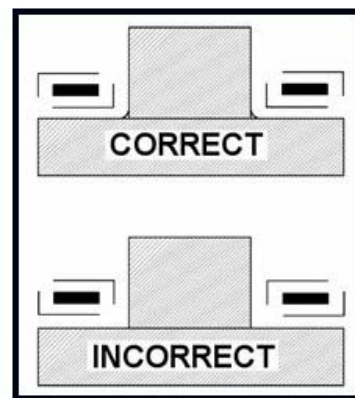
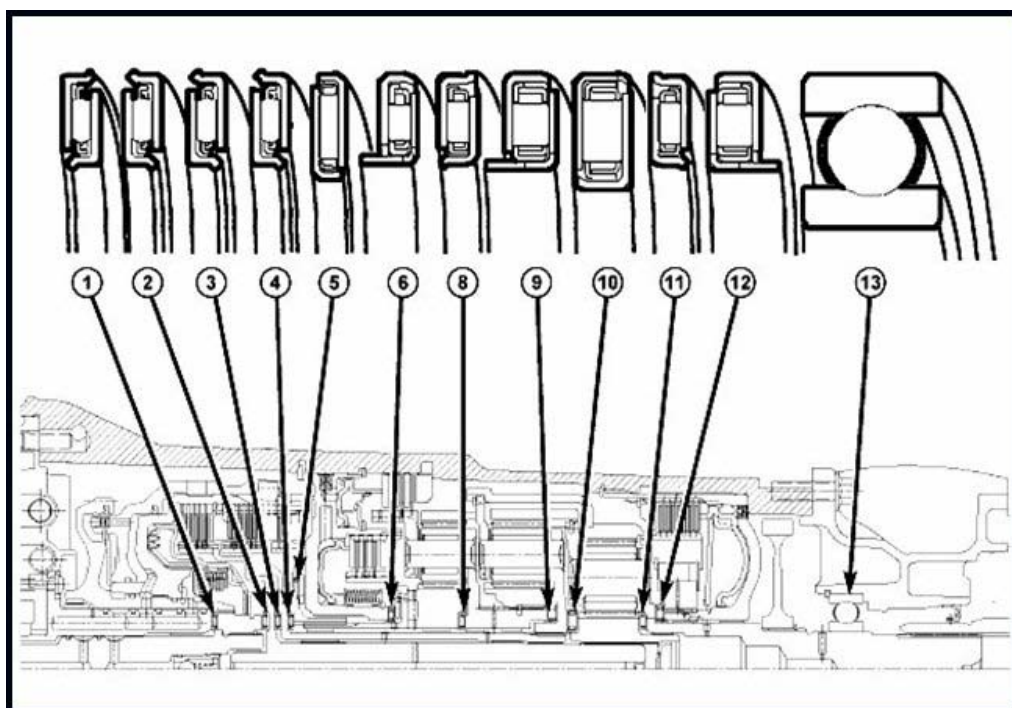


68RFE

Bearing Location and Position

Bearing #1 through #12 appear in the order from front (first in input drum) to rear (last in adapter housing).

Pay close attention when installing the needle bearings. To assure that they get proper lubrication they must be installed so that the oil flows smoothly over the bearing and return to fluid sump.



68RFE

Specifications

TORQUE SPECIFICATIONS			
DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	17.5	-	155
Bolt, torque converter housing to engine upper four	41	30	-
Bolt, inspection cover	10	-	88
Bolt, fill tube at transmission	10	-	88
Nut, fill tube at valve cover	10	-	88
Bolt, torque converter housing to engine lower four	54	40	-
Bolt, transmission collar	68	50	-
Bolt, torque converter to drive plate	31	23	270
Bolt/Nut, crossmember	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Bolt, clevis bracket / rear support	47	35	-
Bolt, converter housing	68	50	-
Bolt, oil pan	12	-	105
Screw, primary fluid filter	4.5	-	40
Nuts, transfer case	35	26	-
Filter, cooler return	9.5	-	84
Bolt, oil pump	28	-	250
Bolt, oil pump body to cover	4.5	-	40
Screw, plate to oil pump body	4.5	-	40
Bolt, valve body to case	12	-	105
Plug, pressure test port	5	-	45
Bolt, reaction shaft support	12	-	105
Screw, valve body to transfer plate	5.5	-	50
Screw, solenoid module to transfer plate	6	-	50
Screw, accumulator cover	7	-	60
Screw, detent spring	4.5	-	40
Bolt, input speed sensor	12	-	105
Bolt, output speed sensor	12	-	105
Bolt, line pressure sensor	12	-	105
Bolt, extension housing	54	40	-
Screw, manual valve cam retaining	4.5	-	40
Screw, manual selector shaft retaining	28	-	250
Cross-Bolt, manual selector shaft	16	-	140

68RFE

Specifications (continued)

CLEARANCE AND END PLAYS		
Component	Metric	Inch
Output Shaft End Play	0.25-0.52 mm	0.010-0.020 in.
Input Shaft End Play	0.52-0.74 mm	0.020-0.029 in.
2C Clutch Pack Clearance	0.99-1.65 mm	0.039-0.065 in.
4C Clutch Pack Clearance	0.77-1.39 mm	0.030-0.055 in.
L/R Clutch Pack Clearance	1.18-2.09 mm	0.046-0.082 in.
OD Clutch Pack Clearance	0.75-1.61 mm	0.030-0.063 in.
UD Clutch Pack Clearance	1.02-1.72 mm	0.040-0.068 in.
Rev. Clutch Pack Clearance	0.58-1.47 mm	0.023-0.058 in.

68RFE FLUID	
Recommended Fluid	Mopar® ATF +4
Service Fill – 68RFE	4x2 – 5.2L (5.5 Quarts)
	4x4 – 6.2L (6.5 Quarts)
Overhaul – 68RFE	15.6-16.6L (16.4-17.5 Quarts)

68RFE Gear Ratios	
1 st	3.23:1
2 nd	1.83:1
3 rd	1.41:1
4 th	1.0:1
5 th	0.81:1
6 th	0.62:1
Reverse	4.44:1

AS68RC

Identification

The AS68RC is an Aisin Seiki 6-Speed rear wheel drive transmission. Primarily used for commercial trucks this unit also goes in the Dodge pickups.

AS68RC				
AS	6	8	R	C
Aisin Seiki	Six Forward Speeds	Relative indication of torque capacity (0 is low, 9 is high)	Rear Wheel Drive	Commercial Application

MODEL YEAR	MARKET	PLATFORM	ENGINE APPLICATION SALES CODE	TRANSMISSION SALES CODE
2007	U.S. Only	DC (3500 Cab & Chassis)	ETJ	DG3
2008	U.S. Only	DC (3500 Cab & Chassis) DM (4500-5500 Cab & Chassis)	ETJ	DG3



AS68RC

Clutch and Band Application Chart

SHIFT LEVER POSITION		GEAR RATIO	DRIVING CLUTCHES			ELEMENT DRIVEN	HOLDING CLUTCHES			ELEMENT HELD
			K1	K2	K3		B1	B2	F1	
P	Park							A		
R	Reverse	-3.54			A	P2 annulus ¹		A		P2 carrier P3 annulus
N	Neutral							A		
D	1 st	3.74	A			P3 sun		A	A	P3 annulus
	2 nd	2.00	A			P2 sun P3 sun	A			P2 annulus
	3 rd	1.34	A		A	P2 sun P3 sun				P2 annulus ² P3 annulus ²
	4 th	1.00	A	A		P2 sun/P2 carrier P3 sun/P3 carrier				None
	5 th	0.77		A	A	P2 carrier P3 annulus				P2 annulus ² P3 sun ²
	6 th	0.63		A		P2 carrier P3 annulus	A			P2 annulus P3 sun ²

A = Element is Applied

¹ Driven in reduction

² Held at reduction (Acts as a held member due to lower rotational speed than driven member).

AS68RC

Solenoid Description and Operation

This transmission uses 4 self-grounded ON/OFF solenoids and 4 PWM (linear) solenoids that are TCM grounded.

The ON/OFF Solenoids A, B, & C (S1, S2 & S3) are used in combination with Linear Solenoids A, B, & C to precisely apply and release the clutches for all forward and reverse gears operations. ON/OFF Solenoid D (S4) and Linear Solenoid D control Lockup.

Use the following chart to troubleshoot shifting concerns.

		ON/OFF SOLENOID			CLUTCH AND BRAKE				
		S1	S2	S3	C1	C2	C3	B1	B2
REVERSE	High Torque	○	X	○			Line Pressure		▲
	Reverse						■		▲
	N → R	○	○	○			■		▲
NEUTRAL	Neutral								▲
DRIVE	N → D	X	○	○	■			●	(▲)**
	1 st	X	X	○	Line Pressure			○	(▲)**
	1 st → 2 nd	X	X	○				●	(▲)**
	2 nd	X	X	X			△	●	
	2 nd → 3 rd	X	X	X			▲	●	
	3 rd	○	X	X		○	▲		
	3 rd → 4 th	○	X	X		●	▲		
	4 th	○	○	X	●	Line Pressure	△		
	4 th → 5 th	○	○	X	●		▲		
	5 th						▲	○	
	5 th → 6 th	X	○	X			▲	●	
	6 th						△	●	
○:Linear solenoid A is in minimum pressure ●:Linear solenoid A is in maximum pressure									
△:Linear solenoid B is in minimum pressure ▲:Linear solenoid B is in maximum pressure									

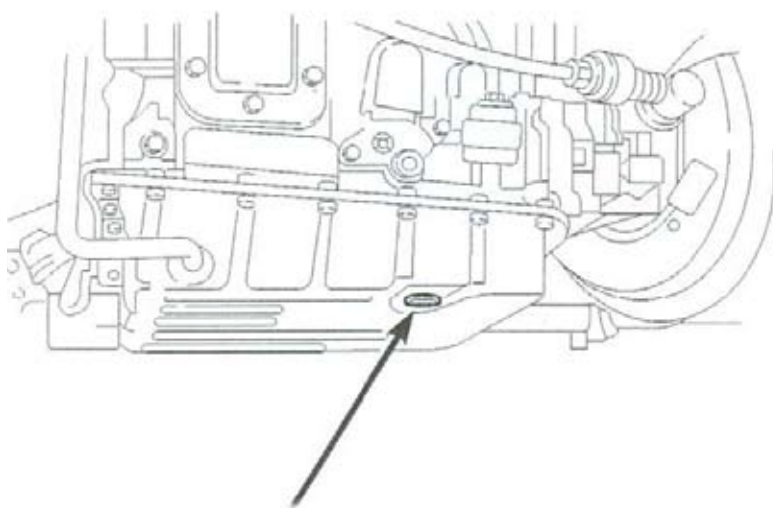
AS68RC

Service Information

Service Intervals are 30,000 miles. Change Filter only if oil is contaminated.
Use ONLY AS68RC Fluid Part Number #05 189977AA.

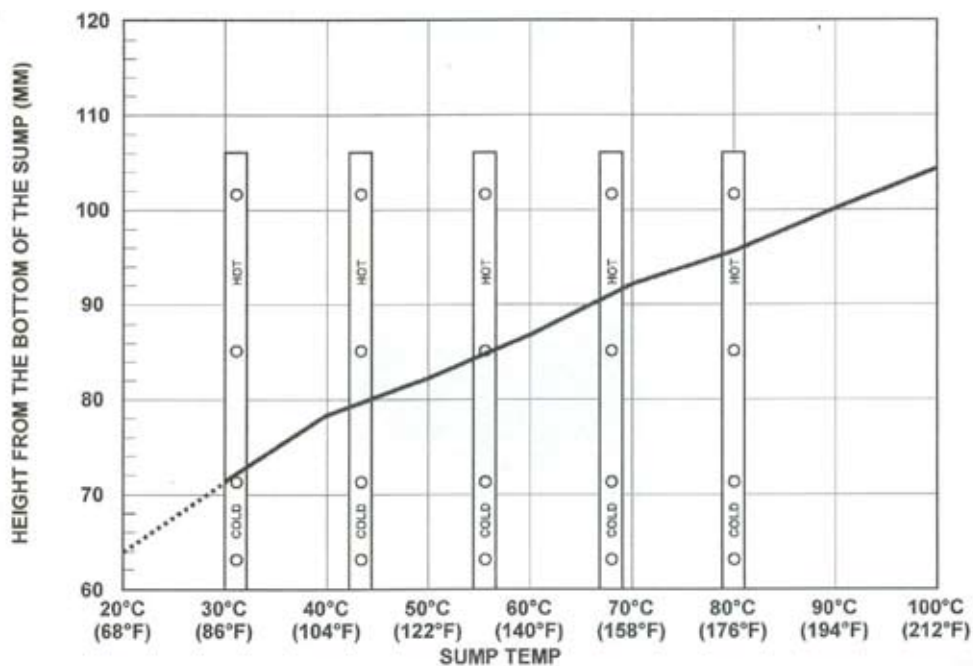
CAUTION: Any other Fluid CAN result in shift concerns or damage.

Capacity 14-15 Qts. (Overhaul) or 7.2Qts. (Service)



Drain Plug

- Note Temperature
(See Chart)
- Check Fluid Level
Idling in Park



Transmission Fluid Temperature Compensation Chart

AS68RC

Pressure Specifications and Tap Locations

Line Pressure:

Forward:

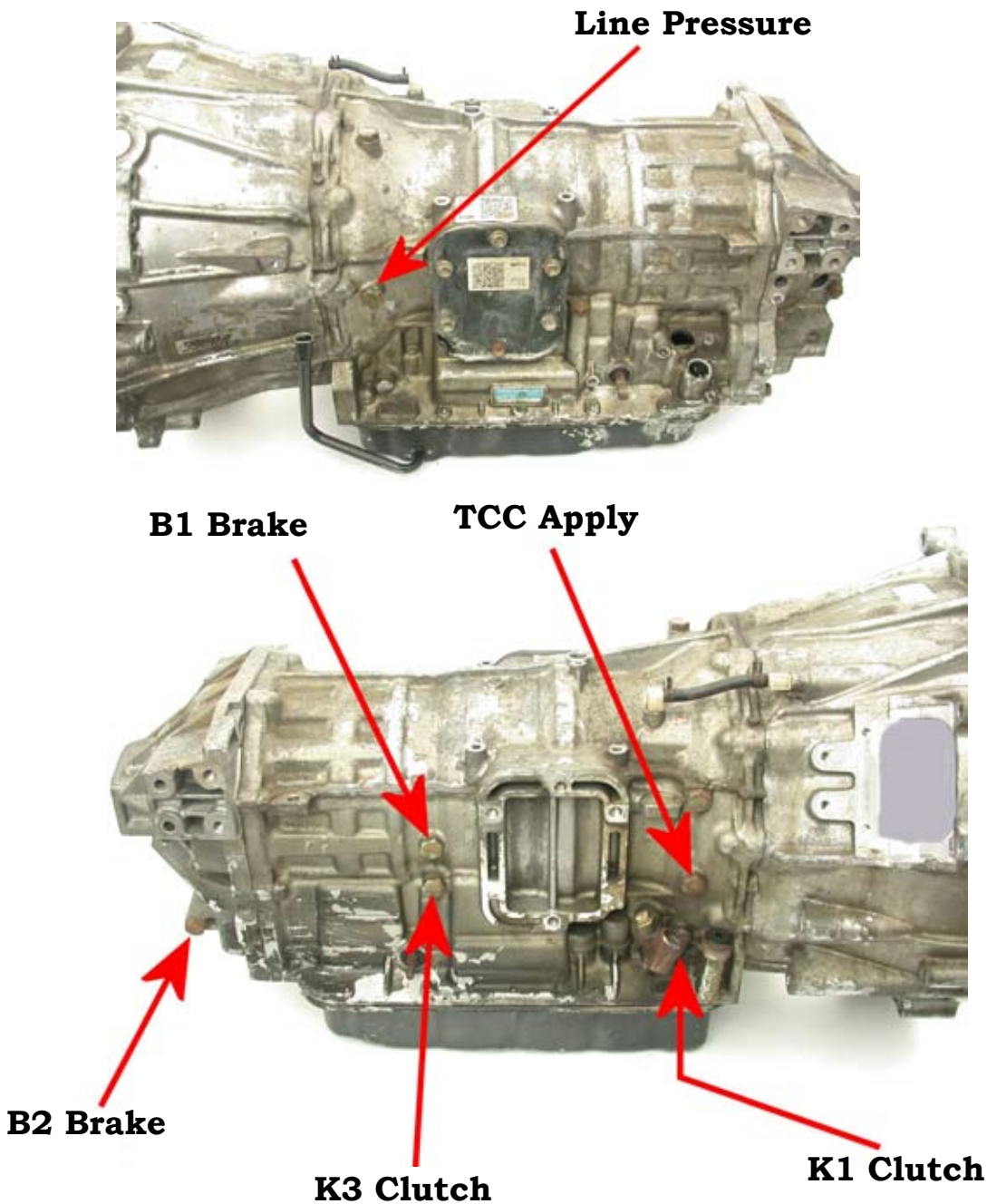
@ Idle: 81-125

@ Stall: 240-290

Park/Neutral

@ Idle: 81-125

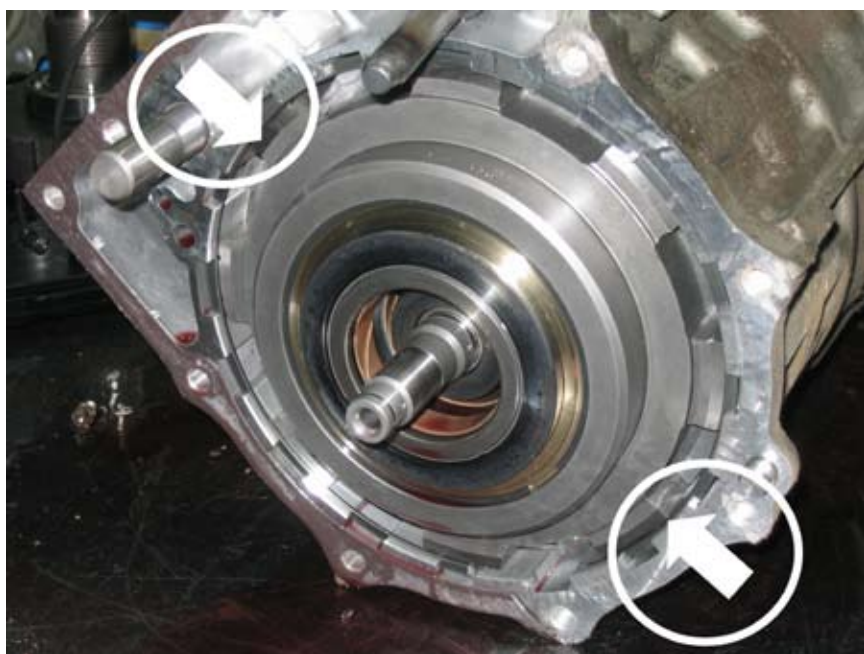
@ Stall: 240-290



AS68RC

Overhaul Tips

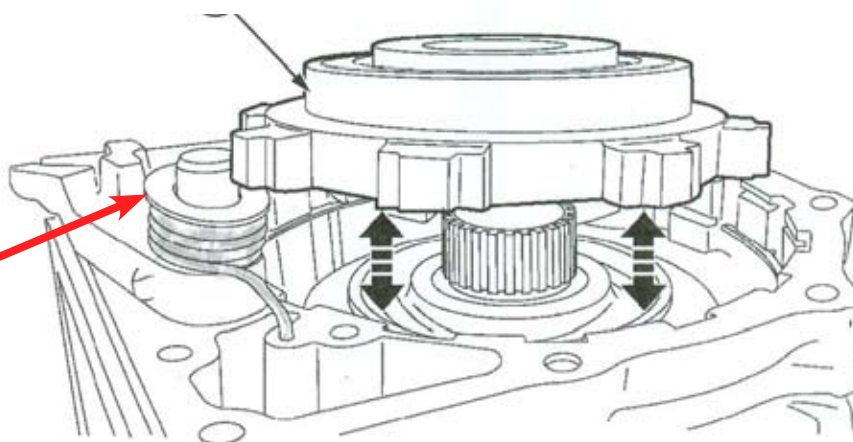
The Low/Rev (F1 Sprag) is located in the case with two snap rings. Make an alignment mark so the Sprag goes back to its original position. There are two (2) lugs opposite of each other, make sure they are installed straight up and down in the case. If you forget, the rear extension housing won't fit.



Make an alignment mark so the Sprag goes back to its original position.

The Manufacturer does not recommend disassembling the L/R Sprag assembly.

L/R Sprag

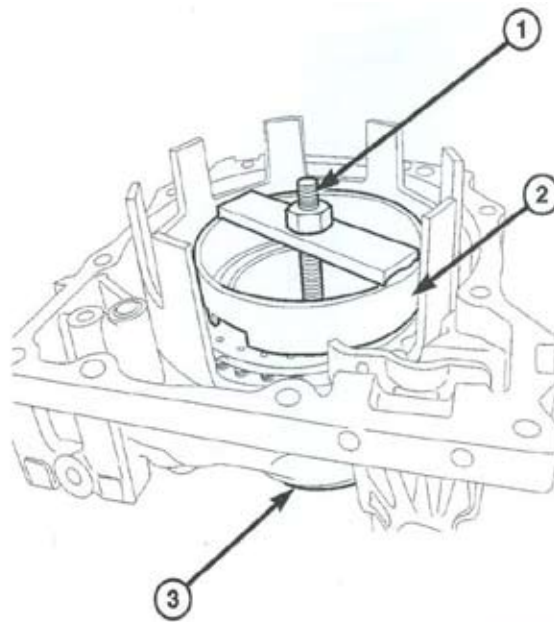


The Washer goes on the backside of the spring

AS68RC

B2 Brake Piston

When removing the B2 Brake Piston, the factory recommends using Tool MD991790. However you can use a Sun Gear Shell from an RE4R01A or a usable substitute. This will allow you to compress the spring to gain access to removing the snap ring.



1	Bolt 8622	3	Washer 9982-2
2	Compressor Plate MD991790		



**The RE4R01A sun shell
does the job well.**

AS68RC

Checking Clutch Travel

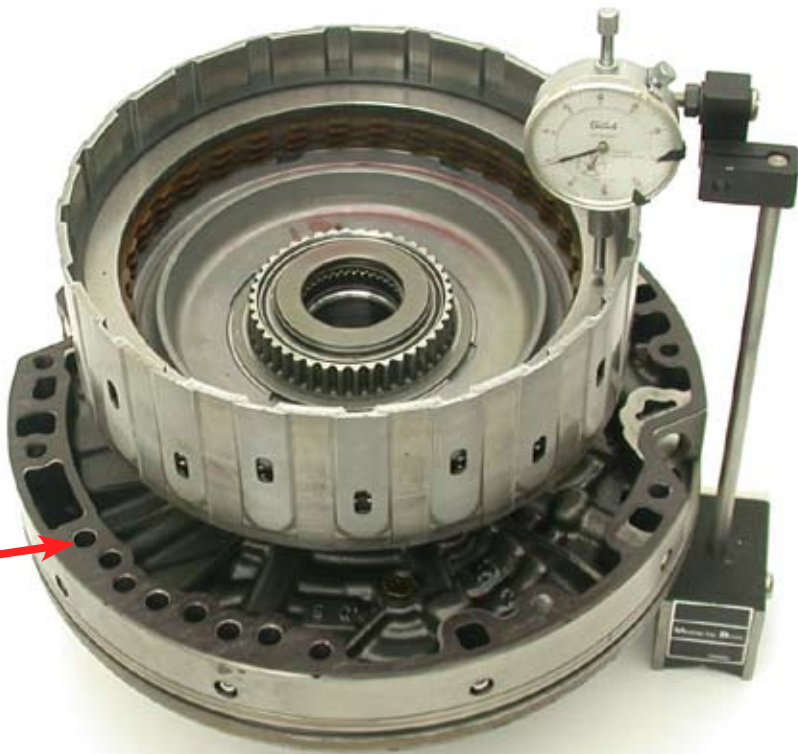
Use a dial indicator to check clutch pack travel. The clutch pack should compress evenly with 58-78 psi applied.

Assemble the clutch stack, note the clutch travel specifications listed. Setup your dial indicator as shown and apply 58-78 psi to compress the clutch plates. Selective reaction plates are available if an adjustment is required.

Clutch Specifications:

B1	0.061 - 0.071
B2	0.072 - 0.090
K1	0.059 - 0.069
K2-K3	0.063 - 0.071

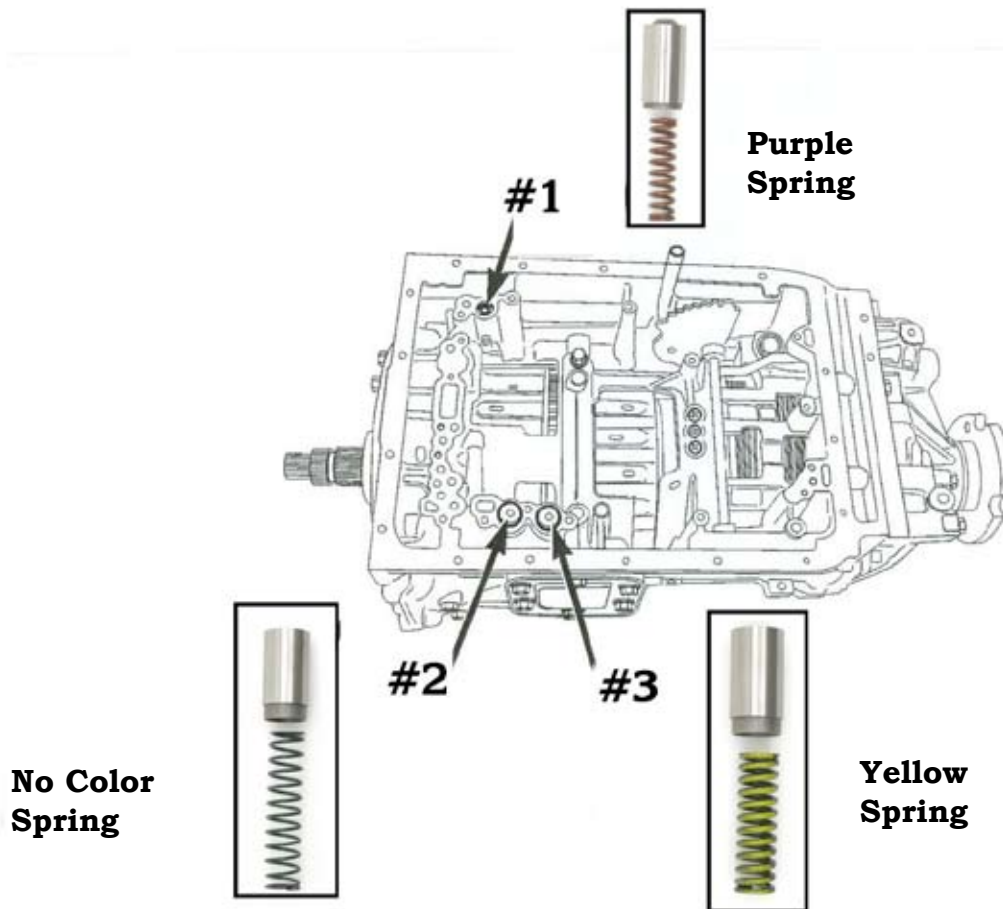
Clutch apply port



The clutch diameter is so large that the traditional feeler gauge method may cause a false reading. This is an example using the K1 Clutch assembly.

AS68RC

Accumulator Identification and Location



Factory Specifications

1	Line Pressure Stabilization (Purple Spring)	3	Garage Shift (Blue Spring)
2	Garage Shift (Pink Spring)		

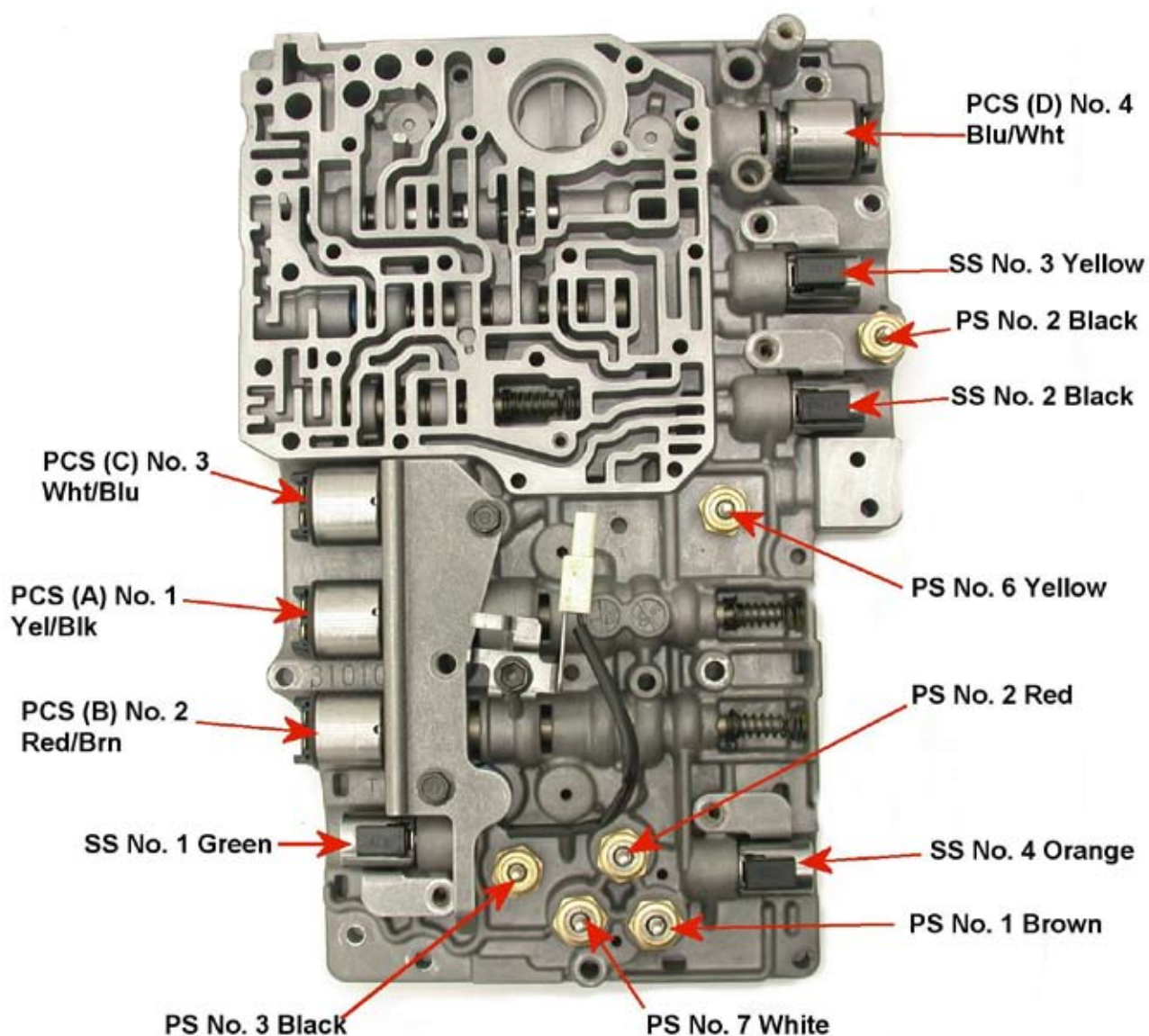
The Springs may be different in color then the factory specifications, during our overhaul the spring colors shown were the colors we removed from the transmission. The Chart lists the factory specifications.

	ACCUMULATORS		SPRING COLOR
	DIAMETER	HEIGHT	
Line Pressure	0.63 in. (16 mm)	1.58 in. (40.18 mm)	Purple
Garage	0.79 in. (20 mm)	1.50 in. (38.18 mm)	Pink
Garage	0.79 in. (20 mm)	1.54 in. (39.18 mm)	Blue

AS68RC

Solenoid and Pressure Switches

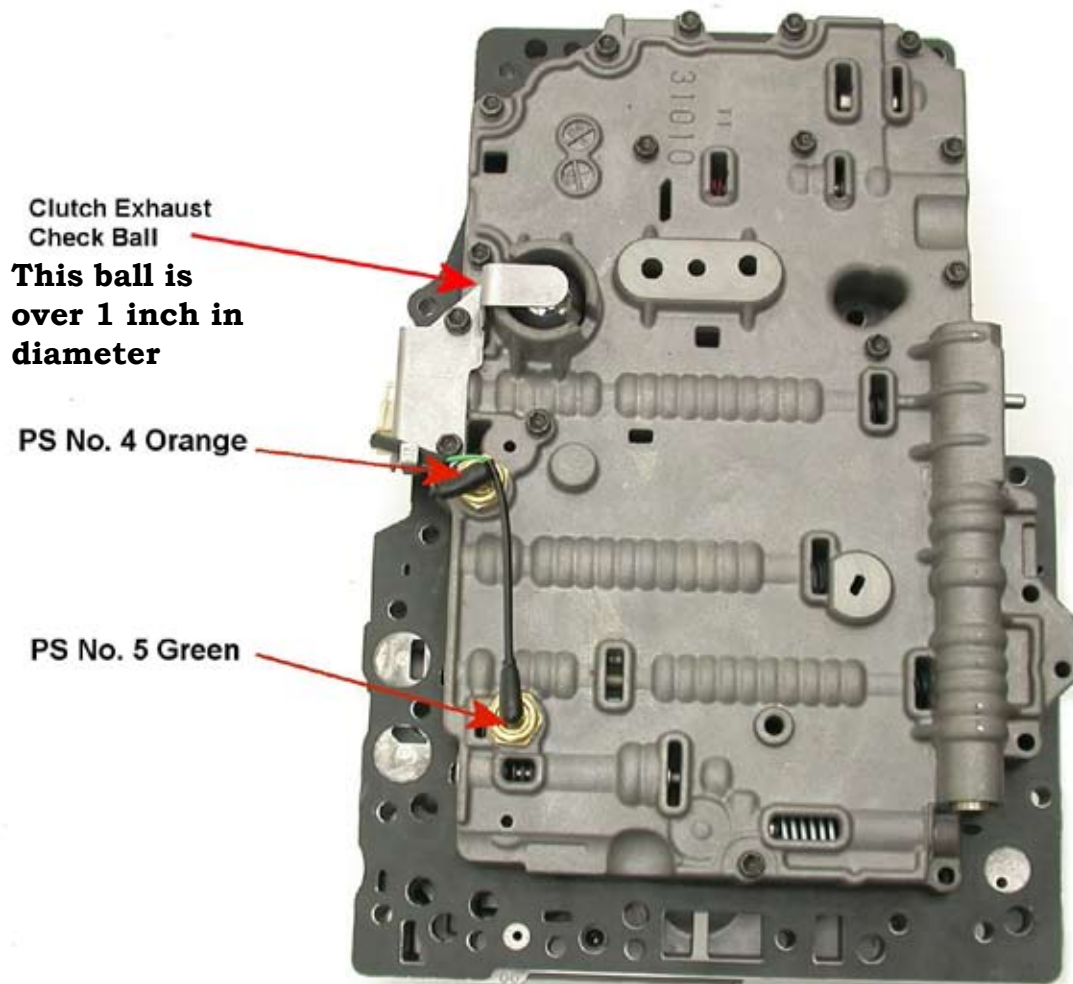
Use the illustration to identify the solenoids and pressure switch and wiring colors during dissassembly and assembly.



AS68RC

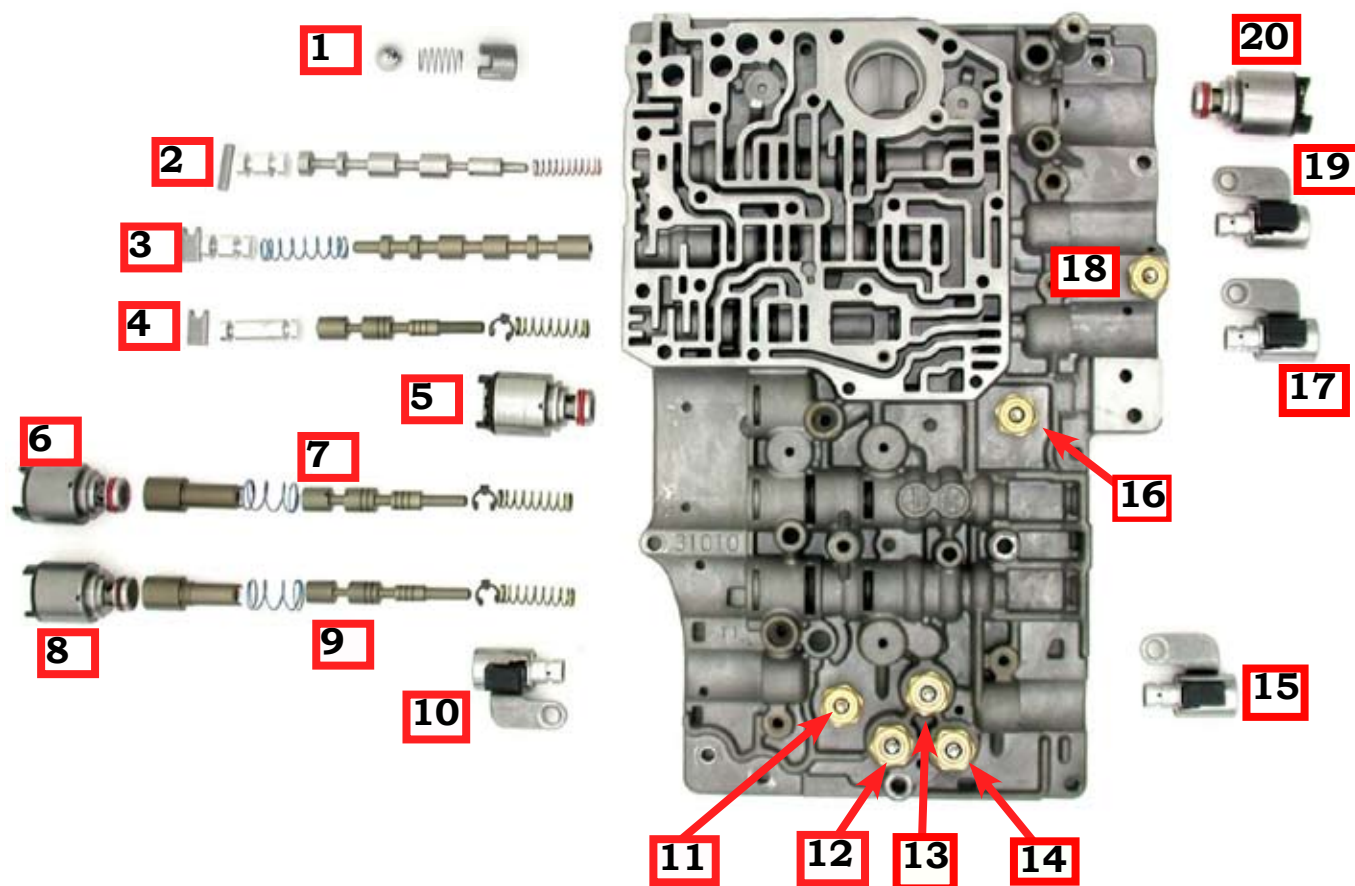
Solenoid and Pressure Switches

Make sure all of the pressure switches are wired correctly



AS68RC

Lower Valve Body Exploded View

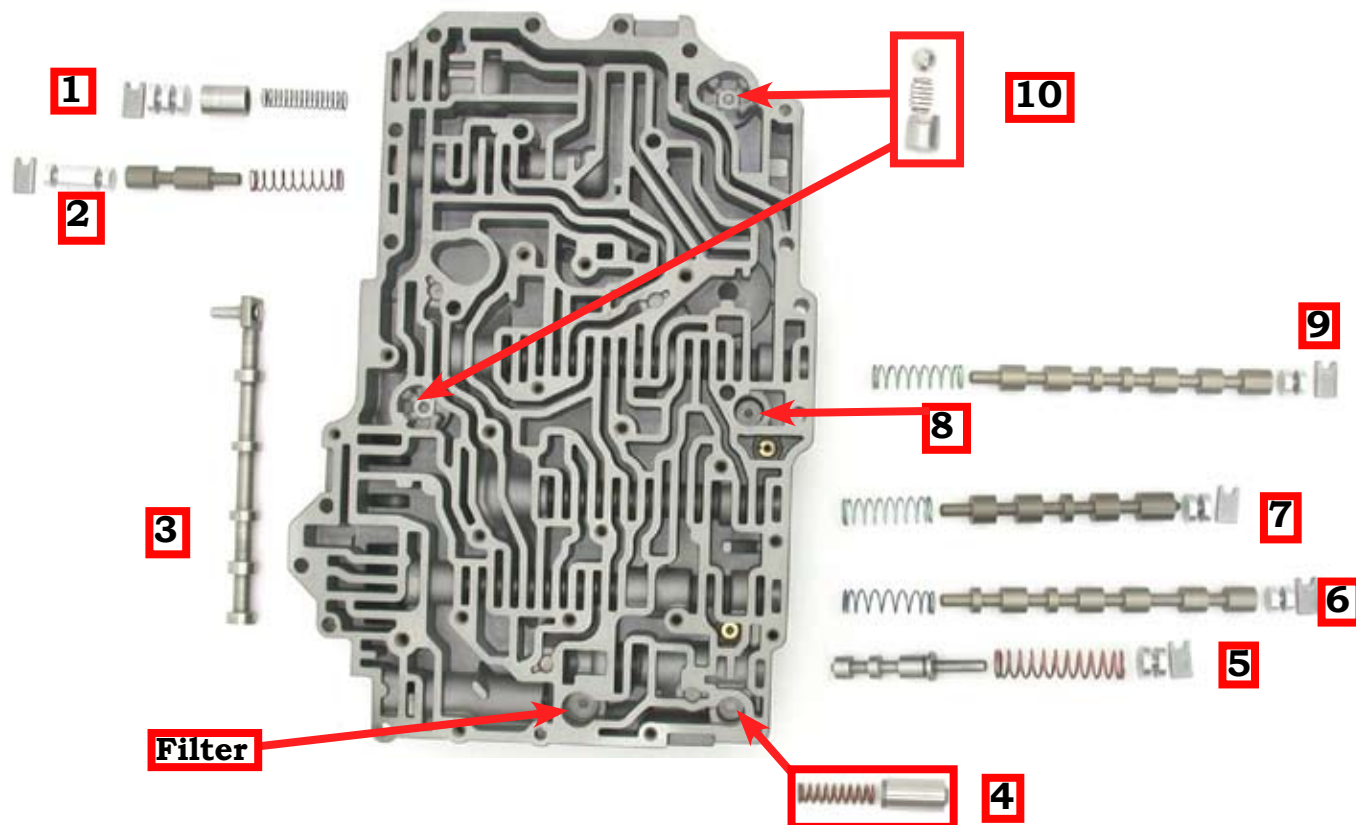


1. Large Check Ball Capsule
2. Lockup Control Valve
3. Shift Valve #4
4. Control Valve #3 for K1 & K3 (Use 3 Clips)
5. Linear Solenoid C
6. Linear Solenoid A
7. Control Valve #1 for K1, K2 & B1 (Use 4 Clips)
8. Linear Solenoid B
9. Control Valve #2 for K3 & B2 (Use 6 Clips)
10. On/Off Solenoid A

11. Pressure Switch #3
12. Pressure Switch #7
13. Pressure Switch #2
14. Pressure Switch #1
15. On/Off Solenoid D
16. Pressure Switch #6
17. On/Off Solenoid B
18. Pressure Switch #8
19. On/Off Solenoid C
20. On/Off Solenoid D

AS68RC

Upper Valve Body Exploded View



1. Drain Valve (Check valve for clutch exhaust oil to drain to pan)
2. Change Valve (Modifies control pressure into line pressure for clutch operation)
3. Manual Valve (Directs oil depending on driver selection)
4. Check Valve
5. Modulator Valve (Regulates oil for solenoid operation)
6. Shift Valve (Identified as number 3 shift valve)
7. Shift Valve (Identified as number 2 shift valve)
8. Check Valve
9. Shift Valve (Identified as number 1 shift valve)
10. Check Ball Capsule

Table of Contents

4X4



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Noise and Vibration

Noise and vibration concerns seem to be the number one complaint on today's fourwheel drive systems. Some noises or vibrations in all-wheel, four-wheel, or part-time fourwheel drive systems may be normal operational characteristics for that particular system.

The key to diagnosing noises and vibrations is to know what is normal operating characteristics and what is not. One of the easiest ways to determine if a noise or vibration is abnormal is to compare the customer's vehicle with a similar vehicle. Similarities should include: Vehicle type (truck, extended cab or short bed, SUV mileage, and equipment). A comparison drive should make it easy to determine if the noise or vibration is abnormal or not.

Some noise and vibration is normal, particularly in part-time four-wheel drive systems when vehicles are operated in fourwheel drive mode on high traction surfaces such as clean dry pavement. These noises or vibrations are usually a result of driveline loading, binding or wind-up and will increase as the vehicle turning radius decreases, this may be normal operation for your particular system. Each type of Four-Wheel drive system has its own particular operating characteristics.

4WD Identification

All-Wheel Drive Systems:

All-wheel drive systems offer the most transparent system operation. However, they do have some driving characteristics such as torque steer not found on two-wheel drive vehicles. Generally, all-wheel drive systems are quieter than similar four-wheel drive systems operated in 4HI, and certainly quieter than in 4LO ranges. On-demand all-wheel drive systems do not operate until wheel slip is detected and the driver may hear or feel the system engage and disengage at times, which is normal.

Part-Time Four-Wheel Drive Systems:

With part-time four-wheel drive systems, engagement and disengagement of the system can be noticeable. These systems are designed to be used on loose traction surfaces such as snow, mud or loose dirt. Driveline binding may occur if operated on high traction surfaces such as hard pavement.

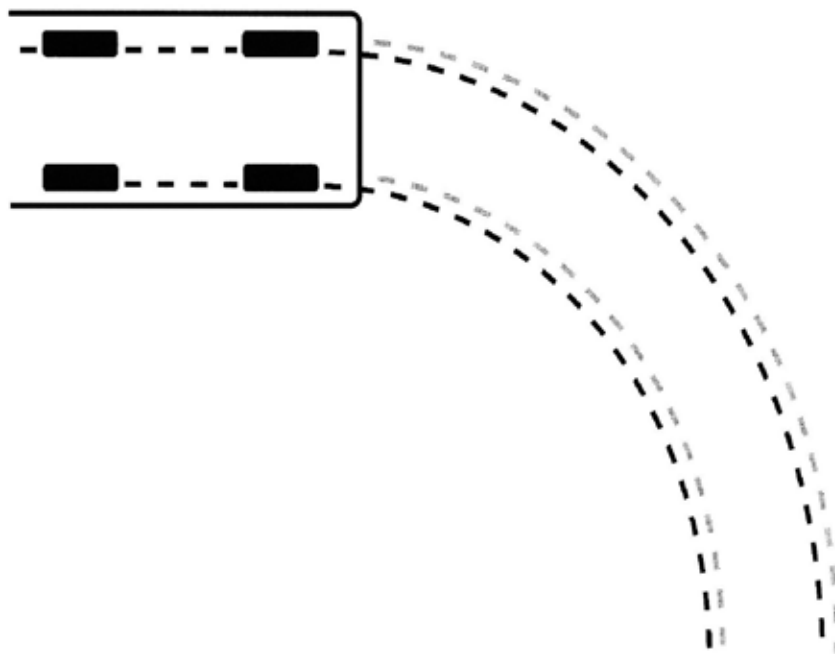
On-Demand Four-Wheel Drive Systems:

Automatic or on-demand systems are more transparent than part-time systems. In “auto” mode, a clutch pack allows for the difference in axle speeds and operates like an all-wheel system.

All Systems

“Crow Hopping”

“Crow hopping” is a common concern on four-wheel drive systems and is due to driveline binding or wind-up. As the vehicle turns, the front and rear axles follow a different arc and turn at different speeds, this results in a bind and the only way to compensate for this is for the wheels to slip. Evidence of this condition can sometimes be found on the tire surfaces. One or more tires may show signs of small scratches or scuffing, around the tire circumference, and are caused by the tire slipping across the road surface while turning.



AWD and 4WD

Diagnostic Checks

There are some basic checks and tire inspections that can be performed in your service bay and on the road that can help isolate the cause of the driveline noise.

AWD/4WD Noise Disgnostic Overview

	Garage Shift *Safely operate vehicle in the service bay using all gear ranges without AWD/4WD *Safely operate vehicle in the service bay using all gear ranges with AWD/4WD engaged
	Road Test *Safely drive the vehicle without AWD/4WD engaged *Safely drive the vehicle in a suitable area with the AWD/4WD engaged (including HI and LO range as available) - Drive vehicle straight and in turns - Drive under a load and cruising - Attempt to re-create exact vehicle/road conditions suggested by owner
	Tire Check *Verify the same tire size *Check for uneven wear *Verify the same rolling circumference at all four tires *Verify proper inflation
	Operational Check *Verify proper operation *Ensure the concern is not a programmed default
	Concern Comparison *Isolate any noise using "chassis ears" or equivalent *Confirm any identified concern by comparing to like vehicle

AWD and 4WD

Diagnostic Checks (continued)

Garage Shift Check:

In the service bay, listen for noises or vibrations as you compare each gear range. Be sure to operate the vehicle in all ranges with the four-wheel drive system engaged in both Hi range and LO range. Check for noises, vibrations, or gear grinding during engagement.

Road Test Check:

Take the vehicle for a test drive, again operating the vehicle in all ranges including HI and LO ranges. Use the “auto” feature if your vehicle is so equipped. Drive in a straight line as well as in turns. Drive the vehicle with and without acceleration load. Try to detect driveline noise or vibrations. Try to recreate the same driving conditions as when the customer experiences the noise or vibration. Sometimes a bad road surface can cause unusual noises or vibrations. Remember, you can’t diagnose a problem if you can’t duplicate it.

Tire Check:

Check all tires to make sure they are all the same size and brand. Different brands may have different circumferences, even though they are the same size. Look for uneven tire wear. Tires with different tire wear will roll at different rates and speeds.



AWD and 4WD

Diagnostic Checks (continued)

Tire Inflation Check:

Always check your tire pressure. Proper and even tire pressure is very important especially with “on-demand” or “all-wheel” systems. A tire with low pressure will roll at a different rate than a tire at the proper pressure. As little as 2 pounds per square inch difference between tire pressures has been known to cause four-wheel drive system drivability concerns.

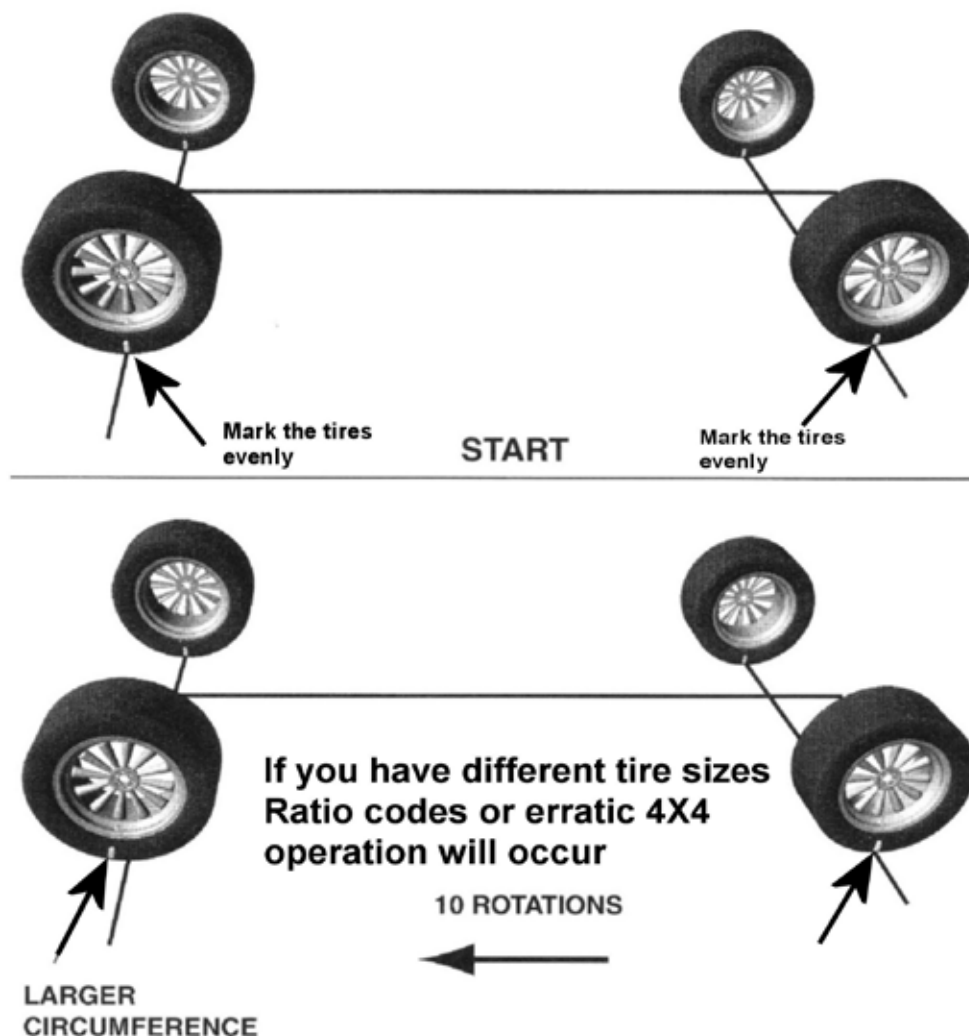


AWD and 4WD

Diagnostic Checks (continued)

Rolling Tire Circumference Check:

Performing the rolling tire circumference check is the easiest and fastest way to tell if you're having a tire circumference concern. Start by marking all the tires at the six o'clock position. Drive forward on a flat surface in a straight line for a minimum of 10 complete tire revolutions. Bring one tire back to the six o'clock position. Check all tires to verify that all tires are within $\frac{1}{2}$ " of the six o'clock position. Tires that do not match will have to be replaced, usually as a complete set (all four tires).



AWD and 4WD

Diagnostic Checks (continued)

Tire Replacement Criteria:

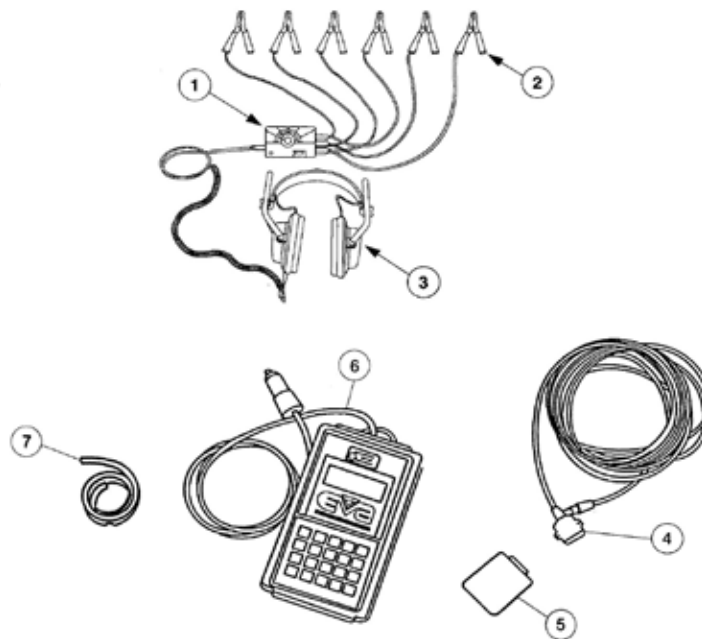
All four tires must be the same brand, size, and speed rating. If a tire must be replaced, the remaining tires must have at least 30% of the tread remaining. Any tires with less than 30% tread remaining, as compared with the new tire, will have to be replaced.

Default Operation:

Most electronic transfer case systems have sophisticated software or built-in logic. The TCCM or GEM system will not allow four-wheel low range to engage unless all parameters are met, and will stay in the previously commanded range. These parameters include but are not limited to, transmission in neutral and vehicle speed is less than three miles per hour. Some vehicles with the GEM system will not engage four-wheel low range if the GEM thinks that the drivers door is open.

Noise Isolation:

There are several tools available today to help isolate noises and vibrations. One of the most helpful tools out there is “Chassis Ears” or even a vacuum hose. “Chassis Ears” is an electronic stethoscope that is available from your local tool supplier. An Electronic Vibration Analyzer (EVA) is also available.



ChassisEAR and Electronic Vibration Analyzer Tools

Item	Description
1	Input Control (channel) Selector
2	Microphone Clamps
3	Headphones
4	Vibration Sensor

Item	Description
5	Software Cartridge
6	Electronic Vibration Analyzer
7	Holding Strap

G.M. Electronic 4x4 System

Diagnosis

The early NV233 systems up to 2004, found on Blazer, S-10 trucks and Tahoe applications, will not allow data or code retrieval with a scanner, however manual code retrieval is available. To retrieve codes manually, locate the data link connector (DLC) near the right side of steering column. Install a jumper wire between the diagnostic pigtail (orange wire at DLC terminal No.13) and ground. Turn ignition switch on and observe the 4WD selector switch status lights. After approximately 3 second, if there is a code in the TCCM system, the 4WD selector switch lights will start to flash. All NV233 transfer case codes are single digit codes. These codes are:

Code #1: TCCM Internal Fault

Code #2: Encoder Circuit Fault

Code #3: Motor Circuit Fault

Code #4: TCCM RAM/ROM Fault

To clear codes: Remove T/L CTSY (20 amp) fuse ("T" series) or "T-CASE" fuse ("K" series); wait 2 ½ minutes and then reinstall fuse. Cycle ignition 5 times, codes should be cleared from TCCM.

When attempting to retrieve codes from the NVG233 transfer case system, you may encounter inoperative 4WD lights. If the 4WD lights are inoperative, check the 10-amp "Gauges" fuse (fuse #4) located in the instrument panel fuse block. If the 10-amp "gauges" fuse is good, inspect the 20-amp "4WD" fuse (fuse #19) also located in the instrument panel fuse block.

If either fuse is blown, repair the affected circuit as needed. The next step is to check the TCCM power feed circuits at terminals #C6, C8, D14 & D15 for 12vdc with the ignition on, and the ground circuits at terminals #C10, D10, D12 & D13 for a good path to ground. The ground path should have less than a 0.05vdc voltage drop. After verifying good power and grounds to the TCCM, the next step is to check for power on TCCM terminals #C11, C12 & C13 with the ignition on. A quick and easy test for the 4WD light system is to ground TCCM terminals #C11, C12 & C13 individually and see if each 4WD light illuminates.

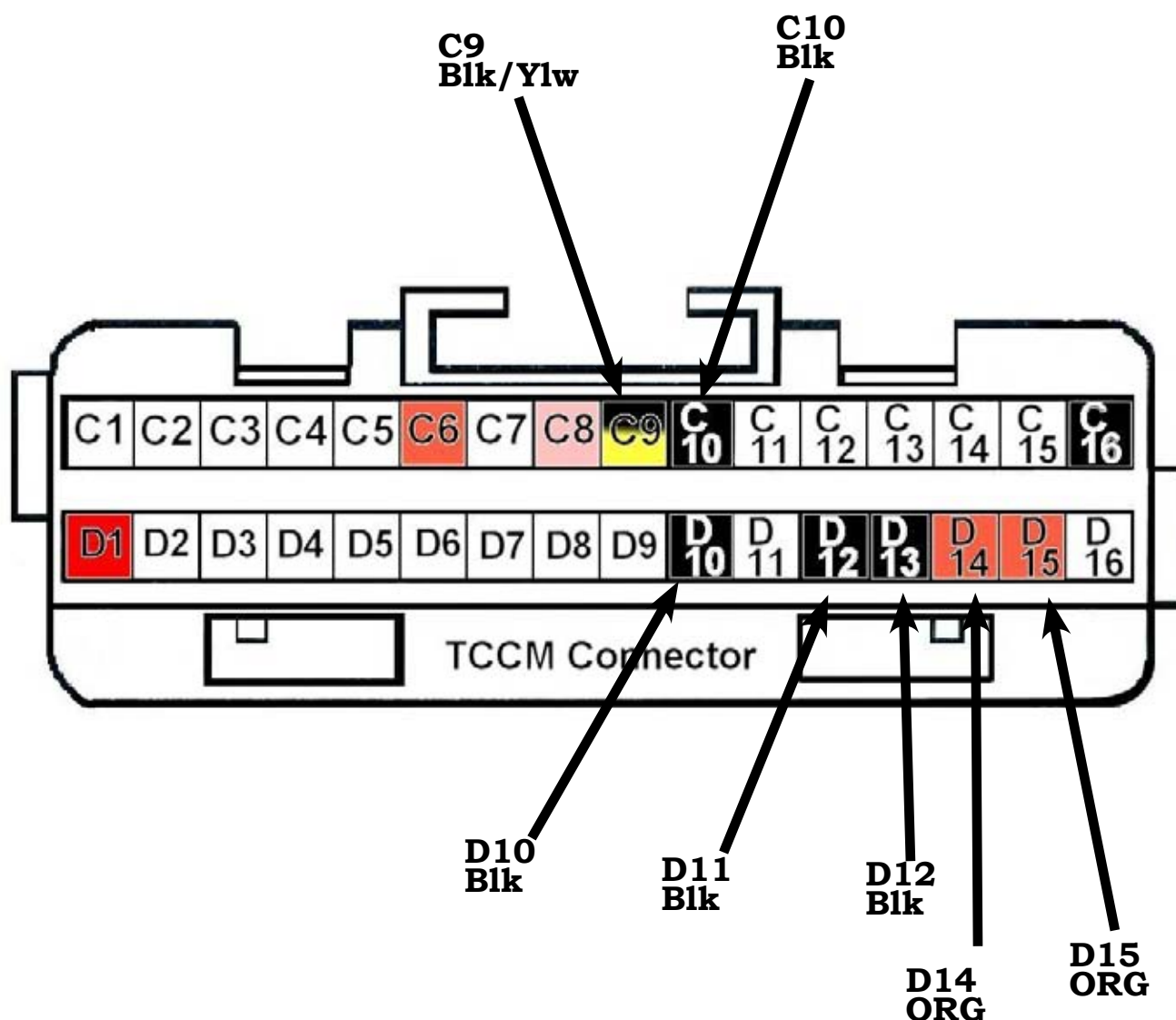
If each 4WD light illuminates, the 4WD light circuits are intact. Suspect a possible TCCM problem. Refer to the TCCM connector views to determine the correct terminal locations.

G.M. Electronic 4x4 System

Diagnosis (continued)

Code #1: TCCM Internal Fault:

Attempt to clear code #1. If the code resets, turn ignition switch on and check for battery voltage on circuit #1640 (orange wire) at TCCM terminals #D14 & D15. If battery voltage is found at TCCM terminals #D14 & D15, check the TCCM ground circuits #150 (black wire) at terminals #C9, C10, D10, D12 & D13. If the TCCM has good power and ground circuits, replace the TCCM and recheck the 4x4 system operation.



G.M. Electronic 4x4 System

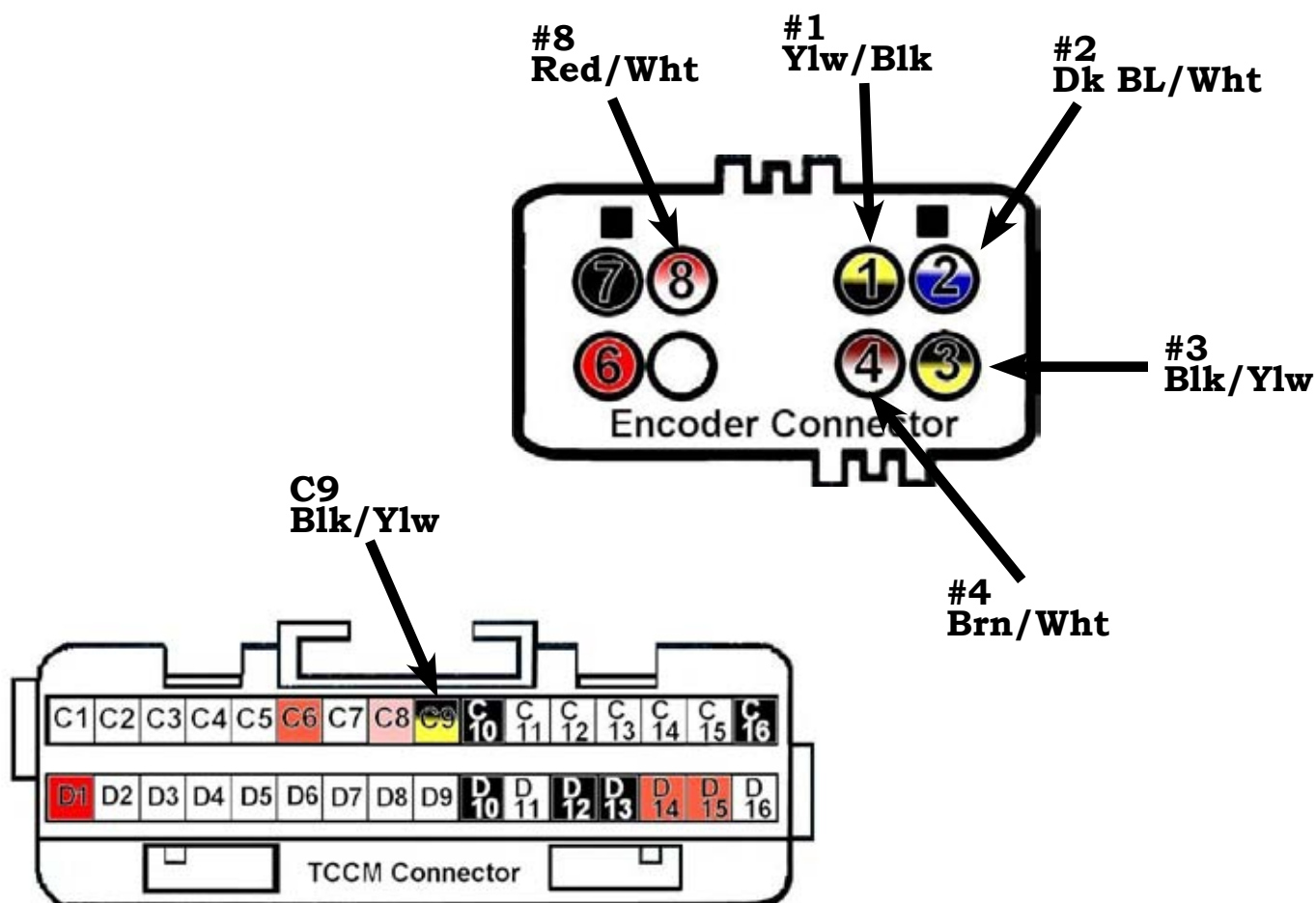
Diagnosis (continued)

Code #2: Encoder Circuit Fault:

Attempt to clear code #2. If the code resets, disconnect the transfer case harness connector. Turn the ignition switch on and check for a 5vdc signal coming from the TCCM to the transfer case harness connector terminals #1, 2, 4, & 8 (encoder circuits A, B, C & D). If the TCCM is delivering a 5vdc signal to the encoder circuits, go to the next step.

The next step is to measure the resistance of the internal encoder circuits to the transfer case ground. If the resistance to case ground is less than 5ohms on any one of the internal encoder circuits, replace the encoder/motor assembly. If the resistance on the internal encoder circuits are greater than 5ohms, check the resistance of circuit #1554 (black/yellow wire) from the TCCM terminal #C9 to the encoder/motor connector terminal # 3.

If the resistance is less than 2ohms, replace the TCCM. (Warning: always check the TCCM power and grounds before replacing the TCCM)



G.M. Electronic 4x4 System

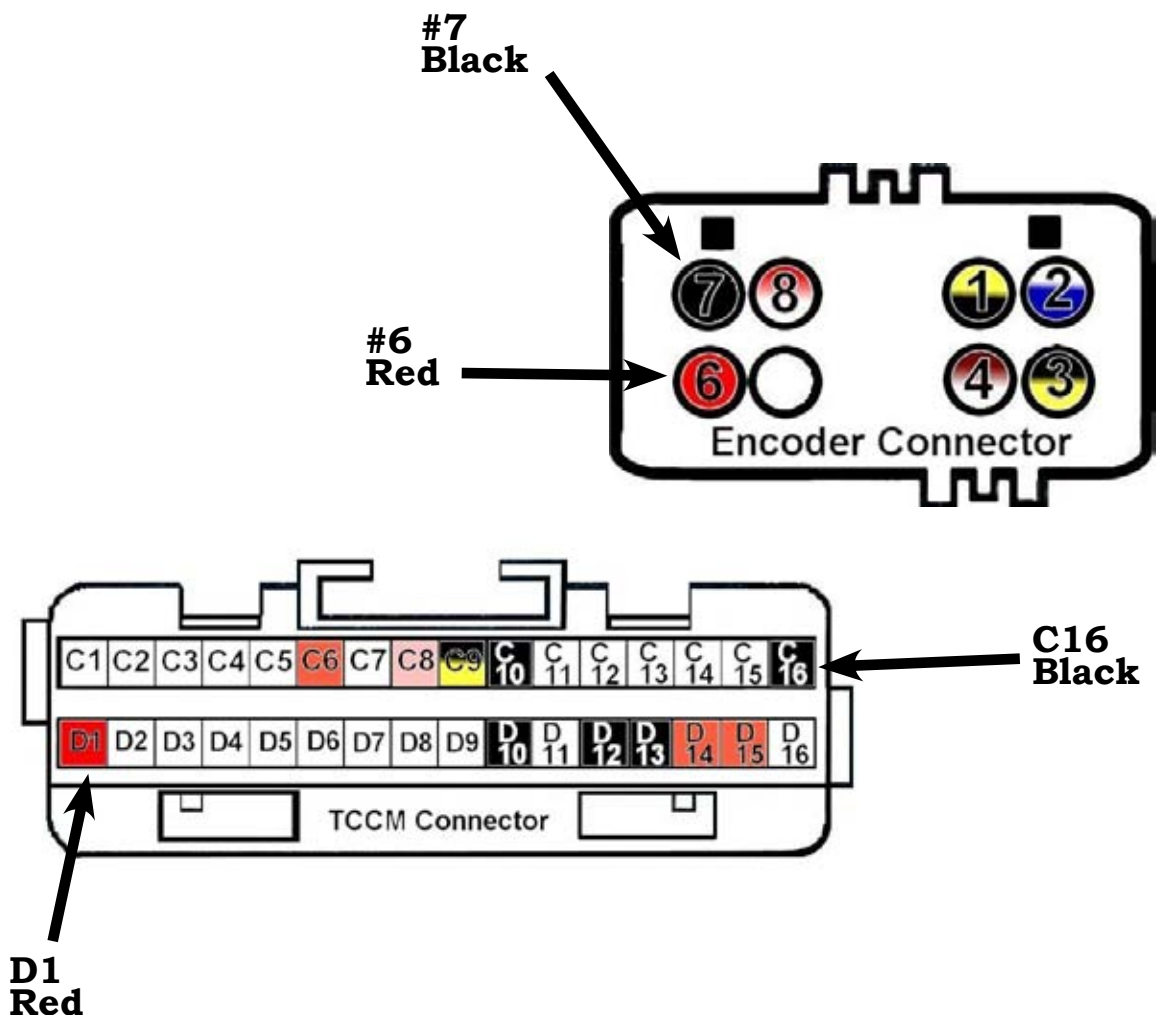
Diagnosis (continued)

Code #3: Motor Circuit Fault:

Attempt to clear Code #3. If the code resets, check 20 amp "4WD" fuse (fuse #19) located in instrument panel fuse block. If the 4WD fuse is blown, repair the circuit as needed.

If the 4WD fuse is not blown, turn the ignition switch on and while moving the 4WD selector switch between 4HI and 4LOW positions, measure the voltage at the encoder/motor connector terminals # 6 & #7. The voltage should alternate from positive 12vdc to negative 12vdc while moving the selector switch between 4HI and 4LOW positions.

If voltage alternates from positive to negative, replace the encoder/motor assembly. If voltage does not alternate from positive to negative, check the motor control circuits going back to the TCCM. If the motor control circuits are good, suspect a faulty TCCM.



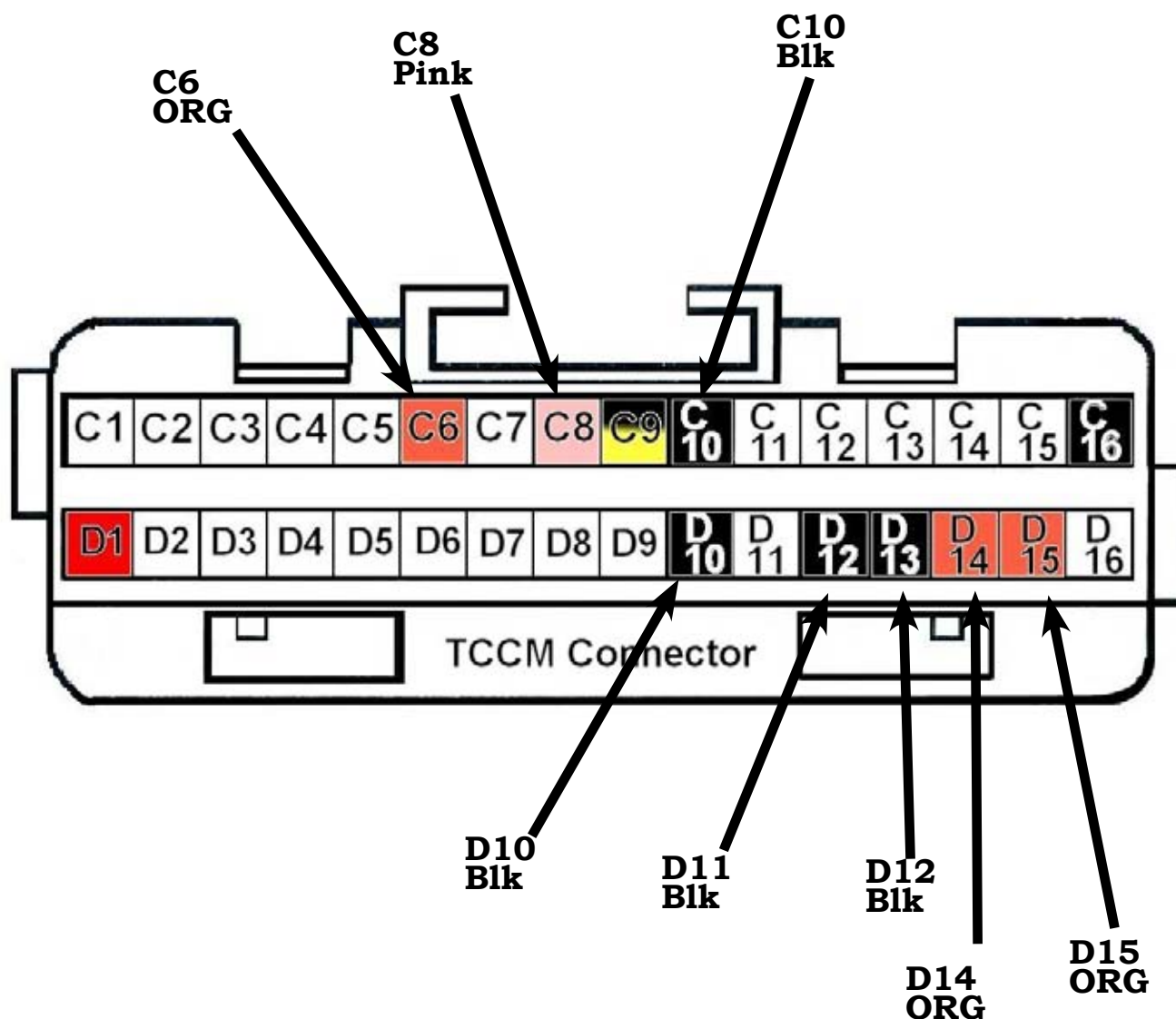
G.M. Electronic 4x4 System

Diagnosis (continued)

Code #4: TCCM RAM/ROM Fault:

Attempt to clear code #4. If the code resets, check for power (12vdc) at TCCM terminals #C6, C8, D14 & D15. Then check the TCCM ground circuits at TCCM terminals #C10, D10, D12 & D13. If the TCCM power and ground circuits are okay, replace the TCCM.

(The vehicle used for this example was a 1996 Chevrolet Blazer 4.3L equipped with a 4L60E transmission and a NVG233 transfer case system. Refer to the four-wheel drive system connector terminal identification chart and specific wiring schematics for your particular vehicle)



ITM 3e AWD System

Introduction

What's New in AWD:

The ITM 3e system is just one of the latest interactive all-wheel drive systems available as part of BorgWarner's growing "iTrac ®" torque management systems portfolio. BorgWarner has a full line of active torque management devices focused on the needs of the ever expanding all-wheel drive market, such as the new "NexTrac®" all-wheel drive system being launched in 2009 Hyundai Santa Fe and/or the Cadillac CTS's "ITM®" all-wheel drive system also being launched this year.

These all-wheel drive systems are among the most advanced interactive all-wheel drive systems available in the world today.

A Closer Look at the "ITM 3e®" System:

The "ITM 3e®" system uses sophisticated controls and algorithms to sense wheel slip and can seamlessly convert to an all-wheel drive system within milliseconds. This enhances vehicle handling by optimizing vehicle traction to both the front and rear wheels when needed.

While driving at highway speeds, the "ITM 3e®" system reduces torque transfer to the rear wheels, which improves fuel economy when compared to a full-time all-wheel drive system. The "ITM 3e®" system is designed to work in conjunction with other vehicle on-board systems such as the anti-lock brake system (ABS) and the electronic ride stability system to provide improved traction and stability when needed.

Electronically Controlled All-Wheel Drive System:

The "ITM 3e®" system requires no front-to-rear slippage to activate the all-wheel drive system, unlike other all-wheel drive systems that rely on pumps or a viscous fluid to transfer torque to the non-driving wheels when needed. This system transfers torque solely in response to accelerator pedal position and other vehicle system inputs.

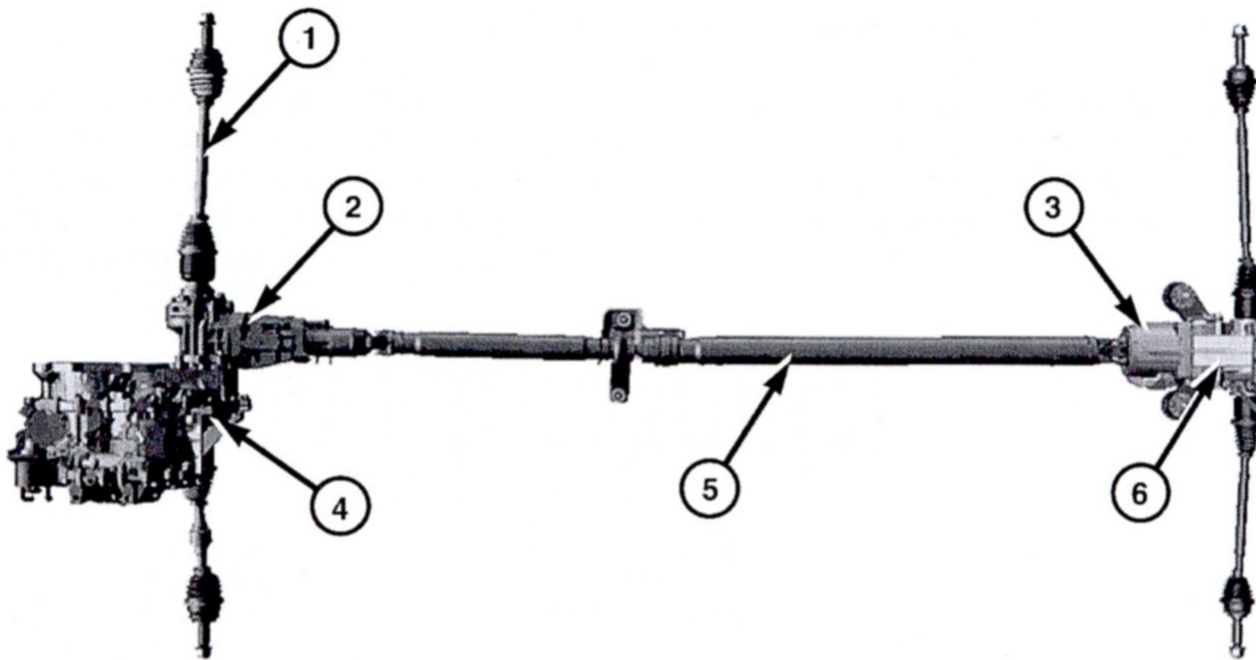
This electronically controlled all-wheel drive system does not incorporate traction control. The all-wheel drive system does not aid in side-to-side traction. The anti-lock brake system (ABS) is responsible for side-to-side traction using brake intervention programming.

ITM 3e AWD System

Components

The electronically controlled all-wheel drive system includes:

- An All-Wheel Drive ECM (AWD ECM)
- A Power Transfer Unit (PTU) or transfer case
- A two-piece drive shaft
- An Electronically Controlled Coupling (ECC)
- A Rear Differential assembly
- Axle shafts



1	Right Front Axle	4	Transaxle
2	Power Transfer Unit	5	Driveshaft
3	Electronically Controlled Coupling	6	Rear Differential

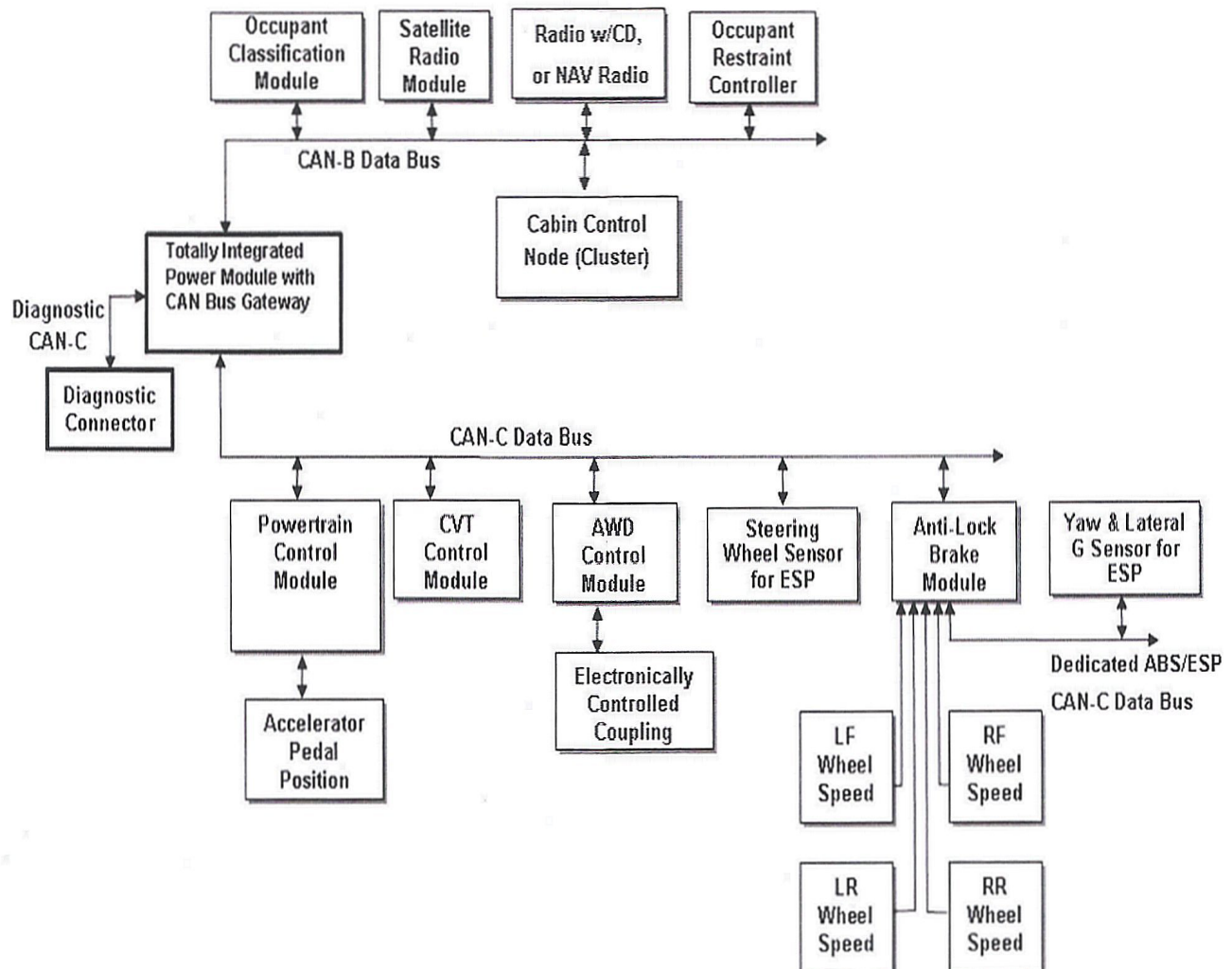
ITM 3e AWD System

Components (continued)

ECM

The AWD ECM communicates with the ABS control module and the PCM over the CAN C “BUS” system. The AWD ECM uses the wheel speed sensor inputs from the ABS module to monitor wheel speeds relative to one another and also determine the vehicle’s actual speed. The AWD ECM uses this information along with the accelerator pedal position to determine how much torque is to be transferred to the rear wheels.

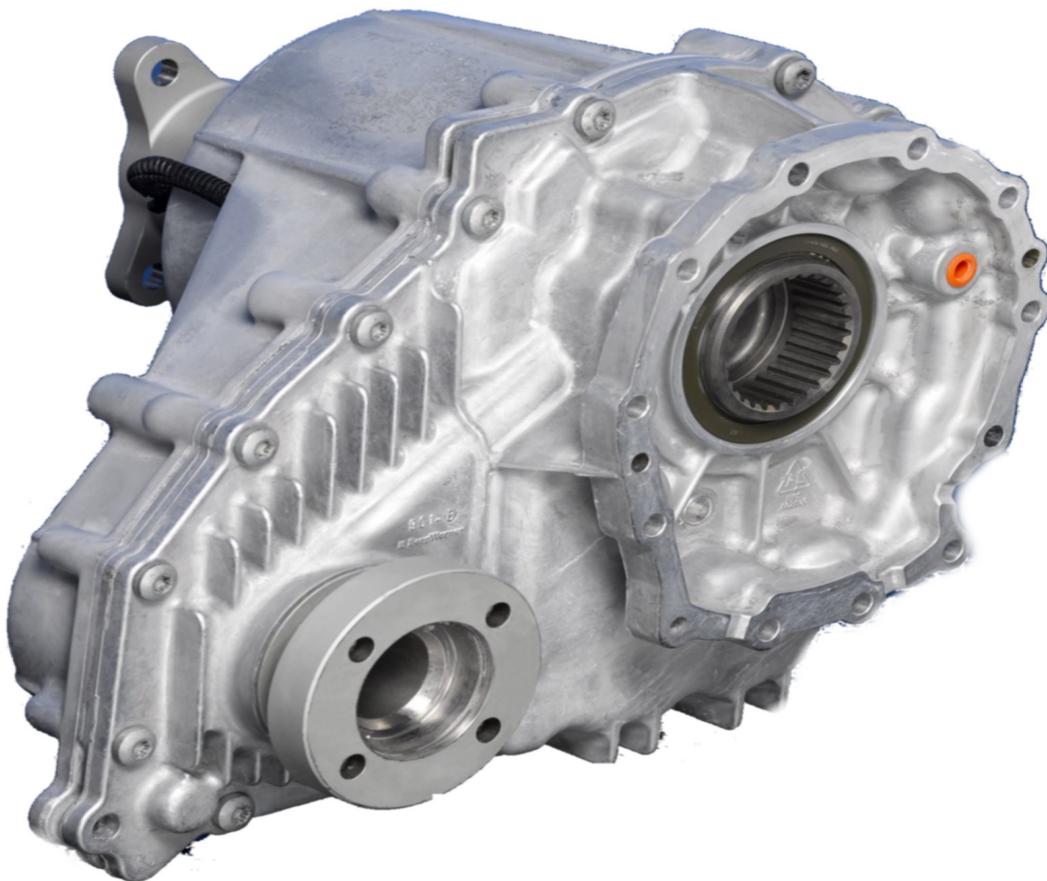
The AWD ECM then sends an electrical current to the ECC that is proportional to the amount of torque required. This allows the torque transfer to the rear wheels, to be fine-tuned to the amount of traction actually needed.



ITM 3e AWD System

Power Transfer Unit (PTU)

The power transfer unit (PTU) or transfer case is mounted to the right side of the transmission. The right axle half-shaft passes through the power transfer unit and drives the right front wheel. The power transfer unit transfers torque from the driving wheels to the rear differential through the drive shaft and electronically controlled coupling (ECC).



ITM 3e AWD System

Two Piece Drive Shaft and the ECTC

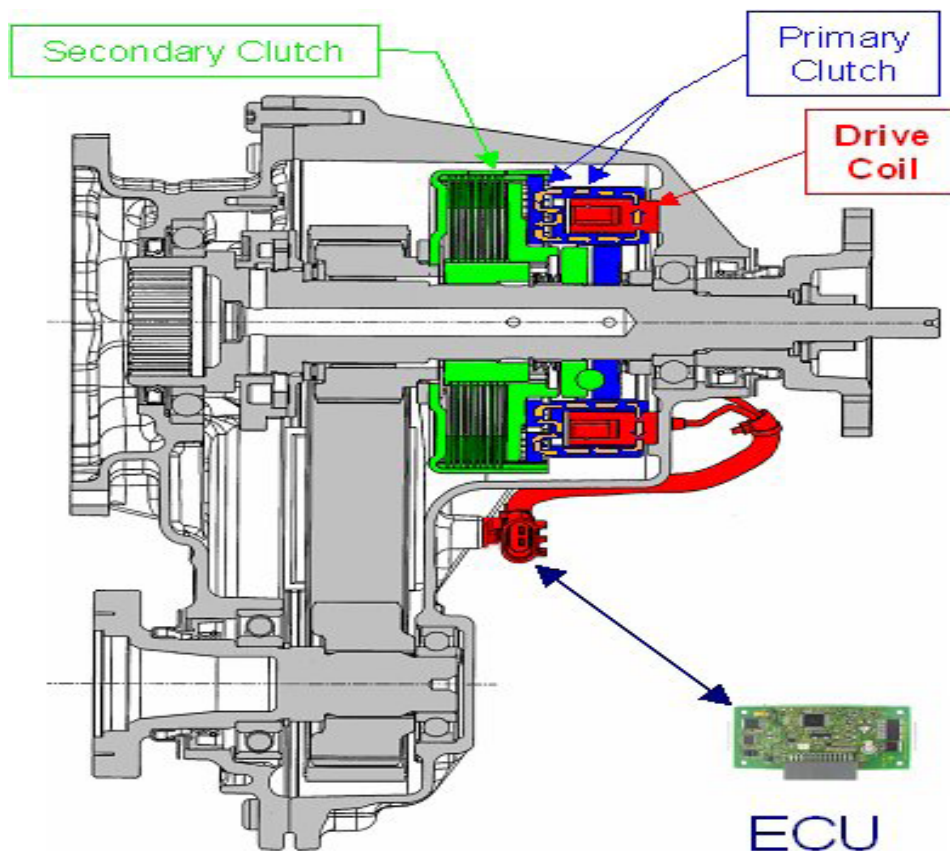
Two Piece Drive Shaft:

The two piece drive shaft connects the power transfer unit to the electronically controlled coupler. A center bearing supports the drive shaft and a center plunge type joint compensates for movement between the engine/power transfer unit and the electronically controlled coupling.

The Electronically Controlled Transfer Case (ECTC)

The purpose of the ECTC is to transmit torque to the rear wheels by way of a two-stage clutch system. The low torque electromagnet powered clutch, is controlled by the AWD ECM.

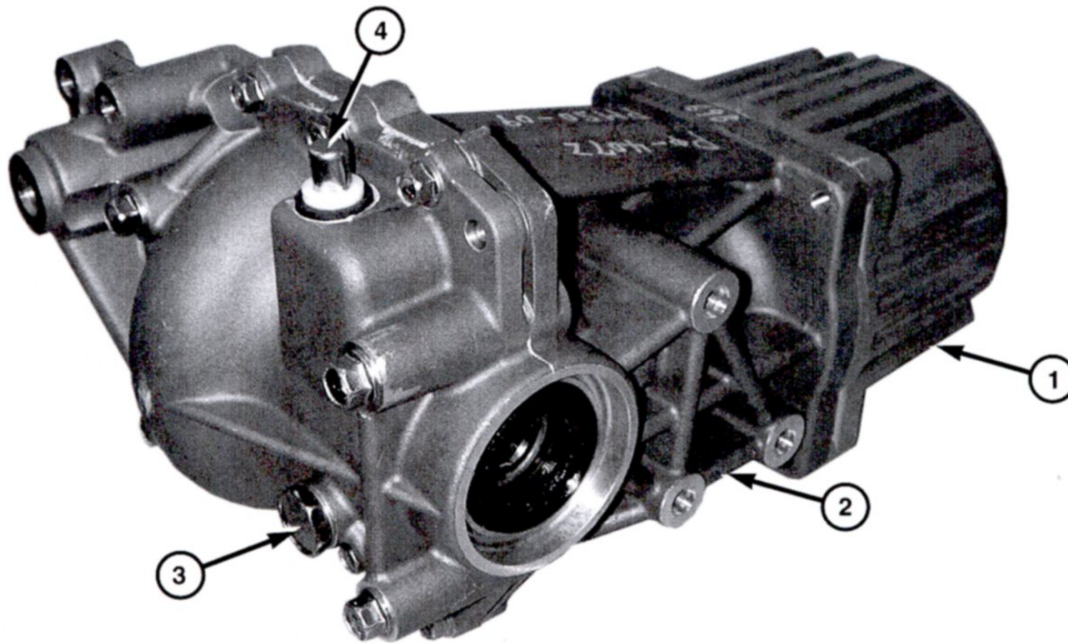
A cam and ball mechanism amplifies the force of the low torque clutch, applying the wet multi-disc main clutch that transmits torque to the rear wheels. The wet clutch is similar to clutch packs in automatic transmissions.



ITM 3e AWD System

The Rear Differential Assembly and Axle Shafts

The rear differential assembly of the “ITM 3e®” system consists of the electronically controlled coupling and the rear differential. The rear differential uses the torque provided by the electronically controlled coupling to drive the rear wheels. The electronically controlled coupling is not serviceable and must be replaced as an assembly.



1	Electrically Controlled Coupling	3	Fill/Level Plug
2	Rear Differential Case	4	Vent Fitting

Axle Shafts:

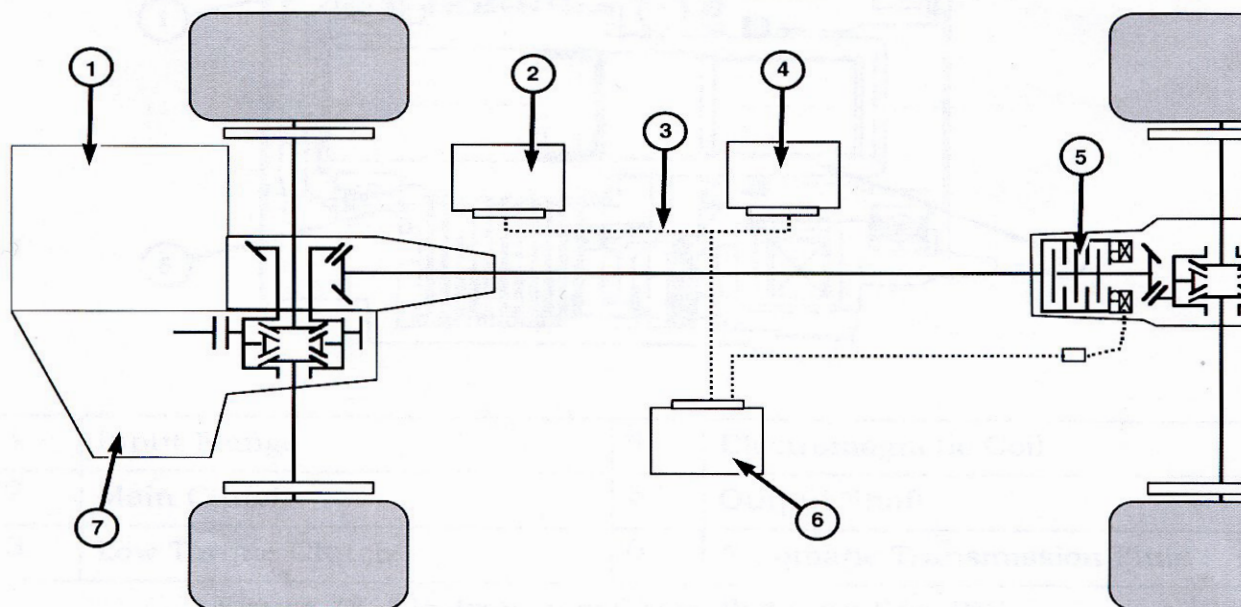
The axle shafts are internal to the rear differential assembly. The purpose of the axle shaft is to transfer torque from the differential carrier to the wheels.

ITM 3e AWD System

How Does the “ITM 3e®” System Work?

The electrically controlled all-wheel drive system includes the following electrical components:

- The AWD Electronic Control Module (AWD ECM)
- The Anti-lock Brake System (ABS) and wheel speed sensors
- The Electronically Controlled Coupling (ECC)



1	Engine	5	ECC
2	PCM	6	AWD ECM
3	CAN C Bus	7	Transaxle
4	ABS ECM		

ITM 3e AWD System

Operating Systems

The system has four operating modes:

- Open loop
- Closed loop
- Wheel speed dependent
- Vehicle dynamics enhancement

The AWD ECM also interfaces with the ABS/Stability ride control system and the traction control system. This interface allows the ABS system to influence rear wheel torque transfer through the EEC and helps the driver maintain control of the vehicle.

Open Loop Operation:

In high power demand situations, the all-wheel drive system immediately starts engaging the electronically controlled coupling, transferring a high percentage of torque to the rear wheels. This prevents front wheel slippage, as power is transmitted to all four wheels. This mode of operation is called open-loop operation, because the AWD ECM does not use inputs from the ABS system to control the torque transfer to the rear wheels.

Closed Loop Operation:

In closed-loop operation, the AWD ECM uses inputs from the ABS control module to determine the proper torque transfer as needed. Power to the rear wheels is also modulated under the following conditions.

- Front wheels slipping on ice while backing will transfer torque to the rear wheels
- Loss of traction at freeway speeds, as in hydroplaning, will transfer torque to the rear wheels.

Both open-loop and closed-loop modes are always active with the closed-loop mode layered on top of the open-loop mode to increase torque to the rear wheels when needed to maintain traction in extreme situations.

ITM 3e AWD System

Operating Systems (continued)

Wheel Speed Dependent Operation:

Wheel Speed dependent mode is independent of the open-loop and closed-loop modes, using wheel speed differences to determine when the vehicle is turning in a tight turn. This condition is indicated by a large difference in the side-to-side wheel speeds. This causes the AWD ECM to reduce torque to the rear wheels which prevents binding in the driveline.

Vehicle Dynamics Enhancement:

Additional AWD ECM calibrations control the torque being sent to the rear wheels for improved handling at speeds between 25 mph and 65 mph. At these speeds, the system increases torque to the rear wheels during cornering. Above 70 mph. and under normal driving conditions, the AWD ECM strategy provides minimal torque transfer to the rear wheels to increase fuel economy.

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Toyota



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U250E

Description



Model		'05 Camry	'04 Camry
Transaxle Type		U250E	U241E
Gear Ratio* ¹	1st	3.943	←
	2nd	2.197	←
	3rd	1.413	←
	4th	0.975	1.020
	5th	0.703	—
	Reverse	3.145	←
Differential Gear Ratio		3.391	2.740
Fluid Capacity Liters (US qts, Imp. qts)		8.0 (8.5, 7.0)	8.2 (8.7, 7.2)
Fluid Type		ATF Type T-IV	←
Weight (Reference)* ² kg (lb)		93.0 (204.6)	89 (195.8)

*¹: Counter gear ratio included

*²: Weight shows the figure with the fluid fully filled.

U250E

Solenoid, Clutch, Brake and One-Way Clutch Application

Transaxle Power Flow

Shift Lever Position	Gear	Solenoid Valve						Clutch				Brake			One-way Clutch	
		S4	SR	DSL	SL1	SL2	SL3	C ₀	C ₁	C ₂	C ₃	B ₁	B ₂	B ₃	F ₁	F ₂
P	Park				○	○								○		
R	R				○	○				○			○	○		
N	N				○	○								○		
D	1st				○	○			○					○	○	○
	2nd					○			○			○		○		○
	3rd		○	Δ*2	○	Δ*2		○	○					○		○
	4th		○	Δ*1◆		Δ*1◆	○	○				○		○		○
	5th	○	○	Δ◆		Δ◆	○	○			○	○				
4	1st				○	○			○					○	○	○
	2nd					○			○			○		○		○
	3rd		○	Δ*2	○	Δ*2		○	○					○		○
	4th		○	Δ◆		Δ◆	○	○				○		○		○
3	1st				○	○			○					○	○	○
	2nd					○			○			○		○		○
	3rd		○		○			○	○					○		○
2	1st				○	○			○					○	○	○
	2nd					○			○			○		○		○
L	1st			○	○	○			○				○	○	○	○

[○ : ON D : Lock-up ON ◆ : Flex lock-up ON (during deceleration only)]

*1: Shift control operates only when 5th is prohibited while traveling uphill / downhill.

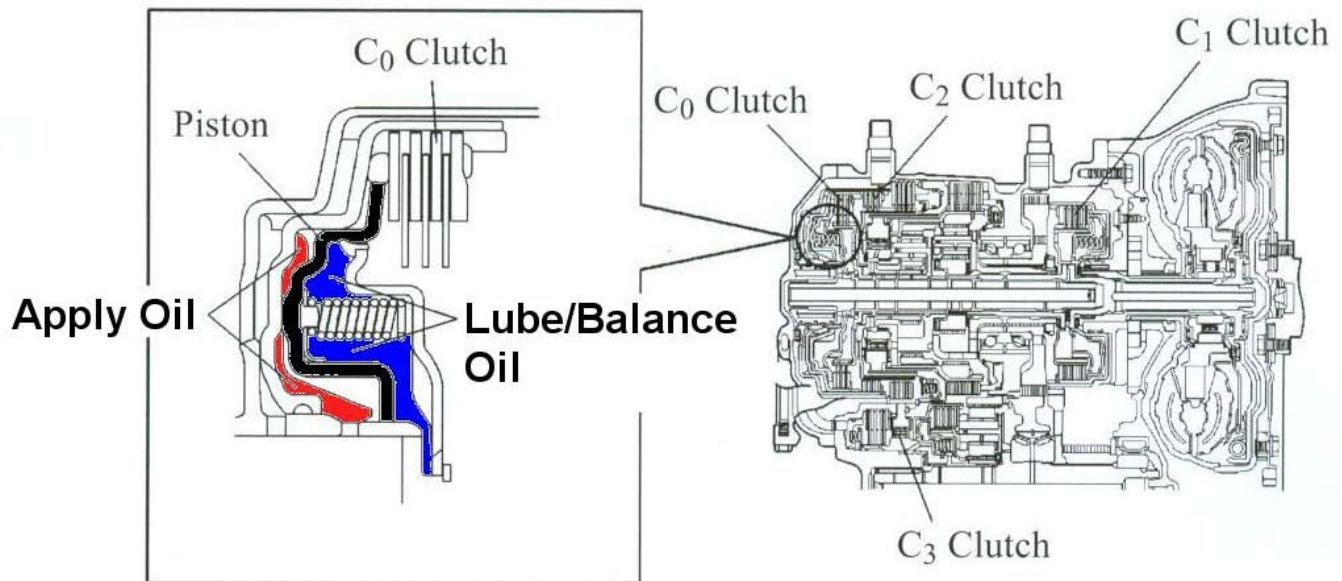
*2: Shift control operates only when 4th is prohibited while traveling uphill / downhill.

U250E

Centrifugal Fluid Pressure Canceling Mechanism

To prevent the generation of pressure by the centrifugal force that is applied to the fluid in the piston when the clutch is released, a check ball is provided to discharge the fluid. This check ball prevented bind ups and clutch fill apply time.

The later design uses lube oil on the front side of the piston to aide in the release of the clutch as shown.

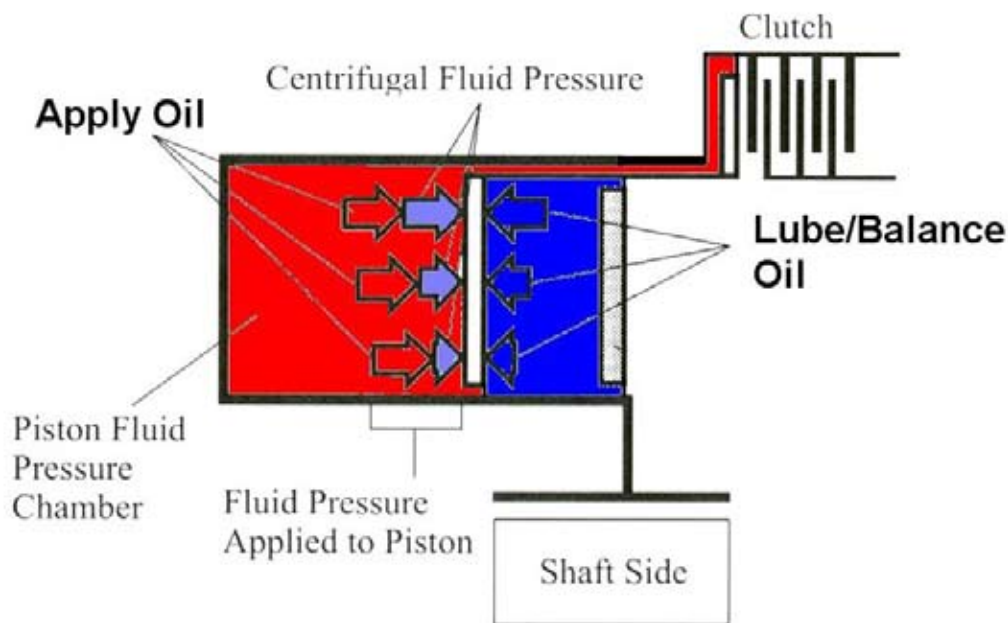


U250E

Centrifugal Fluid Pressure Canceling Mechanism (continued)

The balance piston creates a piston fluid pressure chamber that uses lube oil to create centrifugal fluid pressure on top of the piston. This will counteract any centrifugal pressure created on the bottom or apply side of the piston.

This eliminated the need to discharge the fluid through the use of a check ball, and a highly responsive and smooth shifting characteristic has been achieved.



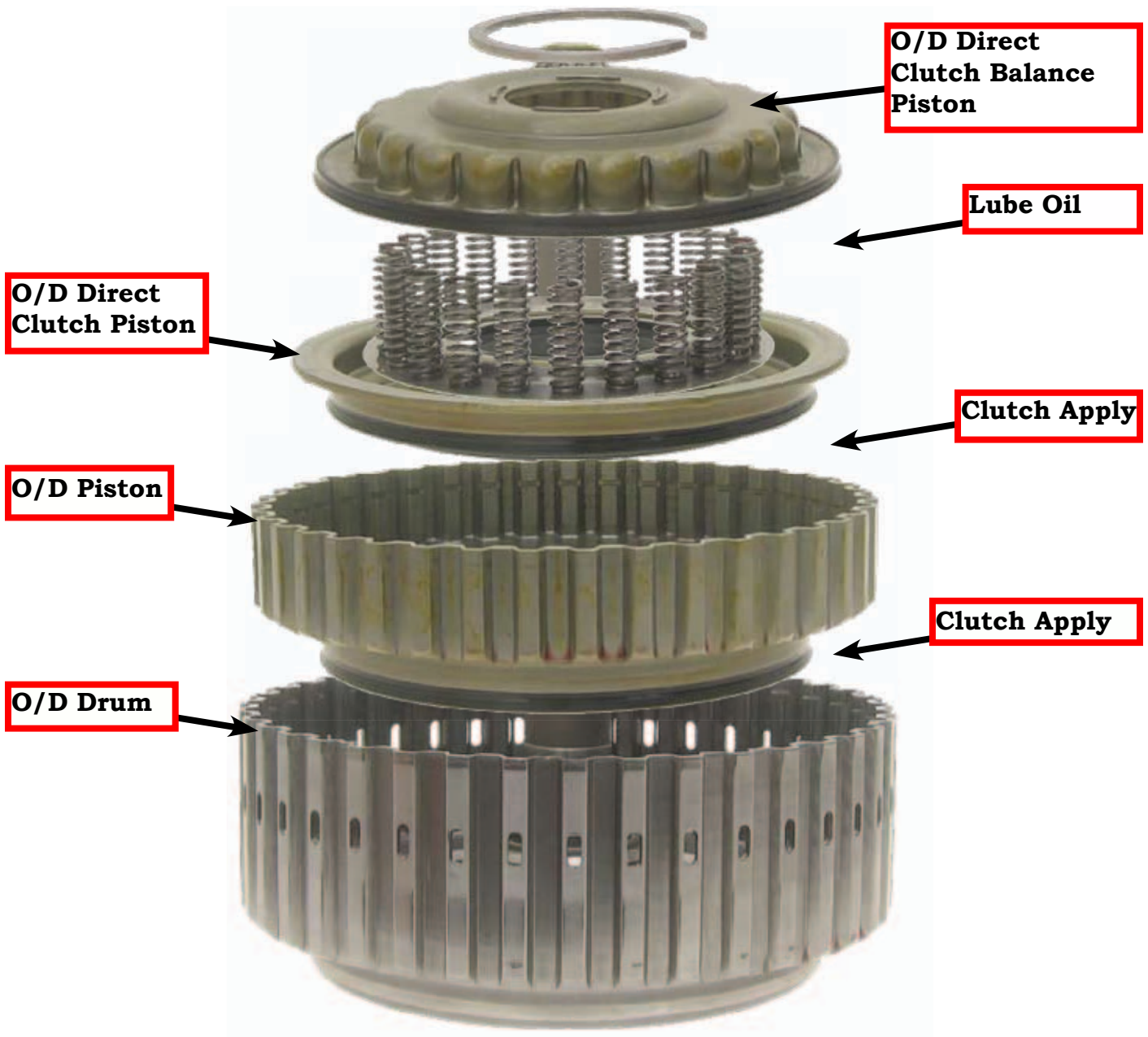
Fluid pressure
applied to piston

Centrifugal fluid pressure
applied to chamber B

Target fluid pressure
(original clutch pressure)

U250E

Centrifugal Fluid Pressure Canceling Mechanism (continued)

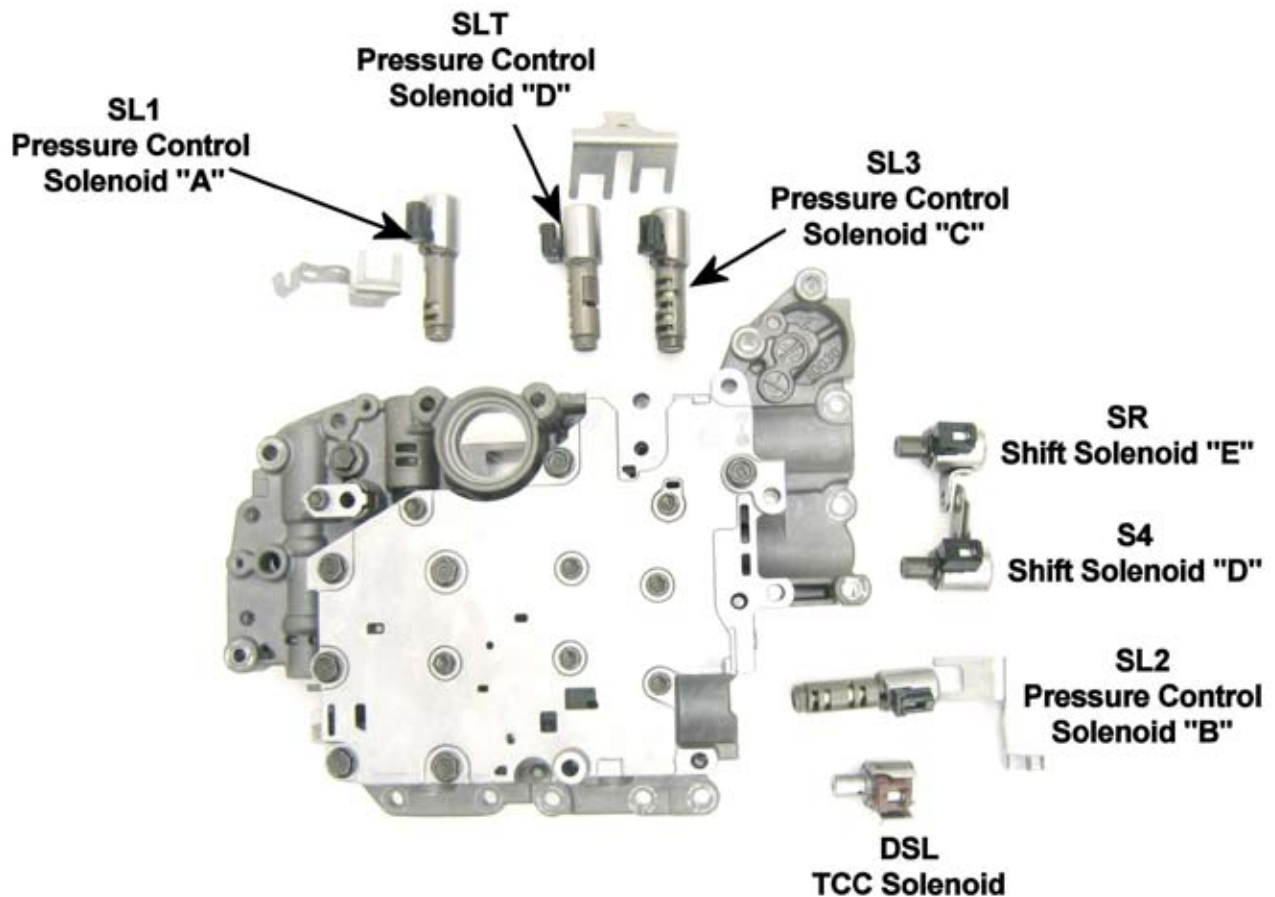


U250E

Solenoid Identification and Locations

It is important to identify the differences between how the repair manuals and the parts manuals list the solenoids, use the chart below for ordering reference.

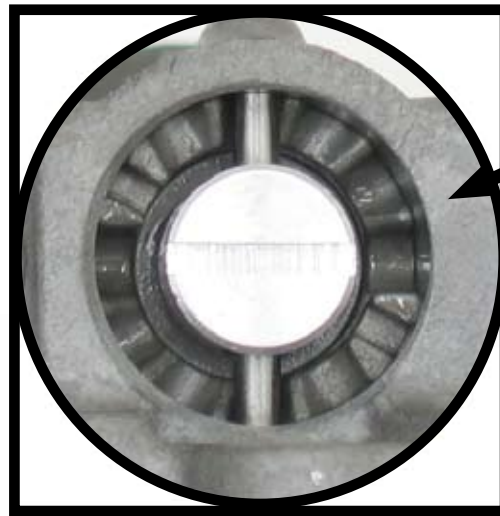
REPAIR MANUAL SOLENOID NAME	PART CATALOG DESCRIPTION
SL1	Solenoid Assembly, Clutch Control No. 1
SL2	Solenoid Assembly, Clutch Control No. 2
SL3	Solenoid Assembly, Clutch Control No. 2
S4	Solenoid Assembly, Transmission 3-Way No. 2 (No. 1)
SR	Solenoid Assembly, Transmission 3-Way No. 2 (No. 2)
SLT	Solenoid Assembly, Line Pressure Control
DSL	Solenoid Assembly, Transmission 3-Way



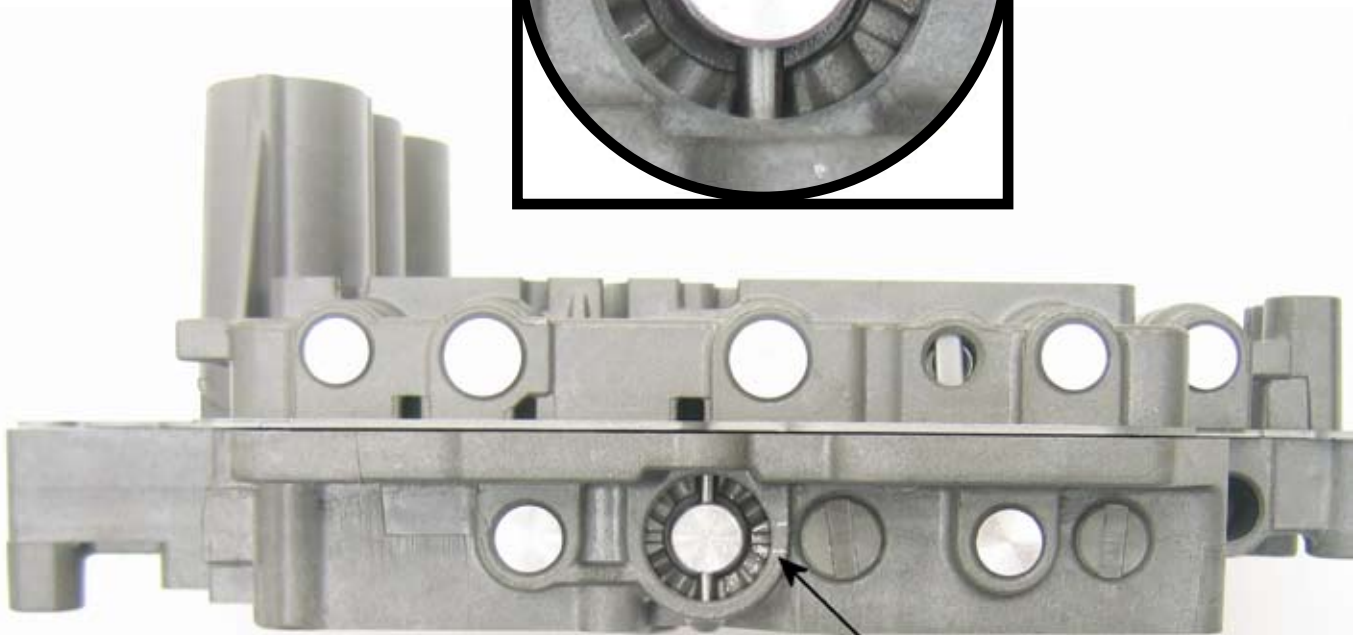
U250E

Pressure Regulator Setting

There is no factory setting information available at this time. Be sure to mark the setting before dissassembly. It is model dependent and will vary from model to model.



**Mark both, the
valve body and the
PR adjuster prior
to removal**



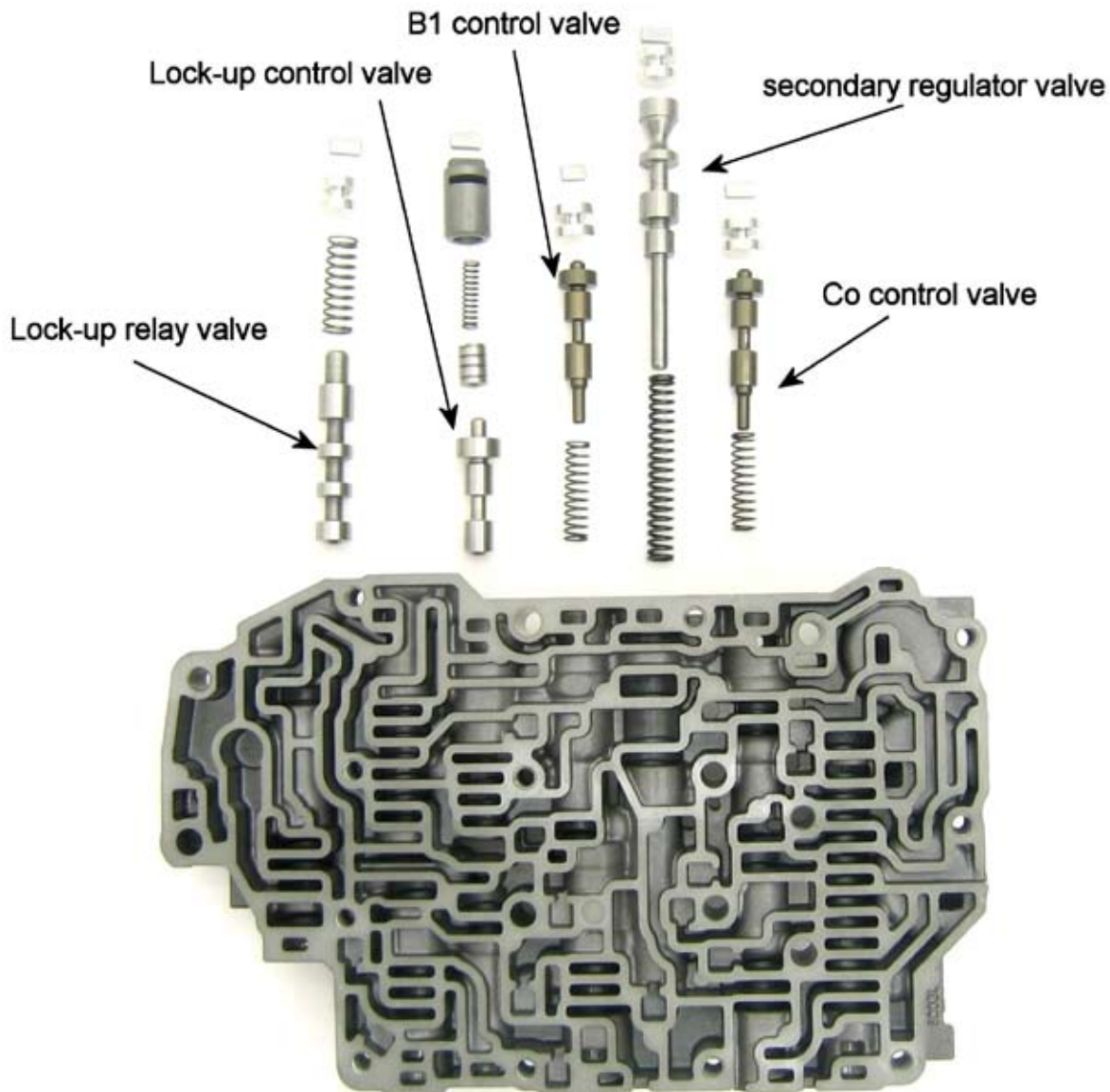
Record PR Setting Before Disassembly

U250E

Valve Body Identification

2007 Model Upper Valve Body

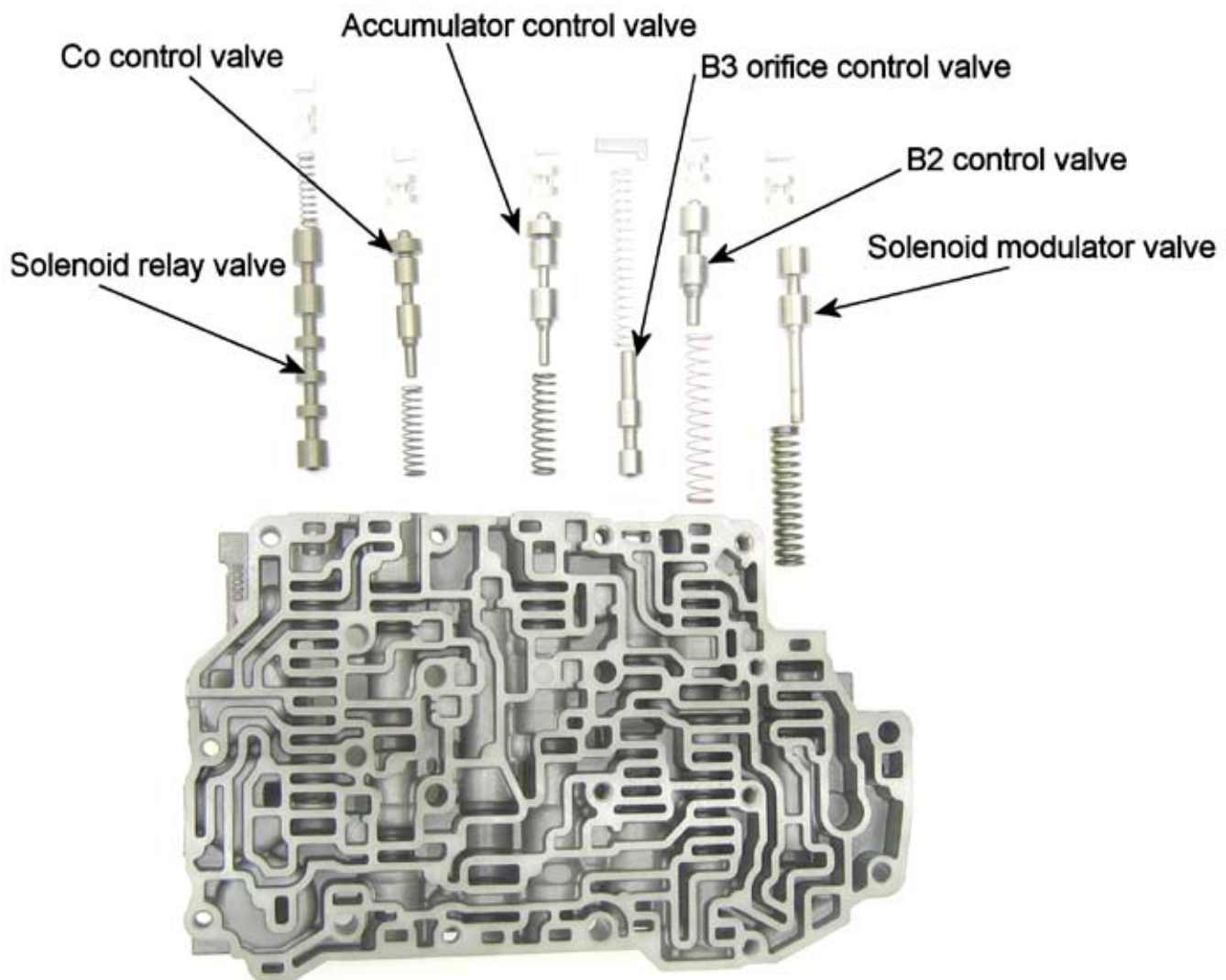
During disassembly, inspect the valves and bores for wear and scoring. Use the following pages for reference during your rebuild.



U250E

Valve Body Identification (continued)

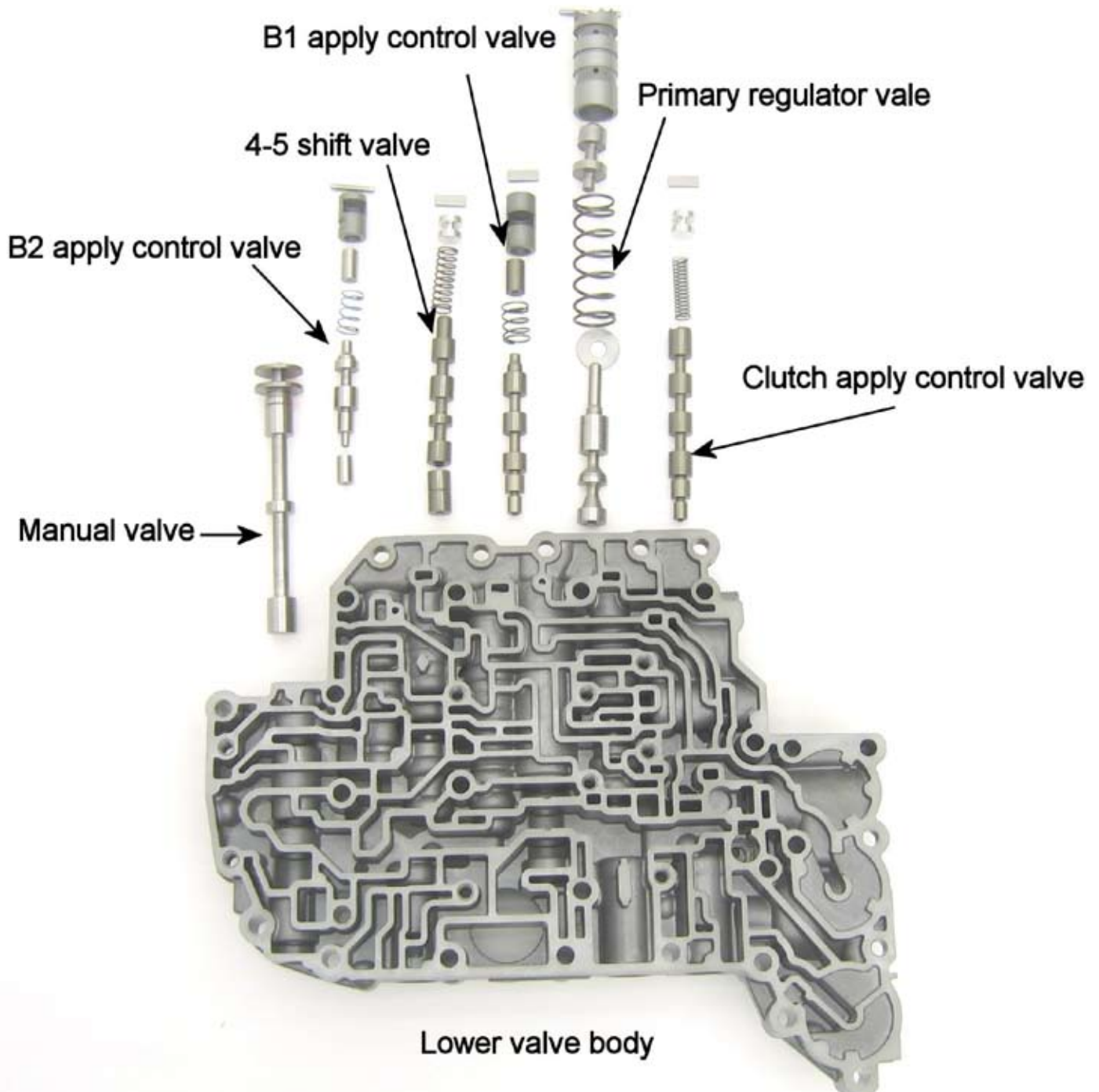
2007 Model Upper Valve Body (continued)



U250E

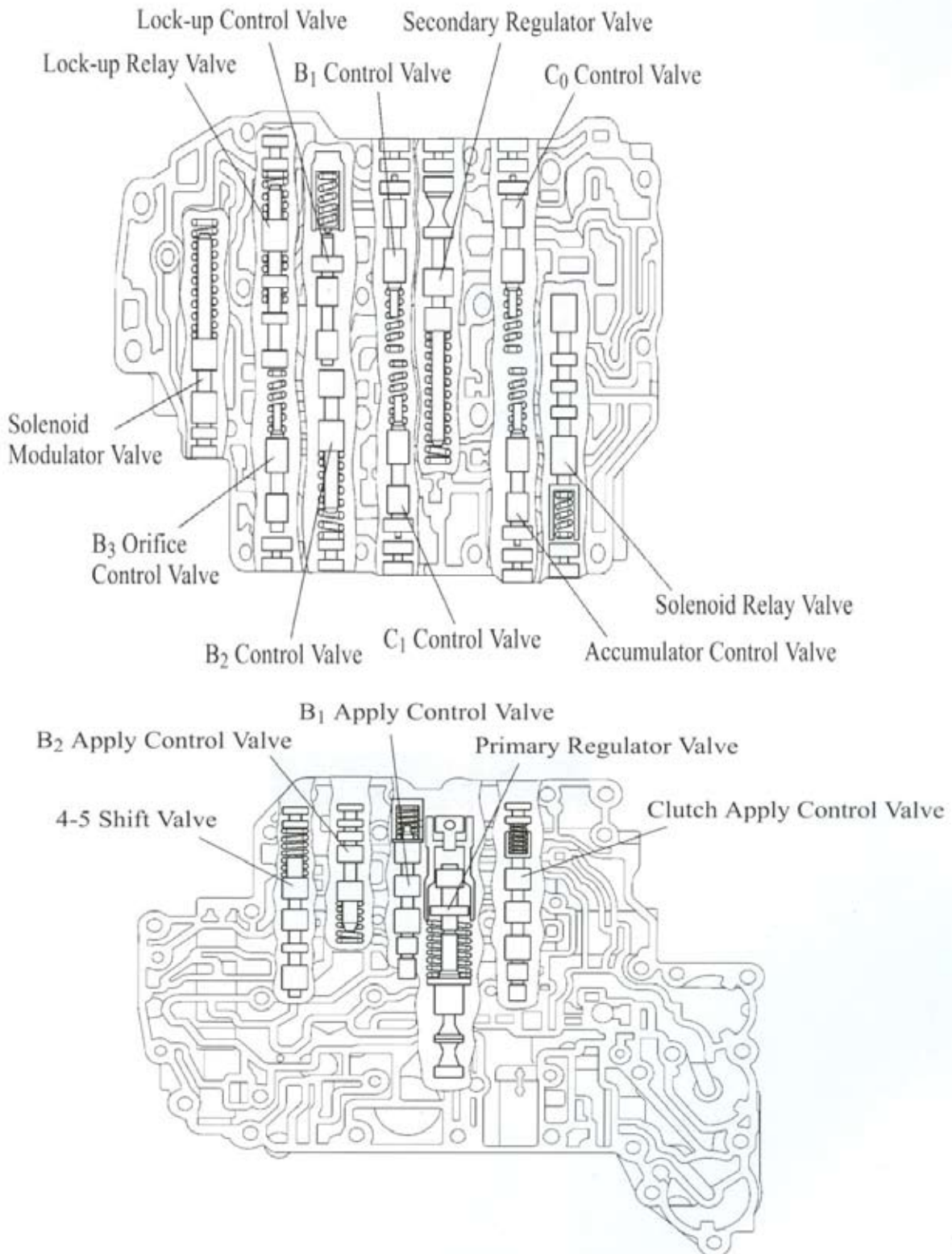
Valve Body Identification (continued)

2007 Model Lower Valve Body



U250E

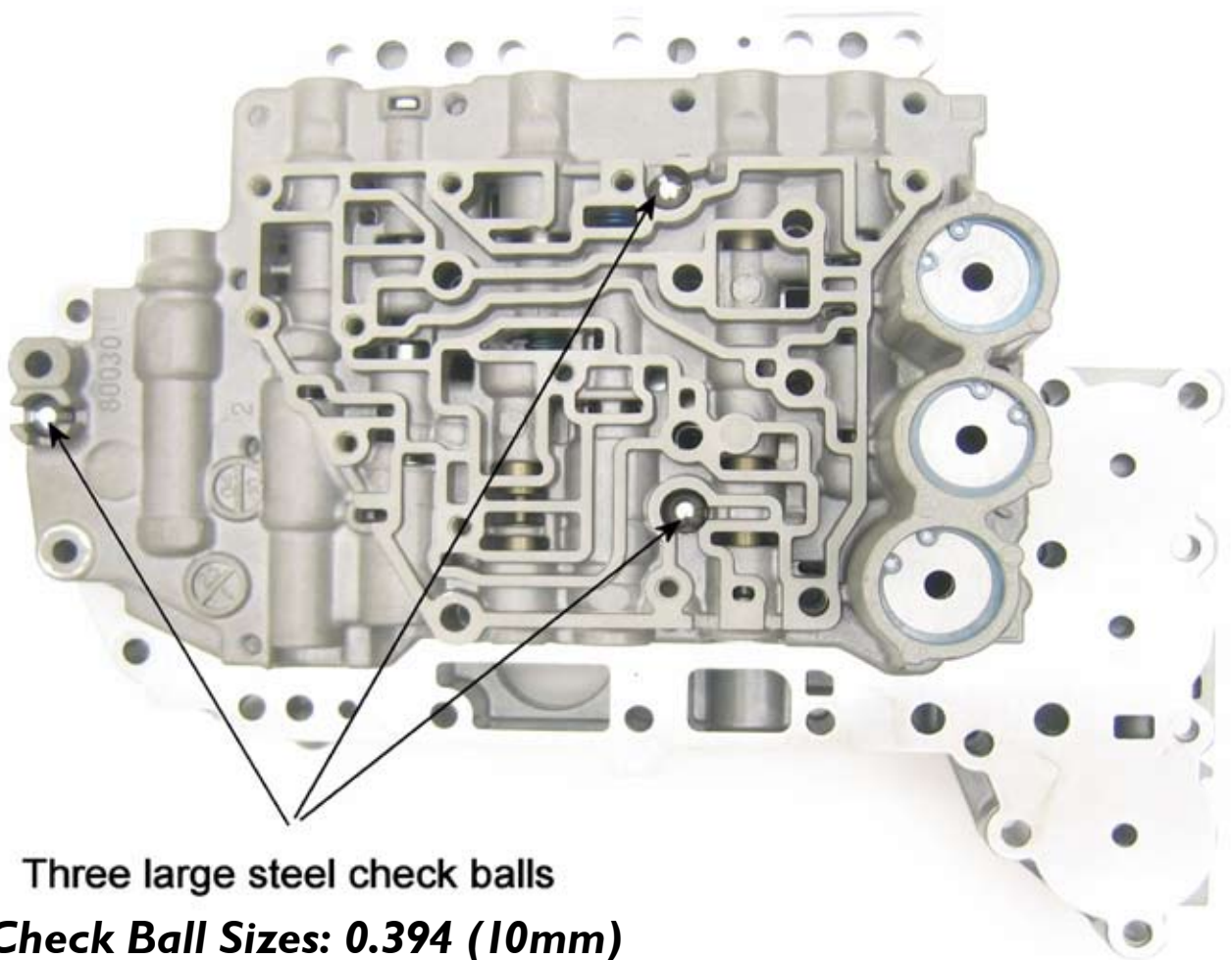
2005-2006 Valve Body Identification



U250E

Large Check Ball Locations

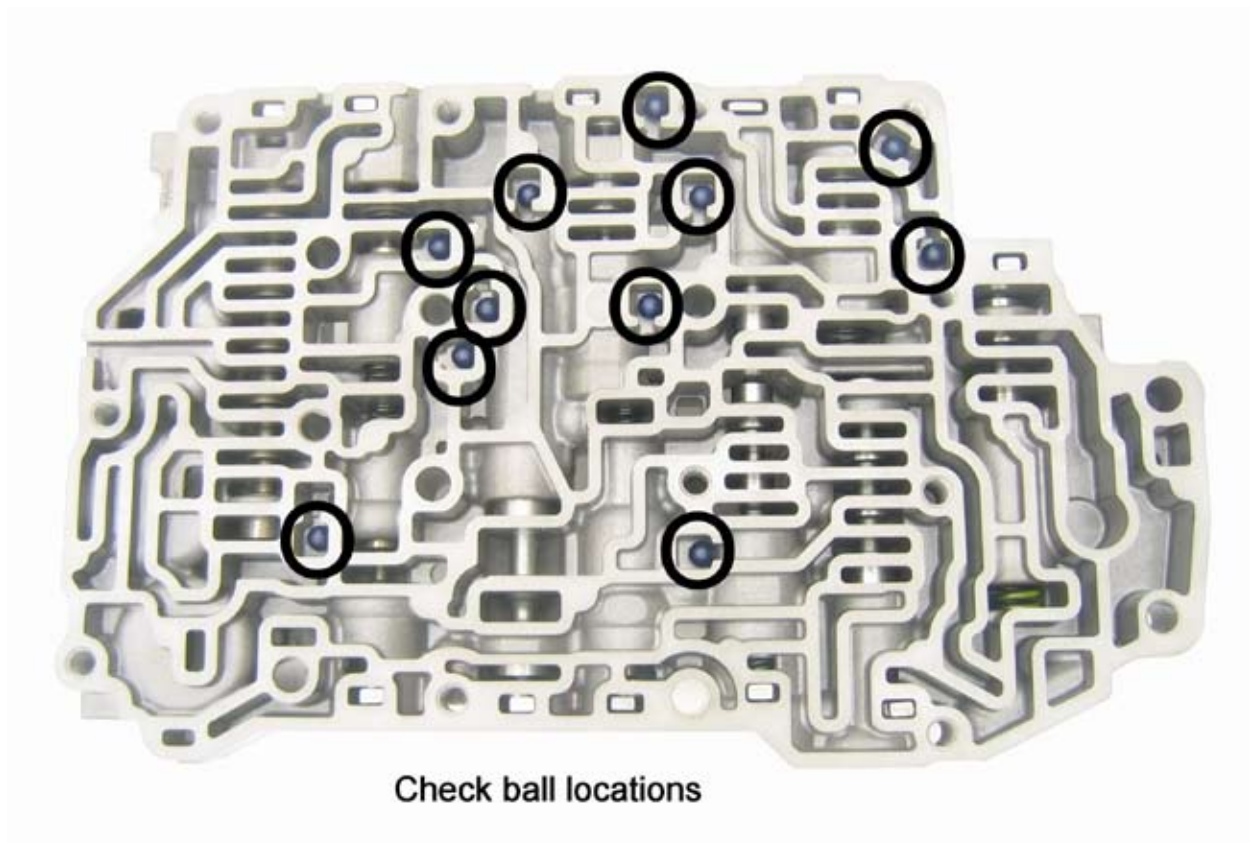
There are three (3) large check balls in the upper portion of the valve body. These check balls are steel and are used for exhausting oil, make sure the check balls seat properly before reusing.



U250E

Small Check Ball Locations

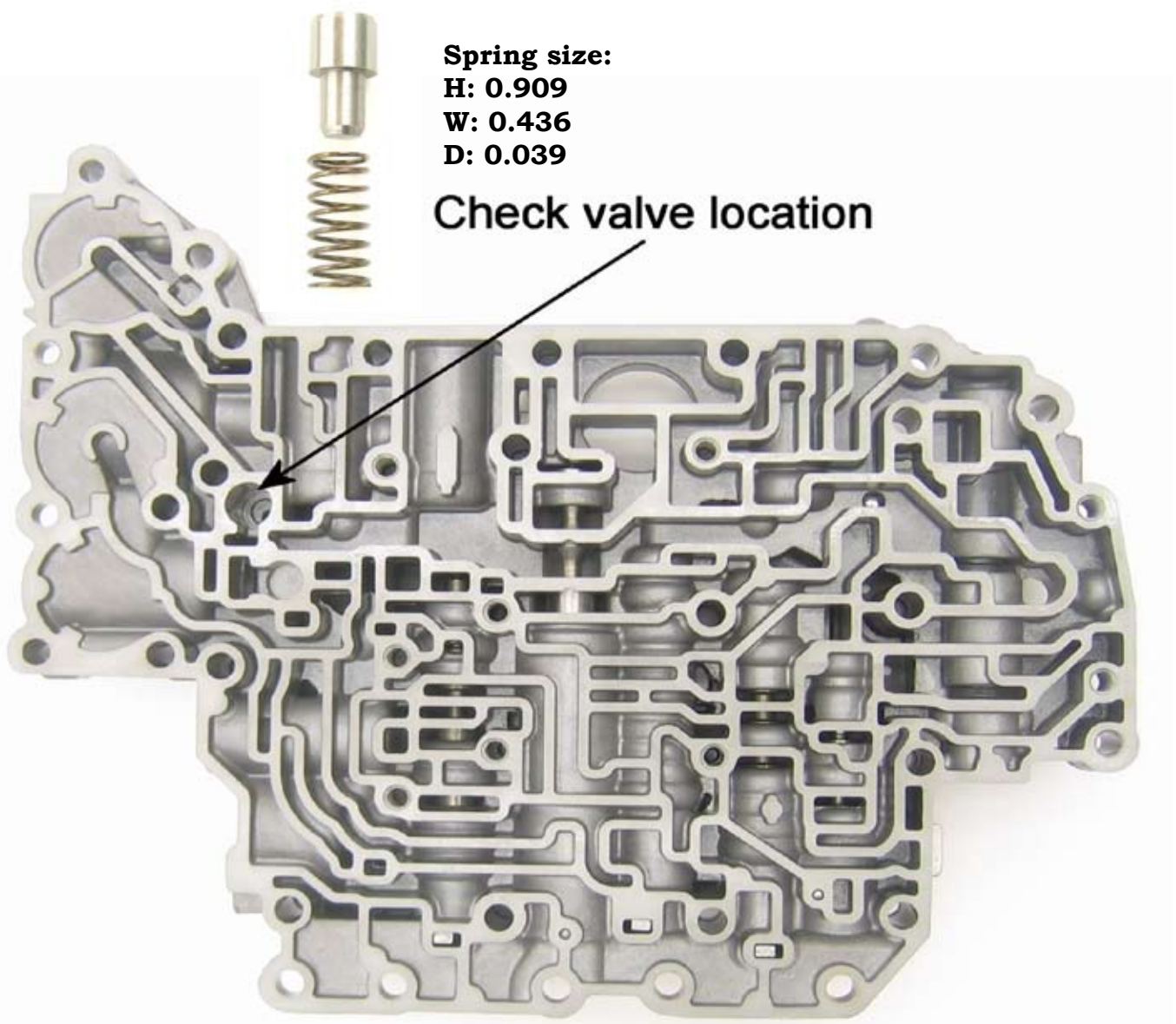
There are eleven (11) check balls in the main portion of the valve body. All of the check balls are composite, make sure the check balls seat properly before reusing. It is recommended to replace the check balls during every rebuild.



U250E

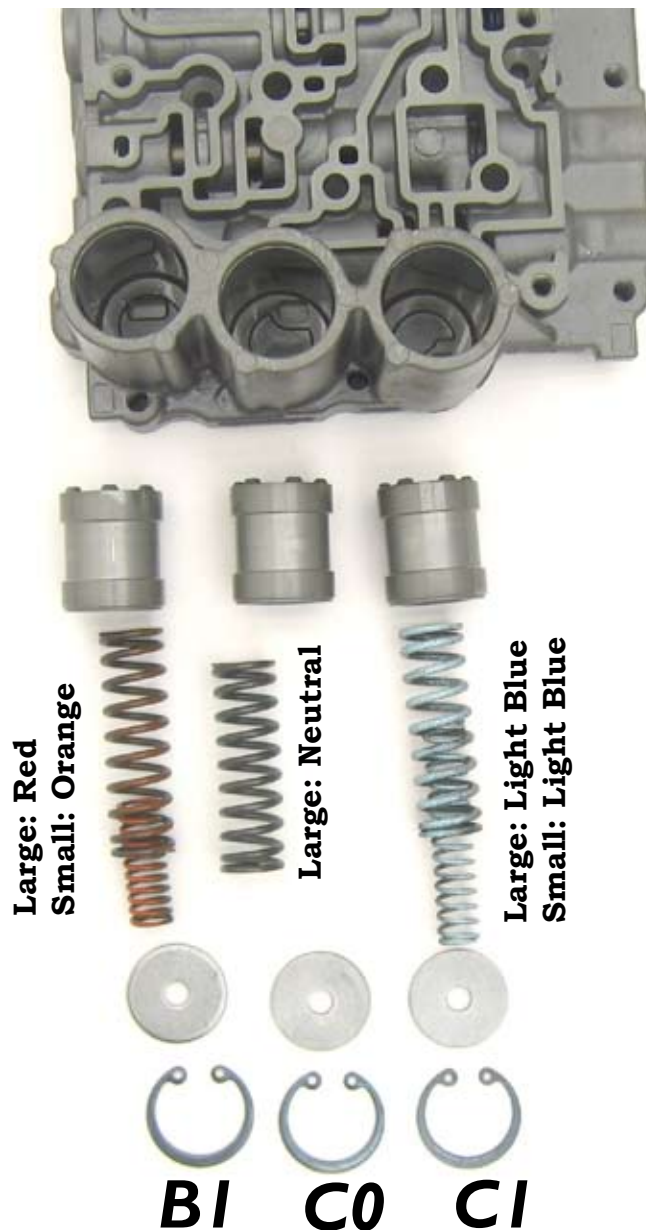
Check Valve Location

The torque converter check valve and spring must be installed as shown. Failure to install it correctly or not at all will result in a converter charge related concern.



U250E

Accumulator Piston and Spring Identification and Locations

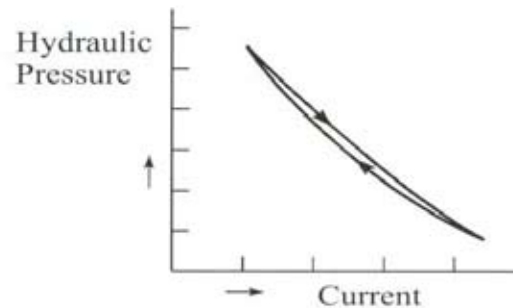
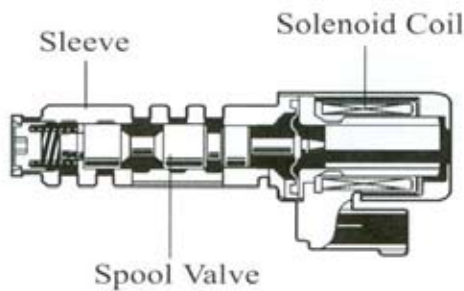


U250E

SL and SLT Solenoid Description

The linear solenoid valve SLT controls the transmission line pressure for a smooth shift based on signals from the throttle position sensor and the vehicle speed sensor. The ECM adjusts the duty cycle of the SLT solenoid valve to control hydraulic line pressure coming from the primary regulator valve.

The solenoids valves SL1, SL2, SL3, and SLT have the same basic structure.

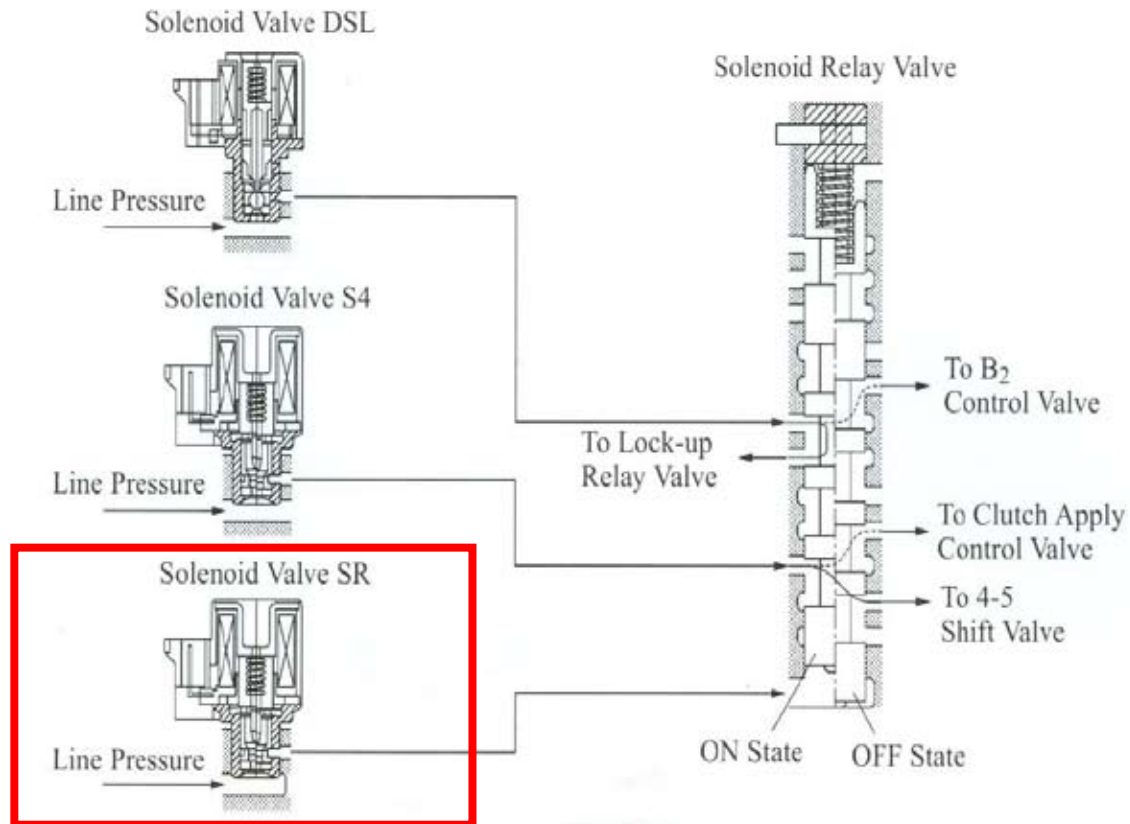


Solenoid Valve	Action	Function
SL1	For clutch and brake engagement pressure control	B ₁ brake pressure control
SL2		• C₀ clutch pressure control • Lock-up clutch pressure control
SL3		C ₁ clutch pressure control
SLT	For line pressure control	• Line pressure control • Secondary pressure control

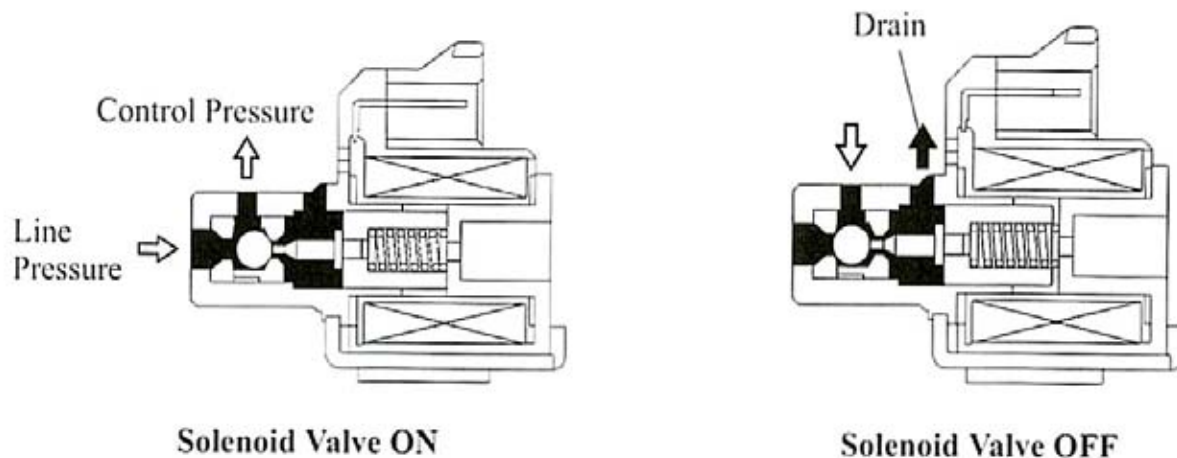
U250E

DSL, S4 and SR Solenoid Description

The Solenoid Valve SR controls the solenoid relay valve. The fluid passages from the solenoid valve DSL and S4 have been redesigned starting in 2007.



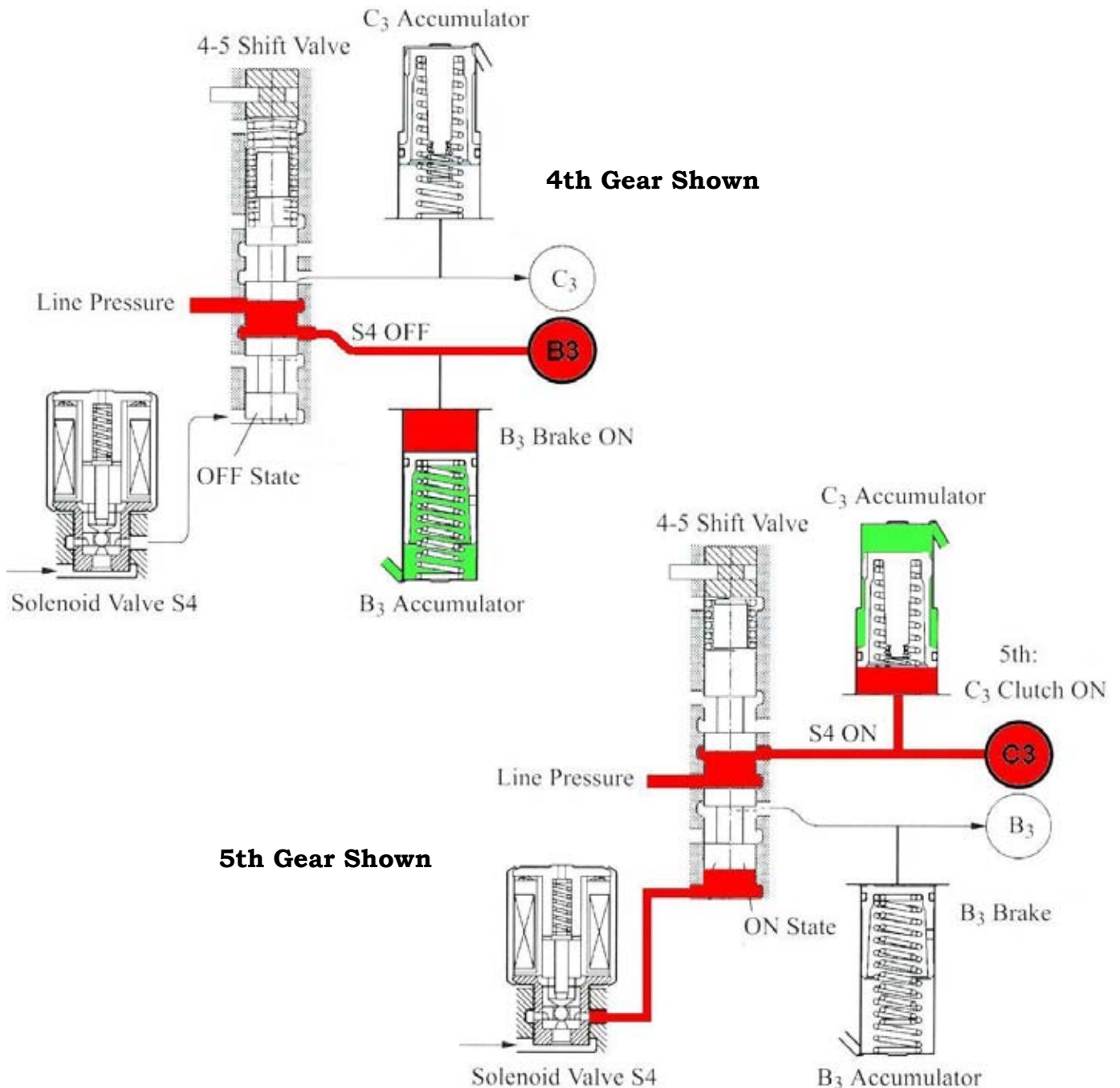
The DSL, S4 and the SR solenoids are three-passage shift solenoid valves.



U250E

DSL, S4 and SR Solenoid Description (continued)

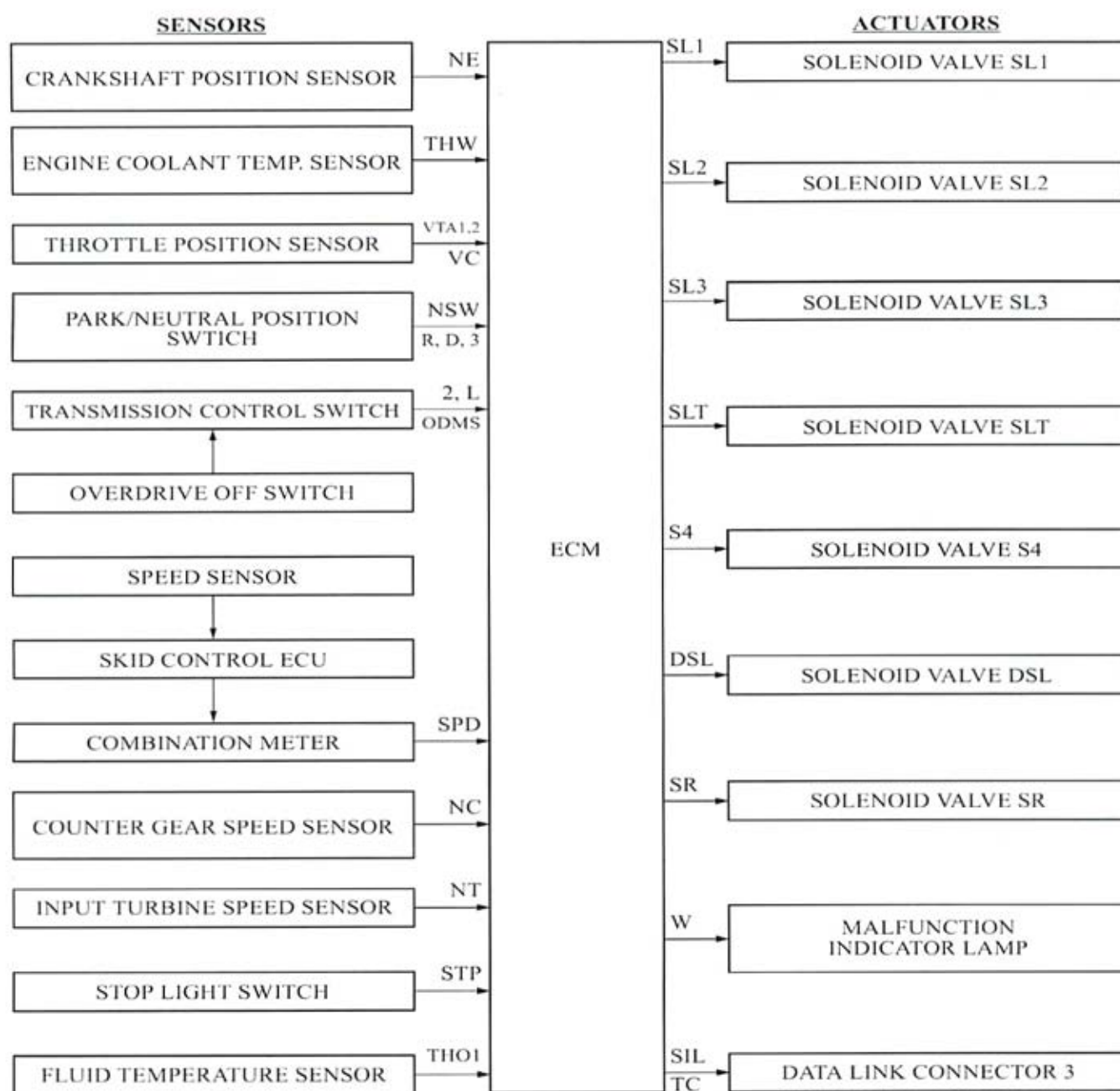
The S4 solenoid valve, when commanded “ON”, controls the 4-5 shift valve to stroke against the spring. Fifth (5th) gear is established by removing pressure applied to the B3 brake and applying pressure to the C3 clutch.



U250E

ECM Inputs and Outputs

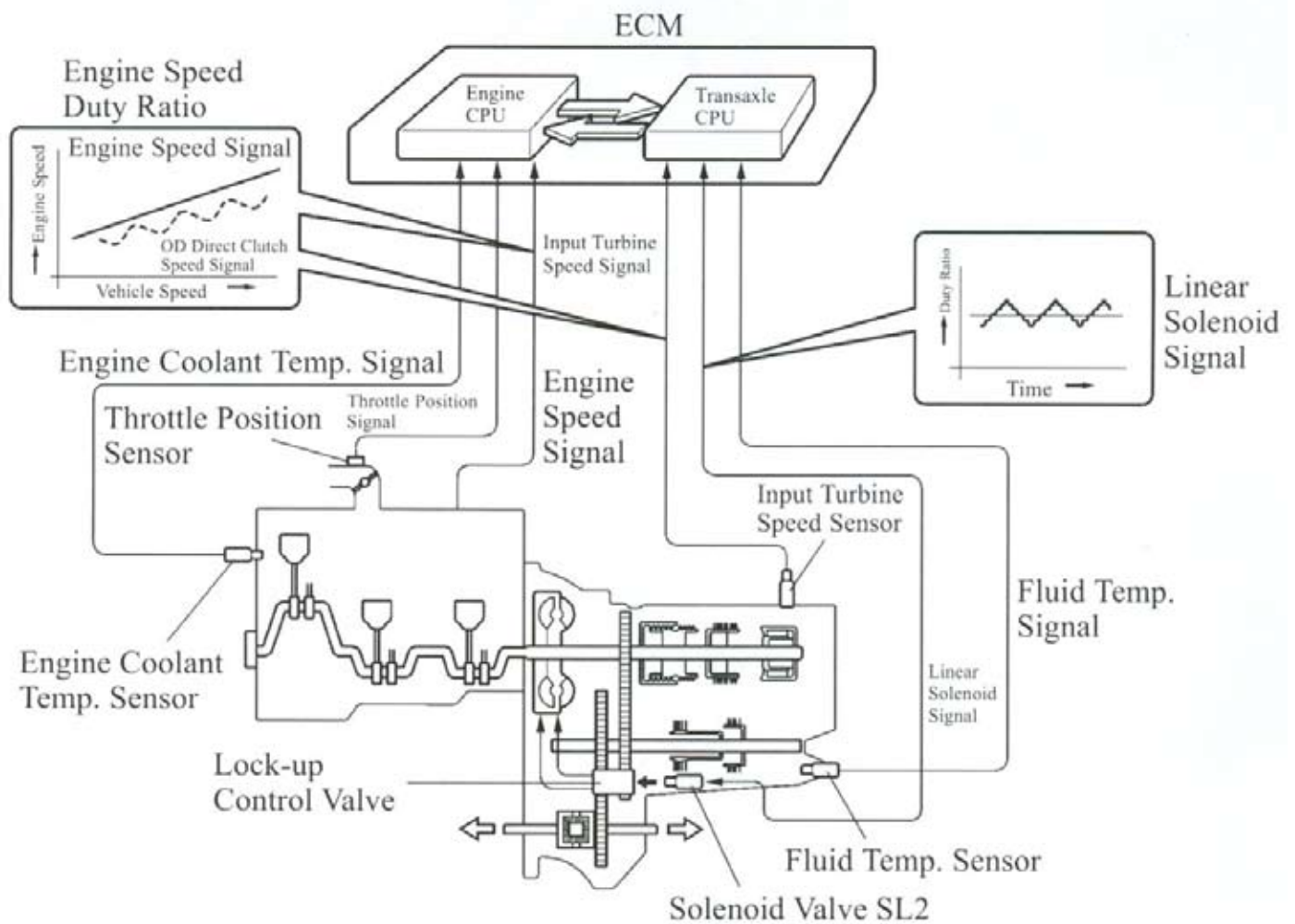
The ECM combines both the Engine CPU and the Transmission CPU. The inputs from the engine and transmission sensors are used to control shift timing and feel. The strategy is derived from emissions related devices.



U250E

ECM Basics

This diagram should be used as a quick reference to identify what controls the transmission.



U250E

Solenoid Codes

P0746	Pressure Control Solenoid "A" Performance (Shift Solenoid Valve SL1)
P0748	Pressure Control Solenoid "A" Electrical (Shift Solenoid Valve SL1)
P0776	Pressure Control Solenoid "B" Performance (Shift Solenoid Valve SL1)
P0778	Pressure Control Solenoid "B" Electrical (Shift Solenoid Valve SL1)
P0796	Pressure Control Solenoid "C" Performance (Shift Solenoid Valve SL1)
P0798	Pressure Control Solenoid "C" Electrical (Shift Solenoid Valve SL1)
P0766	Pressure Control Solenoid "D" Performance (Shift Solenoid Valve SL1)
P2716	Pressure Control Solenoid "D" Electrical (Shift Solenoid Valve SL1)
P0982	Shift Solenoid "D" Control Circuit Short (Shift Solenoid Valve S4)
P0983	Shift Solenoid "D" Control Circuit Open (Shift Solenoid Valve S4)
P0771	Shift Solenoid "E" Performance (Shift Solenoid Valve SR)
P0985	Shift Solenoid "E" Control Circuit Short (Shift Solenoid Valve SR)
P0986	Shift Solenoid "E" Control Circuit Open (Shift Solenoid Valve SR)
P0741	Torque Converter Clutch Solenoid Performance (Shift Solenoid Valve DSL)
P2769	Torque Converter Clutch Solenoid Short (Shift Solenoid Valve DSL)
P2770	Torque Converter Clutch Solenoid Open (Shift Solenoid Valve DSL)

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Mercedes

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722.9

Introduction

The 722.9 transmission can be found in the Mercedes 2004-06 SL500, 2005 & up CL500, E500, S430, 500, SLK350, 55 AMG, 2006 & up C230, 280, 350, CLK350, CLS500, E350, E63 AMG, R350, 500, SLK280 and 2007 & up CLK550, CLS550, CL600, CLS63 AMG, E550, E63 AMG, GL320, 450, ML350, 500, ML63 AMG, R63, and S550.

This 5th generation transmission is the first 7 speed automatic produced by Mercedes Benz. The Mercedes designation for this transmission is New Automatic Gearbox 2 (NAG2) or 7G – Tronic. Along with 7 forward speeds this unit also has 2 reverse gear ratios (similar to the 722.6) depending on whether it's in the Sport or Comfort mode.

Shift Strategy

- Shift strategy improvements include:
- Shorter computer reaction time by 0.1 second
- Downshifts shortened by up to 0.2 seconds
- Coasting downshifts shortened by 0.4/2.5 seconds
- 37-47 MPH acceleration times shortened by 23-28% (model dependant)
- Fuel consumption reduced by up to 4%
- Noise levels reduced, due to lower engine speed in 5th, 6th & 7th gear at constant vehicle speed
- Flexible adaptation to vehicle and engine

Variable Shift Programming

There are two basic shift programs that can be varied by the customer (similar to the 722.6) using the S or C button on the Electronic Shifter Module (ESM).

“S” (Sport)

- 1st gear starts
- Normal shift points
- Reverse gear 1 (-3.416:1)

“C” (Comfort)

- 2nd gear starts
- Earlier up-shifts and later downshifts
- Reverse gear 2 (-2.231:1)

Note: Transmission will start in first gear if any of the following conditions apply:

- 1st gear is manually selected
- 3/4 to full throttle acceleration from start
- Cold engine temp (pre-catalytic warm up)

722.9

Limp Mode

Emergency function or Limp-home mode:

There are a variety of failsafe modes;

- If a solenoid is defective, the gear affected is blocked, example: (solenoid Y3/8y7-B3 clutch is defective: no 1st, 7th or Reverse in “S” mode)
- If hydraulic fault prevents a gear from engaging then the previous gear will be applied.
- If the computer defaults while driving, all solenoids will be turned off. Solenoids that are normally open will allow full pressure to selected clutches and the transmission will be in 6th gear. After shifting to “P” oil pressure from K2 solenoid is redirected to B2/BR solenoid via emergency operation valves and the transmission will now achieve 2nd in “D” and Reverse.

Shift Member		B1	B2 *	B3	BR *	K1	K2	K3
Shift Valve		Y3/8y5	Y3/8y6	Y3/8y7	Y3/8y6	Y3/8y2	Y3/8y3	Y3/8y4
Valve State		Pressure / Current	Pressure / Current	Pressure / Current	Pressure / Current	Pressure / Current	Pressure / Current	Pressure / Current
Gear	Ratio	▲	▲	▲		▲	▲	▲
1	4.377	C=Max / P=0	X / C=V / P=V	X / C=V / P=V		C=0 / P=0	C=Max / P=0	X / C=V / P=V
2	2.859	X / C=V / P=V	X / C=V / P=V	C=0 / P=0		C=0 / P=0	C=Max / P=0	X / C=V / P=V
3	1.921	C=Max / P=0	X / C=V / P=V	C=0 / P=0		X / C=V / P=V	C=Max / P=0	X / C=V / P=V
4	1.368	C=Max / P=0	X / C=V / P=V	C=0 / P=0		X / C=V / P=V	X / C=V / P=V	C=Max / P=0
5	1	C=Max / P=0	C=0 / P=0	C=0 / P=0		X / C=V / P=V	X / C=V / P=V	X / C=V / P=V
6	0.82	X / C=V / P=V	C=0 / P=0	C=0 / P=0		C=0 / P=0	X / C=V / P=V	X / C=V / P=V
7	0.728	C=Max / P=0	C=0 / P=0	X / C=V / P=V		C=0 / P=0	X / C=V / P=V	X / C=V / P=V
N (1)		C=Max / P=0	C=0 / P=0	X / C=V / P=V	C=0 / P=0	C=0 / P=0	C=Max / P=0	X / C=V / P=V
N (2)		X / C=V / P=V	C=0 / P=0	C=0 / P=0	C=0 / P=0	C=0 / P=0	C=Max / P=0	X / C=V / P=V
R (1)	-3.416	C=Max / P=0	see BR	X / C=V / P=V	X / C=V / P=V	C=0 / P=0	C=Max / P=0	X / C=V / P=V
R (2)	-2.231	X / C=V / P=V	see BR	C=0 / P=0	X / C=V / P=V	C=0 / P=0	C=Max / P=0	X / C=V / P=V

X = Shift member applied C = Current applied to solenoid valve P = Pressure from solenoid valve to shift member (0 = zero / V = variable / Max = maximum)

* B2 and BR share the same solenoid valve, the oil is directed to a different member via the selector shift valve.

▲ No current = no pressure
 ▲ No current = max. pressure

(1) = S mode
 (2) = C mode

If transmission enters emergency mode while driving, all solenoid valves are switched off. Trans will shift into 6th gear.
 ? This is because the solenoid valves for B1, K2 & K3 deliver max pressure with no current applied.
 ? After engaging P position, then D position, only 2nd and R gear is available.

722.9

Electronic Control Components

Transmission Control Module (Y3/8n4) (flash capable)

Working Pressure Control Solenoid (Y3/8y1) (line/normally open)

- K1 Clutch Solenoid (Y3/8y2) (normally closed)
- K2 Clutch Solenoid (Y3/8y3) (normally open)
- K3 Clutch Solenoid (Y3/8y4) (normally open)
- B1 Brake Clutch Solenoid (Y3/8y5) (normally open)
- B2 Brake Clutch Solenoid (Y3/8y6) (normally closed)
- B3 Brake Clutch Solenoid (Y3/8y7) (normally closed)
- Torque Converter Lock Up Solenoid (Y3/8y8) (normally closed)

Note:

Normally Closed: high current high pressure/no current no pressure

Normally Open: no current high pressure/high current low pressure

Normally Open solenoids are used for Limp Mode w/no current to transmission.

Two Oil Floats

- Oil Control Float 1 (31)
- Oil Control Float 2 (32)

Three Speed Sensors (3)

(The following components are integral to the valve body assembly)

- Turbine RPM Sensor (Y3/8n1) (front)
- Internal RPM Sensor (Y3/8n2) (center)
- Output RPM Sensor (Y3/8n3) (rear/hall affect)

Range Sensor

- Selection Range Sensor (Y3/8s1) Y3/8s1 Range sensor: Soldered to ECM ribbon cable/ not replaced separately/Permanent Magnetic Linear Contactless Displacement (PLCD) sensor/Permanent magnet on manual valve changes magnetic field and output voltage/ if not relearned or faulty will cause limp mode.

Transmission Fluid Temperature

- The TFT sensor is integral to the TCM.

Electronic Control Components (continued)

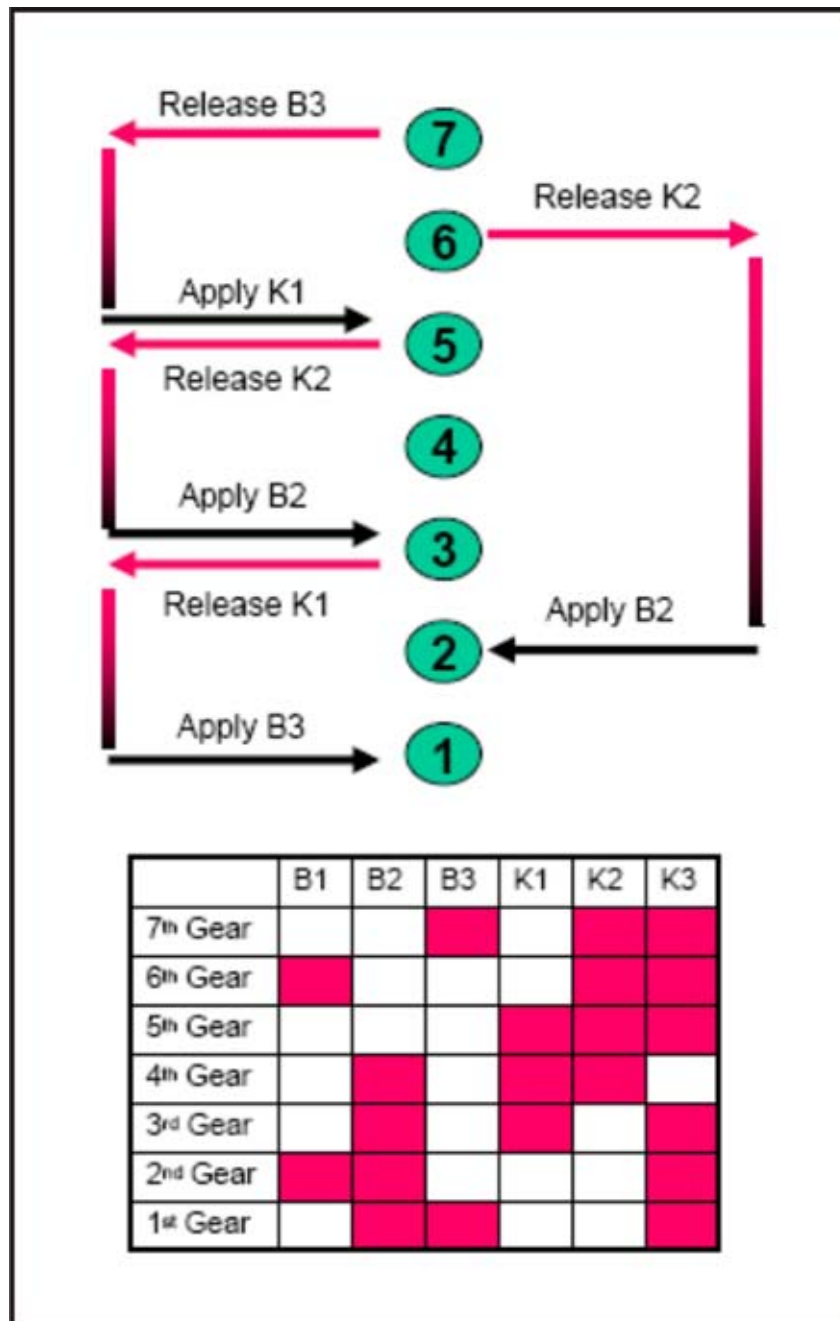


722.9

Shift Sequences

Shift Sequences

In addition to sequentially shifting through gears, the 722.9 downshift programming will allow the transmission to skip gears. Provided that only one member is released and one member is applied.



722.9

Fluid Level Float Function

To prevent oil foaming from the geartrain rotating in the fluid, floats were designed to be installed between the case and the valve body. When the fluid sloshes or fluid level is increased the floats block off oil from entering the geartrain area.

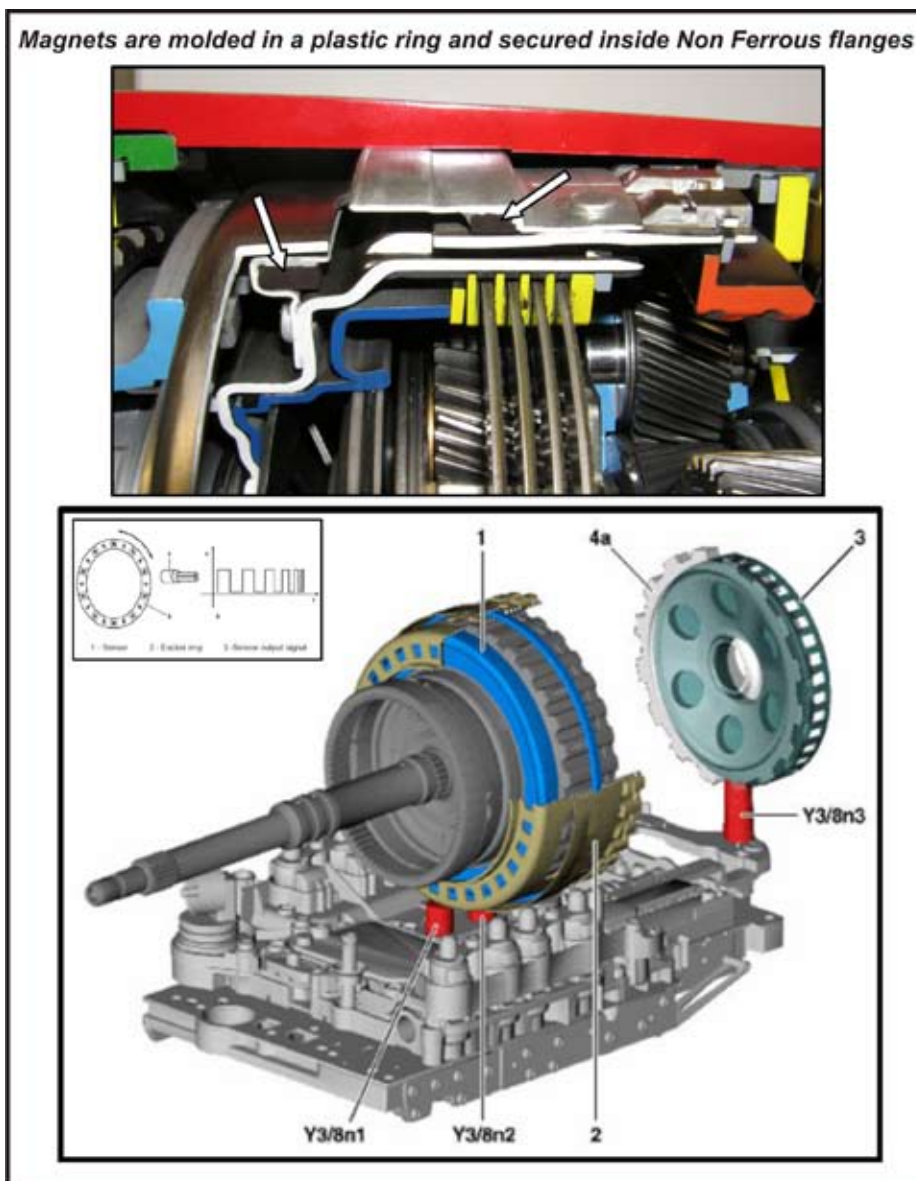


722.9

Speed Sensor Function

The Front speed sensor Y3/8n1; monitors Turbine speed (input shaft/small ring gear). The Center speed sensor Y3/8n2 monitors Ravigneaux carrier speed (ring gear of rear planet). The Rear speed sensor Y3/8n3 monitors Park Pawl gear (exciter ring/2 hall effect)

Note: Magnets are molded in a plastic ring and secured inside Non Ferrous flanges.

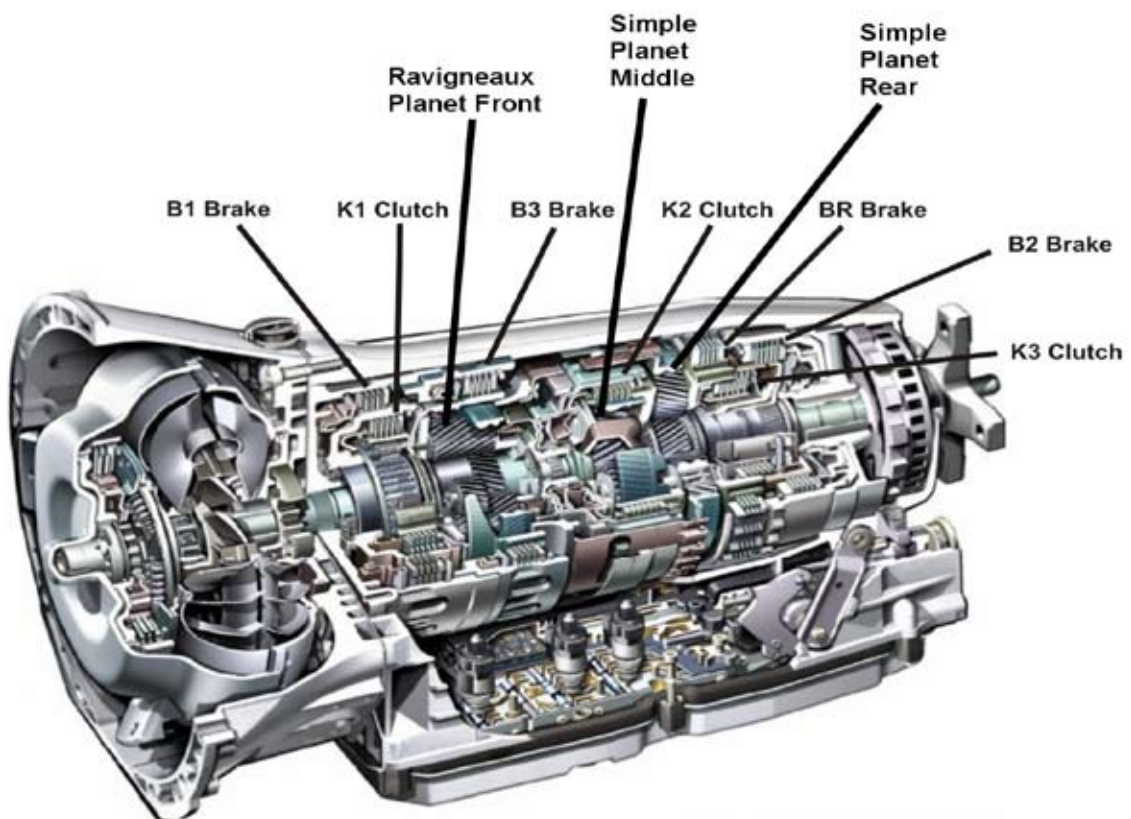


722.9

Clutch Component Location and Apply Chart

Gear ratios are achieved with one Ravigneaux and two Simple planetary assemblies.

- 4 Multi-Disc Brakes
- 3 Multi-Disc Clutches
- No Sprag



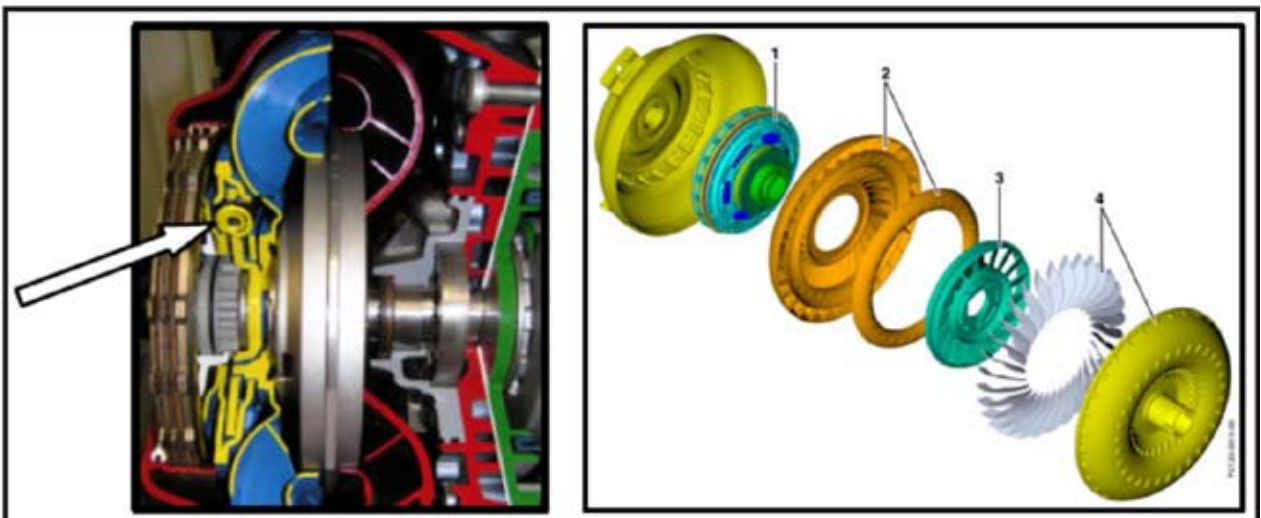
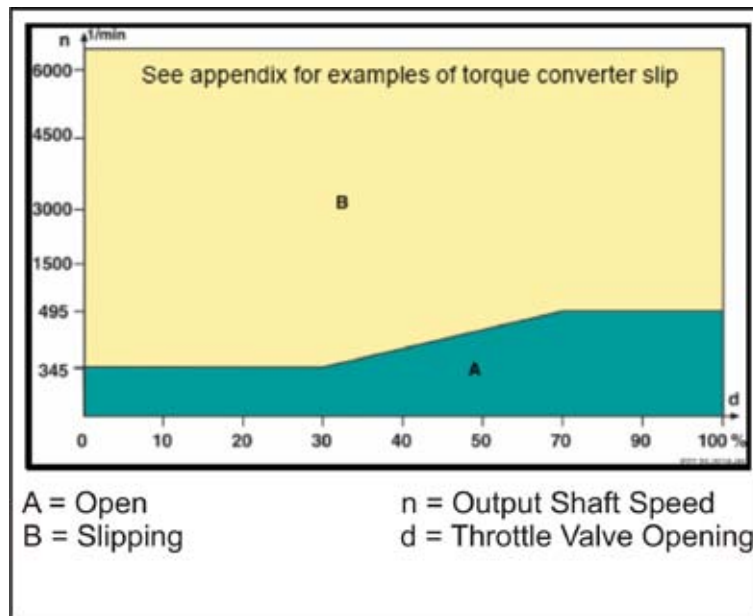
Gear	Gear ratio W7A 700	B1	B2	B3	BR	K1	K2	K3
1	4.377		•	•				•
2	2.859	•	•					•
3	1.921		•			•		•
4	1.368		•			•	•	
5	1.000					•	•	•
6	0.820	•					•	•
7	0.728			•			•	•
N (1)				•				•
R (1)	-3.416			•	•			•
R (2)	-2.231	•			•			•

722.9

Torque Converter

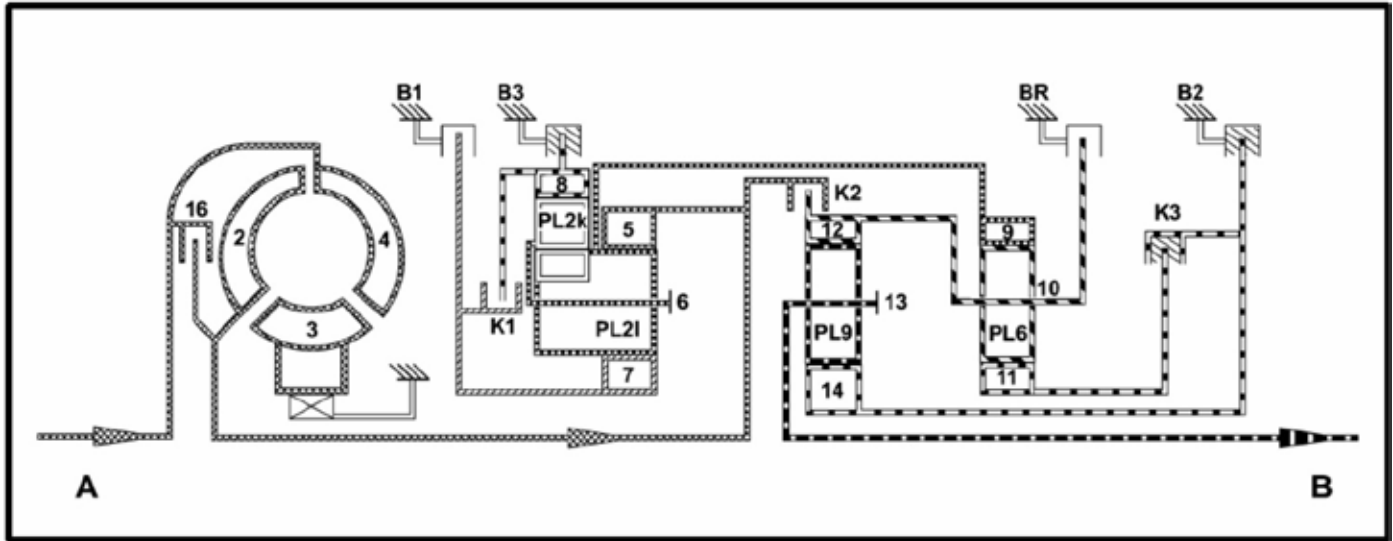
The torque converter operates in an open slip mode in all seven forward gear. In other words lock up is never fully achieved. The converter is open in 1st and 2nd gear if the throttle and the output shaft speed are in “Zone A”. The converter is in slip-control in all seven (7) forward gears if the throttle and the output shaft speed are in “Zone B”. Oil feed pressure to the converter is varied depending on the amount of slip.

The lock-up clutch will turn off and the transmission will shift to a lower gear at oil temperatures of 140°C or higher. The Torque converter holds four (4) liters of fluid and incorporates damper springs integral to lock up clutch to reduce vibration.



722.9

Power Flow 1st Gear



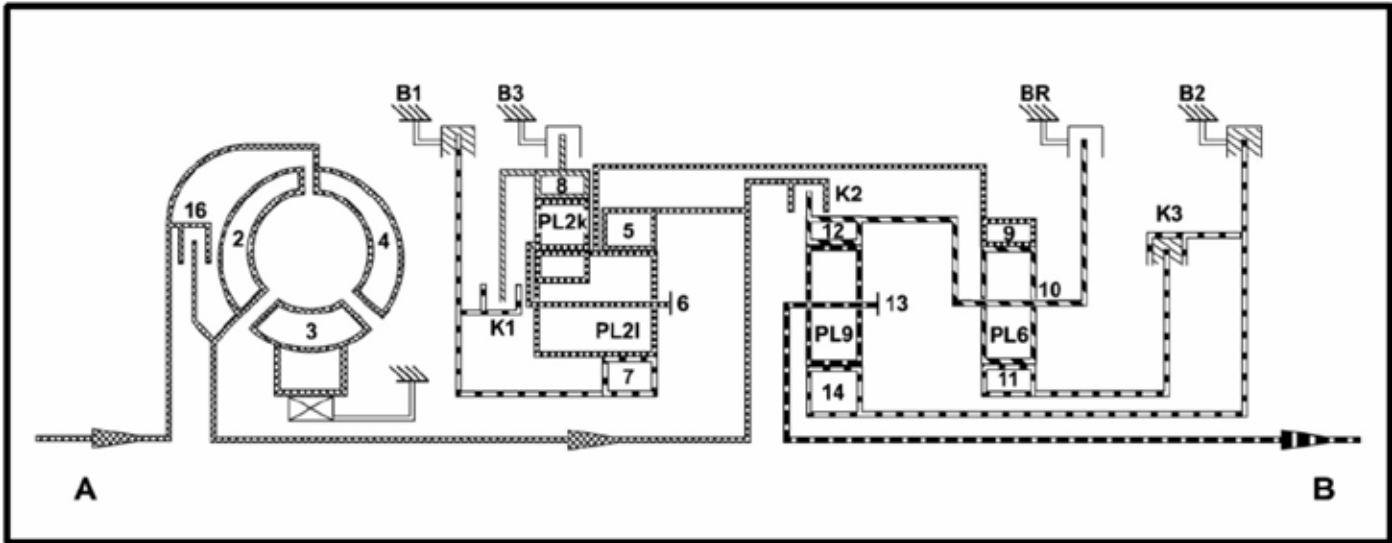
- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disc brake BR
- B1 Multiple-disc brake B1
- B2 Multiple-disc brake B2**
- B3 Multiple-disc brake B3**
- K1 Multi-disc clutch K1
- K2 Multi-disc clutch K2
- K3 Multi-disc clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

The Ravigneaux Planet Small Ring Gear (5) is driven by the Input Shaft. The Long Planet Gears (PL2l) drive the Short Planet Gears (PL2k) to rotate inside the Large Ring Gear (8) held by the B3 Brake Clutch. An increase in torque and reduced rpm is transmitted to the Dual Planet Carrier (6). The Single Rear Planet Ring Gear (9) rotates at the same speed as it is mechanically connected to the Dual Planet Carrier. The Planet Gears (PL6) rotate around the Sun Gear (11) held by the K3 Clutch and rotate the Planet Carrier (10). The Single Front Planet Ring Gear (12) is mechanically connected to the Planet Carrier (10) and rotates at the same speed. Planetary Gears (PL9) rotate around the Sun Gear (14) which is held by the B2 Brake Clutch and transfers the increased torque and reduced rotational speed to the Output Shaft through the Planet Carrier (13). The Output Shaft rotates with reduced input speed in the direction of engine rotation at a ratio of 4.377:1.

722.9

Power Flow 2nd Gear



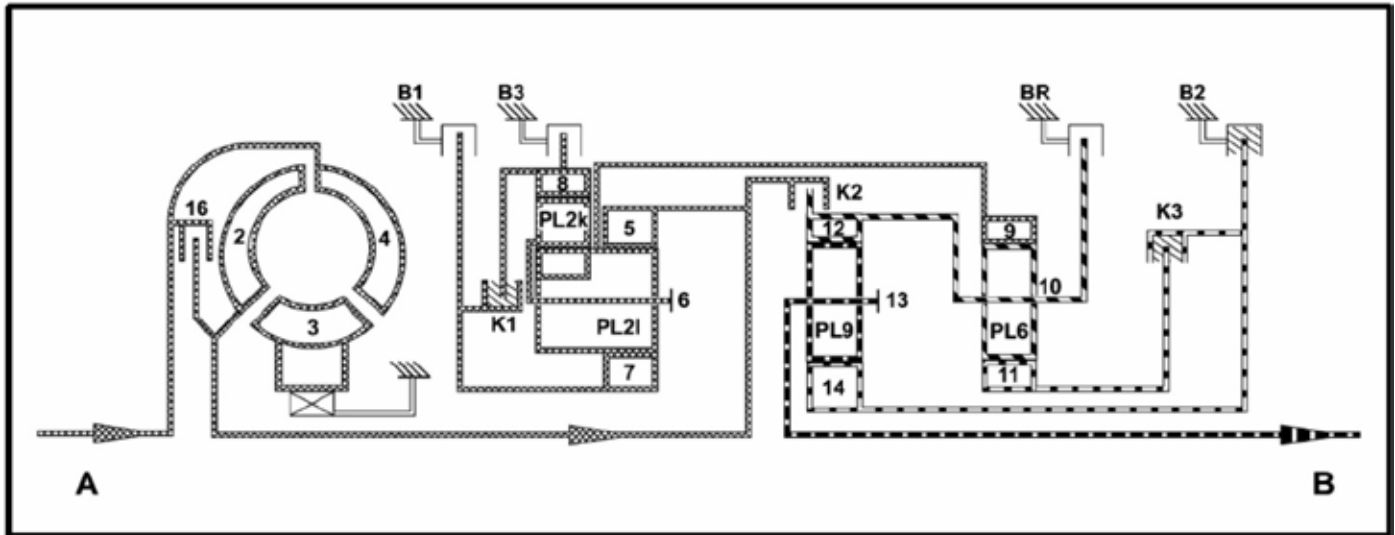
- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear
- 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disk brake BR
- B1 Multiple-disc brake B1**
- B2 Multiple-disc brake B2**
- B3 Multiple-disc brake B3
- K1 Multi-disk clutch K1
- K2 Multi-disk clutch K2
- K3 Multi-disk clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

The Ravigneaux Planet Small Ring Gear (5) is driven by the Input Shaft. The Long Planet Gears (PL2l) rotate around the Sun Gear (7) which is held by the B1 Brake Clutch. An increase in torque and reduced rpm is transmitted to the Dual Planet Carrier (6). The Single Rear Planet Ring Gear (9) rotates at the same speed as it is mechanically connected to the Dual Planet Carrier. The Planet Gears (PL6) rotate around Sun Gear (11) held by the K3 Clutch and rotate the Planet Carrier (10). The Single Front Planet Ring Gear (12) is connected mechanically to the Planet Carrier (10) and rotates at the same speed. Planetary Gears (PL9) rotate around Sun Gear (14) which is held by the B2 Brake Clutch and transfers the increased torque and reduced rotational speed to the Output Shaft through Planet Carrier (13). The Output Shaft rotates with reduced input speed in the direction of engine rotation at a ratio of 2.859:1.

722.9

Power Flow 3rd Gear



- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disk brake BR
- B1 Multiple-disc brake B1
- B2 Multiple-disc brake B2**
- B3 Multiple-disc brake B3
- K1 Multi-disk clutch K1**
- K2 Multi-disk clutch K2
- K3 Multi-disk clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

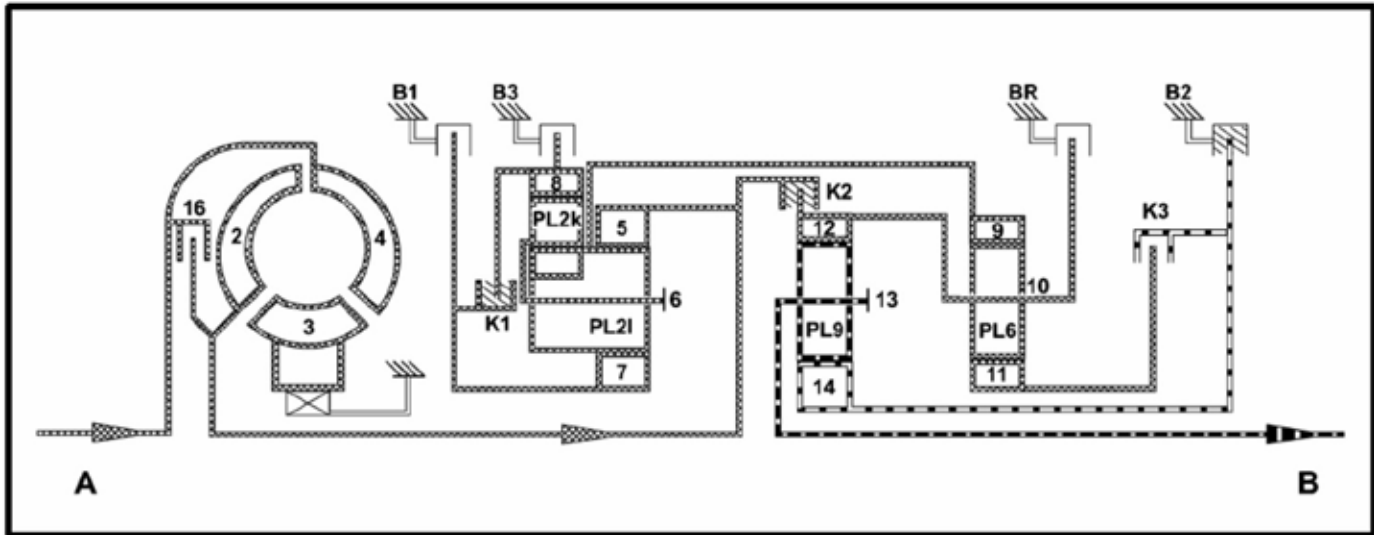
With the K1 Clutch engaged, the Ravigneaux Planetary Gear set components (5, 6, 7, 8, PL2l & PL2k) are locked together and send Input Torque and Input Speed unchanged to the Ring Gear (9). The Single Rear Planet Ring Gear (9) drives the Planet Gear (PL6) to rotate around the Sun Gear (11) held by the K3 Clutch and rotate the Planet Carrier (10). The Single Front Planet Ring Gear (12) is connected mechanically to the Planet Carrier (10) and rotates at the same speed. Planetary Gears (PL9) rotate around the Sun Gear (14) which is held by the B2 Brake Clutch and transfers the increased torque and reduced rotational speed to the Output Shaft through Planet Carrier (13). The Output Shaft rotates with reduced input speed in the direction of engine rotation at a ratio of 1.921:1.

Note:

In 3rd gear the Ravigneaux gear set is locked as one. If a gear noise is being diagnosed and it goes away when in 3rd gear, then check front gear set.

722.9

Power Flow 4th Gear



- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disk brake BR
- B1 Multiple-disc brake B1
- B2 Multiple-disc brake B2**
- B3 Multiple-disc brake B3
- K1 Multi-disk clutch K1**
- K2 Multi-disk clutch K2**
- K3 Multi-disk clutch K3
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

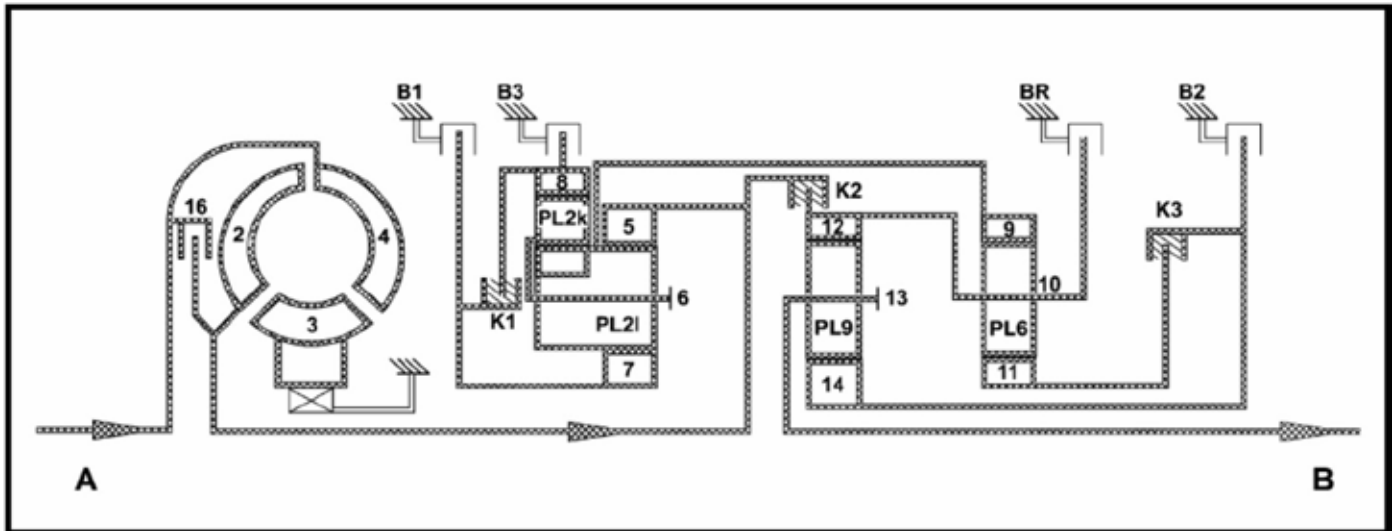
With the K1 Clutch engaged, the Ravigneaux Planetary Gear set components (5, 6, 7, 8, PL2l & PL2k) are locked together and send Input Torque and Input Speed unchanged to the Ring Gear (9). With the K2 Clutch engaged the Single Rear Planet Ring Gear (9) and Single Front Planet Ring Gear (12) rotate at the same speed. The Single Rear Planetary system is locked and not involved in the gear ratio. The engaged K2 Clutch drives the Single Front Planet Ring Gear (12) at Input Speed. The Planetary Gears (PL9) rotate around Sun Gear (14) which is held by the B2 Brake Clutch and transfers the increased torque and reduced rotational speed to the Output Shaft through Planet Carrier (13). The Output Shaft rotates with reduced input speed in the direction of engine rotation at a ratio of 1.368:1.

Note:

In 4th gear the Ravigneaux and rear gear sets are locked as one. If a gear noise is being diagnosed and it only goes away when in 4th gear, then check rear gear set.

722.9

Power Flow 5th Gear



- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disk brake BR
- B1 Multiple-disc brake B1
- B2 Multiple-disc brake B2
- B3 Multiple-disc brake B3
- K1 Multi-disk clutch K1**
- K2 Multi-disk clutch K2**
- K3 Multi-disk clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

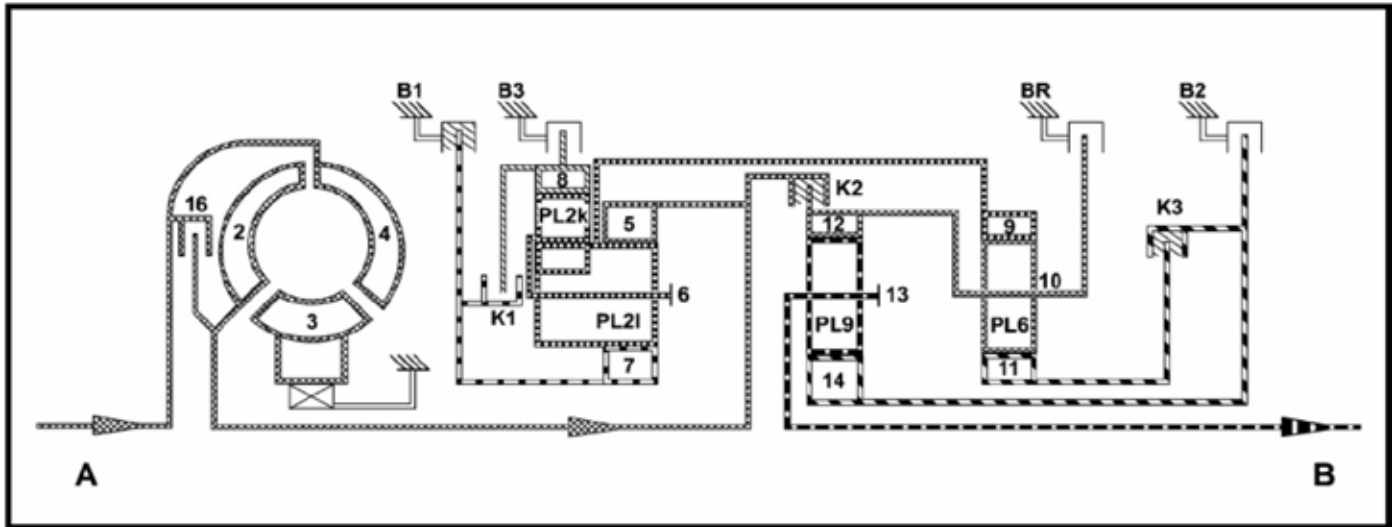
With the K1, K2 and K3 Clutch engaged, the Power Flow runs from the Input Shaft via the locked Ravigneaux Planetary Gear set components (5, 6, 7, 8, PL2l & PL2k) and the locked Front Single Planetary Gear set (12, 13, 14 & PL9) to the Output Shaft and rotate at the same speed as the Input shaft in the direction of engine rotation at a ratio of 1.000:1.

Note:

In 5rd gear, all gear sets are locked as one. If a gear noise is being diagnosed and it only goes away when in 5th gear, then check center gear set.

722.9

Power Flow 6th Gear



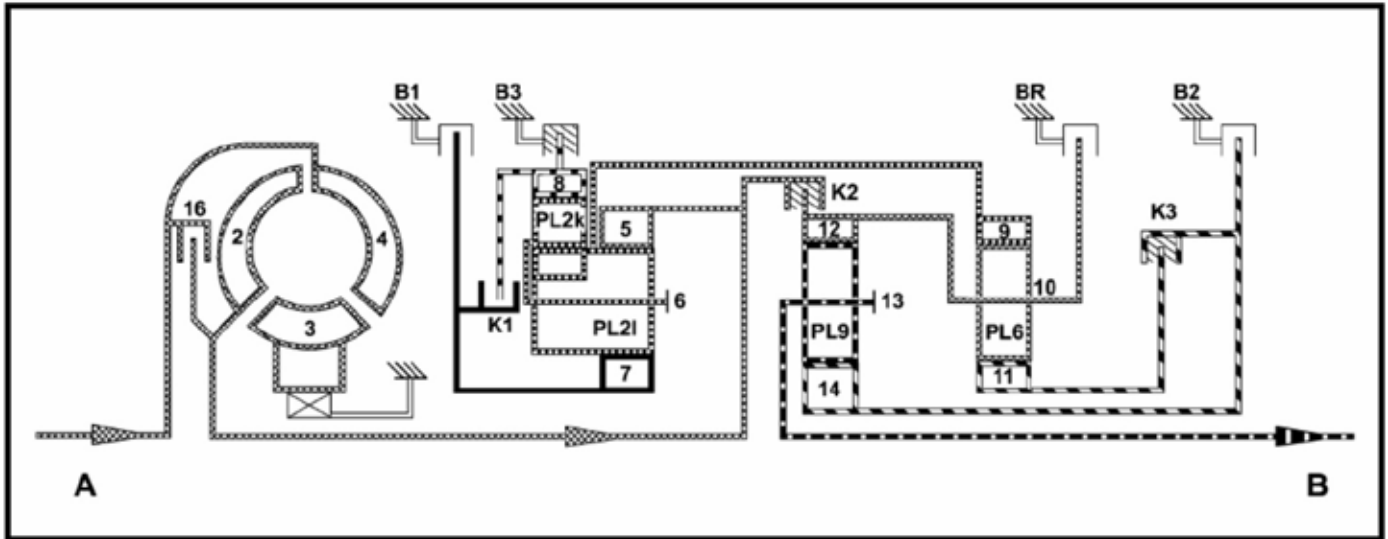
- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear
- 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disc brake BR
- B1 Multiple-disc brake B1**
- B2 Multiple-disc brake B2
- B3 Multiple-disc brake B3
- K1 Multi-disc clutch K1
- K2 Multi-disc clutch K2**
- K3 Multi-disc clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

The Ravigneaux Planet Small Ring Gear (5) is driven by the Input Shaft. The Long Planet Gears (PL2l) rotate around Sun Gear (7) which is held by the B1 Brake Clutch. An increase in torque and reduced rpm is transmitted to the Dual Planet Carrier (6). The Single Rear Planet Ring Gear (9) rotates at the same speed as it is mechanically connected to the Dual Planet Carrier. The Planet Gears (PL6) rotate the Sun Gear (11) which rotates the Sun Gear (14) by the engaged K3 Clutch. Input Torque and Input Speed are transmitted to the Single Front Planet Ring Gear (12) by the engaged K2 Clutch. The speed difference between the Sun Gear (14) and Ring Gear (12) produces an increased speed and reduced torque to the Output Shaft through Planet Carrier (13). The Output Shaft rotates with reduced input speed in the direction of engine rotation at a ratio of 0.820:1.

722.9

Power Flow 7th Gear



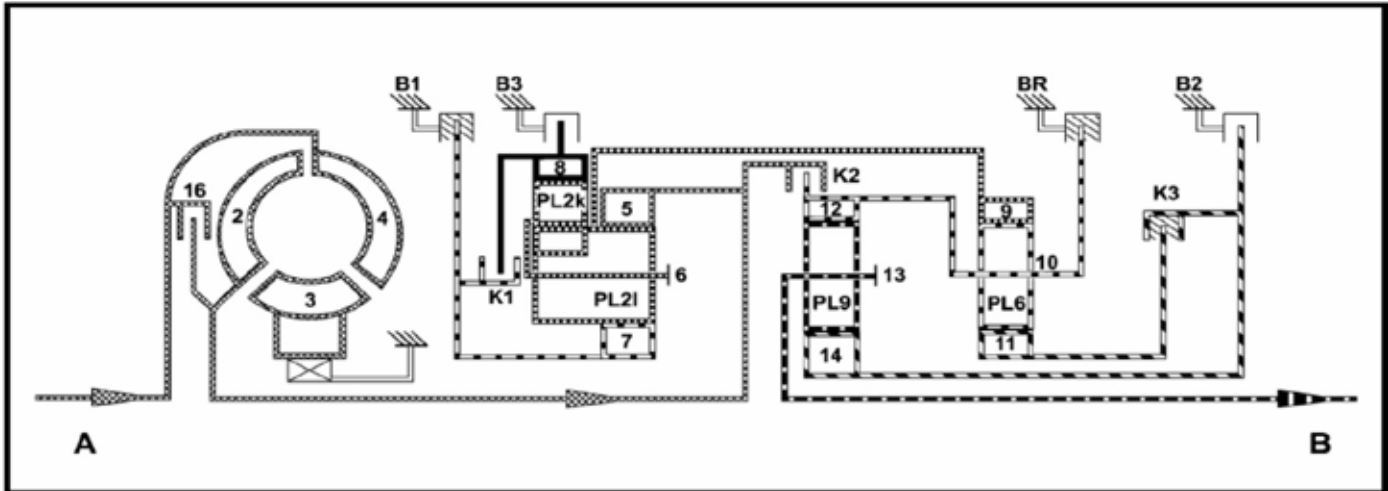
- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disk brake BR
- B1 Multiple-disc brake B1
- B2 Multiple-disc brake B2
- B3 Multiple-disk brake B3**
- K1 Multi-disk clutch K1
- K2 Multi-disk clutch K2**
- K3 Multi-disk clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

The Ravigneaux Planet Small Ring Gear (5) is driven by the Input Shaft. The Long Planet Gears (PL2l) drive the Short Planet Gears (PL2k) to rotate inside the Large Ring Gear that is held by the B3 Brake. An increase in torque and reduced rpm is transmitted to the Dual Planet Carrier (6). The Single Rear Planet Ring Gear (9) rotates at the same speed as it is mechanically connected to the Dual Planet Carrier. The Planet Gears (PL6) rotate the Sun Gear (11) which in turn rotates Sun Gear (14) by the engaged K3 Clutch. Input Torque and Input Speed are transmitted to the Single Front Planet Ring Gear (12) by the engaged K2 Clutch. The speed difference between the Sun Gear (14) and the Ring Gear (12) produces an increased speed and reduced torque to the Output Shaft through Planet Carrier (13). The Output Shaft rotates with reduced input speed in the direction of engine rotation at a ratio of 0.728:1.

722.9

Power Flow Reverse Gear in “S” Mode



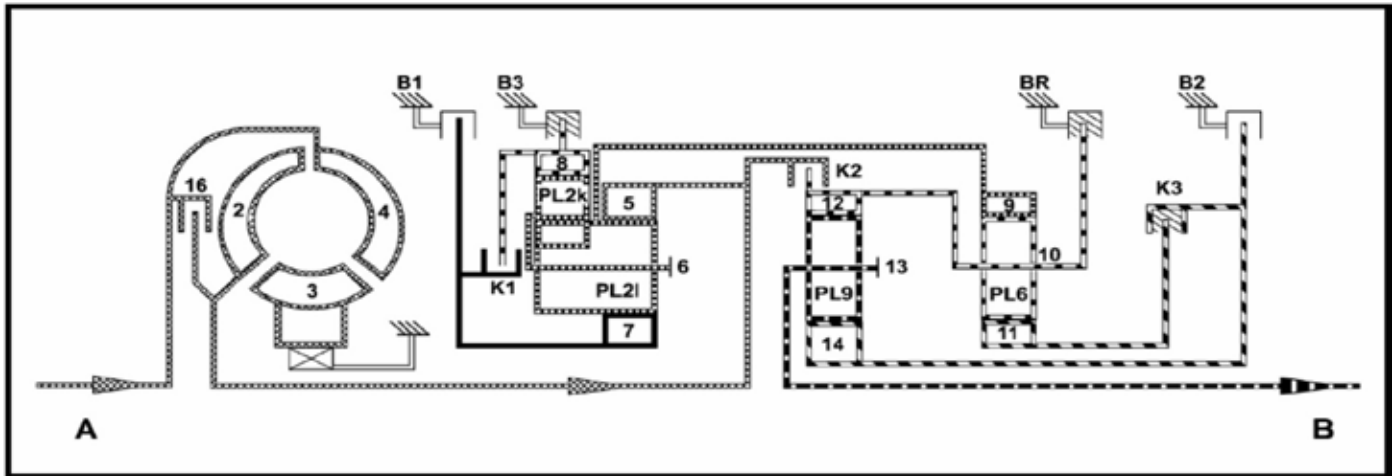
- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear
- 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disc brake BR**
- B1 Multiple-disc brake B1**
- B2 Multiple-disc brake B2
- B3 Multiple-disc brake B3
- K1 Multi-disc clutch K1
- K2 Multi-disc clutch K2
- K3 Multi-disc clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

The Ravigneaux Planet Small Ring Gear (5) is driven by the Input Shaft. The Long Planet Gears (PL2l) rotate around the Sun Gear (7) held by the B1 Brake Clutch. An increase in torque and reduced rpm is transmitted to the Dual Planet Carrier (6). The Single Rear Planet Ring Gear (9) rotates at the same speed as it is mechanically connected to the Dual Planet Carrier. The Planet Gears (PL6) rotate around the Sun Gear (11). The rotational direction of the Sun Gear is Reversed by Planet Carrier (10) which is held by the BR Brake Clutch. The applied K3 Clutch connects Sun Gear (14) to Sun Gear (11). This causing both Sun Gears to rotate at the same speed and direction and drive Planet Gears (PL9). This increases torque and reduces rotational to the Output Shaft through Planet Carrier (13). The Output Shaft rotates at a reduced input speed opposite to the direction of engine rotation at a ratio of -3.416:1.

722.9

Power Flow Reverse Gear in “C” Mode



- 2 Turbine wheel
- 3 Stator
- 4 Impeller
- 5 Small internal-gear wheel
- 6 Dual planet carrier
- 7 Sun gear
- 8 Large internal-gear wheel
- 9 Internal-gear wheel
- 10 Planet carrier
- 11 Sun gear 12 Internal-gear wheel
- 13 Planet carrier
- 14 Sun gear
- 16 Torque converter lockup clutch

- A Input
- B Output
- BR Multi-disk brake BR**
- B1 Multiple-disc brake B1
- B2 Multiple-disc brake B2
- B3 Multi-disk brake B3**
- K1 Multi-disk clutch K1
- K2 Multi-disk clutch K2
- K3 Multi-disk clutch K3**
- PL2k Short planet gears
- PL2l Long planet gears
- PL6 Planet gears
- PL9 Planet gears

The Ravigneaux Planet Small Ring Gear (5) is driven by the Input Shaft. The Long Planet Gears (PL2l) drive the Short Planet Gears (PL2k) which rotate inside the Large Ring Gear (8) held by the B3 Brake Clutch. A decrease in rotational speed is transmitted to the Dual Planet Carrier (6). The Single Rear Planet Ring Gear (9) rotates at the same speed as it is mechanically connected to the Dual Planet Carrier. The Planet Gears (PL6) rotate around Sun Gear (11). The rotational direction of the Sun Gear is Reversed by Planet Carrier (10) which is held by the BR Brake Clutch. The applied K3 Clutch connects Sun Gear (14) to Sun Gear (11). This causes both Sun Gears to rotate at the same speed and direction and drive the Planet Gears (PL9). This increases torque and reduces rotational speed to the Output Shaft through Planet Carrier (13). The Output Shaft rotates at a reduced input speed opposite to the direction of engine rotation at a ratio of -2.231:1.

722.9

Vehicle Towing and Fluid Types

Vehicle Towing

If vehicle must be towed, it should be transported by use of a flat bed trailer. Alternate towing can be achieved with vehicle drive axle removed or lifted. If either afore mentioned options are not available a tow bar (preferred) will suffice under the following conditions/limitations:

1. Turn key to position 2
2. Selector lever to "N" position
3. Max. towing speed 31 mph
4. Max. towing distance 31 miles

Note: If towing distance or speed exceeds pre mentioned values damage may occur to transmission.

Fluid Type

This is a newly developed suggested use "only" transmission fluid, referred to as "ATF 3353 with higher friction consistency, thermal stability and temperature rating. Can also be used on previous model 722.3/.4/.5/.6 transmissions. No scheduled maintenance required (fill for life) and available at Shell & OE oil suppliers in 1 liter bottles under Mercedes Benz part number A001 989 45 03 10.

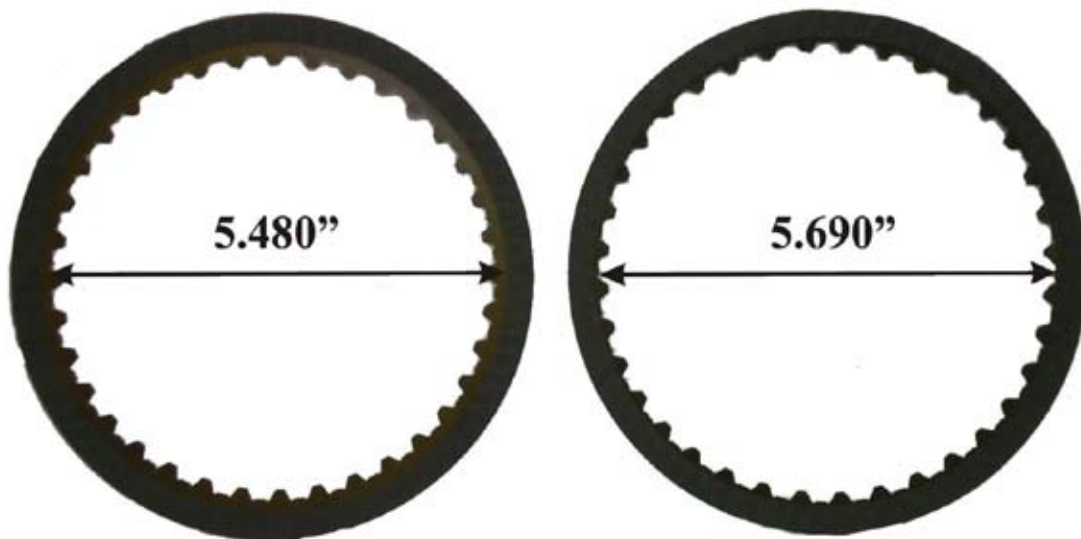


722.6

2-3 Drag, Bind or No 2-3 Shift then Failsafe

A drag or bind during a 2-3 shift or no 2-3 and then failsafe after rebuild. This is caused by installing the incorrect K2 clutch during the transmission rebuild. There are two different internal tooth diameters, one measuring 5.480" and the other 5.690".

K2 Drum



K2 Clutch

722.6

2-3 Drag, Bind or No 2-3 Shift then Failsafe (continued)

This difference in diameter was designed for a 3 pinion rear planet with a K2 clutch hub size of 5.455" for smaller engine vehicles along with a larger 4 pinion hub size of 5.670" for larger engine vehicles.



722.6

2-3 Drag, Bind or No 2-3 Shift then Failsafe (continued)

The outside diameter along with friction thickness is the same for both K2 clutches. Always check the internal diameter fit of the K2 clutch over the rear planetary hub during every rebuild to prevent a mistake.

The part numbers and friction information listed below will aid in selecting the correct K2 clutch when rebuilding a 722.6 transmission whether the unit has a 3 or 4 pinion planet.

722.6 K2 Clutch (.085") 36 Teeth (6 1/2"OD) 1996-Up (With 5.480" ID Fits a **3 Pinion Rear Planet**) quantity 6 Mercedes part # 210-272-00-25

722.6 K2 Clutch (.085") 36 Teeth (6 1/2"OD) 1996-Up (With 5.690" ID, Fits a **4 Pinion Rear Planet**) quantity 6 Mercedes part #140-272-01-25

Incorrect



Correct



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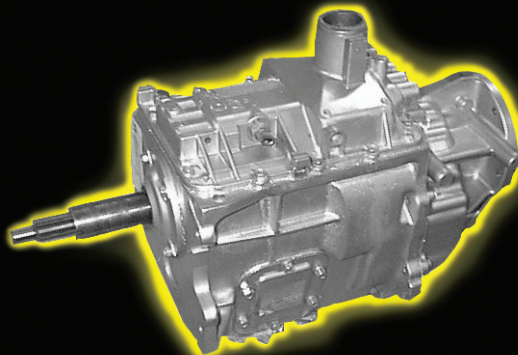
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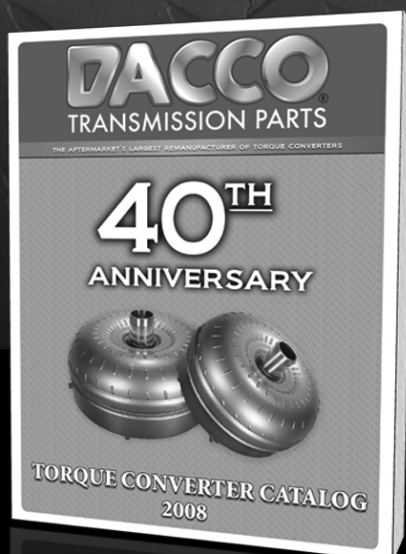
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A handwritten signature in black ink that reads "Lance Wiggins". The signature is stylized with a large, flowing "L" and a long, sweeping underline.

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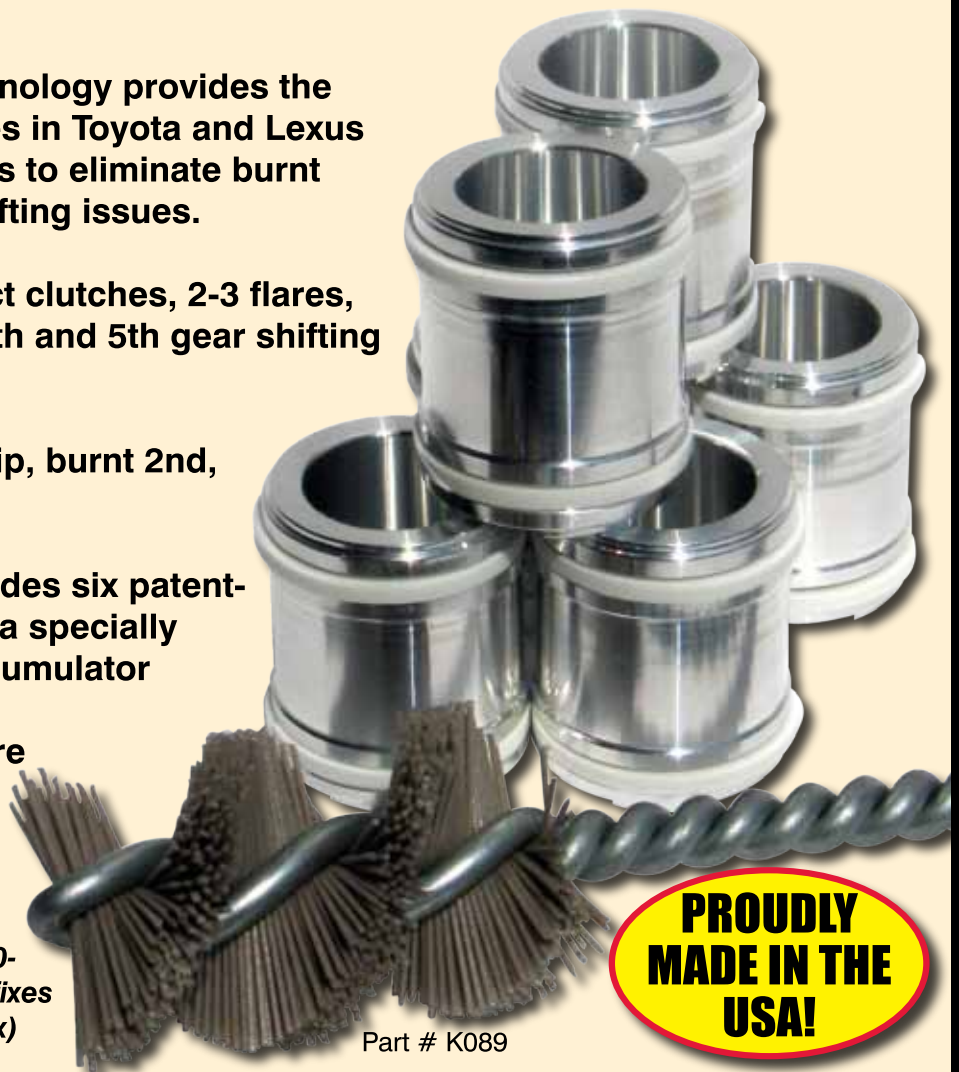
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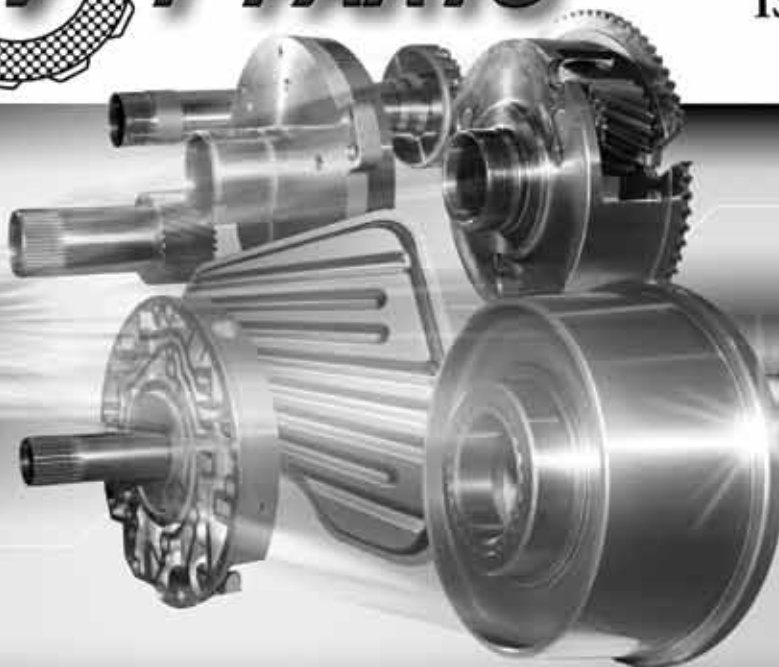
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VIN Code Information

All Units

To identify a GM vehicle through it's VIN (Vehicle Identification Number) you will need to access a new AC Delco website.

1. The web address is www.acdelcotechconnect.com.
2. With your web browser enter the web address.
3. On the homepage, there is a link along the left side of the page labeled "GM VIN Information." Click the link (1) as shown in the graphic below.
4. You may access VIN information ranging from the current model year, back to 1972 by simply clicking on the model year you wish to view from the displayed list. The information on the web is presented as an electronic version of the familiar VIN card in the identical format (.pdf file). If you do not have unlimited access to the web, you may print the VIN information or save the individual model year file to your hard drive for use offline in Windows® by selecting:
 - "File"
 - Then select "Save As"
 - Give the file a name and save it to a preferred location on your hard drive.



All Models

Identifying Non-OEM Calibrations

Today's vehicles present many challenges for the technicians that are required to repair them.

A common concern for today's repair shop is the installation of aftermarket calibrations. Most shops are aware that there are calibrations available that significantly increase engine torque over the stock calibration. The Powertrain in a specific application is designed to handle a specific amount of torque. In fact many OEM's "Detune" their calibrations due to the limitations of the stock drivetrain.

While the aftermarket calibrations are typically designed for "off road use only" we are all aware that this is not happening. Many of the vehicles you are called upon to repair have performance enhancing software installed. Many shops would like to have a method to help identify if a NON-OEM calibration was installed. On late model GM vehicles this can be accomplished by using a "Calibration Verification Number" (CVN). To locate the CVN for a vehicle proceed as follows:

1. Access the GM TIS2WEB website located at <http://tis2web.service.gm.com> (You can also search GM service and choose "GM service and parts operations", then "TIS", then "vehicle calibration information").
2. Once at the website, enter the vehicle VIN in the box and press "GET CAL ID".
3. At the new screen highlight the controller you wish to check for calibration. Click the next button.
4. At the new screen you will be again able to select the type of calibration information you are interested in.
5. You also have another choice which we would suggest you utilize. Click on the box for "complete history". This will give you access to all the calibrations for the various modules. Click the next key.
6. You will notice the website will now display your calibration ID as a "part number". The part number is typically listed as "CAL ID" on your scan tool. The part numbers from the website can then be compared to the CAL ID number on your scan tool to determine if your software is current.
7. Note the website also includes the CVN with the part number. On your scan tool you will typically find the CVN with the CAL ID information. Many scanners include both the CVN and the CAL ID as a part of their data list parameters. Some scanners do not and you will need to choose the "OBD II GENERIC" feature and then select the "MODE 9" function to access the information.
8. The CVN's listed on the website should match the CVN's on your scan tool. If all the CVN's match a GM cal was installed. If a any CVN fails to match, an aftermarket calibration was likely installed.

All Models

Identifying Non-OEM Calibrations (continued)

If you already have a calibration number and would like to get a CVN to check the calibration number against, place the calibration number in the CVN box on the website and press ("GET CVN").

The CVN will be displayed for the calibration number entered if it is a GM calibration. If the display states "Error" or "Invalid Part number" an aftermarket calibration is indicated.

GM Service and Parts Operations	
To obtain the latest electronic controller calibration information for your vehicle, enter the vehicle's 17 character Vehicle Identification Number (VIN) and select 'Get CAL ID'.	
To obtain the Calibration Verification Number (CVN) for any calibration part number, enter the part number of the calibration ID and select 'Get CVN.'	
VIN: 1gnfk13027r2	Get CAL ID
Part Number:	Get CVN
PLACE YOUR VIN HERE AND CLICK GET CAL ID	IF YOU ALREADY HAVE A CALIBRATION # BUT NEED A CVN PLACE THE CAL # HERE, CLICK GET CVN
GM Visit the General Motors site to see the entire GM family of brands.	ACDelco
The TIS software application does not support the use of the browser's Forward and Back buttons. Errors will occur. Please only use the buttons that are displayed on the application screens and not on the toolbar.	

All Models

Identifying Non-OEM Calibrations (continued)

 Service and Parts Operations

Controller
ASC Assist Step Control Module (Pass Thru Only)
BCM Body Control Module
DDM Driver Door Module - After Market Heated Seat kit
DDS Driver Door Switch
DPM Driver Position Module (Seat Modules)
EBCM Electronic Brake Control Module
ECM Engine Control Module
ESCM Electronic Suspension Control Module
HVAC HVAC Control Module
IPC Instrument Panel Cluster

Select the
Controller

Selected Options:

VIN:	1GNFK13027428011
------	------------------

< Back Next > Cancel

PRESS THE
NEXT BUTTON

The TIS software application does not support the use of the browser's Forward and Back buttons. Errors will occur. Please only use the buttons that are displayed on the application screens and not on the toolbar.

All Models

Identifying Non-OEM Calibrations (continued)


Service and Parts Operations

Complete History

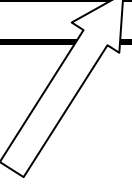


SELECT COMPLETE HISTORY
AND PRESS NEXT

< Back Next > Cancel

Module:

Main Operating System
System
Fuel system
Speedometer
Engine diagnostic
Engine Operation
Slave Operating System
Engine



12605898 - Main Operating

12612291

12614088

Part Number	CVN	Description
12614088	00000F82	New software to ensure proper ethanol content calculation.
12612291	000092CC	Main Operating System
12605898	0000E863	Operating System

Selected Options:

VIN:	1GNFK13027R428011
Controller:	ECM Engine Control Module

The TIS software application does not support the use of the browser's Forward and Back buttons. Errors will occur. Please only use the buttons that are displayed on the application screens and not on the toolbar.

All Models

Identifying Non-OEM Calibrations (continued)

GM Vehicle Calibration Information

VIN:	1GNFK13027R428011
Controller:	ECM Engine Control Module

Calibration History for: Main Operating System

Part Number	CVN	Bulletin #	Description
12614088	00000F82	-	New software to ensure proper ethanol content calculation.
12612291	000092CC	-	Main Operating System
12605898	0000E863	-	Operating System

Calibration History for: System

Part Number	CVN	Bulletin #	Description
12623184	00002C72	07-01-38-010	New calibration to reduce potential for A/C compressor failure. Also addresses customer complaint of compressor noise.
12614232	00008B79	-	New calibration for improved fan control.
12613969	0000F431	-	New calibration to address customer complaint of A/C inoperative in hot restart situations.
12605945	0000BD4D	-	System

Calibration History for: Fuel System

Part Number	CVN	Bulletin #	Description
12614218	0000D7F0	-	New calibration to ensure proper fuel data DIC display.
12605942	0000962E	-	Fuel System

Calibration History for: Speedometer

Part Number	CVN	Bulletin #	Description
12614305	731	-	New calibration to ensure proper display of DIC messages.
12606011	000051D5	-	Speedometer

All Models

Identifying Non-OEM Calibrations (continued)

Calibration History for: **Engine Diagnostic**

Part Number	CVN	Bulletin #	Description
12616059	0000A7BB	-	New calibration with diagnostic enhancements for DTC P0449.
12614140	0000D87E	-	New calibration to ensure proper display of DIC messages.
12610355	0000FF9D	-	New calibration with diagnostic enhancements for DTCs P0121, P0521, P0851, P1400, and P1629.
12606880	000050ED	-	Engine diagnostic

M4455: There are 2 calibration part numbers that are valid for 'Engine Operation'. Read the descriptions from the following tables to determine the correct calibration for this vehicle.

Calibration History for: **Engine Operation**

Part Number	CVN	Bulletin #	Description
12614095	000064ED	-	New calibration to ensure proper display of DIC messages.
12605905	3.00E+05	-	Engine Operation

Part Number	CVN	Bulletin #	Description
12637932	000032B8	-	Select this only to address cruise drop out occurring when activating the power window or heated washer solvent switches. Fuel economy will be negatively impacted. Use labor op code N9629 - Reprogram ECM to Correct Cruise Control Drop-Off Issue.
12605905	3.00E+05	-	Engine Operation

Calibration History for: **Slave Operating System**

Part Number	CVN	Bulletin #	Description
12605899	0000C846	-	Slave Operating System

4T40/45E, 4T65E

New PSM Code P0843

P0843 has been introduced as a new TCC pressure switch code. P0843 will set if the following criteria are met:

- No MAP, TCC Slip, ISS, or TCC electrical DTC's are set
- TFT is between 68-266°F (20-130°C)
- Engine torque is greater than 37 lb ft. (50 Nm)
- TCC is commanded "ON"
- TCC slip indicates the TCC is applied
- The TCC release switch indicates the TCC is "Released"
- The following conditions are present for longer than 6 seconds

If a P0843 is set the PCM will,

- command the TCC OFF.
- freeze the shift adapts.
- inhibited 4th gear in Hot Mode.

To identify the cause of the concern, clear the DTC. Operate the vehicle in 4th gear with the TCC applied and observe the TCC Release Switch status with your scan tool. The release switch should indicate the TCC is applied by displaying "NO" for the TCC release switch parameter on your scan tool. If the release switch displays "YES" on your scan tool when TCC is commanded on, you will need to check the switch and its electrical circuit for proper operation.

4T40/45E, 4T65E

New PSM Code P0843 (continued)

TCC release switch indicates “YES” when the TCC is commanded “ON”

1. Key ON, Engine OFF, monitor the TCC release switch with your scan tool. The TCC release switch should now read “NO”.
2. If it continues to read “YES” proceed to step 3. If the TCC release switch now reads “NO”, proceed to step 4.
3. Unplug the transmission electrical connector with the key “ON”, engine “OFF”. Jump the TCC release switch circuit to ground on the engine harness side of the transmission connector (pin “U” CKT 657). If the scanner continues to display YES you will need to check for an open between the TCM pin “9” (CKT 657) and pin “U” (CKT 657) of the engine side of the transmission electrical connector. With circuit 657 grounded, if the TCC release switch displays NO, check for an open with an ohm meter between the TCC release switch pin “D” (CKT 1804) (Located in the PSM) and the transmission case connector pin “U” (CKT 1804). If the wiring tests good, with your ohm meter check from pin “D” of the PSM to the metal body of the PSM. You should have full continuity. If the resistance does not indicate continuity replace the switch. This process will help isolate if the problem exists in the wiring for the TCC release switch or in the switch itself.
4. If the switch and its circuits indicate that a problem is not present inspect the following:
 - TCC Seal
 - Debris blocking the channel plate TCC release passage
 - Leak in the oil pump seal or the seal/bearing was installed backwards
 - Misaligned or restricted valve body or channel plate gasket
 - Turbine shaft or sprocket seal damaged
 - #1 Check ball (4T65E Only)

NOTE: As noted above some failures may result in a TCC partial applying with some of the apply oil venting into the TCC release switch passage resulting in the DTC being set.

4T40/45E, 4T65E

New PSM Code P0843 (continued)

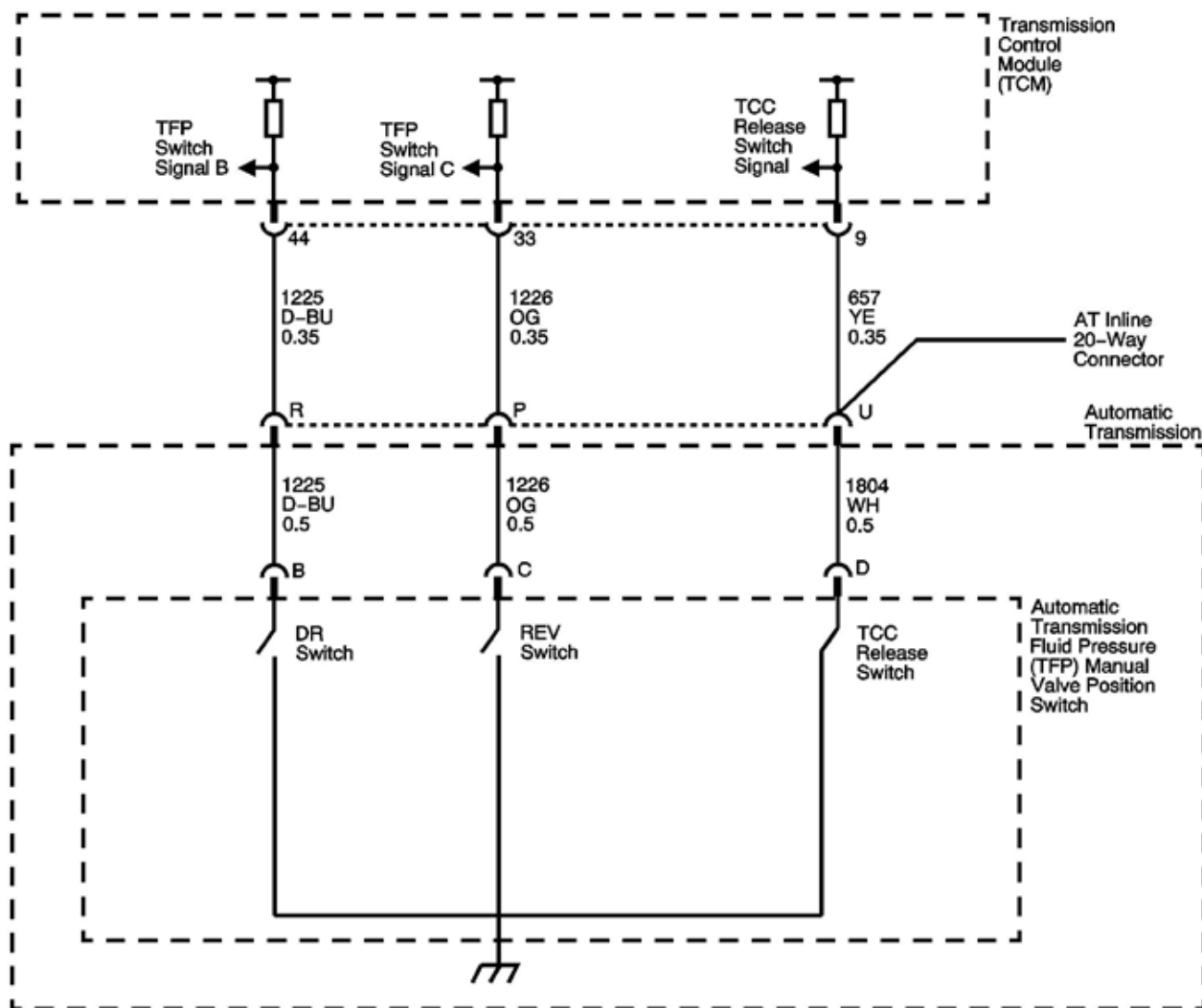
When testing the systems, note the 4T40/45E has a three switch PSM and the 4T65E has only one. The wiring below is an example of a 4T40/45E PSM.

When you jumper the TCC release switch circuit to ground on the engine harness side of the transmission connector, the locations are always pin “9” at the TCM and pin “U” at the transmission.

Pin “9” to Pin “U” Yellow 4T40/45E

Pin “9” to Pin “U” White 4T65E

NOTE: Wire colors may vary always go by pin location.



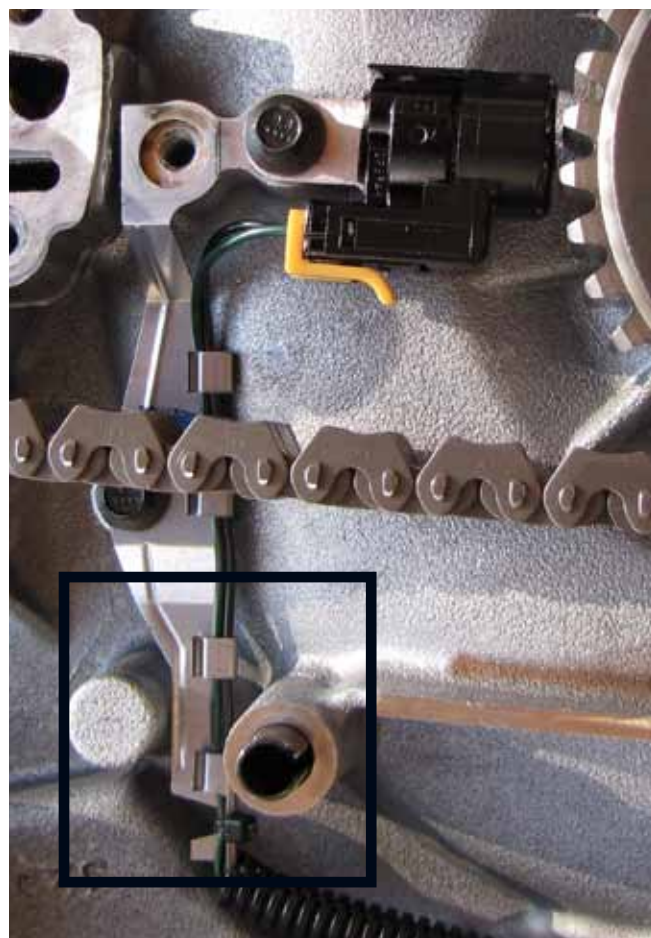
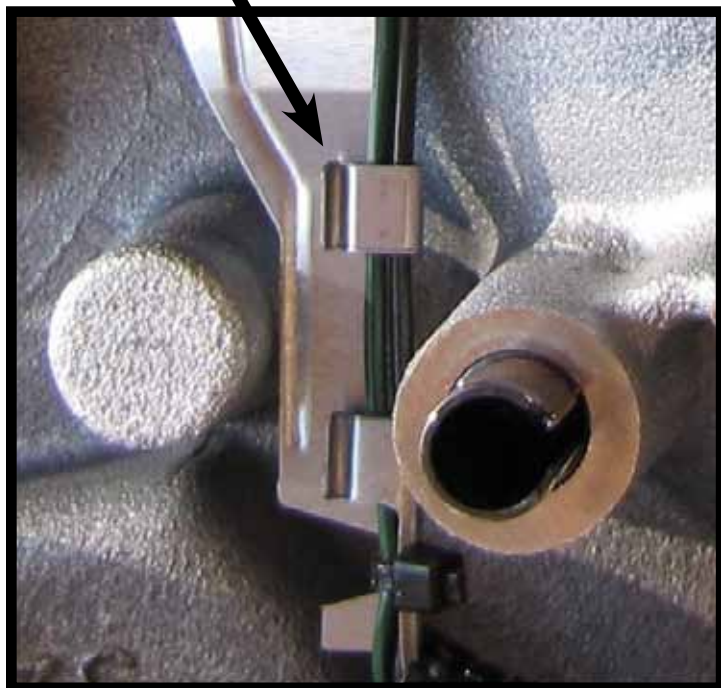
4T40/45E

Erratic Transmission Operation

This condition may be caused by a loss of input speed to the TCM. The Input Speed Sensor wiring may become damaged due to improper routing. Road speed and engine RPM may influence an intermittent short to ground in the input speed sensor harness. The short to ground commonly occurs at one of the wiring clips attaching the input speed sensor to the valve body. A loss of input speed to the TCM may or may not set a P0716 or a P0717 input speed sensor fault.

To help isolate the concern measure the resistance from the transmission connector pins “S” and “V” to ground. There should be NO continuity to ground. Inspect the Input Speed Sensor wiring for evidence of a ground out condition. If a problem is found, repair or replace the sensor and insulate the sensor from the harness clips.

The short to ground commonly occurs at one of the wiring clips attaching the input speed sensor to the case.



4T40/45E

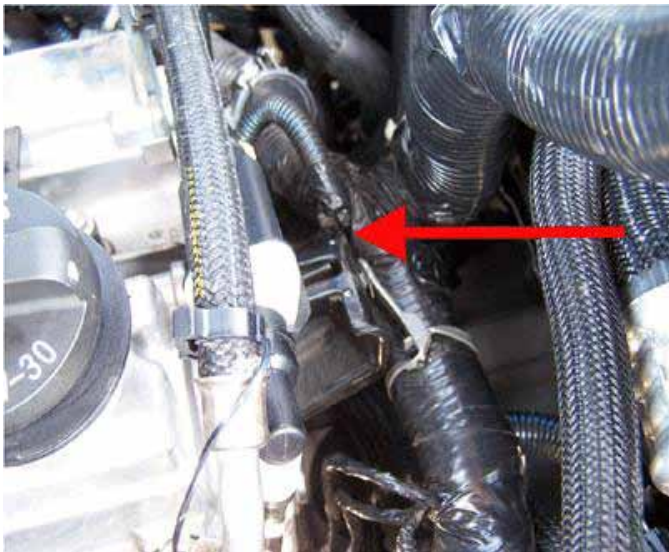
P2135, P2138 APP Performance Codes

2004 and later vehicles equipped with a 4T40E/4T45E transmission may set an APP (Accelerator Pedal Position) DTC P2138. In some cases this may be accompanied by a P2135 DTC.

The following should be inspected:

- Water intrusion into connector C201
- Poor pin tension or connection at the APP sensor
- The harness may be rubbing on the A/C lines (about 3-6" from PCM connectors)
- The harness may be rubbing on the edge of the PCM case
- The harness may be rubbing on the engine block at the oil filter housing area
- The harness may be rubbing on the EVAP purge valve bracket
- The harness may be rubbing at the upper edge of the transmission bell housing area
- The harness may be rubbing on the UBEC (Underhood Bussed Electrical Center)
- Check for poor terminal crimps at the ECM connector pins (Connector C2 Pins 58, 29, 31, 36, 24, 26 on 2006 2.2L engines) (Connector C2 or X2 Pins 40, 53, 57, 59 2007-08 2.2L engines) (Connector C2 Pins 29, 44, 66, 64 Connector C3 Pins 28,44 2006-2007 2.4L engines) (Connector X2 Pins 40, 53, 57, 59 2008- 2009 2.4L engine)

Repair and reposition the harness as required.

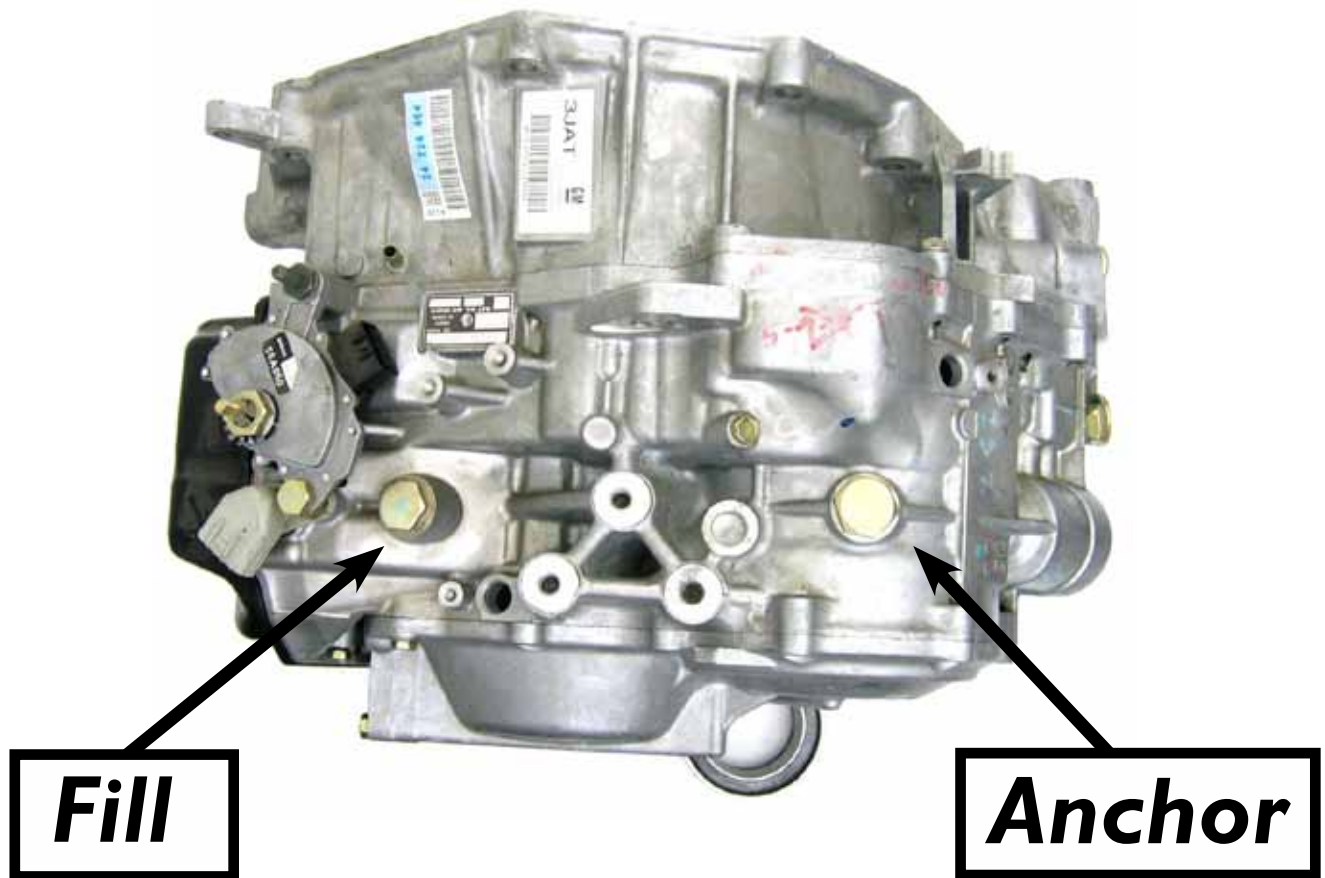


AF23/33-5

Slips/No 3rd After Repair

The AF 23-5 used in the Saturn Ion and the AF 33-5 used in the Saturn Vue, Chevrolet Equinox and Buick Torrent applications may experience a slipping complaint or no 3rd gear concern after the transmission fluid has been serviced or after an internal repair has been performed.

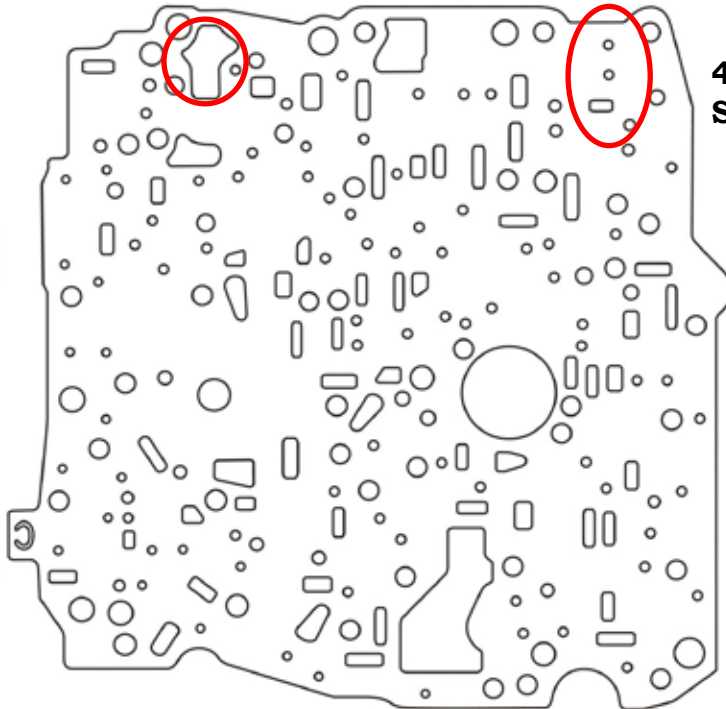
The technician may have removed the wrong bolt to adjust the unit's fluid level. If the technician removed the 3rd gear band anchor bolt instead of the fill bolt, it may allow the anchor to fall out of place leading to the concern. If the technician has removed the wrong bolt, the transmission will need to be disassembled to correct the concern.



4T65E

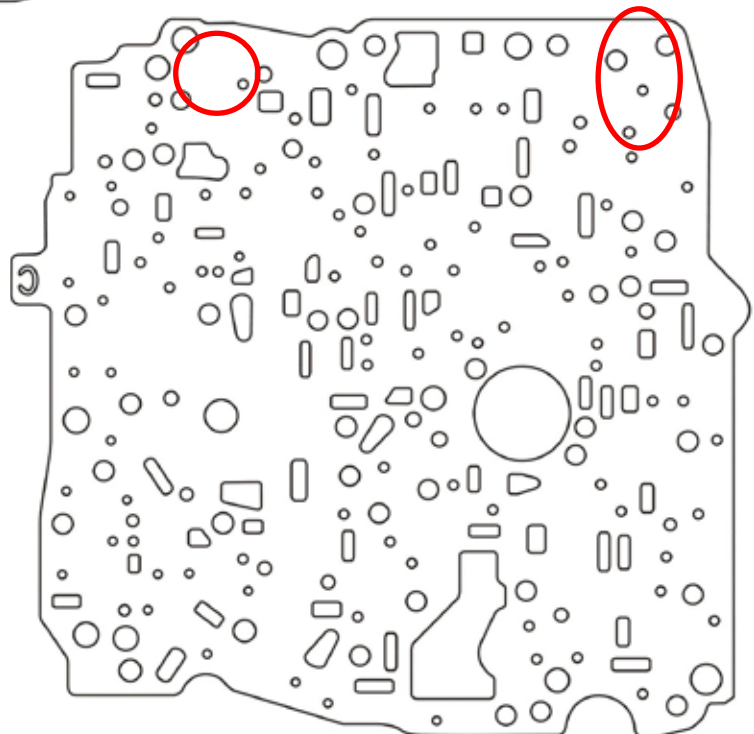
2nd Gear Starts After Overhaul

4T65E 2004 and up Volvo and GM vehicles with the TAP shift mode second gear starts after overhaul. The computer commands show first gear is being commanded. This may be caused by using the wrong valve body gaskets.



**4T65E Non-Tap
Shift Case Gasket**

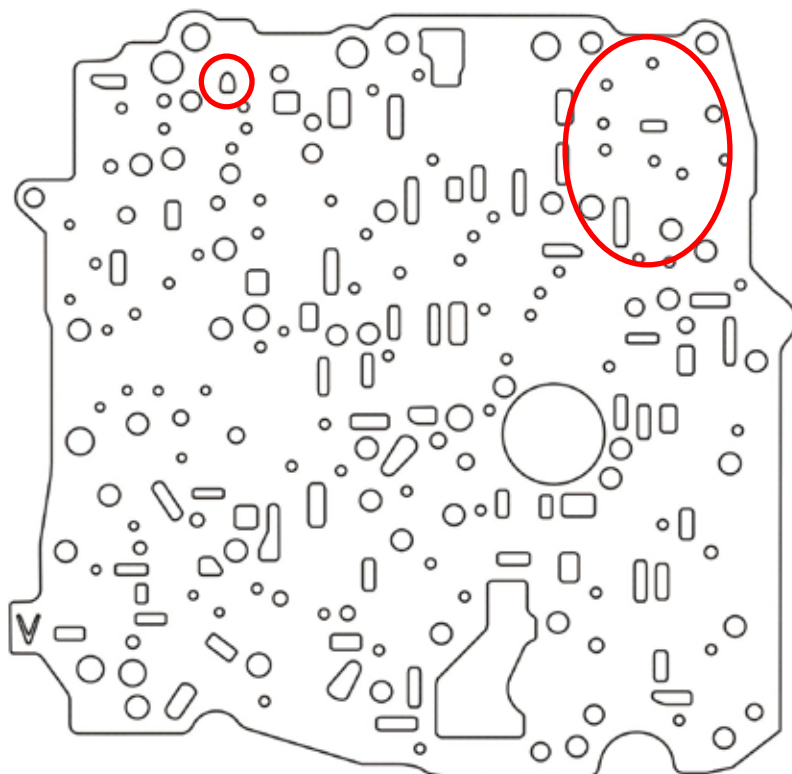
**4T65E Tap Shift
Case Gasket**



Most overhaul kits supply only the non-TAP shift model valve body gaskets. A separate gasket sub kit or the bonded separator plate must be ordered when servicing these model vehicles.

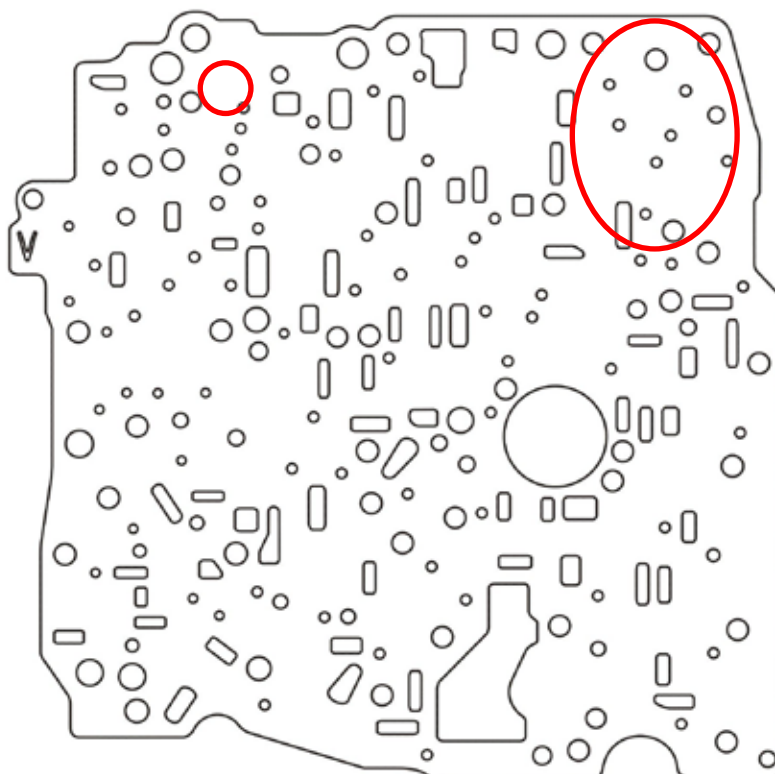
4T65E

2nd Gear Starts After Overhaul (continued)



**4T65E Non-Tap Shift
Valve Body Gasket**

**4T65E Tap Shift
Valve Body Gasket**



4L60/65E with NV246

Service 4X4 Light "ON", and/or DTC C0550

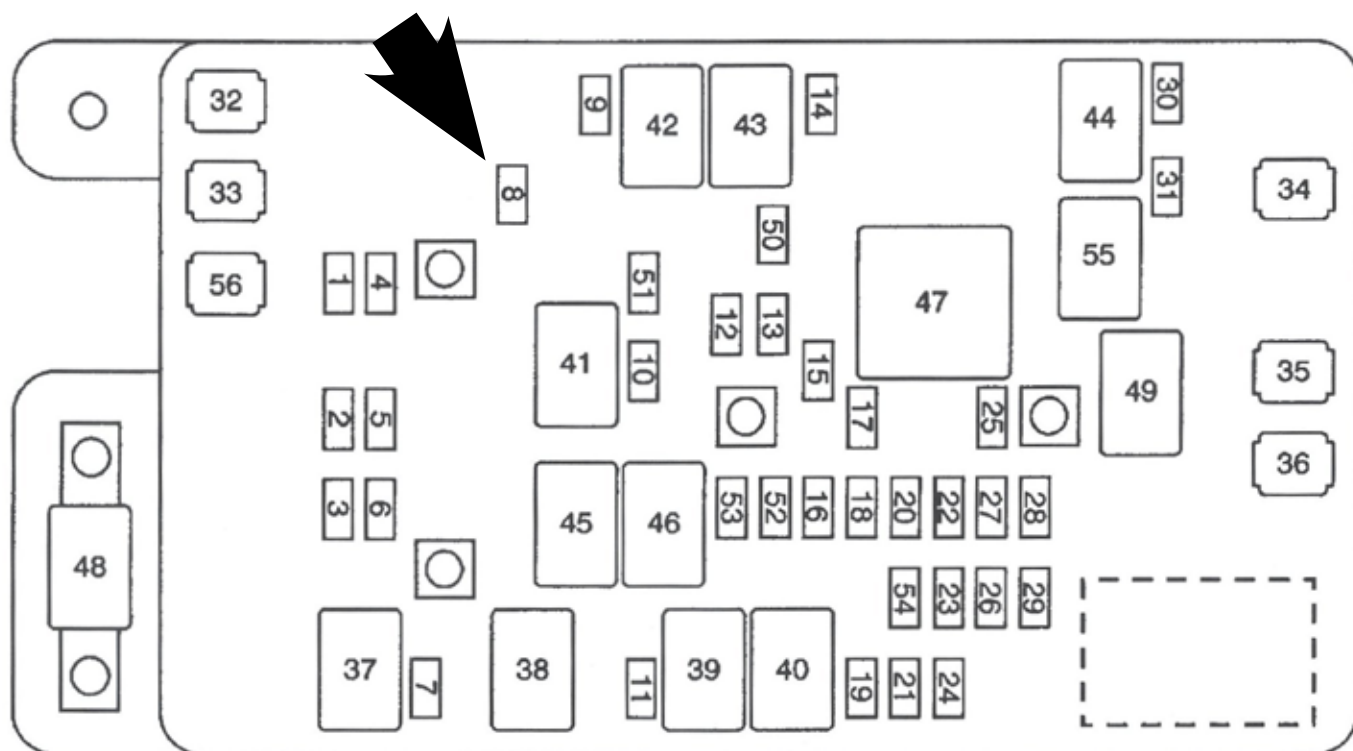
2004 Chevrolet Trailblazer, 2003-2004 GMC Envoy, Sierra, Yukon, 2002-2004 Oldsmobile Bravada, with an electronic shift or active transfer case, may experience an inoperative four wheel drive system. A "service 4x4" light may be illuminated, a code C0550 set in the TCCM or a loss of communication with the TCCM. This may be due to the TCCM not receiving the "wake-up" call during key on or start-up.

If the TCCM does not receive this wake up call during key on or start-up, the TCCM will remain in "sleep" mode. When the TCCM is in "sleep" mode, the TCCM is unable to communicate with the class II data system. If you encounter a "no communication" problem with the TCCM, remove the ATCM, TREC or TCCM fuse for 30 seconds. Reinstall the fuse and recheck the TCCM for communication.

If code C0550 is present in the TCCM, check the TCCM power and grounds circuits. If TCCM power and ground circuits are okay, replace the TCCM.

NOTE: Some models may require the new TCCM to be programmed upon installation.

Remove the ATCM, TREC or TCCM fuse for 30 seconds.



4L60/65/70E, 4L80/85E, 4T40/45E, 4T65E, 4T80E, LCT 1000

Slip or Flare Under a Load

Line pressure boost on GM vehicles is regulated by engine load. Engine load is determined by several load inputs and a software program known as torque modeling. This process started in the mid 1990's. On these applications, it is common to have a slip complaint or transmission damage that can be caused by a lower than required line pressure boost.

In years past, this was an issue that related more to RWD applications than to FWD applications. Now the problem is starting to appear on FWD vehicles also. In most cases no DTC's are set.

MAF is the main input the PCM/TCM/ECM uses to determine engine load. MAF sensor problems not only effect the engine operation but also effect the transmission operation. A skewed or shifted MAF value may worsen with high ambient temperatures (95°F/35°C or above).

MAF problems are compounded by engine health issues such as carbon deposits, compression etc. You should make sure carbon and engine health issues are not the root cause of the concern prior to condemning the MAF sensor. This concern may also be caused by overly oiled aftermarket air filters. With normal use the MAF element can get dirty leading to a lower than actual air flow calculations. In some instances the MAF can simply be cleaned with MAF cleaner such as CRC #599C or #0510. Other times the MAF will need to be replaced.

4L60/65/70E, 4L80/85E, 4T40/45E, 4T65E, 4T80E, LCT 1000

Slip or Flare Under a Load (continued)



Too much oil on the aftermarket filter can create line rise issues.



Contamination builds up here and creates a poor signal to the PCM.



4L60/65/70E

Hard/Erratic Shifts, DTC P0716 and/or P0717

4L60E/4L65E/4L70E applications equipped with an input speed sensor may exhibit a hard/erratic shift complaint accompanied by P0716 and/or P0717 DTC stored in memory.

The input speed sensor is a hall switch. The sensor must have a good power supply and ground to operate. Check the power (Pin “E”) and ground (Pin “V”) supplied to the transmission with your digital multimeter.

The fastest way to check the sensor signal circuit is to use a signal generator and your scan tool. Remove the case connector and use the signal generator to supply a 12 volt square wave to the controller on the signal circuit. Monitor the input speed with your scan tool. If a speed signal is present, the problem is intermittent or you have a problem inside the transmission with the sensor or the harness.

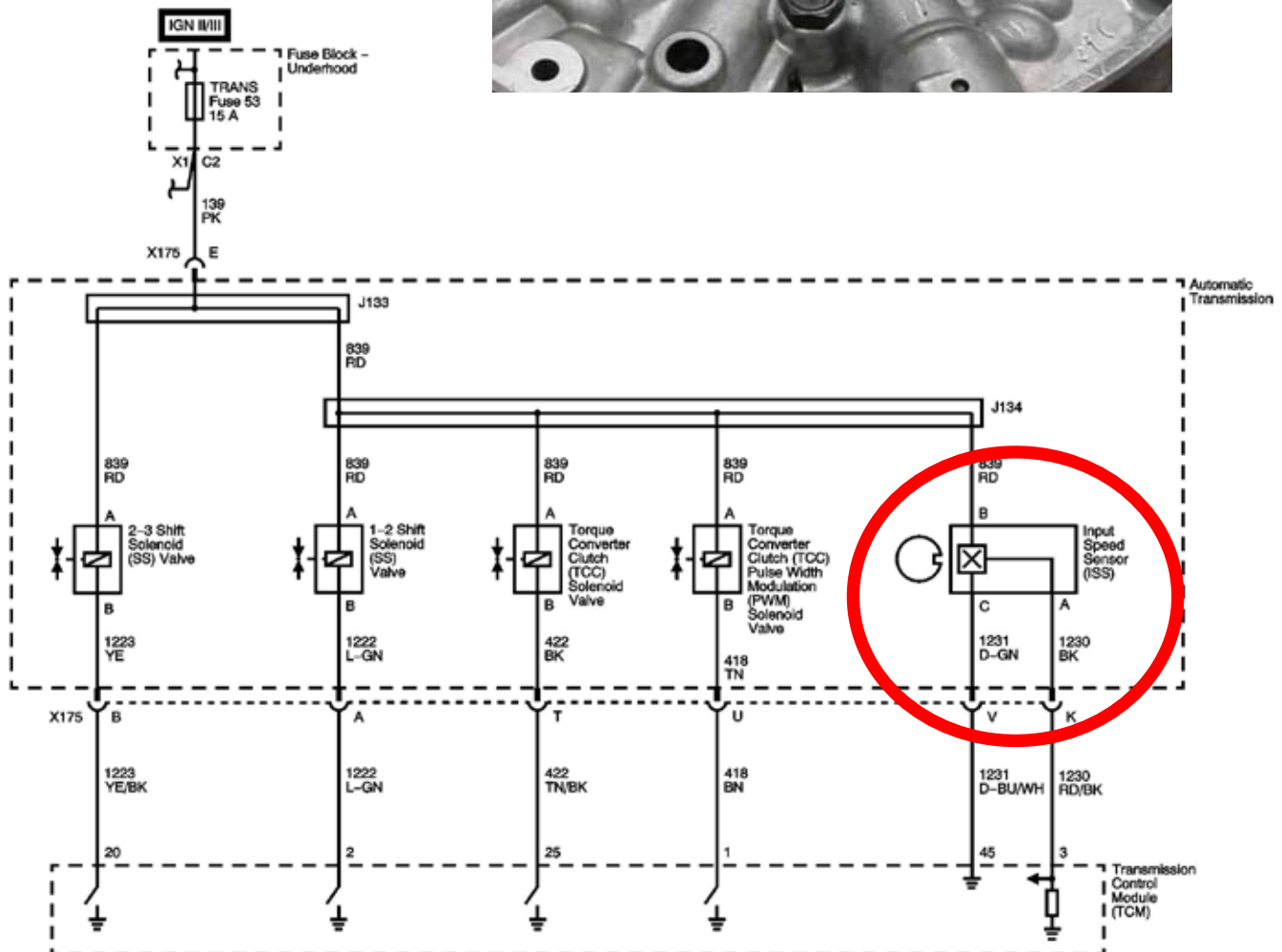
If you do not have access to a signal generator visually inspect the signal circuit for damage between the transmission connector (pin “K”) and the PCM/TCM connector (pin “3” ckt 1230). With the PCM/TCM connector and the transmission connector disconnected, check ckt 1230 for a short to ground with an ohmmeter. If problems are not found, you will need to visually inspect the internal transmission harness and ISS for proper connection and damage.

One common cause for P0716/P0717 DTC has been the input speed sensor wiring. The sensor wiring has been known to short to ground on the pump assembly. Part of the ISS wiring is not shielded in conduit. Casting flash can lead to the sensor shorting to ground on the pump. If either the sensor signal circuit or the sensor voltage feed circuit short to ground, the sensor will not function. If you find the sensor wiring damaged you will need to replace the sensor and dress the sharp edges on the pump that caused the damaged.

4L60/65/70E

Hard/Erratic Shifts, DTC P0716 and/or P0717 (continued)

Input Speed Sensor
wiring



4L60/65/70E

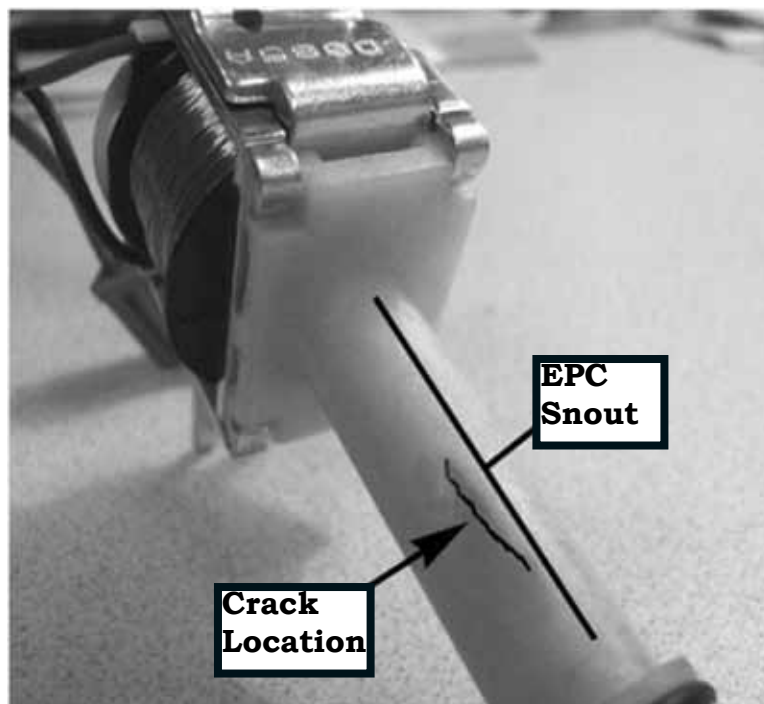
New TCC Slip Code P0894

Codes P0741, P0894 and P1870 are all TCC slip DTC's. P0894 is a new generation code that has replaced P1870. The vast majority of the criteria needed to set one of the DTC's applies to all of the DTC's. The vehicle and software programming determine which DTC is used to represent TCC slip in your particular application.

A couple of the items are new to the list and have become common as of late, such as cracked solenoids, and converter delamination.

The following items can cause the TCC slip DTC's to set:

- TCC ON/OFF solenoid cracking---This is a new item to the list. The solenoid plastic body develops a crack in it leading to leakage
- TCC apply orifice #238 in the pump gets restricted with debris
- TCC apply valve sticks (TCC valve must stroke at least .5 inches)
- TCC regulator valve worn or side loading in the bore causing it to stick intermittently.
- Stator support bushings
- A slipped stator support sleeve
- Faulty TCC PWM solenoid
- Improperly wound TCC valve spring
- AFL valve worn
- TCC O-ring seal
- Torque converter delamination (S/T truck applications built between June-September of 2008 had a problem with the TCC friction material)



4L60/65/70E

Identification Process

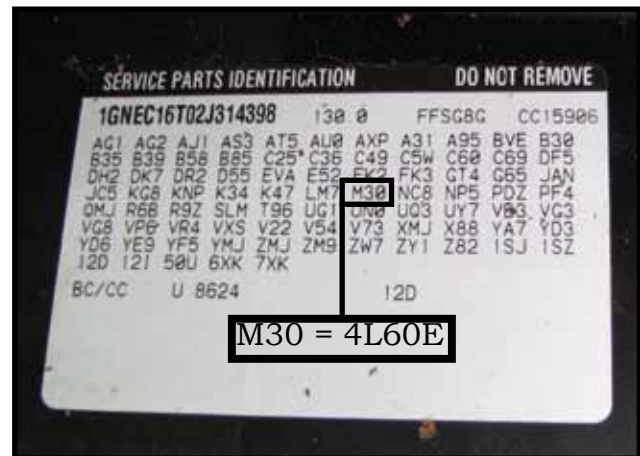
Identifying the type of 4L60 series transmission they are working on. The fastest way if you have access to the vehicle is to look at the RPO (Regular Production Option) label which may also be referred to as a SPID (Service Parts Identification) label. The RPO/SPID label will tell you everything about your GM vehicle. The label contains the vehicle VIN, Paint and Trim codes as well as codes that denote the exact equipment the vehicle was built with. This includes the type of transmission that was used in the vehicle. The RPO/SPID label is typically located in one of the following areas:

- The glove box
- The center console
- The spare tire cover
- The trunk

The 4L60 family of transmissions use the following RPO codes to denote the type of transmission used:

- M30 4L60E
- M32 4L65E (4L60EHD)
- M33 Parallel Hybrid 4L60E (PHT)
- M70 4L70E

If the vehicle is not available, the transmission type can also be identified by looking at the code on the transmission tag or pan rail. The following codes are used to designate the 4L65E and 4L70E applications.



4L65 (RPO M32) (May be called a 4L60E HD) 4L70 (RPO M70)

1KZD
2KZD
3KZD
4SSD, 4KZD, 4CTD
5HMD, 5KSD, 5KCD, 5SZD, 5CSD, 5CTD,
5CZD
6HMD, 6KSD, 6KCD, 6CZD, 6SZD
7CSD, 7HBD, 7KZD, 7SZD
8HBD
9HBD, 9HED

9TYD, 9YSD
8KGD, 8SKD, 8LGD, 8TKD, 8CFD
7CFD, 7CMD, 7CWD, 7KFD, 7KMD, 7SKD,
7TKD
6KMD, 6CWD, 6CMD, 6TKD, 6SKD

4L60/65/70E

Lack of Power, No DTC's Set

Vehicles equipped with the 4L60E, 4L65E or 4L70E may experience a condition described as a lack of power, detonation, miss and/or hesitation or possible erratic shifts. In most instances this condition is not accompanied by DTC's.

A couple of areas that have been known to cause some of these concerns include:

- Stripped stator support splines. This is not a new problem as we have covered it in previous seminars. This condition is again starting to pop up because of improper heat treatment of the stator support splines. Detonation under load is commonly accompanied by a lack of power when the splines are stripped. Stall speed testing can be used to help diagnose this concern.
- Monitor the operation of the Pressure Switch Manifold (PSM) (TFP) with your scan tool while the complaint is present. If the PSM (TFP) indicates that one of the signals is changing without the driver moving the shift lever a problem with the switch or its circuits may exist. Engine families that use the 4L60E/65E/70E transmission utilize a software set that forces the engine into a reduced power mode when unrecognized PSM (TFP) signal change occurs. If this is the case you will need to inspect the wiring for opens and shorts to ground before replacing the PSM (TFP).

Range Signal	A	B	C
Park	OFF	ON	OFF
Reverse	ON	ON	OFF
Neutral	OFF	ON	OFF
OD	OFF	ON	ON
D	OFF	OFF	ON
M2	OFF	OFF	OFF
M1	ON	OFF	OFF
ILLEGAL	ON	OFF	ON
ILLEGAL	ON	ON	ON



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4L80E

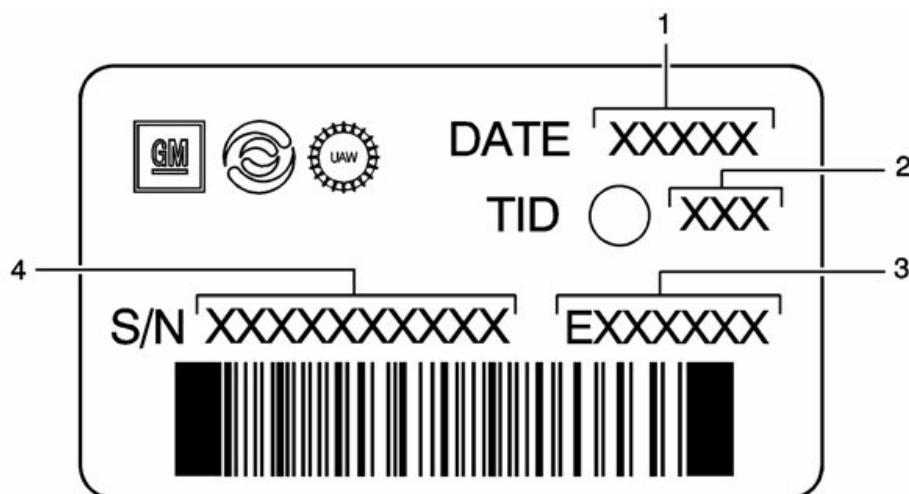
Cracked Flexplate

While working on a 2000-2004 Chevrolet/GMC trucks with a 6.0L engine, you may encounter a cracked or broken flexplate. GM has developed an updated flexplate kit for these vehicles, p/n 12621399.



LCT 1000

Identification



- (1) Date of Manufacture
- (2) Transmission Identification Number
- (3) Engineering Feature Configuration Number
- (4) Serial Number

LCT 1000

Fluid Capacity and Specifications

The spin on filter should be changed at every service. Make sure to reinstall the magnet prior to installing the filter.

Note: Some units with auxiliary equipment can use up to 20 liters of oil.

Transmission	Initial Fill		Refill	
	Quarts	Liters	Quarts	Liters
Allison 1000	12.7	12	7.4	7

**Filter
Magnet**

Some aftermarket filter holes may be too close to the center causing the original magnet to cover the holes.



**Magnet Part#
29535617**



LCT 1000

Fluid Pressure Specifications

Checking main line pressure helps to determine if a transmission malfunction is due to a mechanical or an electrical condition.

Caution: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

- Remove the oil pressure tap plug.
- Install the oil pressure gauge. All transmission fluid level and pressure checks must be made at normal operating temperatures 71-93°C (160-200°F) sump; 82-104°C (180-220°F) converter-out. Check the transmission fluid level.
- Connect a 0-2070 kPa (0-300 PSI) oil pressure gauge to the pressure test adapter fitting.
- Use the scan tool to check the engine RPM.
- With the brakes applied, record the line pressure values at 600 RPM engine speed in NEUTRAL and REVERSE range. The transmission will be in converter mode, torque converter clutch not applied.
- With the brakes applied, record the line pressure values with the engine running at 2,100 RPM in NEUTRAL. The transmission will be in converter mode, torque converter clutch not applied.
- With the brakes applied, use your scan tool to check pressures in FIRST through FIFTH gear ranges at 600 RPM. The transmission will be in converter mode, torque converter clutch not applied, at 600 RPM.
- Compare the data recorded to the line pressure specifications.
- Disconnect the oil pressure gauge.
- Install the oil pressure tap plug.

LCT 1000

Fluid Pressure Specifications (continued)



LCT 1000 Pressure Specs 2000-2003		
Range	Main Pressure @ 600 rpm	Main Pressure @ 2100 rpm
Forward (Torque Converter Clutch not Applied)	101-200 psi (700-1380 kPa)	220-260 psi (1515-1795 kPa)
Forward (Torque Converter Clutch Applied)	N/A	145-170 psi (1000-1170 kPa)
Reverse	101-200 psi (700-1380 kPa)	220-260 psi (1515-1795 kPa)
Neutral/Park	130-240 psi (800-1655 kPa)	220-260 psi (1515-1795 kPa)

LCT 1000 Pressure Specs 2004-On		
Range	Main Pressure @ 600 rpm	Main Pressure @ 2100 rpm
Forward (Torque Converter Clutch not Applied)	101-200 psi (700-1380 kPa)	220-260 psi (1515-1795 kPa)
Forward (Torque Converter Clutch Applied)	N/A	145-170 psi (1000-1170 kPa)
Reverse	101-200 psi (700-1380 kPa)	220-260 psi (1515-1795 kPa)
Neutral/Park	85-105 psi (590-720 kPa)	220-260 psi (1515-1795 kPa)

LCT 1000

Adaptive Strategy Function

If you are experiencing erratic transmission operation, after overhaul or a battery disconnect, it is important to verify which particular gears the erratic operation is occurring. Use the scan tool to determine these shift sequences.

If the shift timing between two gears is not met, the TCM will attempt to adapt the timing of that shift within the program specifications. The vehicle will need to be driven more with the intention of performing that particular type of shift. Many times this will correct the condition. It is possible to reset individual shifts without affecting the other shifts. Monitor the adaptive cells on the scan tool to determine if the adaptive strategies have been met.

NOTE: WHEN REPLACING A FAILED TRANSMISSION WITH A REPLACEMENT UNIT, IT IS IMPORTANT TO RESET THE TCM TO BASE CALIBRATION AND FAST ADAPTS FOR ALL SHIFTS.

This can be done in one step with fast learn. If this is not done, the TCM adaptive values will be at the settings that it learned for the old transmission, and will be in slow adaptive mode. Under these conditions, it would take an unacceptably long time for the adaptive values to converge to levels suitable for the new transmission.

LCT 1000

Principle of Operation

The Allison transmission incorporates control logic that enables the transmission to revert to a limited total hydraulic operation. The hydraulic system provides a limp home mode, allowing the operator to drive the vehicle to a service location. If power is interrupted while the transmission is operating in Reverse or Neutral, the transmission defaults to or continues neutral operations.

The operator may turn off the engine and start the engine again. The shift selector provides Reverse/Neutral/Drive capability regardless of the range where the failure occurred. In this state, pressure control solenoid 1 (PCS1) or Trim A solenoid, is de-energized and allowed the 3rd, 5th and reverse clutch to be applied. If the selector valve is moved to the Reverse position, main pressure is routed to the low and reverse clutch, allowing Reverse operation. If the selector valve is moved to the Drive position, main pressure is routed to the 1-2-3-4 clutch, allowing 3rd range operation.

If a No Forward, No Reverse, or Will Not Move condition occurs follow the steps below.

- Set the parking brake.
- With the ignition OFF, disconnect the X-175 case connector at the transmission.
- Using a fused jumper wire, connect terminal R (Black/White) of the automatic transmission inline 20-way connector to a known good ground.
- Start the engine and move the range selector to Reverse position.
- The transmission should engage Reverse range.
- Move the range selector to the Drive position.
- The transmission should engage Third range.

If Reverse and 3rd range are available in limp home mode, an electrical failure may be indicated. If only 1 of the 2 ranges, or neither, was obtainable, this may indicate an internal hydraulic failure such as one of the following:

- Failed clutch
- Stuck valve
- Solenoid failure
- 1-2-3-4 clutch, 3rd, 5th and reverse clutch, and the low and reverse clutch

LCT 1000

Clutch Clearance

When rebuilding an LCT 1000, be aware that there are no clutch clearance specifications for the C4 clutch assembly.

The C3 clutch adjustment specifications are the same as for the C4 clutch, except the backing plate is 0.6033" min. and the attached thrust washer thickness is 0.115" min.

The manufacturer recommends checking each of the five friction plates for a minimum thickness of 0.0935" in addition to a maximum cone height of 0.0089". The top reaction plate minimum thickness is 0.1224" with a maximum cone height of 0.0157".

The remaining three steel plates need to be a minimum thickness of 0.0961" with a maximum cone height of 0.0157". The backing plate should be at least 0.6063" thick with no measurable cone (warpage). Any variation within nominal specifications will be adapted for by the TCM.

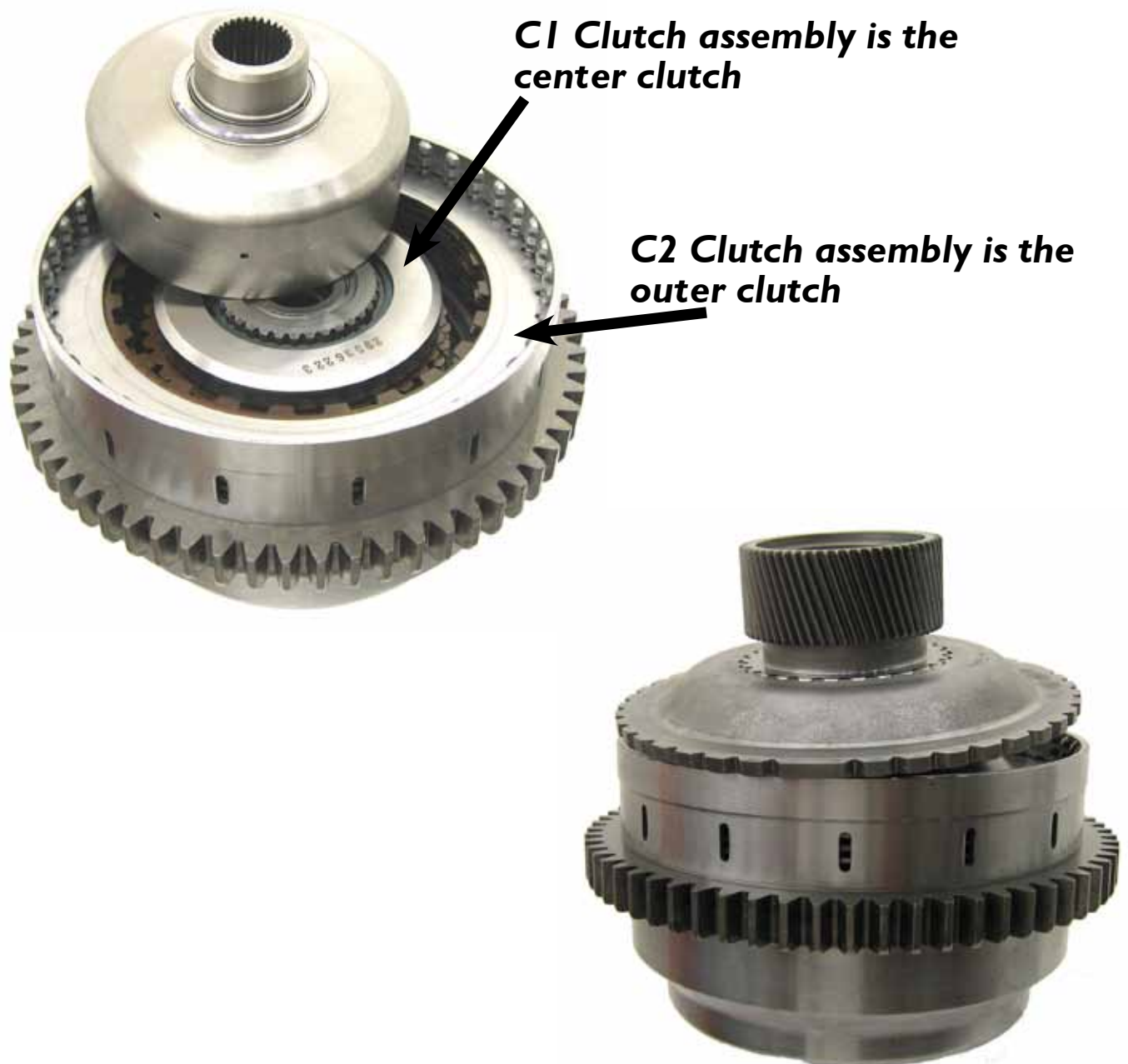
The Allison TCM will tolerate a wide range of clutch clearance. During overhaul or repairs, the factory recommended procedure to set the clutch clearance is to measure each friction and steel. If it is thicker than the minimum specification, it can be used. If a selective plate is used, it will have an ID mark on it. Measure the selective plate thickness. If the thickness is within the specification shown for the specific plate, it can be installed for use.

Under normal use, the computer tracks the clutch operation under all driving conditions to maintain clutch feel. This is called adaptive strategy. After an overhaul, it is important for the computer to have its adaptive strategy reset. A scan tool should be attached to the vehicle and the transmission should have the "Fast Learn" performed.

LCT 1000

Clutch Clearance (continued)

Some of the clutch assemblies used on the LCT 1000 transmission are very hard to calculate with normal shop measuring equipment. Fortunately, the Allison is designed to calculate the clutch apply and release times much like the system used by Chrysler for its 41TE transaxle.



LCT 1000

C1/C2 Piston Assemblies

The C1/C2 housing requires special tools, J43777 for the C1 Clutch and J43776 for the C2 Clutch for disassembly and reassembly. The tools shown below can be fabricated in your shop. In this example we used a late 4T65E reaction shell, an all-threaded T-Bar and a spring compressor fitting.

Fabricated Tools

**Late 4T65E
Reaction
Shell**



C1 Piston



C2 Housing



C2 Piston

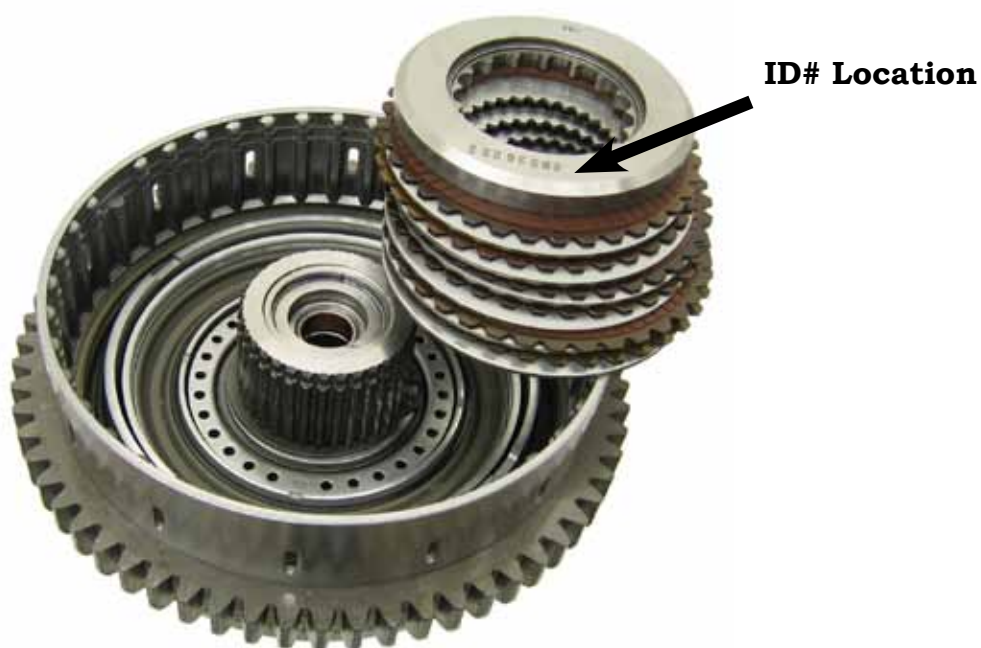


LCT 1000

1-2-3-4 Clutch Backplate

Clutch clearance specifications for the 1-2-3-4 (C1) or the 4-5-6 (C2) clutch pack assembly is difficult to check without the proper tool. If a repeat failure of the C1 or C2 clutch is happening, use the tooling to verify you have the correct spacer plate. The incorrect spacer plate may have been installed prior to you rebuilding the unit.

If the transmission has never been overhauled, replace the original spacer plate with a new one based on the ID marks. Make sure the friction plates are .0935" min. and the steel plates are .0841" min. On the C1, use the ID# stamped on the 1-2-3-4 (C1) clutch backing plate and compare it to the thickness shown in the charts. If the backing plate is less than the specification, replace it.



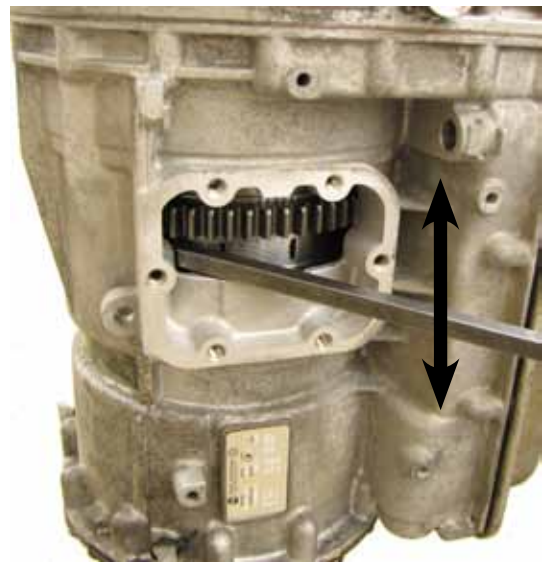
Identification	Plate Thickness	
	Metric	English
2420	11.1-11.9 mm	0.4370-0.04685"
8521	11.54-12.34 mm	0.4543-0.4858"
8522 (6222)	11.98-12.78 mm	0.4717-0.5031"
8523 (6223)	12.43-13.23 mm	0.4894-0.5209"
8524 (6224)	12.88-13.68 mm	0.5071-0.5386"

LCT 1000

Overall Endplay

The overall endplay can be checked with the unit positioned with the bell housing facing up. To check the endplay, the PTO gear is levered up and down with a dial indicator measuring input shaft movement. The endplay should be between .0110-.0610.

The endplay adjustment shims are located on the output shaft. The adjustment shim fits between the collar on the output shaft and the support bearing in the tail housing.



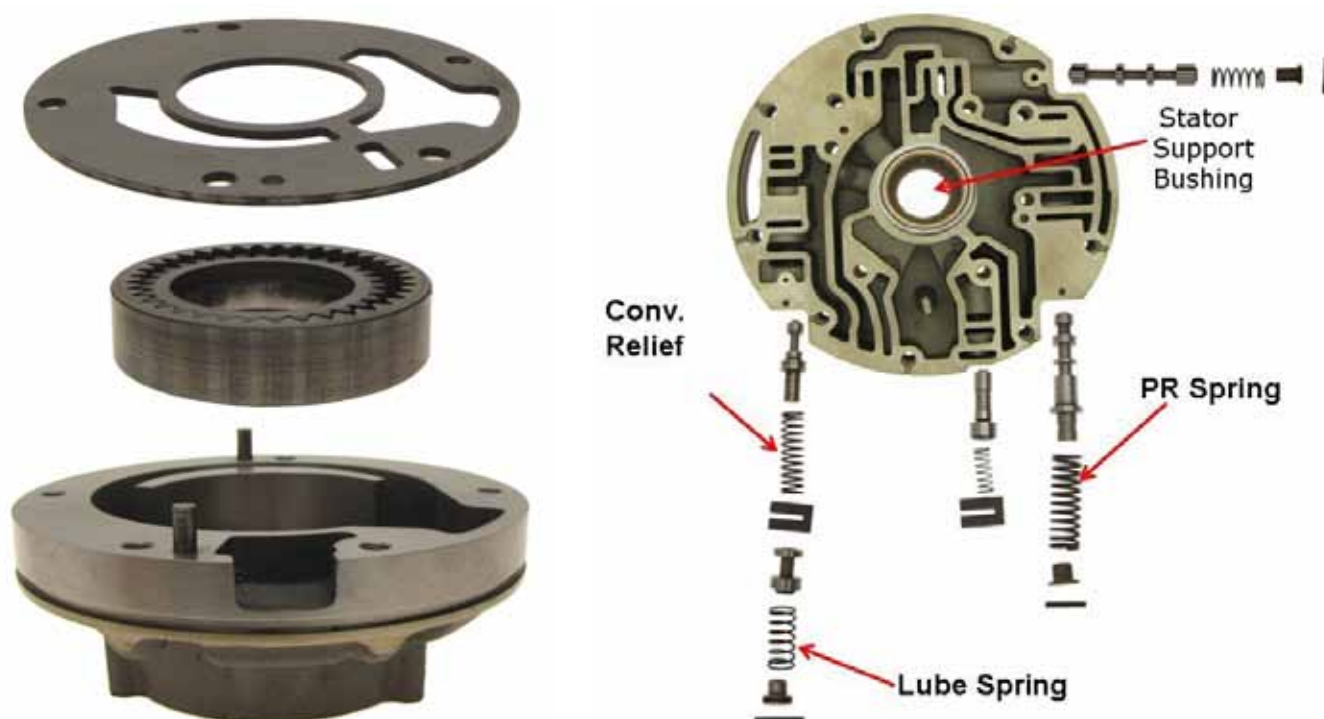
This shim fits between this collar and the bearing in the tail housing and controls overall unit endplay.

Shim Thickness		Identification
Metric	English	
0.245-0.295 mm	0.0096-0.0116"	0 Holes
0.475-0.525 mm	0.0187-0.0207"	1 Hole
0.705-0.755 mm	0.0278-0.0297"	2 Holes
0.935-0.985 mm	0.0368-0.0388"	3 Holes
1.165-1.215 mm	0.0459-0.0478"	4 Holes
1.395-1.445 mm	0.0549-0.0569"	5 Holes
1.625-1.675 mm	0.0640-0.0659"	6 Holes

LCT 1000

Oil Pump Updates and Specifications

The Pump Converter Bushing has been updated to improve pump operation and noise. The Lube Regulator Spring was updated to maintain a minimum of 40 psi of lube pressure. The Converter Relief Spring was updated to improve torque converter drainback. All these can be replaced with a pump assembly. The Converter Relief Spring can be purchased separately.



Part Measured	Specifications	
	Metric	English
Pump Bushing, Max I.D. Important: The pump bushing must have a complete burnt orange Teflon coating. If any portion of the coating is worn and bronze bushing material is visible, the bushing must be replaced.	58.391mm	2.3015"
Inside Pump Gear, Maximum Distance Between Flats	52.165mm	2.0537"
Inside Pump Gear, Maximum Side Clearance	0.066mm	0.0026"
Outside Pump Gear, Minimum O.D.	109.907mm	4.3302"
Outside Pump Gear, Maximum Side Clearance	0.056mm	0.0022"
Outside Pump Gear to Crescent Maximum Clearance	0.0455mm	0.0179"
Pump Body Gear Cavity, Maximum Depth	22.245mm	0.8758"
Pump Body Gear Cavity, Maximum I.D.	110.191mm	4.3302"
Wear Plate, Minimum Thickness	2.950mm	0.1161"

LCT 1000

Internal Mode Switch Logic

When diagnosing the IMS with your scan tool, use the following chart to verify the proper “ON-OFF” operation.

Range	A	B	C	P
P	OFF	ON	ON	OFF
R Transitional	OFF	OFF	ON	OFF
R	OFF	OFF	ON	ON
N	ON	OFF	ON	OFF
D Transitional	ON	OFF	OFF	OFF
D	ON	OFF	OFF	ON
*M	OFF	OFF	OFF	OFF
D1 Transitional	OFF	ON	OFF	OFF
1	OFF	ON	OFF	ON
Invalid	ON	ON	ON	ON
Invalid	ON	ON	ON	OFF
Invalid	OFF	ON	ON	ON
Invalid	ON	OFF	ON	ON
Invalid	OFF	OFF	OFF	ON
Invalid	ON	ON	OFF	ON

ON = Open Circuit

OFF = Grounded Circuit

*M mode allows TAP Up/TAP Down feature to properly function between 1st and 6th gears.

In this range, logic states do not change.

LCT 1000

Internal Mode Switch Installation

Place the new detent lever/IMS assembly in position in the transmission case. Rotate the detent lever/IMS assembly to engage the park pawl apply assembly.

Reinstall the manual shift shaft through the manual shift shaft seal and through the detent lever/IMS assembly. Push the manual shift shaft into the final position in the transmission case. Install the round pin into the transmission case that retains the manual shift shaft. Install the detent lever/IMS retaining bolt using a T27 TORX® bit. Tighten the bolt to 10 N·m (92 lb in).

The fast learn, adapt, procedure must be performed. This can be done in one step using a scan tool. If this procedure is not done, the TCM adaptive values will be at the settings that it learned for the old components and will be in slow adaptive mode. Under these conditions, it will take an unacceptably long time for the adaptive values to converge to levels suitable for the new transmission. Perform the fast learn procedure.



*Thanks to Ted Keating at
www.tktsales.com for the
pictures.*

LCT 1000

P0842, P0847, P0872

DTC Descriptions

DTC P0842: Transmission Fluid Pressure (TFP) Switch 1 Solenoid Circuit Low Voltage

DTC P0847: Transmission Fluid Pressure (TFP) Switch 2 Solenoid Circuit Low Voltage

DTC P0872: Transmission Fluid Pressure (TFP) Switch 3 Solenoid Circuit Low Voltage

Circuit	Short to Ground	Open/High Resistance
PS1 Signal	P0752,P0842	P0751,P0843
PS2 Signal	P0757, P0847	P0756, P0848
PS3 Signal	P0762,P0872	P0761,P0873

These codes can be caused by a fault in a clutch circuit, the valve body, a shift solenoid, or a faulty pressure switch circuit. If you clear the code and drive it, the code might come right back or only appear intermittently. Therefore these codes can be difficult to diagnose.

As a means of verifying whether a shift solenoid, shift valve or clutch is at fault, the shift solenoids C, D and E can be swapped. With the valve body removed, each clutch can be air checked. See ATRA bulletin #1296 for air check positions.

NOTE: Always service the spin on oil filter at regular intervals. Make sure the magnet located at the top of the filter is present. Always make sure the valve body bolts are evenly tighten to 84-110 in. lbs.

A burnishing tool to smooth out any irregular marks in the bore for the E shift valve is available in the aftermarket. If the E shift valve sticks in its bore, it usually effects 4th gear and sets P0872. If the code is cleared, the vehicle will shift normally 1-2-3.

LCT 1000

Pressure Switch Manifold Logic

The easiest part of the system to test is the pressure switches. Connect a scan tool and display the four pressure switch circuits. With the engine off and ignition key on, the pressure switch 1, 2 and 3 should show “Open” and the reverse switch should be “Closed”.

Start the engine and shift the transmission into Reverse. Each pressure switch should immediately display the opposite switch position. Try wiggling the harness to see if the switches change state. If the pressure switches test okay, the next test is to confirm the clutch operation. Using the appropriate scan tool, perform a clutch apply test. The scan tool will indicate if any clutches are unable to function.

Range	Pressure Switch 1-N/O		Pressure Switch 2-N/O		Pressure Switch 3-N/O		Pressure Switch 4-N/C	
	Switch Status	Scan Tool Status	Switch Status	Scan Tool Status	Switch Status	Scan Tool Status	Switch Status	Scan Tool Status
R	Open	High*	Closed	Low	Closed	Low	Closed	Low
N	Closed	Low	Closed	Low	Closed	Low	Open	High
1	Open	High	Closed	Low	Open	High	Open	High
2	Open	High	Open	High	Open	High	Open	High
3	Closed	Low	Open	High	Open	High	Open	High
4	Closed	Low	Open	High	Closed	Low	Open	High
5	Open	High	Open	High	Closed	Low	Open	High
6	Open	High	Open	Low	Closed	Low	Open	High
N/C = Normally Closed								
N/O = Normally Open								
* Pressure switch 1 (PS1) reverts to the Closed/Low state with throttle applied in reverse.								

LCT 1000

Gear Ratio Error in 5th



Technical Bulletin # 1256

Transmission: Allison LCT 1000

Subject: Gear Ratio Error in 5th or 6th Before and After Overhaul

Application: GM

Issue Date: June, 2009

Allison LCT 1000

Gear Ratio Error in 5th (P0735 2001-2005), or 6th (P0736 2006-On) Before and After Overhaul.

This problem can be caused by a damaged range fork in the transfer case causing the transfer case to pop out of gear at freeway speeds. Units affected are 2001-Current K Series Chevy Silverado/GMC Sierra 2500HD/3500. The 4x4 Allison transmission uses the vehicle speed sensor on the transfer case as an output speed sensor. When the transfer case goes to neutral, the computer sees input RPM change as vehicle speed maintains and thinks that the transmission is slipping.

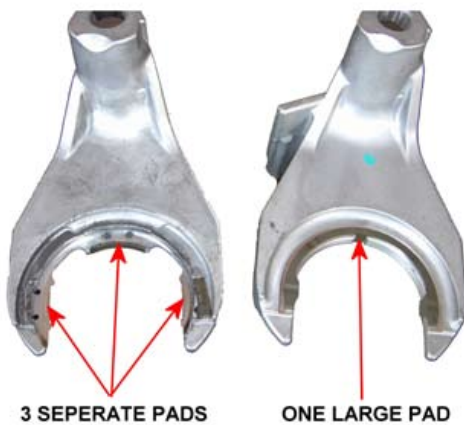
One of the main causes for this failure is a lack of lubrication due to low fluid level. Over time, the pump assembly wears a pin hole into the magnesium case and produces a small leak. GM has released an updated clip that resists wear from the pump into the case.

GM has also released an updated range fork and hub assembly to help with wear issues. Anaheim Gear of Anaheim, California recommends using GM Autotrak fluid for improved durability.

Autotrak Fluid Part #: 12378508

Range Fork Part #'s: 12544310 (261 XHD) 12384964 (263 XHD)

New Style



LCT 1000

Gear Ratio Error in 5th (continued)

Technical Bulletin # 1256



Range Hub Part #: 12384958

Updated Case Clip Part #: 89059653



**CLIP IMPROVES CASE DURABILITY
WHERE THE PUMP RIDES**

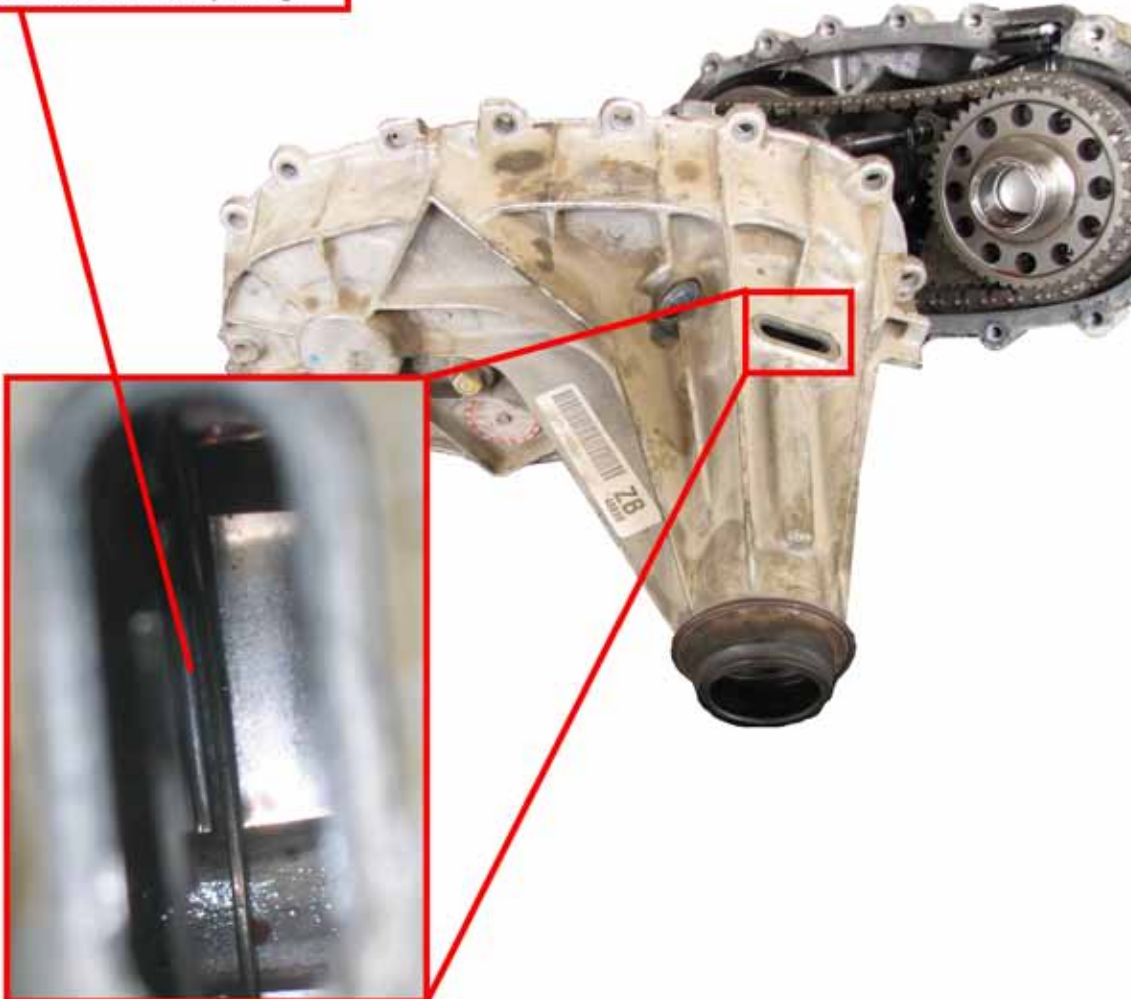
LCT 1000

Gear Ratio Error in 5th (continued)

We've also found the snap ring groove in the rear case half for the output bearing is wearing out. The magnesium case is too soft and the axial movement of the output shaft causes the snap ring groove to widen as much as 0.0200". This excess clearance causes the entire shaft to walk back and forth, resulting in range fork wear and a freeway speed neutral condition.

There is no fix for the case other than replacement.

Inspect for excessive wear
behind the snap ring



LCT 1000

Late/No Shifts, Lack of Power

LCT 1000 applications may exhibit late shifts, no shifts, or a lack of power complaint. This condition may be caused by the PTO switch indicating that the PTO is being commanded on. It may act very similar to a plugged fuel filter issue and likely will not set DTC'S. The TCM is being commanded by the ECM to change the shift points for the transmission. The engine speed will typically be limited to 2000-3000 RPM (depending on calibration).

The PTO switch can be monitored with a scan tool on most applications. If the PTO switch is activated or if the switch has failed, the ECM will limit the engine speed no matter what throttle opening is being commanded. In addition you may note that turbo boost pressure, MAF and fuel delivery commands indicate that the engine is not under full load.

When these conditions are met, the ECM will command the TCM to change the shift points which can lead to the complaint. If the switch is in the off position, check the switch and wiring with your scan tool or multimeter and replace/repair as necessary. The PTO switch on the 2001-06 applications is located right of center on the dash.

NOTE: Many customers are installing PTO switches in vehicles that were not originally equipped with a PTO from the factory. The factory harness is in place up to connector C106 so the installation is fairly simple. PTO switch kits are available from several sources. This means this condition may occur even though the vehicle is not equipped with a PTO. Customers are using the PTO input to force the engine to "idle up" to speed the engine warm up.

Late/No Shifts, Lack of Power (continued)



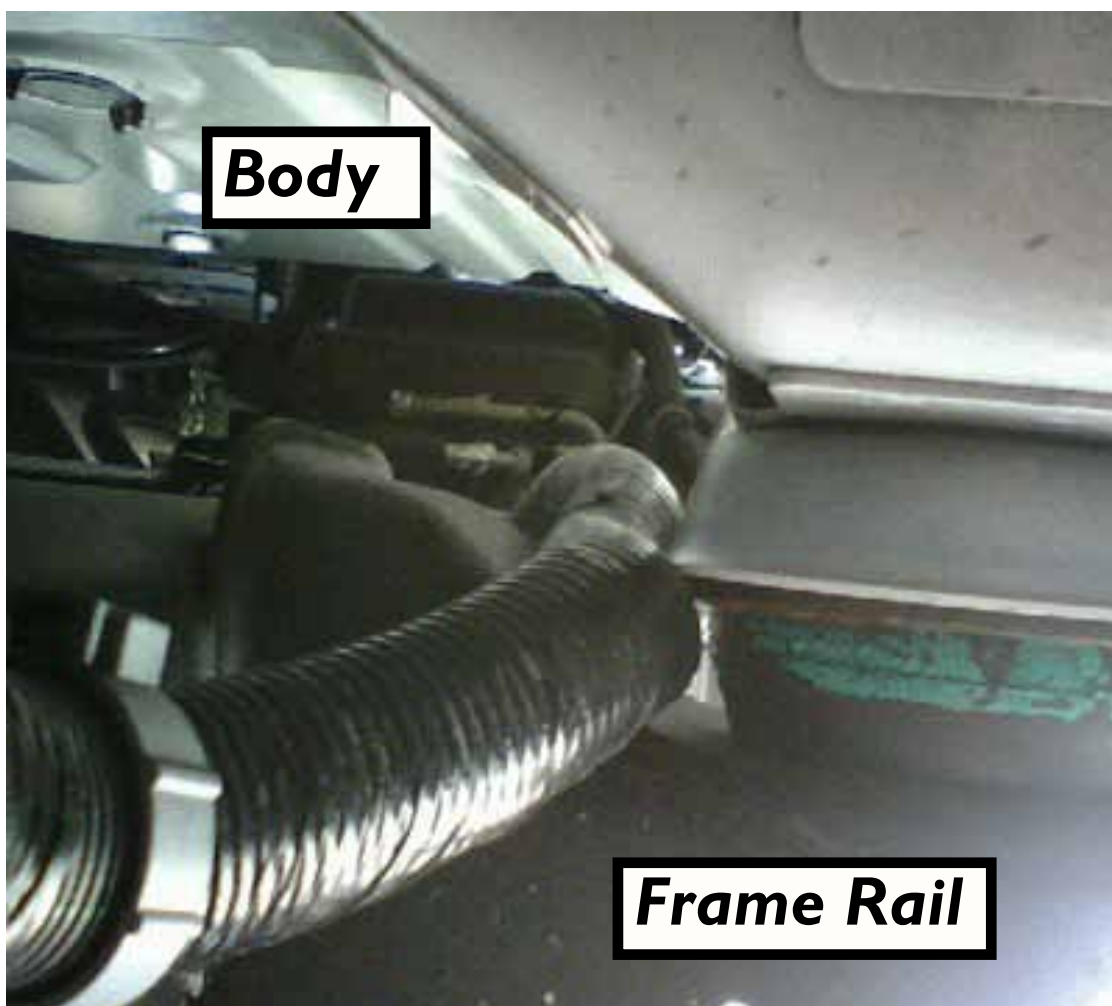
LCT 1000

No Shifts and/or No Movement, DTC's

LCT 1000 applications may exhibit any of the following conditions:

- Transmission will not move forward or reverse (range inhibited)
- Possible electrical related shift solenoid, temp sensor or PSM DTC's
- Transmission will move forward and reverse but will not shift
- Concern may be intermittent

Inspect the main transmission harness for being pinched where the frame rail meets the body (at the body mounts). If the harness is pinched repair the wiring and reroute it to prevent it from becoming pinched again. This problem is common on crew cab applications.



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Company Profile

Whatever It Takes (WIT) was founded in 1999 by Kenny Hester, a 30-year veteran in the Transmission parts supply business. WIT is the complete source for all its customer's transmission parts needs, whether it is new, used, or remanufactured. Parts are currently distributed by 22 branch locations throughout the U.S. With the main remanufacturing and distribution located within 10 minutes of U.P.S.' major Air Hub, Whatever It Takes is able to quickly ship parts worldwide. The majority of the sales staff have been in the business for over 18 years. WIT is an employee owned, customer driven company, there are no stockholders or investors to report to. As owners, the WIT employees' only job is to provide the customer with the things they need to be the most successful shop possible.



Products

Whatever It Takes carries top-quality products from manufacturers such as Raybestos, Toledo Trans-Kits, Allomatic, ATEC-Transtool, ATSG, Autocraft Manufacturing, Borg Warner, CVC Torque Converters, DT Components, Hayden Coolers, Life Automotive, Lubegard, Powertrain Systems, Precision International, Rostra, Sachs Clutch Kits, Sonnax, SPX Filtran, Stellar Group, Superior, Teckpak-Fitzall, Transgo, Tri- Components, TTXE, Valeo Clutch Kits, Zoom Technology, OE manufacturers and many others. In addition to new O.E. parts, W.I.T. also carries a full line of remanufactured and used parts for both Automatic & Standard transmission. W.I.T. remanufactures Standard transmissions & transfer cases that include a 12 month/ unlimited mile warranty against parts and workmanship.*



Customer Service

Customer Service is the cornerstone that W.I.T. was founded on, and has helped it become a major competitor in the transmission parts business. Whatever It Takes prides itself on its excellent customer service and having the parts you need by maintaining a minimum fill rate of 98.8%. W.I.T. prides itself on taking care of its customers. Service, Experience, Quality, Product Availability, Timely Credits, a dedicated Customer Service line are just a few of the reasons why Whatever It Takes has become a major competitor in the transmission parts business. WIT is able to ship its parts overnight to most of the North and South Eastern U.S. With its strategically placed stores, it is possible for WIT to service about 80 % of the country within 2 days. In addition to using UPS & Fed-Ex to ship its packages Whatever It Takes also offers free Night-Box delivery to many areas. By making this commitment, WIT helps to increase its customer's profit margin. With Night-Box delivery, Builders no longer have to wait around for UPS or FedEx to arrive; their package is delivered overnight so the parts are waiting on them the next morning.



Research & Development

The Research & Development team stays current with the latest transmissions & take photos of every part in these transmissions in order to provide most complete transmission catalog in the industry. They gather information on common wear issues with each new transmission, and develop text descriptions for all the Catalogs and WIT's website (www.wittrans.com). The R & D team was responsible for creating W.I.T.'s Catalog CD with point and click technology, The Award winning & most up-to-date Vehicle to Automatic Transmission Guide in the Industry, & now the only Vehicle to Manual Transmission Guide in the industry!



Management

Kenny Hester, President.....	800-940-0197 ext.1150
Rick Skaggs, VP of Operations.....	800-940-0197 ext.1166
David Bailey, VP of Branch Operations....	800-940-0197 ext.1501
Tom Conroy, VP of Sales & Marketing.....	800-633-3134 ext.2134
John Huff, VP of Finance.....	800-940-0197 ext.1151
Customer Service.....	800-940-0197 ext.1560

AWF-21B

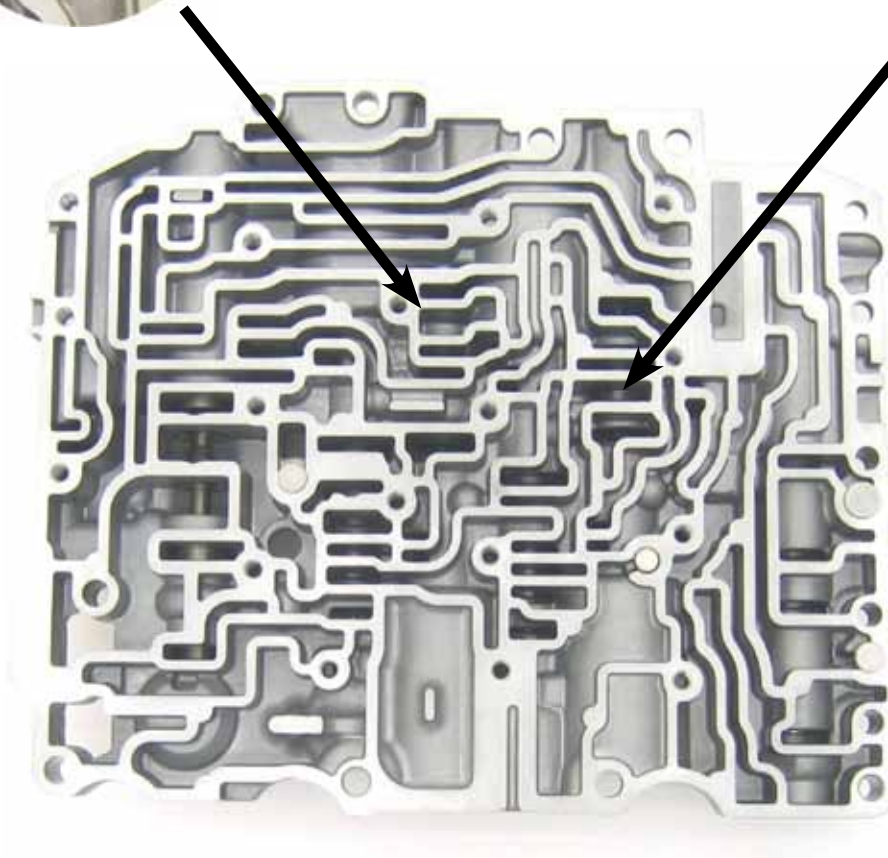
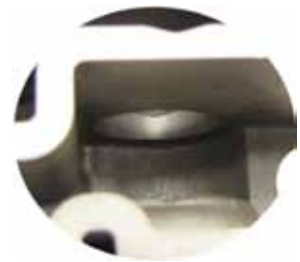
Harsh, Erratic or Slow Downshifts/Upshifts

These shift concerns have been caused by several bores wearing out in the valve body. Always inspect the valve body bores carefully. If worn bores are found the valve body needs to be replaced or repaired. Always reprogram the TCM with the latest updates.

A bore that is worn has a shine to it and may have visible ridges.



A bore that is a dull aluminum color is in good shape.



AX4S/AX4N

Erratic Shifts or Shuttle Shifting

1996-2006 Ford Taurus with an AX4S/AX4N transmission may experience erratic shifts or shuttle shifting on acceleration from a stop. This condition may be caused by an erratic VSS/OSS signal coming into the PCM. Check the VSS/OSS signal going to the PCM. If the VSS/OSS signal is erratic be sure to inspect the wiring from the VSS to the controller. If the wiring is OK, replacing the VSS sensor may correct this concern.



Early VSS



Late OSS

4F50N

Erratic Transmission and Engine Operation

2004-2007 Ford Freestar vehicles may be experiencing erratic transmission operation. These may include harsh or delayed shifts/engagements, no reverse, erratic engine operation, engine overheating, engine lean condition, misfire (possibly leading to melted electrodes on the spark plug) and rough idle.

These symptoms may be caused by water leaking down through the cowl panel (cowl top vent) and entering the PCM through the PCM connector cover.

Prevent water build up by removing the cowl drain plugs and resealing the cowl.



4F50N/AX4S/AX4N

1-2 or 2-3 Flare Shift

Shift concerns such as a 1-2 or 2-3 flare may be caused by the intermediate piston cracking. These cracks are very difficult to see. Replacing the intermediate piston with an updated piston (4F1P-7E005-AA) will usually correct this condition.



The cracks in the piston may be very difficult to see. Replacing the piston on every rebuild is a good idea.

6F50N

No Reverse, 3rd or 5th Gears

The Ford Edge, Taurus, Sable, Taurus X and the Lincoln MKX may experience no reverse, 3rd or 5th gears. Trouble codes P0733 (3rd gear ratio error), P0735 (5th gear ratio error), P0756 (Direct clutch system fault) may be present with the malfunction indicator light (MIL) on.

To diagnose this condition is simple. Unplug the transmission. Does reverse come back? If the reverse engagements return then the sun shell is not the issue.

If the forward engagements are good with the transmission plugged in chances are very high that line pressure is NOT the problem.

Ford has released an updated intermediate sun shell assembly (7T4Z-7A019-A) to correct this problem.



The weld holding the sun gear to the shell breaks.

The updates sun shell assembly comes with a new #3 thrust bearing.



Thanks to Nick Medlen from Reliable Transmissions for the broken shell

6F50N

PCM Reflashes for Various Concerns

6F50N equipped vehicles may exhibit a harsh driveline clunk at low speed below 10 mph during stop and go driving. This may be due to a PCM calibration issue. There is a new calibration to improve low speed stop and go driving feel.

It's normal for the vehicle to roll while stopped on a slight incline, with the vehicle in drive or reverse gear and the brakes not applied. There is a new calibration that will improve the hold capability on a slight grade and improve the ability to creep in drive and reverse. Customers should be advised that using the brake is still the best way to avoid rolling on a incline, grade or hill.

Go to www.motorcraftservice.com for the latest calibration files.

The screenshot shows the Motorcraft Technical Resource website. The browser window title is "Service Information for Ford, Lincoln and Mercury Vehicles - Motorcraft Technical Resource - Windows Internet Explorer". The address bar shows the URL: <http://www.motorcraftservice.com/vdirs/retail/default.asp?pageid=&gutsid=>. The website features the Motorcraft logo and the tagline "QUALITY PARTS FOR FORD, LINCOLN AND MERCURY VEHICLES". The main content area is titled "Motorcraft® Technical Resource Access" and includes a navigation menu on the left with categories like "Technical Resources", "Non-Subscription Resources", "Subscription Products", and "My Subscriptions". The main text area contains information about the technical resource access, including a link to "Order A Subscription" and a "Join Now!" section with a "SIGN UP" button. There is also a "Member Login" section with fields for "Username:" and "Password:". The website is displayed in a Windows Internet Explorer browser window with a status bar at the bottom showing "Internet" and "100%".

4R100

No Upshift

While working on a Ford F-series truck with cruise control you may experience a no upshift condition and possibly code P0500 may be set in the PCM memory. If the cruise control servo is interfering with the VSS signal, disconnecting the cruise control servo will usually correct the VSS concern. If disconnecting the cruise control servo corrects the VSS concern, replacing the cruise control servo assembly is recommended.

Unplug the wires from the back of the Cruise Control Assembly



Torqshift

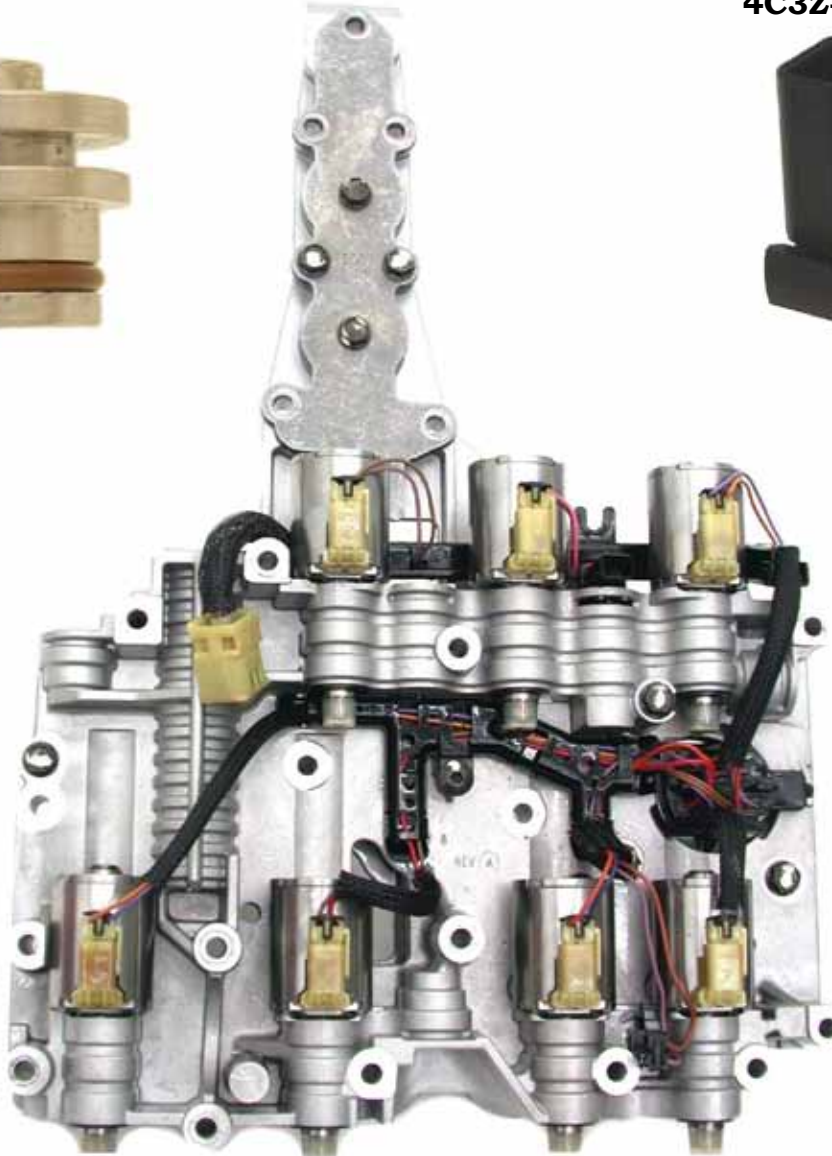
Dummy Pressure Switches

From the first run of Torqshift transmissions, the solenoid bodies have had pressure switches built into them. These pressure switches have never been used by the computer as an input. Early Torqshift valve bodies had five pressure switches and the late Torqshift only has one pressure switch. These pressure switches can come apart and leak pressure. Always inspect the pressure switches for breakage. New plugs are available from the aftermarket.

Aftermarket plug



**OEM plug
4C3Z-7E440-AA**



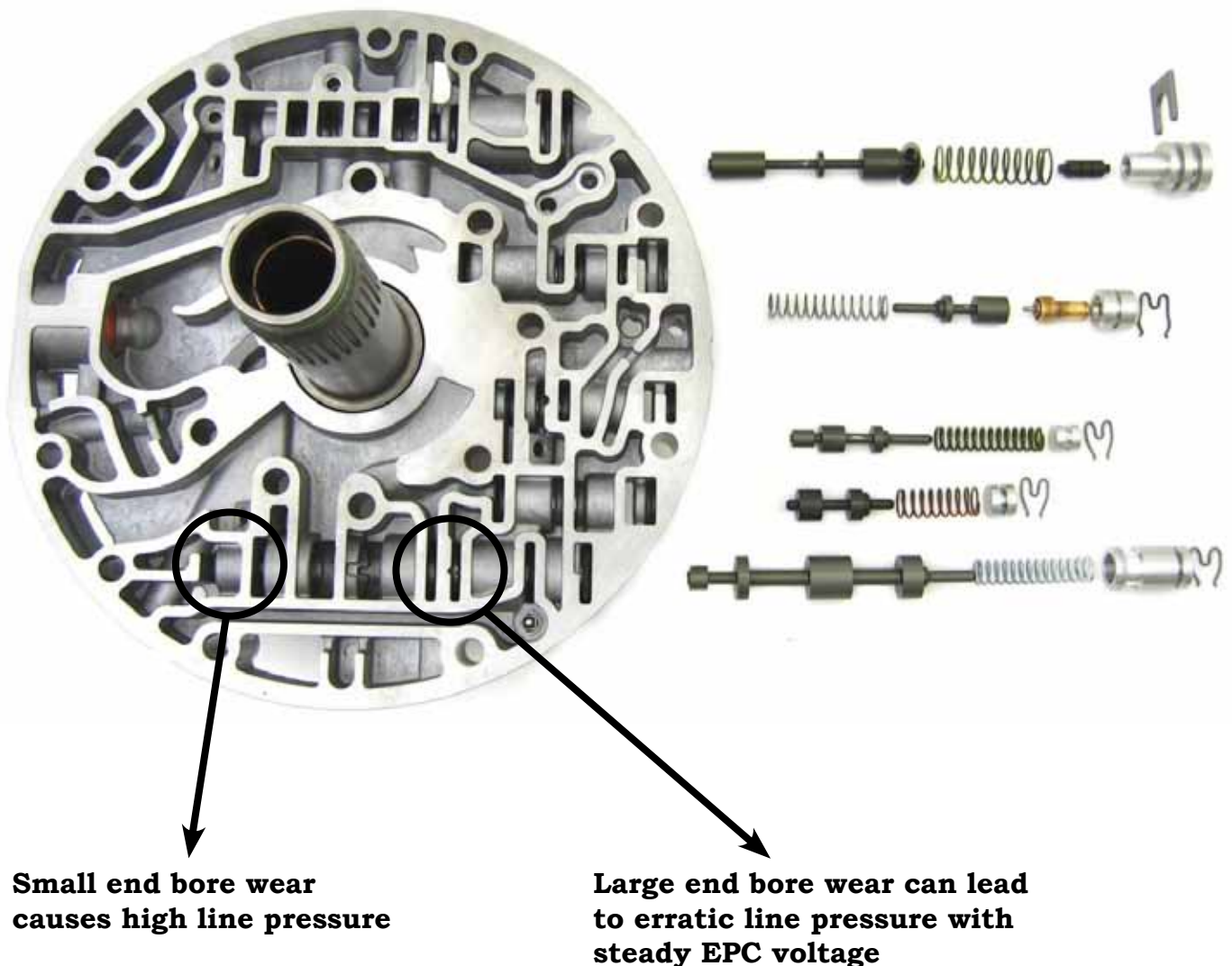
Torqshift

High or Erratic Line Pressure

High or erratic line pressure can be caused by Pressure Regulator Valve bore wear. If the small end of the valve bore is worn this will allow balance oil to leak off causing high line pressure.

If the large end bore closest to the spring wears out this will allow converter charge oil into the boost area of the Pressure Regulator Valve. This may show up on a pressure gauge as erratic line pressure rise with steady EPC voltage.

Currently the fix is to replace the stator or repair the stator.

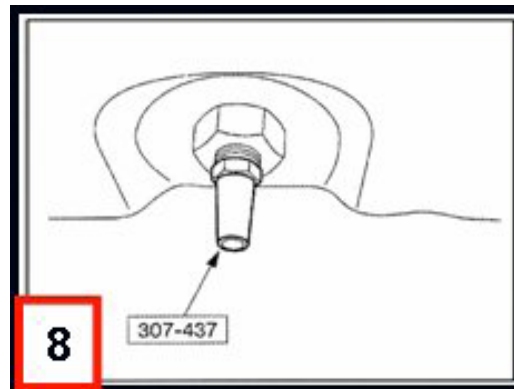
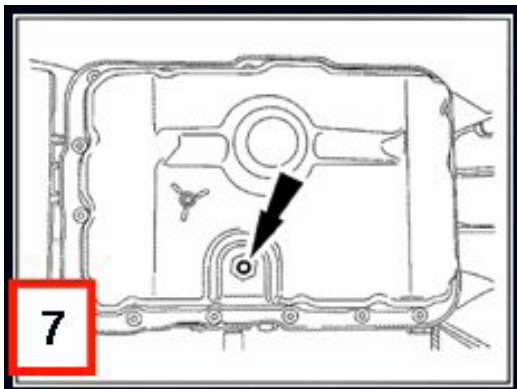
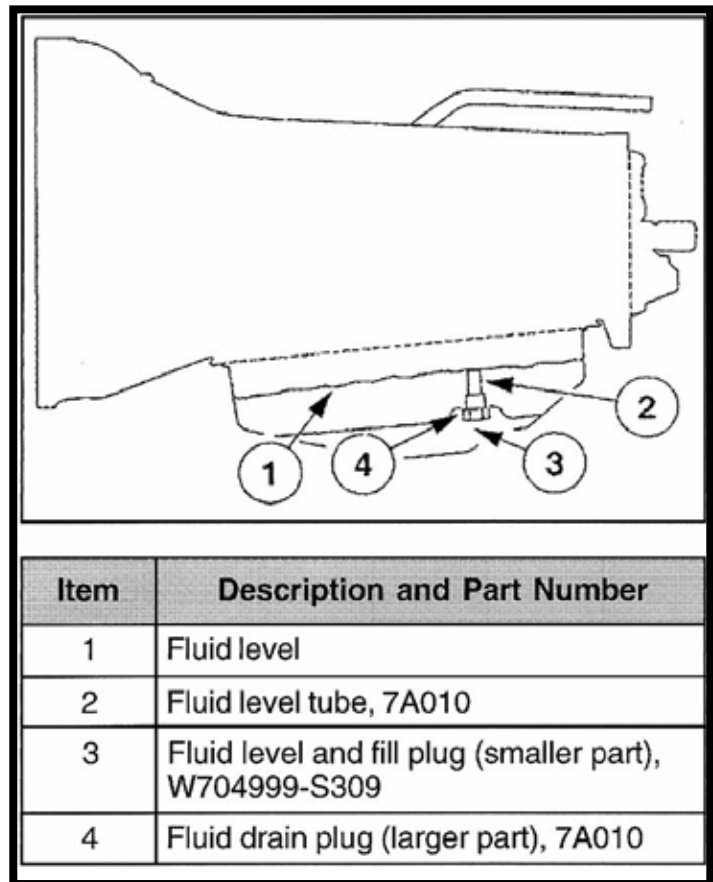


5R55N/W/S

Oil Fill Procedure

The N/W/S transmissions do not have a fluid level indicator stick. When checking fluid level it must be set at a specific oil temperature. To correctly set the fluid level, use the following procedures.

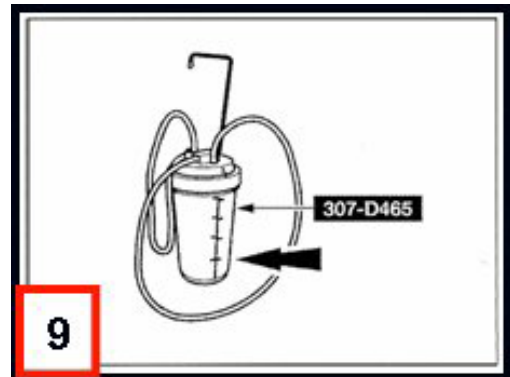
- 1: Use a scan tool to monitor the Transmission Fluid Temperature (TFT).
- 2: Start the engine.
- 3: Note: Engine idle speed is approximately 650 rpms. Run engine so that the transmission fluid temperature is between 27- 47°C (80-120°F).
- 4: Move selector through all ranges allowing to engage in all gears.
- 5: Place the range selector in **“DRIVE”**.
- 6: Make sure the vehicle is on a level platform.
- 7: Hold the larger fluid drain plug with a wrench and remove the smaller (center) fluid level and fill plug with a 3/16-inch Allen Key.
- 8: Install the fluid level and fill plug adapter into the fluid drain plug.



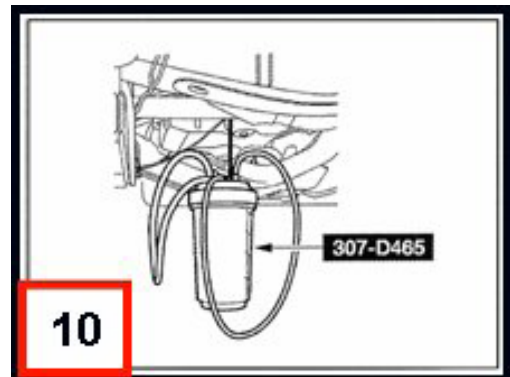
5R55N/W/S

Oil Fill Procedure (continued)

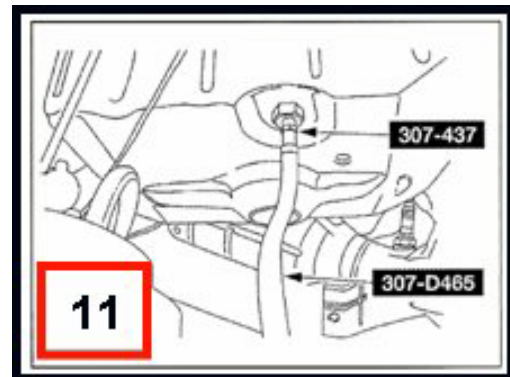
9: Prior to filling the fluid transporter/evacuator/injector with clean transmission fluid, make sure the canister is clean. Fill with clean automatic transmission fluid.



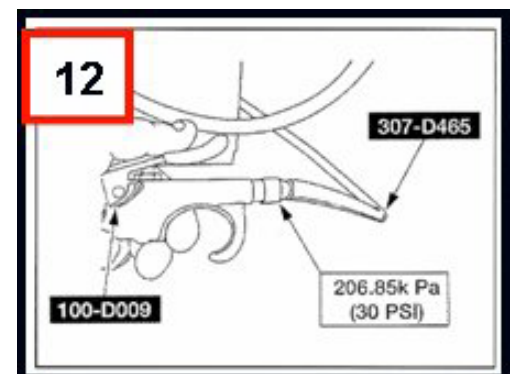
10: Hang the fluid transporter/evacuator/injector under the vehicle. Position it upright and close to the transmission.



11: Connect the open end of the fluid hose from the fluid transporter/evacuator/injector to the fluid level and fill plug adapter in the bottom of the fluid drain plug.



12: Apply a maximum of 206.85 kPa (30 psi) to the open end of the vacuum/pressure hose from the fluid transporter/evacuator/injector. Fluid will immediately start flowing out of the fluid transporter/evacuator/injector into the transmission fluid pan.



5R55N/W/S

Oil Fill Procedure (continued)

13: Add one pint of transmission fluid into the fluid pan. Stop the process by releasing the air pressure and removing the air nozzle from the end of the hose.

14: Inspect the fluid level in the fluid transporter/evacuator/injector. If the fluid drains back into the canister, the transmission is full. If no fluid drains back, more fluid will need to be added. Repeat steps until full.

15: Pull extra oil out by using a vacuum pump on the open end of the vacuum/pressure hose.

16: Allow fluid to drain till drips or small stream is noticed at 27-29°C (80-120°F).

17: Reinstall the small (center) fluid level indicating plug with a 3/16 Allen Key.

18: Check the operation of the transmission by moving the range selector level slowly through each gear, stopping in each position and allowing the transmission to engage.

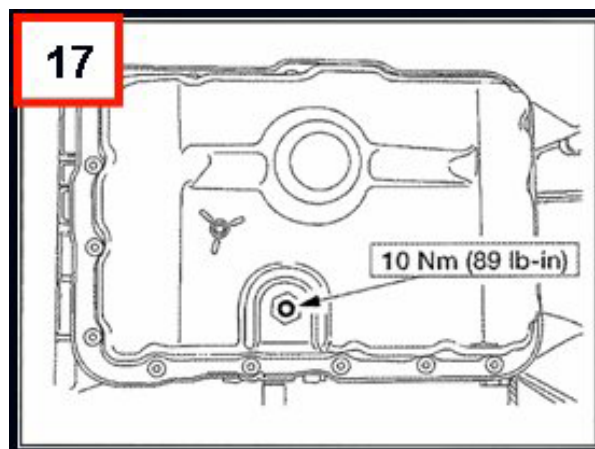
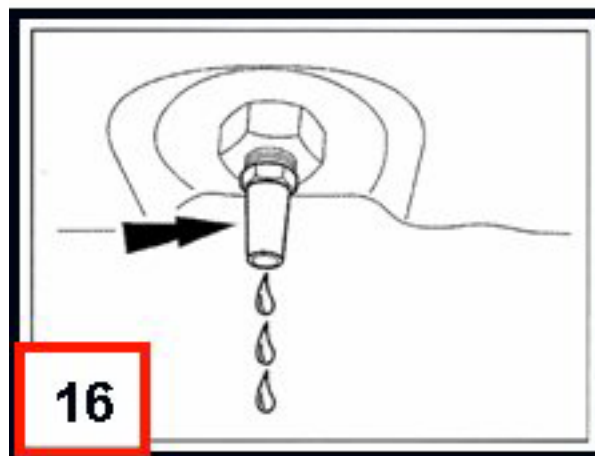
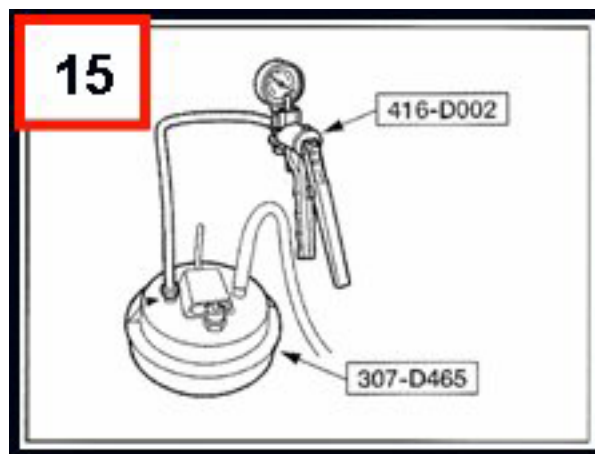
Always use Manufacture Specific Fluids

High Fluid Level

May cause the fluid to become aerated, due to the churning action of rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission damage.

Low Fluid Level

Can result in poor transaxle engagement, slipping, or damage. This could also indicate a leak in one or more of the transaxle seals or gaskets.



5R55N/W/S

Harsh 2-3 Shifts

Installing a 0.75:1 ratio planet set in place of a 0.71:1 ratio planet set will cause harsh 2-3 shifts. Brain deadening the computer will soften the shifts for a few miles but the harsh shift will eventually return. May also cause a TCC slip code.

NOTE:

Large Sungear = Small pinions on the OD Planet
Small Sungear = Large pinions on the OD Planet

5R55W provides the following gear ratios:

Reverse: 3.07:1
1st : 3.22:1
2nd : 2.41:1
3rd : 1.54:1
4th : 1.00:1
5th : 0.75:1

5R55S provides the following gear ratios:

Reverse: 3.07:1
1st : 3.22:1
2nd : 2.29:1
3rd : 1.54:1
4th : 1.00:1
5th : 0.71:1

5R55N provides the following gear ratios:

Reverse: 3.07:1
1st : 3.22:1
2nd : 2.41:1 (early production) or 2.29:1 (late production)
3rd : 1.54:1
4th : 1.00:1
5th : 0.75:1 (early production) or 0.71:1 (late production)

5R55N/W/S

Harsh 2-3 Shifts (continued)

94 Teeth
0.71:1 Ratio



72 Teeth
0.75:1 Ratio



38 Teeth
0.71:1 Ratio



24 Teeth
0.75:1 Ratio



4R100, 4R70W with Transfer Case Erratic Speedometer Reading

1997-1998 Ford F150, F250, Expedition and 1998 Lincoln Navigator, may have erratic transmission operation or erratic speedometer operation. The malfunction indicator lamp may be illuminated and code P0503 (VSS) may or may not be stored in the PCM.

A loose speedometer drive gear, located on the transfer case output shaft, may be causing an erratic VSS signal to the PCM and the instrument cluster. Replace the speedometer drive gear with a tighter fitting new design speedometer drive gear.

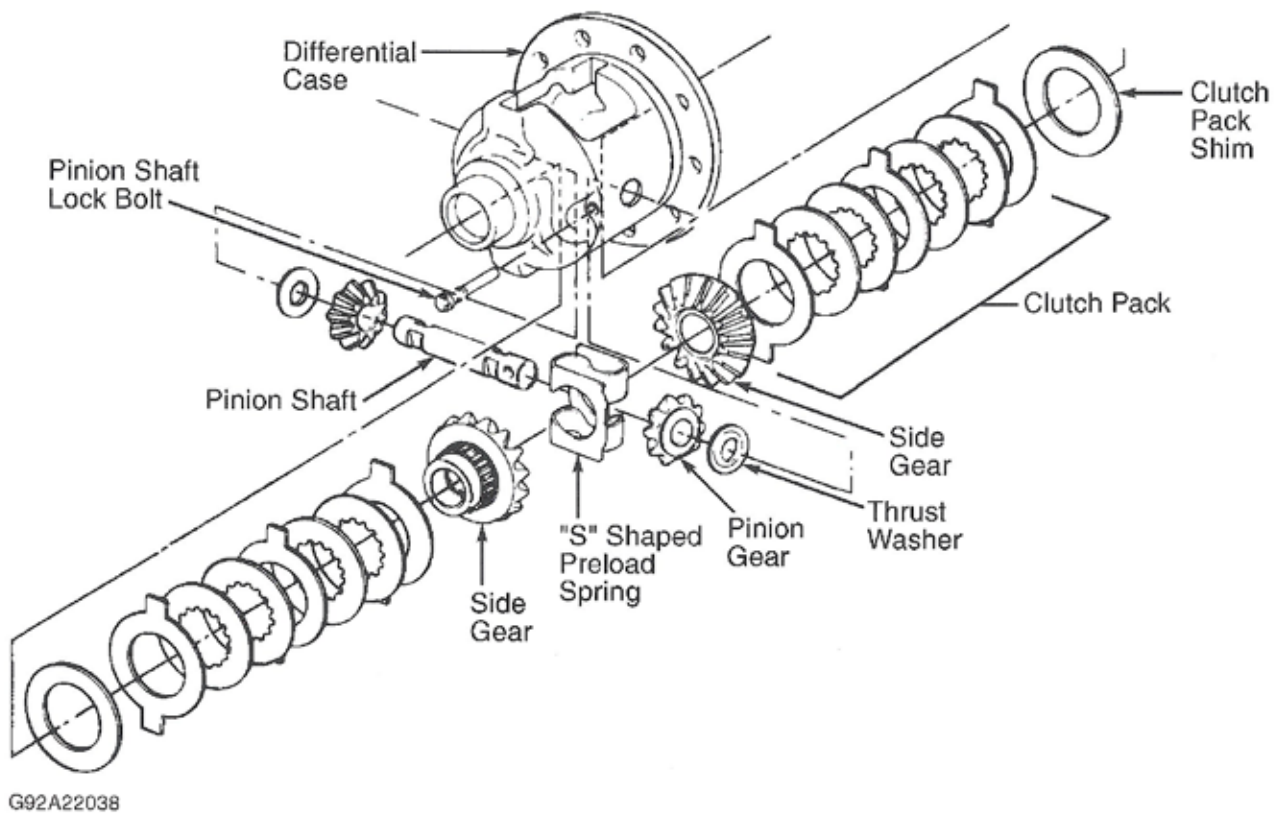


Part # F7TZ-17285- AA

4R100, 4R70W

Chatter Type Noise

1997-1998 Ford E150, F150, F250, Expedition or 1998 Lincoln Navigator with a limited slip differential, may experience a chatter type noise or feeling coming from the rear axle while turning. This concern may be caused by the differential limited slip clutch packs being gauged too tightly. Install a Traction-Lock Clutch Pack Kit to correct this concern.

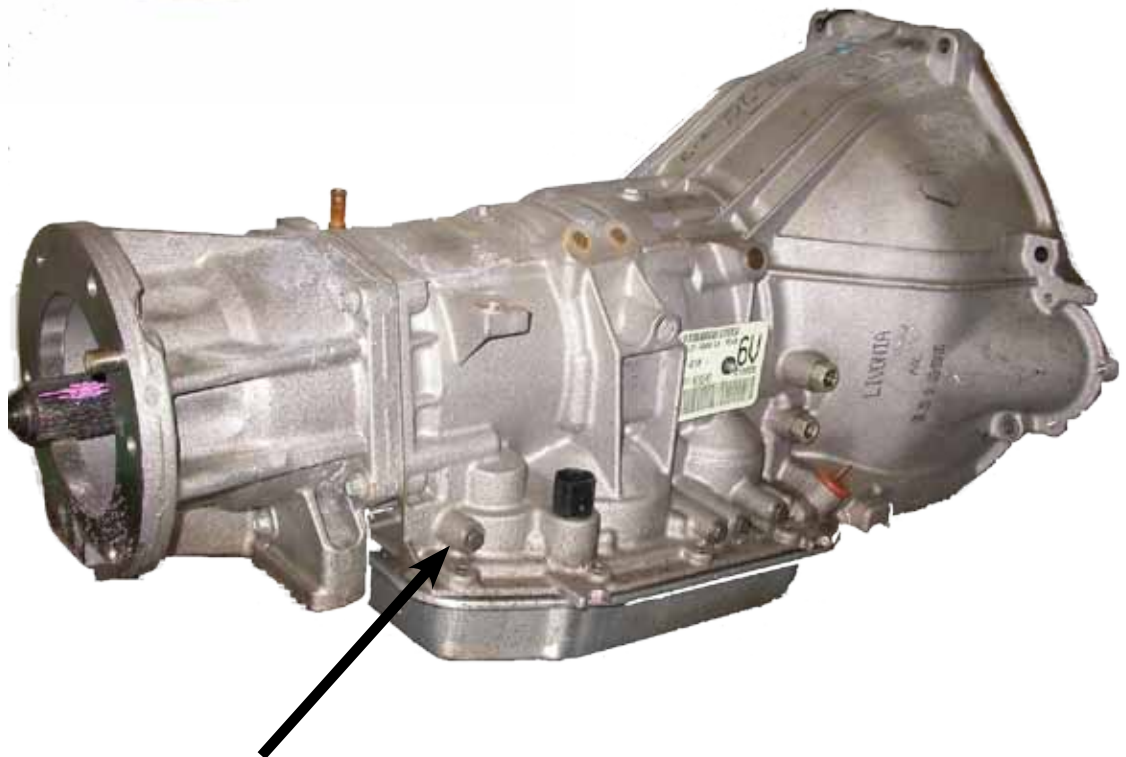


Parts #'s are F75Z-4947-AA (9.75 ring gear) and F75Z-4947-AB (10.25 ring gear)

4R70W/E and 4R75E

Low Speed Tie-up

4R70W/E and 4R75E low speed tie-up (1st gear coast under 10 mph). This may be caused by a damaged 2-3 (molded rubber design) accumulator piston. To verify the concern tap into the direct clutch pressure tap. If there is pressure in 1st gear the accumulator is damaged. Replace the accumulator piston to resolve this issue.



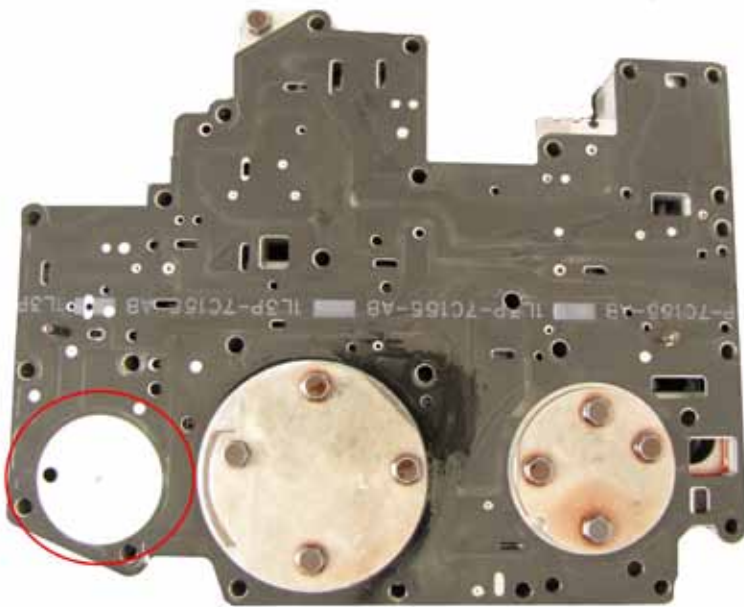
3rd Clutch Pressure Tap

4R70W/4R75E 2001- On

Falling Out of Gear at a Stop

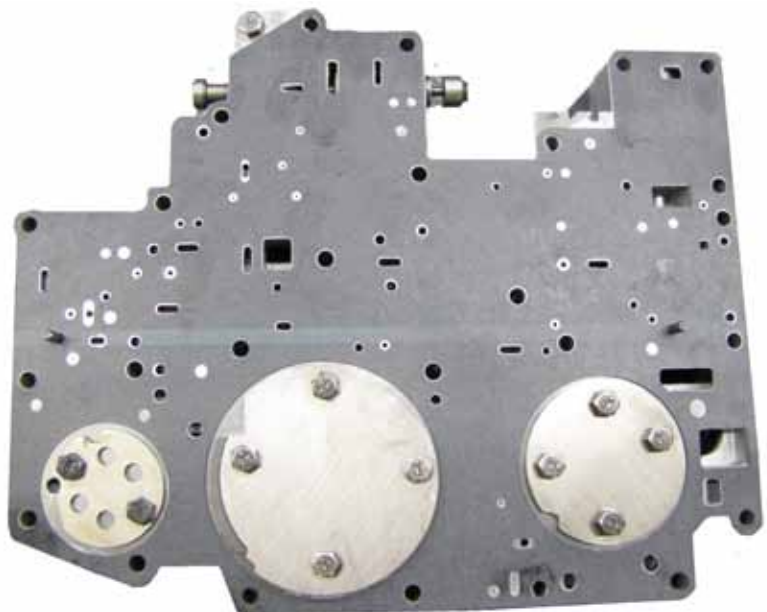
In 2001, Ford eliminated the reinforcement plate on the valve body below the third gear accumulator. The reduced clamping force against the separator plate has caused cross leaks that stroke the 3-4 shift valve at idle, causing a neutral condition at a stop.

Use the following instructions to modify 2001 and up valve bodies to accept a plate from an AOD transmission.



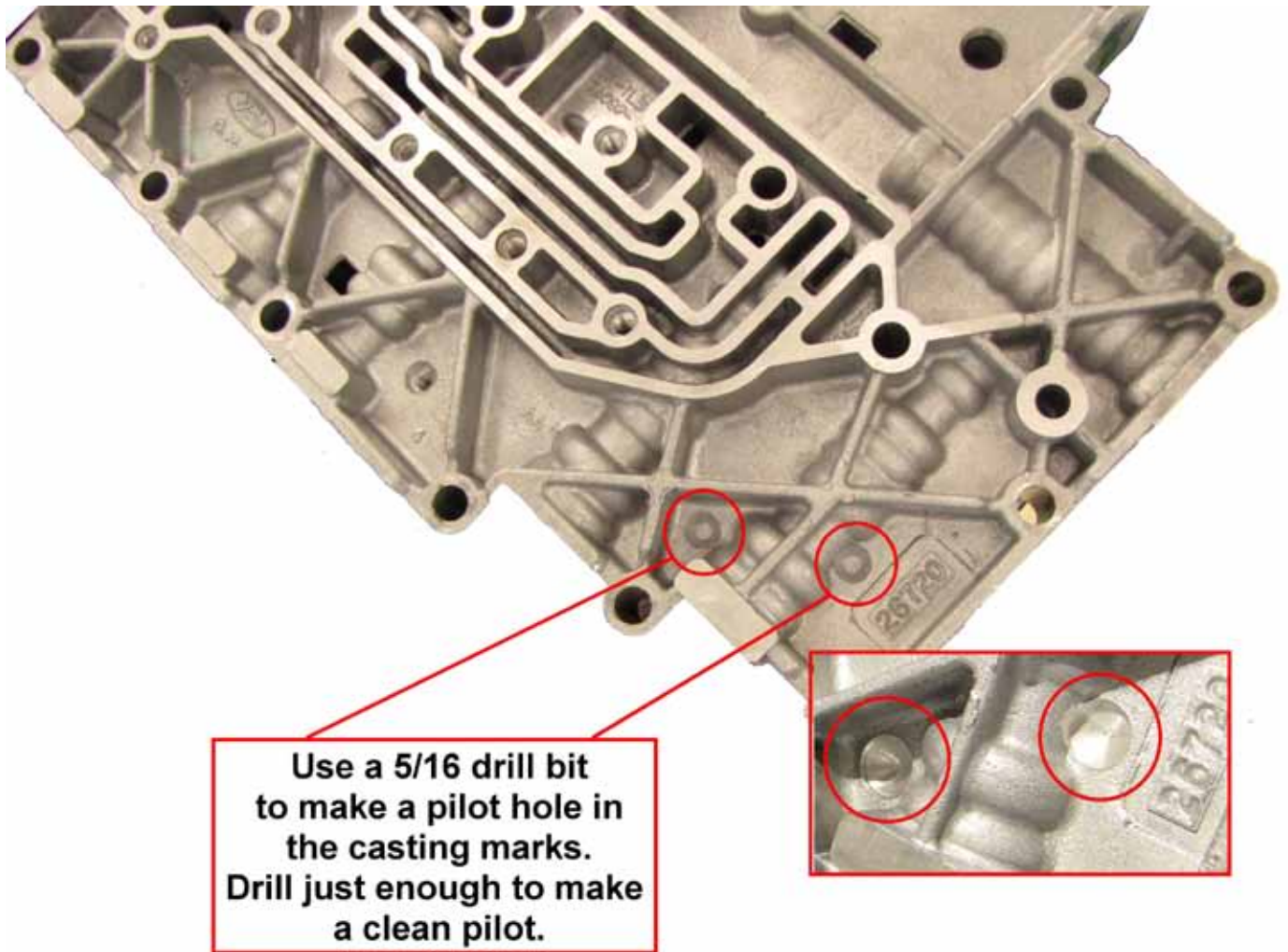
Stock valve body without reinforcement plate

Stock valve body with modified reinforcement plate



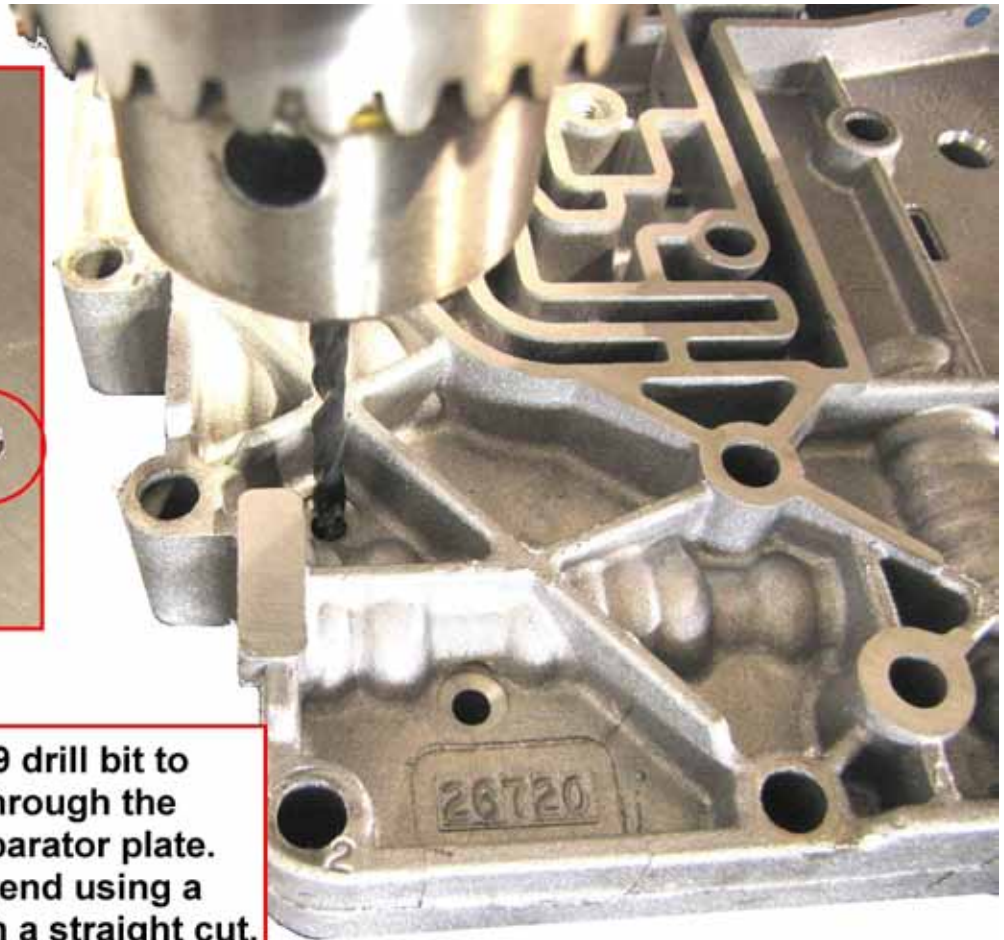
4R70W/4R75E 2001- On

Falling Out of Gear at a Stop (continued)



4R70W/4R75E 2001- On

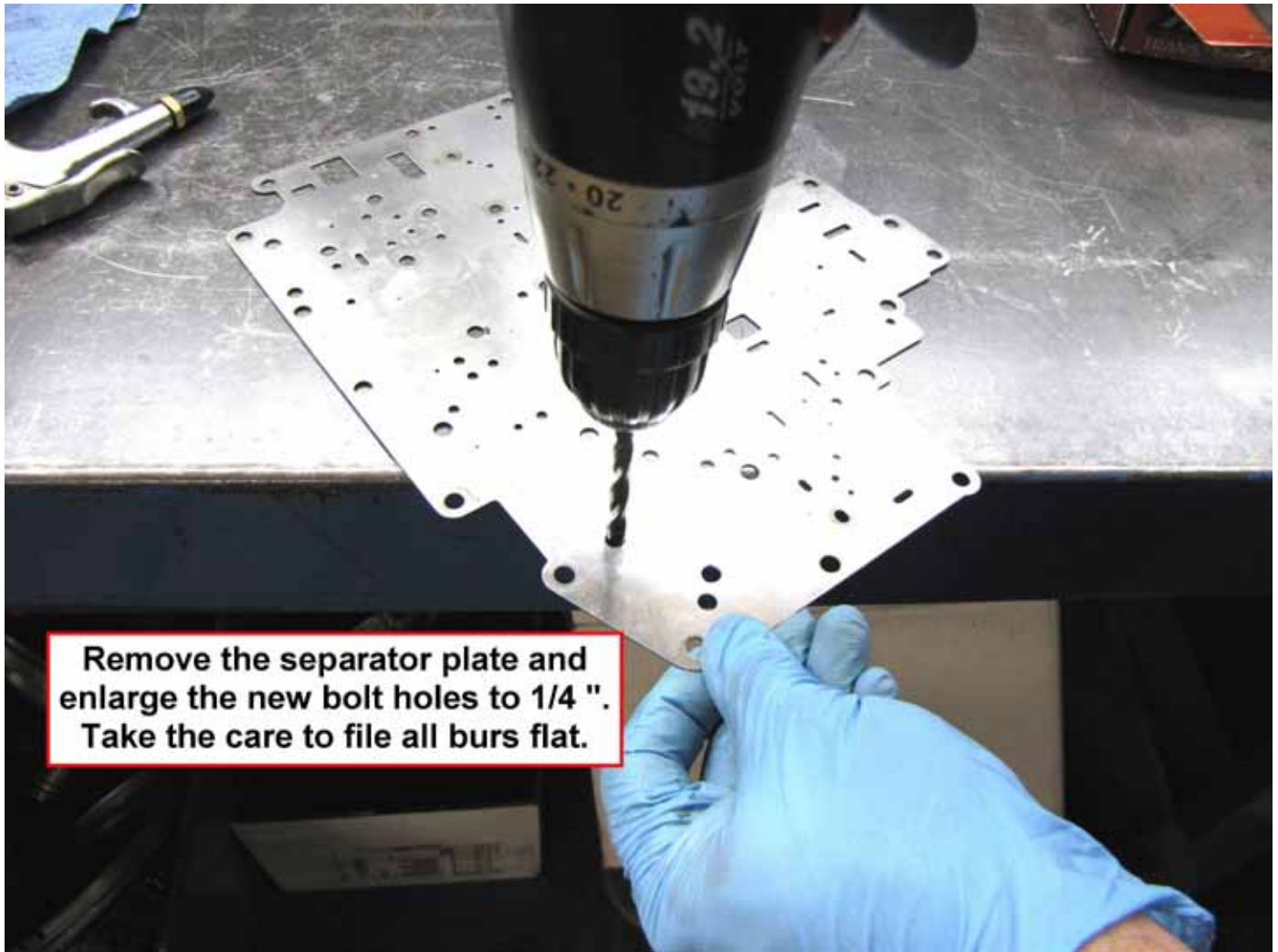
Falling Out of Gear at a Stop (continued)



Use a 13/64" or #9 drill bit to drill all the way through the valve body and separator plate. We highly recommend using a drill press to maintain a straight cut.

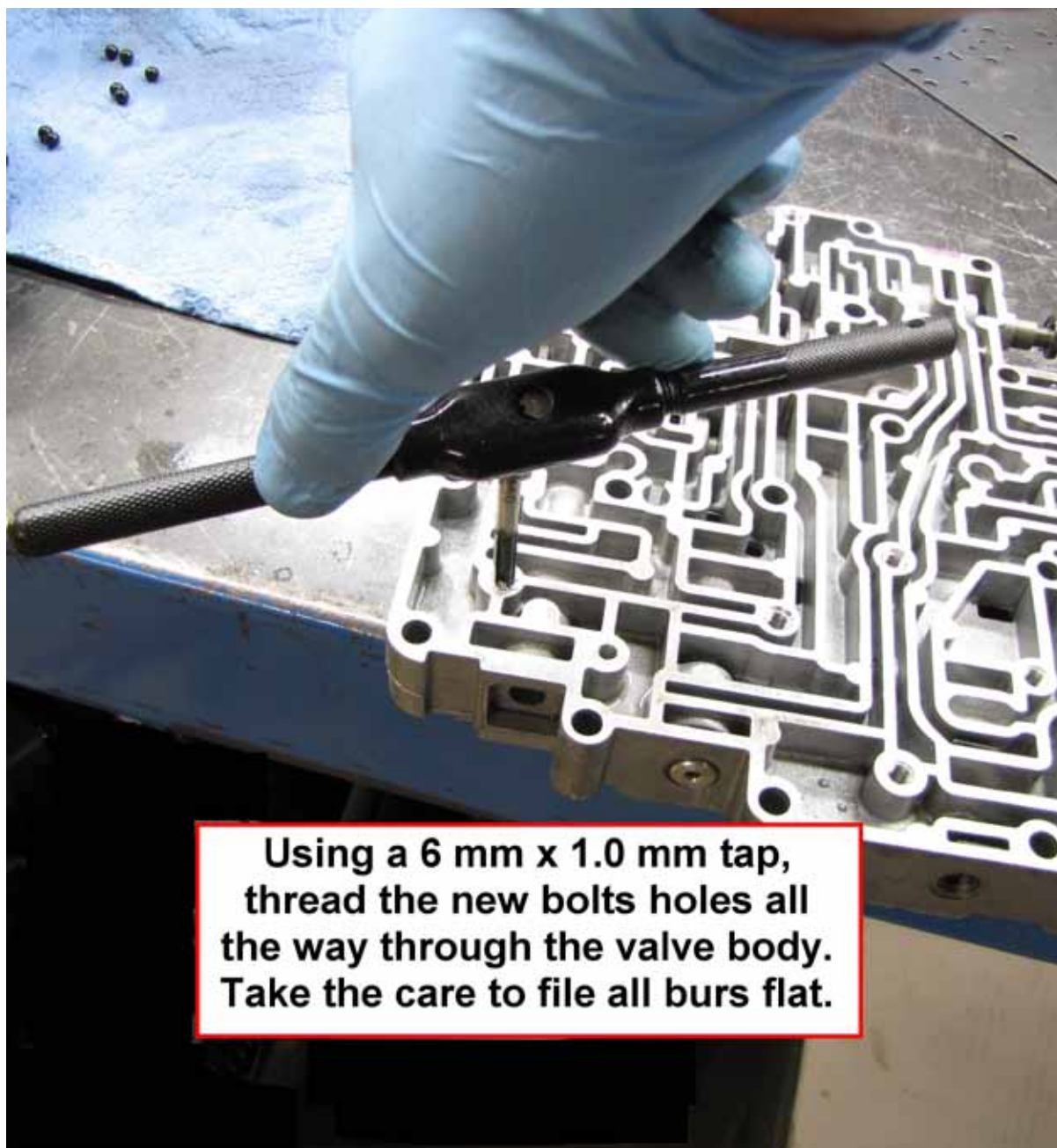
4R70W/4R75E 2001- On

Falling Out of Gear at a Stop (continued)



4R70W/4R75E 2001- On

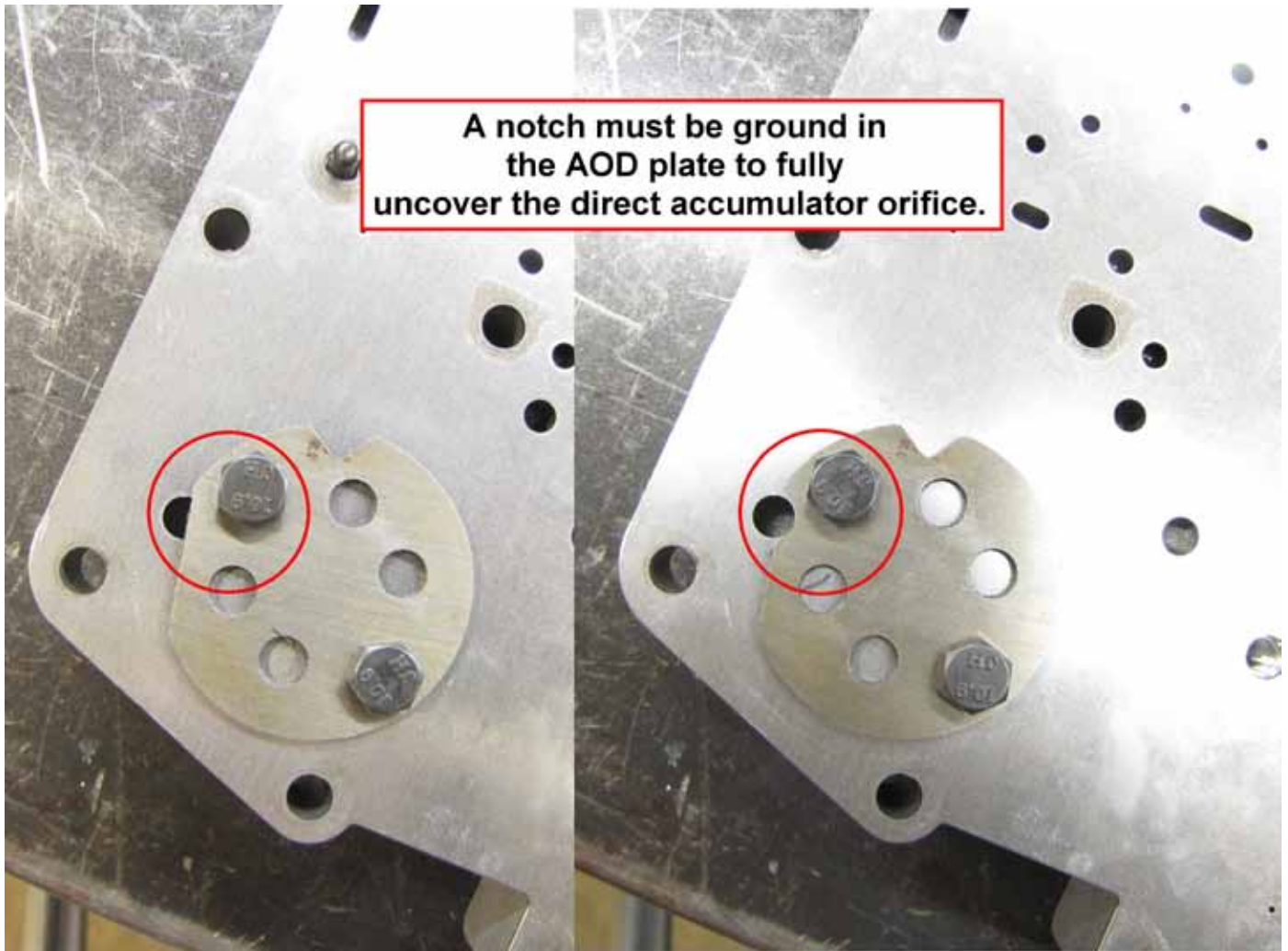
Falling Out of Gear at a Stop (continued)



4R70W/4R75E 2001- On

Falling Out of Gear at a Stop (continued)

Use the bolts and reinforcement plate from an AOD.





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AW55-50SN

Pressure Control Solenoid Service

The following pages cover SLT (Line Pressure), SLS (Shift Pressure) and SLU (Lockup) solenoid servicing and adjustment during and after overhaul. Though these valve bodies have severe problems with wear, often times small bumps and clunks can be cured by cleaning and adjusting these solenoids. We highly recommend using an aftermarket calibration kit that contains the necessary components to fully dismantle the solenoids for cleaning.

Bench Service:

- Remove the adjustment detent clip at the tip of the solenoid.
- Measure the height of the adjustment screw and record measurements.
- Unscrew the adjuster.
- Remove the regulating valve and inspect for any signs of wear.
- When installed without the spring, the valve should move freely when shook.
- Reassemble the solenoid using the original height measurements.



Measure distance
before disassembly

AW55-50SN

Shift Pressure Control Solenoid (SLS)

Solenoid Duties:

- Reverse engagement
- All upshifts and downshifts
- The solenoid works with the shift pressure control plunger only. It is pulsed to control the feed rate of the clutch apply oil dependent on load.

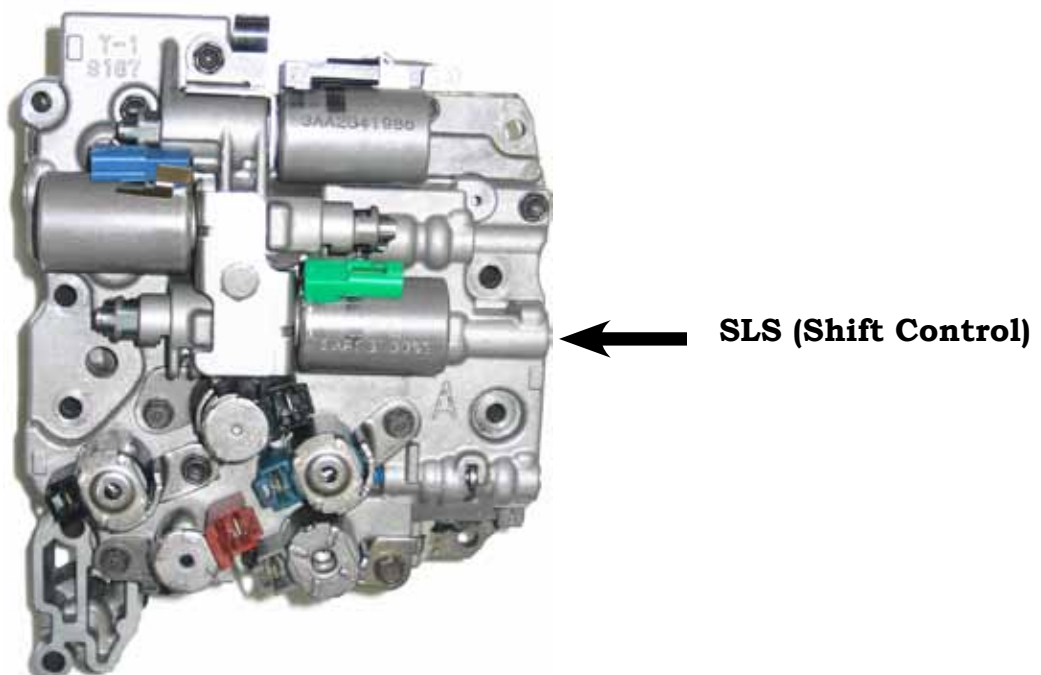
SLS Adjustments in the Vehicle:

- Turning the adjustment in (clockwise):
 - Decreases delay in reverse
 - Firms up all shifts (felt more on the 1-2 shift)
 - Helps repair 2-3 flair **NOTE: Proper band adjustment is crucial to 2-3 shift feel. Confirm adjustment before adjusting solenoid.**
 - Helps repair slight flairs on the 3-4 and 4-5 upshifts

CAUTION: Adjusting the SLS Solenoid too far in can cause a loss of TCC.

- Turning the adjustment out (counterclockwise):
 - Softens harsh reverse
 - Softens upshifts (felt more on the 1-2 shift)
 - Helps with forced 3-2 flair

CAUTION: Solenoid adjustments should never exceed 2 turns in or out.



AW55-50SN

PWM Lockup Solenoid (SLU)

Solenoid Duties:

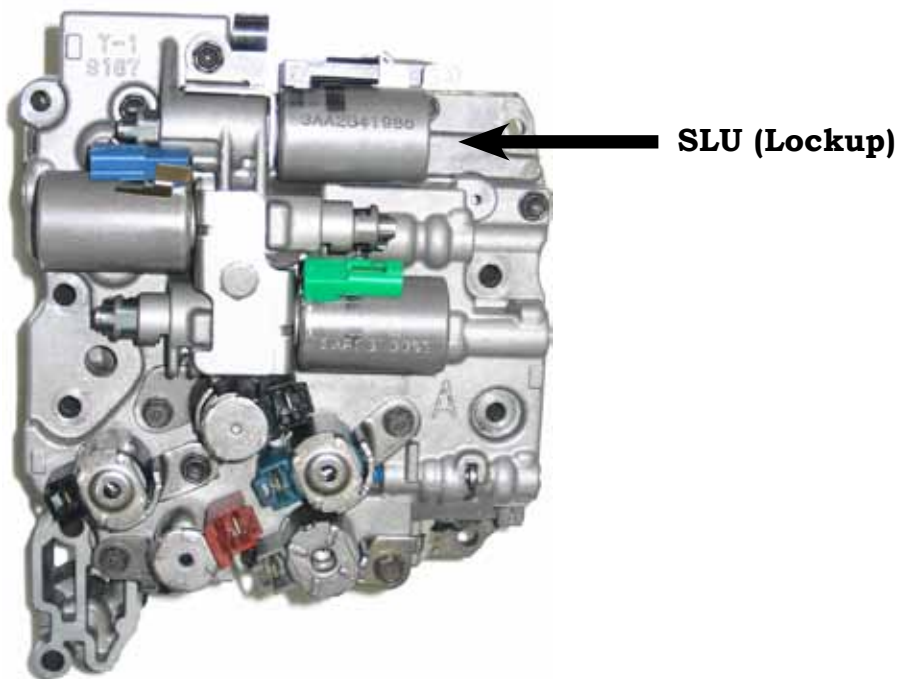
- 1-2 upshift feel
- 2-1 downshift feel
- TCC apply rate
- TCC release rate
- This solenoid works against the TCC valves for lockup rate of apply, and works the B-2 and B-5 control valves to control shift feel during the 1-2, 2-1, 2-3 and 3-2 shifts.

SLU Adjustments in the Vehicle:

- Turning the adjustment in (clockwise)
 - Increases firmness of the 1-2 upshift
 - Increases firmness of the 2-1 downshift resulting in a clunk
 - Increases TCC firmness
- Turning the adjustment out (counterclockwise)
 - Softens 1-2 shift feel
 - Reduces 2-1 downshift clunks
 - Softens TCC feel

CAUTION: Solenoid adjustments should never exceed 2 turns in or out.

NOTE: If the 1-2, 2-1 downshifts are OK, do not adjust this solenoid for 2-3 concerns.



AW55-50SN

Line Pressure Solenoid (SLT)

Solenoid Duties:

- Reverse and forward engagement feel
- Overall line pressure
- This solenoid not only works against the pressure regulator valves for line pressure control, but also works the C-1 control valve for forward engagements, the B-1 valve for 1-2/2-1 shifts and the B-4 valve for 2-3 shifts.

SLT Adjustments in the Vehicle:

- Proper SLT adjustments are performed with a 0-100 psi gauge on the SLT pressure tap
- Pressure readings are to be taken while the transmission is in the D position 0-6 psi at idle; 75-80 psi at WOT
- Pressure is increased by turning the adjustment screw in (clockwise)
- Pressure is decreased by turning the adjustment screw out (counterclockwise)
- If pressure is too high:
 - Harsh engagements, especially into D
 - Harsh upshifts
 - Harsh downshifts
 - 2-3 bind
- If pressure is too low:
 - Delayed engagements, especially N-D
 - 2-3 flair
 - Soft upshifts

Note: Proper band adjustment is crucial to 2-3 shift feel confirm band adjustment prior to adjusting the solenoid.

CAUTION: Solenoid adjustments should never exceed 2 turns in or out.

SLT (Line Control)



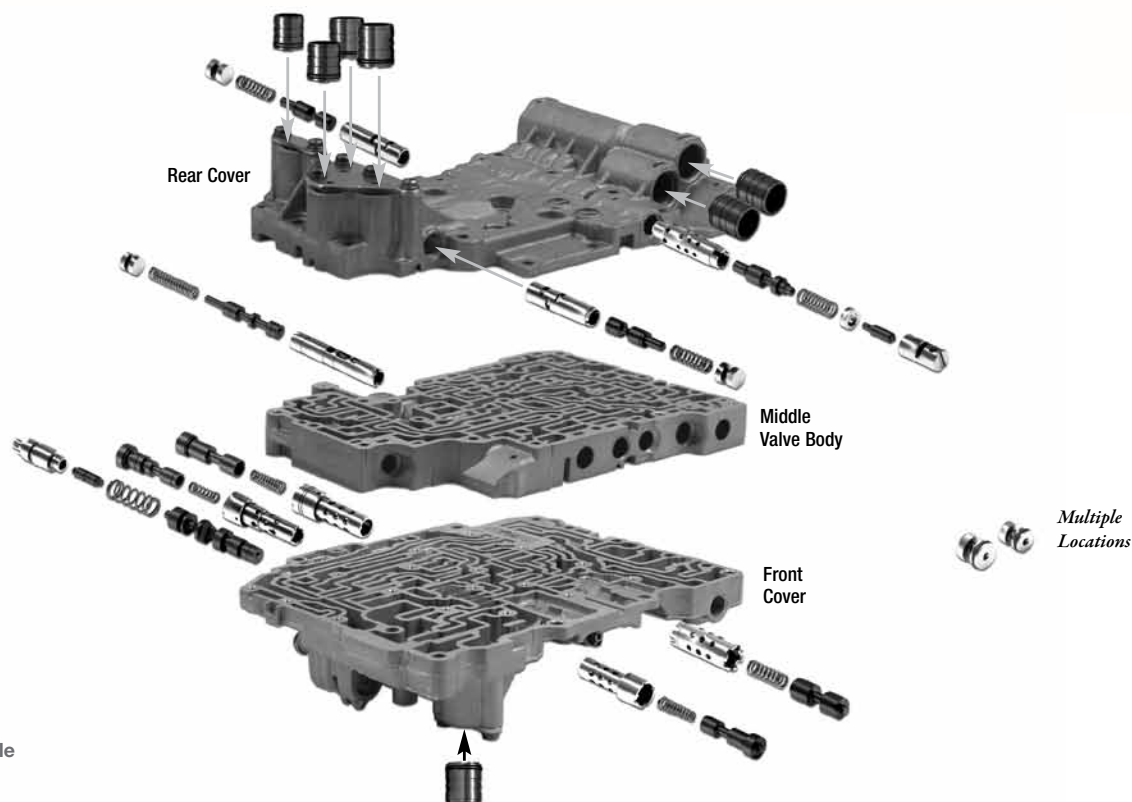
AW55-50SN

SLT Pressure Tap Location

Use a 0-100 psi gauge to monitor pressure at this location while making SLT solenoid adjustments. The pressure reading should be 0-6 psi at idle and 75-80 psi at WOT.



Sonnax AW 6 Speed Valve Body Repair Chart



TF-81SC Valve
Body is Pictured.

Parts for TF-80SC &
TF-60SN are also available
see chart below.

AW 6 SPEED SERIES	
Brand Designations	AW Designations
VW/Audi (09G, 09K, 09M); BMW/Mini (6F21WA)	TF-60SN
Ford (AF21); Mazda (AW6A-EL)	TF-81SC
Volvo (AM6); Opel (AF40); Peugeot (TF-80); Saab (AF40/6); Land Rover (TF-80)	TF-80SC

Part Name	Quantity per Unit	Part Number	Required Tool*	TF-80SC	TF-81SC	TF-60SN
Main Pressure Regulator & Boost Assembly	1	15741-01K	F-15741-TL			✓
K2 Clutch Control Valve Kit	1	15741-05K	F-15741-TL5			✓
K3 Clutch Control Valve Kit	1	15741-08K	F-15741-TL8			✓
Secondary Regulator Valve Kit	1	15741-11K	15741-TL11			✓
Accumulator Piston Kit	5	15741-14K	None	✓	✓	✓
Solenoid Modulator Valve Kit	2	15741-18K	F-15741-TL18 **			✓**
B1 Brake Control Valve Kit	1	15741-22K	F-15741-TL22			✓
C1/K1 Clutch Control Valve Kit	1	15741-25K	F-15741-TL25	✓	✓	✓
Lockup Clutch Control Valve Kit	1	15741-29K	F-15741-TL29 **	✓**	✓	✓**
End Plug Kit	5	15741-35K	None	✓	✓	✓
End Plug Kit	5	15741-36K	None	✓	✓	✓
Main Pressure Regulator & Boost Assembly	1	39741-01K	F-39741-TL	✓	✓	
C2 Clutch Control Valve Kit	1	39741-05K	F-39741-TL5	✓	✓	
C3 Clutch Control Valve Kit	1	39741-08K	F-39741-TL5	✓	✓	
Secondary Regulator Valve Kit	1	39741-11K	F-39741-TL11	✓	✓	
Solenoid Modulator Accumulator Piston Kit	2	39741-14K	None		✓	
Solenoid Modulator Valve Kit	2	39741-18K	F-39741-TL18	✓	✓	
B1 Band Control Valve Kit	1	39741-22K	F-39741-TL22	✓	✓	

*All "F-tools" require the use of the VB-FIX reaming fixture (not required for 15741-TL11). **F-15741-TL29PL Adapter Plate is required for TF-60SN & TF-80SC.



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AW55-50SN

In-Car Solenoid Adjustment

Use the following instructions to make a test pan that can be temporarily installed after overhaul to make solenoid adjustments without having to take the pan on and off for every adjustment.

During the test drives, simply cover the holes with duct tape or rubber plugs to minimize leaking and when the desired shifts are met, reinstall the original pan.



SLS Adjustment



SLU Adjustment



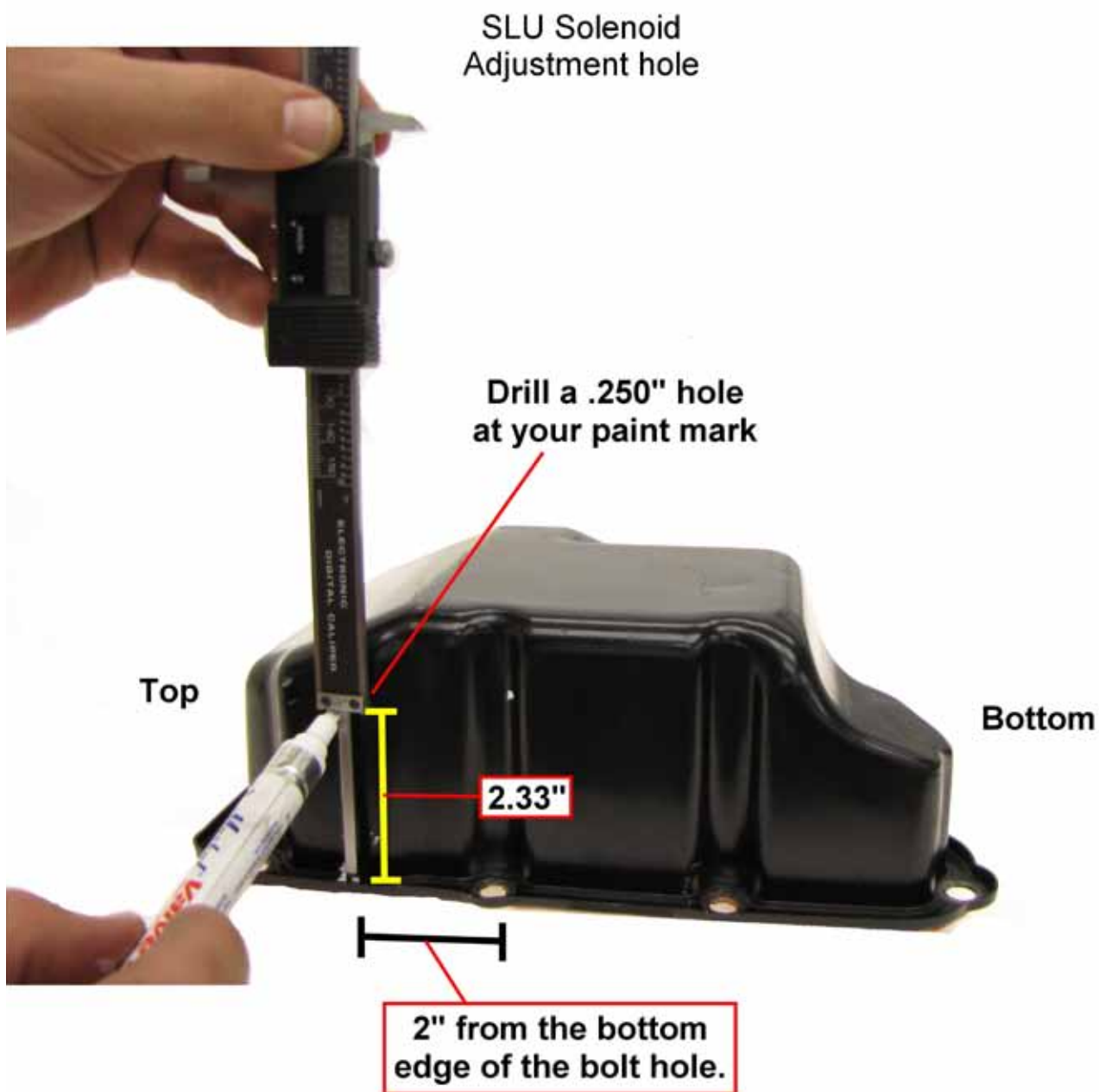
SLT Adjustment

A Special Thanks to Sonnax for the information.

AW55-50SN

In-Car Solenoid Adjustment (continued)

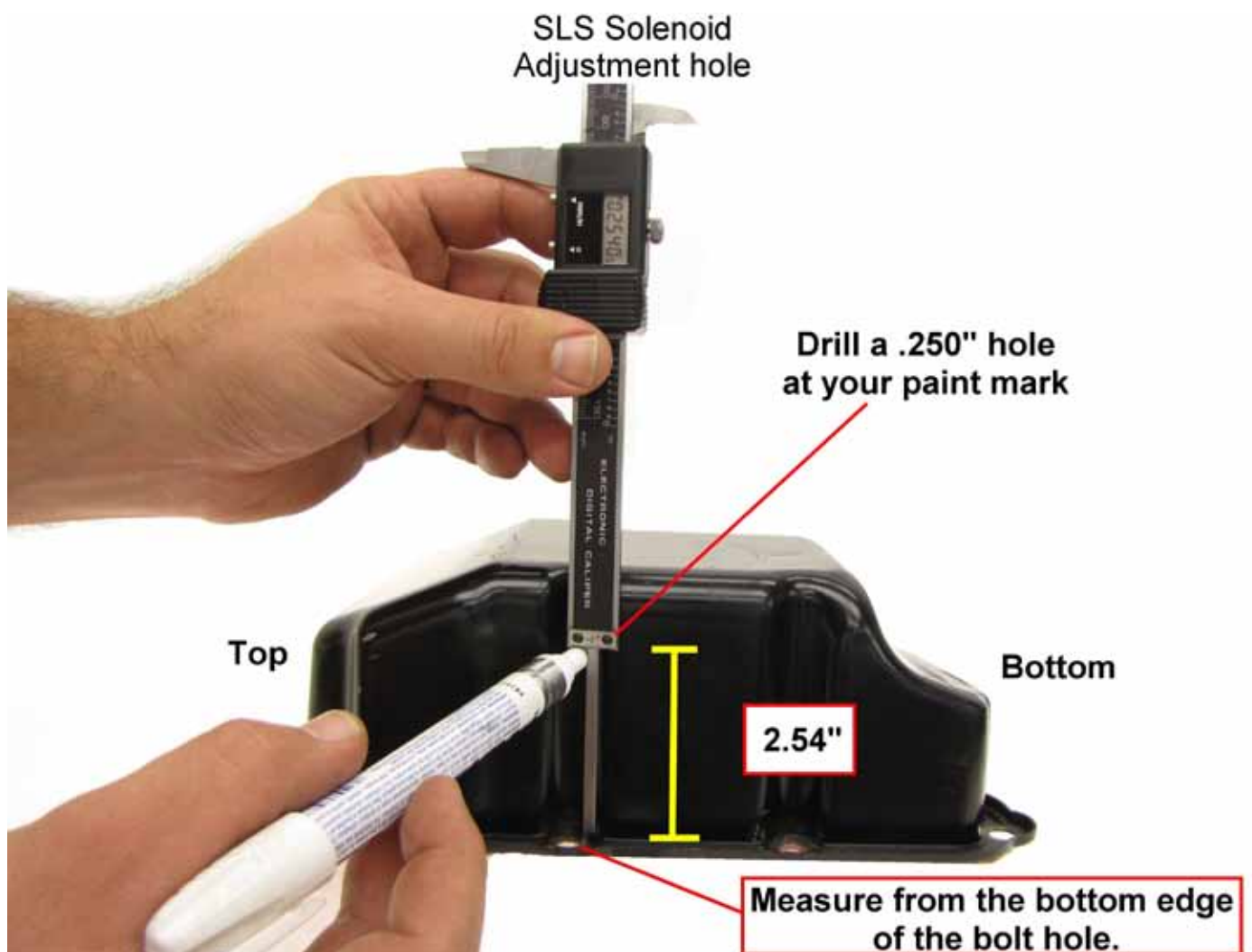
Use a core pan as your test tool. Clean all debris from the pan and make sure it is not damaged. Use a paint style marker to mark points of entry. Use the illustration below for the SLU solenoid adjustment location.



AW55-50SN

In-Car Solenoid Adjustment (continued)

Using the same paint style marker, use the illustration below for the SLS solenoid adjustment location.

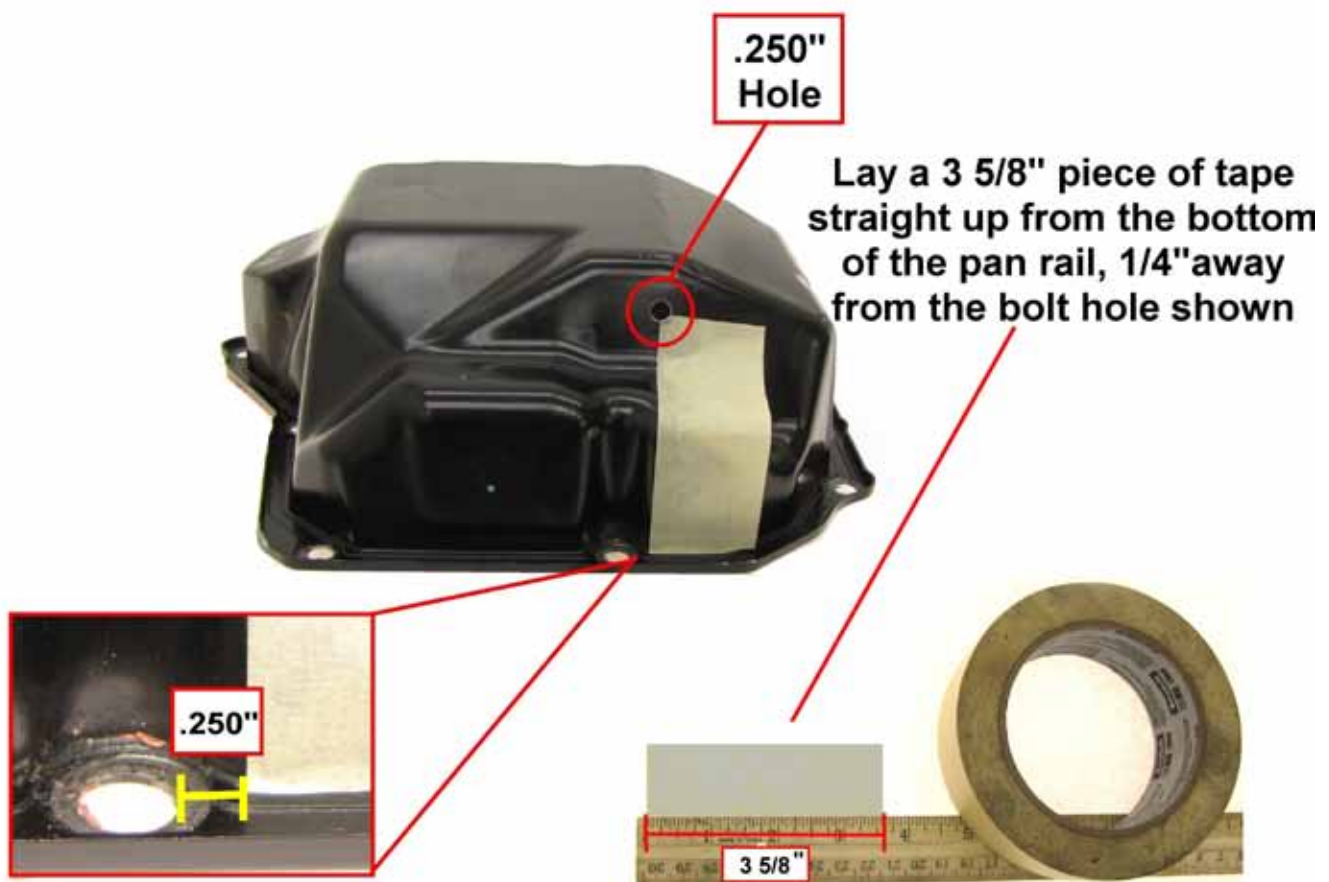


AW55-50SN

In-Car Solenoid Adjustment Pan (continued)

Using the same paint style marker, use the illustration below for the SLT solenoid adjustment location.

SLT Solenoid
Adjustment hole



AW55-50SN/AF33-23/RE5F22A

2-3 Flare After Overhaul

A 2-3 flair is a common complaint after overhaul. Usually the flair can be associated with valve body wear and pressure related issues. The third gear band clearance can also contribute to the flair condition. Install the servo and band anchor with the case half removed and adjust the servo travel to 0.250". The servos are selectable.

The servos shown are for all AW55 applications except Nissan



RE5F22A

2-3 Flare After Overhaul (continued)

Nissan Only



No Grooves
2.508"
Nissan# 31615 8Y005



1 Groove
2.528"
Nissan# 31615 8Y004



2 Grooves
2.547"
Nissan# 31615 8Y003



3 Grooves
2.567"
Nissan# 31615 8Y002



4 Grooves
2.587"
Nissan# 31615 8Y001

AW55-50SN/AF33-23/RE5F22A

2-3 Flare After Overhaul (continued)

All Others



Nissan



Nissan

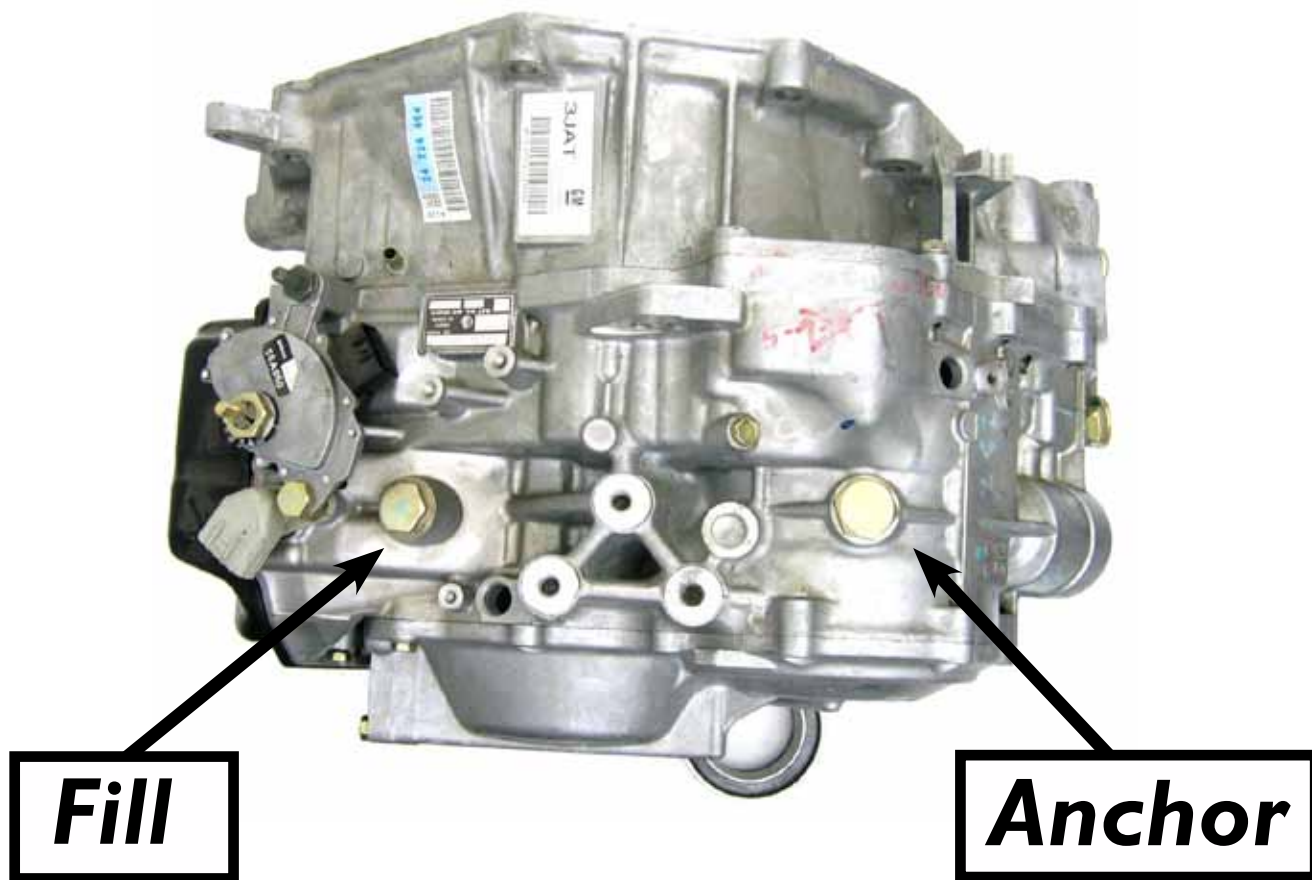


AW55-50SN/AF33-23/RE5F22A

Slips/No 3rd After Repair

The AF 23-5 used in the Saturn Ion and the AF 33-5 used in the Saturn Vue, Chevrolet Equinox and Buick Torrent applications may experience a slipping complaint or a no 3rd gear concern after the transmission fluid has been serviced or after an internal repair has been performed.

The technician may have removed the wrong bolt to adjust the unit's fluid level. If the technician removed the 3rd gear band anchor bolt instead of the fill bolt, it may allow the anchor to fall out of place leading to the concern. If the technician has removed the wrong bolt, the transmission will need to be disassembled to correct the concern.



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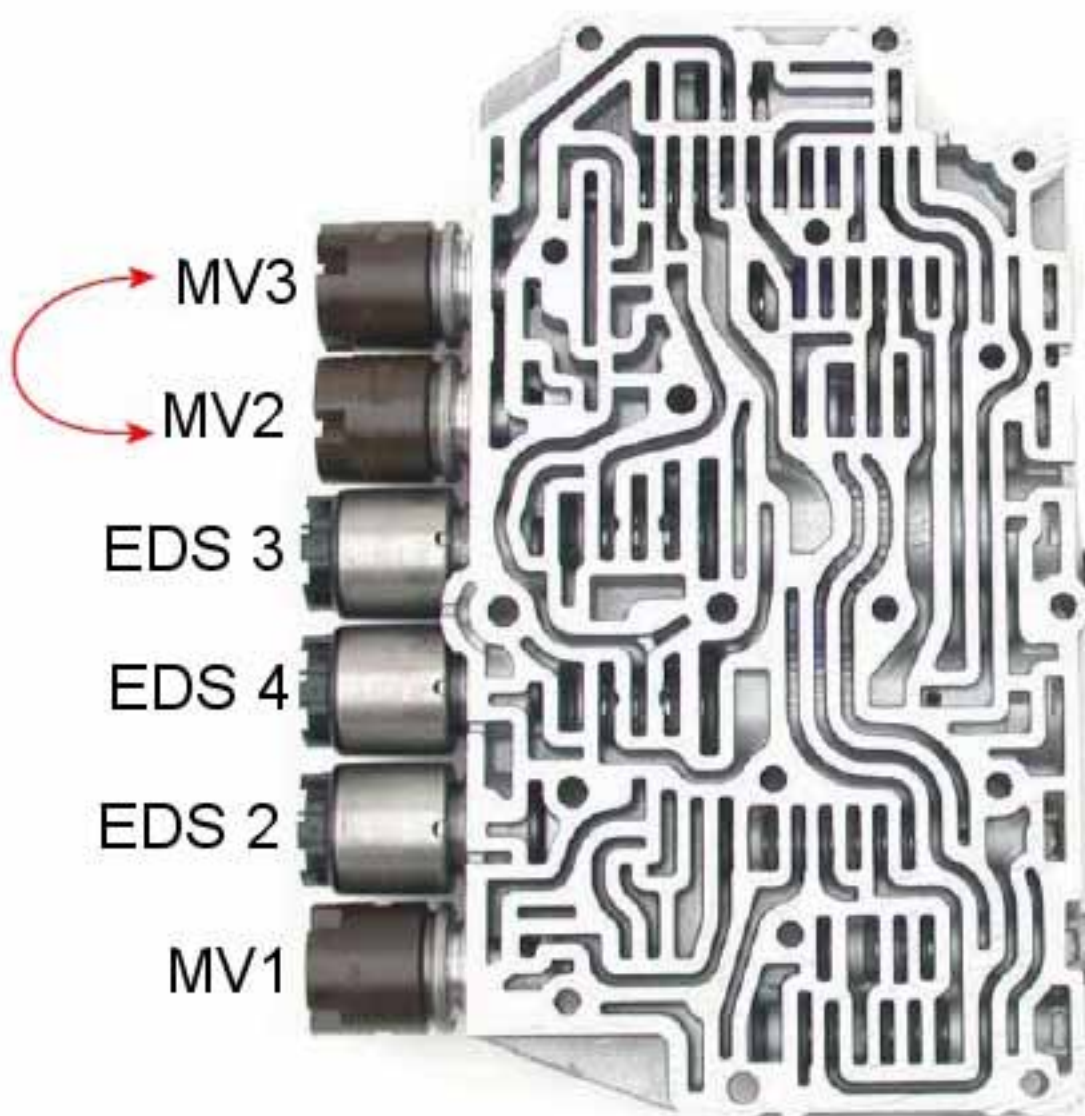
www.valvebodypros.com

16870 Joleen Way, Suite 4, Morgan Hill, California 95037

ZF5HP19/19FL

No Reverse After Overhaul

A ZF5HP19 experiencing a no reverse after overhaul may be caused by a faulty MV2 (N89) solenoid. The first step is to unplug the transmission harness. If reverse applies, it may be a bad tiptronic switch or inhibitor switch. If reverse fails to engage, switch the MV2 (N89) and MV3 (N90) solenoids with one another as a test. If reverse comes back, but forward problems still occur, switch the solenoids back and replace the MV2 with another solenoid.



ZF4HP22/24

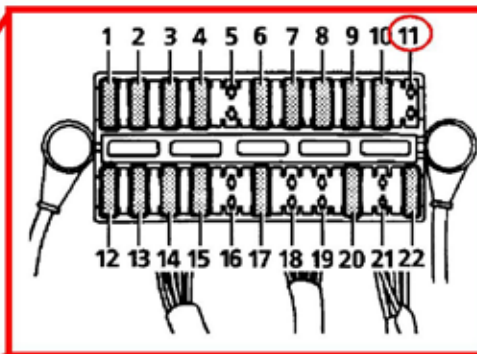
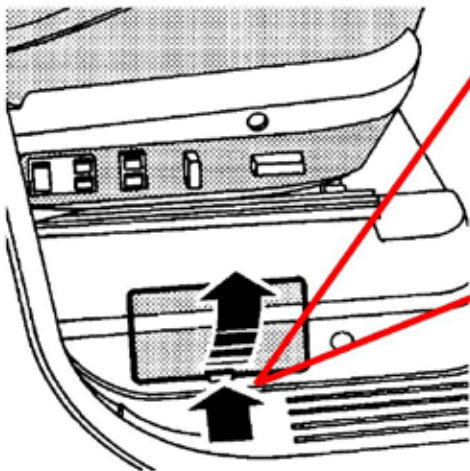
No Movement

A no movement concern after being towed may be caused by a fuse being installed into a transfer case neutral inducing space. The fuse space was designed to allow the vehicle for towing. Check to see if the fuse was installed, remove the fuse and test drive the vehicle. Fuse 11 is located on the right side fuse box. The message center will read "Transfer Neutral" when the fuse is installed.

1995-2002 Range Rover uses fuse 11

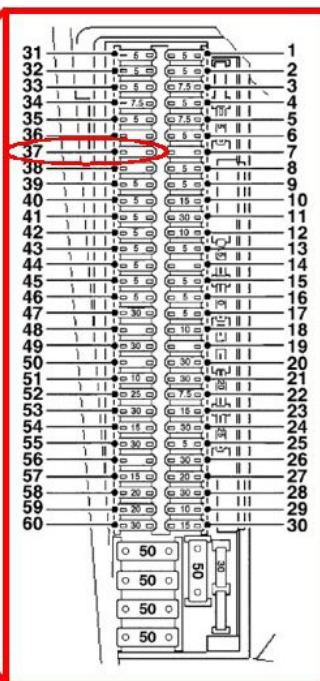
2003-up Range Rover uses fuse 37

**1995-2002
Range Rover**



A fuse in the #11 location will command the transfer case to neutral.

**2003-Present
Range Rover**

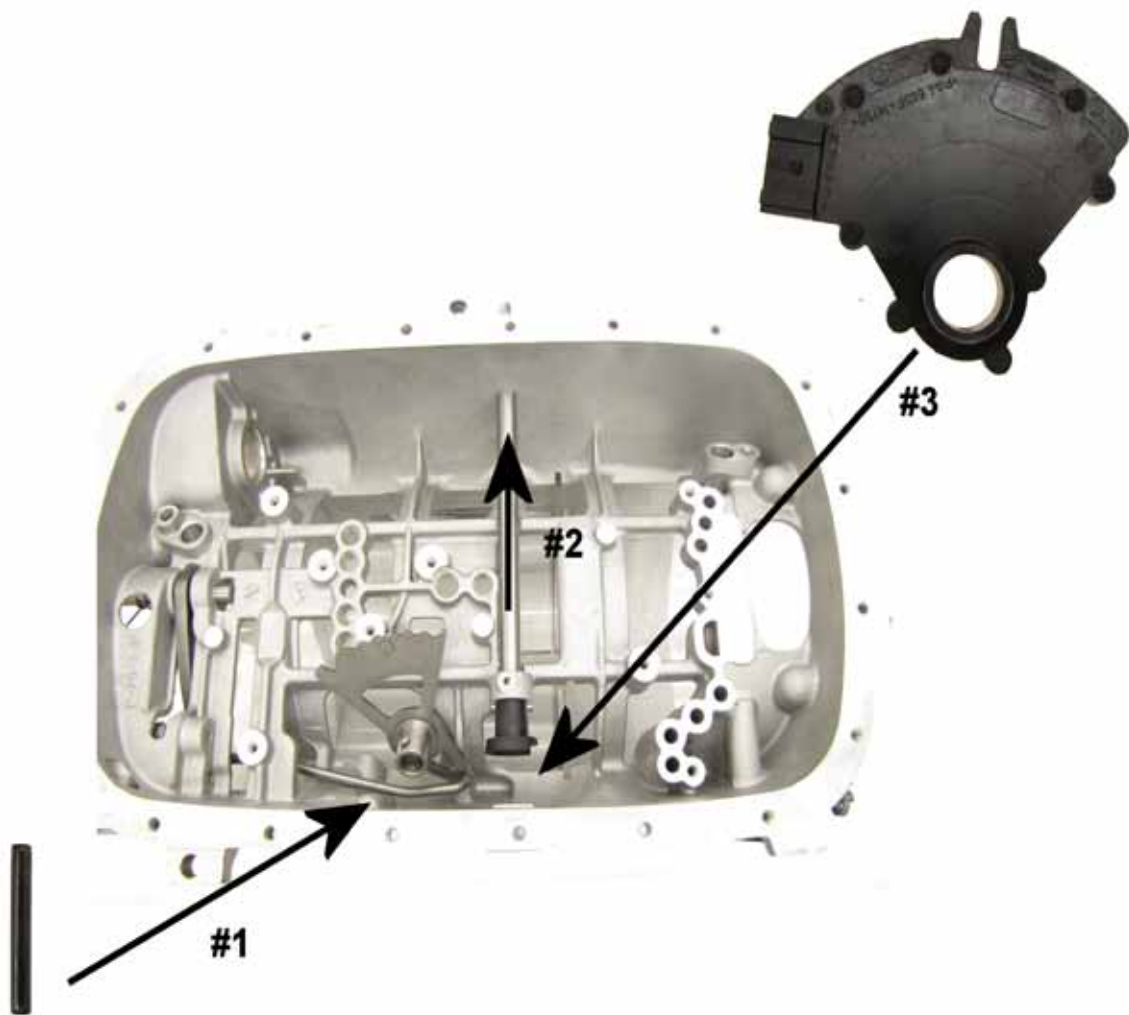


A fuse in the #37 location will command the transfer case to neutral.

5L40E

Intermittent and/or No Reverse

A 5L40E experiencing an intermittent no reverse may be caused by a faulty Internal Range Sensor most common in BMW vehicles. Use scanner data to see if range sensor readings are correct. If the transmission goes into reverse when the main connector is unplugged, reverse is being electronically inhibited. Replacing the Range Sensor will repair this concern.



1. Remove the roll pin.
2. Carefully slide the manual shaft out of the rooster comb/range sensor assembly.
3. Remove and replace the range sensor.

RE4F04A

Chirp Noise During the 2-3 Shift

1999-2000 Nissan Quest or Altima with a RE4F04A transmission may experience a chirp type noise coming from the transmission during the 2-3 shift at light throttle.

This chirp noise may be coming from the high clutch assembly. Adding two (200cc each) bottles of ATF Treatment to the transmission fluid will correct this problem. Nissan's ATF treatment part number is 31003-31X61P.



Caution! This is a metallic container and it is packed in oil absorbent material. Be sure to wipe the bottle clean to prevent ATF contamination.

RE5F22A

CKP and/or CAM Sensor Code

2004 & up Nissan Maximas with the RE5F22A transmission may be experiencing codes for the Crank and/or Cam sensor causing the transmission to go into failsafe. There will be no communication or codes set in the transmission module. The problem is usually a broken wire at the sensor. To correct the problem repair the wiring at the connector or replace the sensor.



The Crank Sensor is located under the vehicle between the transmission and engine, attached to the bottom of the bellhousing.

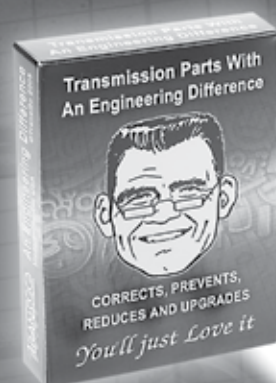
Cam Sensor 1 Bank 1



Cam Sensor 2 Bank 2



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SK® AW55-50



Reduces/Corrects/Prevents

Delay or Bang into Drive
4-3 and 3-2 Coast Clunk
2-3 or 3-4 Cutloose
4-3 or 3-2 KD Runaway
Converter Slip/Shudder

Saves Cost of New Valve Body

Fits: 2001-08 Volvo, 2004-08 Nissan RE5F22A
AF33-5 - 2002-08 Saab - 2003-04 Saturn
05-06 Chevrolet Equinox - Pontiac Torrent



SK® 09D



Reduces/Corrects/Prevents

Rough shifts, flares during up shifts & kick down. Rough coast downshifts, no pressure rise, TCC slip/shudder.

Fits: VW Touareg/ Porsche Cayenne



SK® AWF21



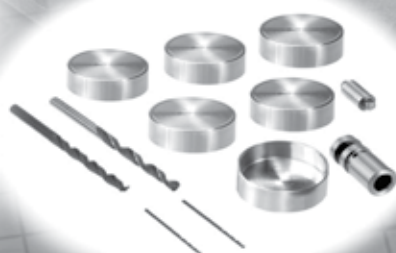
Reduces/Corrects/Prevents

Rough shifts, Bump-Bump downshifts above 30 mph hot, Part throttle downshift bang, Flares during up-shifts & kick-down, Rough coast downshifts. No pressure rise, TCC slip/shudder. Poor shift quality.

Fits: 05-06 Ford Fusion & 500, 05-06 Mazda 6
06 Lincoln Zephyr, 06 Mercury Milan,
05-06 Mercury Montego



SK® 09G



Reduces/Corrects/Prevents

Harsh Shifts, Cut Loose, Rough Coasting Downshifts, Slow Pressure Rise, TCC Slip

Fits: Audi A2, A4 06 2.0L, Audi TT 03-04 1.8L
BMW Mini Clubman 08 1.6L
BMW Mini Cooper 02 1.6L
VW Beetle 05 1.8-2.5L, Jetta 05 1.9-2.5L
Passat 06 2.0L & 3.6L, Touran 03 1.6-2.0L

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01M, 096, 01P

Bind in Reverse and 2nd Gear Starts

01M, 096, 01P New Beetle, Jetta, Eurovan vehicles with a bind in reverse and 2nd gear starts may be caused by the B2 clutch support not being indexed properly.

The notch in the support must key into the alignment “leg” at the 5 o'clock position on the center support. Once the pump is tightened, make sure the differential can be turned in the reverse direction.



The notch in the support must key into the alignment “leg”.

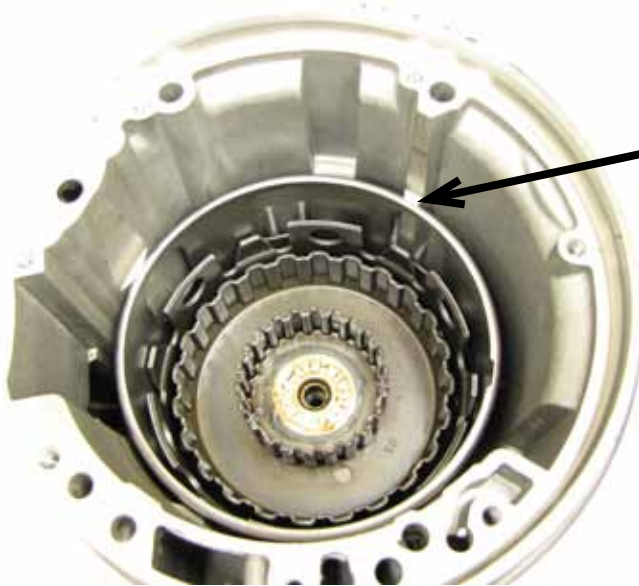
01M, 096, 01P

Bind in Reverse and 2nd Gear Starts (continued)

The reason this problem is so common is the clutch assemblies must be installed before the support tube is installed. When the technician installs the support tube, they have to slide it down against the case and it's impossible to see whether it's seated on the snap ring instead of on the alignment "leg". Another way a builder can tell the B2 clutch support tube is all the way down, is to install the support without the clutch packs installed. Make sure the support is down all the way. Place a reference mark in the case in line with the upper edge of the support tube. During reassembly, make sure the reference mark is visible. If not, the support tube is not down all the way.

If the vehicle still binds in Reverse after overhaul, try unplugging the transmission connector. If it backs up, the TSS and OSS wiring is probably installed backwards. If the vehicle still binds in Reverse with the wiring unplugged, turn off the engine.

Attempt to push the car backwards. If you cannot push the vehicle backwards the B2 clutch is mechanically stuck on.



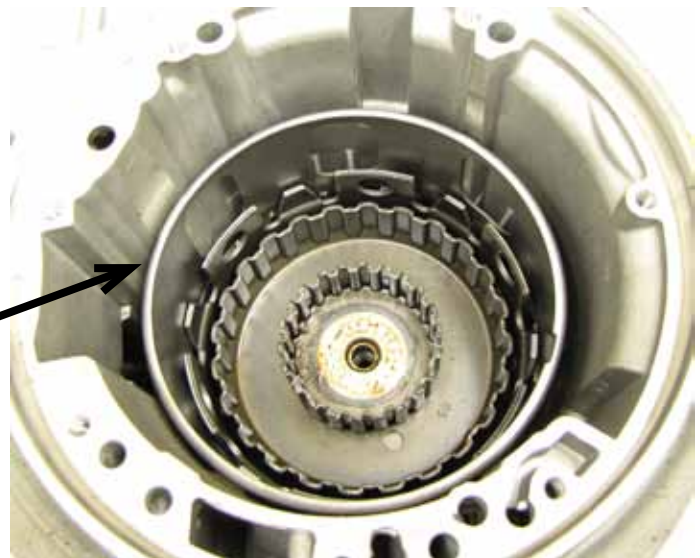
RIGHT!

The support is indexed correctly. A mark can be made on the case to easily identify the correct depth in the case.

NOTE: The input drum assembly has been left out for ease of illustration.

WRONG!

The B2 clutch support is NOT indexed correctly note the index mark is not visible.



01M, 09A

Staying in Neutral

A staying in Neutral (TCM commanded) problem with no codes that could effect 2001-2003 VW Jetta vehicles may be caused by the brake light bulbs or the brake switch. The brake light system is directly related to TCM function. Make sure to check the brake lights prior to diagnosing this concern. Replace the bulbs or brake switch if necessary.

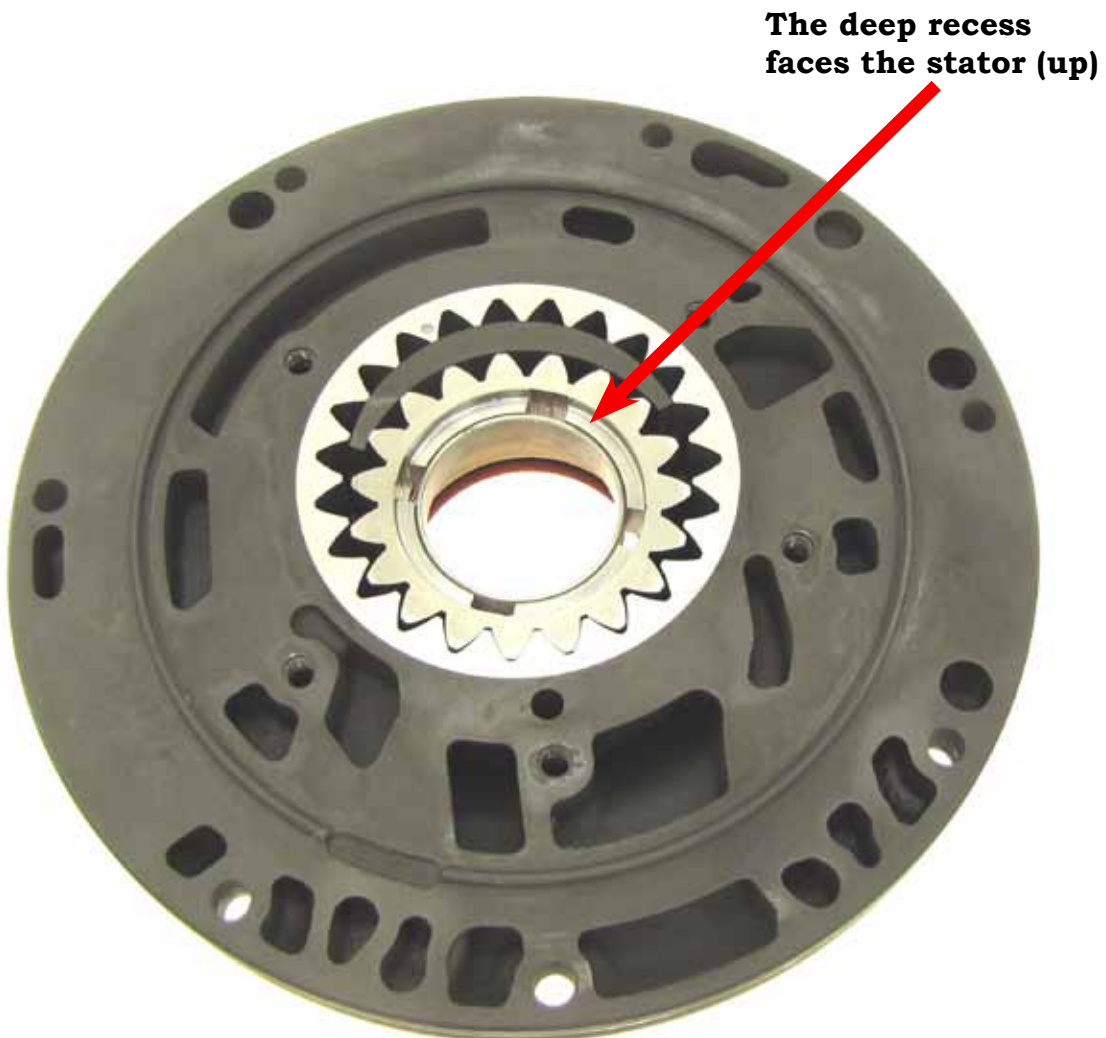


01M

TCC Slip Code 1192

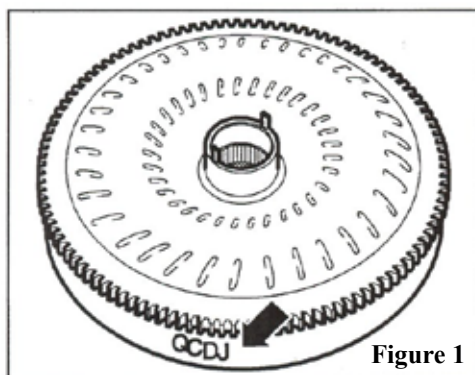
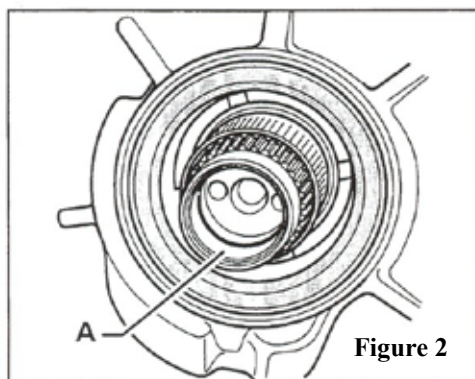
Code 1192 may be caused by installing the inner pump gear incorrectly. The correct way to install the inner gear is to have the deep recess facing the stator support.

Also make sure the correct torque converter is used. Some vehicles built after 2000 used a needle bearing located in the support converter shell to support the input shaft. The other design did not have a needle bearing on the converter support. Refer to ATRA Bulletin #1090.



01M**TCC Slip Code 1192 (continued)****Technical Bulletin # 1090****Transmission:** 01M**Subject:** Converter Bushing Design**Application:** 2000-up VW**Issue Date:** May, 2007**01M****Converter Bushing Design**

Starting in the model year 2000, some 01M transmissions started using a converter with a needle bearing between the turbine shaft and converter. The converters which include the needle bearing can be identified with D, H or J in the 4th digit of the converter code. See Figure 1.

**Figure 1****Figure 2**

When a converter that includes a needle bearing is used, the bushing at the end of the turbine shaft MUST be removed

01M, JF506E, 09G, ZF5HP19FL

Codes, Erratic Shifts and Adaptive Strategies

Codes, erratic shifts, harsh engagements or any abnormal shift conditions may be caused by a disconnected or dead battery. Make sure no codes are present. Use the appropriate software and scan tool to set the adaptive strategy, throttle setting and/or base settings. Unless the base settings are performed, you may not be able to correct, troubleshoot or diagnose any other issues.



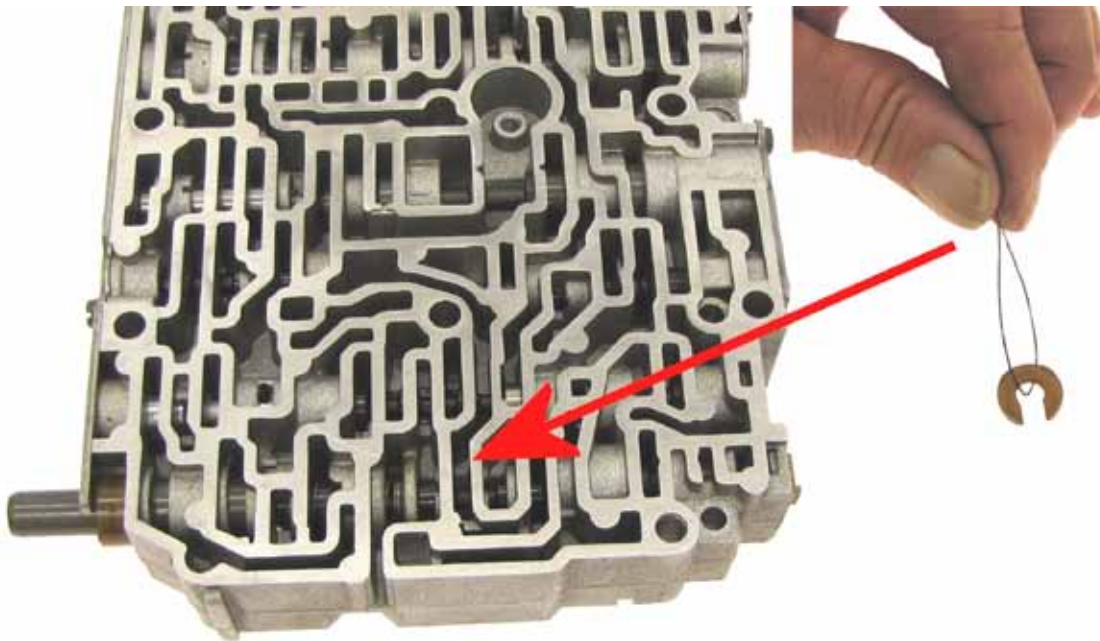
722.3/4/5

Late Shifts

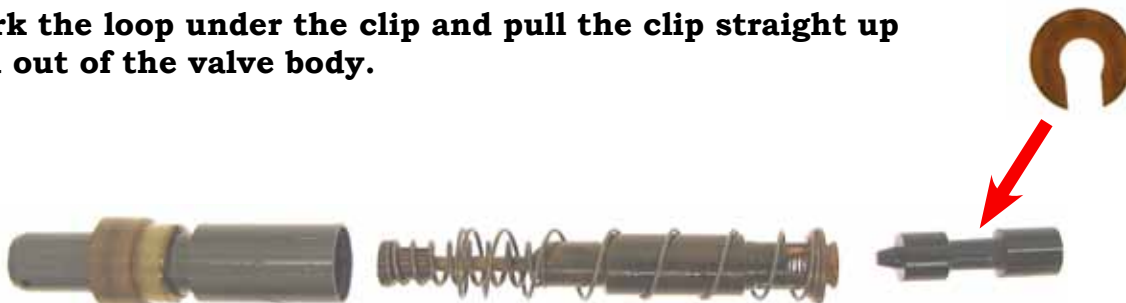
Most late shifts problems on the Mercedes 722.3/4/5 are caused by a sticking throttle valve in the main valve body. It may seem free if you're checking the valve while still in the valve body with a scribe or small screw driver.

You must remove the throttle plunger and throttle valve to verify the valve's movement. You won't be able to see the area where the throttle valve doesn't return to its correct location in the bore. You must remove the plastic throttle valve "E" clip, to gain access to the throttle valve.

The availability of this clip is almost impossible to locate. Luckily there is an easier way to remove the plastic "E" clip without breaking it with the use of fishing line. Thread the line under the clip, then simply pull up on both ends of the fishing line and remove the "E" clip.



Work the loop under the clip and pull the clip straight up and out of the valve body.



F5A42/51

Erratic, Flare, or Harsh 2-3 Upshift or 3-2 Downshift

Hyundai vehicles equipped with the F5A42/51 transaxle may experience an erratic 2-3 shift, 2-3 flare, harsh 2-3 or 3-2 shift. If clearing the adaptive learning does not repair the issue, check for a reflash on the computer.

Note: Prior to adaptive learning and reflashing make sure there are no engine related trouble codes or driveability issues that could interfere with normal transmission operation.

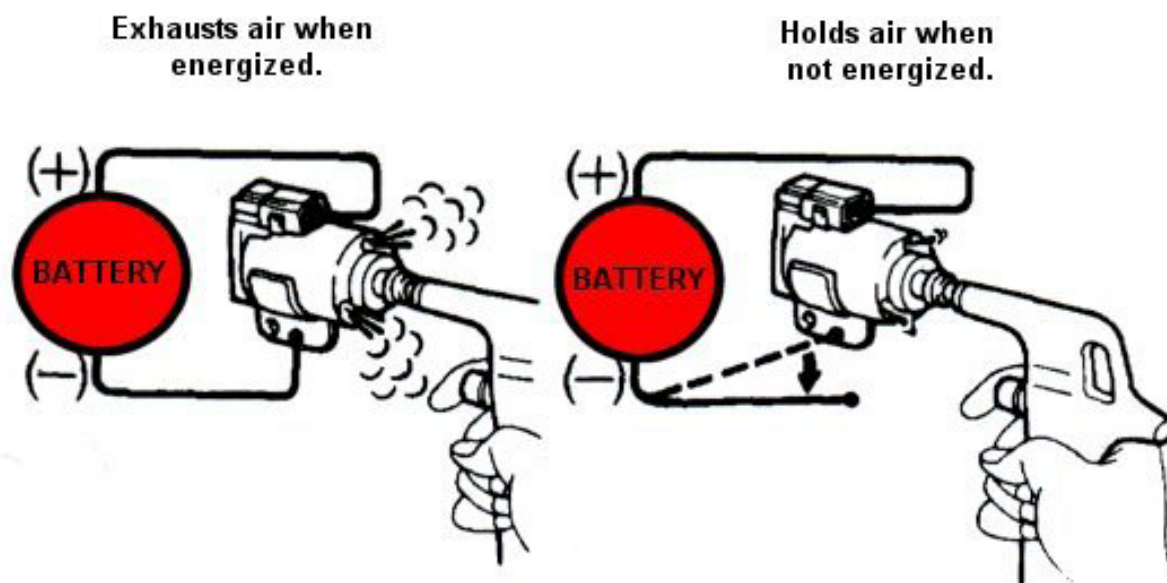
Model	Disconnect the battery, touch the terminals together and press on the brake pedal.	Use the GDS, Hi Scan or equivalent scan tool.
2006-On Azera		X
2001-2004 Elantra	X	
2005-On Elantra		X
2007-On Entourage		X
2001-2004 Sante Fe	X	
2005_On Sante Fe		X
1999-04 Sonata	X	
2005-On Sonata		X
2003-2004 Tiburon	X	
2005-On Tiburon		X
2005-On Tucson		X

A240E Series 1996-On

Code P0770

Code P0770 is a Shift Solenoid SL (TCC) malfunction and/or stuck off. Toyota has done a good job with keeping the lockup system simplified in most of their units. Even though P0770 mentions the TCC solenoid in the definition, rarely is it the problem.

The solenoid is a simple on/off type solenoid that can be tested on the bench by blowing air into the snout of the solenoid while turning the solenoid on and off with voltage. The valve bodies rarely have any issues with bore wear because the TCC valving is a simple on/off, switch valve type system. If the valve moves freely in the bore, then the issue is not likely in the valve body.

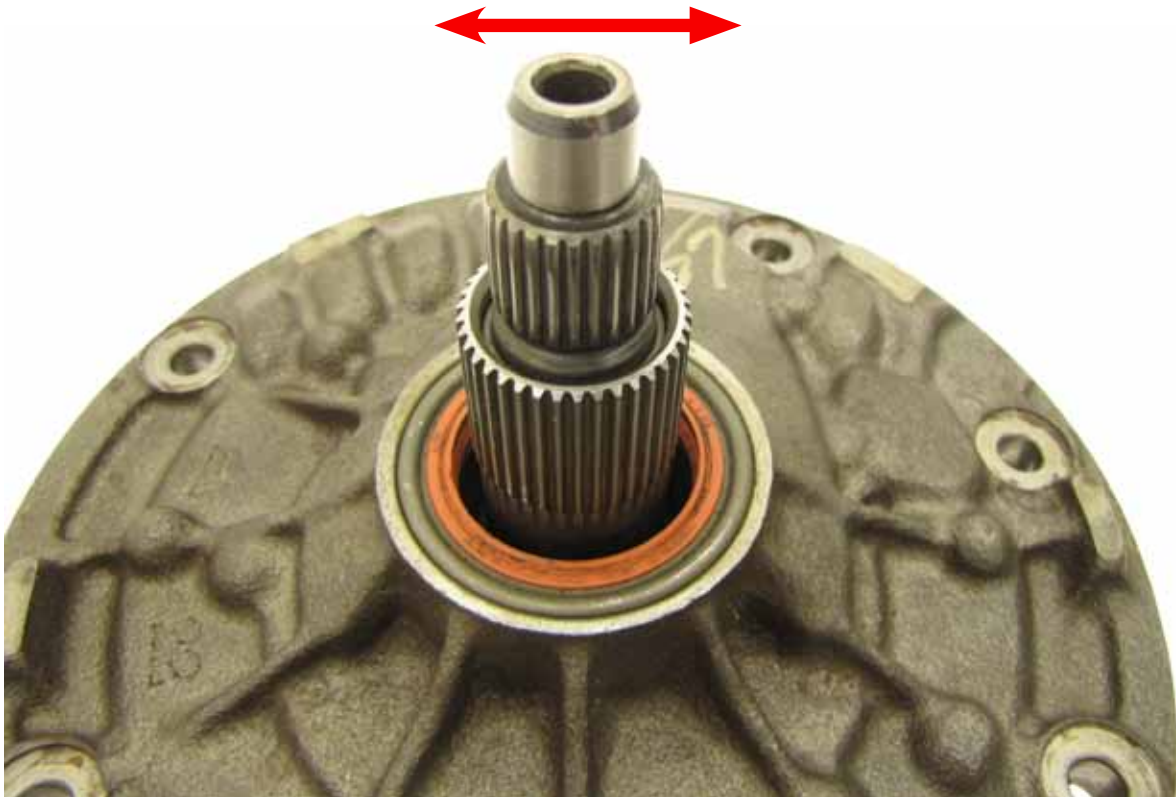


A240E Series 1996-On

Code P0770 (continued)

The most common cause for the P0770 is wear in the front Stator Support Bushing. This can cause premature failure of the lockup clutch. The bushing must have no more than .003" clearance around the input shaft. In most cases of a repeat P0770 code, over .020" of wear has been seen in this area.

Check for wear at the front Stator Support Bushing

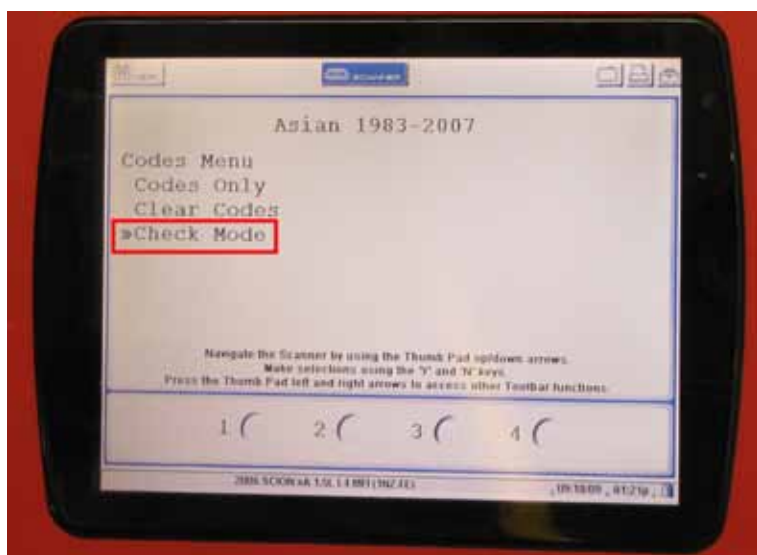


All 1996 and on Toyota

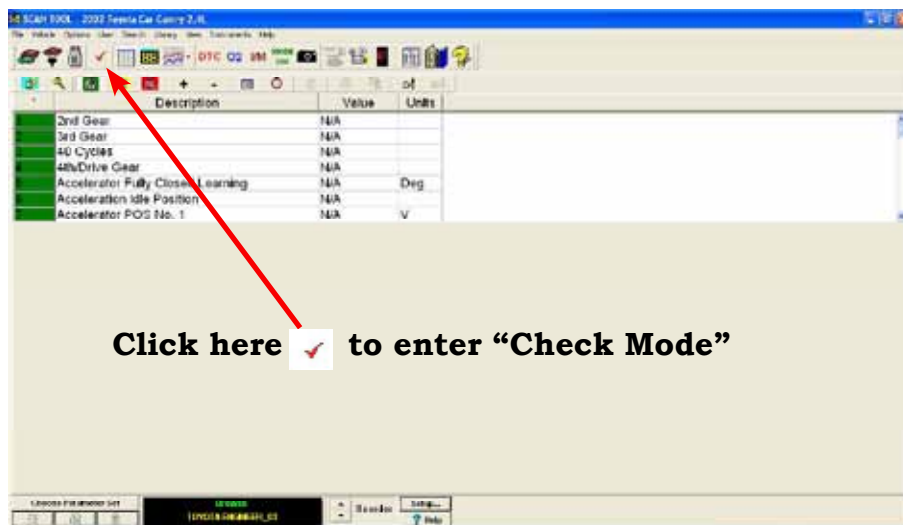
Intermittent P0770 Code/Check Mode

P0770 (Shift Solenoid E performance/stuck off) is a torque converter clutch ratio code. Toyota uses two trip logic for setting the P0770, even if lockup never works, it will take an entire day or two for the code to set. To properly diagnose the P0770, the ECM must be put into “Check Mode” so the code can be switched to one trip logic. Only in “Check Mode” will the computer set the code when the fault is present during the test drive. Consult your scan tool’s user manual to determine if your tool has the function available. Once “Check Mode” is selected the check engine light will flash rapidly to acknowledge “Check Mode” then turn off. The vehicle is now ready to be test driven.

CAUTION: Once “Check Mode” has been chosen, all codes in the vehicles memory will be erased. Make sure to record all code numbers in memory before entering “Check Mode”.



From the main menu select the codes menu to get to the “Check Mode”.



A750E/F

Introduction

A750E



A750E(2WD)/A750F(4WD) Gear Ratios

1st	3.52
2nd	2.042
3rd	1.4
4th	1
5th	0.716
Reverse	3.224

A750E/F Applications Toyota

Year	Model
2003 – 2008	4-Runner
2007 – 2008	FJ Cruiser
2005 – 2008	Sequoia
2005 – 2008	Tundra
2003 – 2007	Land Cruiser
2005 – 2009	Tacoma
Lexus	
2003 – 2007	LX 470
2003 – 2008	GX 470

A750E/F

Application Chart

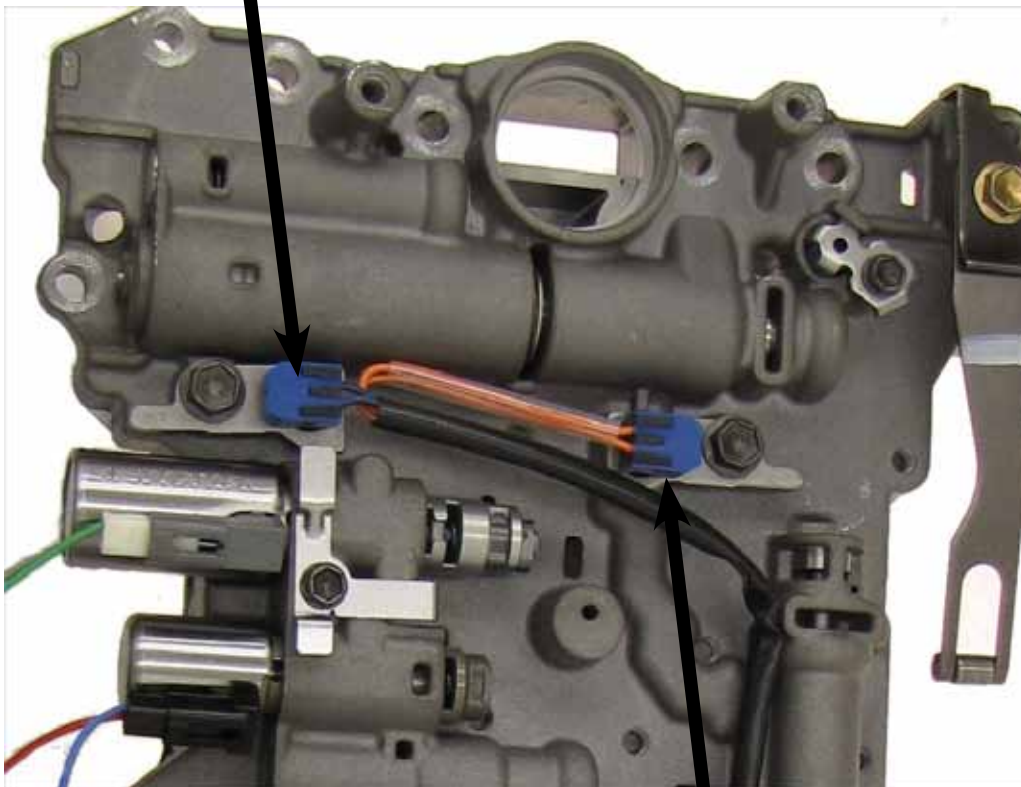
A750E/F Solenoid, Clutch, Brake and One-Way Clutch Application Chart																	
Shift lever position	Gear	Solenoid Valve						Clutch			Brake				One-Way Clutch		
		S1	S2	SR	SL1	SL2	SLU (TCC)	C1	C2	C3	B1	B2	B3	B4	F1	F2	F3
P	Park	ON				ON											
R	Reverse *	ON				ON				X	X			X	X		
N	Neutral	ON				ON											
D	1st	ON				ON		X									X
	2nd	ON	ON			ON		X					X		X	X	
	3rd		ON			ON		X		X			*X*		X		
	4th					ON	ON	X	X	*X*			*X*				
	5th			ON	ON		ON		X	X	X		*X*				
4	1st	ON				ON		X									X
	2nd	ON	ON			ON		X					X		X	X	
	3rd		ON			ON		X		X			*X*		X		
	4th					ON	ON	X	X	*X*			*X*				
3	1st	ON				ON		X									X
	2nd	ON	ON			ON		X					X		X	X	
	3rd *		ON					X		X	X		*X*				
2	1st	ON				ON		X									X
	2nd *	ON	ON	ON				X				X	X				
SHIFT-L Switch "ON"	1st*	ON						X						X			
X: Applied *X*: Applied but is not transmitting power transmission *: Engine Braking																	

A750E/F

ATF Temperature Sensors

This transmission uses two temperature sensors, each with a different function. ATF Temperature sensor #1 is used by the ECM to modify pressure control of the clutches and brakes. If this sensor fails, fifth gear upshifts and flex lockup are prohibited. ATF Temperature sensor #2 is used for shift timing control when the ATF temperature is high.

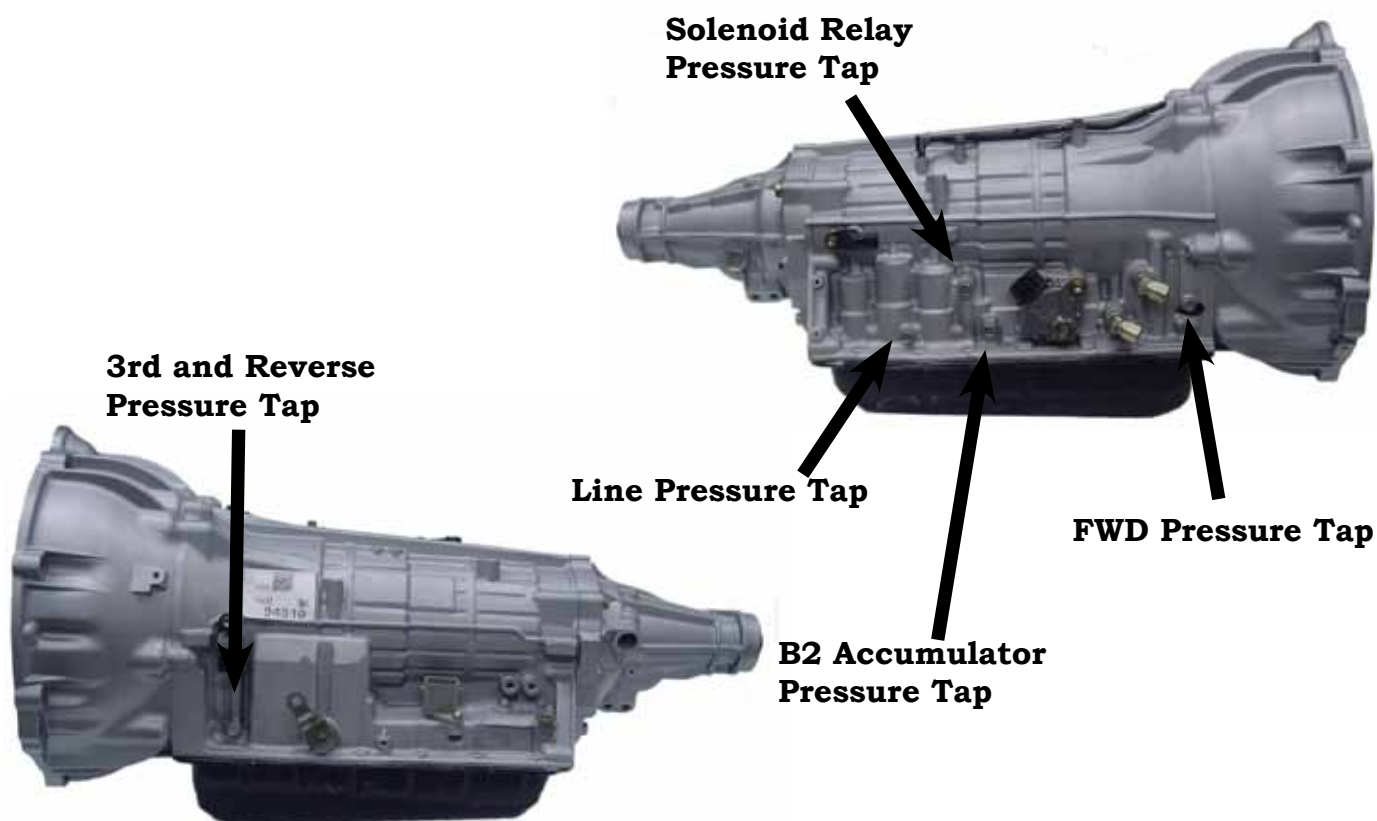
ATF Sensor #2 has two Blue wires



ATF Sensor #1 has two Orange wires

A750E/F

Line Pressure Specifications



A750E/F Line Pressure Specifications		
Condition	D Position	R Position
Idling	53-59 psi	73-84 psi
Stall	196-212 psi	188-205 psi

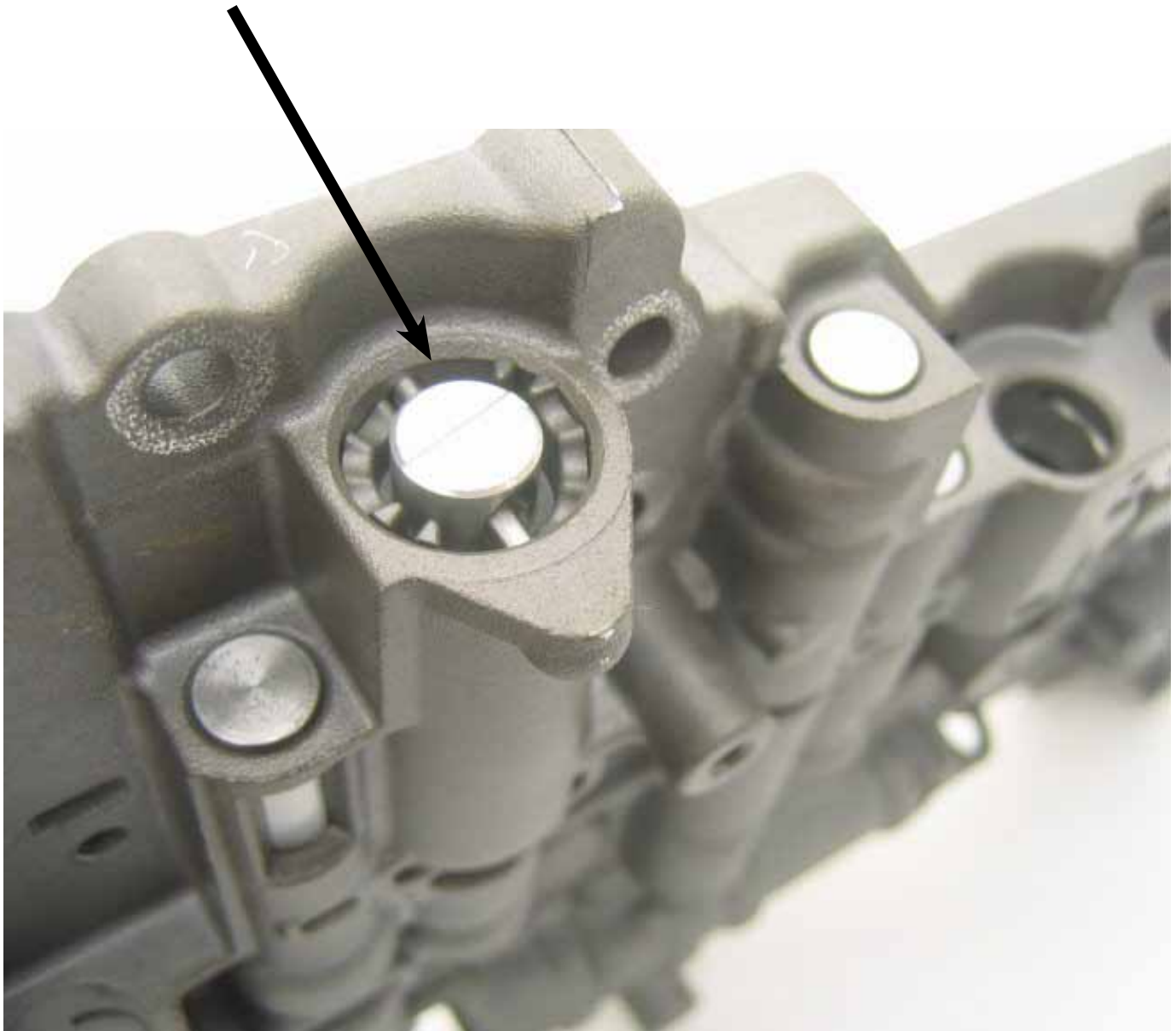
Pressure Evaluation	
Problem	Possible Cause
If pressure is too high in all positions	*Shift Solenoid SLT is defective *Pressure Regulator Valve sticking
If pressure is too low in all positions	*Shift Solenoid SLT is defective *Pressure Regulator Valve sticking *Oil pump is worn
If pressure is low in the D position only	*D position circuit fluid leakage *C1 clutch leakage
If pressure is low in the R position only	*R position circuit fluid leakage *C3 clutch leakage *B4 clutch leakage

A750E/F

Accumulator Control Pressure

Make sure you record the setting prior to removing the accumulator control valve assembly. There is no factory preset specification. From the factory setting, you can turn the stepper in to induce a firm shift feel. Backing the stepper out will induce a softer shift feel.

**Mark the sleeve and the valve body
before you remove the assembly**



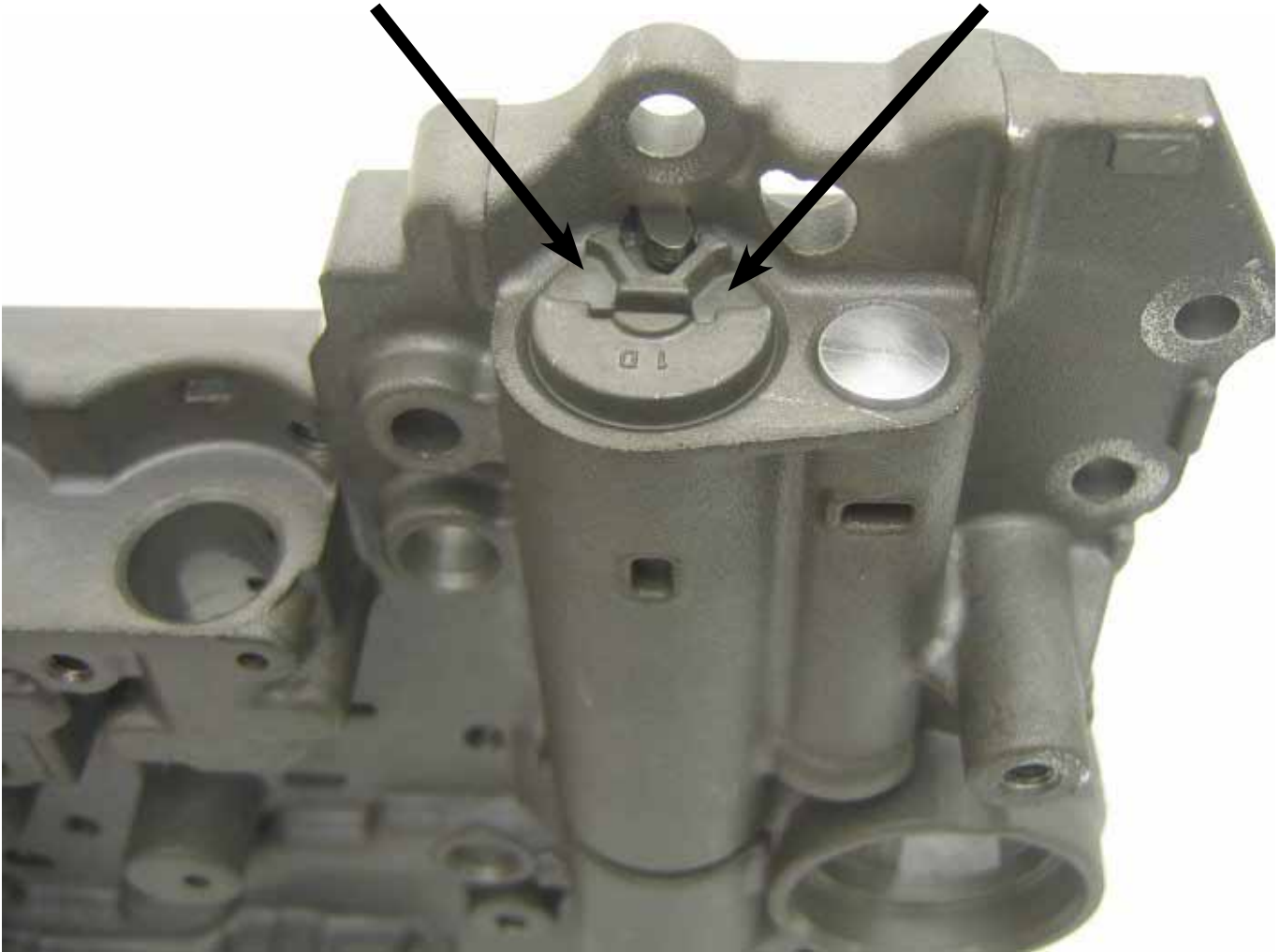
A750E/F

Primary Regulator Valve Setting

Make sure you record the setting prior to removing the Regulator control valve.

**Tallest step will be the
highest base pressure
reading**

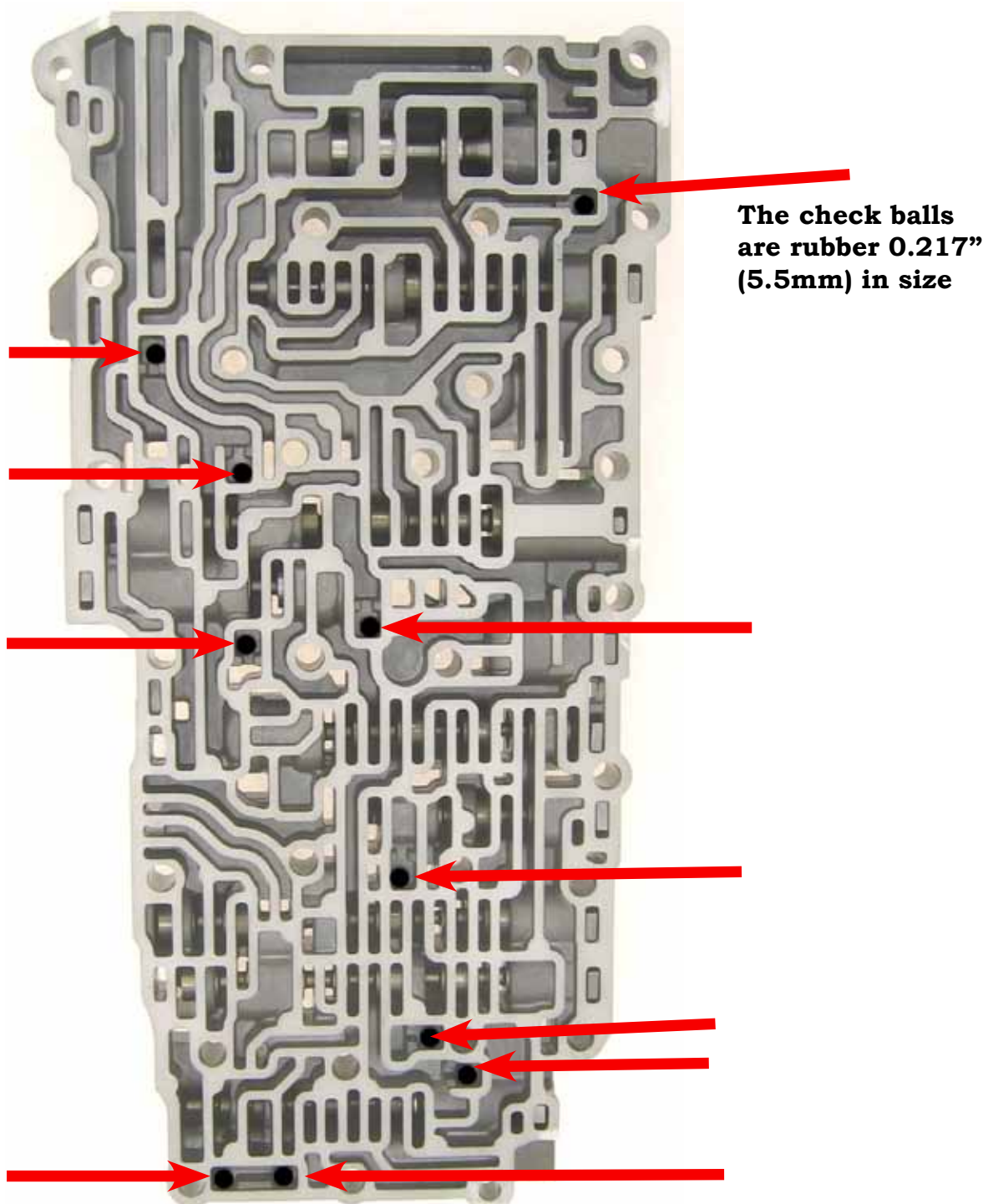
**Shortest step will be the
lowest base pressure
reading**



A750E/F

Upper Valve Body #1 Check Balls

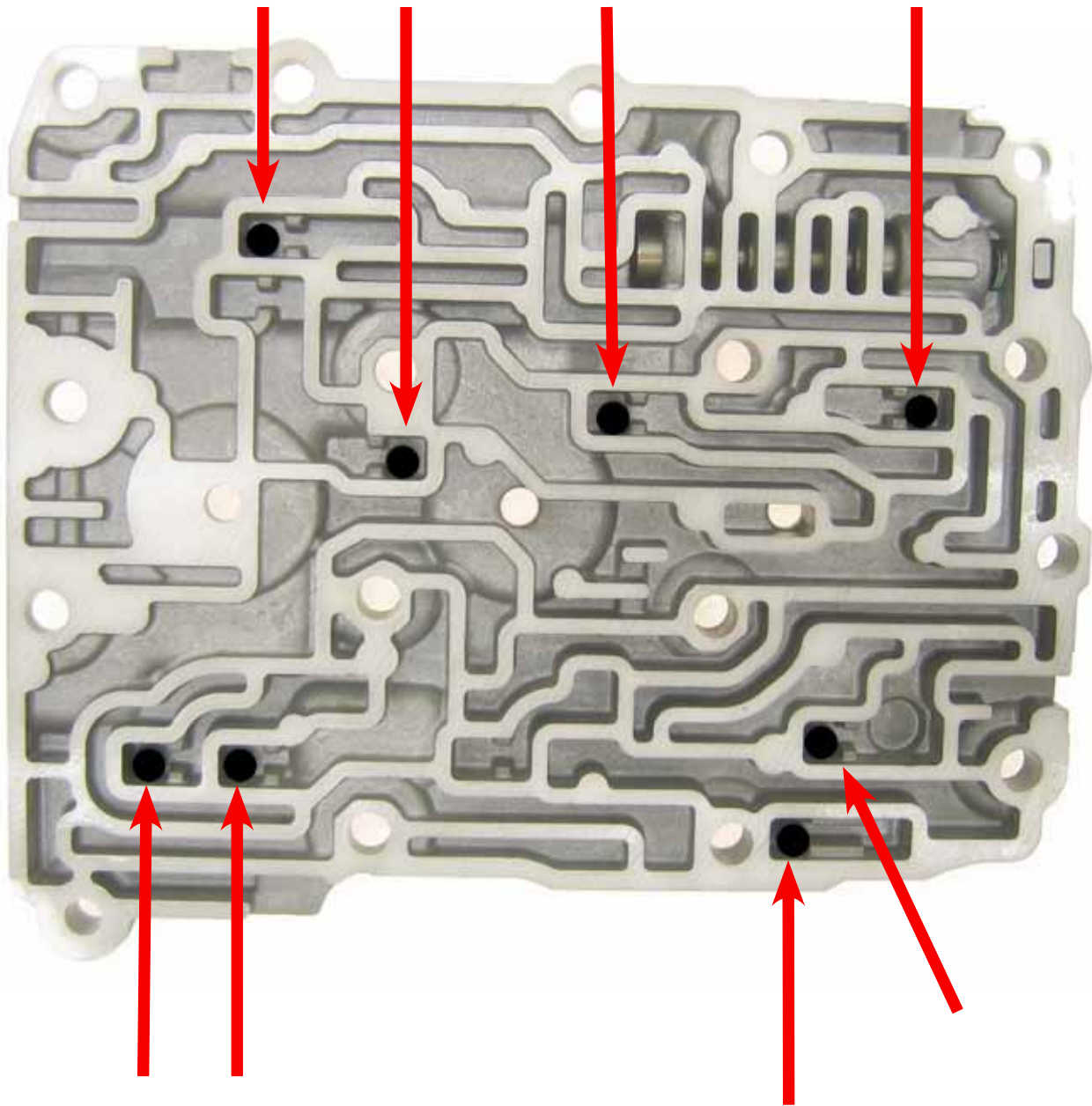
There are three sections to the A750E/F valve body. Upper valve bodies #1 and #2 are the only valve bodies with check ball locations.



A750E/F

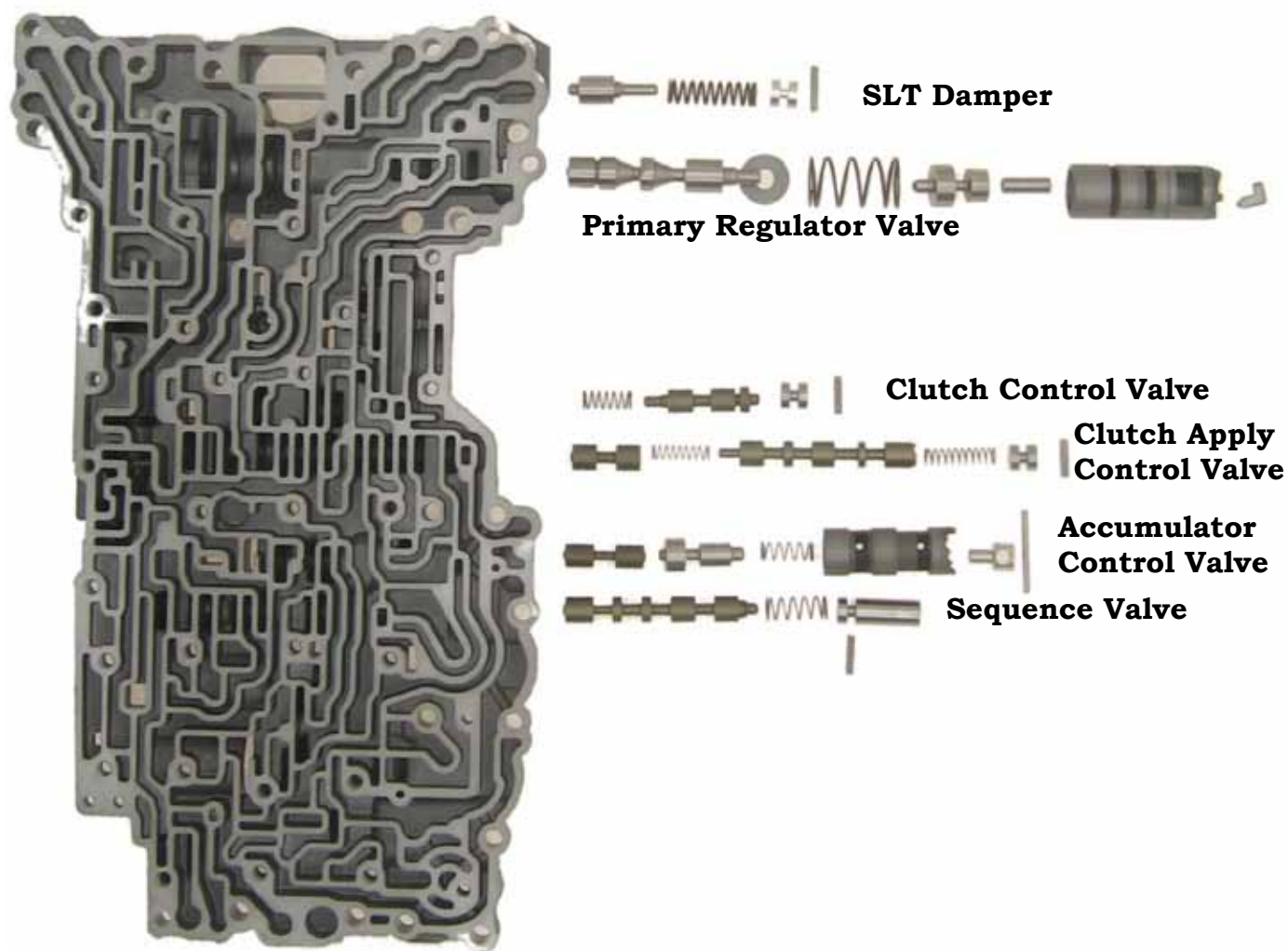
Upper Valve Body #2 Check Balls

The check balls
are rubber 0.217"
(5.5mm) in size



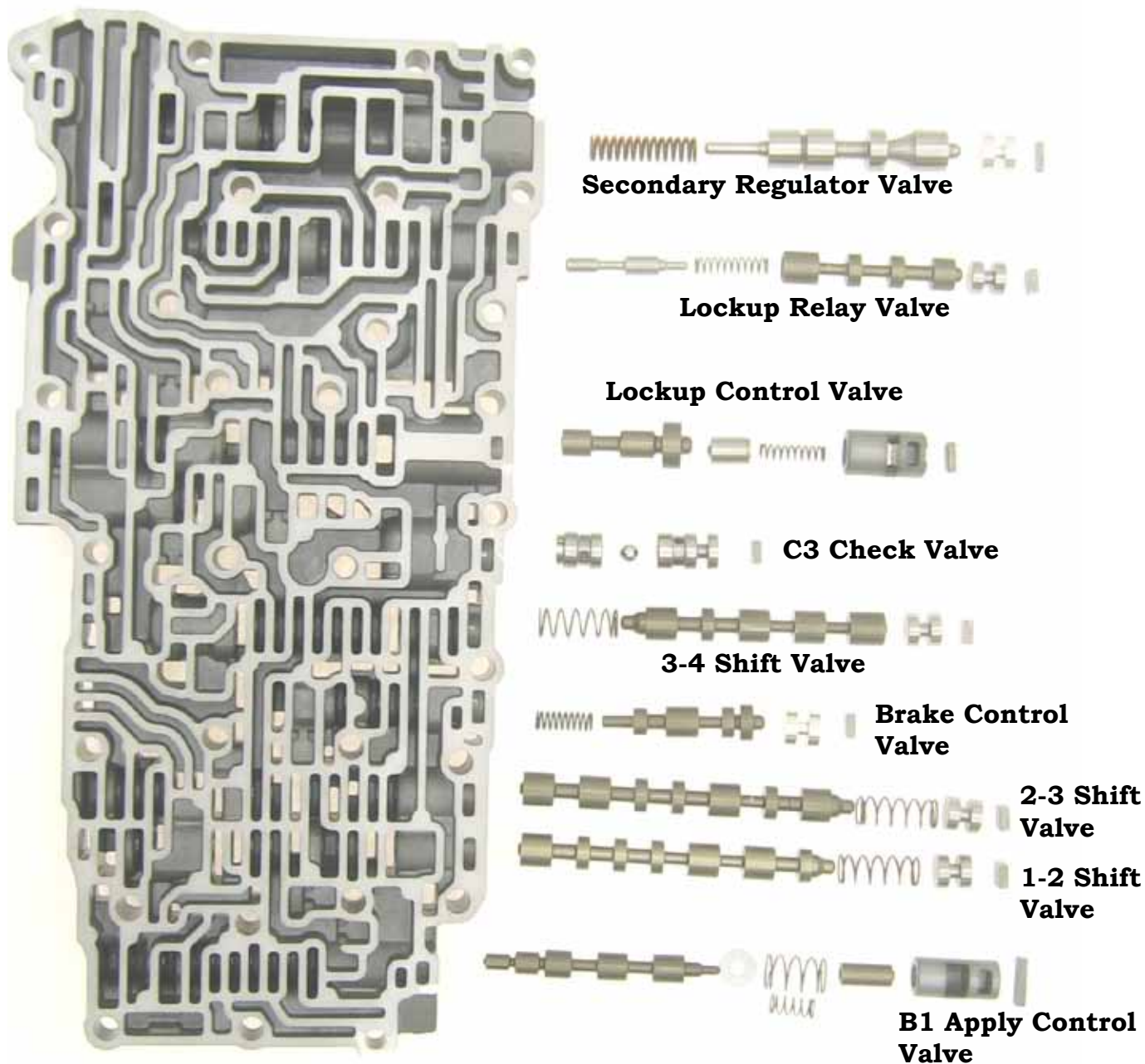
A750E/F

Lower Valve Body #1 Exploded View



A750E/F

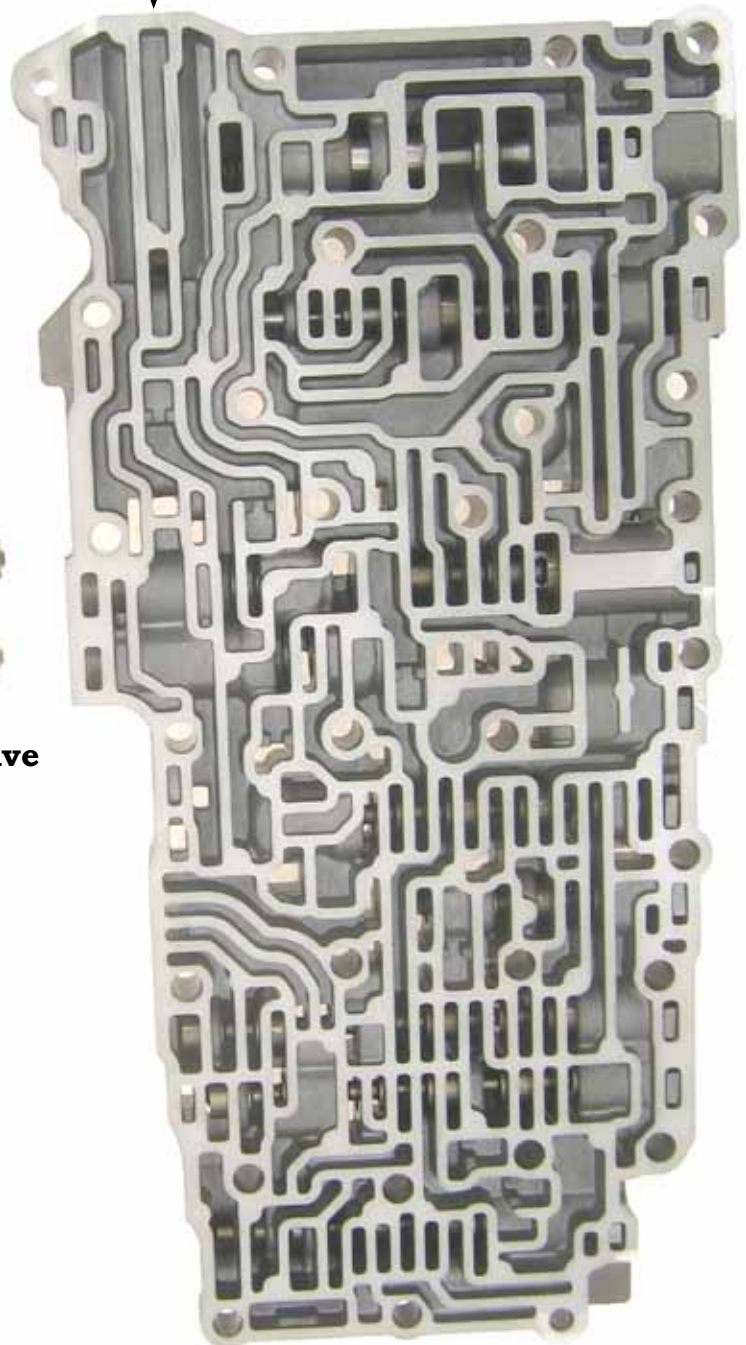
Upper Valve Body #1 Exploded View



A750E/F

Upper Valve Body #1 Exploded View (continued)

B1 Accumulator
located on the back
side of the upper
valve body



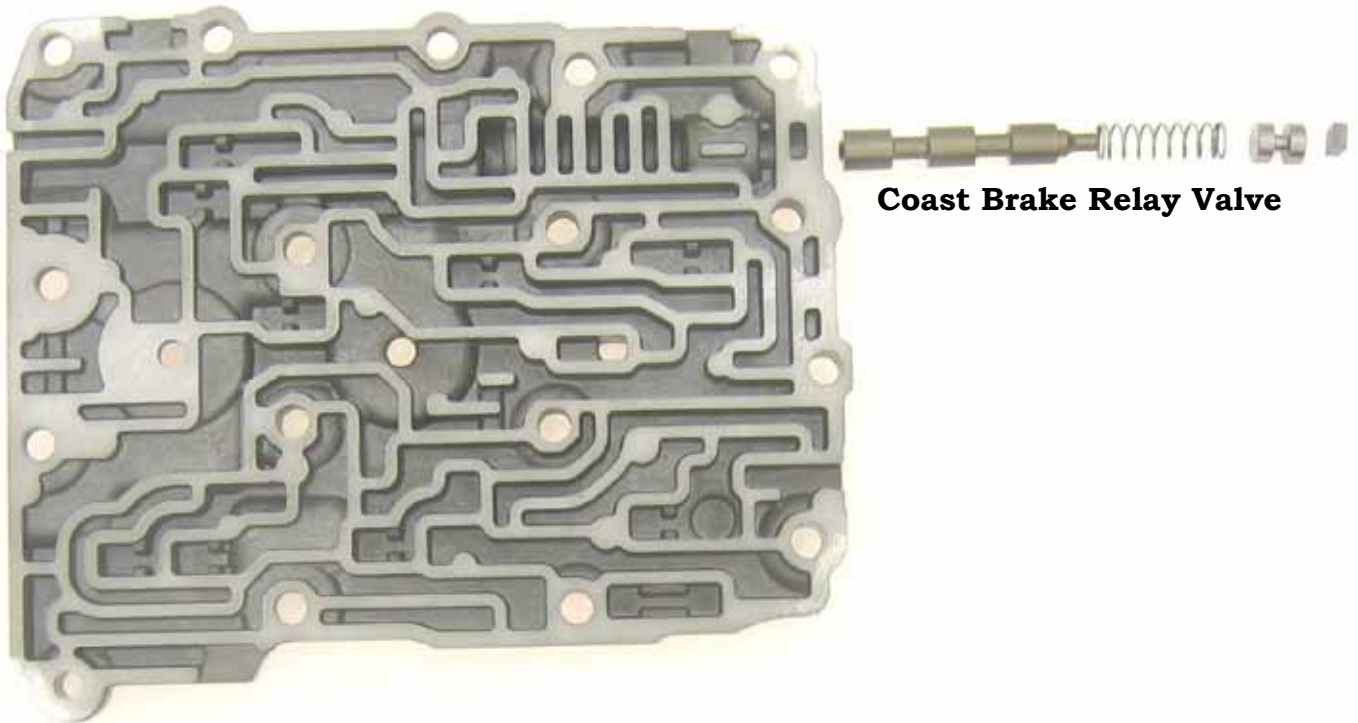
Clutch Lock Valve



Solenoid Modulator Valve

A750E/F

Upper Valve Body #2 Exploded View



Coast Brake Relay Valve

A750E/F

Solenoid Location

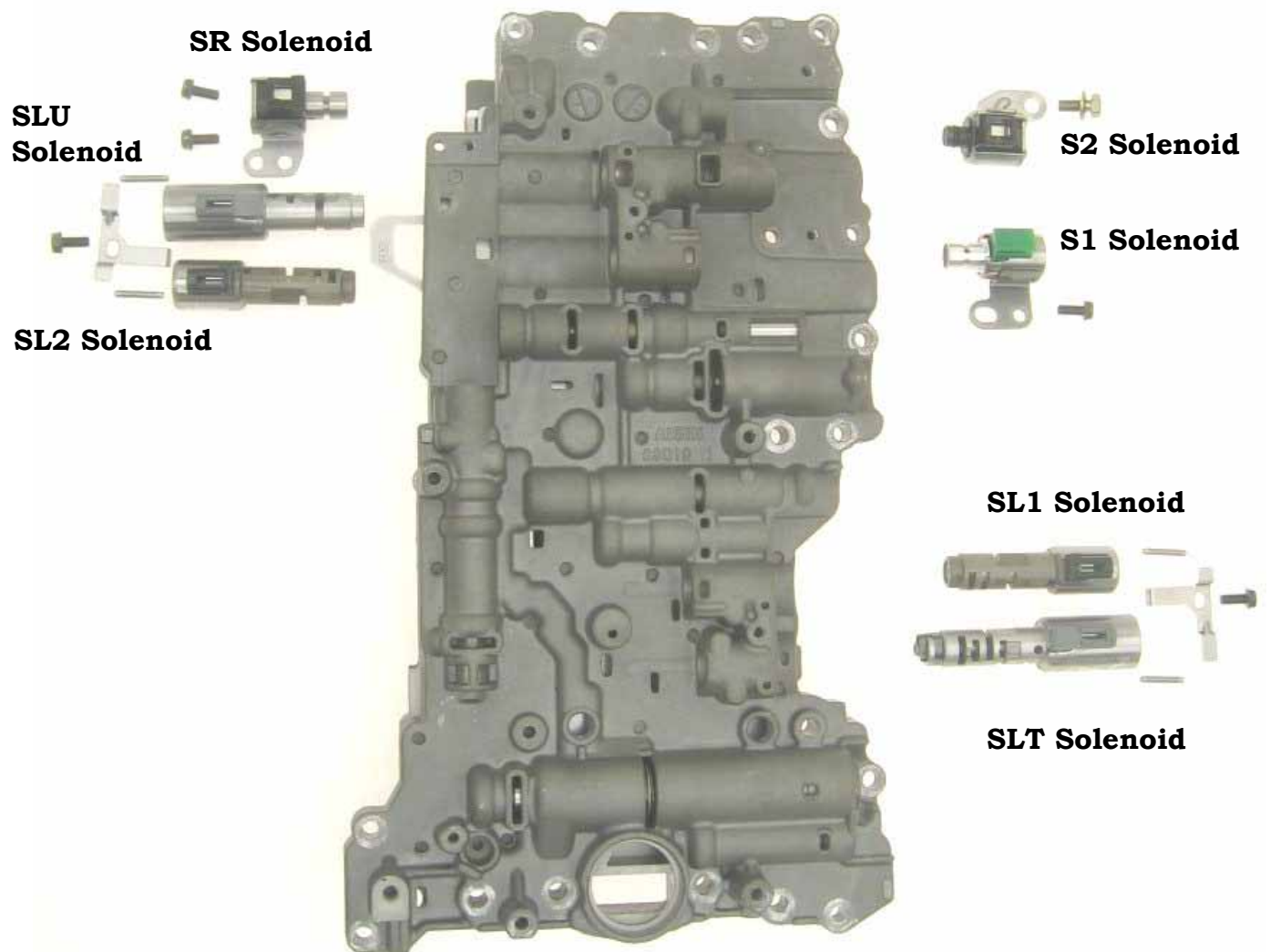
REPAIR MANUAL

S1	Shift Solenoid A
S2	Shift Solenoid B
SR	Shift Solenoid E
SL1	Pressure Control Solenoid A
SL2	Pressure Control Solenoid B
SLT	Pressure Control Solenoid D
SLU	TCC Pressure Control Solenoid

SOLENOID NAME

PARTS CATALOG PART DESCRIPTION

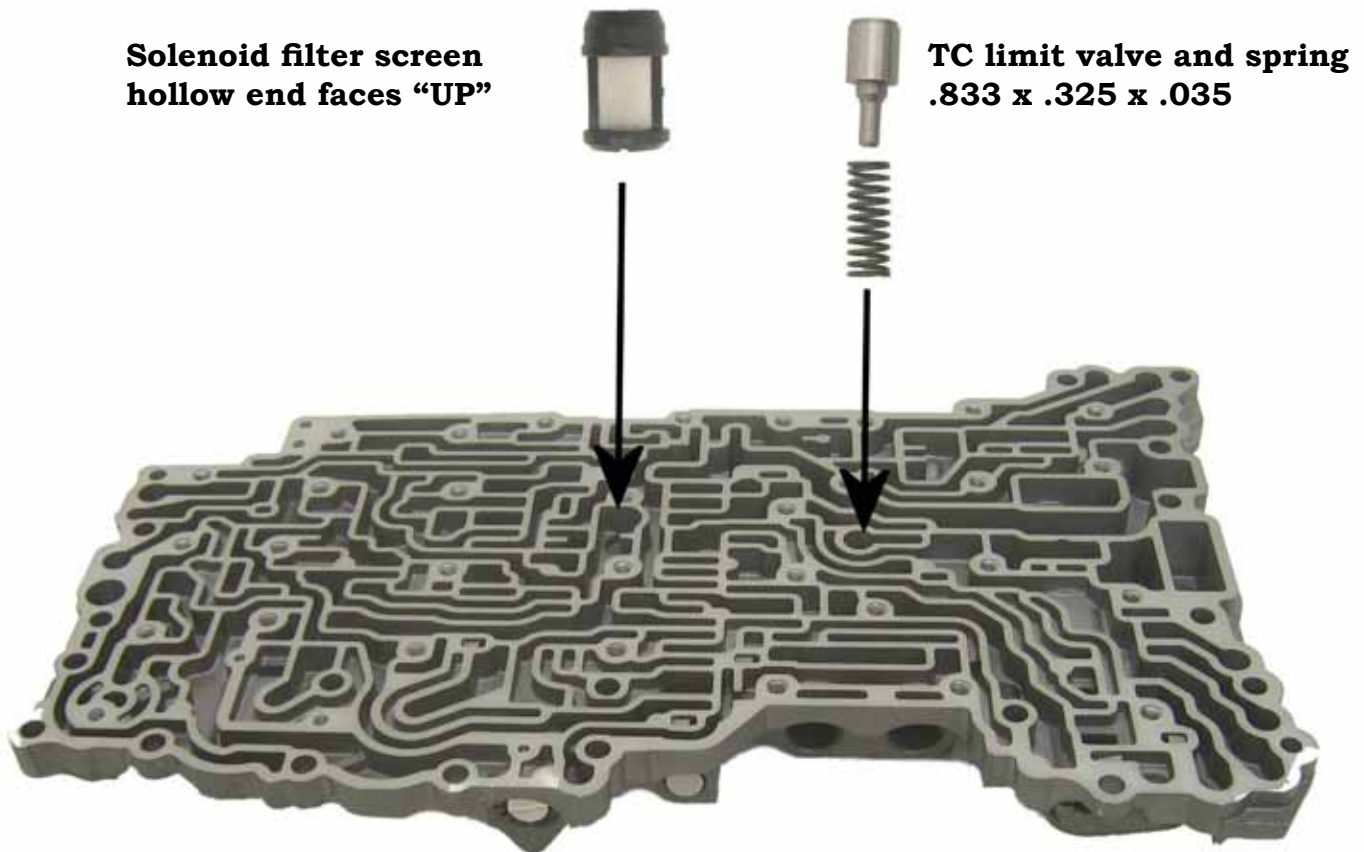
3 Way Transmission Solenoid
Transmission Solenoid #3
3 Way Transmission Solenoid #2
Clutch Control Solenoid #1
Clutch Control Solenoid #2
Line Pressure Control Solenoid
Lockup Control Solenoid



A750E/F

Lower Valve Body #1

The solenoid filter screen must be installed open end “UP”. When properly installed the screen will snap into the separator plate. The torque converter check valve must be installed as shown.



A750E/F

Lower Valve Body #1 (continued)

The pressure limit check ball is used for exhaust purposes due to extremely high pressure. The limit check ball will blow off at approximately 300 psi.



Honda 5spd

2-1 Coast Down Neutral when Cold or No Forward

No forward after driving for a short distance and coasting to a stop. The transmission will engage forward when manual 2nd or low is selected. This symptom usually occurs when the transmission is cold. The next coast down stop the symptom is gone. This problem in time will escalate to a no forward movement in drive 4 or drive 3. The only vehicles affected by this complaint are equipped with V6 engines and listed on the chart.

Honda Models		
Year	Model	Unit
2005-2008	Accord	Hybrid MURA
2003-2007	Accord	BAYA/MAYA
2002-2004	Odyssey	BYBA
2005-2009	Odyssey	BGRA
2003-2009	Pilot	BVGA
2006-2009	Ridgeline	BJFA/MJFA

Acura Models		
Year	Model	Unit
2000	3.2 TL	M7WA
2001-2003	3.2 TL	BGFA/MGFA/B7WA
2004-2008	TL	BDGA
2007-2008	TL Type 5	BDHA
2001-2002	MDX	MGHA/BGHA
2003-2004	MDX	MDKA
2005-2006	MDX	BDKA
2007-2008	MDX	BYFA
2007-2009	RDX	BWEA
2005-2009	RL	MJBA

Honda 5spd

2-1 Coast Down Neutral when Cold or No Forward (continued)

Failure usually occurs in the low one way clutch (sprag) and/or inner sprag race (part of 1st gear). The outer sprag race (low clutch hub) in most cases may not need replacement.

Inner race inspection: The 1st hold clutch hub must be pressed out from 1st gear with 1st gear facing up. After the components are disassembled, 1st gear (inner race) can be inspected. Excessive wear on the 1st gear inner race will require replacement.

**1st Gear
(Inner Race)**



Check for wear here



**Low Clutch Hub
Assembly**



**First Hold Clutch
Hub**



**Hub presses out in this
direction**



Honda 5spd

2-1 Coast Down Neutral when Cold or No Forward (continued)

Outer race and sprag inspection: Removing the sprag element from the low clutch hub requires the snap ring holding the bearing in place. There is no need to remove the retainer on the other side of the hub assembly. The bearing must be pressed out in the direction towards the snap ring. The reason for this procedure is the extended lip on the sprag element shown will not pass by the stepped edge inside the outer race. The extended lip will only allow the sprag to be installed or removed in one direction.

Replace components as needed. If both races are fine then only the sprag element needs to be replaced.

The sprag element is only available from the dealer as a complete assembly with the low clutch hub and bearing (Low Clutch Hub assembly). An alternative is to use an early 1982-86 4L60 (700R4) narrow sprag element without the two brass washers. This will also require leaving out the spacer to allow the sprag to fit. The spacer will not be needed because sprag will rest next to the bearing outer race and not move out of place.

The 4L60 sprag has no extended lip, it can be installed incorrectly. After the sprag is placed into the low hub assembly; check the rotation with the 1st gear (inner race) before pressing the bearing back in place.

**1st Hold Clutch Hub
(HOLD)**

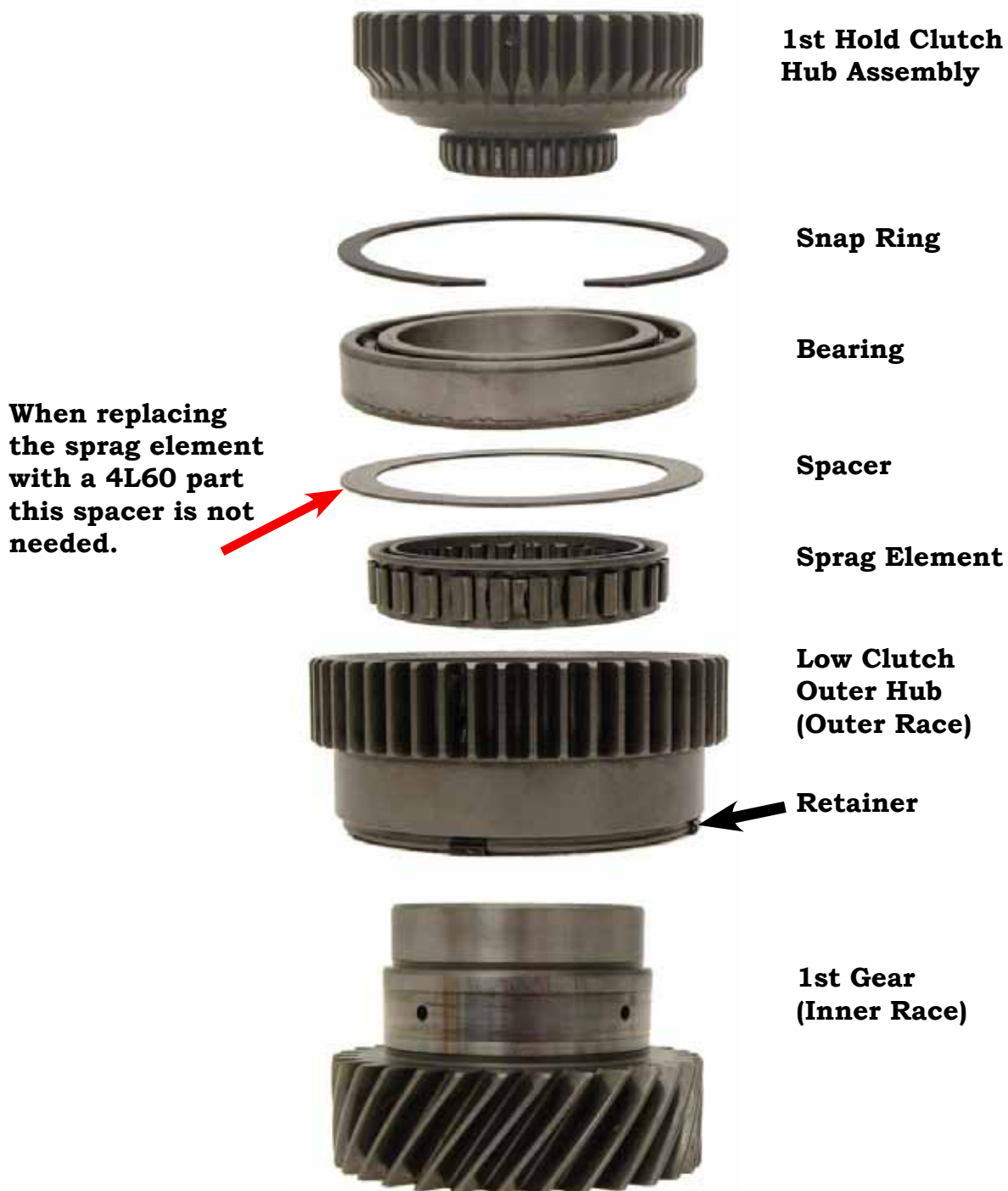
**1st Clutch Hub
(TURN)**

**1st Gear
(HOLD)**



Honda 5spd

2-1 Coast Down Neutral when Cold or No Forward (continued)



All Honda Units

Case Wear

Any movement of the bearings in the case is unacceptable. The wear seems to be most common on the Main (Input) shaft bearing pocket in the rear case half, but reports of wear on secondary and counter shaft bearing pockets have been made. Complaints from this wear can range from bind ups in reverse, whine noise and/or gear facing damage. There are machine shops offering case repair by boring and installing a sleeve in the worn pocket.

Note: Whenever case wear is present, the apply bushings in the shaft will be worn and must be replaced along with case replacement/repair.

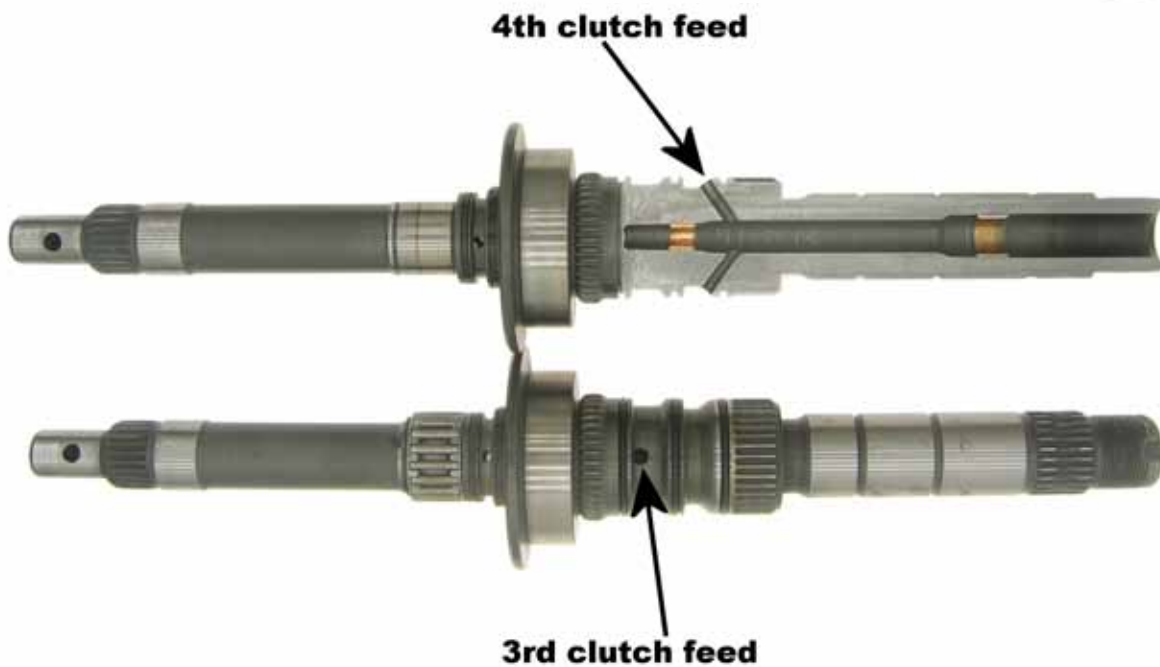
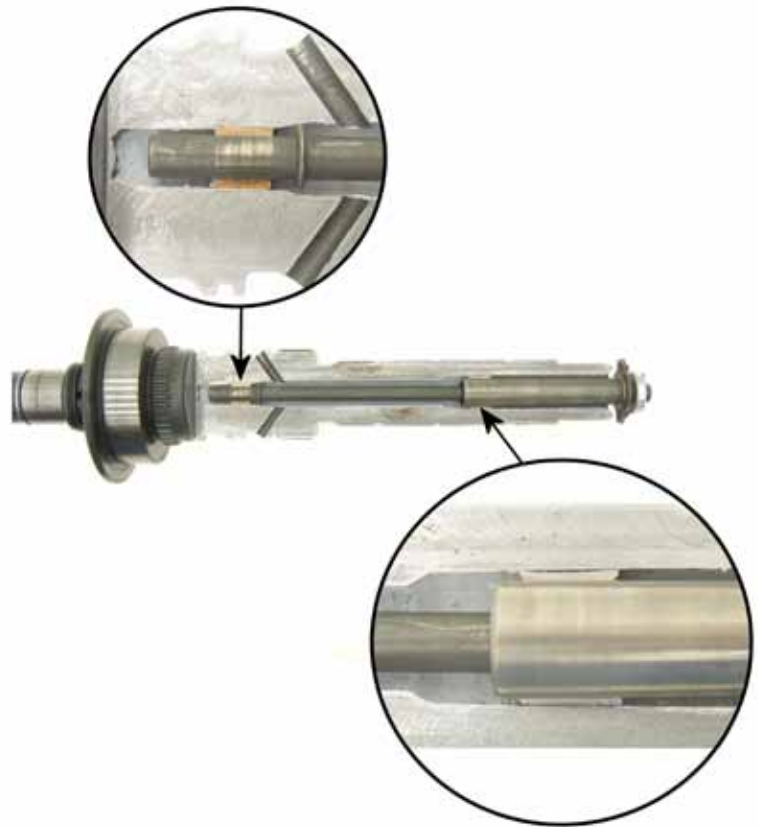


All Honda Units

Shaft Bushing Wear

Sealing bushings must be replaced if there is any failure with the shaft's bearings.

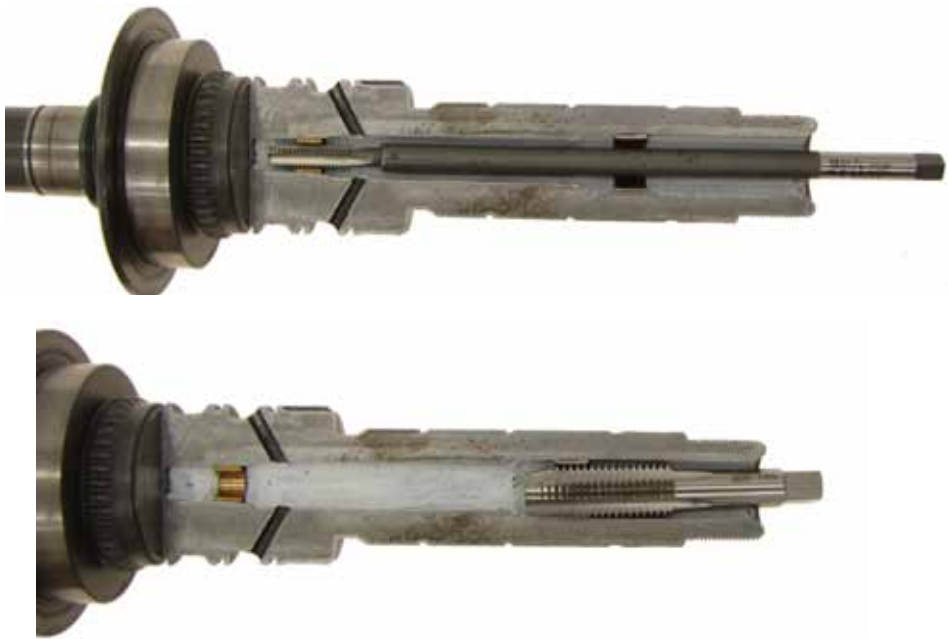
BAXA/MAXA
Example



All Honda Units

Shaft Bushing Replacement

Use the special taps to thread the bushings.



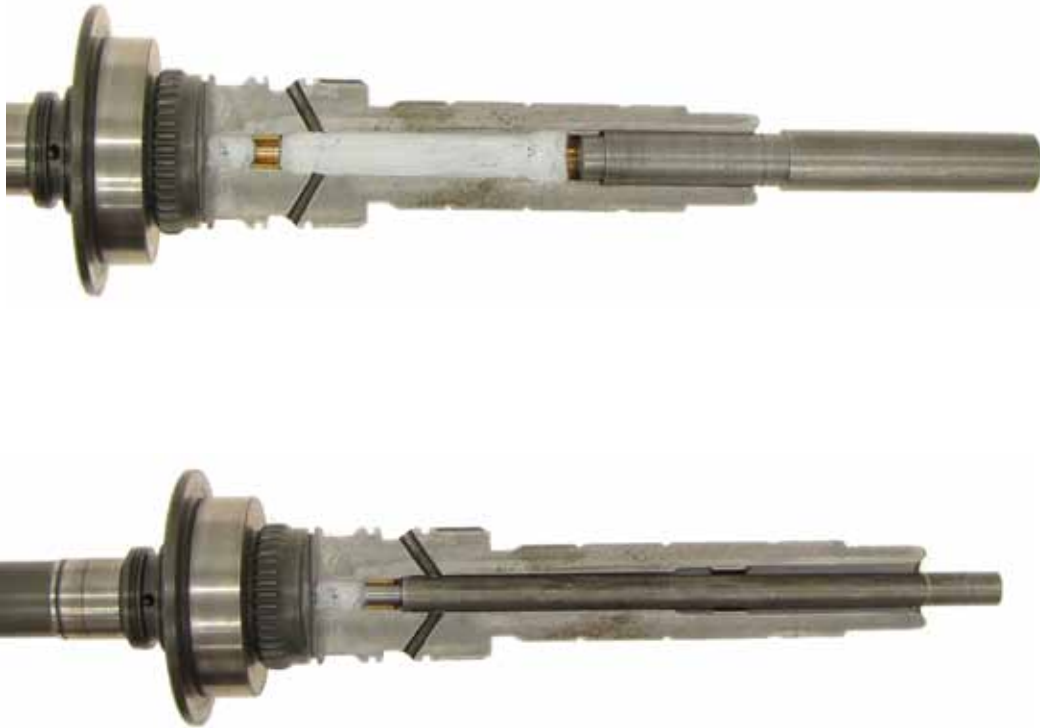
Thread the bolts into the bushing to remove them from the shaft.



All Honda Units

Shaft Bushing Replacement (continued)

The drivers provided have grooves to indicate when the bushing is driven in far enough.



Tool Kit provided by Mike Tilley at Arizona Transmission Machine Sales and Service

BAXA, MAXA, B6VA, M6HA, MDWA, B7TA, B7VA, B7XA, B7ZA, M7ZA

Erratic 1-2 Shift and/or Stacked 2-3 Shift

The second clutch pressure switch is a critical input to the TCM/PCM for clutch timing control and clutch overlap during the 1-2 shift. A faulty second clutch pressure switch can cause one or more of the following symptoms:

- Delayed 1-2 shift
- Long sliding 1-2 shift
- Harsh 1-2 shift
- Stacked 2-3 shift

There are several different switch calibrations used on the different transaxle/vehicle combinations. The switches have different closing pressures, and are identified by the color of the plastic connector. It is recommended that the switches only be replaced with the correct color. If you are not certain of the switch application it is recommended to order the switches from the dealer using the vehicle information to ensure getting the correct switch.

NOTE: The second and third clutch pressure switches are very sensitive to moisture and chemicals. Do not wash them with a parts washer or solvents.

**2nd Clutch Pressure
Switch 4Cyl Unit**

**2nd Clutch Pressure
Switch 6Cyl Unit**



MDKA, BDKA, BWEA, MJBA, BJFA, MJFA, PVLA, PVGA

Feed Pipe Damage

Remove CPC C feed tubes prior to case separation to prevent feed tube damage. These tubes fit into the valve body inside the case. If the pipes are damaged they are available from the Acura dealer.

Pipe measurement

8mm X 53mm

8mm X 25.2mm

8mm X 36mm

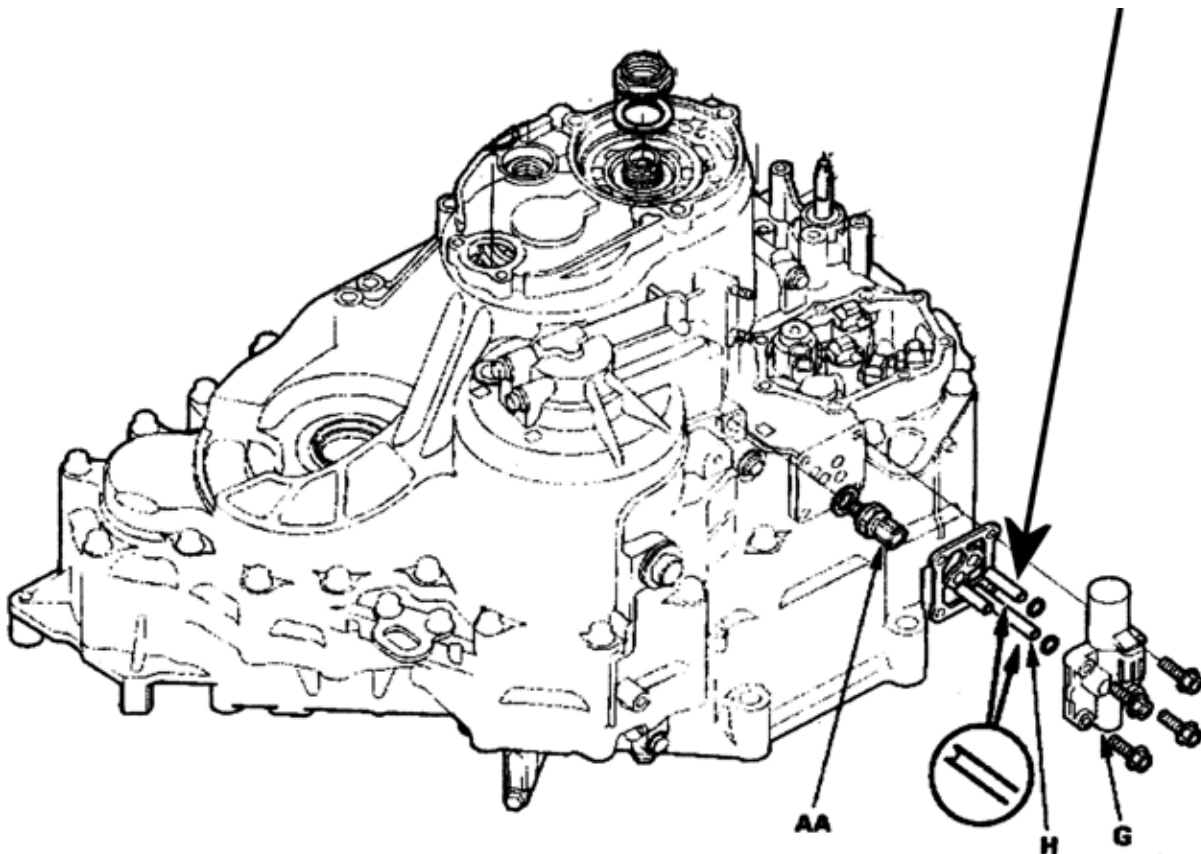
Part number

22750-RDK-010

22761-P7Z-000

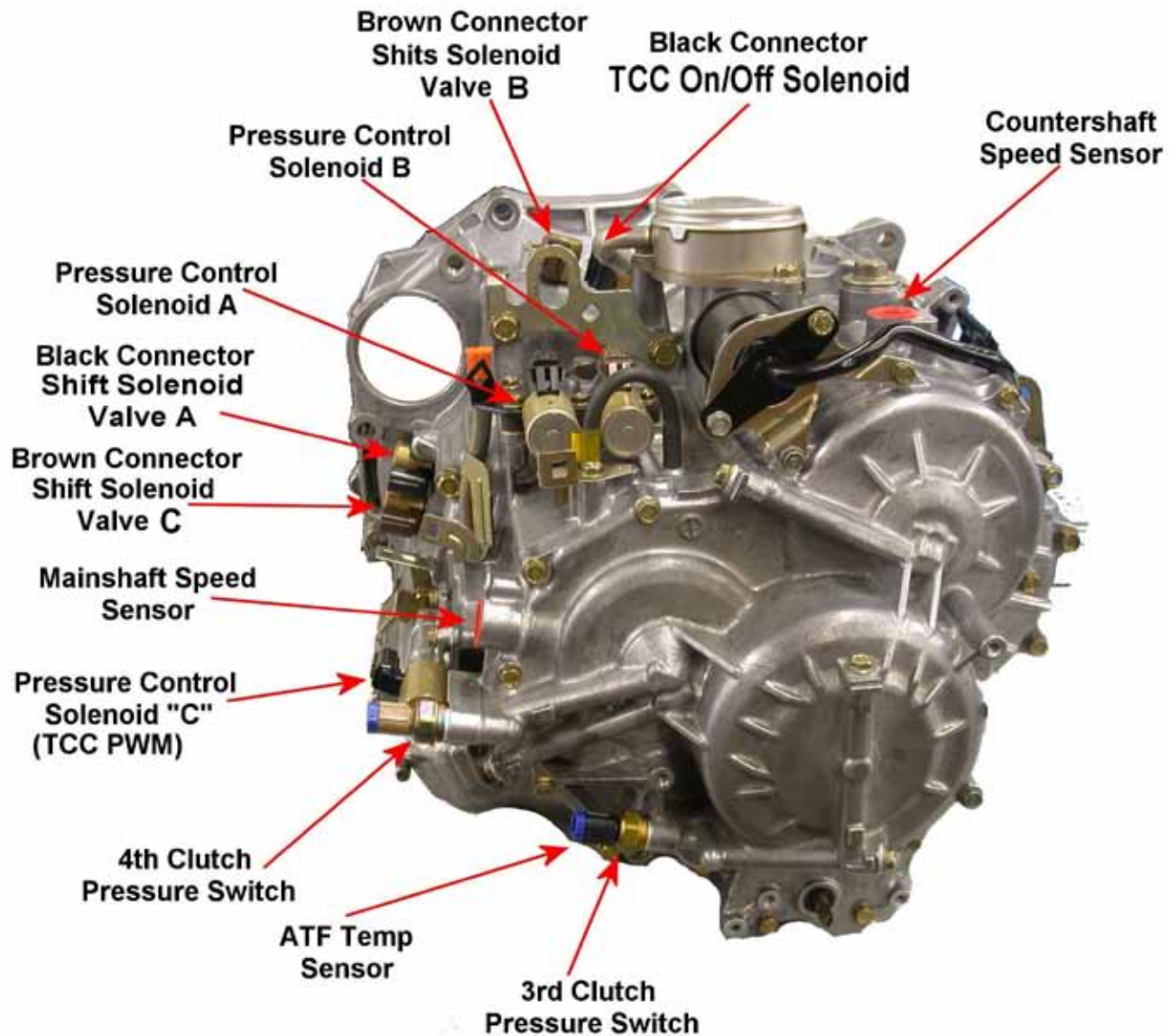
22770-P7Z-000

Always remove these 3 pipes before splitting the case halves



BYBA

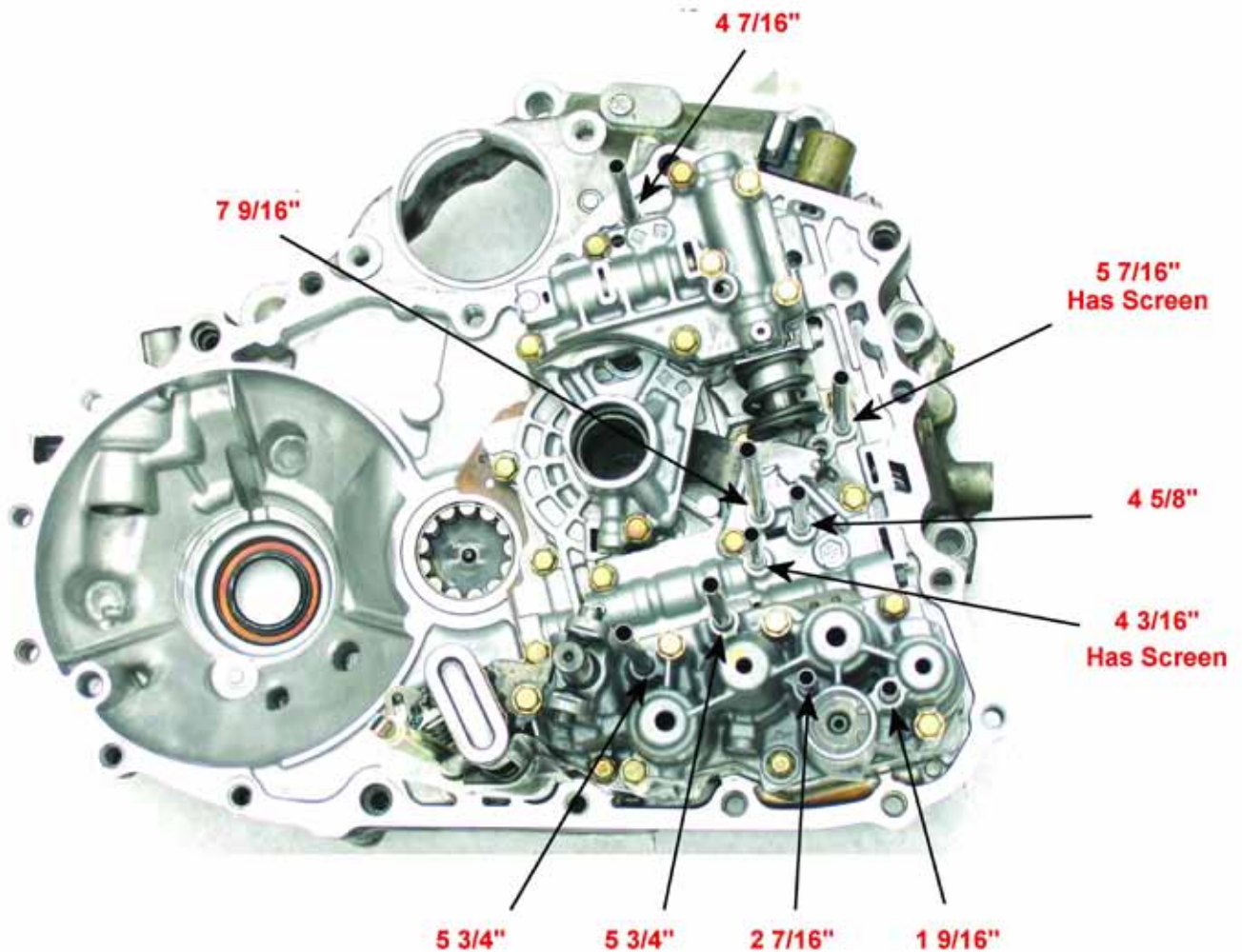
Electronic Component Identification



BMXA

Feed Pipe ID and Location

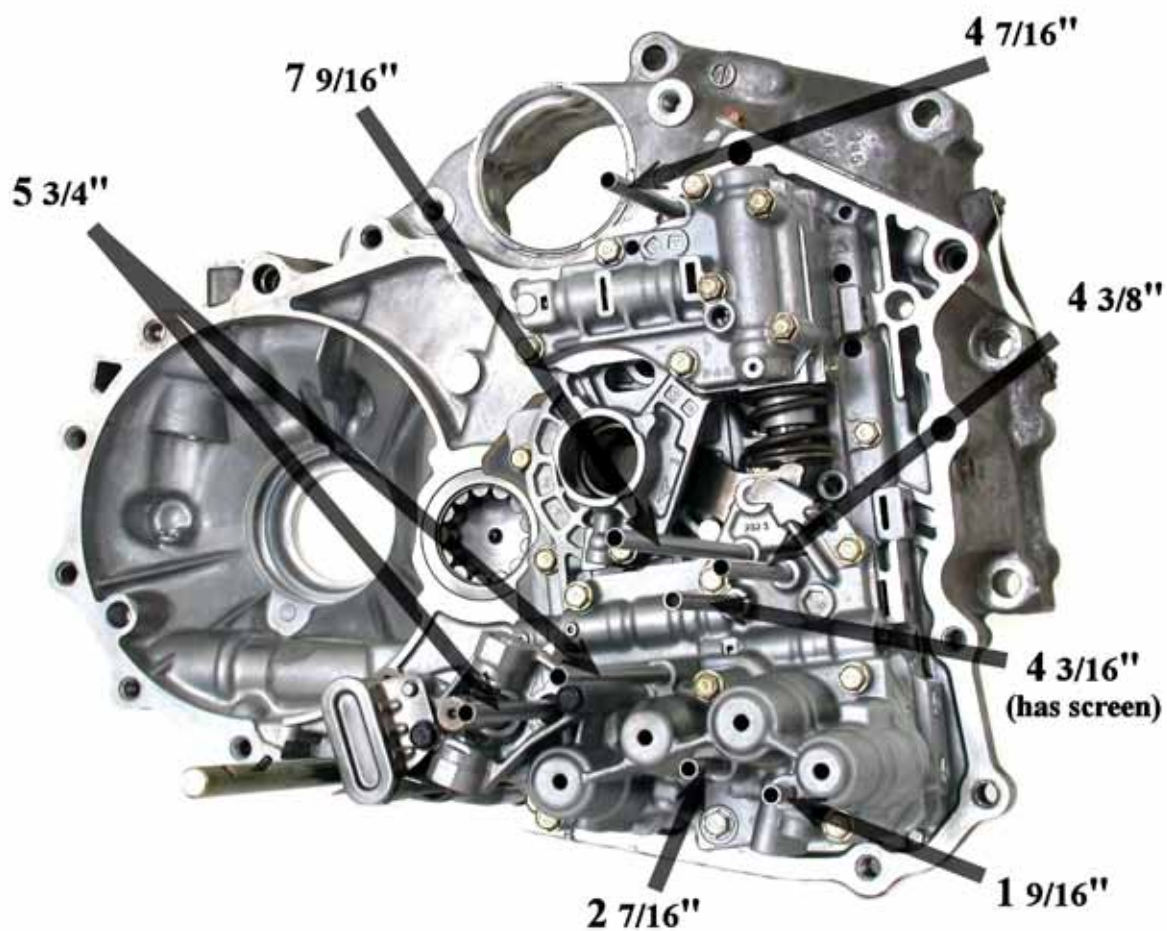
2001 and newer Honda Civic feed pipe ID's and locations. Use the picture to identify feed pipes and their correct locations.



A4RA, B4RA, M4RA

Feed Pipe ID and Location

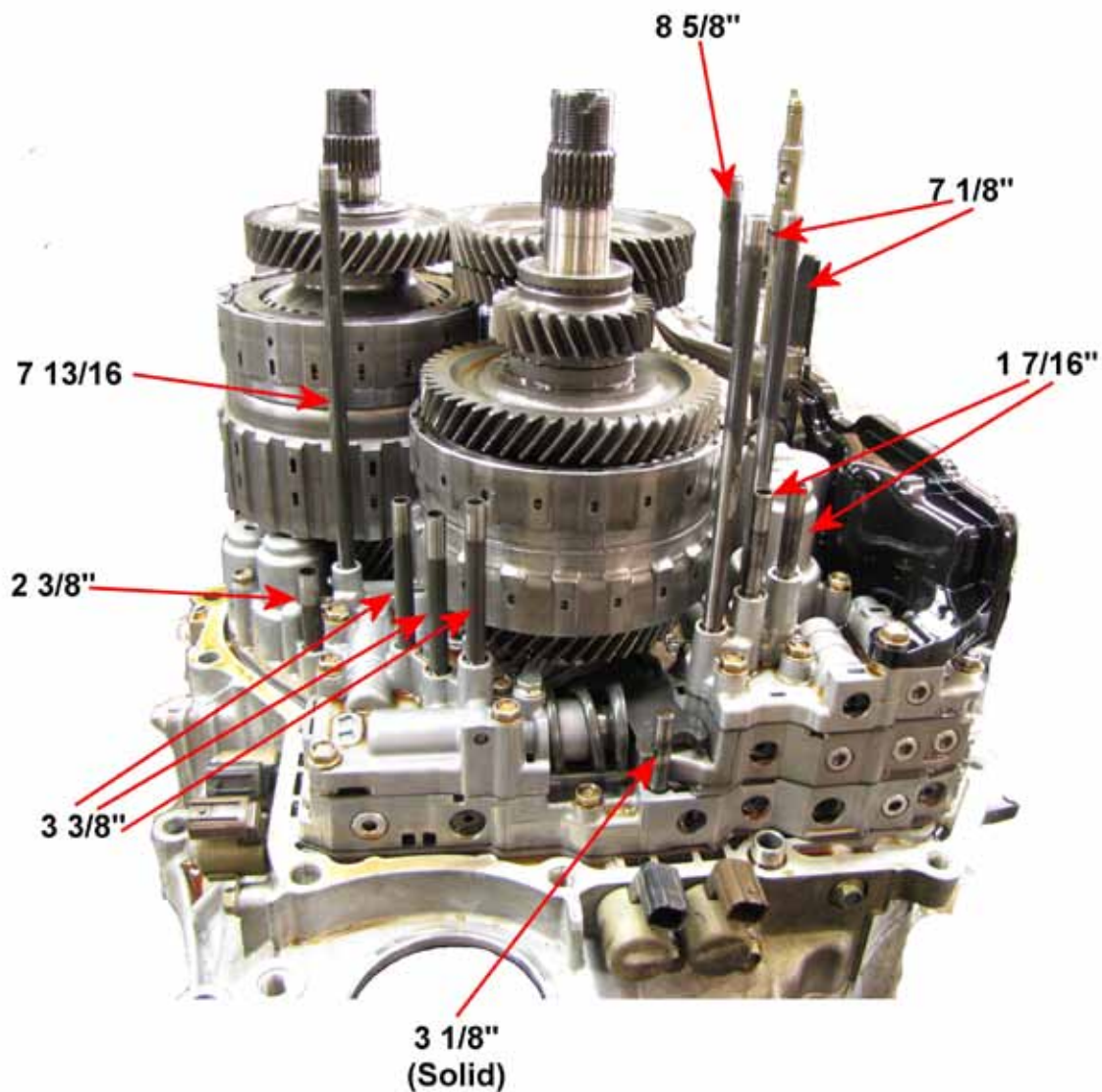
1996-2000 Honda Civic feed pipe ID's and locations. Use the picture to identify feed pipes and their locations.



BYBA

Feed Pipe ID and Location

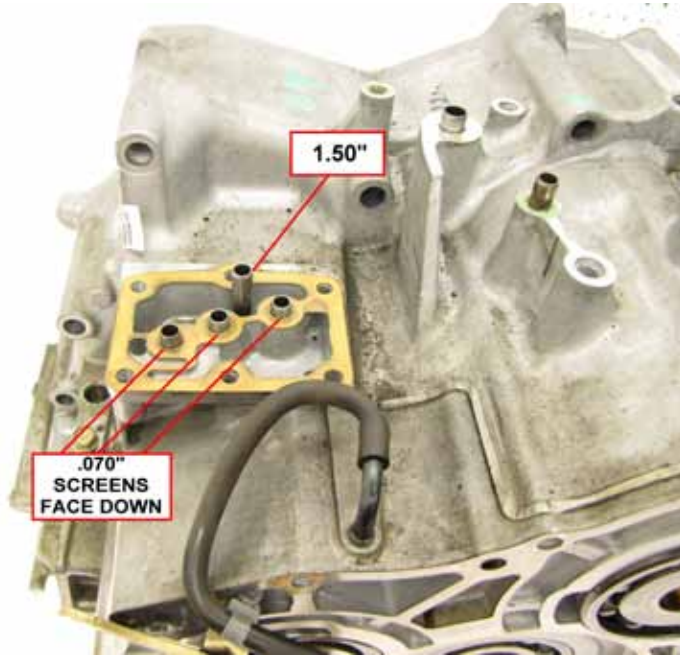
Use the picture to identify feed pipes and their locations.



BYBA

Feed Pipe ID and Location (continued)

Use the picture to identify feed pipes and their locations.



**Pressure control solenoid
CPC "C" (TCC) filter screen
location**



All Honda Units

Clutch Clearances

Proper clutch clearance adjustment is critical for proper transaxle operation. Too tight, and the clutch can drag and burn up; too loose, and you could end up with a flare or shift timing problem. The following charts list all of the Honda and Acura transaxles, and provide the clutch clearance specifications for each clutch pack. We've separated these units by the number of clutch packs in the transaxle: 4, 5 and 6 clutch units as well as by speeds. Find the unit you're working on and set the clutch clearances carefully, to make sure your rebuilds work—and last—the way they're supposed to.

Acura 4 Speed Clutch Pack Clearances (4 Clutch Models)				
Model	1st	2nd	3rd	4th
B6VA	0.045"-0.053"	0.028"-0.035"	0.024"-0.031"	0.016"-0.024"
M7ZA	0.047"-0.055"	0.033"-0.041"	0.022"-0.030"	0.022"-0.030"
B7VA				

Acura 4 Speed Clutch Clearance Chart (5 Clutch Models)					
Model	1st Clutch	1st Hold	2nd Clutch	3rd Clutch	4th Clutch
A6VA	0.026"-0.033"	0.031"-0.039"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
M1WA	0.026"-0.033"	0.031"-0.039"	0.022"-0.030"	0.022"-0.030"	0.022"-0.030"
MPMA/SP7A	0.026"-0.033"	0.020"-0.031"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
S4XA					
SKWA	0.026"-0.033"	0.020"-0.031"	0.016"-0.024"	0.016"-0.024"	0.016"-0.024"
MR9A	0.026"-0.033"	0.028"-0.035"	0.030"-0.037"	0.030"-0.037"	0.030"-0.037"

Acura 4 Speed Clutch Clearance Chart (6 Clutch Models)						
Mode	1st Clutch	1st Hold Clutch	2nd Clutch	3rd Clutch	4th Clutch	Reverse Clutch
M5DA	0.026"-0.033"	0.028"-0.035"	0.024"-0.031"	0.024"-0.031"	0.020"-0.028"	0.030"-0.037"
M5HA						
MPYA						

Acura 5 Speed Clutch Pack Clearances						
Model	1st Clutch	1st Hold Clutch	2nd Clutch	3rd Clutch	4th Clutch	5th Clutch
B7WA	0.043"-0.051"	N/A	Type S: 0.033"-0.041"	0.028"-0.035"	0.022"-0.030"	0.022"-0.030"
BGFA/MGFA						
M7WA			Other: 0.028"-0.035"			
BDGA	0.043"-0.061"	0.020"-0.035"	0.033"-0.041"	0.023"-0.035"	0.022"-0.030"	0.022"-0.030"
BDHA	0.045"-0.053"	0.024"-0.039"	0.041"-0.049"	0.031"-0.039"	0.030"-0.037"	0.030"-0.037"
BDKA	0.043"-0.051"	0.024"-0.039"	0.039"-0.047"	0.028"-0.035"	0.022"-0.030"	0.022"-0.030"
BGHA/MGHA	0.043"-0.051"	0.020"-0.035"	0.033"-0.041"	0.028"-0.035"	0.022"-0.030"	0.022"-0.030"
BWEA	0.045"-0.053"	0.024"-0.039"	0.041"-0.049"	0.031"-0.039"	0.030"-0.037"	0.030"-0.037"
BYFA	0.045"-0.053"	0.024"-0.039"	0.041"-0.049"	0.035"-0.043"	0.030"-0.037"	0.030"-0.037"
MCTA (2004-2005)	0.032"-0.040"	N/A	0.035"-0.043"	0.032"-0.040"	0.037"-0.044"	0.037"-0.044"
MCTA (2006-0N)	0.032"-0.040"	N/A	0.046"-0.054"	0.039"-0.044"	0.037"-0.044"	0.037"-0.044"
MDKA	0.043"-0.051"	0.024"-0.039"	0.039"-0.047"	0.028"-0.035"	0.022"-0.030"	0.022"-0.030"
MJBA	0.047"-0.053"	N/A	0.043"-0.049"	0.033"-0.039"	0.030"-0.035"	0.031"-0.037"
MRMA	0.048"-0.056"	N/A	0.030"-0.037"	0.033"-0.041"	0.029"-0.037"	0.029"-0.037"

All Honda Units

Clutch Clearances (continued)

Honda 4 Speed Clutch Pack Clearances (4 Clutch Models)				
Model	1st Clutch	2nd Clutch	3rd Clutch	4th Clutch
A4RA/M4RA	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
AK	0.016"-0.028"	0.016"-0.028"	0.016"-0.028"	0.016"-0.028"
AS	0.016"-0.028"	0.026"-0.031"	0.016"-0.023"	0.016"-0.023"
BDRA/B4RA/S4RA	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
B6VA	0.045"-0.053"	0.028"-0.035"	0.024"-0.031"	0.016"-0.024"
B7VA/B7XA/B7ZA B7TA/B7YA	0.047"-0.055"	0.033"-0.041"	0.022"-0.030"	0.022"-0.030"
BAXA/MAXA	0.045"-0.053"	0.028"-0.035"	0.024"-0.031"	0.016"-0.024"
BMXA/SLXA	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
BZKA/MZKA	0.050"-0.058"	0.033"-0.041"	0.029"-0.037"	0.029"-0.037"
CA	0.026"-0.033"	0.026"-0.031"	0.016"-0.023"	0.016"-0.023"
F4	0.026"-0.033"	0.020"-0.028"	0.016"-0.024"	0.016"-0.024"
G4	0.026"-0.033"	0.020"-0.028"	0.020"-0.028"	0.016"-0.024"
K4	0.030"-0.037"	0.016"-0.024"	0.016"-0.024"	0.016"-0.024"
L4	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
L5	0.026"-0.033"	0.020"-0.028"	0.020"-0.028"	0.016"-0.024"
M6HA	0.045"-0.053"	0.039"-0.047"	0.024"-0.031"	0.016"-0.024"
M7ZA	0.047"-0.055"	0.033"-0.041"	0.022"-0.030"	0.022"-0.030"
MDWA	0.045"-0.053"	0.028"-0.035"	0.024"-0.031"	0.016"-0.024"
ML4A	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
MPRA	0.026"-0.033"	0.020"-0.028"	0.016"-0.024"	0.016"-0.024"
MY8A	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"	0.016"-0.024"
P1	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
PL5X	0.026"-0.033"	0.020"-0.028"	0.020"-0.028"	0.016"-0.024"
PY8A	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"	0.016"-0.024"
RO	0.026"-0.033"	0.020"-0.028"	0.016"-0.024"	0.016"-0.024"

All Honda Units

Clutch Clearances (continued)

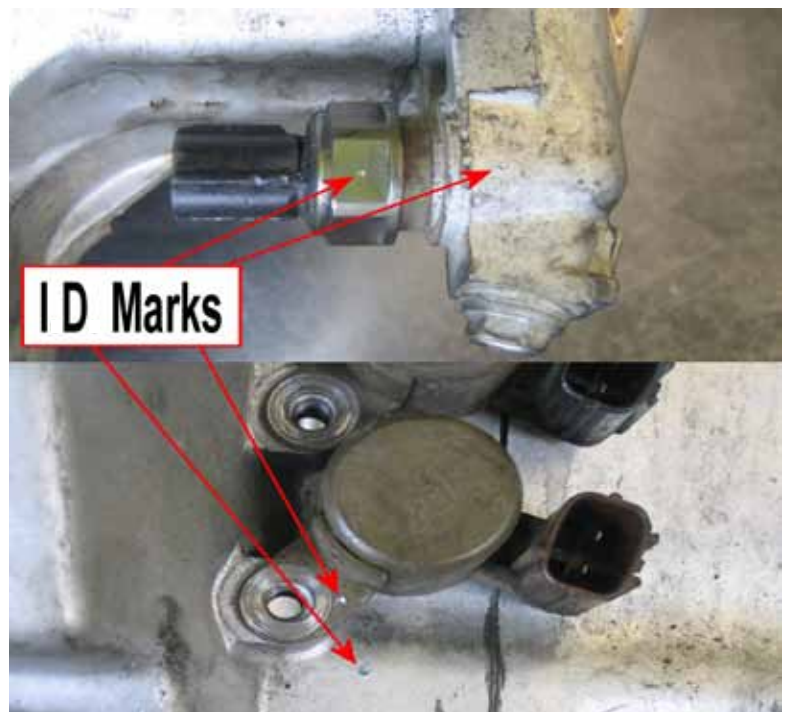
Honda 4 Speed Clutch Pack Clearances (5 Clutch Models)					
Model	1st Clutch	1st Hold Clutch	2nd Clutch	3rd Clutch	4th Clutch
A0YA	0.026"-0.033"	0.031"-0.039"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
A6VA					
APX4	0.026"-0.033"	0.028"-0.035"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
B0YA	0.026"-0.033"	0.031"-0.039"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
M1WA	0.026"-0.033"	0.031"-0.039"	0.022"-0.030"	0.022"-0.030"	0.022"-0.030"
M24A	0.026"-0.033"	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
MDMA/M4TA/MRVA	0.026"-0.033"	0.020"-0.031"	0.016"-0.024"	0.016"-0.024"	0.016"-0.024"
MDLA/MCVA					
MPOA	0.026"-0.033"	0.031"-0.039"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
MP1A					
MP7A	0.026"-0.033"	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
MPJA	0.026"-0.033"	0.031"-0.039"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
MPSA	0.026"-0.033"	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
MPWA Acura	0.026"-0.033"	0.031"-0.039"	0.022"-0.030"	0.022"-0.030"	0.022"-0.030"
MPWA Honda	0.026"-0.033"	0.028"-0.035"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
MPXA					
MPZA	0.030"-0.037"	0.024"-0.039"	0.028"-0.035"	0.026"-0.033"	0.022"-0.030"
PX4B	0.026"-0.033"	0.031"-0.039"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
S4XA	0.026"-0.033"	0.026"-0.033"	0.026"-0.033"	0.016"-0.024"	0.016"-0.024"
S5					
SP7A					

Honda 5 Speed Clutch Pack Clearances						
Model	1st Clutch	1st Hold Clutch	2nd Clutch	3rd Clutch	4th Clutch	5th Clutch
BAYA/MAYA (03-05)	0.043"-0.051"	0.020"-0.035"	0.028"-0.035"	0.028"-0.035"	0.022"-0.030"	0.022"-0.030"
BAYA/MAYA (06-ON)	0.043"-0.051"	0.020"-0.035"	0.033"-0.041"	0.028"-0.035"	0.028"-0.035"	0.028"-0.035"
BCLA/MCLA (03-04)	0.050"-0.058"	0.020"-0.035"	0.035"-0.043"	0.037"-0.044"	0.029"-0.037"	0.029"-0.037"
BCLA/MCLA(2005)	0.050"-0.058"	0.020"-0.035"	0.035"-0.043"	0.037"-0.044"	0.037"-0.044"	0.037"-0.044"
BCLA/MCLA(06-ON)	0.054"-0.062"	0.020"-0.035"	0.046"-0.054"	0.048"-0.056"	0.037"-0.044"	0.037"-0.044"
BJFA	0.045"-0.053"	0.024"-0.039"	0.041"-0.049"	0.031"-0.039"	0.030"-0.037"	0.030"-0.037"
BGRA	0.043"-0.051"	0.020"-0.035"	0.033"-0.041"	0.028"-0.035"	0.028"-0.035"	0.028"-0.035"
BVGA	0.043"-0.051"	0.020"-0.035"	0.033"-0.041"	0.028"-0.035"	0.028"-0.035"	0.028"-0.035"
BVLA	0.045"-0.053"	0.024"-0.039"	0.041"-0.049"	0.031"-0.039"	0.028"-0.035"	0.030"-0.037"
BYBA	0.043"-0.051"	0.020"-0.035"	0.028"-0.035"	0.028"-0.035"	0.022"-0.030"	0.022"-0.030"
MKYA/GPLA	0.050"-0.058"	N/A	0.035"-0.043"	0.033"-0.041"	0.037"-0.044"	0.037"-0.044"
MKZA/GPPA						
MNZA/MZKA	0.054"-0.062"	N/A	0.045"-0.053"	0.048"-0.056"	0.037"-0.044"	0.037"-0.044"
MURA	0.047"-0.053"	0.024"-0.039"	0.043"-0.049"	0.033"-0.039"	0.031"-0.037"	0.031"-0.037"
MZHA/MZJA	0.054"-0.062"	N/A	0.046"-0.054"	0.048"-0.056"	0.037"-0.044"	0.037"-0.044"
PGVA/PVLA	0.045"-0.053"	0.024"-0.039"	0.041"-0.049"	0.031"-0.039"	0.030"-0.037"	0.030"-0.037"
SMMA	0.064"-0.072"	N/A	0.020"-0.028"	0.029"-0.037"	0.028"-0.035"	0.029"-0.037"
SPCA	0.064"-0.072"	N/A	0.028"-0.035"	0.037"-0.044"	0.028"-0.035"	0.037"-0.044"

B7XA

Making ID Marks

Use a center punch and small hammer to make a “neat” ID Mark on the pressure switches and solenoids. Pressure switches can be interchanged, but are calibrated for specific gears. A mismatch can produce shift feel concerns.



All Hondas

Handling the Electronics

Do not allow electronic parts to soak in solvent; this can create after overhaul problems. If the valves in the linear solenoids show signs of scratching or galling, they should be replaced.



Switch “CLOSES” at 36 psi or greater

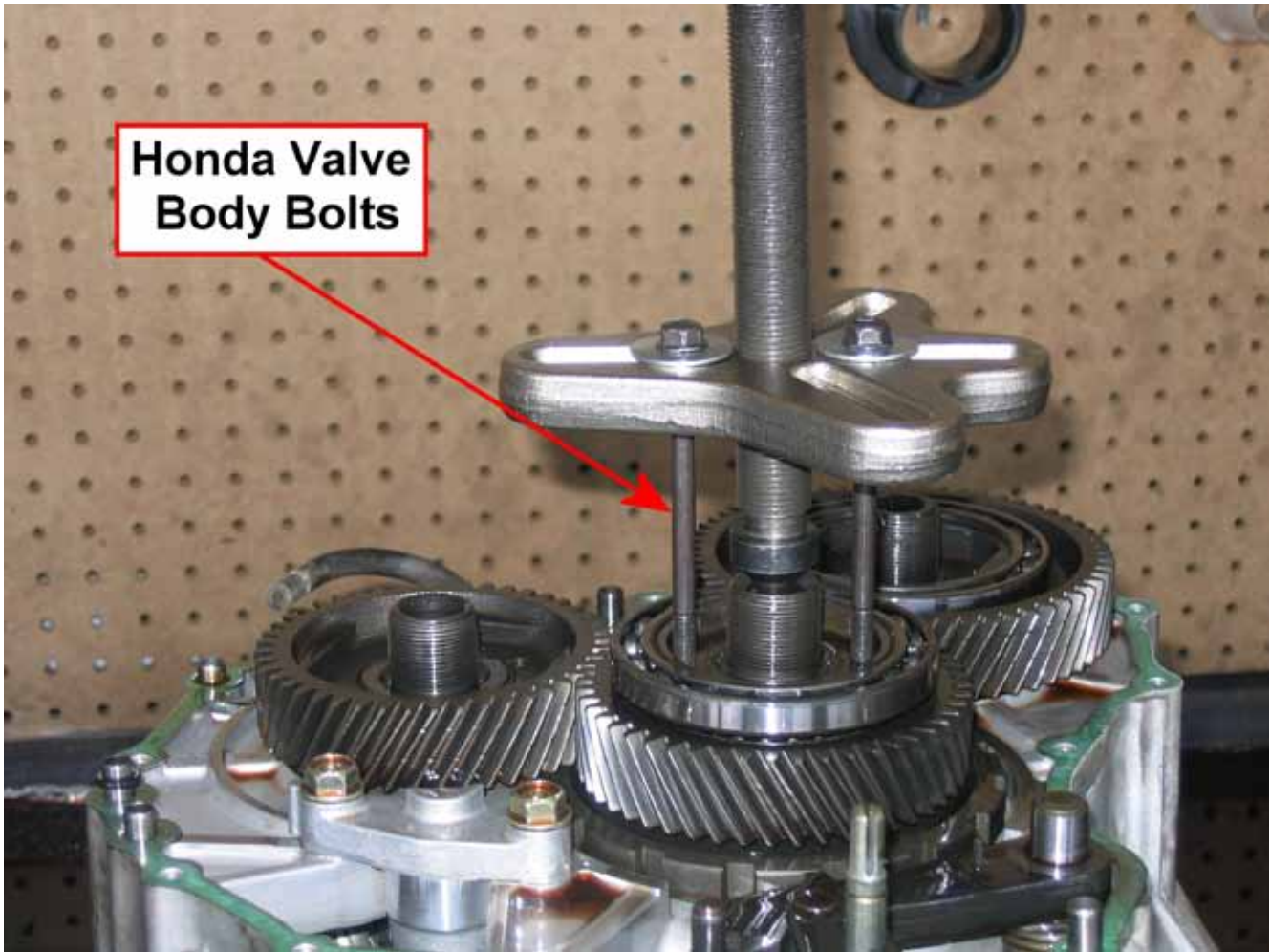


Switch “OPENS” at 35 psi or lower

All Honda Units

Removing Pressed Gears

Always use a steering wheel puller to remove pressed on gears. Using a screw driver or prybar will chip the gears everytime and can cause “drive thru” clicking sounds. On some models there may be a bearing under the gear being removed. Do not over extend the puller bolts or bearing damage may occur.



All Honda Units

Bearing Alignment

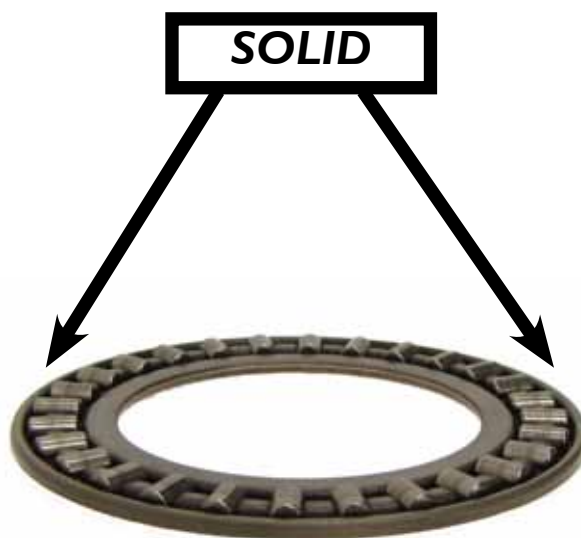
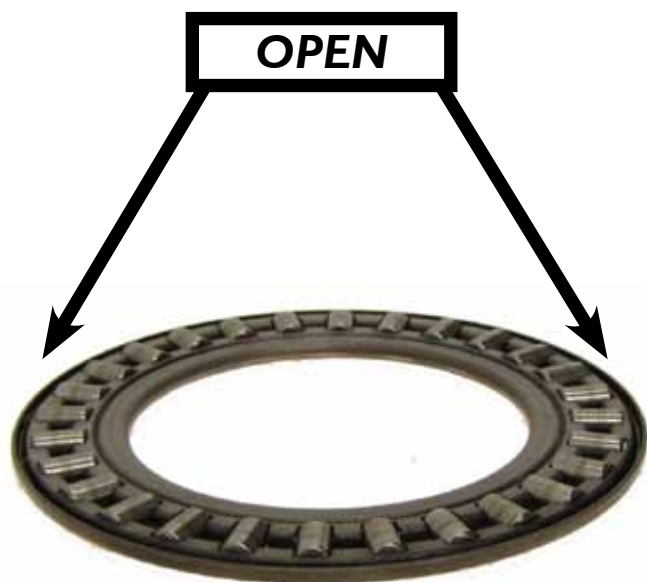
Most applications are forgiving when it comes to bearing position, but some later model units are critical with bearing direction.



All Honda Units

Bearing Alignment (continued)

Note the direction of the outer lip of the bearing, the solid portion of the lip of the bearing faces the bottom of the gear when aligned from the outside.



All Honda Units

Assembly Tips

Note the position of parts on paper. Some units will allow the reverse idler to be installed upside down. This will create a noise or grinding complaints.



All Honda Units

Bearing and Gear Wear

Closely inspect needles and bearings for pitting. It is common for the needles to pit, but not damage the races.



Gear facing should be inspected for galling when any bearing or case wear at the bearing pockets occur.



All Honda Units

Matching the Parts

Use a center punch and a small hammer to mark the drums, pressure plates and pistons with each other. Use a zip tie to keep the pressure plate, steels, snap ring and cushions together.



All Honda Units

Cleaning and Inspecting

Thoroughly clean the reed valves in the pistons. Pistons must be replaced when grooved at the seal surface.



All Honda Units

Cleaning and Inspecting (continued)

Debris can build up and stick to the sides of the drum, using solvent to loosen the material before placing the drum in the hot tank will help clean the debris out while in the washer. Skipping this step will cause the debris to come loose while you're blowing them dry with compressed air, or even worse, when the clean, fresh transmission fluid starts circulating through the unit on the test drive.



All Honda Units

Drum Assemblies

When reassembling the drum assemblies, set up all of the marked components on the bench (drums, pistons, and steel/pressure plate packs). Replace all of the old steels with new steels and pre-soak all of the clutches in Honda fluid. Use the clearance charts to set up the packs if any hard parts within the drum were replaced.



All Honda Units

Helpful Rebuilding Tips

Always loosen and torque valve body bolts in a circular or star pattern...Just as it is important to tighten valve body bolts in an even pattern to prevent warping, loosening valve body bolts evenly will reduce the amount of problems related to warped castings.

Note the check ball and small parts locations by taking pictures or with light “dimple” markings...Honda is very generous with repair information, but sometimes the drawings showing small parts locations can be confusing. Make sure to flat file any markings that are made during disassembly before reassembly.

Remove all valves and springs during valve body repair...Especially after failures that create excessive material (torque converter or bearing failure), all valves must be removed and cleaned individually. Use valve organizing trays from your local parts supplier to keep the valves and springs in the right direction and order. Not only are Honda valve bodies one of the pickiest when it comes to stuck valves, they’re also the hardest valve bodies to get to once in the vehicle. Take the time to do it right the first time.

Use a spray cleaner and compressed air to clean valve bodies...Compressed brake clean out of a can does a great job of lifting debris out of the nooks and crannies in the castings. When blowing dry with compressed air, look for dark colored smudges to come out of the casting. If a smudge appears, give it another shot of brake clean and blow dry until clean.

Stay away from dirty solvent...Unless the solvent is continuously ran through filters, it is not recommended to use a solvent tank to clean Honda parts. The floating debris from other failed transmissions floating in unfiltered solvent will stick to your parts and can cause the valves to stick once back in the car.

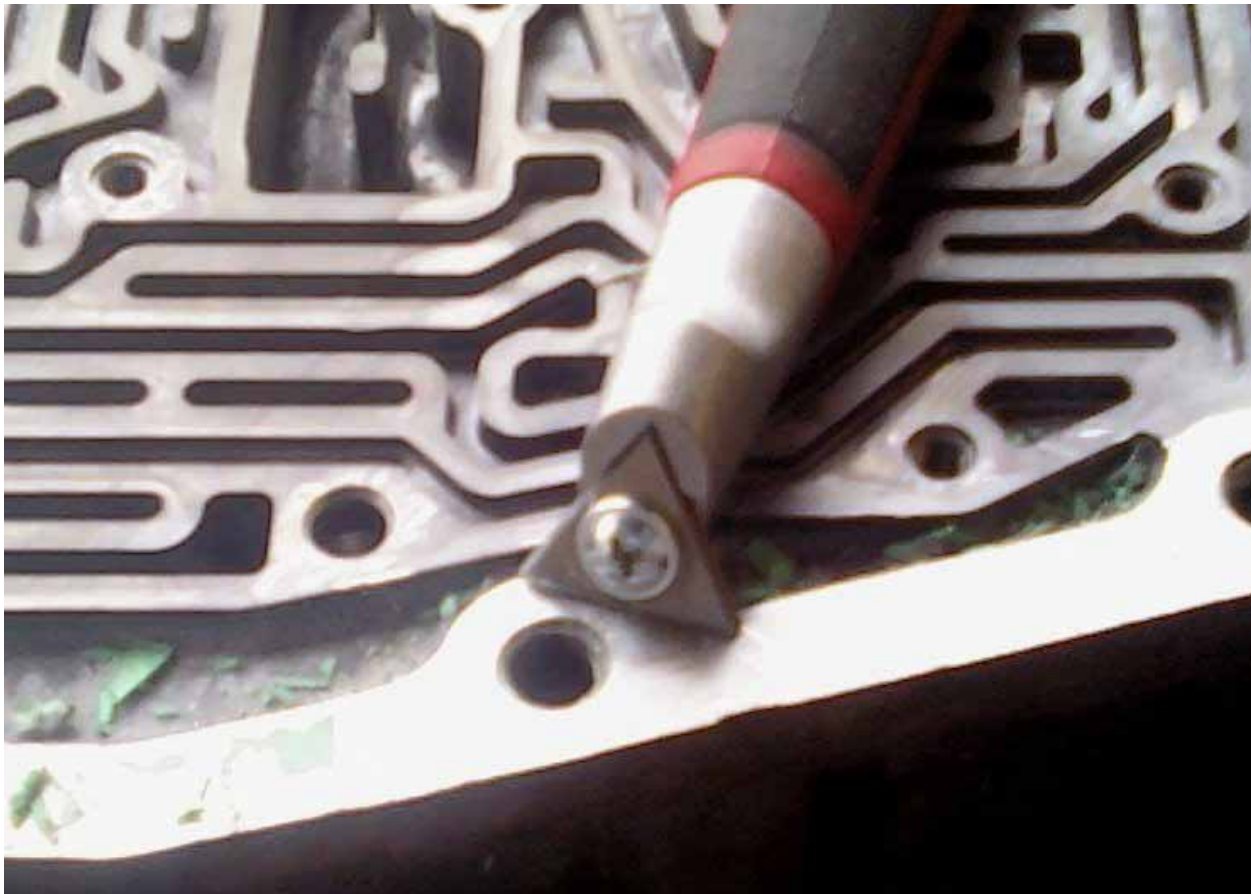
Never guess when it comes to parts locations or specifications...Honda does a good job of sharing detailed repair information with technicians. Most rebuild kits come with pamphlets containing most general rebuilding information. Repair software like Mitchell and All-data have all the detailed information that a technician needs to get the job done right.

All Honda Units

Case Preparation

Honda case gaskets are extremely difficult to clean off of the case. Fight the urge to clean them off the easy way with angle grinders and abrasive pads. The channel casting for the valve body is too close to the gasket surface and can easily be damaged using any power tools.

Power tools will start to grind on the aluminum once past the gasket and cause excess debris to contaminate the case and your work area. Take the time and care to remove the bulk of the gasket with a razor blade and then use a carbide tipped scraper like the one shown below to get those stubborn pieces off.



All Honda Units

Valve Body Reassembly

Lubricating the separator plates will help seal the plates against the worm tracks and will help prevent shifting problems at first start up.



- **Use plenty of ATF when reassembling**
- **Saturate all of the valves before placing back in the bores**
- **Wet all mating surfaces with ATF**



All Honda Units

Valve Body Reassembly (continued)

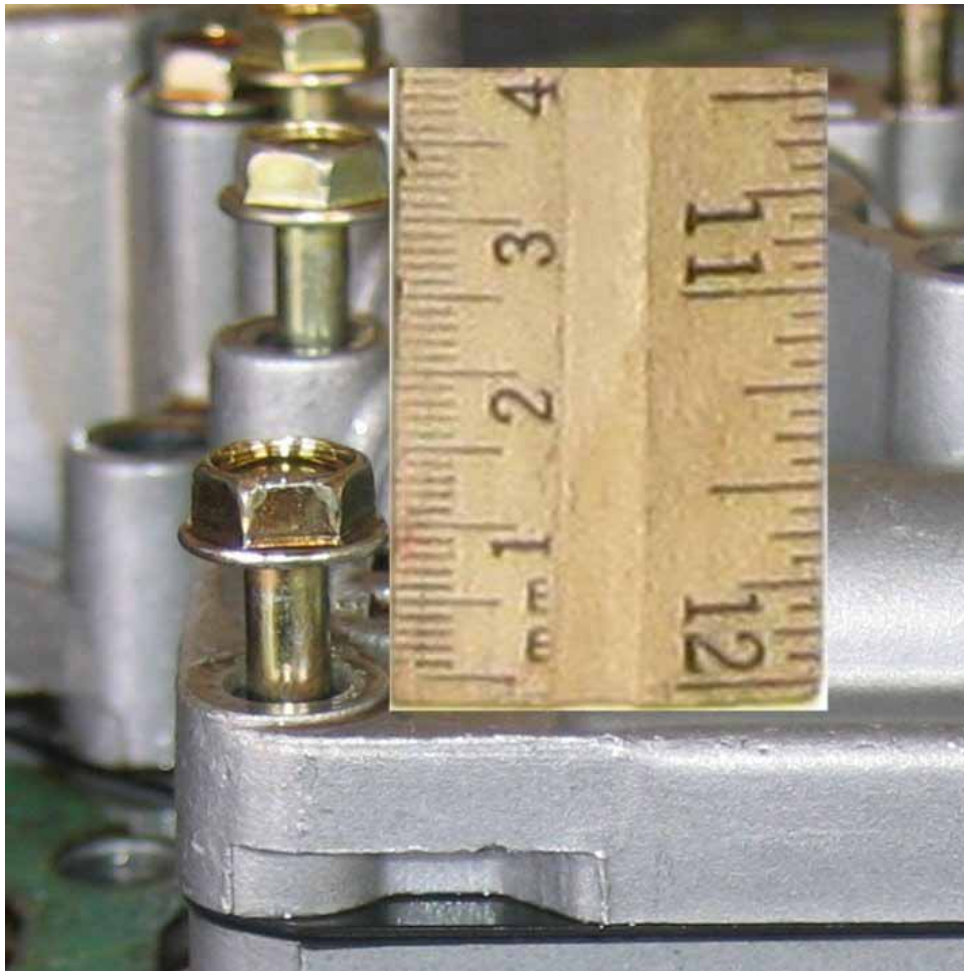
Lubricating the valve body and pump components helps with fluid pick up at the first start up.



All Honda Units

Valve Body Reassembly (continued)

- Always torque the valve bodies in a circular pattern.
- Use a speed handle to run the bolts down.
- Lay your bolts out in order by length.
- All Honda valve body bolts stick up approximately 10mm when installed in their correct locations.



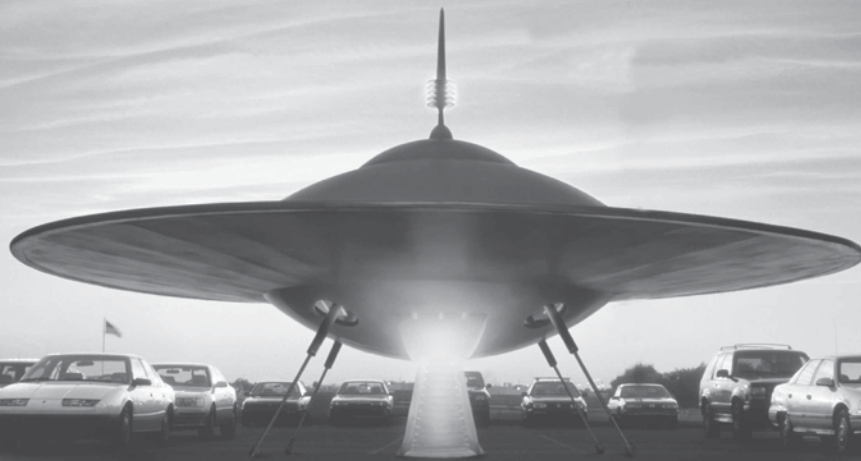
All Honda Units

Accumulator Bores

Use Scotch Bright™ general purpose hand pads to surface the accumulators and reverse servo bores.



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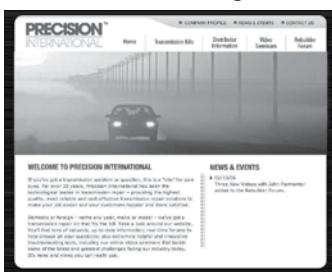
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42-48RE

False Temperature Readings

42-48RE transmissions with a false temperature sensor reading may be caused by a faulty sensor. Early transmission sensors had a decrease in resistance as temperature increased.

This sensor was used 1993 ½ through 1999. Starting in 2000 the transmission temperature sensor reads the opposite, resistance increased as the temperature increased. It is very important not to mix these sensors up. The best way to ID what year you have is to look at the transducer connector. Early transducer has an oval connector and the late transducer has a rectangle connector. When switched the temperature reading will show -30°F and/or 300°F.



**1993 1/2 - 1999
Transducer**



**2000 - on
Transducer**

Coolant Temperature Sensor Transmission Temperature Sensor up to 1999 Temperature vs Resistance			
°C	°F	Min ohms	Max ohms
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

TOT Temperature vs Resistance 2000 - On			
°C	°F	Min ohms	Max ohms
-40	-40	1094	1176
0.0	32	1587	1672
25	77	1960	2040
70	158	2709	2860
100	212	3284	3500
120	148	3684	3950
150	302	4110	4450

42-46RE, 45RFE, 545RFE, 42RLE

Killing the Engine when Coming to a Stop

Dodge and Jeep RWD vehicles with gas engines may have a condition where the engine will die while coming to a stop. This may occur all the time, intermittently, cold, hot or only after a long drive. When restarted the engine acts normal, it will stay running in Drive or Reverse. This condition usually does not set any codes.

This can be misdiagnosed as the TCC staying on and killing the motor. The actual cause is a weak crankshaft speed sensor located at the right lower side of the engine block.

The reason that it only kills the engine coming to a stop is that it's normal for the PCM to run the fuel injectors in fuel-cut-mode during lift throttle braking. It is supposed to "refire" the injectors when the crankshaft sensor indicates idle speed. However, the crankshaft speed sensor signal can be so weak, the PCM stays in fuel-cut-mode and the engine dies.

The three wire crank sensor can fail over time

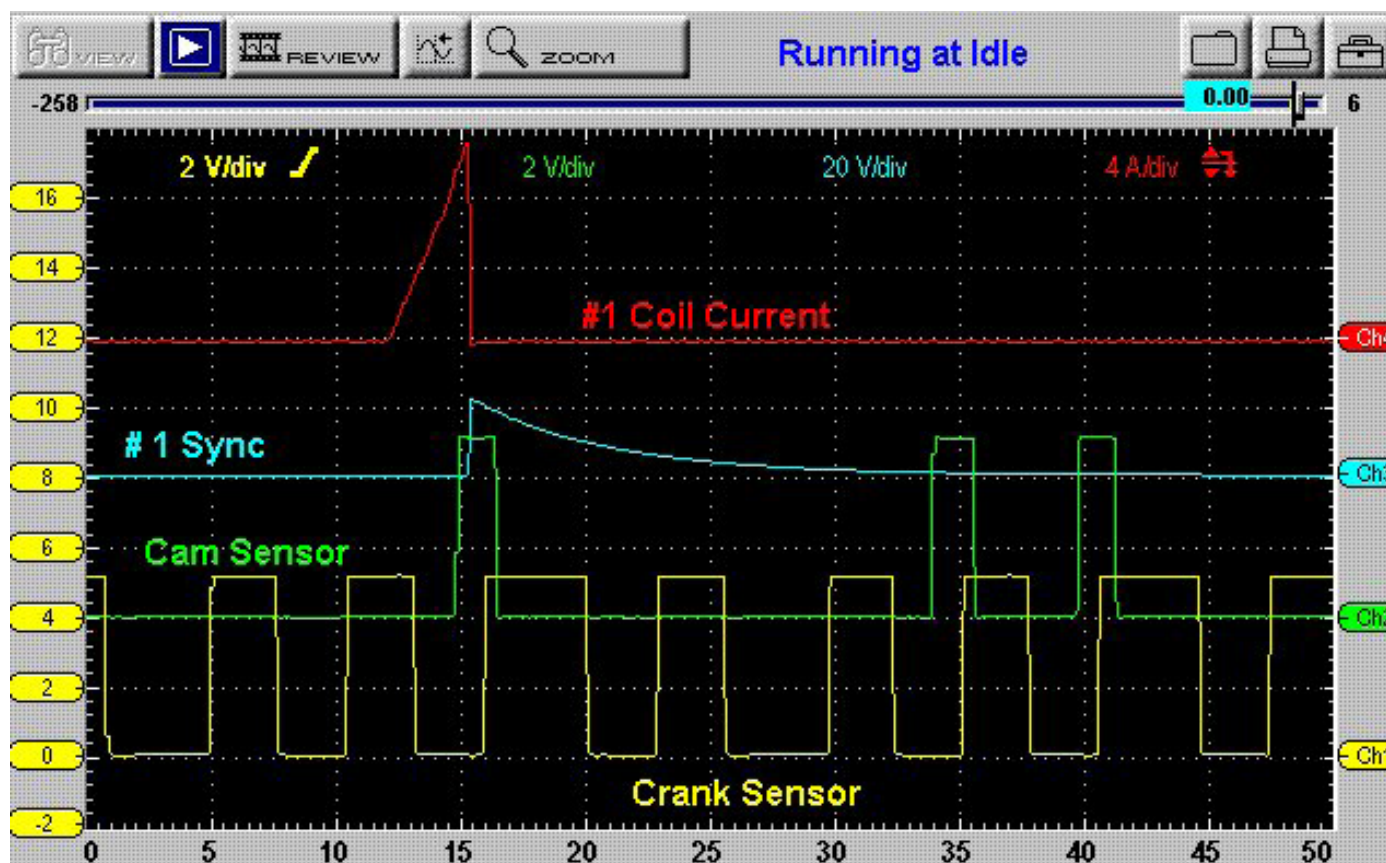


The crank sensor (CKP) is located on the lower right side of the engine block

42-46RE, 45RFE, 545RFE, 42RLE

Killing the Engine when Coming to a Stop (continued)

The sensor is a three wire, hall effect type sensor that runs a square wave DC signal. The following wave form was captured from a known good sensor.



A failed sensor may have a lower amplitude square wave (below 5 volts), or may be a fuzzy or erratic wave pattern or may have no signal at all.

41TE, 42LE, 42RLE

No Forward Movement, Erratic Shifting, Possible P0731, P0732, P0733, and P0734 Ratio Codes

This complaint is becoming more common, especially in early models, with the TCM's causing neutral conditions in forward gears or ranges. Sometimes, ratio codes will be present, but most of the time there are no codes. In situations where there is no movement in first gear, unplugging the transaxle connector induces a second gear start.

If the transaxle engages with the connector off and has reverse, suspect illegal commands from the computer. If any gear neutralizes while driving, check solenoid commands using a multichannel scope. L.E.D. lights don't work very well because of the pulse type signal that the TCM uses to fire the solenoids. The solenoids share a common voltage that is fed from the EATX relay and the computer pulses the solenoids through the ground side when the solenoid is on.

These transaxles use an unconventional firing order compared to other transmissions. Use the following chart for solenoid firing order.

41TE, 42LE, & 42RLE Solenoid Firing Chart					
Range	Gear	UD Solenoid	OD Solenoid	LR/TCC Solenoid	2-4/LR Solenoid
P/N				ON	ON
R	Reverse				
OD	1			ON	ON
	2				
	3		ON		ON
	3 TCC on		ON	ON	ON
	4	ON	ON		
	4 TCC on	ON	ON	ON	
3	1			ON	ON
	2				
	3		ON		ON
	3 TCC on		ON	ON	ON
1	1			ON	ON
The UD and 2-4/LR solenoids are normally open (Applied Clutch)					
The OD and LR/TCC solenoids are normally closed (Not Applied Clutch)					

41TE, 42LE, 42RLE, RE Units

Solenoid and ETAX Relay Diagnostics

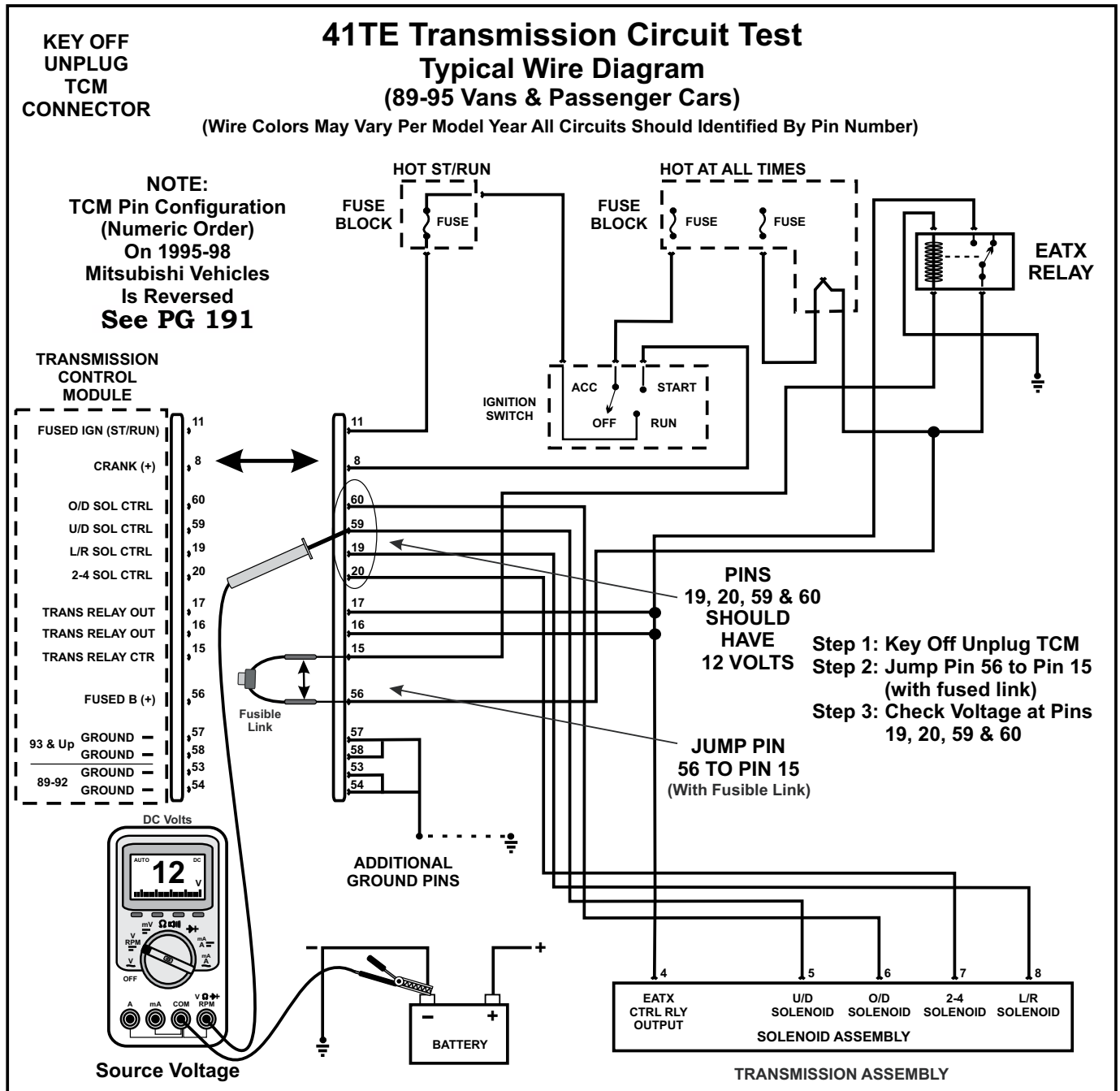
Use the following diagrams to quickly diagnose solenoid and relay codes right from the computer. Keep in mind the following rules when using these diagrams.

1. When jumping terminals to power, ALWAYS use a fused jumper wire.
2. All voltage readings must match battery voltage. Example: If battery voltage measures 12.6 volts across the battery terminals, then it must read 12.6 volts at the pin that is being checked. If the voltage is less than battery voltage by 0.5 volts or more, there is a problem with that circuit.
3. Use the negative battery terminal as ground.

NOTE: All wire schematics should be verified with factory manuals when possible. Wire colors may vary per model year and all circuits should be identified by pin number.

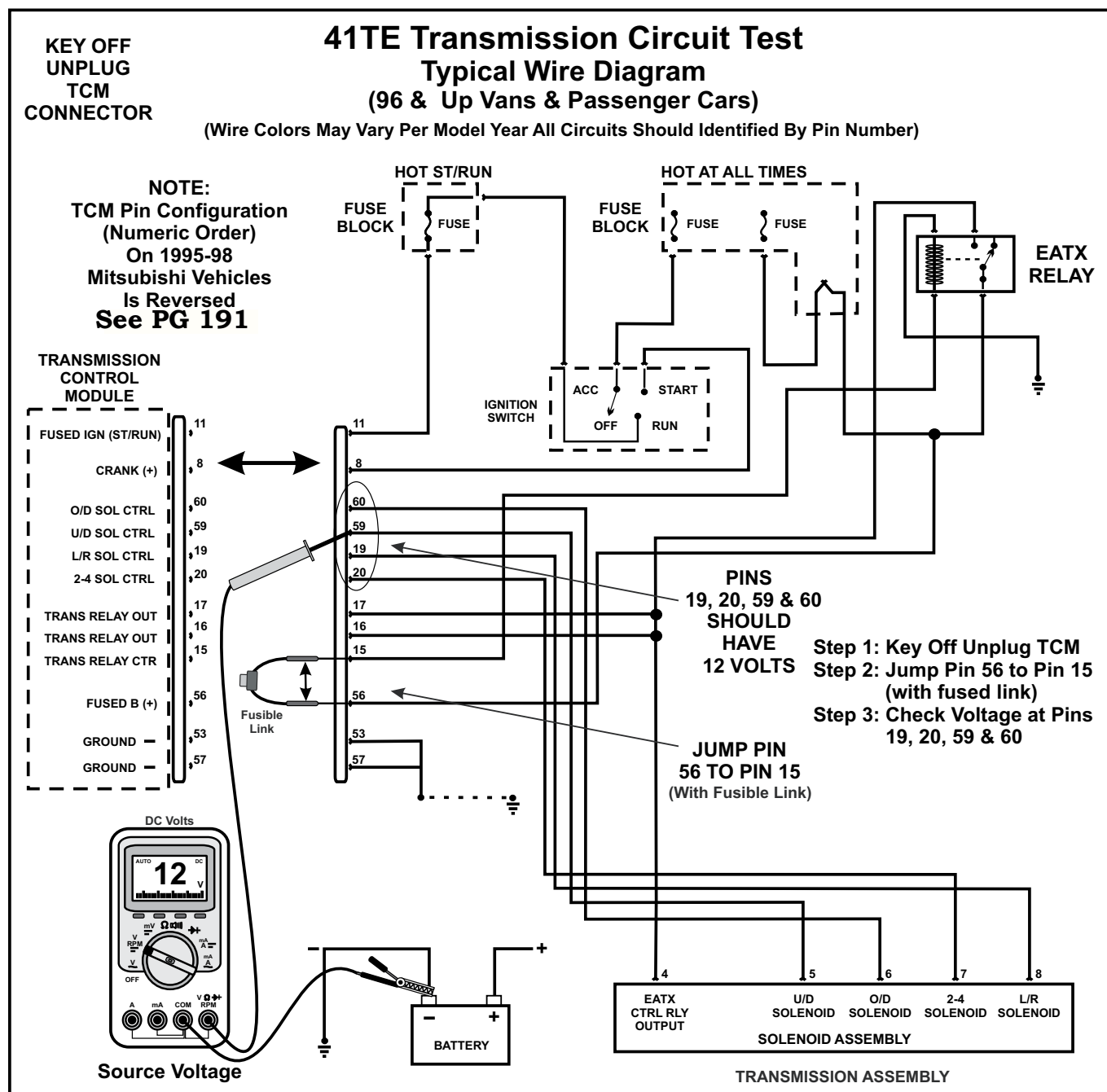
41TE

89-95 Transmission Circuit Test



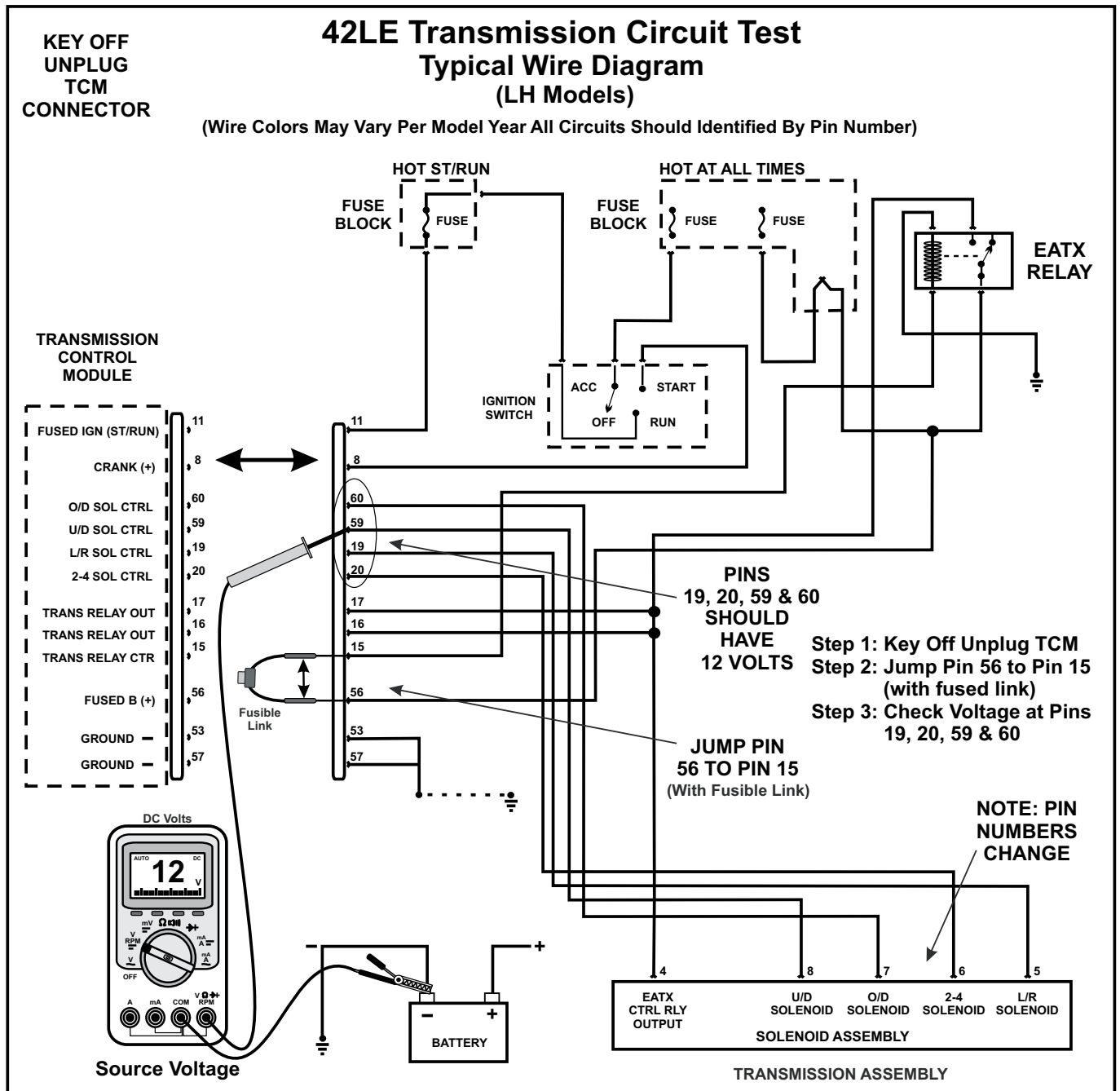
41TE

96 and Later Transmission Circuit Test



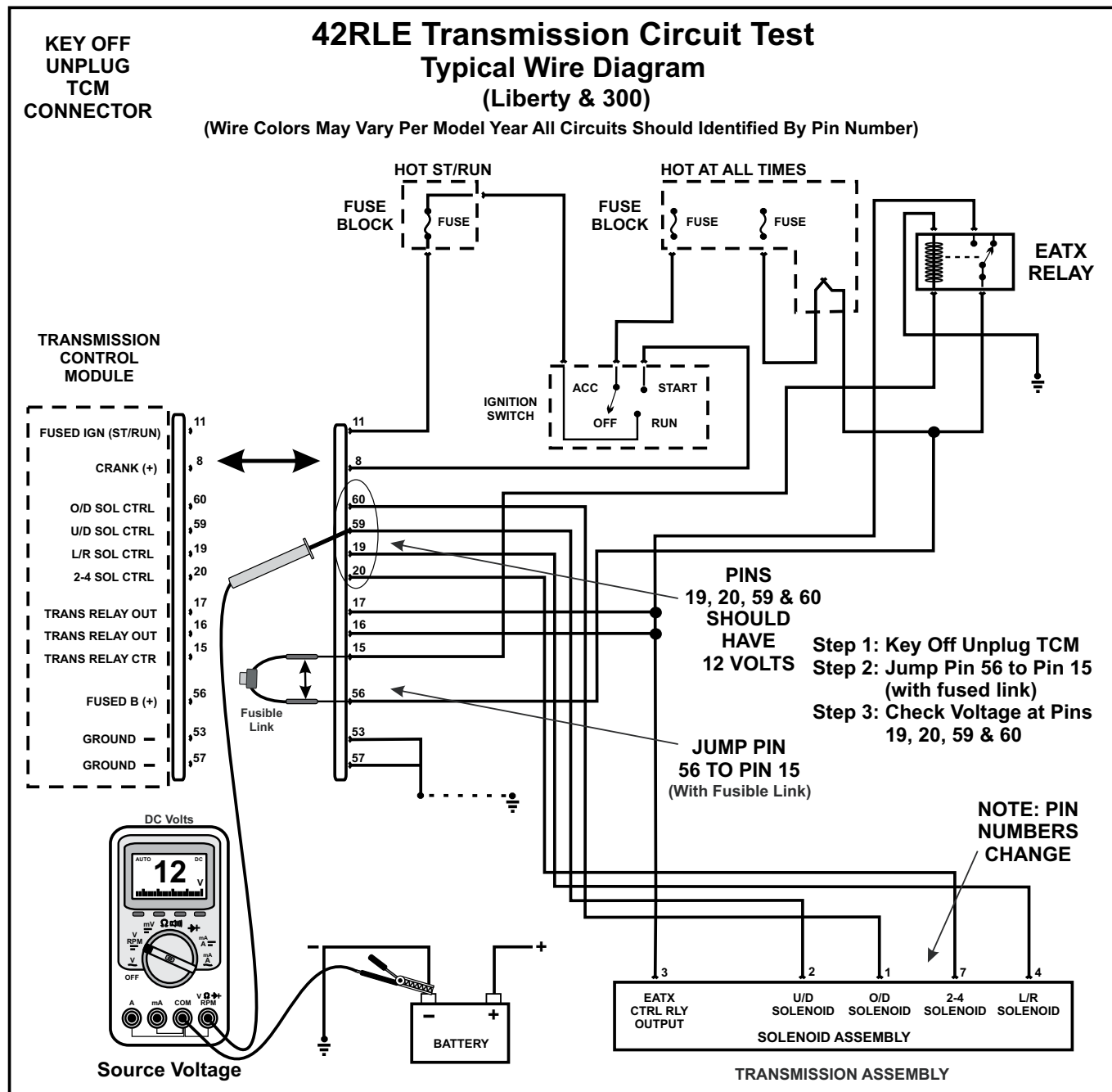
42LE

LH Model Transmission Circuit Test



42LE

Liberty and 300 Transmission Circuit Test

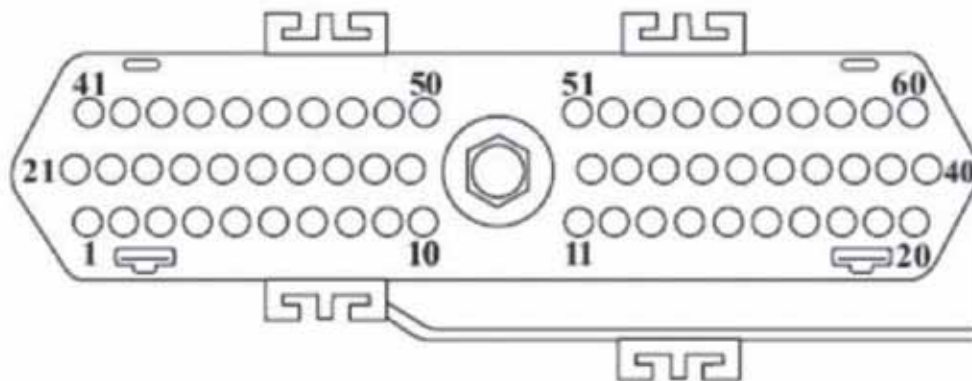


41TE and Mitsubishi

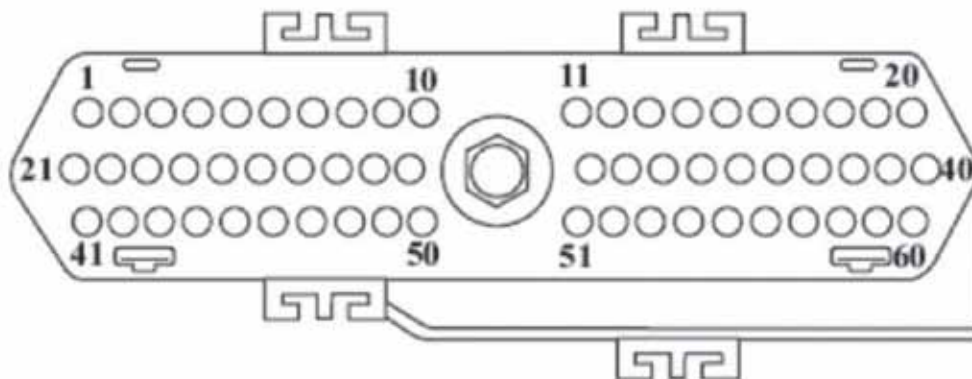
TCM Connector

41TE (604)

**CHRYSLER 60 WAY
TCM CONNECTOR**

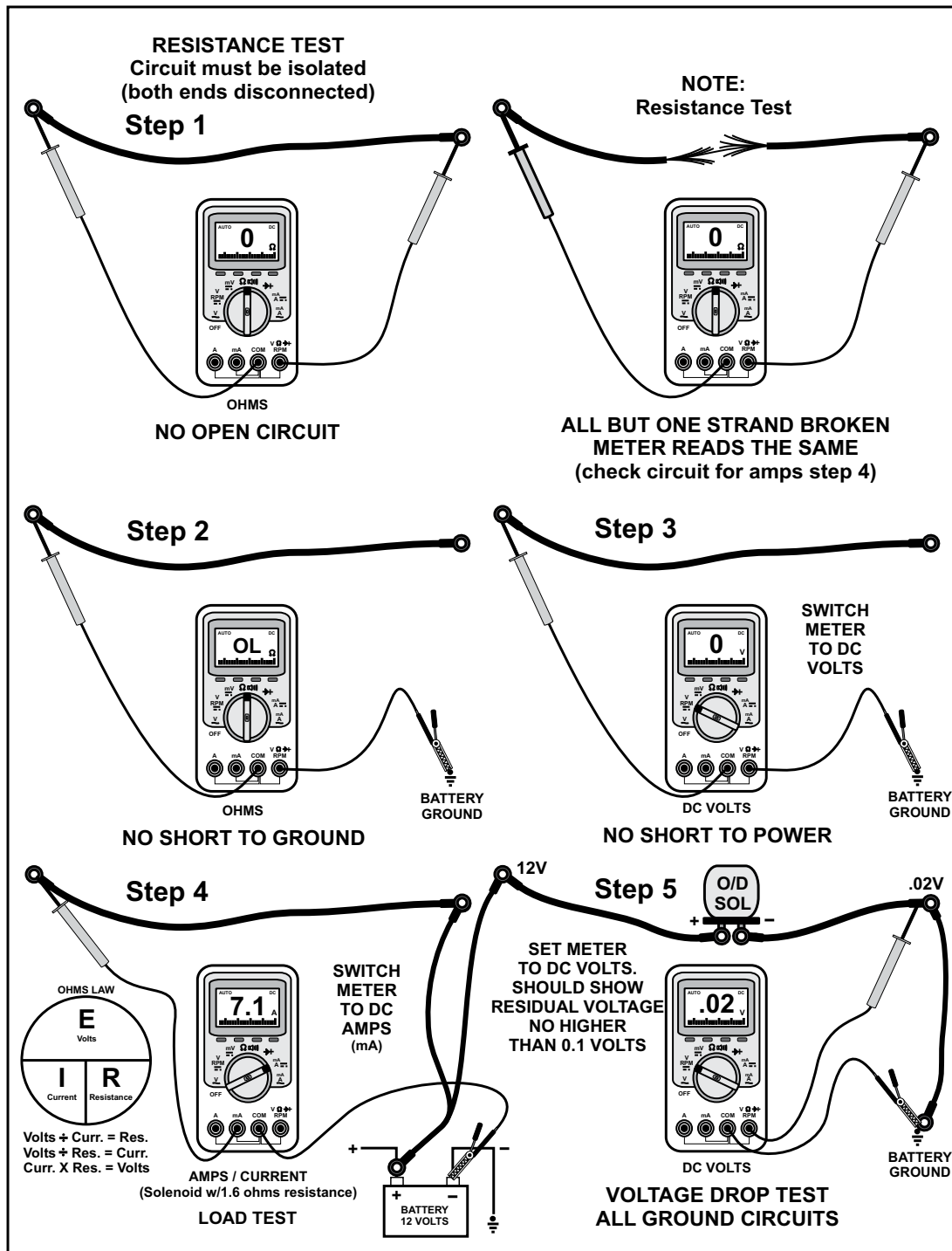


**MITSUBISHI B-85
TCM CONNECTOR**



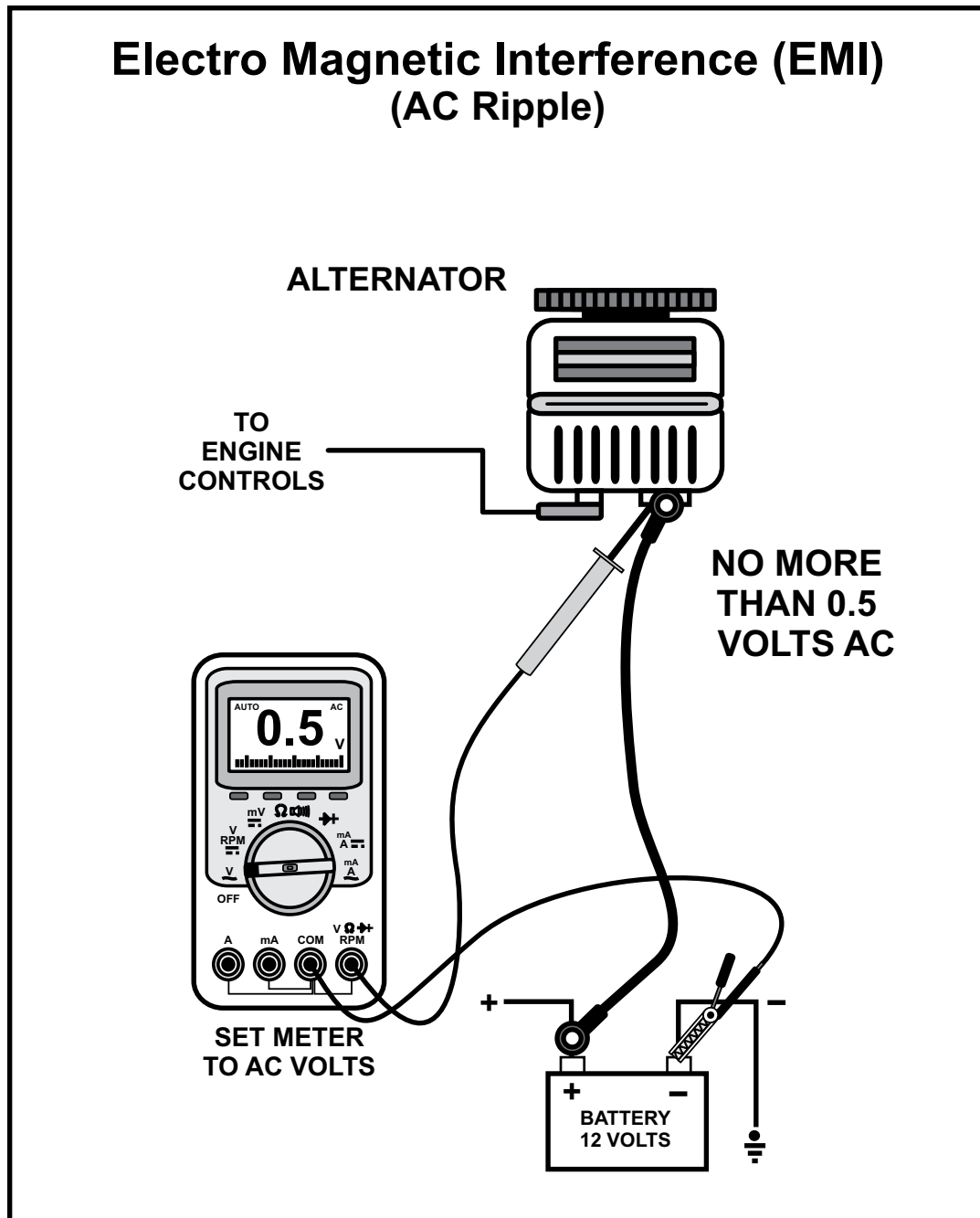
All Units

Basic Electrical Tests To Check Circuit Integrity



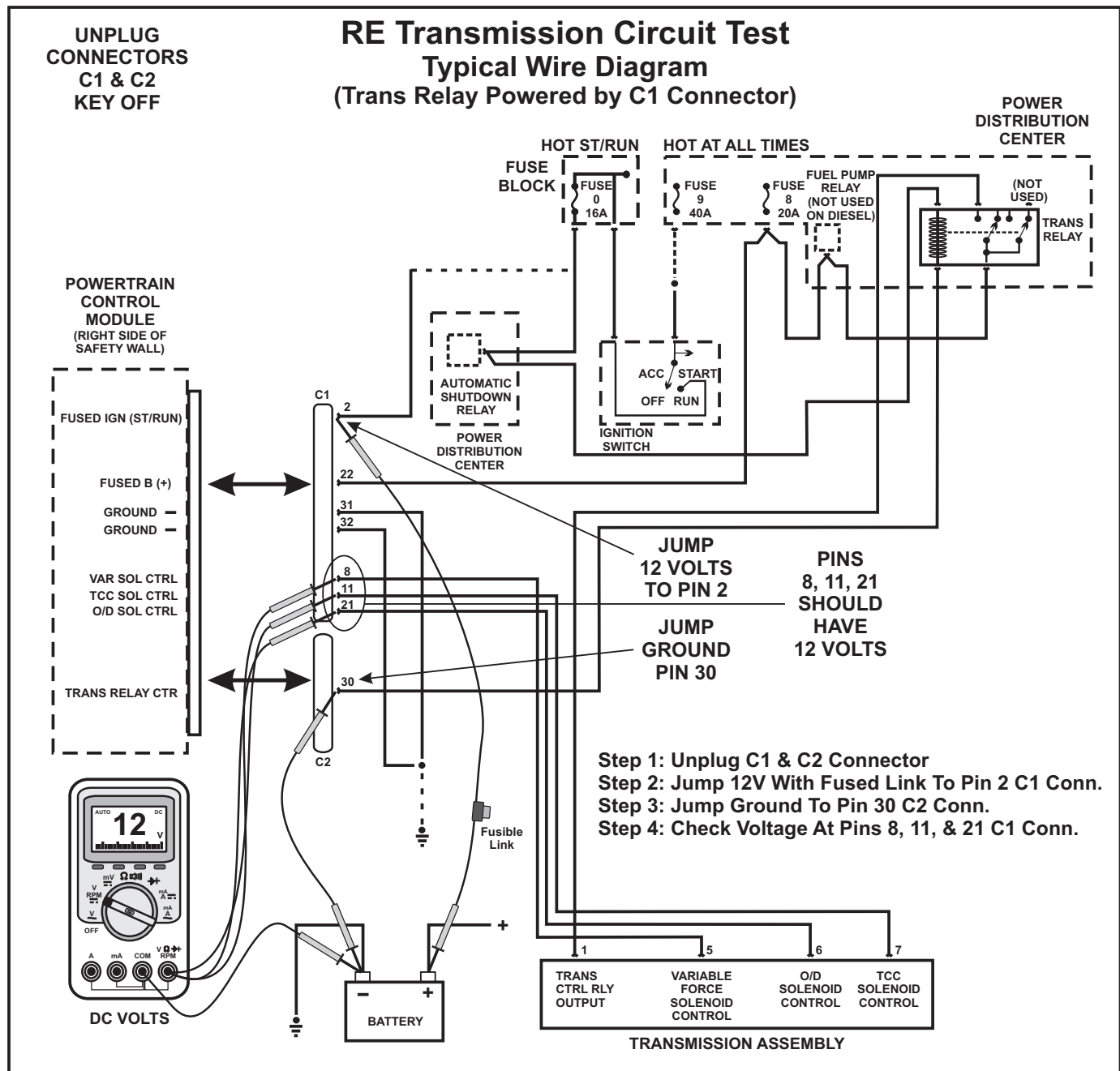
All Units

Basic Test For TPS or Speed Sensor Noise Interference



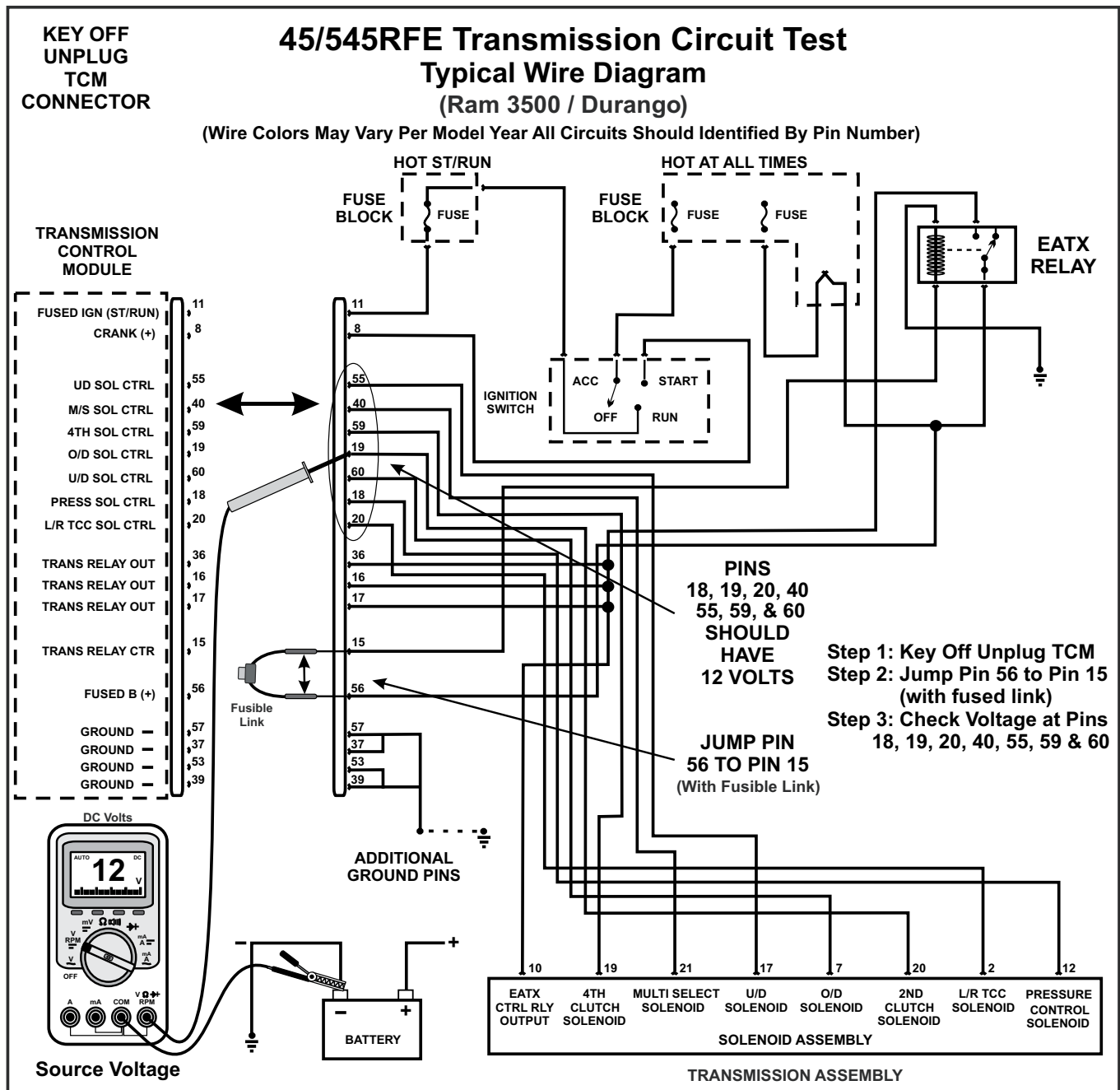
RE Units

Transmission Circuit Test



45/545RFE Units

Ram 3500 and Durango Transmission Circuit Test



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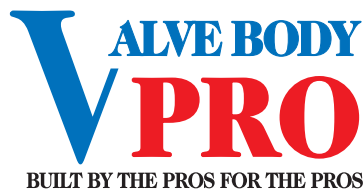
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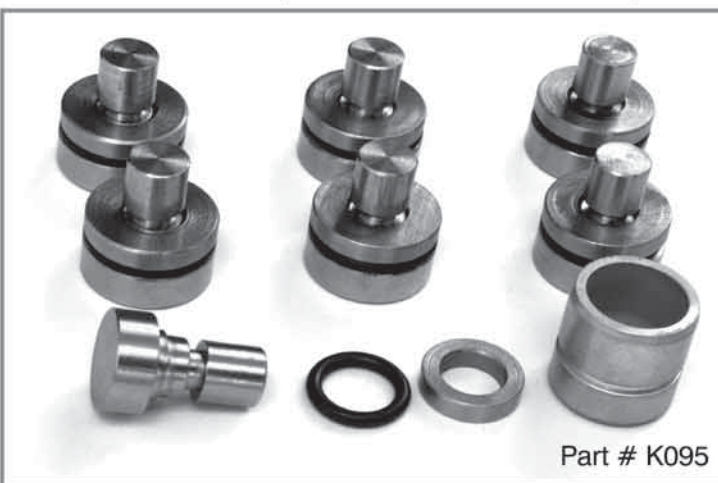
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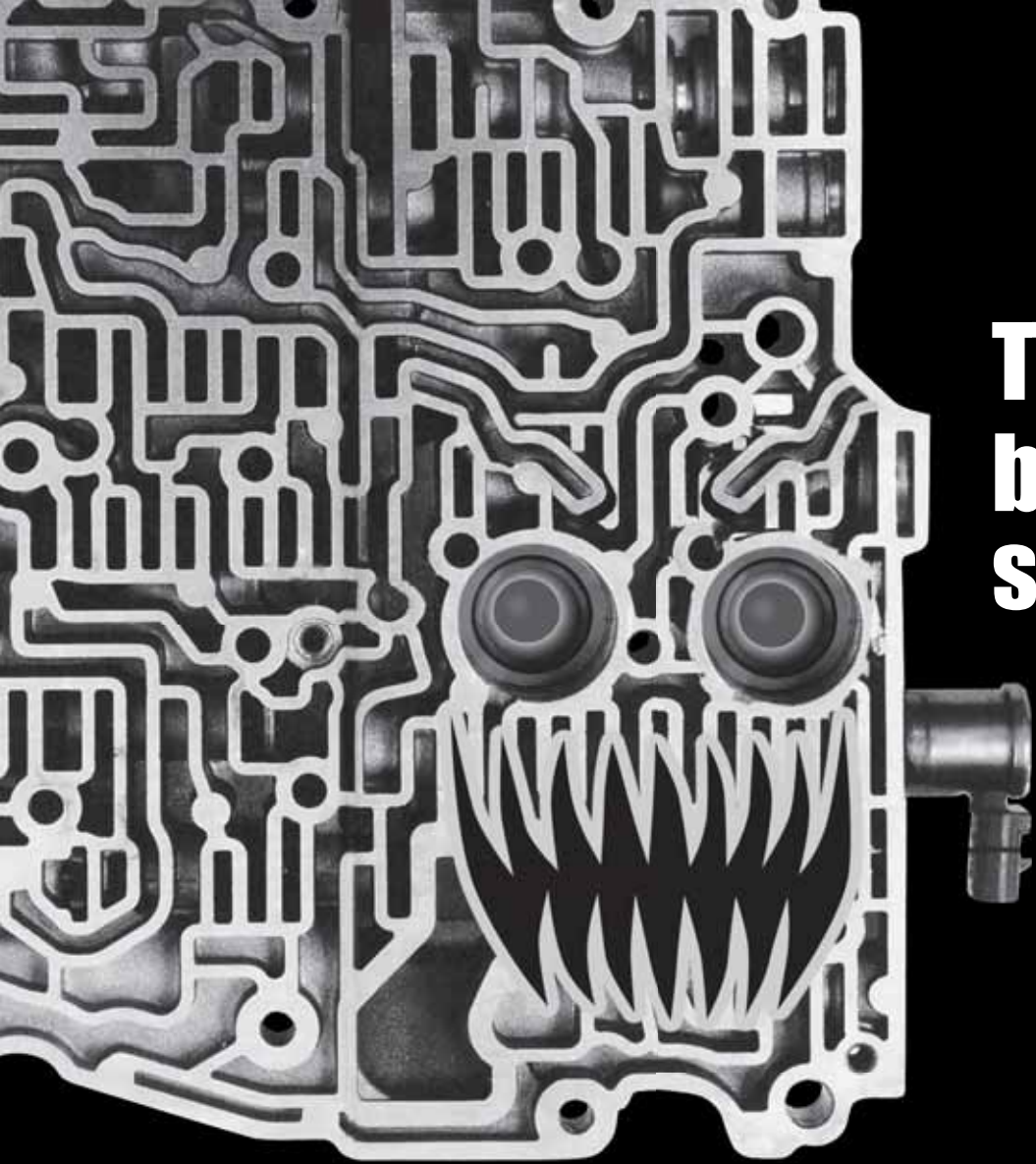
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The purpose of the ATRA is to maintain the highest standards in the automatic transmission repair industry for work quality, customer service and business success.

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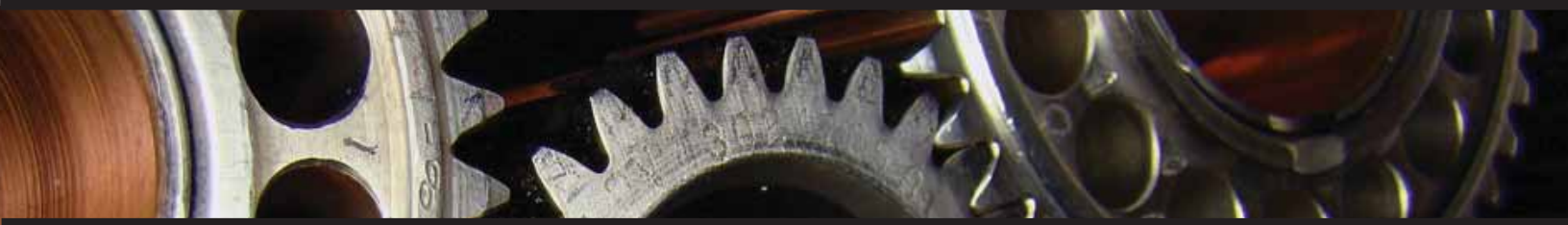
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TRANSMISSION OVERVIEW

GM:	CHRYSLER:	FORD:
LCT 1000	41TE	AWF 21B
4L60/65/70E	545RFE	6F50
4T65E	45RFE	AX4N
4L30E	42RLE	5R55N/W/S
6L80	42-46RE	
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4T40/45E	RE5R05A	
	All Hondas	
	AW55-50SN	

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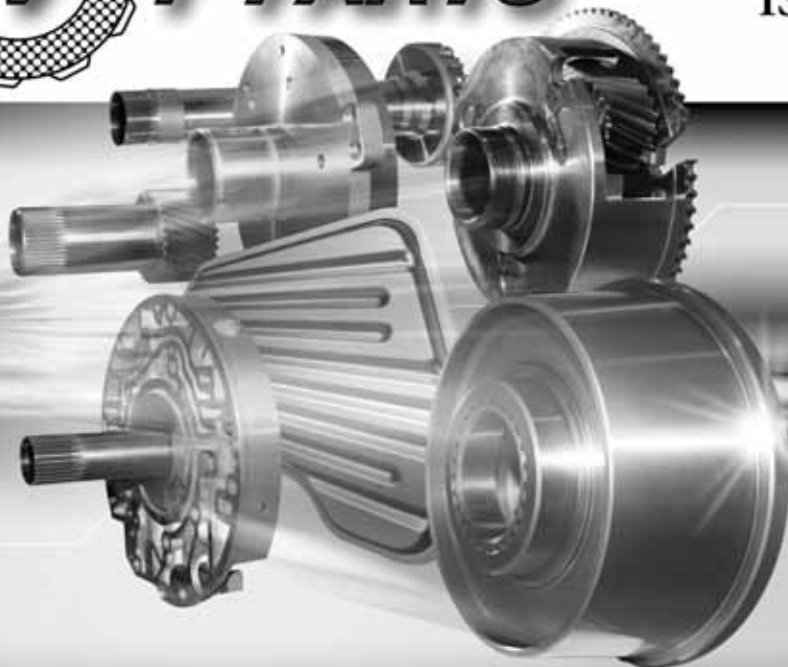
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All Models

Module Damage After Replacement

Starting with the 2010 model year the electrical and diagnostic systems underwent major changes on many GM vehicles. GM is moving towards a common system for all GM vehicles sold worldwide.

Known as the “Global A” diagnostic and communication architecture it will standardize how the systems function and communicate on all vehicles. Currently the Global A architecture is being used on new models such as:

2010-2011	Buick La Crosse/Allure
2011	Buick Regal
2010-2011	Cadillac SRX
2010-2011	Chevrolet Camaro
2010-2011	Chevrolet Equinox
2011	Chevrolet Cruze
2010-2011	GMC Terrain
2010	Saab 9.5
2010	Saab 9.4X

Other vehicle models are scheduled to roll out as new platforms and updates to the current models occur. With the Global A architecture you are no longer able to swap a control module from another vehicle into your vehicle you are having problems with. If you do so you will likely damage the module you are putting into the problem vehicle. In addition, the vehicle will likely develop a start/stall or no start condition.

The Global A system is designed to be used worldwide. Many countries have very strict regulations regarding vehicle theft requirements that the manufactures must adhere to. To meet these requirements GM developed the Global A architecture. Special software security codes are loaded with the specific VIN into the controllers at the assembly plants. The controllers only have the capability of storing one VIN and it's specific security codes.

When someone puts the controller out of another vehicle into the vehicle that was having problems, the VIN and software security codes will not match and that controller will be locked out. While the controller is not actually damaged it will not work in any vehicle including the one you just took it out of. That means if you put the controller you were using as a substitute back it to its original vehicle it will remain locked out and that vehicle will no longer run either.

All Models

Module Damage After Replacement (continued)

While module swapping has presented theft lock/no start problems on some earlier vehicles without the Global A system, this condition is now much more serious. You not only end up with a no start but you may now render the module in question inoperative.

In addition, swapping modules on a Global A vehicle can lead to numerous DTC's that lead you to replace parts that do not have a problem or to "Ghost or Sleeper Symptoms" that only occur after multiple key cycles or battery power downs.

The Global A system has capabilities of handling in excess of 100 different controllers on its data bus systems. While GM is not close to using that many modules on its current products it is expanding the number of controllers that are used. This means that this problem may occur even if you swapping a module other than the ECM.

Common modules such as the IPC, ECM, BCM, EBCM, SDM, ECC also fall under this limitation. Like other things in our industry, module swapping as a way of locating a bad module is now behind us.

4T40E/4T45E

Miss, TCC Surge, 2.2L, 2.4L

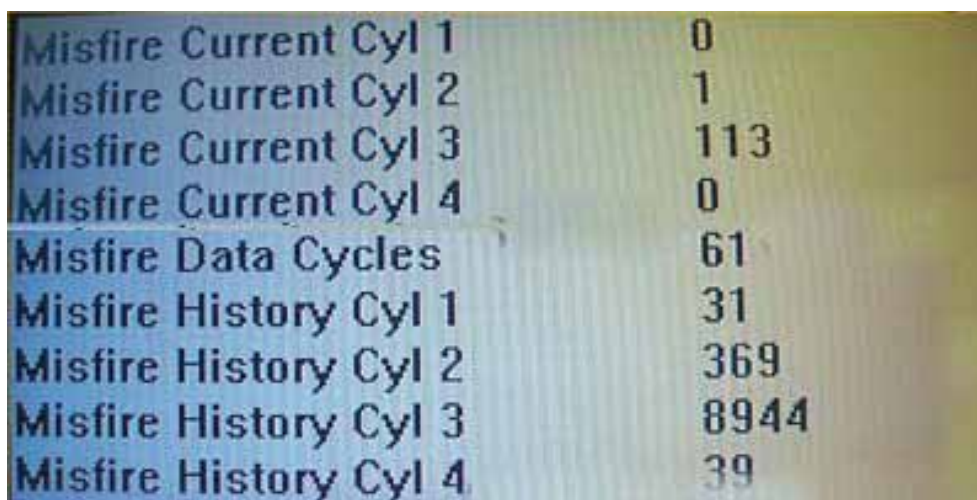
A surge type concern that may be interpreted as a transmission related complaint on 2002 and later 2.2L, 2.4L 4T40E/4T45E applications may be caused by a misfire.

In most instances the technician will need to have the vehicle under load to duplicate the concern. The problem is load sensitive and can be isolated by monitoring the engine misfire counters. You will typically see high misfire counts on the cylinders in question. You may or may not have a misfire DTC set (P0300-P0304).

If a misfire is present inspect the following areas:

- Inspect for evidence of the spark jumping to ground on the A/C lines, near the A/C compressor
- Inspect for evidence of the spark jumping to ground on the transmission mount
- Inspect for evidence of the spark jumping to ground on the transmission lines
- Inspect for evidence of coil arc over at the coils themselves
- Inspect the ignition coil ground
- Inspect the fuel injector wiring for being shorted to ground on the A/C line bracket at the rear of the cylinder head near the transmission

If a misfire is present, a full tune up may be in order.



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Misfire History Cyl 3	8944
Misfire History Cyl 4	39

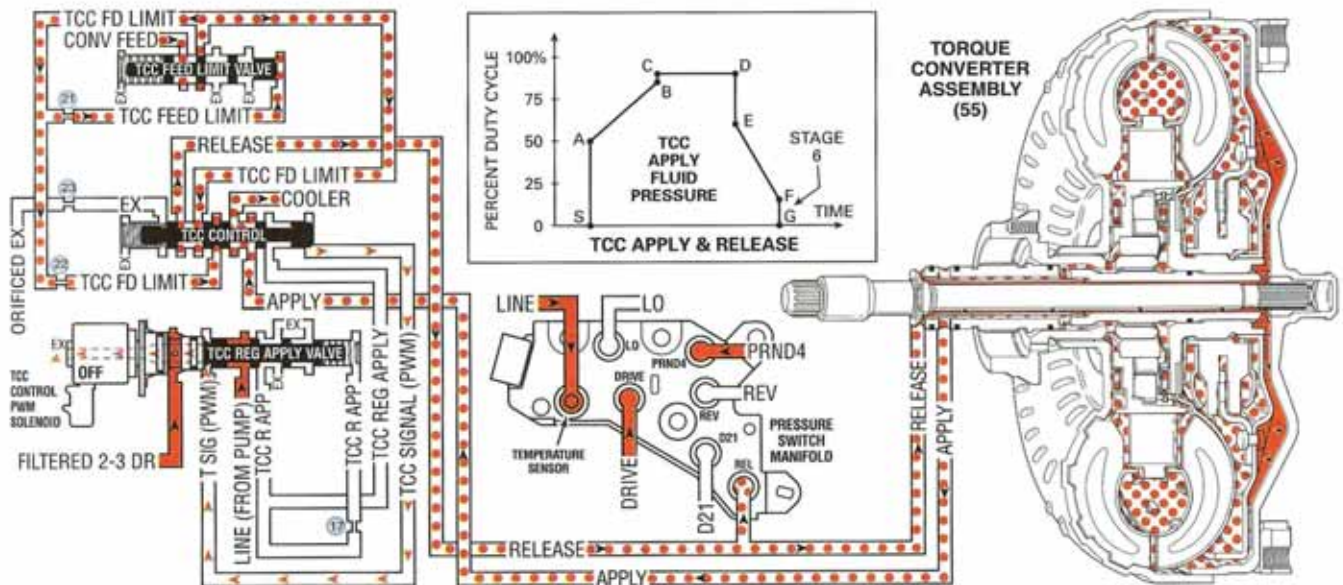
Stalls When Coming to a Stop

A complaint of stalling when coming to a stop or a “chugging” type complaint when the vehicle is coming to a stop. The condition may be intermittent and the engine will typically restart after stalling. This condition may be caused by the TCC not being fully released.

The TCC is not fully releasing when the vehicle is at lower road speeds or when coming to a stop. An electrical issue with the TCC system should not cause a stalling complaint with this application, if a chuggle complaint is present check to be sure the TCC is being commanded off and that the TCC is releasing electronically.

Inspect the cooler lines for evidence of damage. If the cooler lines appear to be in good physical condition you will need to isolate the cooler from the transaxle. To help isolate the cause for the concern, disconnect and loop the cooler lines with a piece of hose. If the problem is no longer present, a restricted cooler may be the cause of the concern. Replace or flush the cooler if a restriction is present.

If the problem still occurs with the cooler lines looped inspect the TCC Apply valve for sticking and/or the TCC solenoid for problems.



4T45E

DTC P1818 (TFP), Multiple Concerns

Any or all of the following concerns may be present:

- SES/MIL light on
- Power door lock features inoperative
- Retractable hard top roof inoperative
- Transmission shift interlock inoperative
- Cruise control inoperative
- Hybrid auto stop inoperative on hybrid applications
- Engine speed limited to 4000 RPM after a cold start (below 50°F, (10°C))
- Hard shifts
- P1818 set (TFP Valve Position Sw. - Drive Without Drive Ratio)

P1818 will set if:

- No MAP, TP, ISS, OSS or shift solenoid DTC's are set
- Calculated TP is greater than 10%
- OSS 153 RPM or greater
- Calculated engine torque is greater than 33 lb ft (45 n-M)
- TFT greater than 68°F (20°C)
- The TCM detects the ratio for reverse (2.14-1) is present, but the TFP indicates the car is in P/N or a forward gear range.

If a P1818 sets the TCM will:

- Command high line pressure
- Freeze the shift adapts

A problem with the TFP (Transmission fluid pressure switch) or its circuits may lead to some of the problems. To isolate if the TFP is causing the concerns monitor TFP switch position with your scan tool.

Range Signal	B	C	TFP Scan Values
Park/Neutral	HI	HI	Low= 0 Volts, High= Battery Voltage
Reverse	HI	LOW	
Drive	LOW	HI	
Invalid	LOW	LOW	

Clear the DTC's. If the TFP switch indicated position and the actual shifter position do not agree, use your diagnostics to help you isolate the cause of the problem.

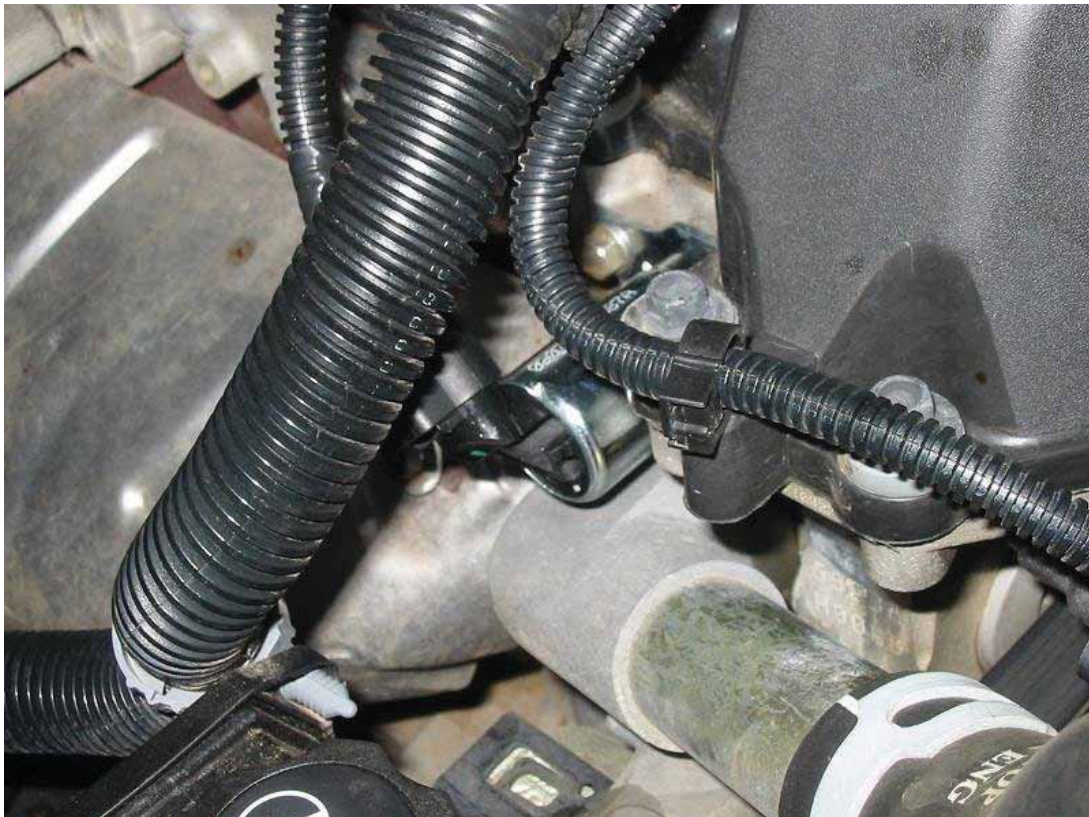
If the scan values indicate the TFP is operating correctly, a false P1818 may have set. If that is the case, a revised calibration is available for a false P1818 DTC. Install the updated calibration.

4T45E

Engine Lugs, Erratic Transmission Operation

Engine Lugs and/or Erratic transmission operation may be caused by an engine code P0013 or P0014 Camshaft Position (CMP) Actuator solenoid Control Circuit.

When these codes set the TCM goes into torque management mode replacing the CMP actuator fixed the harsh shift concern problem.



4T65E

P0741 TCC Circuit Performance/Stuck Off

Impala, Malibu, Monte Carlo

The torque signal regulator valve was updated due to sticking concerns. The sticking is due to expansion/contraction of the metal valve and the aluminum bore. This concern is most prevalent during cold temperature operation and may lead to TCC related issues and DTC's (P0741).

The update to address this concern includes a material change for the valve. The new valve is made of "Anodized Aluminum". Kits are available to address this concern on 2004 and Later 4T65E applications.

24244403:(Non-Tap) TCC Signal Regulator Valve, Spacer Plate Assembly

24244405: (Non-Tap) Updated Valvebody, which includes updated TCC Regulator Valve and Spacer Plate

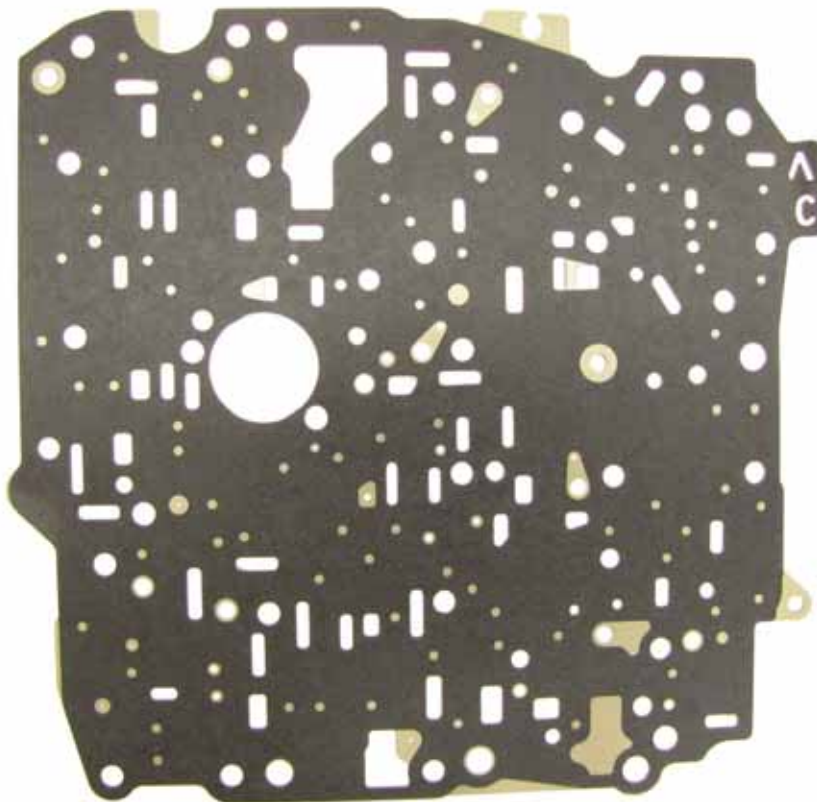
24244404: (Tap Models) TCC Signal Regulator Valve, Spacer Plate Assembly

24244406: (Tap Models) Updated Valvebody, which includes updated TCC Regulator Valve and Spacer Plate

TCC Signal Regulator Valve



Non-Tap Spacer Plate Shown



4T65E

P0741 After Rebuild

A code P0741 (Torque Converter Stuck Off) present after overhaul, can be caused by installing the wrong stator support shaft. There's a different length stator support and turbine shaft found in the 4T65E transaxle than that found in the 4T60E.

4T65E**Stator
Support****4T60E****Turbine Shaft**

6.250"



6.000"



4T65E

P074I After Rebuild (continued)

With the correct stator support installed (shown side by side) the amount of the turbine shaft extending out is about equal on both applications.

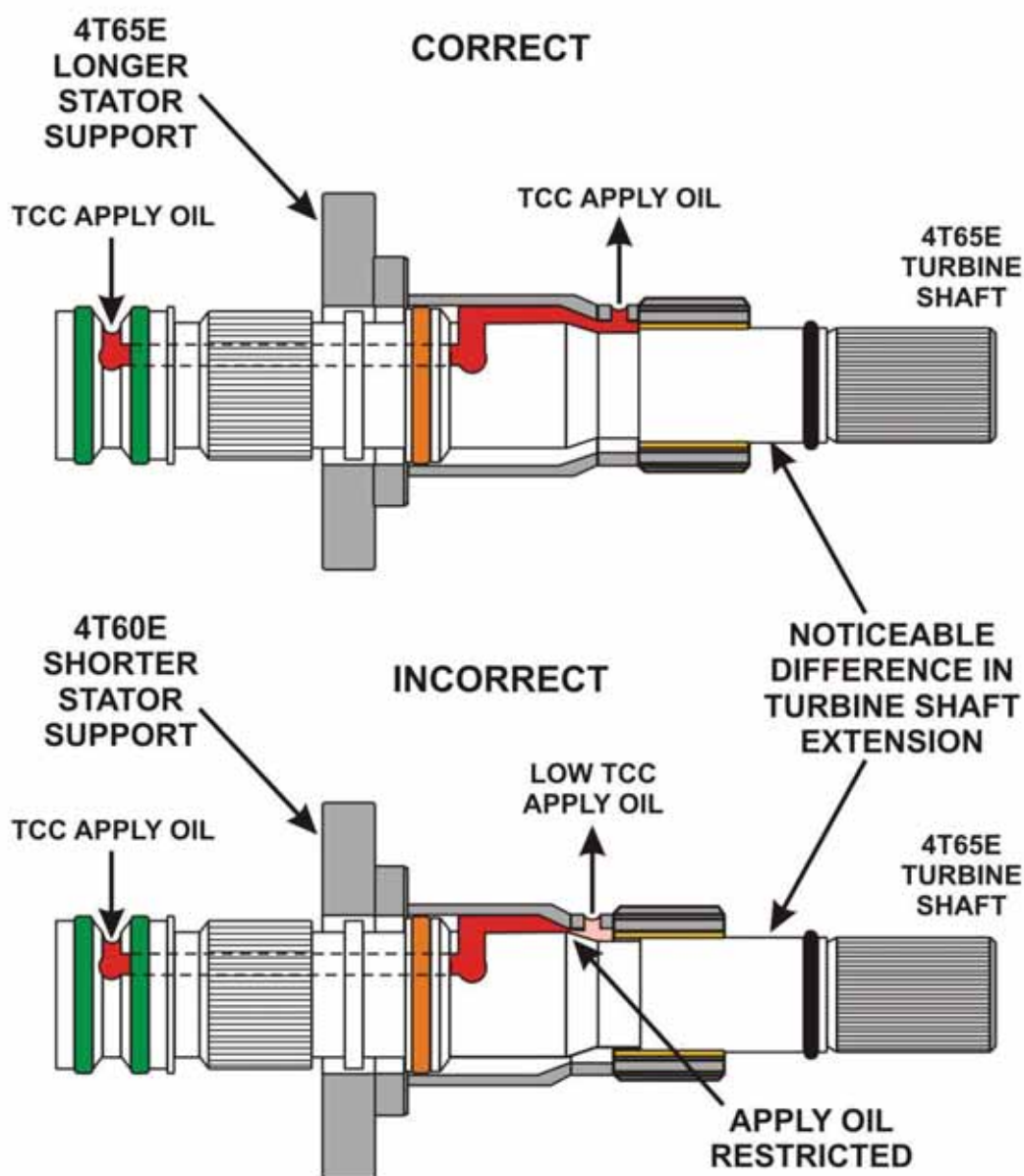


4T65E

P0741 After Rebuild (continued)

When a 4T60E stator support is installed onto a 4T65E transmission, a noticeable difference of turbine shaft extension can be seen. If the mistake is made the ramped area where the TCC apply oil passes between the inside of the stator support and the turbine shaft becomes restricted. This will cause a low volume of TCC apply oil setting DTC P0741.

Note: Always check the support when purchasing any transmission.



4T65E

Multiple Codes

Silhouette, Lumina, Tran Sport

Multiple codes, erratic shifts, and/or harsh engagements may be a damaged transmission wiring harness. This may be caused by a sharp edge of the air cleaner box coming in contact with the wiring harness. Remove the sharp edge from the bottom of the air cleaner box, repair and reposition the wiring harness to correct this concern.



4T65E

Harsh Shifts, Multiple Codes

Harsh shifts may be caused by the internal wiring harness being routed incorrectly, there may also be several codes including P0742, P2761, P2764.

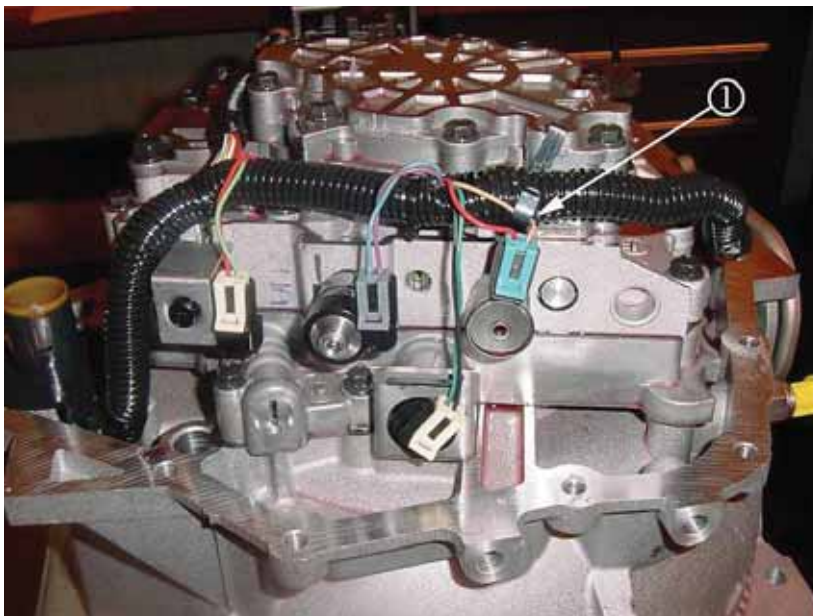
The DTC's will set if the following conditions are met:

P0742 will set if:

- No ISS, OSS, TP DTC's are set
- P0741 is not set
- Engine RPM is greater than 500
- Calculated TP is 8-90%
- TCC PWM is commanded OFF
- Gear Ratio is between .66-1.68
- Engine Torque is greater than 37 lb ft (50 N m)
- VSS is greater than 10 mph (16kph)
- The TCC slip speed is between -20 and +40 RPM for 6 seconds, 3 times during the same ignition cycle (3.5L and 3.9L).
- The TCC slip speed is between -20 and +40 RPM for 5 seconds, 3 times during the same ignition cycle (5.3L).

If a P0742 is set the PCM will:

- Command maximum line pressure
- Freeze shift adapts
- Turn on the SES lamp on the second consecutive failure



4T65E

Harsh Shifts, Multiple Codes (continued)

P2764/P2761 will set if:

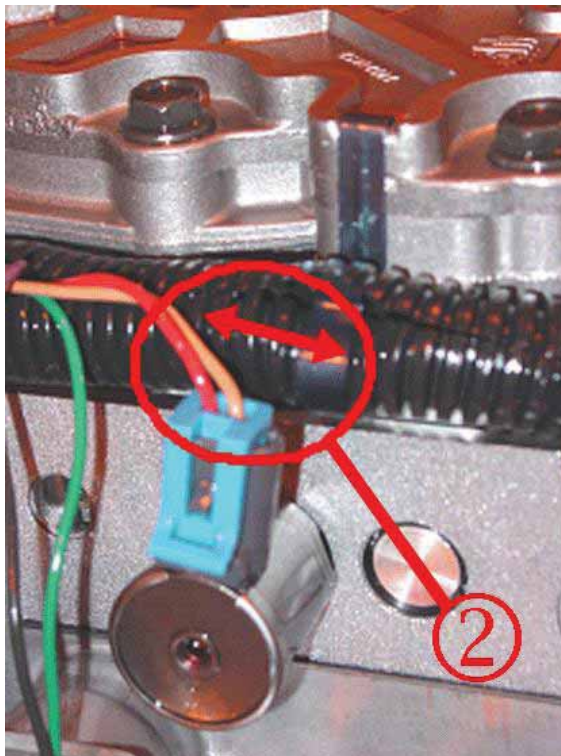
- The PCM commands the TCC PWM solenoid OFF, and the circuit feed back voltage is low OR
- The PCM commands the TCC PWM solenoid ON, and the circuit feed back voltage is high

One of the above conditions is present for longer than 4 seconds

If a P2764/P2761 is set the PCM will:

- Command maximum line pressure
- Command TCC off
- Freeze the shift adapts
- Inhibit 4th gear if you are in hot mode

Problems with the internal transmission wiring harness are common on these applications. Typically the tan wire (CKT 418) is shorting to ground on one of the support brackets for the internal harness. The TCC PWM solenoid wiring was not designed to be held by the bracket that supports the internal harness and it's conduit. If someone attempts to use the bracket to support the TCC PWM wiring it will cause the wiring to chafe which will short the circuit to ground. If the harness is damaged you may want to replace it. The part number is 24229643.



4T65E

DTC's, Lack of Power, Shift Concerns

Some 2006-2010 Chevrolet Impala and Monte Carlos equipped with the 4T65E transaxle may set multiple DTC's and exhibit shift related concerns. In addition, you may hear the customer comment regarding a lack of power that is associated with the other problems the vehicle is exhibiting. Upon inspection you may find any combination of the following codes set, P0641, P0532, P0522, P0452, P0335, P0106, P0101, P0068, P2120, P2122, P2123, P2125, P2127, P2128, or P2138. Like other areas of concern, this condition is likely to be intermittent and the DTC's will likely be stored as history type codes.

The most common causes for this condition is wiring harness chafing and circuit pin tension concerns.

Wire Chafing

- Inspect the harness as it runs past the power steering pump. In many instances the harness comes in contact with the power steering pump pulley leading to the problem.
- Inspect the main harness where it runs over the transaxle and under the air cleaner box. Many times the harness rubs through on the transmission case.
- Inspect the harness where it runs under the right rear seat. Sometimes the harness is pinched between the seat frame and the floor pan.

Pin Tension

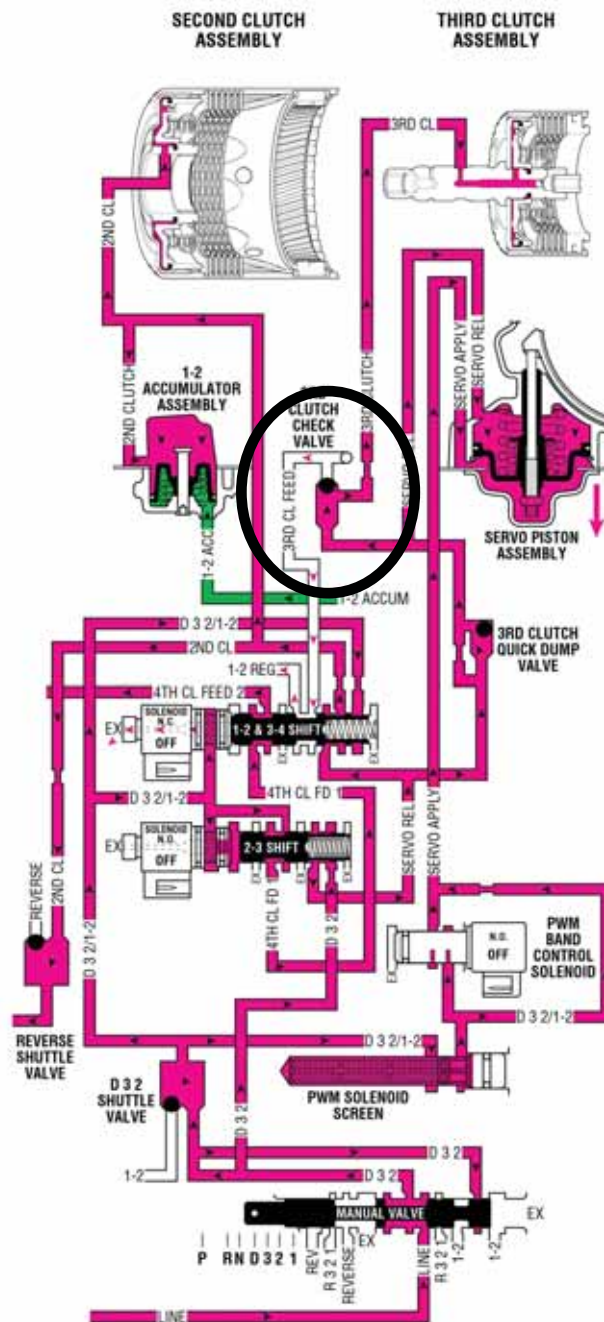
- Check terminal tension for the APP circuits (circuits 1164, 1161, 1271, 1274, 1162, 1272) at the APP sensor, connector X111, and the ECM.



4L30E

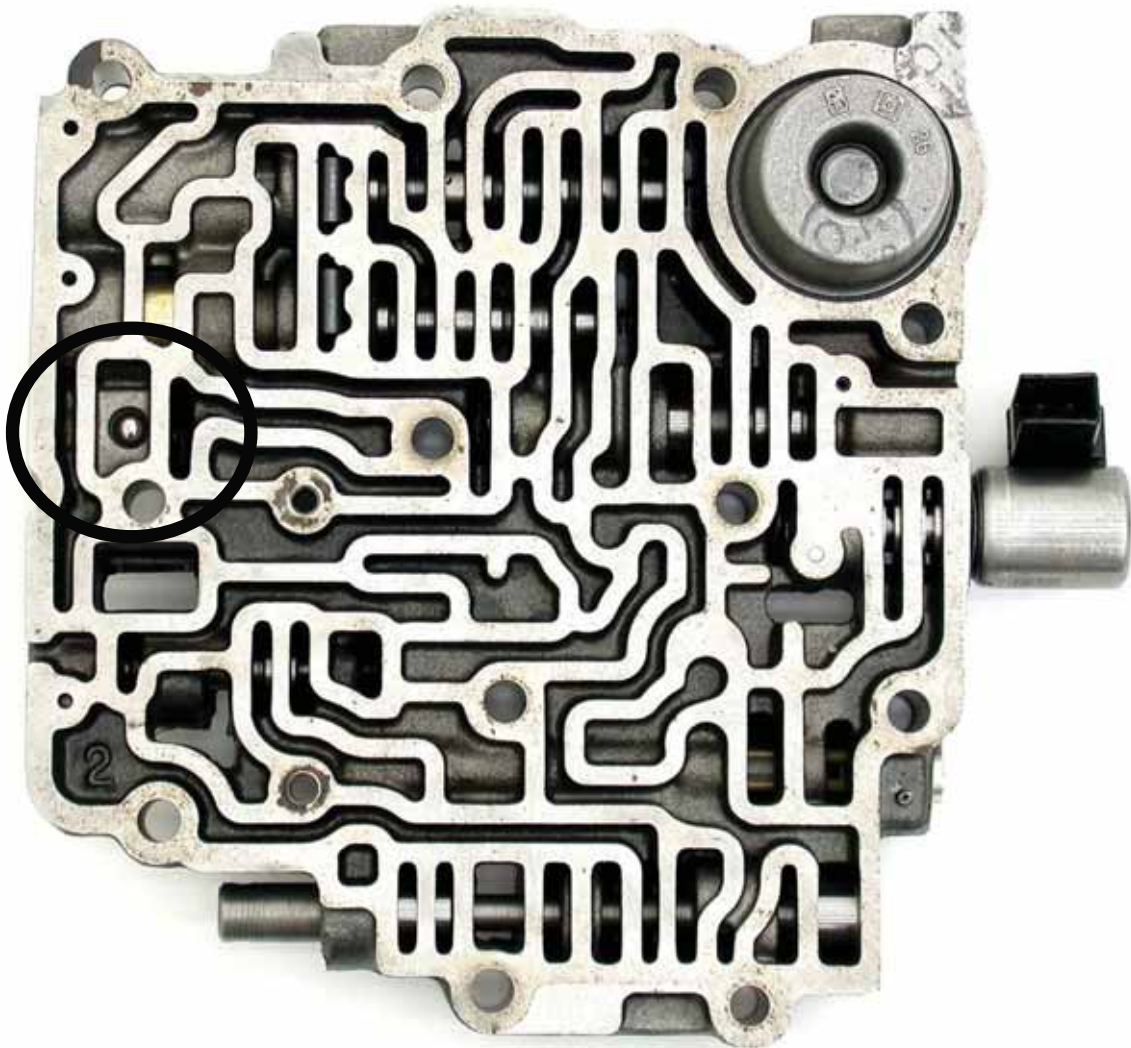
Tie-Up on the 3-4 Shift

A tie-up during the 3-4 shift may be caused by leaving out the 3rd clutch check valve in the main valvebody. Leaving the ball/valve out allows the servo release oil to drain causing a tie-up on the 3-4 shift. Make sure to install the 3rd check valve.



4L30E

Tie-Up on the 3-4 Shift (continued)



4L65E

Binding in Reverse

A binding in reverse or a concern of driving forward in neutral may be caused by improper installation, mis-match parts, cracks or incorrect rings. Leakage at the turbine shaft rings can cause converter charge oil to enter other clutch circuits. This can cause binding concerns or failure in the clutch assembly.



4L60E/4L65E/4L70E

P0756 SSB Performance/Stuck Off

C/K and S/T

P0756 is a performance DTC and is typically not related to an electrical problem. Prior to the DTC setting the customer may have had a complaint regarding the transmission not starting in 1st gear. In some instances the transmission may be starting in 2nd, 3rd or 4th gears with no DTC's set. Code P0756, may be intermittent.

P0756 will set if:

- DTC's P0122, P0123, P0502, P0503, P0740, P0742, P0753, P0758, P0785, P1810, P2761, are not set.
- Engine has ran for at least 5 seconds
- Shifter is in the D4 range
- TP is greater than 10%
- Calculated engine torque is between 50-400 lb ft (36-295 Nm)
- PCM calculates the ratio between 0-1.4 to 1
- PCM is commanding 1st gear (3.06 to 1)
- Conditions of starting in a higher gear are present for more than 1 second
- PCM calculates the ratio between .9-1.2 to 1
- PCM is commanding 2nd gear
- Conditions of starting in a higher gear are present for more than 2 seconds

If P0756 sets the PCM will:

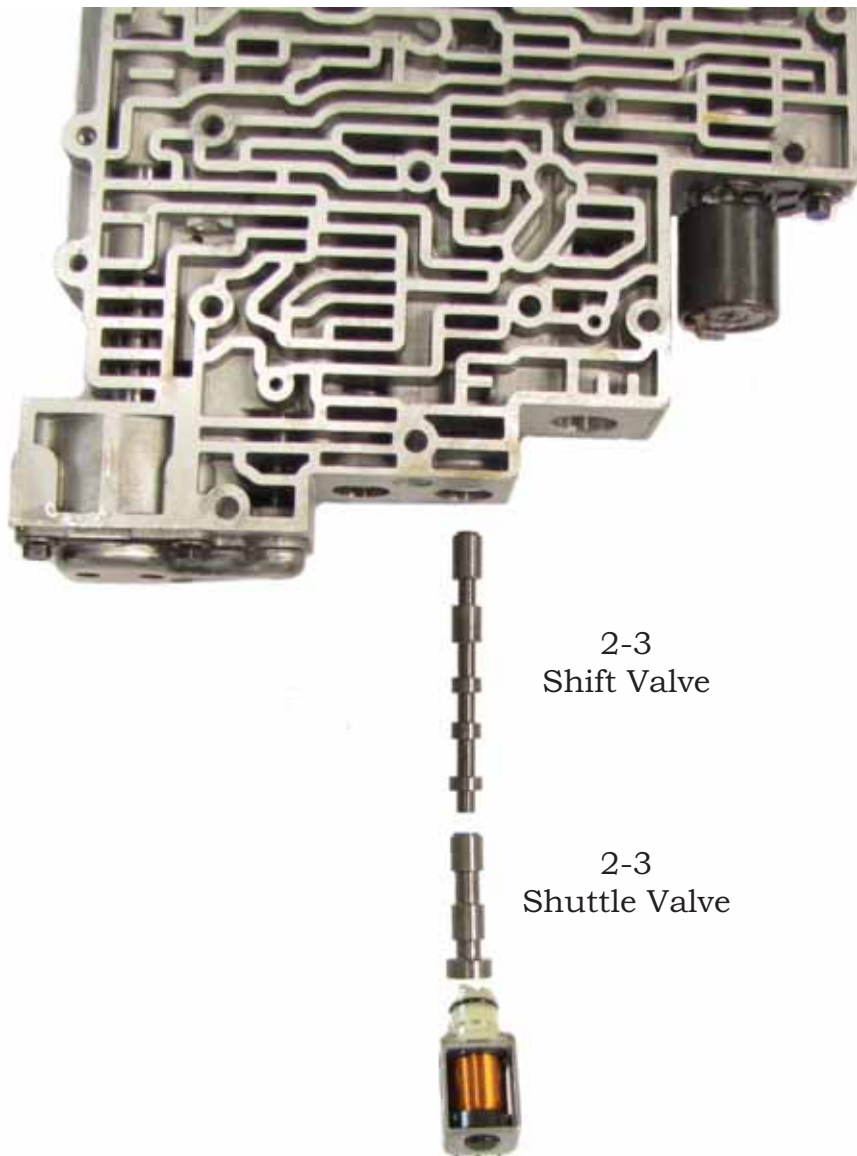
- Command maximum line pressure
- Commands 3rd gear
- Inhibits TCC
- Commands the MIL "ON"
- Freezes shift adapts

4L60E/4L65E/4L70E

P0756 SSB Performance/Stuck Off (continued)

To repair this concern check for the following:

- Check for debris in the spacer plate orifice #29. Orifice #29 is quite small and debris will typically accumulate on top of the spacer plate leading to feed restriction concerns.
- 2-3 shift valve may be sticking
- 2-3 shuttle valve may be sticking
- 2-3 solenoid may be leaking or cracked



4L60/65/70E

2009/2010 Updates

Several updates were made to the 4L60E family of transmissions for all applications except Holden vehicles. (2009) (All 2010 applications now include the updates)

The update includes:

- Eliminate the Transmission Fluid Pressure Switch Manifold (TFP or PSM)
- Eliminate the Neutral Safety Backup Light switch (NSBU or P/N)
- Eliminate the 3-2 downshift solenoid and valving
- Remove the abuse valves and hardware
- Install an Internal Mode Switch (IMS) (may be called a park/neutral switch in some manuals)
- Update the wiring harness, manual shaft, detent spring and park rod to accommodate the IMS upgrade. (Park rod will back service)
- New DTC's were added for the IMS, these include:
 - 1) P1820 - Internal Mode Switch A Circuit Low Voltage
 - 2) P1822 - Internal Mode Switch B Circuit High Voltage
 - 3) P1823 - Internal Mode Switch P Circuit Low Voltage
 - 4) P1825 - Internal Mode Switch Invalid-Range
 - 5) P1826 - Internal Mode Switch C Circuit High Voltage
 - 6) P1915 - Internal Mode Switch does not Indicate Park/Neutral (P/N) During Start
- Update the valvebody and spacer plate to reflect the changes by changing oil channeling and castings for bores and valves that were eliminated.
- Upgrade D4 channeling for the manual valve
- Bonded spacer plates

The updates were implemented as a cost control measure and did not have anything to do with the unit's durability. The valvebody, PCM and the hardware updates are not designed to back service previous model applications, nor should previous year valvebodies be installed on any application that utilizes the 2009 updated parts package.

4L60/65/70E

2009/2010 Updates (continued)



IMS Switch Logic

Position	A	B	C	P
Park	Low	High	High	Low
Reverse	Low	Low	High	High
Neutral	High	Low	High	Low
D4	High	Low	Low	High
D3	Low	Low	Low	Low
D2	Low	High	Low	High
D1	High	High	Low	Low

4L60/80E

Quick Circuit Test 1993-on

PCS Circuit Test

Using the line pressure chart provided, if the reading on the scan tool indicates that the PCM is commanding low line pressure (Approx. 1 amp) and the multi-meter reading display indicates a high pressure command (low amps near zero), the PCM will need to be replaced.

1. Cut the PCS solenoid (force motor) high circuit wire.
2. Connect the red lead of the multi-meter (DVOM) to the wire going to the PCM.
3. Place the red lead into the amps jack and set the multi-meter to DC Amps.
4. Connect the black lead to the wire going to the transmission.
5. With the scan tool connected to the vehicles DLC; start the vehicle and compare the PCS desired amps (DES A) and PCS actual amps (ACT A) data pid display to the reading on the multi-meter.

NOTE: Some scan tool definitions vary, you may have EPC, PCS, or Force Motor.

Amps	Line Pressure
0.98	55 - 65 psi
0.90	65 - 90 psi
0.80	90 - 115 psi
0.70	110 - 130 psi
0.60	130 - 145 psi
0.50	140 - 160 psi
0.40	148 - 168 psi
0.30	155 - 175 psi
0.20	160 - 180 psi
0.10	165 - 185 psi
0.02	170 - 190 psi

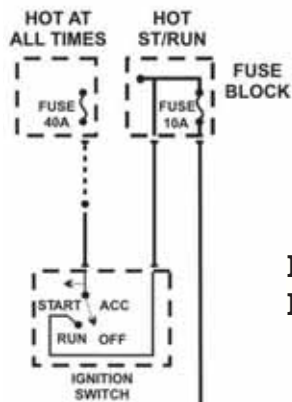
4L60/80E

Quick Circuit Test 1993-on (continued)

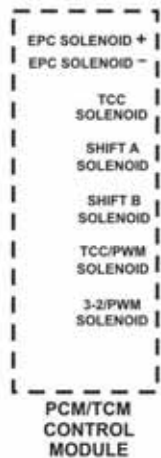
PCS Circuit Test (continued)

(Wire Colors May Vary Per Model Year All Circuits Should Identified By Pin Number)

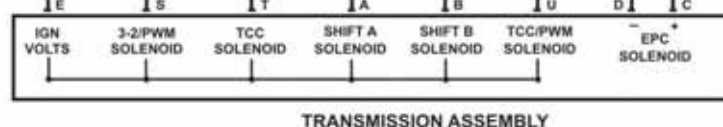
POWER DISTRIBUTION CENTER



Note: Example of High Line Pressure casued by a Bad PCM/Prom



Amps	Line Pressure
0.98	55 - 65 psi.
0.90	65 - 90 psi.
0.80	90 - 115 psi.
0.70	110 - 130 psi.
0.60	130 - 145 psi.
0.50	140 - 160 psi.
0.40	148 - 168 psi.
0.30	155 - 175 psi.
0.20	160 - 180 psi.
0.10	165 - 185 psi.
0.02	170 - 190 psi.

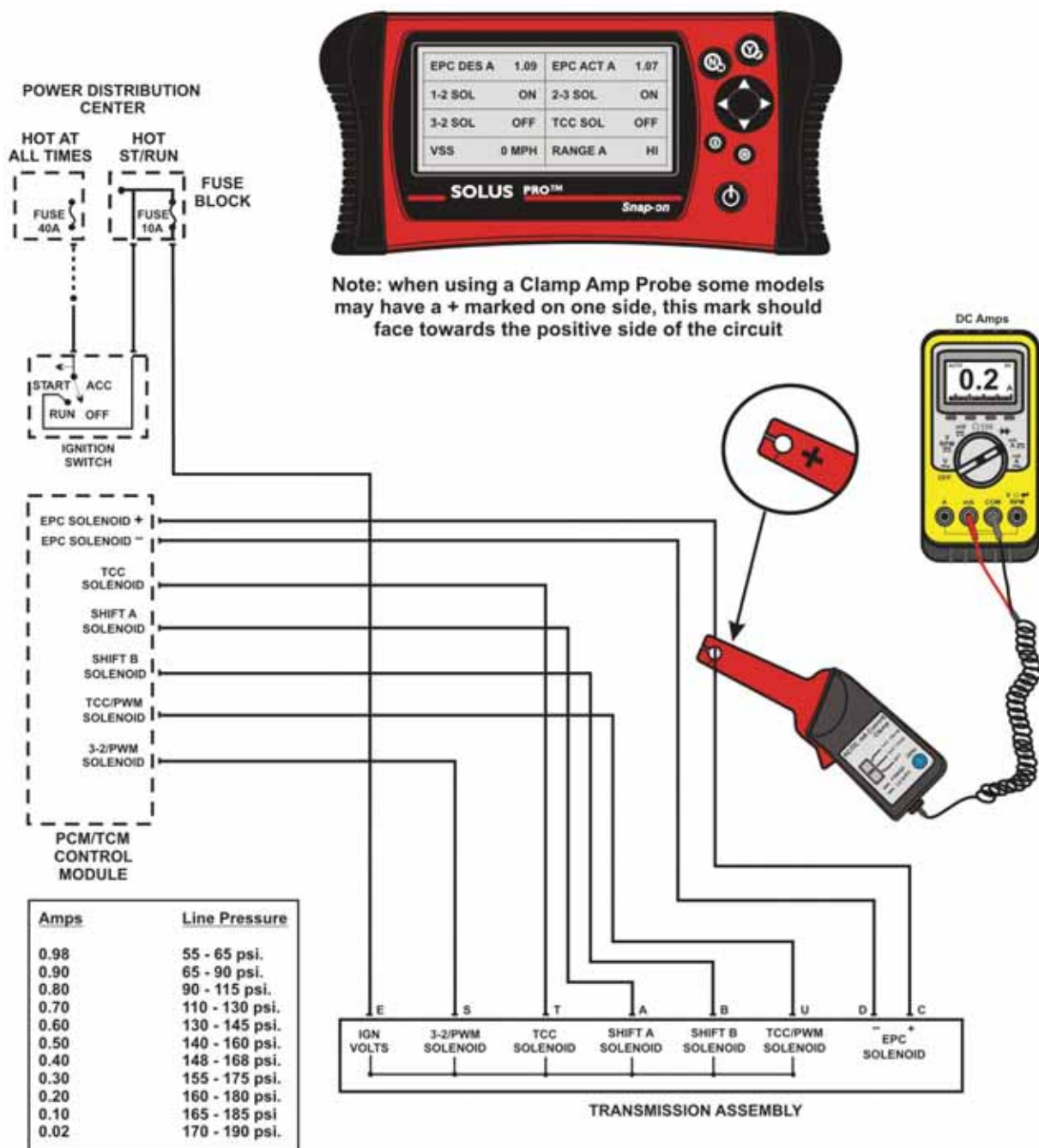


4L60/80E

Quick Circuit Test 1993-on (continued)

PCS Circuit Test (continued)

Same test using an amp clamp adapter or meter, clamped around the high side circuit wire. Note: Not necessary to cut PCS wire. Some amp clamps may have a + sign on one side of the clamp jaws, this mark should face toward the high side power flow. If clamped incorrectly will “only” cause a negative reading on the multi-meter or clamp amp meter.

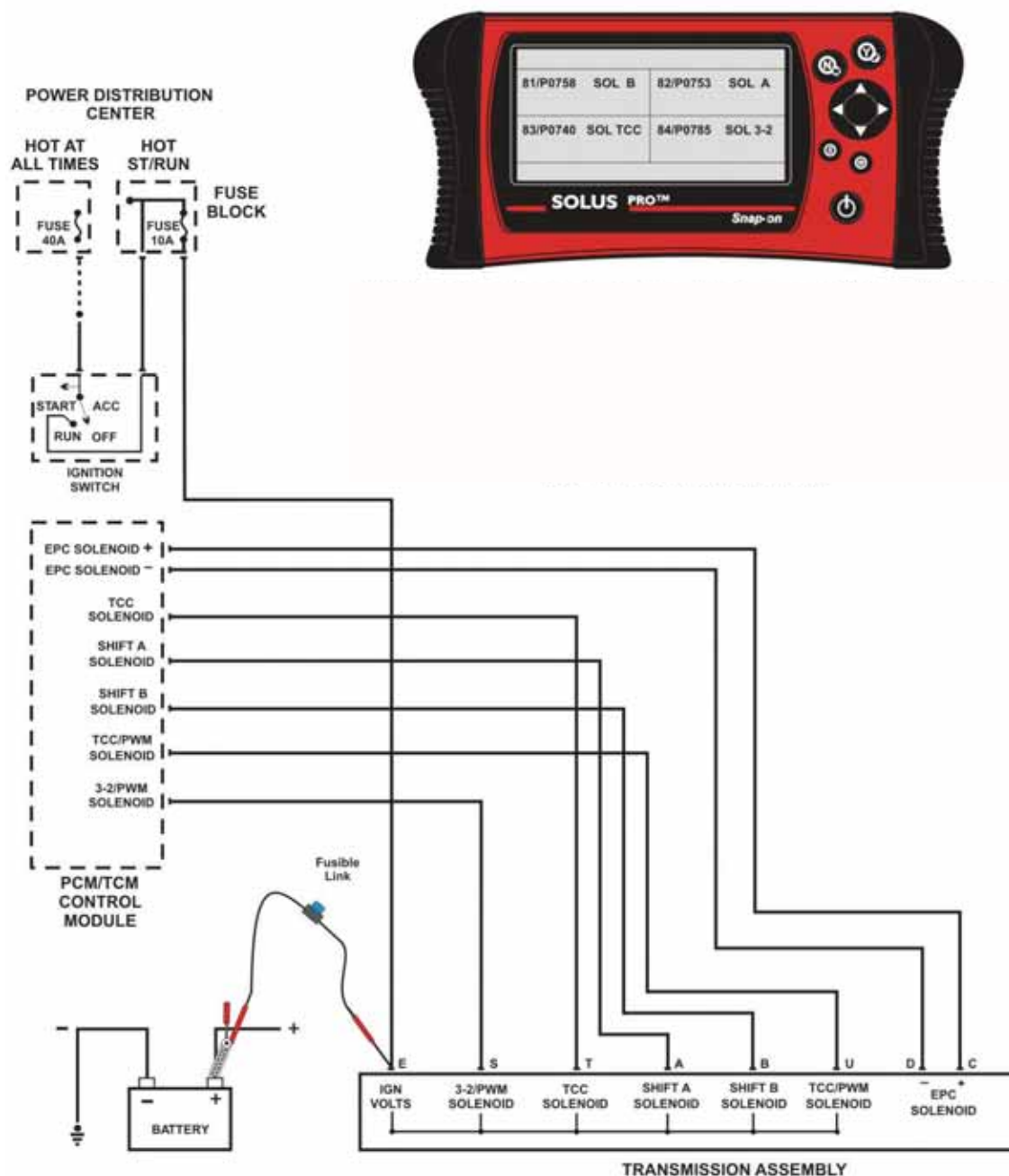


4L60/80E

Quick Circuit Test 1993-on (continued)

Ignition Switch Test

Solenoid codes that set during start up or when vehicle is being driven. Jump battery voltage through a fusible link to pin E at the transmission connector. Most common cause is a bad ignition switch.



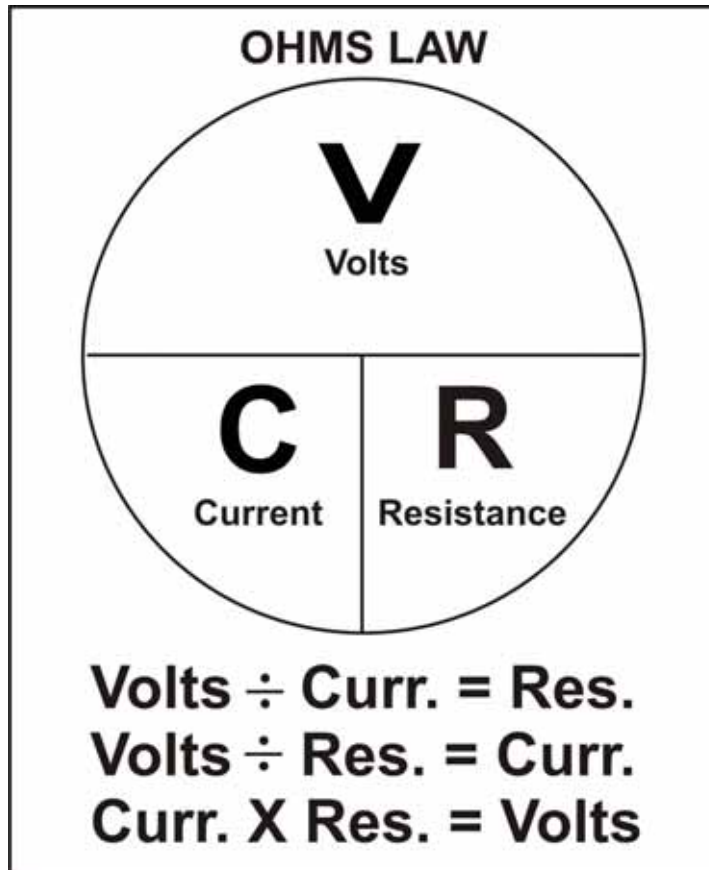
4L60/80E

Quick Circuit Test 1993-on (continued)

Ignition Switch Test (continued)

1. Remove Power Supply Fuse to Pin E of the transmission connector.
2. With your multi-meter set on DC Amps; connect the Red Lead (POS) to the Fuse Power Terminal, and then connect the Black Lead (NEG) to the terminal going to the Transmission Connector Pin E.
3. Connect the Scan Tool to the DCL, turn key on engine off, go to the scan tool's Functional Test Mode go to Solenoid Test.
4. Activate each solenoid while monitoring the amp draw to determine which solenoid or circuit is at fault.

Note: Using the Ohms Law chart along with the solenoid resistance to determine what the correct amperage should be. Important: The voltage should rise and fall quickly, best when using a Graphing Meter or Oscilloscope. A bad signal is caused by a faulty PCM solenoid driver.



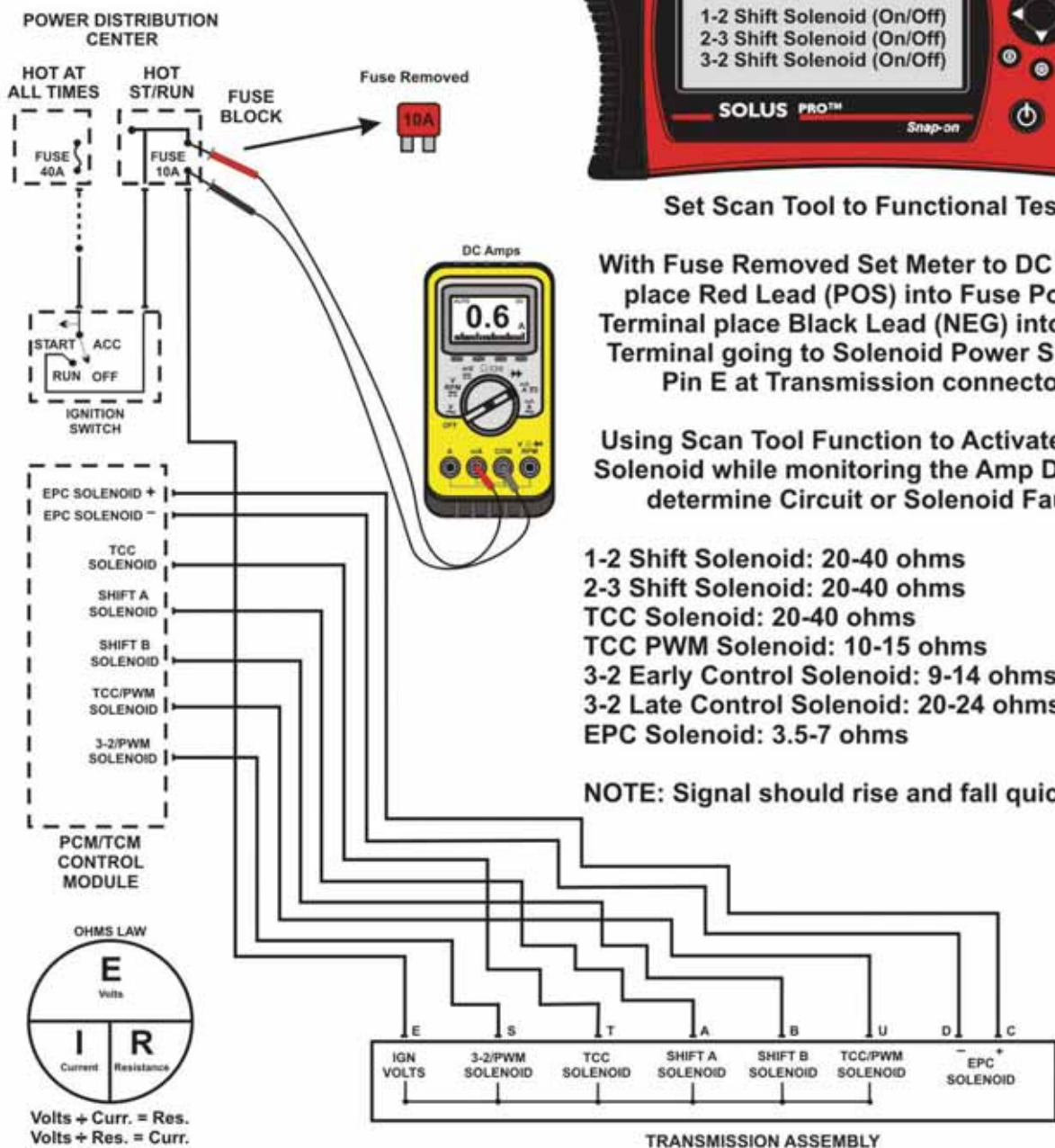
4L60/80E

Quick Circuit Test 1993-on (continued)

Ignition Switch Test (continued)

Key On
Engine Off

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)



Set Scan Tool to Functional Test

With Fuse Removed Set Meter to DC Amps
place Red Lead (POS) into Fuse Power
Terminal place Black Lead (NEG) into Fuse
Terminal going to Solenoid Power Supply
Pin E at Transmission connector

Using Scan Tool Function to Activate each
Solenoid while monitoring the Amp Draw to
determine Circuit or Solenoid Fault

1-2 Shift Solenoid: 20-40 ohms
2-3 Shift Solenoid: 20-40 ohms
TCC Solenoid: 20-40 ohms
TCC PWM Solenoid: 10-15 ohms
3-2 Early Control Solenoid: 9-14 ohms
3-2 Late Control Solenoid: 20-24 ohms
EPC Solenoid: 3.5-7 ohms

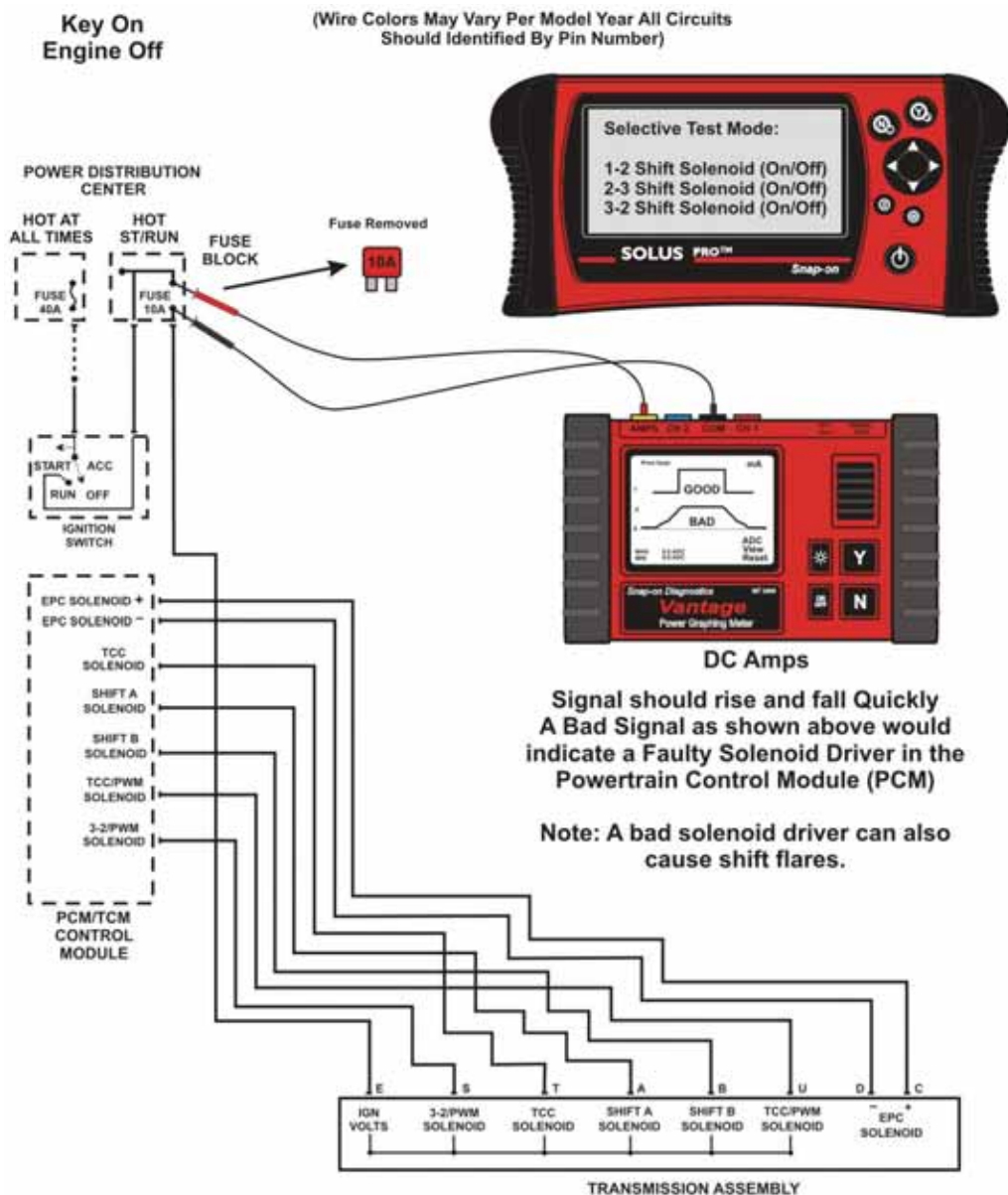
NOTE: Signal should rise and fall quickly.

4L60/80E

Quick Circuit Test 1993-on (continued)

Ignition Switch Test with a Graphing Meter or Oscilloscope

These diagrams derived from information that has been carefully compiled from industry sources known for their reliability and should be accurate. Always verify the correct circuits are being tested with a factory manual whenever possible. Wire colors vary from module to module as well as year to year. Always identified the circuits that are being tested by their connector pin identification.



4L60/65/70E, 6L80/90, 2ML70

“U” Codes Set, Intermittent Communication, Shift Problems

2007-2010 C/K Trucks

Some full size GM trucks may set any or all of the following DTC's: U0100, U0101, U0102, U0106, U0109, U0117, U0121, U0122, U0132, U0137, U0140, and/or U0073. Along with any of the DTC's set, technicians may not be able to communicate with some modules at times depending where and when the fault occurs. In addition, you may have any/all of the following symptoms:

- The transmission may not shift or defaults to its default gear
- The door locks may cycle lock/unlock without customer input
- The engine may not start or crank or it may start then stall
- The driver information center (DIC) may display a service message
- The dash gauges may appear to be intermittent or operate erratically
- Chimes and dash gauges may be erratic when using the brake

Typically a problem exists with the vehicle wiring harness or its connectors. The data communication circuits 2500 and 2501 are a “twisted pair” and are light brown in color. There are several different areas that may lead to these concerns. The following represent the most common causes for the above conditions.

- The electric adjustable brake pedal may have rubbed through the DLC harness and shorted the high speed data line to ground on the motor body itself. This scenario may occur based on brake pedal movement and may or may not occur if the pedal is in the released position. Inspect the DLC wiring for evidence of the harness shorting to ground on pedal motor.
- EBCM (Electronic Brake Control Module), PTO (Power Take OFF) FPCM (Fuel Pump Control Module) VCIM (Vehicle Communications Interface Module)(On Star) Connectors as well as connector X-109 and X-115 need to be checked for pins that may have backed out, pin tension, terminal corrosion and fretting problems. Connector X-115 and X-109 are located on the left fender well above the shock tower area. If the EBCM, FPCM or the On Star module is suspected of causing the problem, remove the fuse for the suspect module to determine if the communication system comes back on line. If it does the module may require replacement. If fretting is present, use GM 12377900 (Canada 10953529) Nyogel 760 grease on the terminals before reconnecting the connectors.

4L60/65/70E, 6L80/90, 2ML70

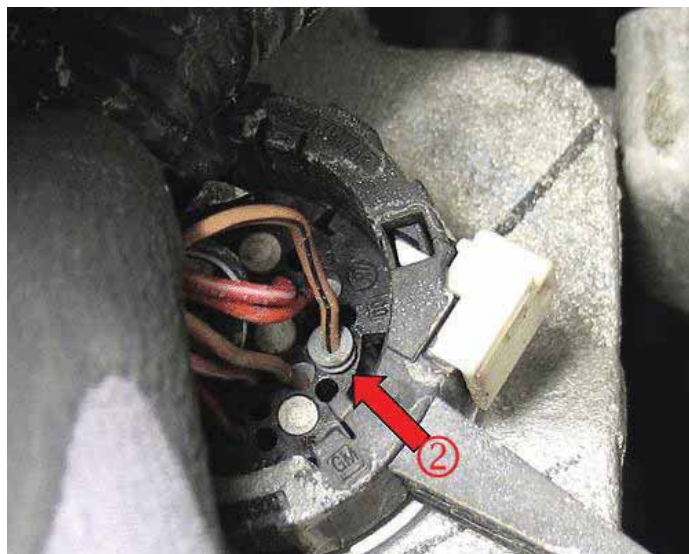
“U” Codes Set, Intermittent Communication, Shift Problems (continued)

2007-2010 C/K Trucks

- The harness may be pinched under the bed of the truck. Inspect the harness near the rear of the truck for being pinched between the bed and frame of the truck.



- A poor connection, pin tension, backed out terminal or a damaged connector at the transmission pass thru may also cause the concern. Inspect the transmission harness (6L80/6L90).



4L60/65/70E, 6L80/90, 2ML70

“U” Codes Set, Intermittent Communication, Shift Problems (continued)

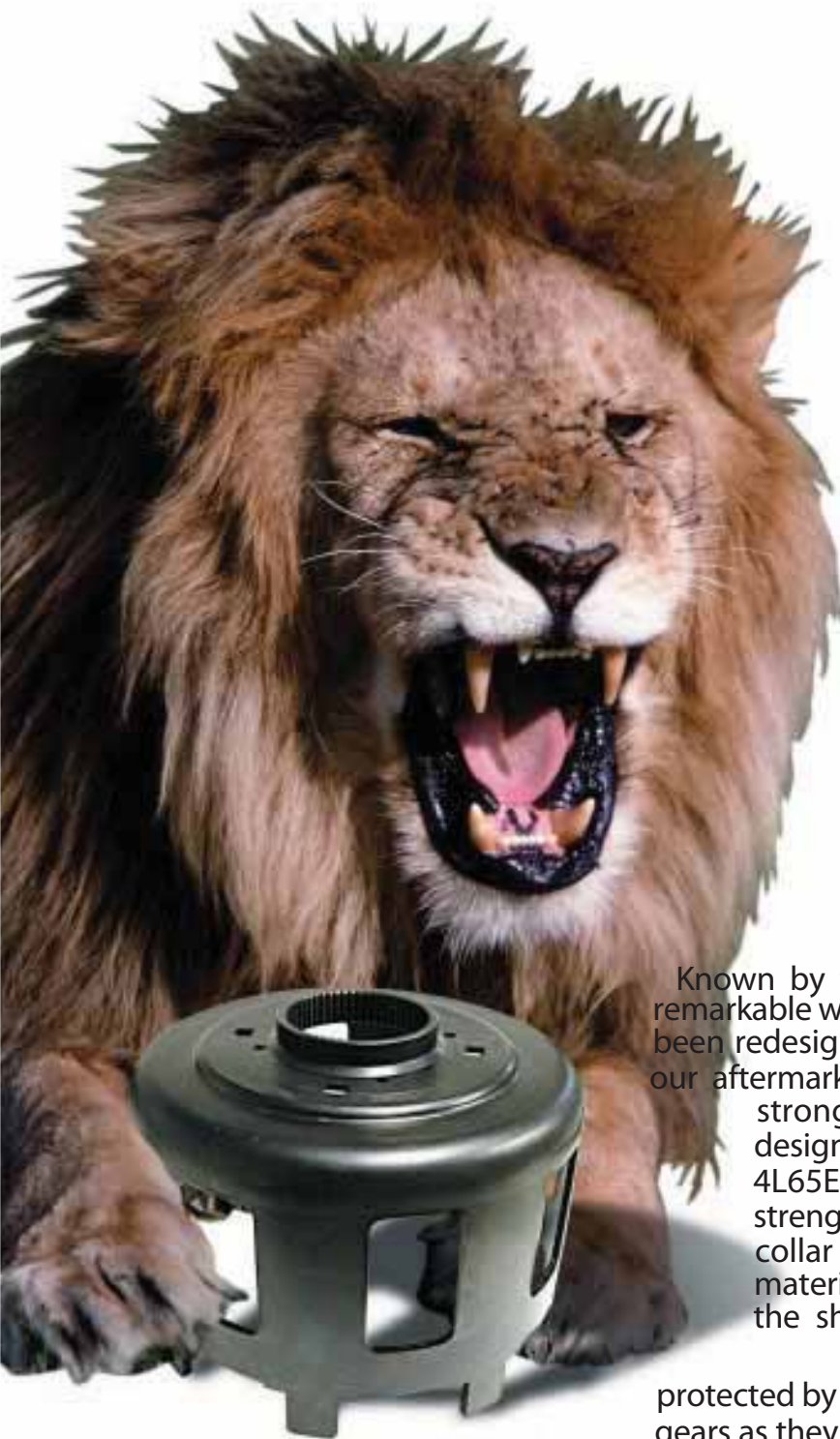
2007-2010 C/K Trucks

- The harness may be chaffed near the parking brake pedal and/or the left side of the IP junction fuse box near/on the mounting bracket. A short to ground of the main harness in this area may cause any of the following fuses to blow in addition to the communication issue that may be present, 60A - MBEC1 (#72) (Underhood fuse box), 30A - AMP (#40) (Underhood fuse box), 15A - RDO (#41), 10A - IPC (#46) (Underhood fuse box), 15A - AIRBAG BATT (#51) (Underhood fuse box), 10A - DSM (Left side of IP fuse box).

Customer concerns such as erratic operation of the instrument gauges and chimes as well as driver information messages may be caused by a number of faults:

- The harness may be pinched under the cab body mount located on the left frame rail.
- The harness may be chafed near connector X108 (on the engine near the radiator hose) on a harness bracket
- The data line terminating resistor may have shorted (normally 110-130 ohms) or the harness may be pinched near the terminating resistor. The terminating resistor is located in the left rear corner of the truck on the frame rail. Replace the terminating resistor if needed with part number 88988999.
- The IP junction fuse block may have a bad connection at connector X1.(Connector attached to the fuse block)
- The harness may be pinched between the fuel lines and the cab in the bellhousing area.
- The brackets supporting the harness at the rear of the intake manifold (bellhousing area) may have chaffed the harness.
- G102 and/or G300 may have a poor connection usually due to undercoating that is trapped between the terminal and the chassis/body/engine. G102 is located at the lower left front of the engine block, except on 2ML70 hybrid applications which is located on the rear of the left cylinder head. G300 is located near the drivers side door at the body mount area.

If a chaffed or pinched wire is found repair the damaged wire and reroute the harness as necessary.



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4L80E

Shuttle Shift 6.5L Diesel

A transmission complaint of a 2-3, 3-2 and a 3-4, 4-3 shift shuttle at 25% throttle or higher may have an intermittent complaint of a hard start condition, no codes stored. Scan tool data reveals the shuttle shift is being commanded by the PCM. This vehicle is a drive by wire system, no TPS. Always check the Accelerator Pedal Position Sensor (APPS) and the alternator for electromagnetic interference (EMI also known as AC ripple).

Unbolting the battery feed wire to the alternator as a quick test is a good way to isolate if the EMI is being caused by a faulty alternator. Alternator EMI is an all too common problem on many vehicles foreign or domestic.

This same symptom can be the Pump Cam Optical/Fuel Temperature sensor mounted on top of the Injection Pump. According to GM the Injection Pump Cam signal is an optical sensor that receives a 5 volt reference signal that allows the PCM to measure fuel injector pulse ring RPM and position. The PCM uses this signal to control fuel injection timing and start of injection. The PCM compares this signal with the Crankshaft Position (CKP) sensor for diagnostic purposes. The Fuel Temperature sensor works like an Intake Air Temperature (IAT) sensor to control fuel volume.

A quick test to diagnose a shift shuttle symptom caused by this sensor would be to disconnect it. The vehicle will be difficult to start but once its running and the symptom no longer exists during the road test, replace the sensor. The Optical/Fuel Temperature sensor comes with the Injector Pump.

Pump Cam Optical/Fuel Temperature sensor



Crankshaft Position (CKP) Sensor

4L80E

No Line Rise 6.5L Diesel

A no line rise condition on vehicles equipped with a 6.5L diesel engine may be caused by a Fuel Solenoid Driver Module. During a stall pressure test (brake torque) the line rise results are perfect. As soon as the wheels begin to turn at approximately 5 to 7 mph line pressure never rises above 60 psi (base line). This problem is caused by a bad Solenoid Driver Module located on the side of the Injector Pump.

Electronic signals from the Accelerator Pedal Position (APP) sensor, Temperature sensor, Pump Cam sensor (Optical/Fuel Temperature) and Crankshaft position sensor are received by the PCM. These signals are used by the PCM to control fuel flow through the Fuel Solenoid.

This problem has been known to happen with a new Fuel Solenoid Driver Module right out of the box. Just because it's new doesn't mean it's good. There may not be any noticeable drivability issues with the way the engine operates.

The Fuel Solenoid Driver Module is available through the aftermarket with a pigtail harness to relocate it to the firewall. The location of the Fuel Injector Pump assembly along with the sensors and module are in an area that can become quite hot. There are no quick checks for this item.



6L45/50 AWD Applications

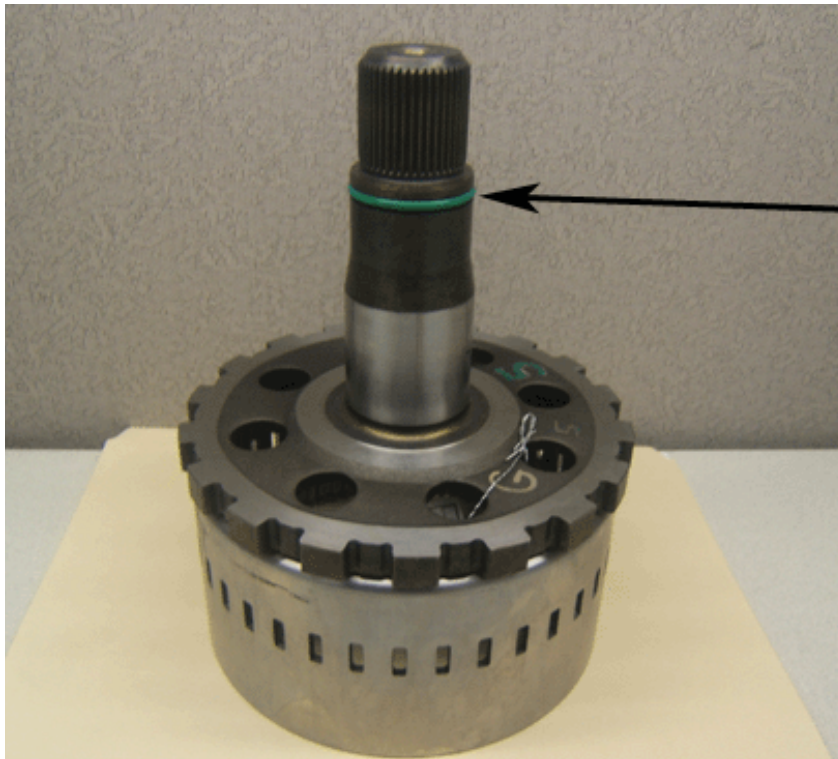
Grinding Noise, No Forward, No Reverse

Some 2007-2010 Cadillac all wheel drive (RPO MX7) STS, SRX, CTS vehicles equipped with a 6L45 (RPO MYA) or a 6L50 (RPO MYB) may exhibit a grinding or no movement forward or reverse condition.

The splines of the transmission output shaft or transfer case input shaft may be worn or the shaft may have broken. To address this concern updated parts were released.

An updated transmission output shaft was released with an O-ring groove built into the shaft. The O-ring is designed to help maintain the grease located between the transfer case input shaft splines and the transmission output shaft splines. Without grease rapid spline wear will occur. If the transmission output shaft is damaged you will need to replace both the transmission output shaft and the transfer case input collar. Because of changes to the collars the updated design transmission output shaft will not properly mesh with the previous design transfer case input collar.

Upon normal R&R of the transfer case note the condition of the splines on both shafts. If the splines look to be in good physical condition you may want to reuse the parts you have. Simply place 2 O-rings (GM #24251228) onto the transmission output shaft. Lube both shaft splines with high temperature wheel bearing grease and reinstall the transfer case.



6L45/50 AWD Applications

Grinding Noise, No Forward, No Reverse (continued)

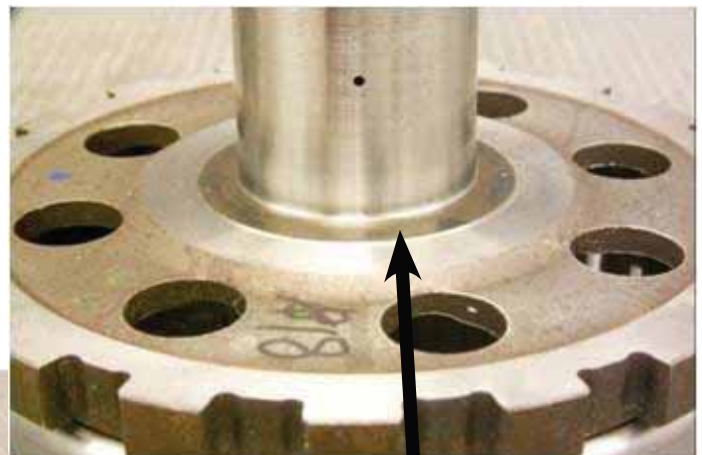
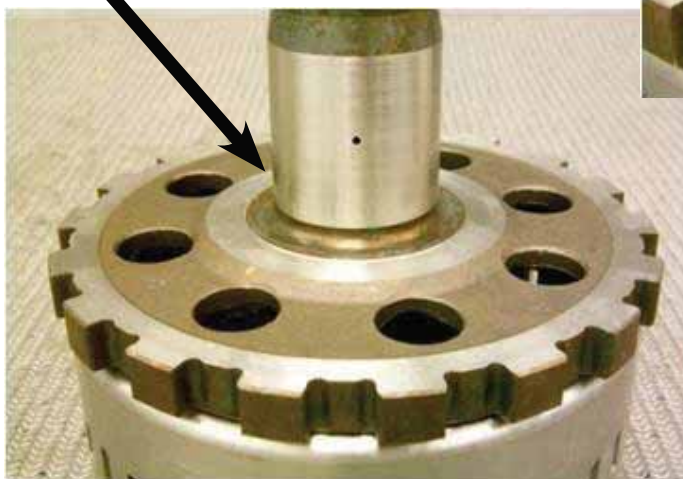
Two other updates were also made to the transmission output shaft. The induction hardening process was extended into the fillet radius where the shaft typically breaks. In addition, the design of the fillet was changed to reduce the stress on that area of the shaft.

Updated parts are available under the following part numbers:

- Transmission Output shaft (MYB, 6L50) #24251229
- Transmission Output shaft (MYA, 6L45) #96043341
- Transfer Case Input shaft (Cadillac CTS) #19256369
- Transfer Case Input shaft (Cadillac STS, SRX) #19256370
- Shaft O-ring seal # 24251228

NOTE: When installing the transfer case onto the transmission, make sure the 2 alignment dowels are properly positioned in the transfer case. Always make sure you properly lubricate the shaft splines.

Increased Fillet



Small Fillet

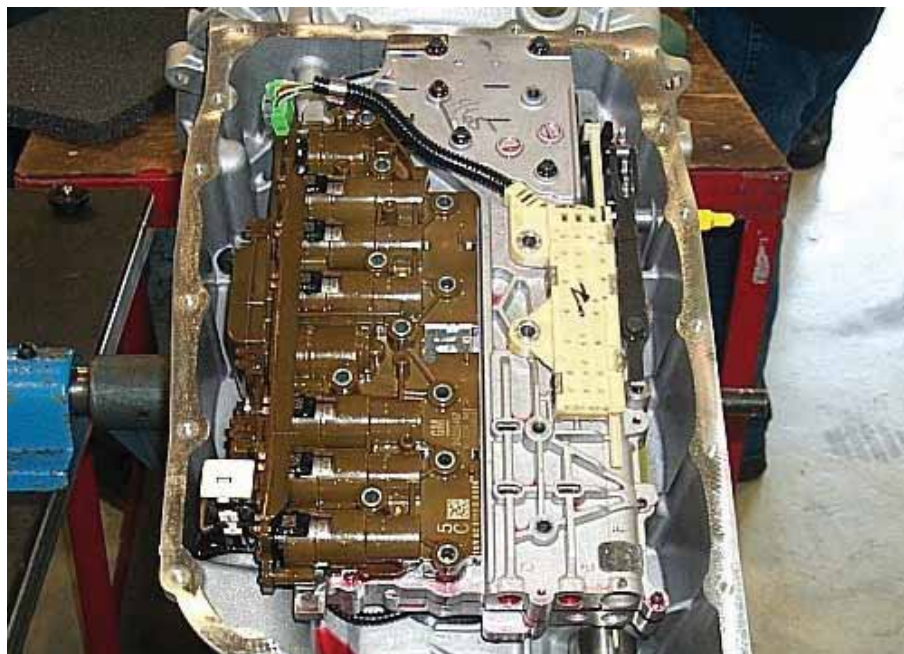
6L80

New Valvebody Bolts

There are six new inverted 50 Torx Plus valvebody to case bolts used on late model 6L80 transmissions.

Sockets are sold individually from other suppliers. If the tool is unavailable or time is an issue; use a bellhousing bolt (50 Torx) from a late model (removable bell housing) 4L60E w/2 nuts attached to the threads to remove the inverted 50 torx plus valvebody to case bolts.

GM Tool Part # DT-48285



6L80

Intermittent Harsh Downshift, Chuggle or Shudder During Deceleration 5.3L

Some Tahoe, Suburban, C/K Trucks may experience an intermittent shift feel related complaint with the powertrain package listed above. They may complain that sometimes forced downshifts are very aggressive. In addition some customers may complain that the truck exhibits a chuggle or shudder during deceleration intermittently.

This is considered a normal condition with this powertrain package and you should not attempt to repair it. The condition is caused by a self test that is used to check the post cat O2 sensors.

During closed throttle deceleration the ECM drives the fuel system rich, then into deceleration fuel cutoff mode which shuts off the injectors, as a way to check the response rate of the post cat O2 sensors. When the test begins, if the transmission is in 6th gear and vehicle speed is above 45 MPH (72 kph) the TCC will be applied. When the test ends and the vehicle is still decelerating, the fuel injectors are turned back on. This may cause a chuggle or shudder feeling from the vehicle.

If the driver steps into the throttle deep enough to command a downshift while this test is operating a firm downshift may be experienced. This is due to TCC being locked during the downshift. If the transmission is in 5th gear or vehicle speed is below 45 MPH when the test begins the TCC will not be applied and the complaint will not likely occur.

This test is designed to occur one time per key cycle. If the test is aborted due to throttle input, the test can be rerun up to 10 times per key cycle.

6L80

No or Slipping 3rd, 5th, and Reverse, Flare on the 2-3 Shift

Tahoe, Suburban, C/K Trucks with 6L80 (RPO MYC) and 6L90 (RPO MYD) transmissions may experience a slipping or a no apply of the 3/5-Reverse clutch. In addition you may have a P0776 DTC set.

P0776 will set if:

- P0716,P0717, P0722,P0723, P1825 DTC's are not set
- TFT greater than 32°F (0°C)
- High side Driver 1 is operational
- Driven wheel speed greater than 80 RPM
- Driven and Non Driven wheel speeds are within 150 RPM
- Input speed greater than 60 RPM
- PCS 2 is on
- 3rd or 5th gear ratio has been achieved
- The TCM detects an incorrect on-coming clutch gear ratio, or flare, when the 3-5-R clutch is commanded "ON" for 2.25 seconds and the transmission input shaft speed is greater than 60 to 100 RPM from the anticipated input shaft speed

If a P0776 is set the TCM will:

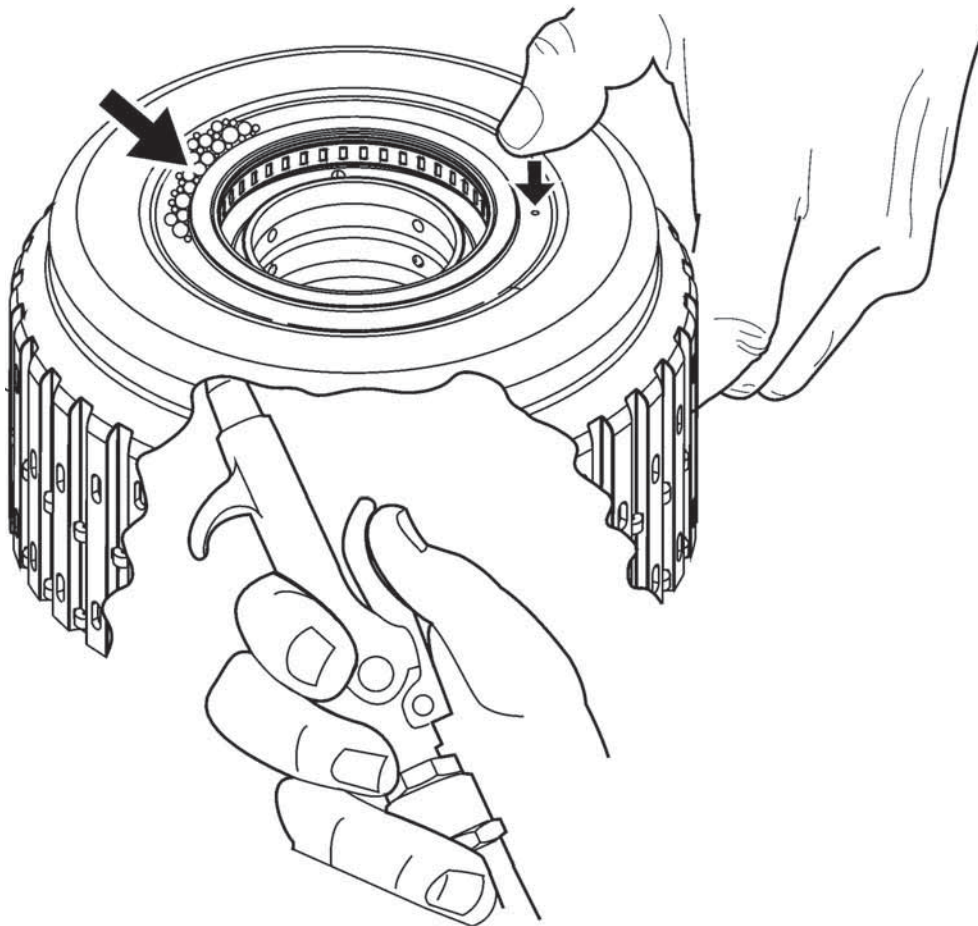
- Command maximum line pressure
- Inhibit TCC
- Freeze adapts

6L80

No or Slipping 3rd, 5th, and Reverse, Flare on the 2-3 Shift (continued)

Conditions like no 3rd, slipping in 3rd, 5th and reverse or flare shifts on the 2-3 shift may be due to a problem in several different areas. Three common areas are:

- 3-5 Reverse regulator valve may be sticking. (Located in the upper valvebody)
- A leak in the 3-5 reverse drum. To isolate this as the cause, air check the drum with soapy water as shown.
- Leaking seals on the back of the pump stator support. Make sure you are using the correct seals for your year (covered in the 2009 seminar book) and that the seals were correctly installed.



2011 ATRA Technical Seminars



LOCATIONS

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2/19/11	Charlotte, NC
3/5/11	St. Louis, MO
3/12/11	Boston, MA
3/19/11	Phoenix, AZ
3/19/11	Orlando, FL
3/26/11	Biloxi, MS
3/26/11	San Antonio, TX
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4/30/11	Fremont, CA
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TRANSMISSION OVERVIEW

GM:

LCT 1000
4L60/65/70E
4T65E
4L30E
6L80
4L65E
4L80E
4T40/45E

CHRYSLER:

41TE
545RFE
45RFE
42RLE
42-46RE

FORD:

AWF 21B
6F50
AX4N
5R55N/W/S

IMPORT:

RE5R05A
All Hondas
AW55-50SN

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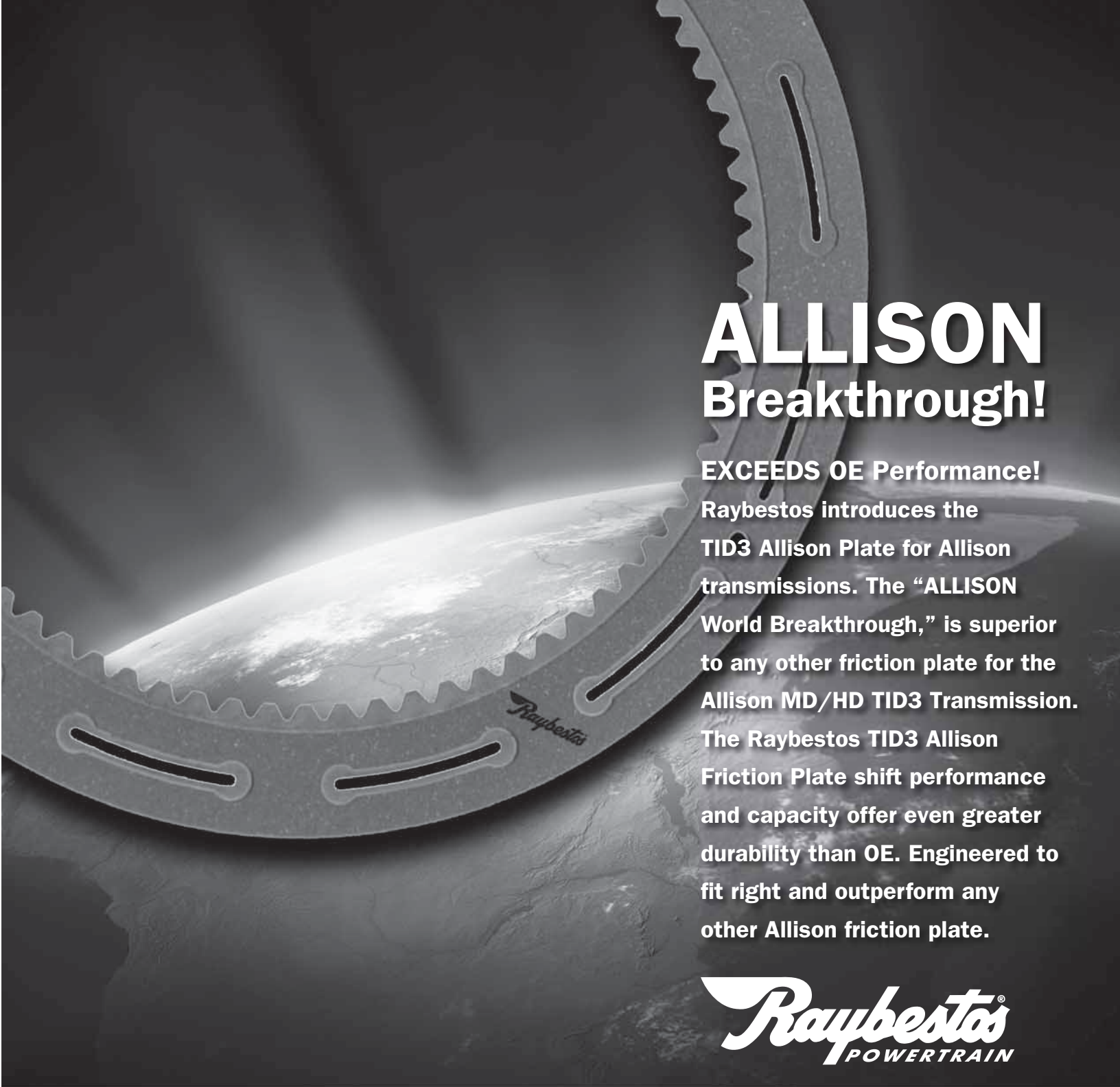
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LCT 1000

P0777 and/or P0735

C/K 2500 and 3500 Trucks

A flare or slip condition during different driving conditions including a slip that is most prevalent in 5th or reverse gear may be caused by a damaged C3 piston or piston seal. Generally a P0735 and/or a P0777 DTC is also set.

P0735 will set if:

- Engine speed, Turbine speed, Output speed exceeds 200 RPM.
- TFT greater than -13°F (-25°C)
- No speed sensor or shift solenoid DTC's are set
- 5th gear ratio indicates a slip of more than 100 rpm for longer than 2 seconds

If a P0735 sets the TCM will:

- Command the transmission to 4th gear
- Freeze the shift adapts
- Inhibit TCC

P0777 will set if:

- Engine speed, turbine speed, output speed exceeds 200 RPM.
- TFT greater than -13°F (-25°C)
- No speed sensor or shift solenoid DTC's are set
- The gear ratio remains the same even though a shift has been commanded

If a P0777 sets the TCM will:

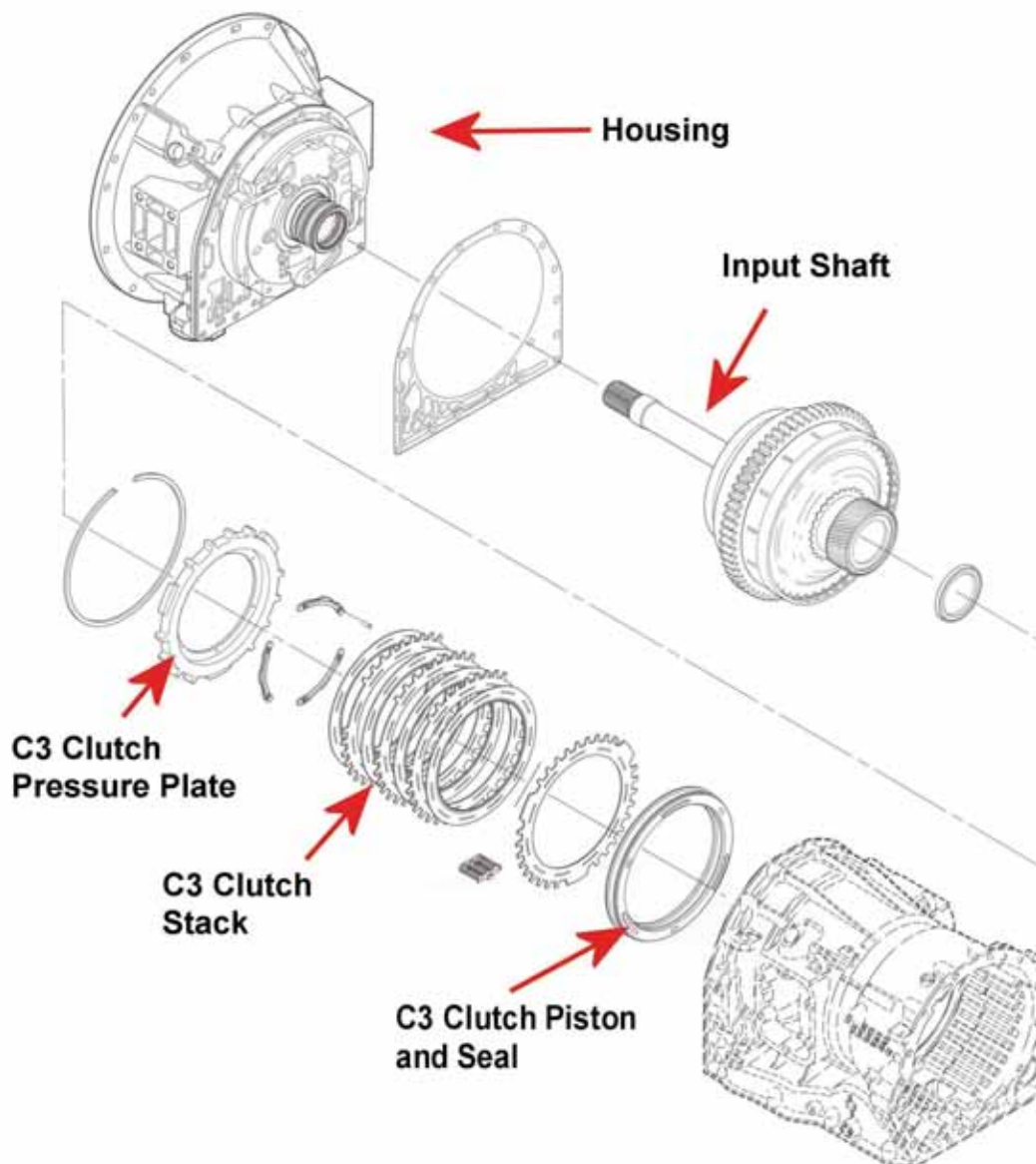
- Command the transmission to neutral or into the previously commanded gear depending on what gear you were in when the DTC set.

LCT 1000

P0777 and/or P0735 (continued)

C/K 2500 and 3500 Trucks

The most common cause of this concern is the seal on the C3 piston may be damaged or starting to delaminate. To repair this concern replace the C3 piston.



LCT 1000

P0960 Set, Harsh Shifts

C/K 2500 and 3500 Trucks

Some Allison LCT 1000 transmissions may develop an open in the internal wiring harness that controls the modulated main solenoid (Line Pressure Control Solenoid). This condition is generally intermittent and may result in a P0960 DTC (TCM detects an open circuit in GND return signal line from the solenoid valve).

Generally the cause of the concern cannot be found through a visual inspection process as the wiring typically breaks inside the insulation. P0960 represents an electrical problem with the PCS or its wiring.

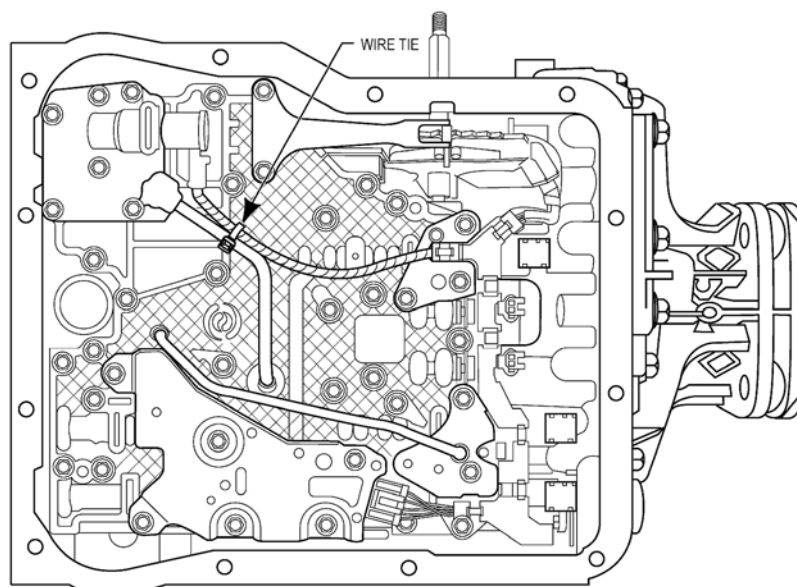
P0960 will set if:

- P0657, P0658, or P0659 is not set
- Battery voltage is between 9-18 V
- Engine speed is greater than 200 RPM
- High Side Driver 1 (HSD1) is enabled
- The TCM determines an open circuit condition is present for longer than 1 second in the PCS or its circuit

If a P0960 is set the TCM will:

- Command maximum line pressure

The internal wiring harness has an open or high resistance in the wiring harness that is attached to the modulated main solenoid (PCS). Check the continuity of the wiring with an ohm meter while you flex the wire. If an open is found, you will need to replace the modulated main harness. If you replace the harness add a wire tie to the area shown in the diagram.



LCT 1000

DTC's P0741 and/or P0218

C/K 2500 and 3500 Trucks

Some customers may comment regarding the service engine soon lamp being on intermittently. In some instances the TCM will have a P0741 (TCC Stuck Off) and/or a P0218 (Transmission Fluid Over Temperature) set in memory. It is likely that the condition leading to the DTC's will not be able to be duplicated unless the vehicle is put under a heavy load, such as towing a trailer up a steep incline at highway speeds. The DTC's will set if the following conditions are met.

P0741 will set if:

- P0716, P0717, P0721, P0722 and P0743 are not set
- Ignition voltage is greater than 9.0 volts and less than 18 volts
- TP 10-90 %
- TCC is commanded ON
- Forward range is indicated
- TCC slip value greater than 80 RPM for 15 seconds

P0218 will set if:

- P0711, P0712, P0713 are not set
- Ignition voltage is greater than 9.0 volts and less than 18 volts
- Engine is running

Transmission temperature greater than 126°C (252°F) for 10 seconds

If a P0741 or P0218 is set the TCM will:

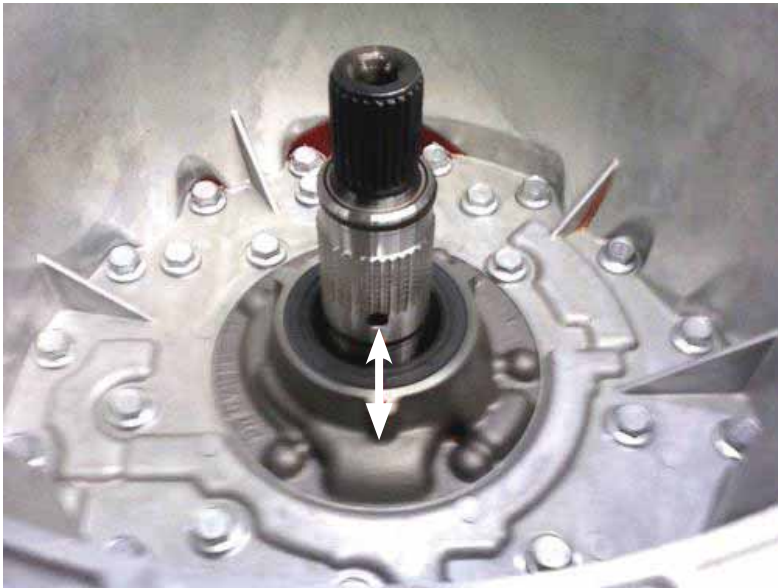
- Inhibit TCC
- Illuminate the SES on the second consecutive failure
- Freeze the shift adapts

LCT 1000

DTC's P0741 and/or P0218 (continued)

C/K 2500 and 3500 Trucks

Inspect the stator for evidence that the stator has rotated in the pump stator support. Look at the holes in the stator support as shown in the picture. The holes will have rotated in the counter clockwise direction if the condition is present. A correctly positioned support will have the hole in the support at 6 o'clock and the passage shown at 12 o'clock, as shown in the picture. If the condition is found, replace the support or the pump half.



LCT 1000

Multiple Complaints, Possible Codes

C/K 2500 and 3500 Trucks

LCT 1000 applications may exhibit various different shift timing/feel complaints. In addition the technician may find one or more DTC's set. Which DTC's have set will vary depending on which wires in the harness are damaged. In addition, the instrument panel cluster may show that the transmission is overheating.

The main transmission harness may have become pinched between the lines and/or clip and the body of the truck in the bellhousing area. Repair the damaged wiring and reroute the harness to be sure the condition can no longer occur.

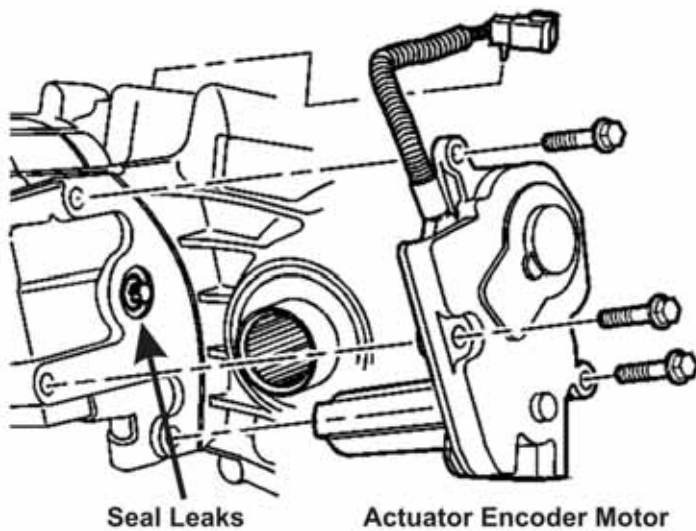


NVG 246

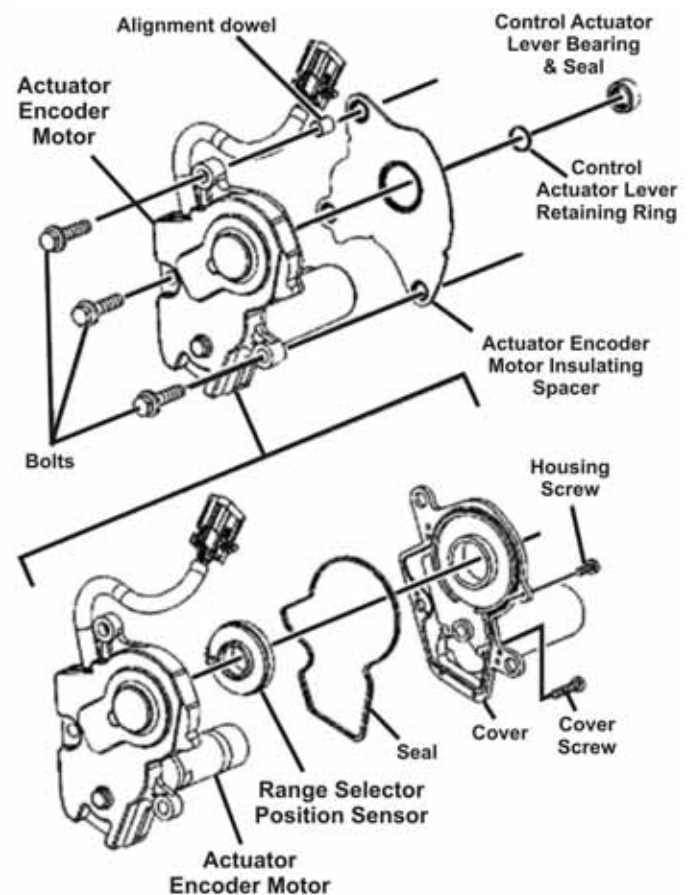
Encoder Motor Range Sensor Failure

K 1500 Trucks

Encoder motor range sensor failure can be caused by a linkage bearing and seal assembly leak into the encoder motor without any signs of external leak. The range sensor can be purchased separately GM part #88962315.



Actuator Lever Bearing and Seal Assembly Part # 12547464



NVG 246

C0308 4X4 Lamp “ON”

K 1500 Trucks

1998 and later full size GM pickup and SUV applications equipped with a NV 246 auto track transfer case may set a C0308 DTC accompanied by the 4x4 system being inoperative. This condition will also cause the “service 4X4” system display to illuminate on the dash. In addition you may find the “ATC” fuse blown and communication DTC’s (U Codes) stored.

This condition may have started after engine or starter work was performed.

C0308 will set if:

- TCCM measures continuity to ground via a key on bias voltage self test
- TCCM measures voltage drop across the motor and the motor drive circuits and determines an open or high resistance condition exists
- If either test fails the C0308 DTC will set

If a C0308 sets the TCCM will:

- Inhibit 4x4 operation
- Illuminate the “service 4x4” system message in the dash

Check the motor resistance. If the motor and its circuits are not shorted to ground, or open, check the TCCM power and ground circuit integrity. You may be directed by the service information to replace the TCCM at this point. Do not replace the TCCM until you inspect the other vehicle grounds.



NVG 246

C0308 4X4 Lamp “ON” (continued)

K 1500 Trucks

If the power and ground to the TCCM are good, inspect ground G102, G104 and G107. While these grounds are not directly connected to the TCCM, the circuits that are used by G102, G104 and G107 will use the encoder and TCCM to provide ground if one of those grounds is faulty. This has shown that it will lead to the condition we are discussing.

G102 is located mid way on the drivers side of the engine block next to the oil pan rail on 4.8L, 5.3L and 6.0L engines and at the front of the engine near the oil pan rail on the 8.1L engine. G102 is a main ground for the ignition coil packs. G107 is mounted on/near the top drivers side of the bellhousing and acts with G104 to provide ground for several components such as the A/C system, TAC system and ignition and fuel pump relays. G104 is mounted to the back of the cylinder head.

We have seen several problems with the ground connections at the engine. The road salt and magnesium chloride that is common on our roads today is attacking the grounds, causing corrosion inside the insulation at the eyelet ends. Check the grounds with a load test or a voltage drop test to ensure they are in good condition.



NVG 246 and NVG 263

C0327 Encoder DTC

K 1500 Trucks

Some NV 246 and NV 263 transfer case applications in GM full size pickups and SUV's may exhibit set a code C0327. This code may also be accompanied by a P0836 in the TCM, and/or a P0500, P1875 set in the PCM. In addition the 4x4 system will not shift and the "service 4x4" light will be illuminated in the dash.

C0327 will set if:

- The TCCM sees the encoder values either all high voltage or all low voltage levels
- Commanded motor position does not match the desired motor position

If a C0327 is set the TCCM will:

- Inhibit 4x4 operation
- Illuminate the "service 4x4" lamp in the dash

Technicians are replacing the complete encoder and motor assembly for this issue. Several years ago GM released the encoder as a separate item. If you choose, the encoder is available under the following part numbers:

- NV 246= 88962315
- NV 263= 88962313

NOTE: Kits include instruction sheets

NOTE: It's recommended to update the software for the TCCM after this repair.



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AF-21

Introduction

The AF-21 is a compact, lightweight 6-speed. The transmission is used in Ford, Lincoln, Mercury, Mazda, Volvo, and various other Euro manufactures.

The transaxle control is separate from the PCM, this unit uses both the PCM and the TCM to determine the best available shift quality.



**The TCM is located
on the transmission
manual shaft**

AF-21

Vehicle Applications

America

Ford Five Hundred
Ford Fusion
Land Rover 2
Lincoln Zephyr
Mazda 6
Mazda CX-7
Mazda CX-9
Mazda MPV

Mercury Milan
Mercury Montego
Saab 9-3
Volvo S40
Volvo S60
Volvo V70
Volvo XC70
Volvo XC90

Europe

Alfa Romeo 159
Alfa Romeo Brera
Alfa Romeo Spider
Cadillac BLS
Citroen C4
Citroen C5
Citroen C6
Fiat Croma
Lancia Delta

Opel/Vauxhall Astra
Opel/Vauxhall Vectra
Opel/Vauxhall Zafira
Opel/Vauxhall Insignia
Peugeot 307
Peugeot 407
Peugeot 607
Renault Espace
Renault Vel Satis



The ID is located next to the End Cover



AF-2I

Clutch, Band and One-Way Application

C1 Clutch

The C1 clutch connects the front planetary carrier to the rear sun gear of the rear planetary set. The C1 clutch is applied in 1st, 2nd, 3rd and 4th.

C2 Clutch

The C2 clutch connects the intermediate shaft to the rear planetary carrier. The C2 clutch is applied in 4th, 5th and 6th.

C3 Clutch

The C3 clutch connects the front planetary carrier to the middle sun gear of the rear planetary set. The C3 clutch is applied in Reverse, 3rd and 5th.

B1 Brake

The B1 brake locks the middle sun gear of the planetary gear set. The B1 brake is applied in 2nd and 6th.

B2 Brake

The B2 brake locks the rear planetary carrier in reverse gear when the vehicle speed is less than 4 mph (7km/h).

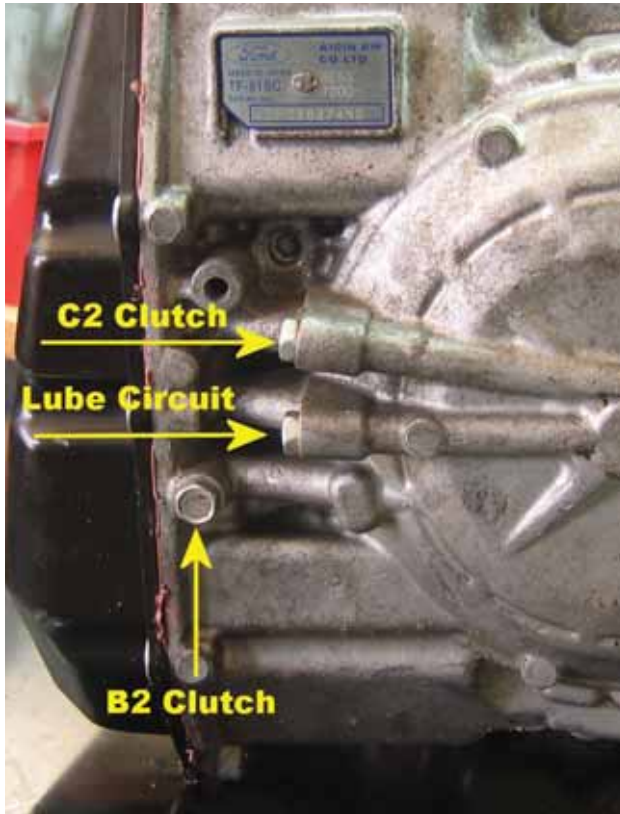
F1 One-Way Clutch

The F1 one-way clutch locks the counter clockwise rotation of the rear planetary during 1st gear operation.

Clutch and Band Application Chart						
	C1	C2	C3	B1	B2	F1
Reverse			X		X	
1st	X					X
2nd	X			X		
3rd	X		X			
4th	X	X				
5th		X	X			
6th		X		X		

AF-2I

Pressure Test



Clutch	Range	Pressure
C1	Drive (1st-4th)	28-199 psi.
C2	Drive (4th-6th)	28-199 psi.
C3	Drive (3rd-5th)	28-199 psi.
C3	Reverse	57-270 psi.
B2	Low/M1	85-199 psi.
B2	Reverse	57-270 psi.



AF-2I

Valvebody Breakdown

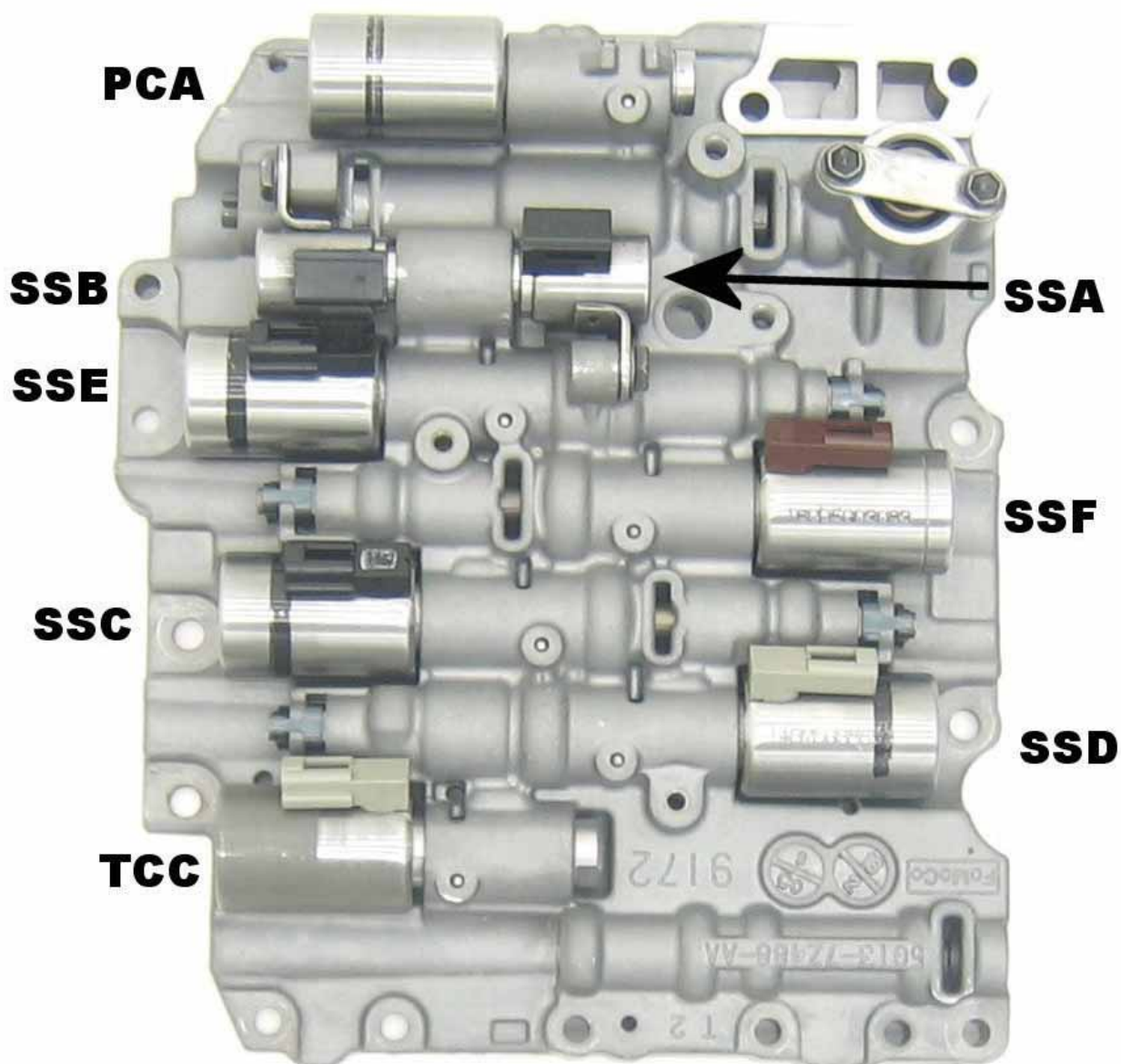
Do not mix the solenoids up! Shifting problems, codes and ratio errors may occur. Mark the solenoids prior to removal.

Pay close attention to the solenoid retaining pins. If you lose a pin you can make a new one out of an old needle bearing.

Pin measurements are 0.932 X 0.118

SSA and SSB = 11-15 Ohms

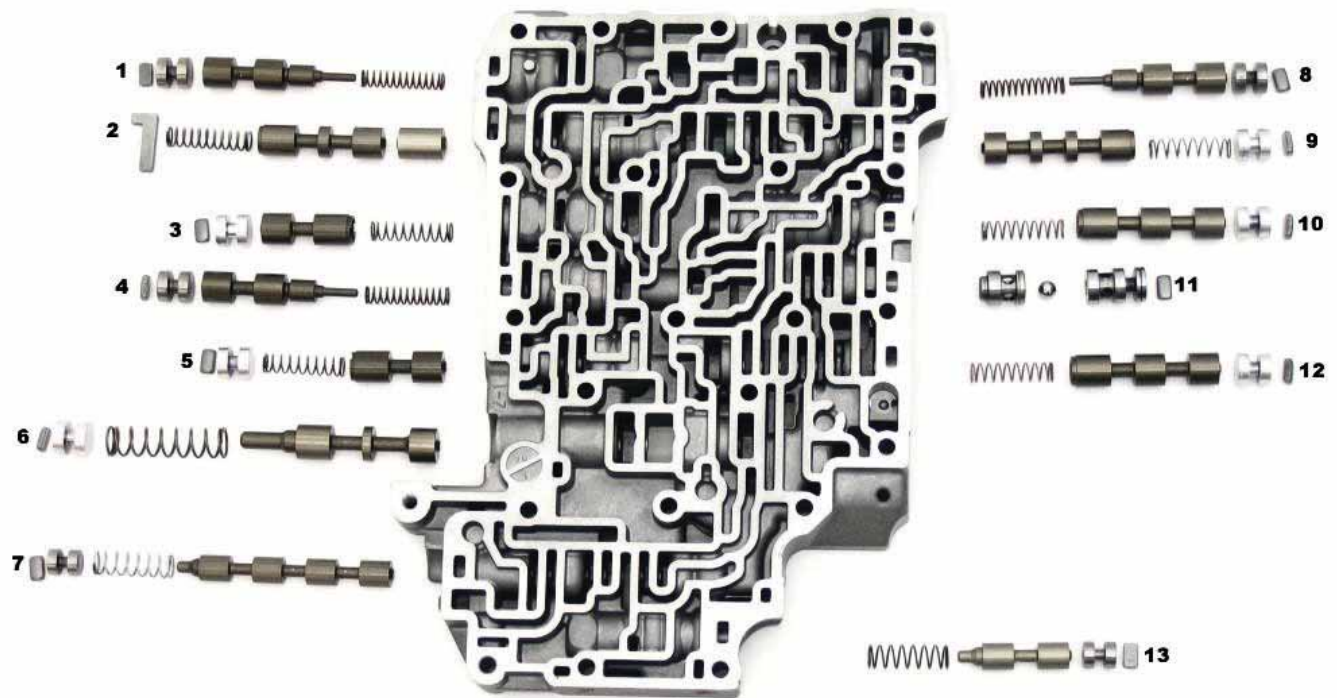
SSC, SSD, SSF, SSE, TCC and PCA = 5.7 ohms



AF-21

Valvebody Breakdown (continued)

These valvebodies are experiencing a tremendous amount of wear in the valve bores. The wear is caused by a combination of side loading and the composition of the aluminum the valvebody is constructed of. The aftermarket has repair kits for the most popular valves. Carefully inspect each valve and bore for signs of wear.



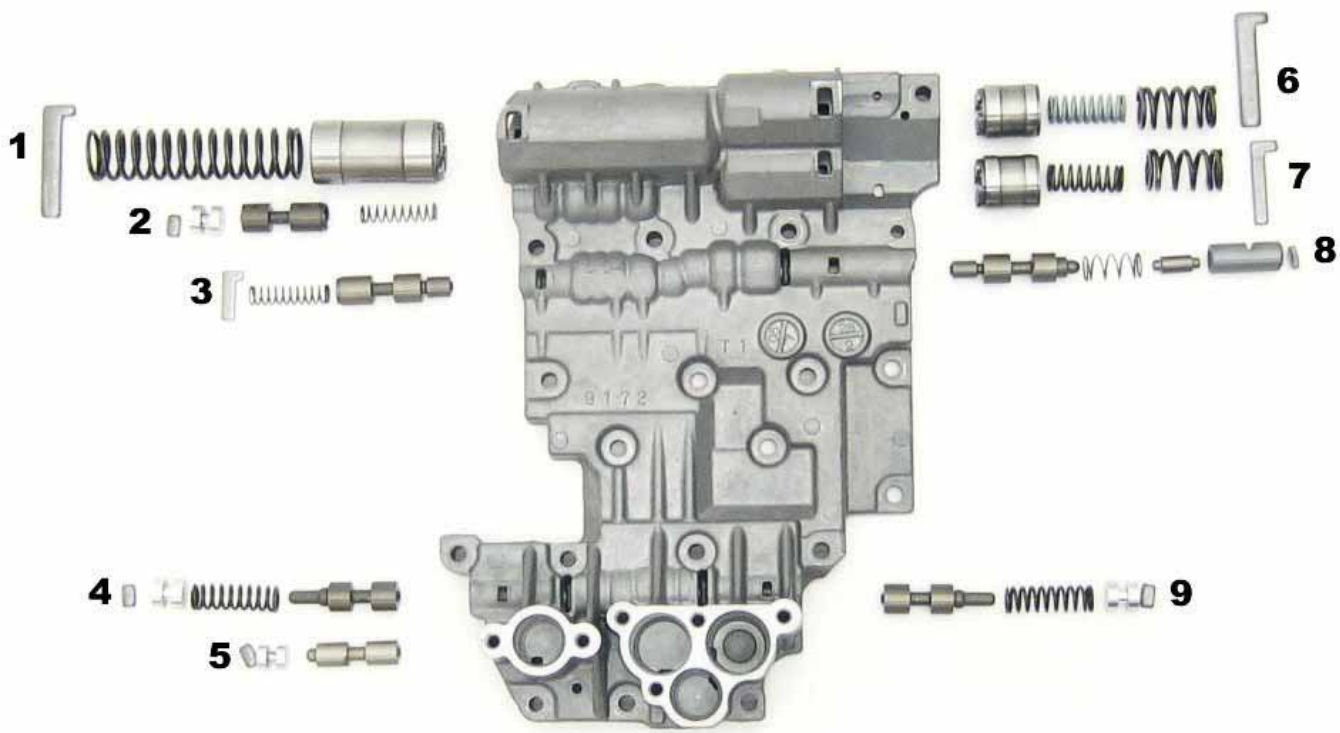
1. C1 Shift Valve
2. B2/C2 Switch Valve
3. C2 Relay Valve
4. C3 Signal Valve
5. B1 Signal Valve
6. Secondary Regulator Valve
7. Sequence Valve

8. B1/C3 Control Valve
9. Lock Up Relay Valve
10. B1/C3 Relay Valve
11. B1/C3 Shift Restrict Valve
12. B1/C3 Switch Valve
13. Cutback Valve

AF-2I

Valvebody Breakdown (continued)

The high failure valves in the Upper Valvebody are the Solenoid Modulator valves and the Lock up control valve. Worn solenoid modulator valves can cause ratio codes in 4th, 5th and 6th gear. A worn lock up valve can cause TCC surge and a possible P0741 TCC slip code.



1. **Forward Accumulator**
2. **C1 Relay Valve**
3. **C2 Clutch Timing Valve**
4. **Solenoid Modulator Valve**
5. **Engine Brake Engagement Valve**
6. **C1 Accumulator**
7. **C3 Accumulator**
8. **Lock Up Control Plunger Valve and Sleeve**
9. **Solenoid Modulator Valve**

AF-21

Valvebody Breakdown (continued)

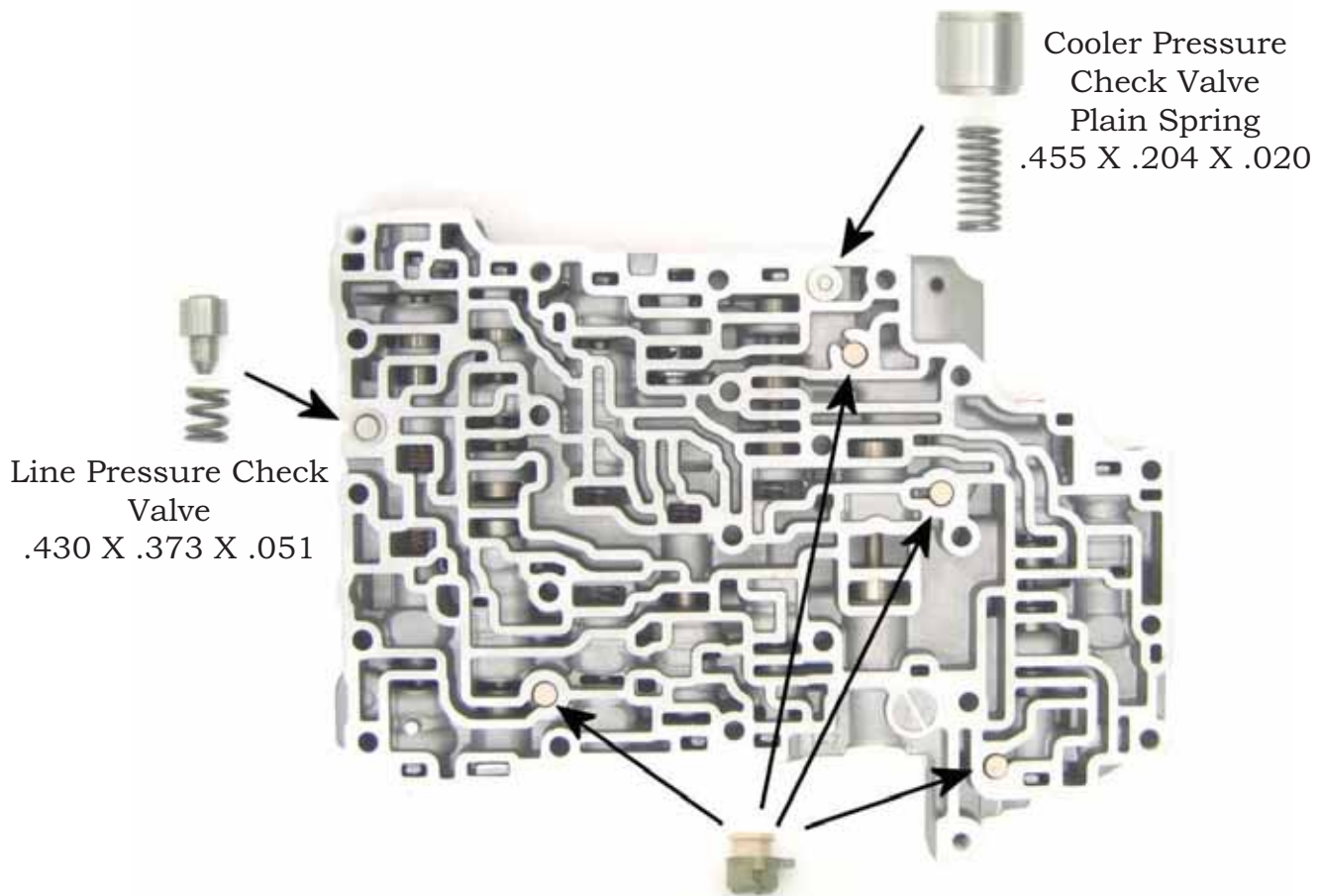


Special thanks to Maura Stafford at Sonnax for the check valve names

AF-21

Valvebody Breakdown (continued)

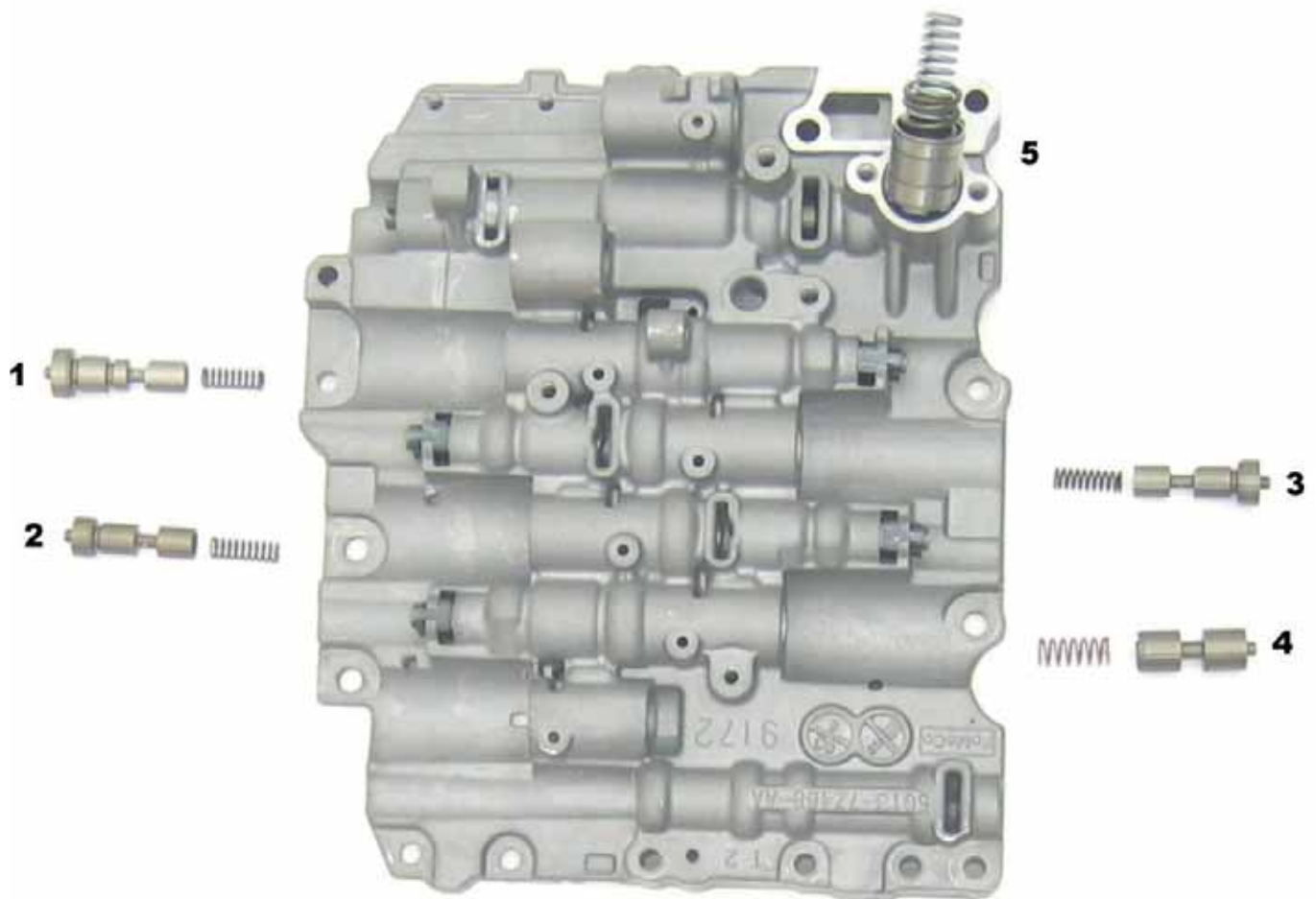
The check valves are installed with blue side facing down into the valvebody slot.



AF-21

Valvebody Breakdown (continued)

Always measure the depth of the adjuster before disassembly. The clutch and band control valves are a very common wear areas. Inspect these closely for side to side movement in the valvebody. There are repair kits available from the aftermarket.

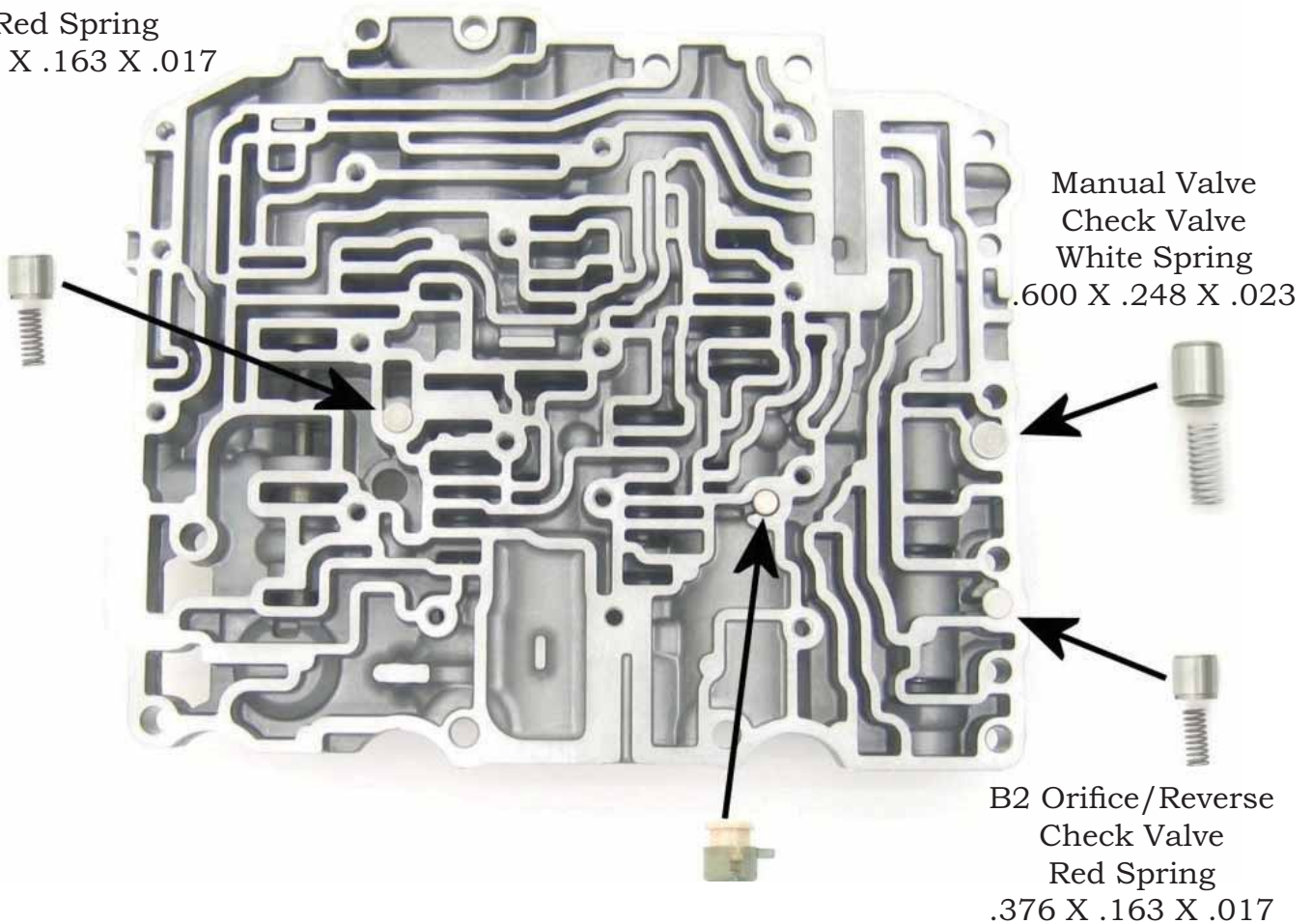


1. B1 Band Pressure Control Valve
2. C3 Clutch Pressure Control Valve
3. C2 Clutch Pressure Control Valve
4. C1 Clutch Pressure Control Valve
5. B1 Band Accumulator

AF-21

Valvebody Breakdown (continued)

Regulated
Exhaust1
Check Valve
Red Spring
.376 X .163 X .017

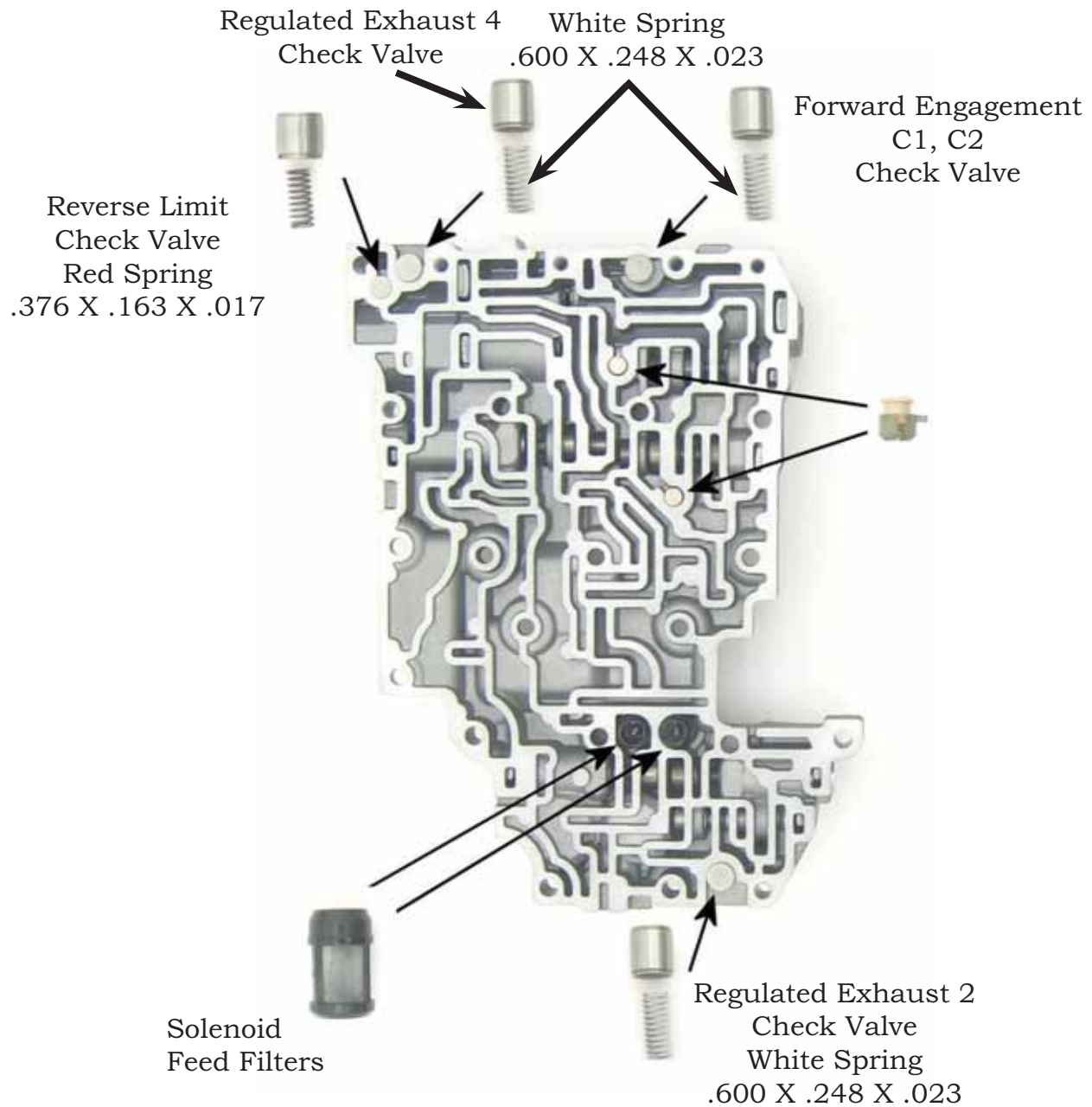


Special thanks to Maura Stafford at Sonnax for the check valve names

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AF-21

Valvebody Breakdown (continued)



AF-2I

Accumulator Piston and Spring Locations

Check for collapsed or broken springs. If the accumulator bores are worn you can replace the pistons with aftermarket pistons with seals.



FNR5

Harsh 3-4 Shift

A Ford FNR5 or Mazda FN5AEL transmission, may be experiencing a harsh 3-4 shift at times. We have encountered numerous instances where a worn servo pin bore in the case, has been the cause of harsh 3-4 shifts. Servo pin bore wear is becoming an issue on a large number of transmissions these days. Inspecting the servo pin bore for wear should be a regular part of any rebuild procedure. Servo pin bore repair kits are available from your local suppliers.



4/5R55E

Engine Stall After Rebuild

Special care should be taken when rebuilding a 4R44E or 5R55E transmission. The input shaft on 4/5R55E is approximately 10" and the input shaft on a 5R55S/W/N is approximately 10 1/4".

If the longer shaft is installed in place of the shorter shaft the engine will stall on start up. Eventually you may get the engine to run and this will cause the tip of the input shaft to grind off against the torque converter cover and cause metal particles through the transmission and cooling system.

The installer may not notice the lack of end play between the converter and flywheel (flexplate) because the studs of will already be aligned in the flywheel and there would be no need to try and turn the converter. The part numbers for the correct input shaft application are listed below.

Part Numbers

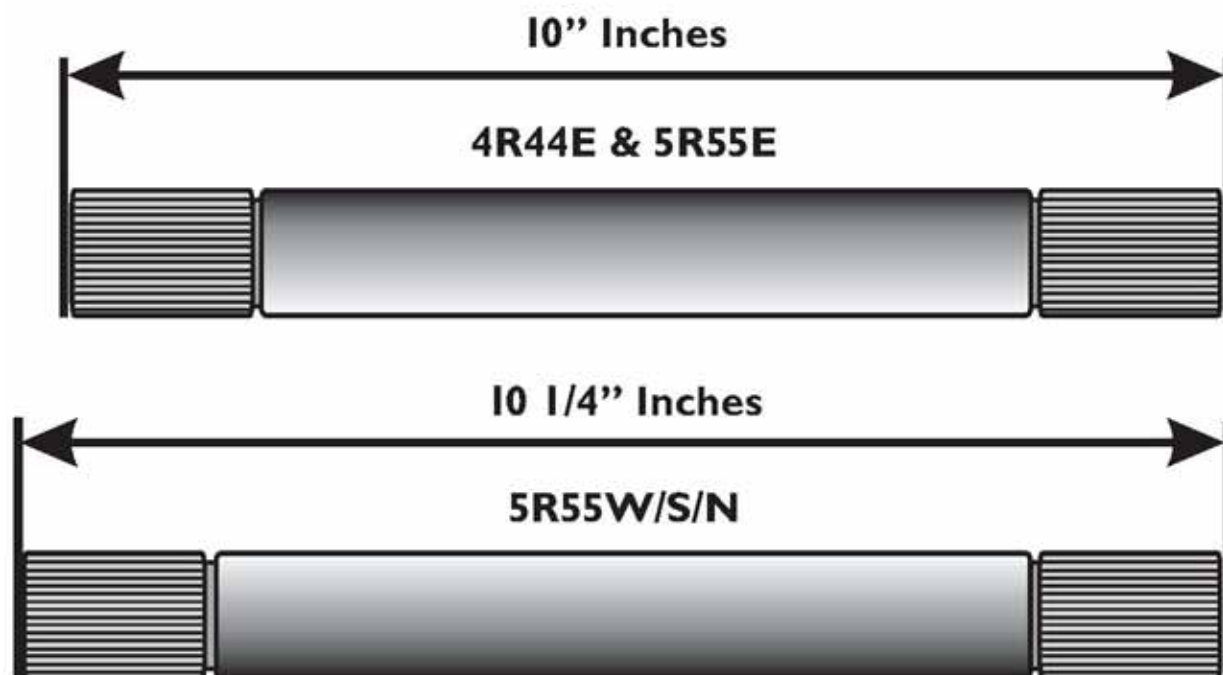
4R44E & 5R55E

XL2Z-7017AA

5R55W/S/N

XW4Z-7017AA

Input Shaft



4R75W

4X4 Inoperative

While working on Ford's electronically controlled 4X4 systems, you may encounter an inoperative 4X4 system. The 4X4 control module (GEM, 4WDCM or TCCM) may or may not have DTC's set in the control module. Wiring and connection concerns continue to be a problem, especially after transmission repairs. Always inspect the 4X4 system wiring harness for damage or loose connections. Here is an example of a Ford F150 4X4 system wiring harness that was damaged during a previous transmission repair.



5R55N/W/S, 4R/5R44/55E

Thermal Element Function

Some technicians may be confused as to how the hydraulic cooler bypass systems works on some Ford transmissions.

There has been times when the thermal element or fluid cooler bypass sleeve may stick and cause internal components to fail without setting any temperature related codes. This same problem may also cause an intermittent lockup code P0741.

Some reprogramming kits may supply a block to keep the fluid cooler bypass stroked in the normal temperature position. The Valve opens at an operating temperature between 150°F and 170°F.

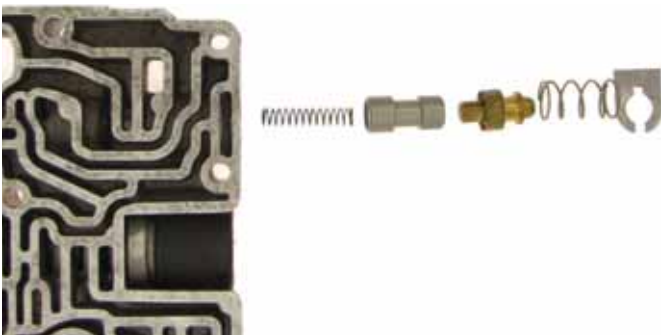
5R55N Thermal Bypass Valve



5R55W/S Thermal Bypass Valve



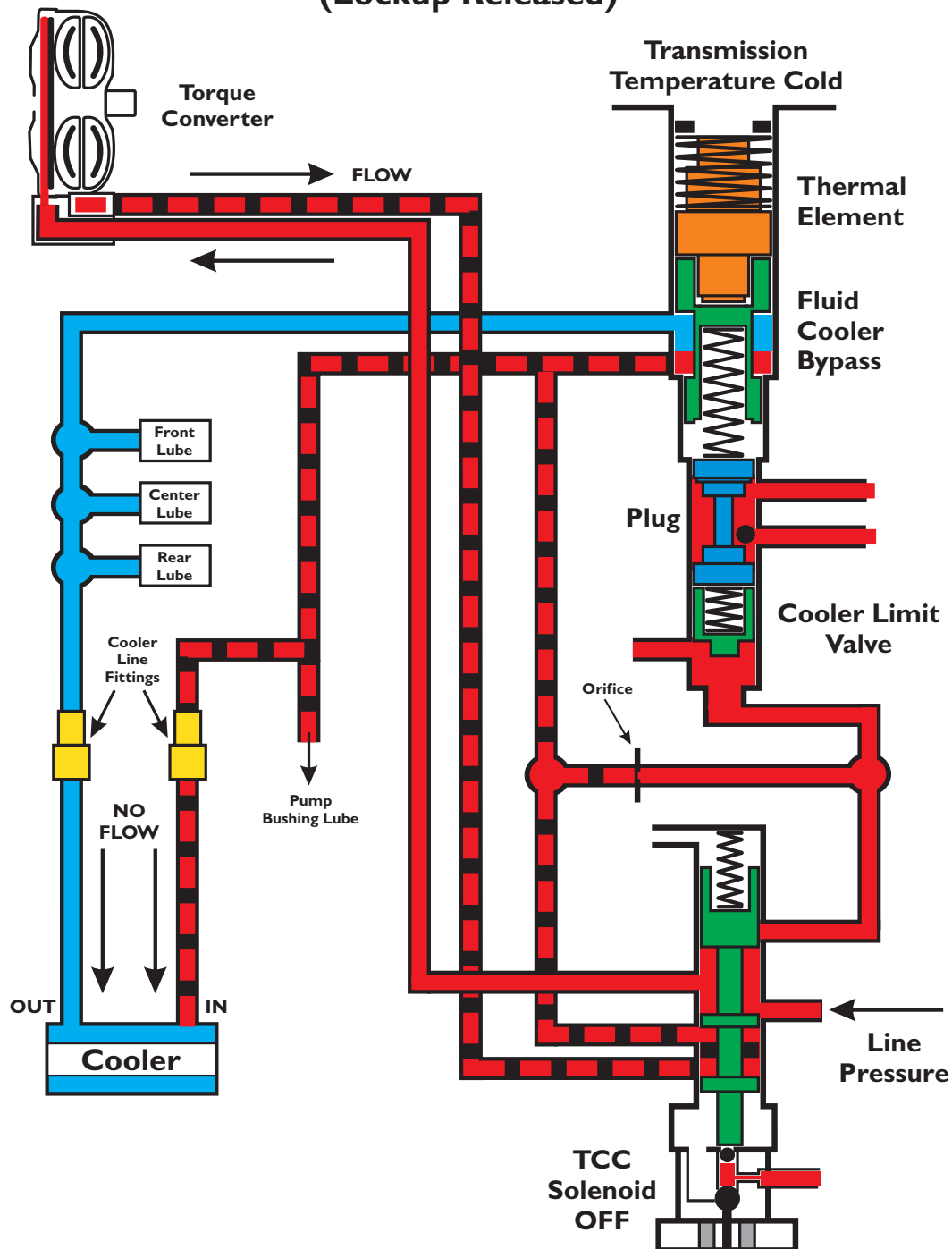
4/5R55E Thermal Bypass Valve



4R/5R44/55E

Thermal Element Function (continued)

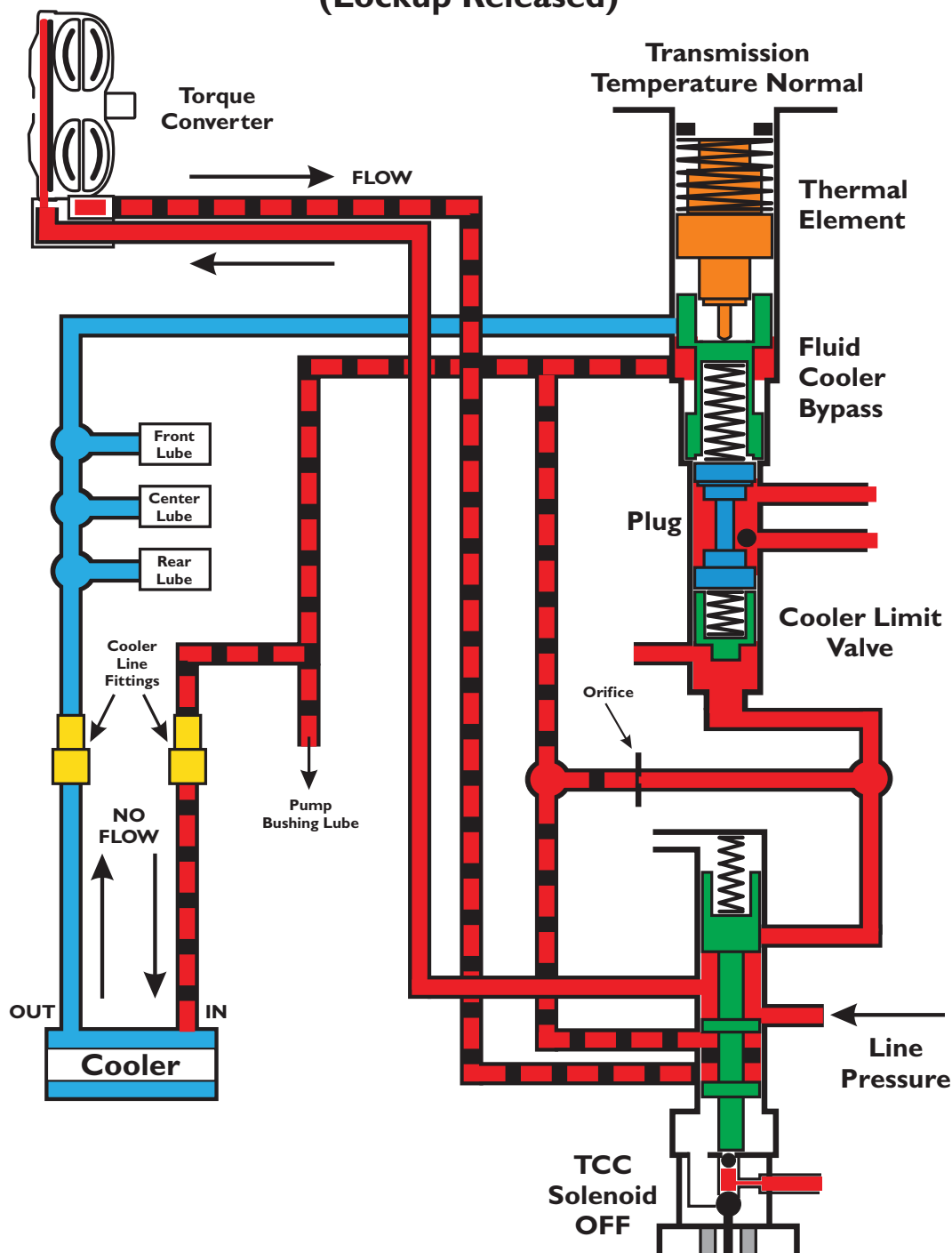
4/5R55E Thermal Valve Function (Lockup Released)



4R/5R44/55E

Thermal Element Function (continued)

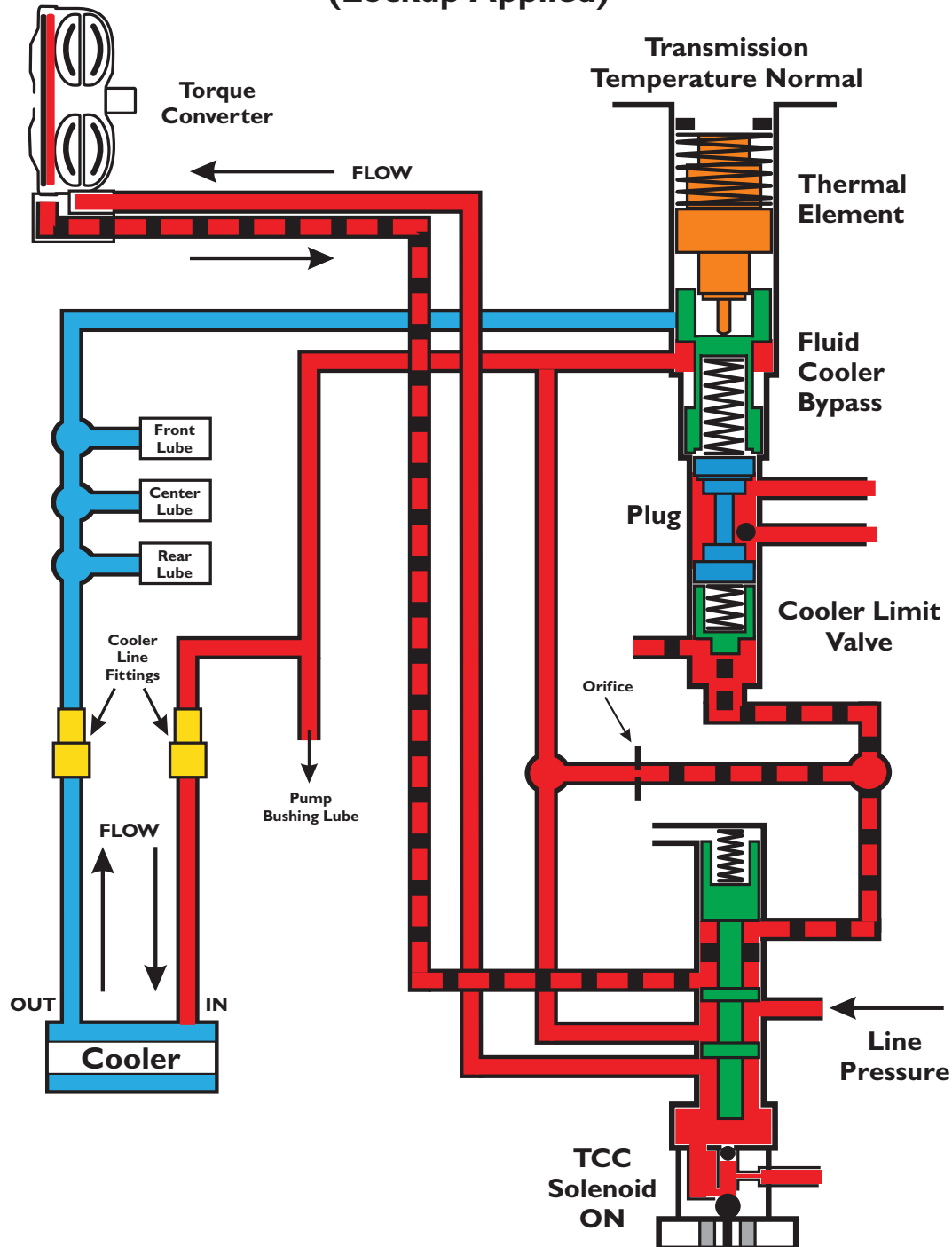
4/5R55E Thermal Valve Function (Lockup Released)



4R/5R44/55E

Thermal Element Function (continued)

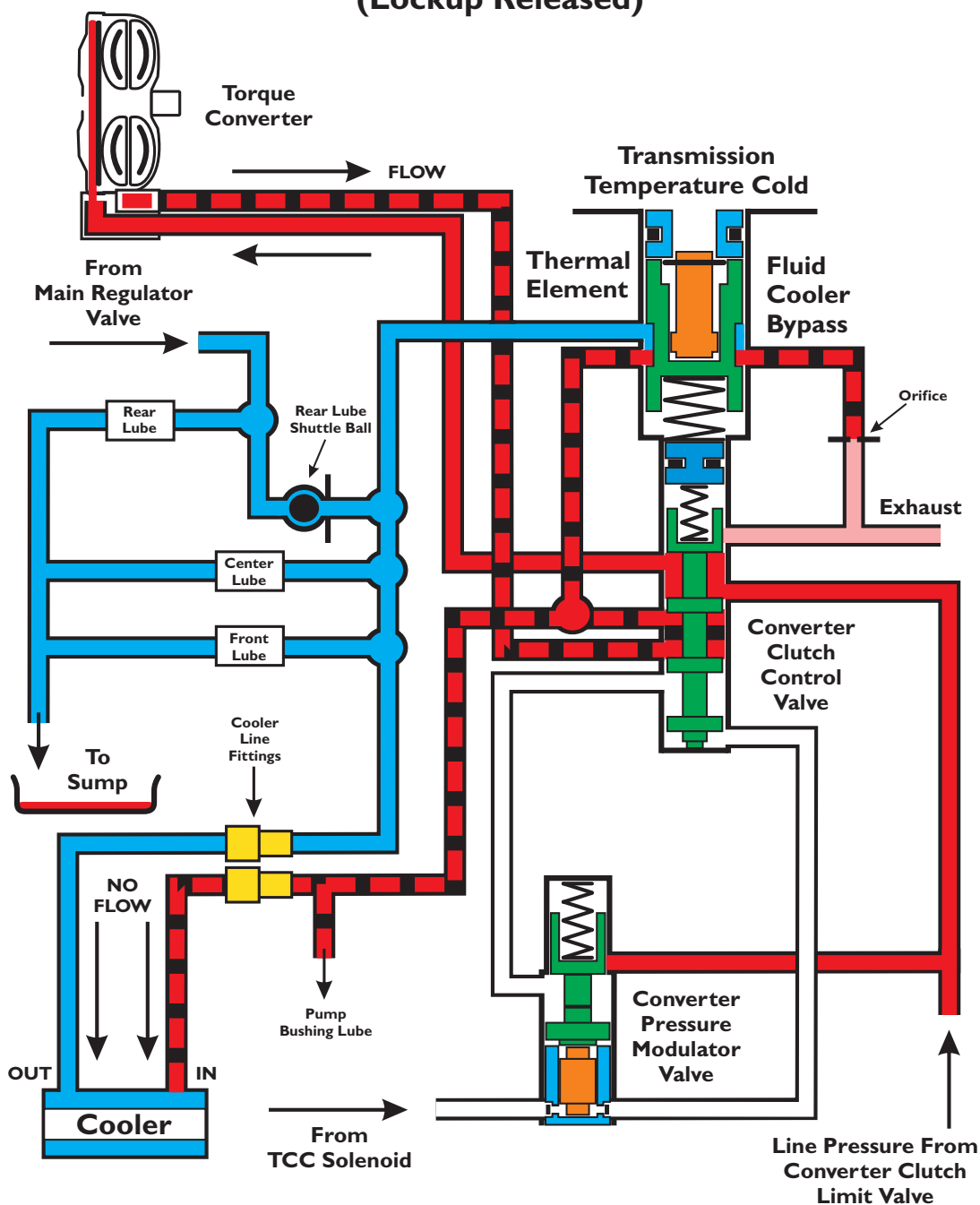
4/5R55E Thermal Valve Function (Lockup Applied)



5R55W/S

Thermal Element Function

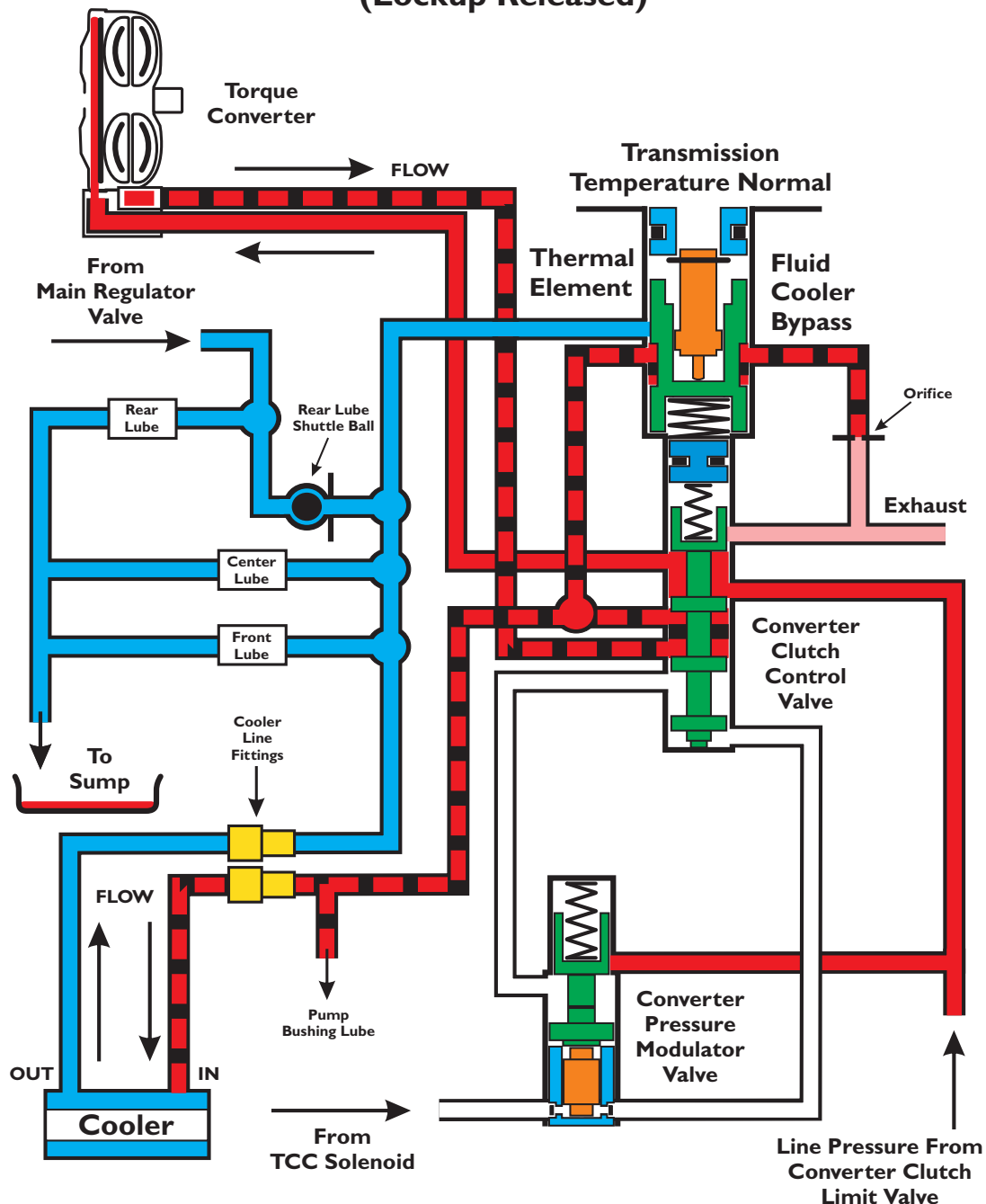
5R55W/S Thermal Valve Function (Lockup Released)



5R55W/S

Thermal Element Function (continued)

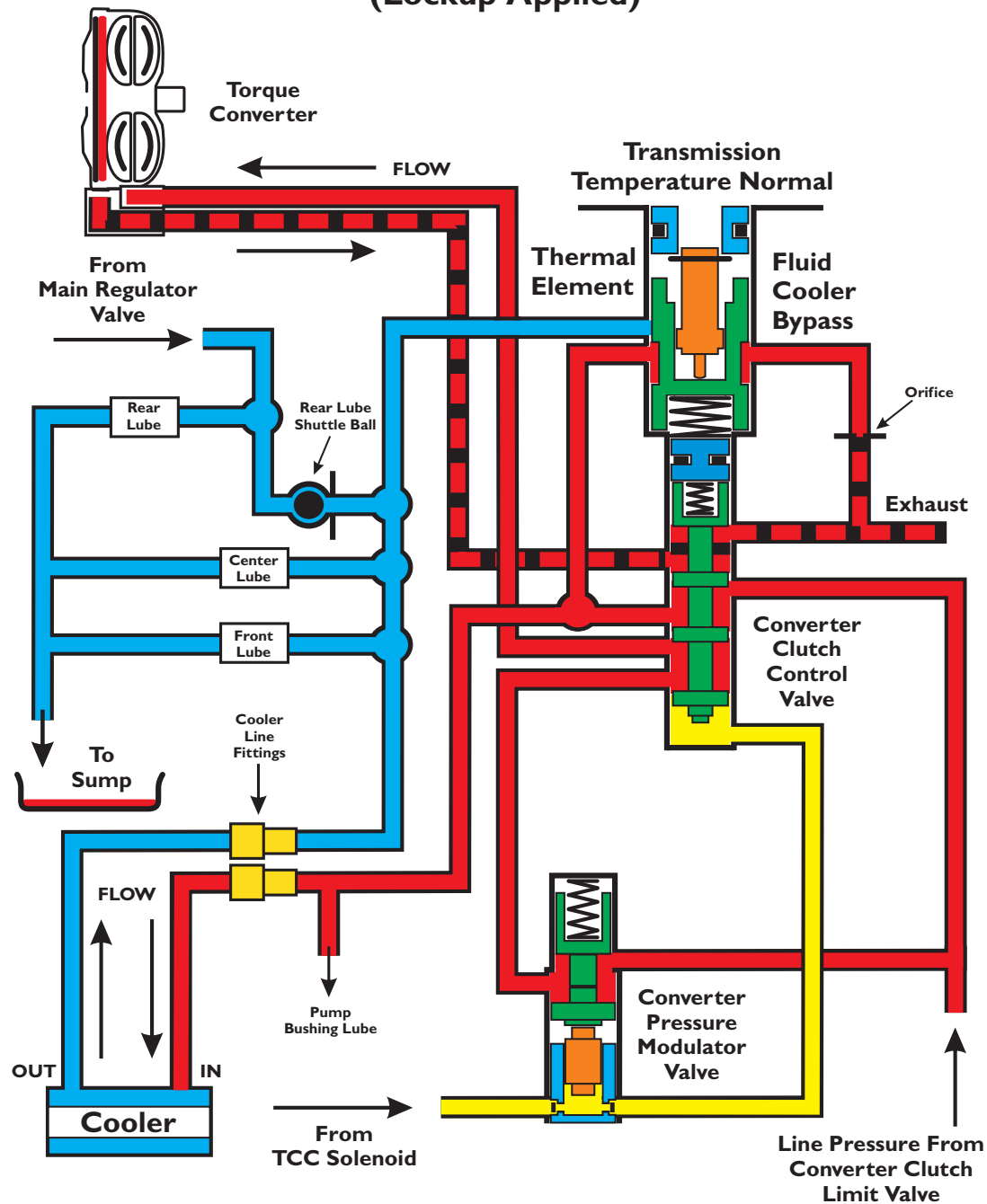
5R55W/S Thermal Valve Function (Lockup Released)



5R55W/S

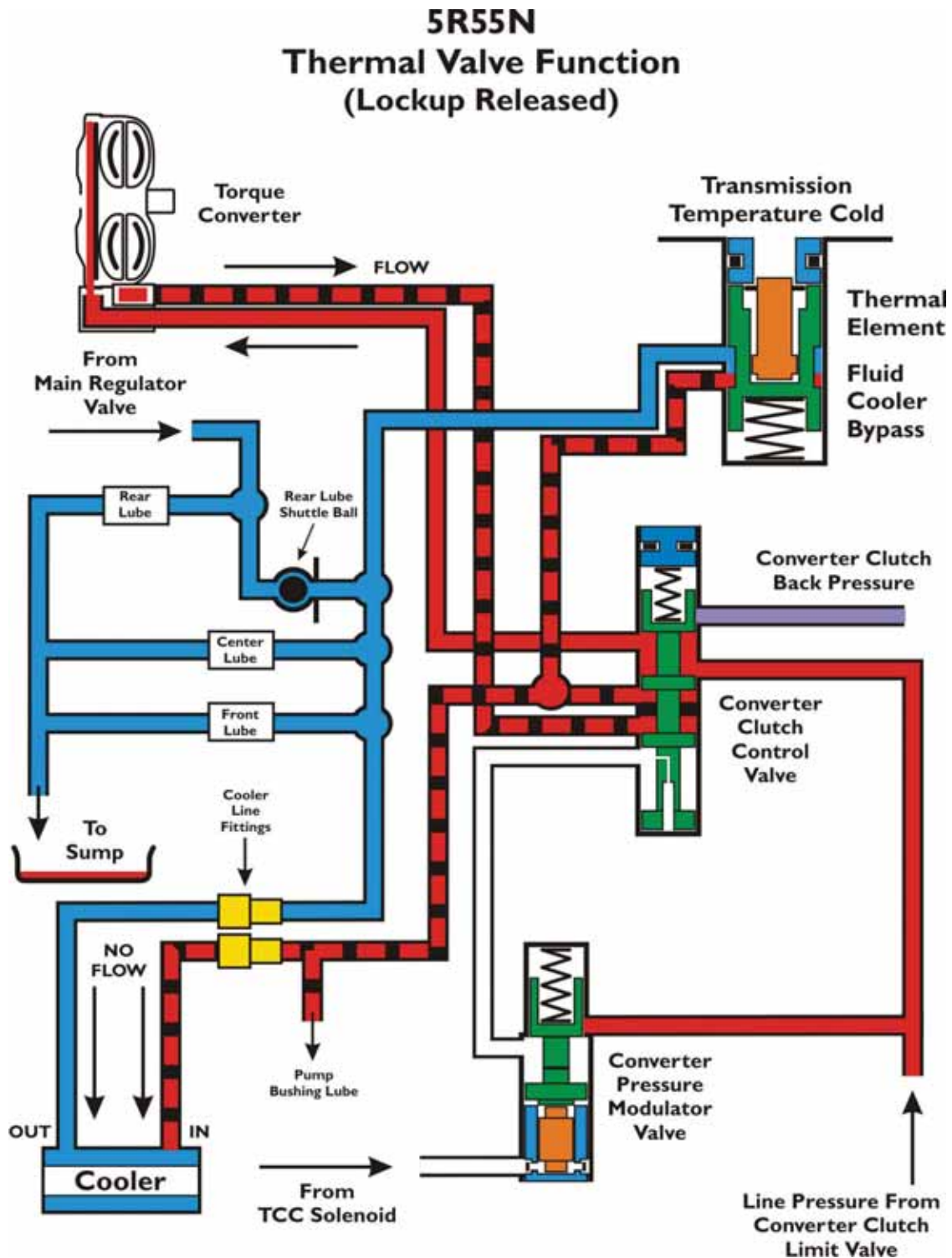
Thermal Element Function (continued)

5R55W/S Thermal Valve Function (Lockup Applied)



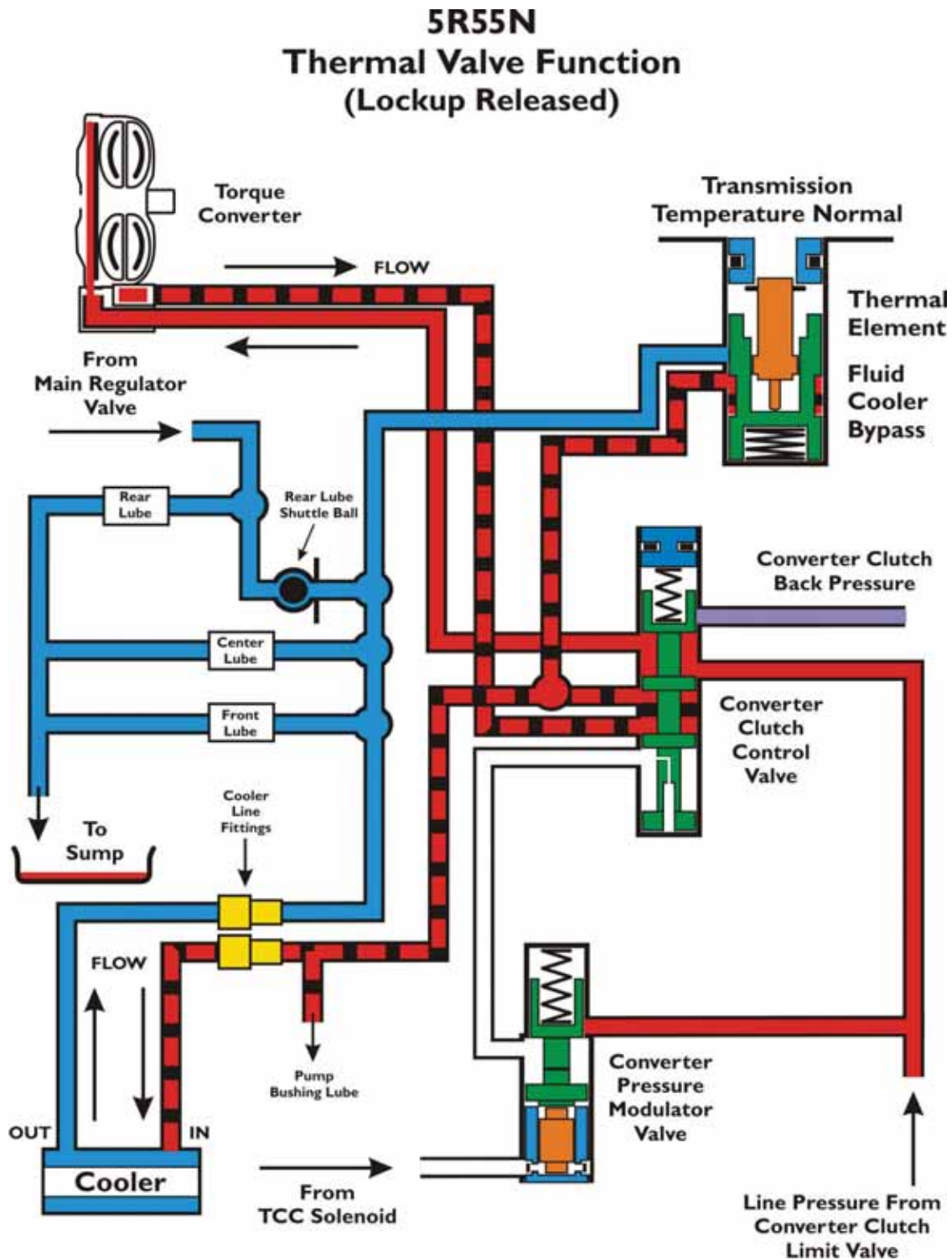
5R55N

Thermal Element Function



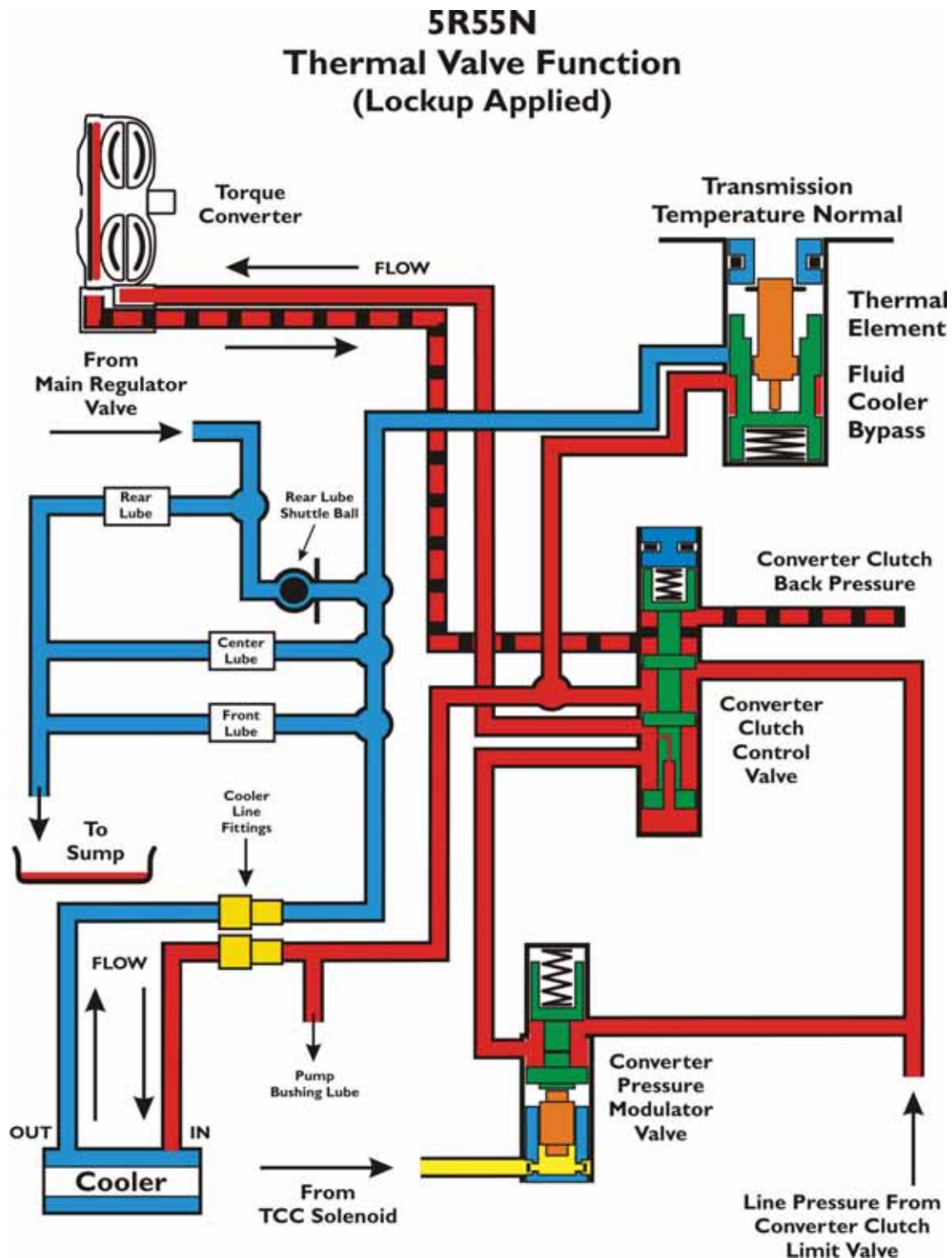
5R55N

Thermal Element Function (continued)



5R55N

Thermal Element Function (continued)



5R55N/W/S

Metal in the Pan

There may be no particular symptom other than metal in the pan. The ring gear hits the shell generating metal which may be seen in the sump. There may be a no noise heard and the snap ring may still be in place just broken in several places. This is something that may only be noticed on a teardown for a normal rebuild for other reasons.

There are two options to repair this problem, replace the assembly or replace the retaining ring from another used 5R55N/W/S transmission or a snap ring from a TF6 or a 4L60E forward clutch hub will work as a replacement.



5R55N/W/S

Metal in the Pan (continued)

The 4L60E forward hub retainer ring will have to be modified by shortening the length at one end to fit the 5R55W hub. The snap ring from the TF6 hub will work as a direct fit and is much stronger than both the original or 4L60E retainers.

ATRA would like to thank Wayne Deveau from Transmissions of West Palm Beach Florida for the information and parts to make this article possible.



Torqshift

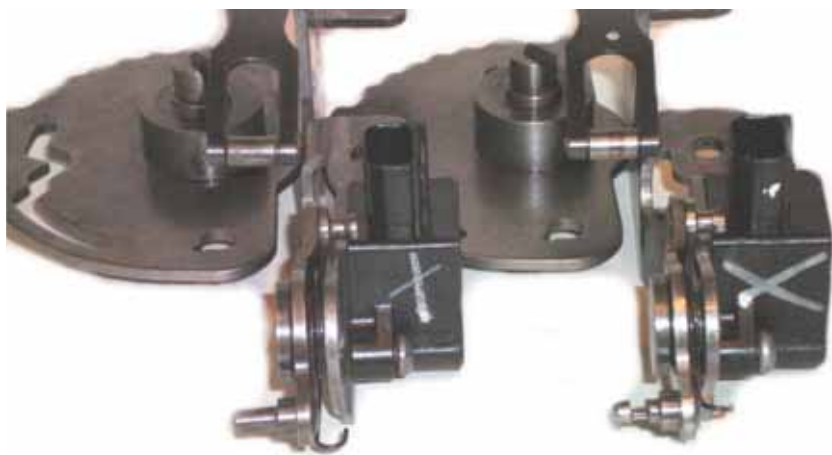
Delay and/or No Reverse

A complaint of a delay and/or intermittent no reverse concern may be caused by a faulty Internal Range Sensor.

After inspecting the linkage and shifter assembly. Remove the pan and inspect the IR Sensor. With the rooster comb pushed away from the sensor. A clearer view reveals that the pin that follows the worm track in the rooster comb is worn paper thin.

The other item that was noticeable on the new sensor was the return spring for the sensor pin cam. The newer sensor had a different spring configuration that placed more tension on the pin to rooster comb contact.

Special thanks to the guys over at Al's Transmissions in Sunrise, Florida.



Used

New



Remember that Old-Time Service?



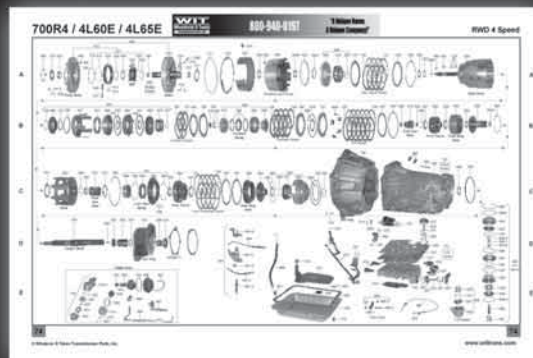
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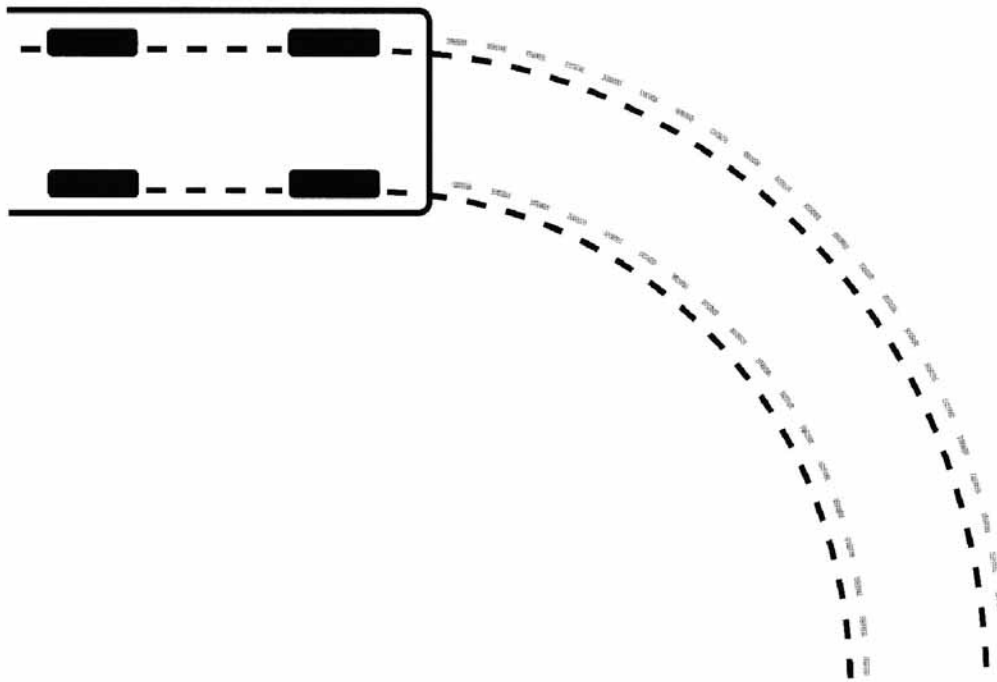
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4WD All

Bumping When the 4X4 is Engaged

A bumping noise and/or feel on an Explorer when the T-Case is switched to the 4wd “High” mode may be caused by tire wear. Check all of the tires, make sure they are acceptable and are the same brand. Measure the tires, make sure they all are between 1/8 and 1/4” in total difference.

During the test the tires measured from 92” to 93.75” when added together and divided by 4 averaged to 93”/multiplied by 2 = 186. Rotated tires so that front and rear had 186, bumping stopped.





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AWD

Shudder and/or Binding On Turns

A shudder and/or bind on turns may be caused by the spider gear washers in the differential or PCM calibration. If the “Tire Monitoring System” light is illuminated on the dash, check the tire pressures and circumferences. Use your scan tool to check data, you may see the two front tire pressures correct at 34-35 psi. and the rear tires showing 0 psi. and 255 psi.. This may be caused by a programming issue. Update the PCM to the latest calibration.

If this concern is not taken care of by the tires and/or the rotation of the tires, or PCM recalibration, check the rear differential spider gear washers, they may be knurled. If so, replace the spider gears and washers.



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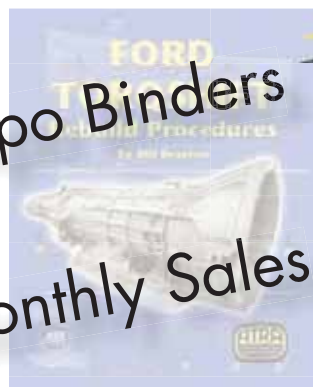
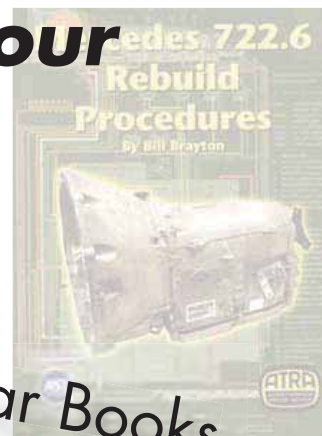
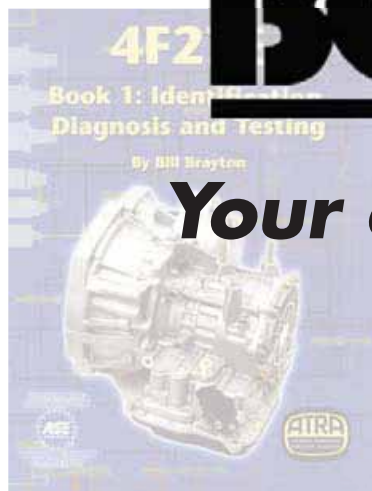
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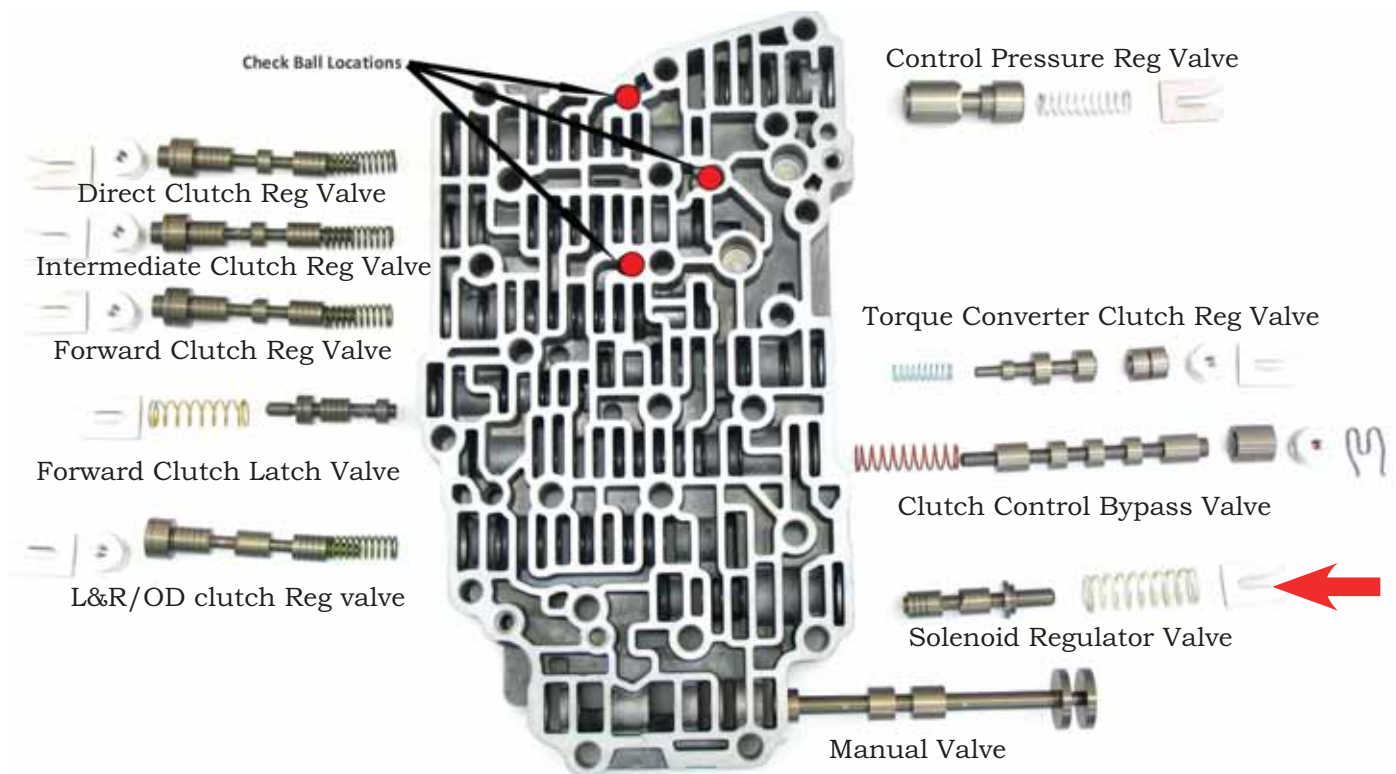
6F35N

Transmission Slips/Shifts Erratic

The 6F35N came out in 2009 & up in the Milan, Fusion, Escape, Mariner, Escape Hybrid, Mariner Hybrid.

Erratic/slipping shifts is caused by a worn solenoid regulator valve. The bore wears out and this causes low pressure to the control solenoids.

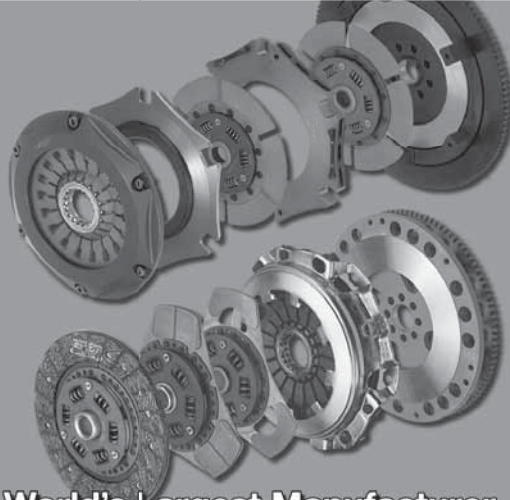
Carefully inspect the solenoid valve bore for wear. If the valve moves excessively in the bore replace the valve body. Note: There are aftermarket replacement valves in development at this time.



A Special Thanks to Rick Bennington at Jim Jennings Transmission!



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6F50N

No 4th, 5th or 6th Gear/Major Planet Failure

The loss of 4th, 5th and 6th gears is caused by the Overdrive clutch snap ring popping out of the drum. The major planet failure occurs when the snap ring works its way between the sun shell and the rear planet assembly. The snap ring from the RE4F04A input clutch is a great replacement snap ring



The snap ring gets in between the sunshell and the planet



Overdrive Clutch snap ring pops out

A Special Thanks to Rick Bennington at Jim Jennings Transmission!

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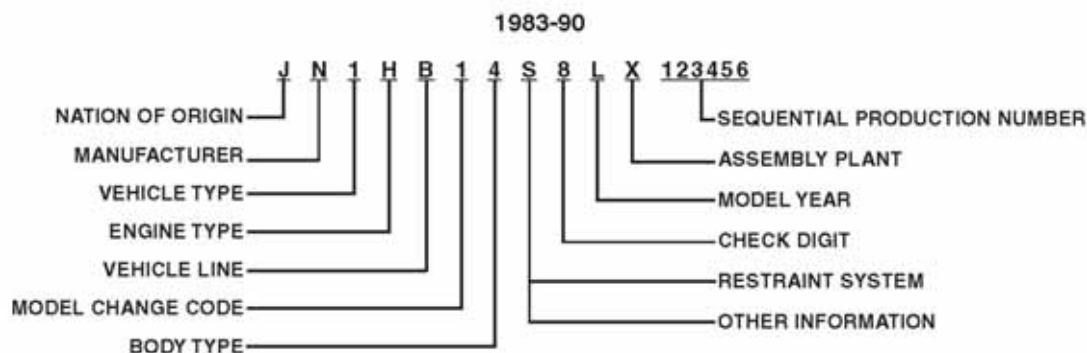
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Nissan ALL

VIN Identification

The Vehicle Identification Number (VIN) is stamped on a metal plate. The plate is attached to the upper left corner of the instrument panel and is visible from outside the vehicle through the windshield. It can also be found on the Vehicle Certification Label located on the left front door lockface panel and/or door pillar.



NISSAN

VIN Position 1 = Nation of Origin

J Japan
1 USA
3 Mexico

VIN Position 2 = Manufacturer

N Nissan

VIN Position 3 = Vehicle Type

1 Passenger Car - Japan
4 Passenger Car - USA
6 Truck - Japan/USA
8 MPV - Japan

VIN Position 4 = Engine Type - Passenger Car

C	1.8 L	4 Cyl	(CA18ET)	1983-87
C	1.8 L	4 Cyl	(GA18DE)	1988-90
C	2.8 L	6 Cyl	(L28E)	1983
C	2.8 L	6 Cyl	(L28ET)	1983
C	3.0 L	V6	(VG30ET)	
C	3.0 L	V6	(VG30ETT)	
E	1.6 L	4 Cyl	(CA16DE)	1987
F	2.0 L	4 Cyl	(Z20)	1983-85
F	2.4 L	4 Cyl	(KA24)	1990
G	1.6 L	4 Cyl	(GA16)	1989-90
H	2.0 L	4 Cyl	(CA20E)	1983-89
H	2.4 L	4 Cyl	(KA24E)	1989-90
H	2.8 L	6 Cyl	(L28E)	1983
H	3.0 L	V6	(VG30E)	
H	3.0 L	V6	(VG30)	1989
M	1.5 L	4 Cyl	(E15S)	1983
M	1.6 L	4 Cyl	(E16)	1984-88
N	2.4 L	4 Cyl	(KA24E)	1990
N	2.4 L	4 Cyl	(Z24)	1983-89
P	1.6 L	4 Cyl	(E16S)	1983-88
P	1.6 L	4 Cyl	(E16)	1987-89
P	1.6 L	4 Cyl	(E16S)	1987-89
R	2.2 L	4 Cyl	(Z22E)	1983
R	3.0 L	V6	(VG30)	1990
S	1.7 L	4 Cyl Diesel	(CD17)	1983-86
S	2.4 L	4 Cyl	(KA24E)	
S	2.4 L	4 Cyl	(Z24)	1987-90
S	2.8 L	6 Cyl	(CA16DE)	
S	2.8 L	6 Cyl Diesel	(LD28)	1983

VIN Position 4 = Engine Type - Truck/Van/Pathfinder

H	2.0 L	4 Cyl	(Z20)	1984-87
H	3.0 L	V6	(VG30E)	1986-89
H	3.0 L	V6	(VG30)	1989-90
J	2.5 L	4 Cyl Diesel	(SD25)	1983-87
M	2.2 L	4 Cyl	(Z22)	1983
N	2.4 L	4 Cyl	(Z24)	1984-87

N	2.4 L	4 Cyl	(Z24)	1986-89
S	2.4 L	4 Cyl	(Z24)	1987-89
S	2.4 L	4 Cyl	(Z24)	1990
S	2.4 L	4 Cyl	(KA24E)	1990

VIN Position 5 = Vehicle Line

B	Sentra	1983-90
J	Maxima	1989-90
S	240SX	1989-90
T	Stanza	1983-89
U	Stanza	1990
U	Maxima	1983-88
Z	280ZX	1983
Z	300ZX	1984-90

D	Truck/Pathfinder
C	Van
M	Axxess

		1990
--	--	------

VIN Position 6 = Model Change Code

0	Stanza Wagon	1986-89
0	Maxima	1989-90
1	Maxima	1983-88
1	300ZX	1984-90
1	Axxess	1990
1	Sentra	1983-86
1	Stanza	1983-86
1	Truck/Pathfinder	
2	Sentra	1987-90
2	Stanza	1987-90
2	Pulsar	1983-86
2	200SX	1983-88
3	Pulsar	1987-90
3	240SX	1989-90
2	Van	1987-88, 90

VIN Position 7 = Body Type - Passenger Car

1	4 Dr Sedan	
2	2 Dr Sedan	1983-94
3	4 Dr Hardtop	1983-87
3	4 Dr Hatchback	1983-88
4	2 Dr Hardtop	1983-87
4	2 Dr Coupe	
4	2 Dr Hatchback	
5	4 Dr Wagon	
6	2 Dr Hatchback	1988-90
6	2 Dr Coupe (2+2)	1990

VIN Position 7 = Body Type - Truck/Pathfinder

1	Pickup - Reg Bed
2	Pickup - Long Bed
3	Pickup - Double Cab
4	Van/Pathfinder
5	Cab & Chassis
6	King Cab - Wagon
6	Pathfinder

VIN Position 8 = Passenger Car - Restraint System

A	Passive Belt System - 3 Point
B	Air Bag Equipped
C	Air Bag Equipped
J	Passive - Motorized - 2 Point (4WD-AWD)
P	Passive - Motorized - 2 Point (FWD-FWD)

VIN Position 8 = Truck/Van/Utility - Drive Type/Other Info

H	Heavy Duty
S	Standard
S	FWD-FWD
Y	4WD-AWD

VIN Position 9 = Check Digit

VIN Position 10 = Model Year

D	1983	H	1987
E	1984	J	1988
F	1985	K	1989
G	1986	L	1990

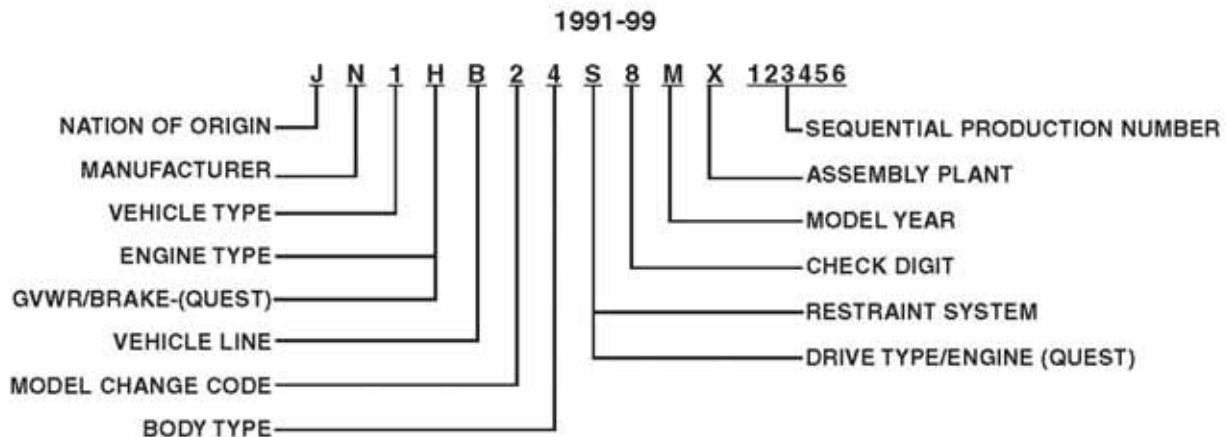
VIN Position 11 = Assembly Plant

C	Smyrna, Tennessee - USA
H-M	Tochigi, Japan
K	Mexico
T	Oppama, Japan
U	Zama, Japan
W	Kyushu, Japan
X	Hiratsuka, Japan
Z	Kyoto, Japan
4	Nagoya, Japan
5	Murayama, Japan
9	Gunba, Japan
9	Fujiyvu, Japan

VIN Position 12-17 = Sequential Production Number

Nissan ALL

VIN Identification (continued)



NISSAN

VIN Position 1 = Nation of Origin

J Japan
1 USA
3 Mexico

VIN Position 2 = Manufacturer

N Nissan

VIN Position 3 = Vehicle Type

1 Passenger Car - Japan
2 Quest (VAN)
3 Convertible - Japan
4 Passenger Car - USA
6 Truck - USA
8 Pathfinder (SUV)

VIN Position 4 = Engine Type - Passenger Car

A	1.6 L	4 Cyl	(GA16)	1995-98
A	2.4 L	4 Cyl	(KA24)	1995-98
B	2.0 L	4 Cyl	(SR20)	1994-99
B	2.4 L	4 Cyl	(KA24DE)	1994
C	3.0 L	V6	(VG30DET)	1991-94
C	3.0 L	V6	(VG30)	1995-96
C	3.0 L	V6	(VQ30)	1995-99
D	2.4 L	4 Cyl	(KA24)	1998-99
E	1.6 L	4 Cyl	(GA16DE)	1991-94
E	3.0 L	V6	(VE30DE)	1992-94
F	2.4 L	4 Cyl	(KA24E)	1991-93
G	2.0 L	4 Cyl	(SR20D)	1991-93
H	2.4 L	4 Cyl	(KA24E)	1991
H	3.0 L	V6	(VG30E)	1991-94
M	2.4 L	4 Cyl	(KA24DE)	1991-94
R	3.0 L	V6	(VG30DE)	1991-96

VIN Position 4 = Engine Type - Truck/Van/MPV

A	3.3 L	V6	(VG33)	1996-99
D	3.0 L	V6	(VG30E)	1993-94
D	2.4 L	4 Cyl	(KA24)	1998-99
E	3.3 L	V6	(VG33)	1999
H	3.0 L	V6	(VG30E)	1991-94
H	3.0 L	V6	(VG30)	1995-96
S	2.4 L	4 Cyl	(KA24E)	1991-94
S	2.4 L	4 Cyl	(KA24)	1995-98

VIN Position 4 = GVWR/Brake (Quest)

D	5001 - 6000 lbs-Hydraulic (Quest)
X	5001 - 6000 lbs-Hydraulic (Quest)
Z	5001 - 6000 lbs-Hydraulic (Quest)

VIN Position 5 = Vehicle Line

A	Maxima	1995-99
B	240SX	1995-98
B	NX Coupe	1991-93
B	Sentra	1991-99
J	Maxima	1991-94
L	Altima	1998-99
S	240SX	1991-98
U	Altima	1995-97
U	Stanza	1991-92
U	Stanza/Altima	1993-94
Z	300ZX	1991-96

D	Pathfinder	1995
D	Truck/Pathfinder	1991-94
D	Truck (Pickup)	1995-99
N	Quest	1993-99
R	Pathfinder	1996-99

VIN Position 6 = Model Change Code

0	Altima	1998-99
0	Maxima	1991-94
2	300ZX	1991-96
2	Maxima	1995-99
2	Stanza	1991-92
3	240SX	1991-94
3	NX Coupe	1991-93
3	Sentra	1991-94
3	Altima	1993-97
4	Sentra	1995-99
4	240SX	1995-98
4	200SX	1995-98

0	Pathfinder	1996-99
1	Pathfinder	1991-95
1	Pickup	1991-94
1	Pickup	1995-97
1	Quest	1993-99
2	Frontier Pickup	1998-99

VIN Position 7 = Body Type - Passenger Car

1	4 Dr Sedan	1991-99
1	2 Dr Coupe	1995-97
2	2 Dr Coupe	1998
2	2 Dr Sedan	1991-94
4	2 Dr Coupe	1991-94
4	2 Dr Hatchback	1991-94
4	2 Dr Coupe	1995-98
5	4 Dr Wagon	1991
6	2 Dr Coupe (2+2)	1991-96
6	2 Dr Convertible	1992-94

6	2 Dr Fastback	1993-94
6	2 Dr Coupe T-Bar	1993
7	2 Dr Convertible	1993-96

VIN Position 7 = Body Type - Truck/Pathfinder/MPV

1	Pickup - Regular Bed	
1	Quest - Van	1993-99
1	Pickup - Long Bed	1991-96
4	Quest - Cargo Van	1994
5	Pathfinder 4 Dr	1996-99
6	Pickup - King Cab	
7	Pathfinder 4 Dr	1991-95

VIN Position 8 = Passenger Car - Restraint System

A	Front Air Bags/Side Air Bags/Manual Belts
A	Passive Bell
B	Passive Motorized
C	Driver Air Bag/Driver & Pass. Side Air Bags
D	2 Air Bags/Manual Belts
F	Driver Air Bag
H	Passive - Motorized 4WD-AWD
J	Passive - Motorized FWD-RWD
S	Manual Belts
W	2 Air Bags & Motorized Restraint (Quest)

VIN Position 8 = Truck/Van/Utility - Drive Type/Engine

1	3.0 L	V6	(VG30)	(Quest)
S	FWD-RWD			
W	3.0 L	V6	(VG30)	(Quest)
Y	3.0 L	V6	(VG33)	(Quest)
Y	4WD-AWD			

VIN Position 9 = Check Digit

VIN Position 10 = Model Year

M	1991	T	1996
N	1992	V	1997
P	1993	W	1998
R	1994	X	1999
S	1995		

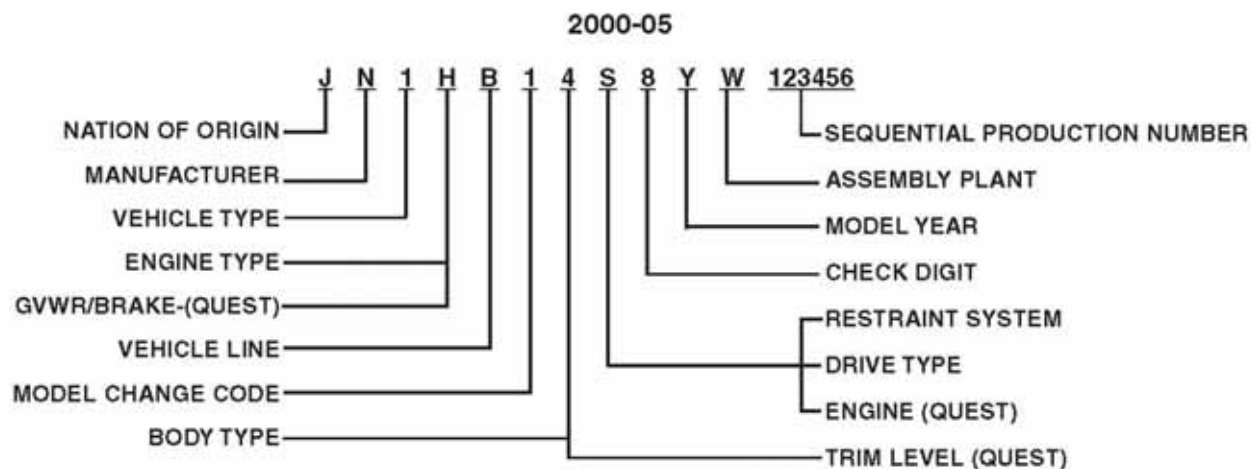
VIN Position 11 = Assembly Plant

C	Smyrna, Tennessee - USA
K	Mexico
L	Mexico
M	Tochigi, Japan
T	Oppama, Japan
U	Zama, Japan
W	Kyushyu, Japan
X	Hiratsuka, Japan

VIN Position 12-17 = Sequential Production Number

Nissan ALL

VIN Identification (continued)



NISSAN

VIN Position 1 = Nation of Origin

J Japan
1 USA
3 Mexico
5 USA

VIN Position 2 = Manufacturer

N Nissan

VIN Position 3 = Vehicle Type

1 Xterra (SUV) - USA
1 Passenger Car - Japan
2 Quest (Van) - USA
3 Convertible - Japan
4 Passenger Car - USA
6 Truck - USA
8 Pathfinder/Murano (SUV) - USA

VIN Position 4 = Engine Type - Passenger Car

A 2.5 L 4 Cyl (QF25DE)
A 3.5 L V6 (VQ35DE) 2003-05
B 2.0 L 4 Cyl (SR20DE) 2000-01
B 3.5 L V6 (VQ35DE) 2002-05
C 1.8 L 4 Cyl (QG18DE) 2000-03
C 3.0 L V6 (VQ30DE) 2000-01
D 1.8 L 4 Cyl (QG18DE)
D 2.4 L 4 Cyl (KA24DE) 2000-01
D 3.5 L V6 (VQ35DE) 2000-03

VIN Position 4 = Engine Type - Truck/Van/SUV

A 3.3 L V6 (VG33E) 2000
A 3.5 L V6 (VQ35DE) 2003-05
A 4.0 L V8 (VQ40DE) 2005
A 5.6 L V8 (VK56DE) 2004-05
B 3.5 L V6 (VQ35DE) 2004-05
D 2.4 L 4 Cyl (KA24DE) 2000-04
D 3.5 L V6 (VQ35DE) 2001-04
E 3.3 L V6 (VG33E) 2000-04
M 3.3 L V6 (VG33ER) 2001-04

VIN Position 4 = GVWR (Quest)

X 5001 - 6000 lbs/Hydraulic (Quest)
Z 5001 - 6000 lbs/Hydraulic (Quest)

VIN Position 5 = Vehicle Line

A Maxima 2000-05
B Sentra 2000-05
L Altima 2000-05
Z 350Z 2003-05

A Pathfinder, Armada, Titan 2004-05
D Frontier, Xterra 2000-04
N Quest 2000-02
R Pathfinder 2000-05
V Quest 2004-05
Z Murano 2003-05

VIN Position 6 = Model Change Code

0 Altima 2000-01
3 Maxima 2000-03
3 350Z 2003-05
4 Maxima 2004-05
5 Sentra 2000-05

0 Pathfinder 2000-04
0 Murano 2003-05
0 Frontier 2005
0 Xterra 2005
1 Quest 2000-02
1 Pathfinder 2005
2 Frontier, Xterra 2000-04
2 Quest 2004-05

VIN Position 7 = Body Type - Passenger Car

1 4 Dr Sedan 2000-05
4 2 Dr Coupe (350Z) 2003-05
5 4 Dr Wagon 2000-02
6 2 Dr Convertible (350Z) 2004-05

VIN Position 7 = Body Type - Truck/Van/Util. Vehicle

1 Pickup (Std Cab) 2000-01
1 Quest (Van) 2000
6 Pickup (King Cab) 2 Dr 2000-05
7 Pickup (Crew Cab) 4 Dr Short Bed 2000-04
7 Pickup (Crew Cab) 4 Dr 2005
7 Pathfinder 4 Dr Utility 2000-01
8 Xterra, Murano, Quest 4 Dr 2000-03
8 Pathfinder, Armada, Murano, Xterra 4 Dr 2004-05
8 Quest 2004-05
9 Pickup (Crew Cab) 4 Dr Long Bed 2002-05
9 Pathfinder 4 Dr Utility

VIN Position 7 = Trim Level (Quest)

5 GXE 2001-02
6 SE 2001-02
7 GLE 2001-02

VIN Position 8 = Passenger Car - Restraint System

A Driver/Passenger/Side Air Bags/Side Air Bags - Manual Belts
A Driver/Passenger/Side Air Bags - FWD/RWD
B Driver/Passenger/Side Air Bags - 4WD/AWD
D Driver/Passenger Air Bags - Manual Belts
E Driver/Passenger/Curtain Type Air Bags - Manual Belts, FWD/RWD
F Driver/Passenger/Curtain Type Air Bags - Manual Belts, 4WD/AWD

VIN Position 8 = Truck/Van/Util. Vehicle - Drive Type

A FWD-FWD (4 Wheel ABS)
B 4WD-AWD (4 Wheel ABS)
C 4WD-AWD (4 Wheel ABS)
S FWD-FWD (Rear Wheel ABS)
T FWD-FWD (4 Wheel ABS)
X FWD-FWD
Y 4WD-AWD
W 4WD-AWD (4 Wheel ABS)
U FWD-FWD

VIN Position 8 = Engine

T 3.3L V6 (VG33E) 2000-02 (Quest)

VIN Position 9 = Check Digit

VIN Position 10 = Model Year

Y 2000 3 2003
1 2001 4 2004
2 2002 5 2005

VIN Position 11 = Assembly Plant

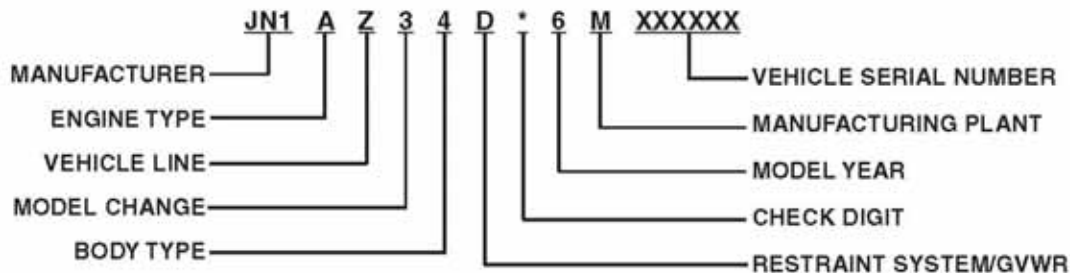
5 Kosal, Japan
C Smyrna, Tennessee - USA
D Avon Lake, Ohio - USA
L Mexico
N Canton, Mississippi - USA
T Oppama, Japan
W Kyushyu, Japan

VIN Position 12-17 = Sequential Production Number

Nissan ALL

VIN Identification (continued)

2006-09



NISSAN

VIN Position 1 through 3 = Manufacturer

JN1 Nissan, Passenger Vehicle (350Z) (G7-R)
 JN8 MPV (Murano, Rogue)
 1N4 USA Produced Passenger Vehicle (Altima, Maxima)
 1N6 USA Produced MPV (Frontier, Titan)
 1N6 USA Produced Truck (Quest)
 3N1 Mexico (Sentra, Versa)
 5N1 USA Produced MPV (Armada, Pathfinder, Quest, Xterra)

VIN Position 4 = Engine Type

A MF20DE (Sentra)
 A QR25DE (Altima, Sentra, Rogue)
 A VK56DE (Armada, Titan)
 A VQ40DE (Frontier, Pathfinder, Xterra)
 A VQ35DE (350Z, Murano, Maxima)
 A VQ37VHR
 A VR38DETT (GR-T)
 B MR18DE (Versa)
 B VK56DE (Flexible Fuel Vehicle)
 B VK56DE FFV
 B VQ56DE (Titan) (Flexible Fuel Vehicle)
 B VQ35DE (Altima, Maxima, Quest)
 B VQ35HR (350Z) (08)
 B QR25DE (Frontier, Sentra)
 C HR16DE (Versa)
 C QG18DE (Sentra)
 C QR25DE HEV (Altima) (07-08)

VIN Position 5 = Vehicle Line

A Nissan Armada, Titan, Maxima
 B Nissan Sentra (06-08)
 B6 Nissan Sentra (09)
 C Versa
 D Nissan Frontier (06-08)
 DO Nissan Frontier (09)
 L Nissan Altima
 N Nissan Xterra (06-08)

NO Nissan Xterra (09)
 R Nissan Pathfinder (GR-T)
 S Nissan Rogue (S35)
 V Nissan Quest
 Z Nissan 350Z, Murano (Z50) (370Z)

VIN Position 6 = Model Change (0 to 9)

VIN Position 7 = Body Type

G Coupe
 1 4 Dr Sedan (Altima, Maxima, Sentra, Versa)
 3 4 Dr HB (Versa)
 4 Coupe (350Z) (370Z) (GR-T)
 6 King Cab (Frontier, Titan)
 6 Conv (305Z)
 7 Crew Cab (Frontier, Titan)
 8 4 Dr Wagon (Armada, Murano, Pathfinder, Xterra)
 8 4 Dr Wagon (Passenger Vehicle, 4 Dr Van (Cargo Van) (Quest)
 8 Hatchback
 9 Crew Cab Extra Long

VIN Position 8 = Restraint System/GVWR

A Dual Front SRS Air Bags & SRS Side Airbags
 A Dual Front & Side Air Bags, 3-Point Manual Seat Belts (Sentra, Versa)
 A 2WD, 4-Wheel ABS, Class E (Armada, Titan)
 A D+ SRS Side Air Bags (350Z)
 B 4WD, 4-Wheel ABS, Class E (Armada, Titan)
 C 4WD, 4-Wheel ABS, Class F
 D Dual Front SRS Air Bags & 3-Point Manual Seat Belts (Altima, Versa)
 D Driver & Passenger SRS Air Bags (350Z)
 D Dual Front Air Bags & 3-Point Manual Seat Belts (Sentra, Versa)
 D 2WD, 4-Wheel ABS, Class F
 E Dual Front SRS Air Bags, SRS Side Airbags & SRS Curtain Airbags

E Dual Front SRS Air Bags, SRS Side & Curtain Air Bags & 3-Point Manual Seat Belts (Altima, Maxima, Sentra, 350Z)
 E A+ SRS Curtain Air Bags (06-07)
 E D+ SRS Side Airbags + SRS Airbags
 F AWD, Front Air Bag, Side Airbag & Curtain Airbag
 F 4WD, LWB, 4-Wheel ABS, Class F
 G 2WD, LWB, 4-Wheel ABS, Class F
 M AWD, Front Air Bag
 T 2WD (Murano, Rogue)
 T 2WD, 4-Wheel ABS, Class C (Frontier)
 U 2WD
 U 2WD, 4-Wheel ABS, Class D (Frontier, Pathfinder, Xterra)
 U Standard, 2WD, w/4-Wheel ABS, Class D (Quest)
 V AWD, 4WD (Rogue)
 W 2WD
 W 4WD, 4-Wheel ABS, Class D (Frontier, Pathfinder, Xterra)
 W AWD (Murano)

VIN Position 9 = Check Digit (0 to 9 or x)

VIN Position 10 = Model Year

6 2006 8 2008
 7 2007 9 2009

VIN Position 11 = Manufacturing Plant

C Smyrna, Tennessee (Altima, Frontier, Maxima, Pathfinder, Xterra)
 L Aguascalientes, Mexico (Sentra)
 M Tochigi (350Z) (370Z) (GR-T)
 N Canton, Mississippi (Altima, Armada, Quest, Titan)
 W Kyushu (Murano, Rogue)

VIN Position 12-17 = Vehicle Serial Number

RE5R05A

Identification

Starting in mid-2002, JATCO introduced the RE5R05A: a rear-wheel drive, 5-speed automatic transmission used in the Infiniti Q45. Since then, this unit has appeared in Infiniti and Nissan drivetrains. Infiniti uses it in CX25, FX35, FX45, G35, M35/35x, Q45, and QX56 vehicles. Nissan uses it in the 350Z, Z, Frontier, Pathfinder, Armada, Titan, and Xterra.

The transmission gear ratio can be identified by using the ID tag on the right rear side of the case, attached just above the pan rail.

There are three different ratio combinations for this transmission.



RE5R05A

Fluid Specifications

The recommended fluid for the RE5R05A is Nissan Matic Fluid J (part synthetic). You can also use Castrol Transmax J type fluid. Make sure whatever fluid you are choosing, that it meets requirements for Japanese JASO 1A standard, which is also approved by GM and Ford requiring DEXRON III or MERCON ATF.



RE5R05A

Clutch and Band Application Charts

Floor Shift Models

Shifter Position		I/C	HLR/C	D/C	R/B	FR/B	LC/B	Fwd/B	1st OWC	Fwd OWC	3rd OWC
P											
R			A		A	A			*		*
N											
D	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
	5th	A	A			A			oo		oo
4	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
3	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
2	1st		a*				a**	A	*	*	*
	2nd			A		A	A	A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
1	1st		A			A	A	A	*	*	*
	2nd			A		A	A	A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		

A = Applied

a* = Operates under priming conditions

a** = Operates under priming conditions

* = Operates during progressive acceleration

oo = Operates and effects power while coasting

I/C: Intermediate Clutch
 HLR/C: High and Low Reverse Clutch
 D/C: Direct Clutch
 R/B: Reverse Brake
 FR/B: Front Brake
 LC/B: Low Clutch Brake
 Fwd/B: Forward Brake
 1st OWC: 1st One-Way Clutch
 Fwd OWC: Forward One-Way Clutch
 3rd OWC: 3rd One-Way Clutch

RE5R05A

Clutch and Band Application Charts

Column Shift Models

Shifter Position		I/C	HLR/C	D/C	R/B	FR/B	LC/B	Fwd/B	1st OWC	Fwd OWC	3rd OWC
P											
R			A		A	A			*		*
N											
D	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
	5th	A	A			A			oo		oo
M5	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
	5th	A	A			A			oo		oo
M4	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
	4th	A	A	A					oo		
M3	1st		a*				a**	A	*	*	*
	2nd			A				A		*	*
	3rd		A	A		A			oo		*
M2	1st		a*				a**	A	*	*	*
	2nd			A		A	A	A		*	*
M1	1st		A			A	A	A	*	*	*
	2nd			A		A	A	A		*	*

A = Applied

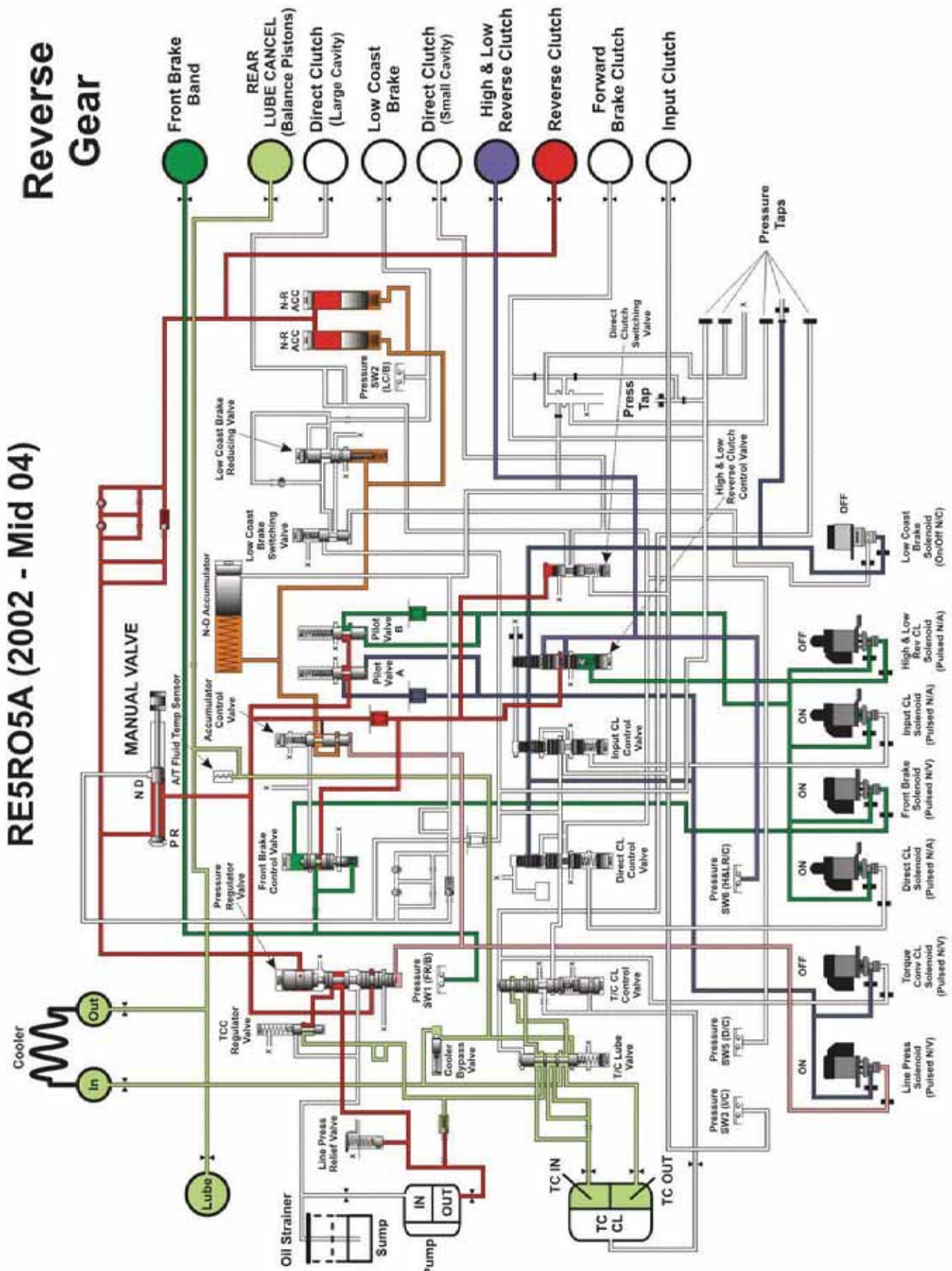
a* = Operates under priming conditions

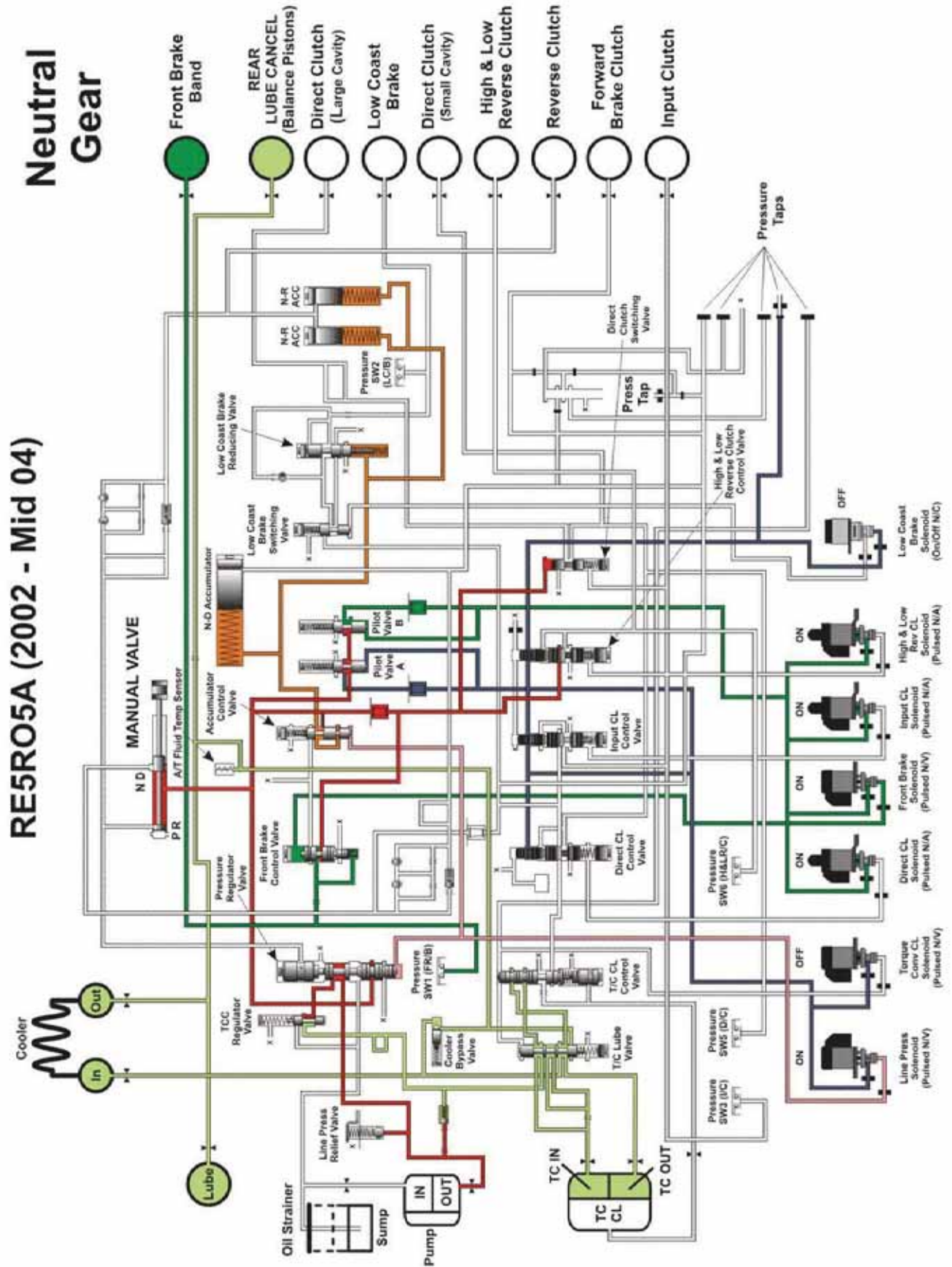
a** = Operates under priming conditions

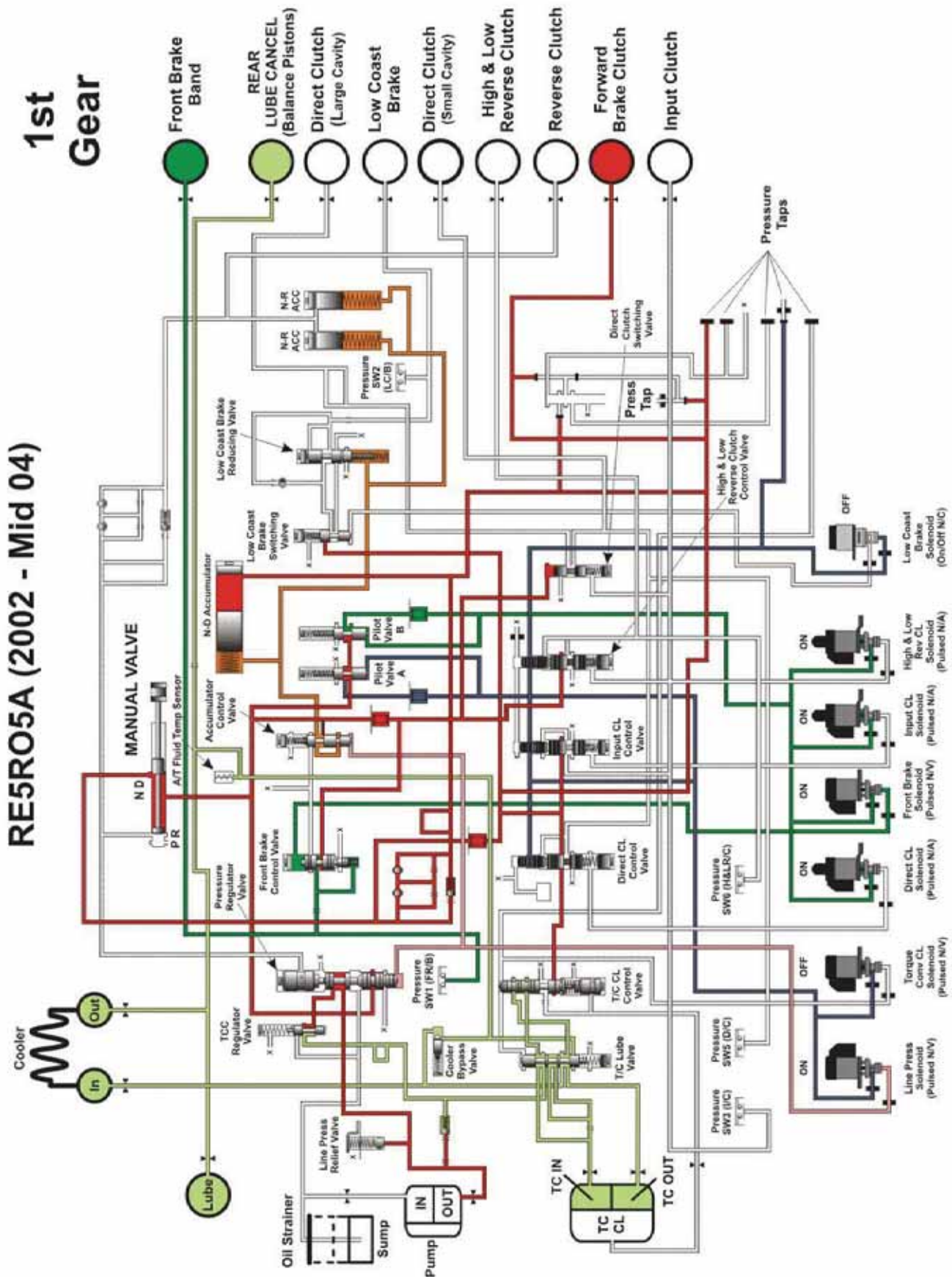
* = Operates during progressive acceleration

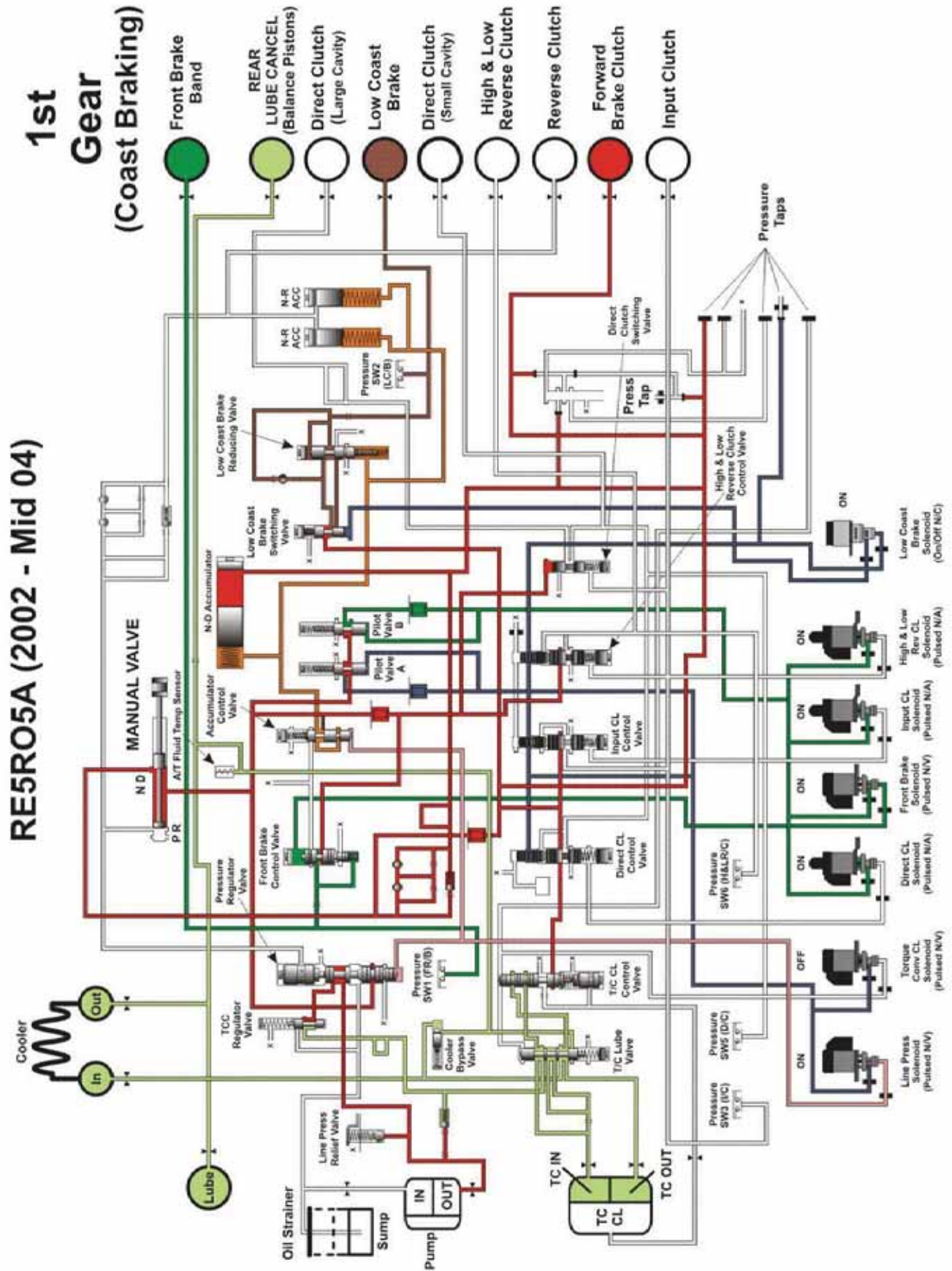
oo = Operates and effects power while coasting

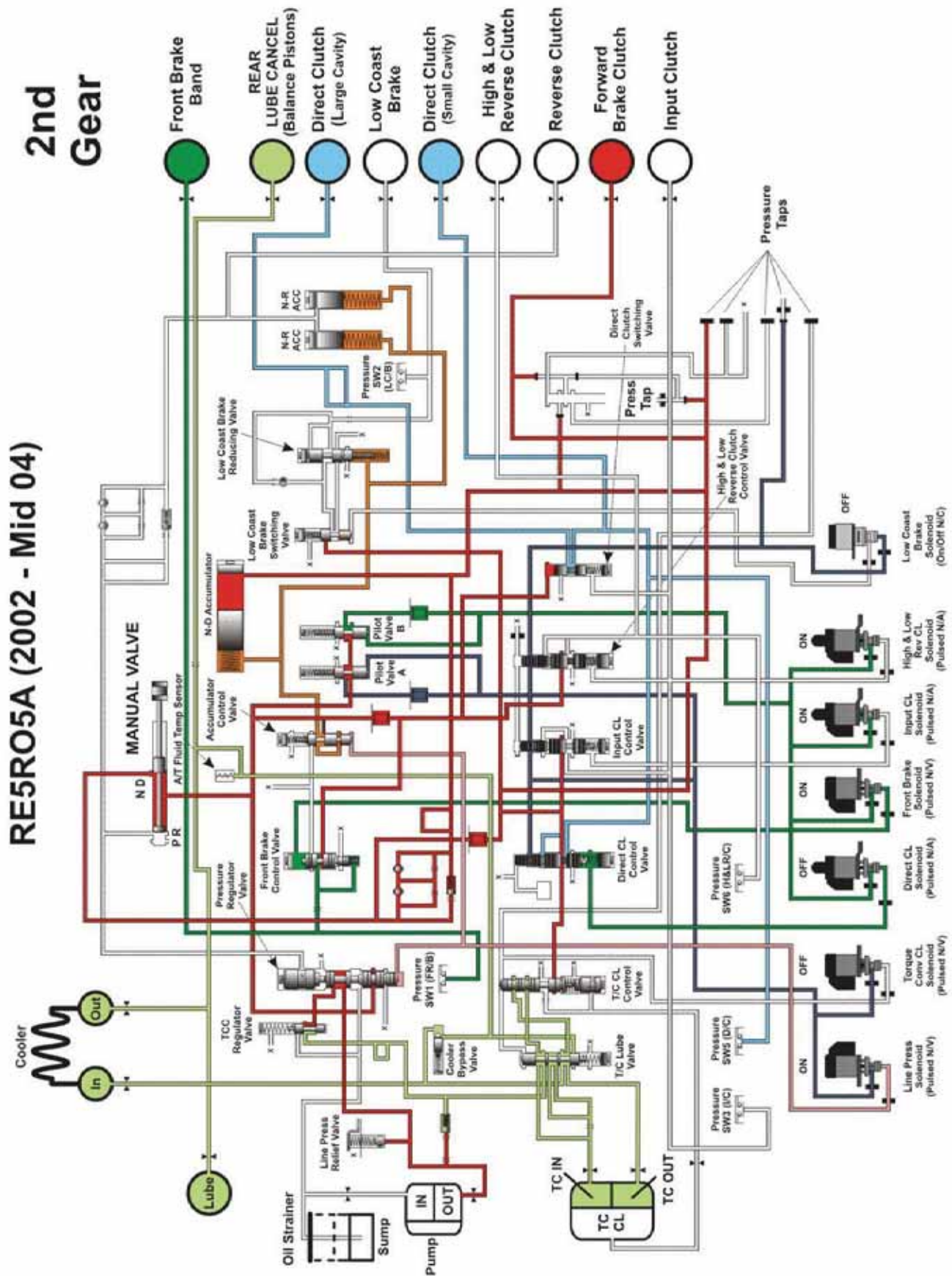
I/C: Intermediate Clutch
 HLR/C: High and Low Reverse Clutch
 D/C: Direct Clutch
 R/B: Reverse Brake
 FR/B: Front Brake
 LC/B: Low Clutch Brake
 Fwd/B: Forward Brake
 1st OWC: 1st One-Way Clutch
 Fwd OWC: Forward One-Way Clutch
 3rd OWC: 3rd One-Way Clutch





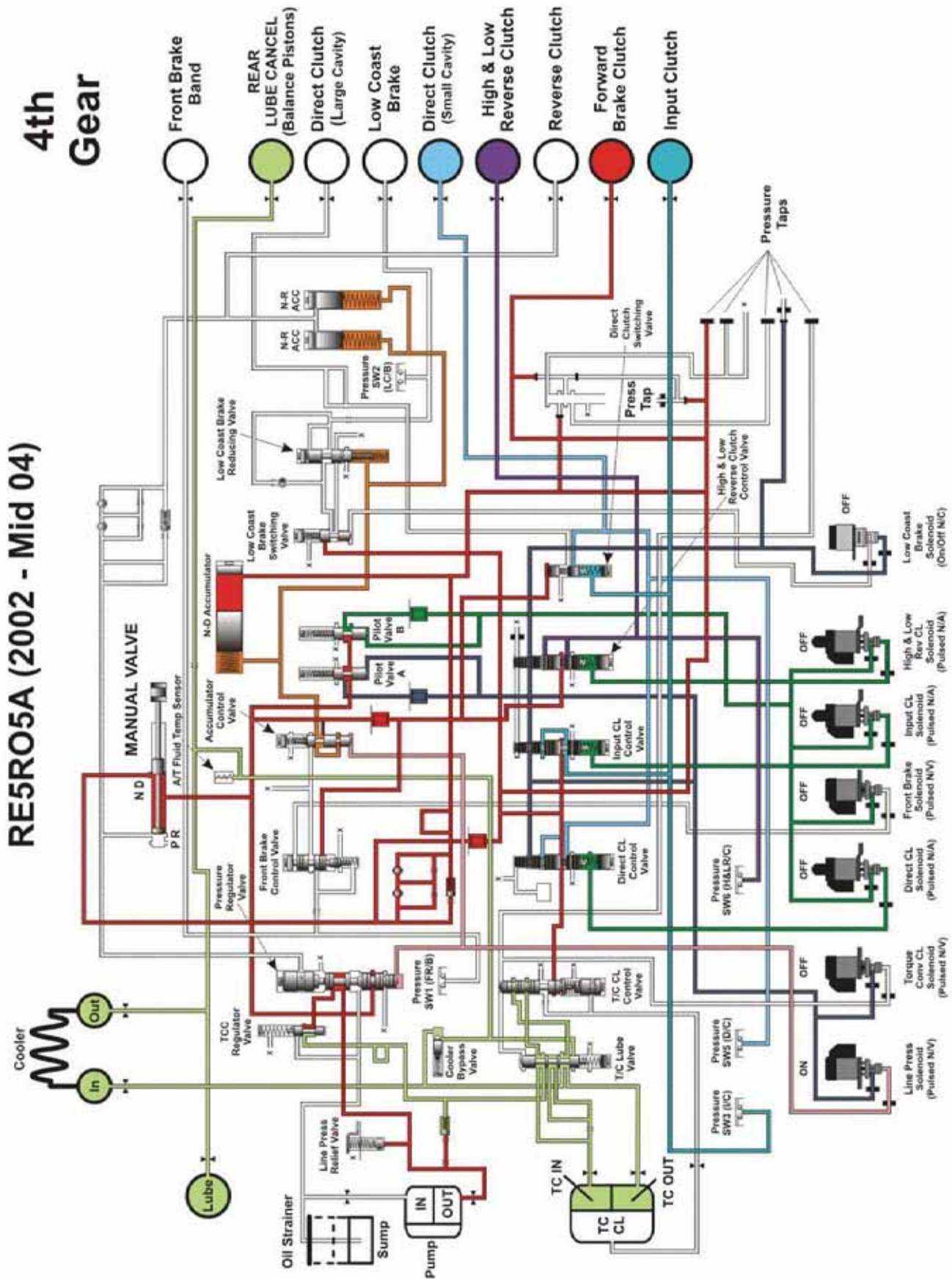






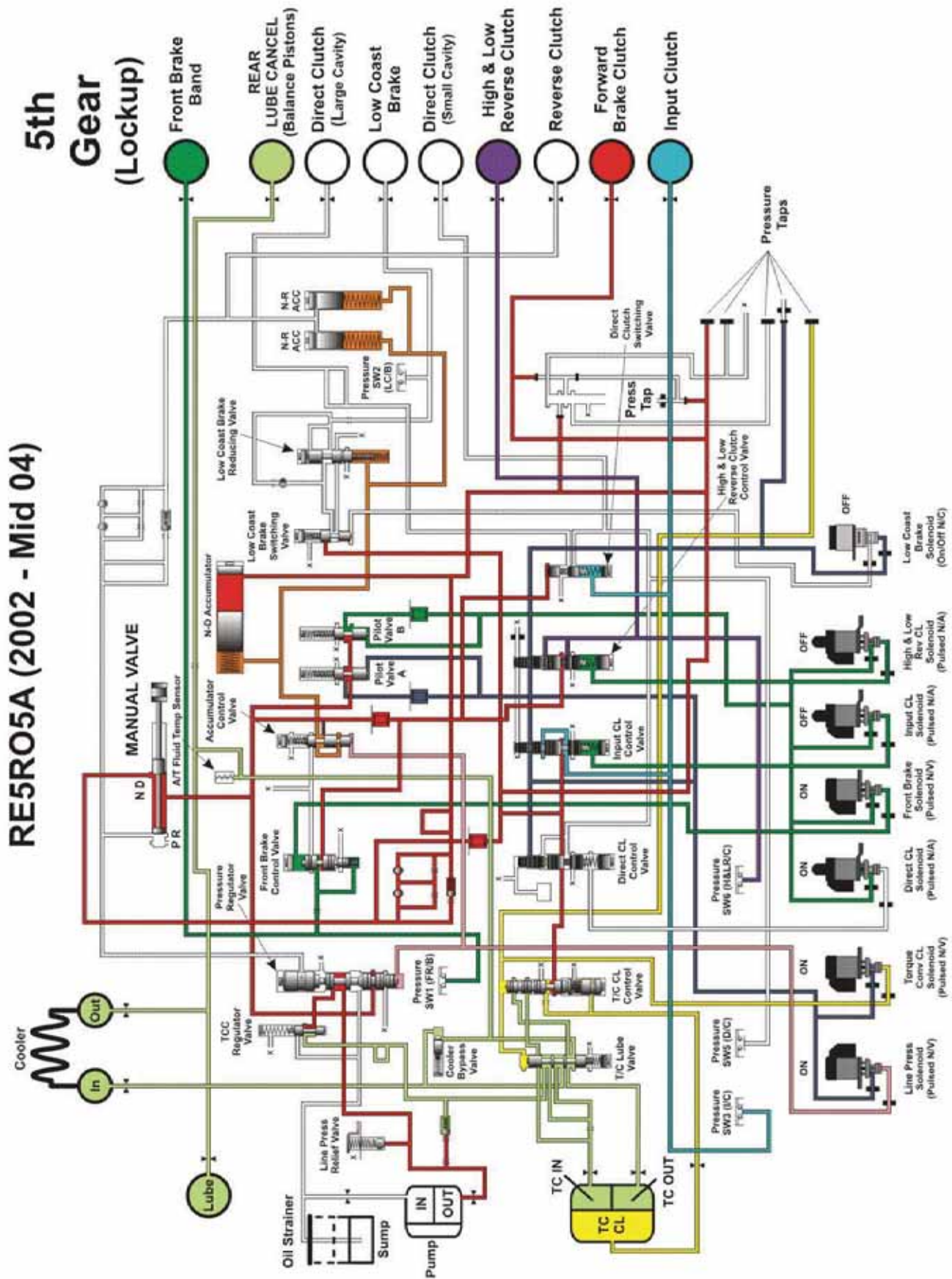
3rd Gear





5th Gear

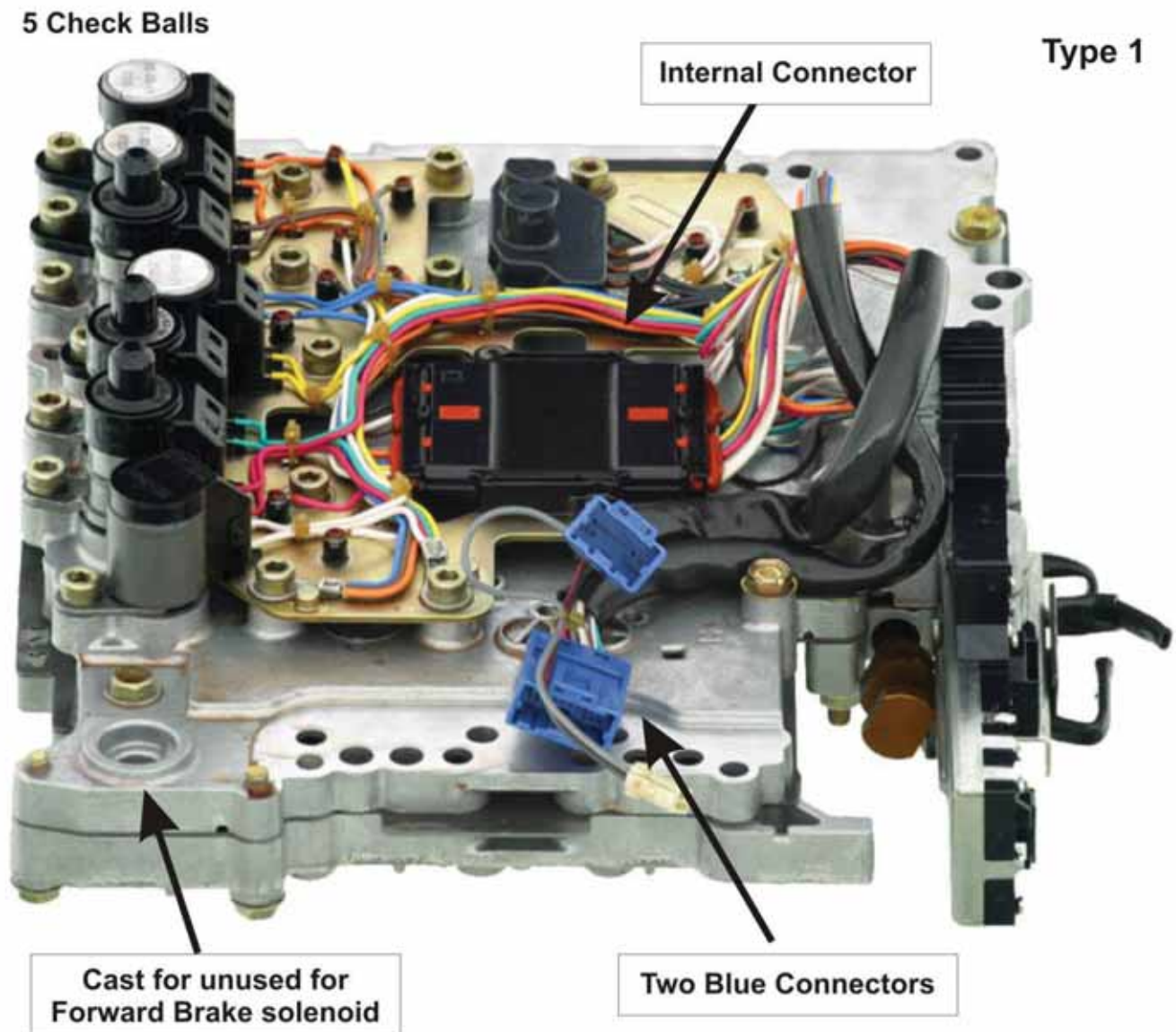




RE5R05A

Computer and Wiring Identification

The Type 1 valvebody system can be identified by the two blue connectors found in Infiniti vehicles up to Mid 2004. The TCM for the Type 1 valvebody system is located in the right kick panel next to the ECM. In Mid 2004 the Type 2 valvebody system with TCM was incorporated in all Infiniti and Nissan vehicles.



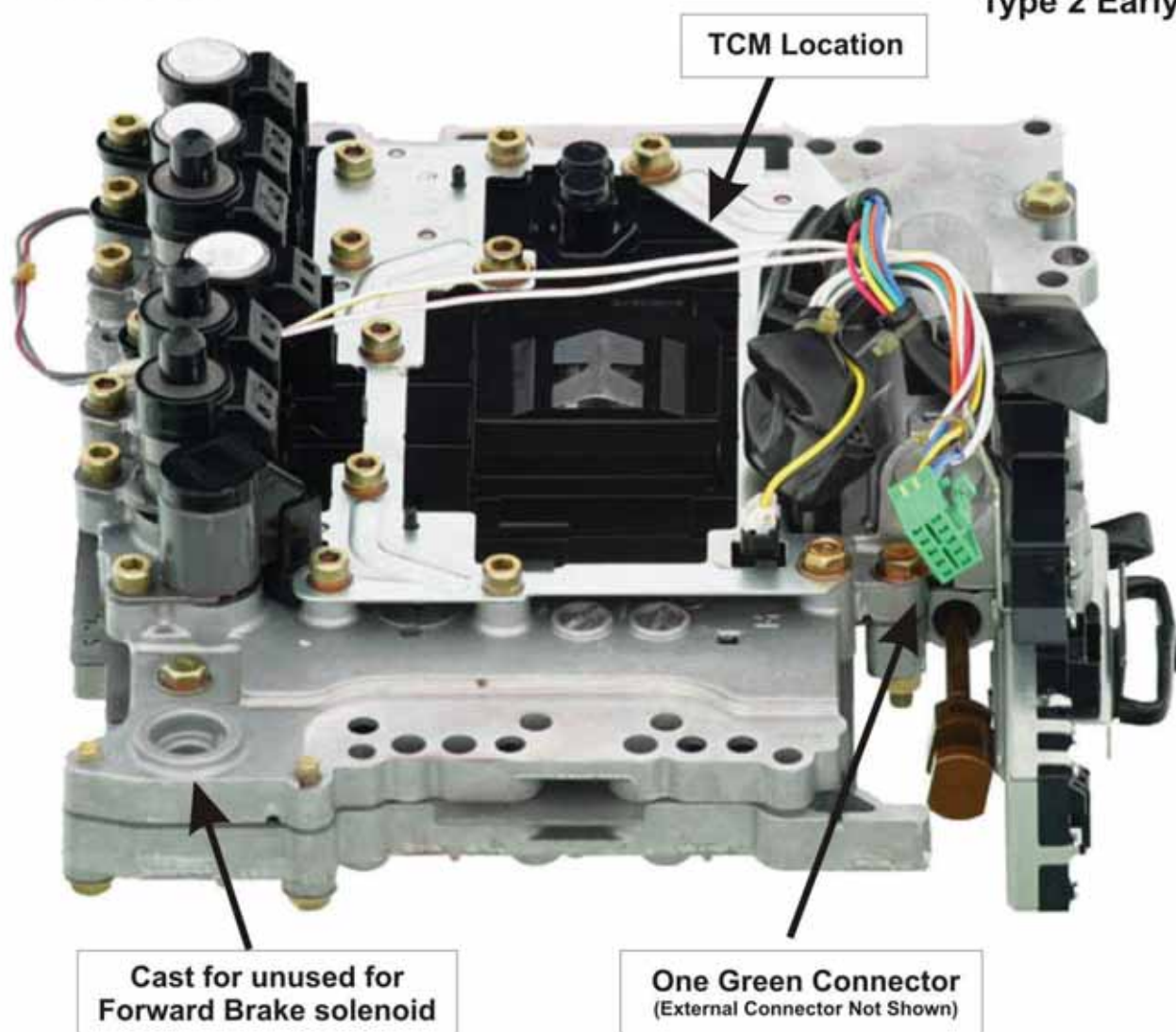
RE5R05A

Computer and Wiring ID (continued)

The Type 2 Early valvebody system can be identified by the single green connector found on all Mid 2004 and later Infiniti and Nissan vehicles. The TCM on the Type 2 is actually the complete transmission computer system; that is it combines the TCM, pressure switches, Input Speed Sensors, Range Sensor, and Solenoid connector and bolts onto the valvebody. This is becoming a common practice; almost all manufacturers seem to be heading in this direction.

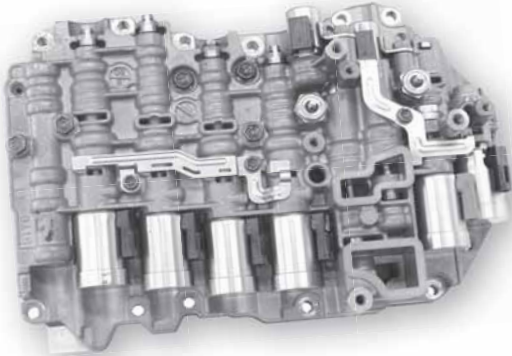
5 Check Balls

Type 2 Early



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- SOLPRO solenoids give you more options in serving your customer and your own in-house needs.



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Please contact your parts supplier or Valve Body Pro for price and availability

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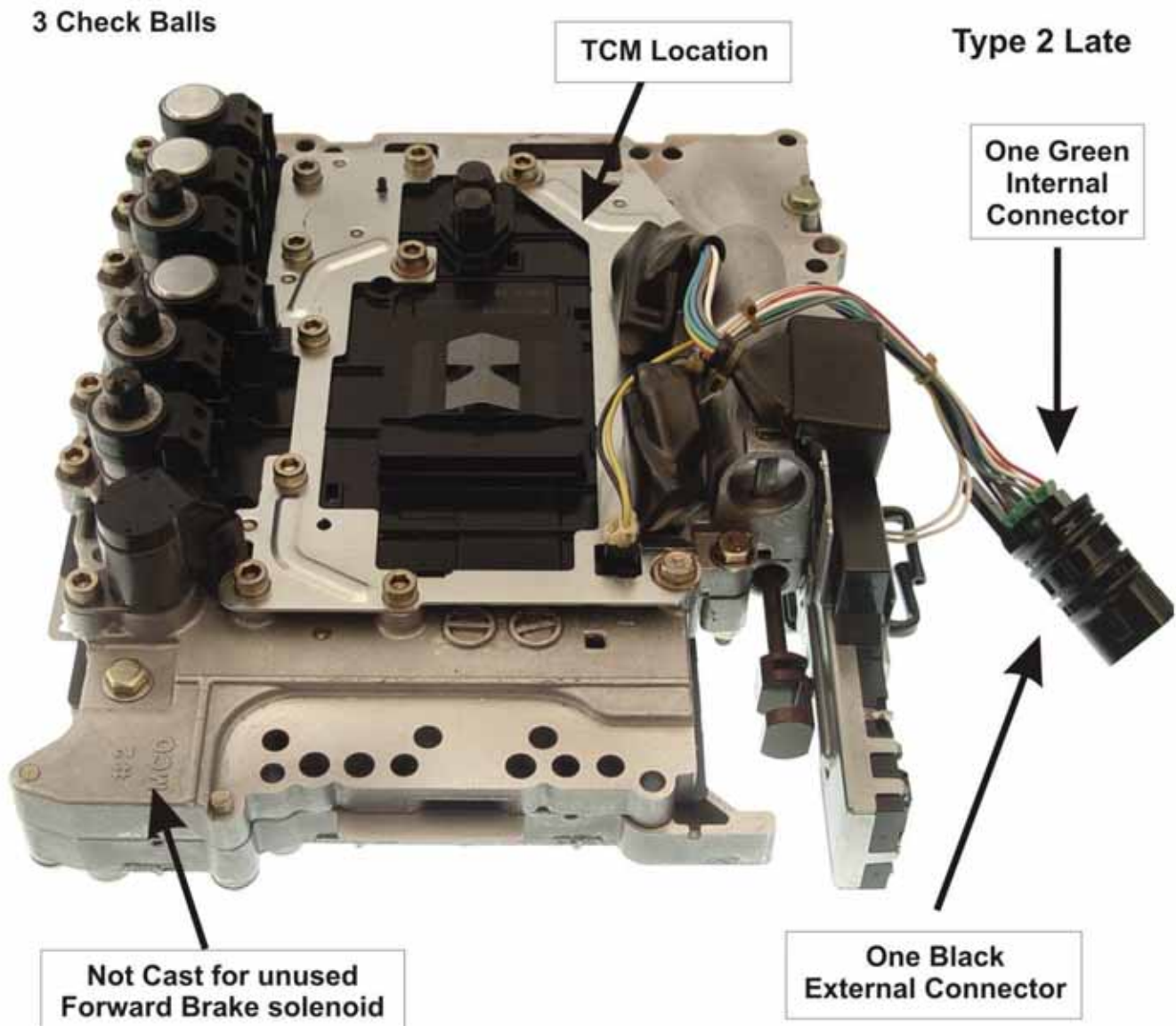
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www.valvebodypros.com • valvebodypro@gmail.com

RE5R05A

Computer and Wiring ID (continued)

The Type 2 late valvebody system can be identified by the single black connector. The TCM on the Type 2 is also the complete transmission computer system.



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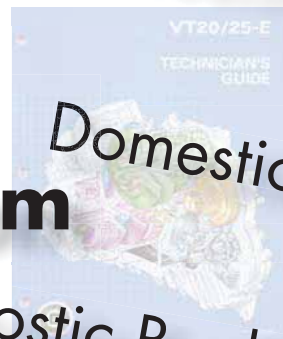
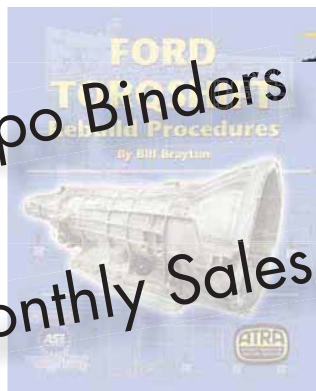
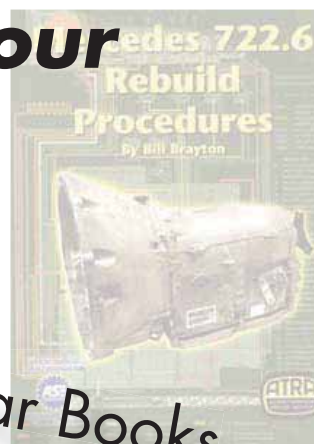
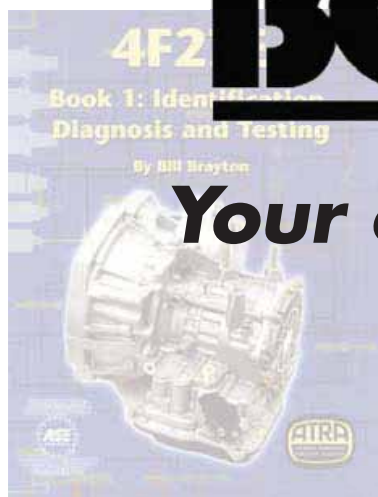
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RE5R05A

Solenoid Function

There are seven (7) solenoids on the valve body. All of the solenoids operate and connect directly to the TCM. All of the solenoids except the Low Coast Brake solenoid have 3.3 ohms resistance. The Low Coast Brake solenoid has 23 ohms resistance. The TCM controls all of them using a duty cycle signal. When checking solenoid operation you'll need a CAN adapter for your scan tool or an interface adapter that checks the solenoid operation.

When checking the solenoid operation via your scan tool data will read in amps with the exception of the Low/Coast solenoid which will read On/Off. All of the solenoids operate between 0.0 to 0.8 amps. Something interesting to look at is the operating range for these solenoids.

For example, the TCC solenoid will run at 0.2 to 0.4 amps during slip and 0.4 to 0.7 amps when it's fully locked up. The Input Clutch, Front Brake, Direct Clutch and High/Low Solenoids operate at 0.6 to 0.8 amps while disengaging the clutches (solenoids energized), and 0.0 to 0.05 amps when the clutches are engaged (solenoids de-energized).

RE5R05A Solenoid Apply Chart							
Gear	Pressure Solenoid	TCC Solenoid	Direct Clutch Solenoid	Front Brake Band Solenoid	Input Clutch Solenoid	High/Low Reverse Solenoid	Low Coast Brake Solenoid
Park	PWM	Off	ON	ON	ON	Off	Off
Reverse	PWM	Off	ON	ON	ON	Off	Off
1st	PWM	Off	ON	ON	ON	Off	ON
2nd	PWM	Off	Off	ON	ON	ON	Off
3rd	PWM	Off	Off	ON	ON	Off	Off
4th	PWM	ON	Off	Off	Off	Off	Off
5th	PWM	ON	ON	ON	Off	Off	Off
(c): During coast down							

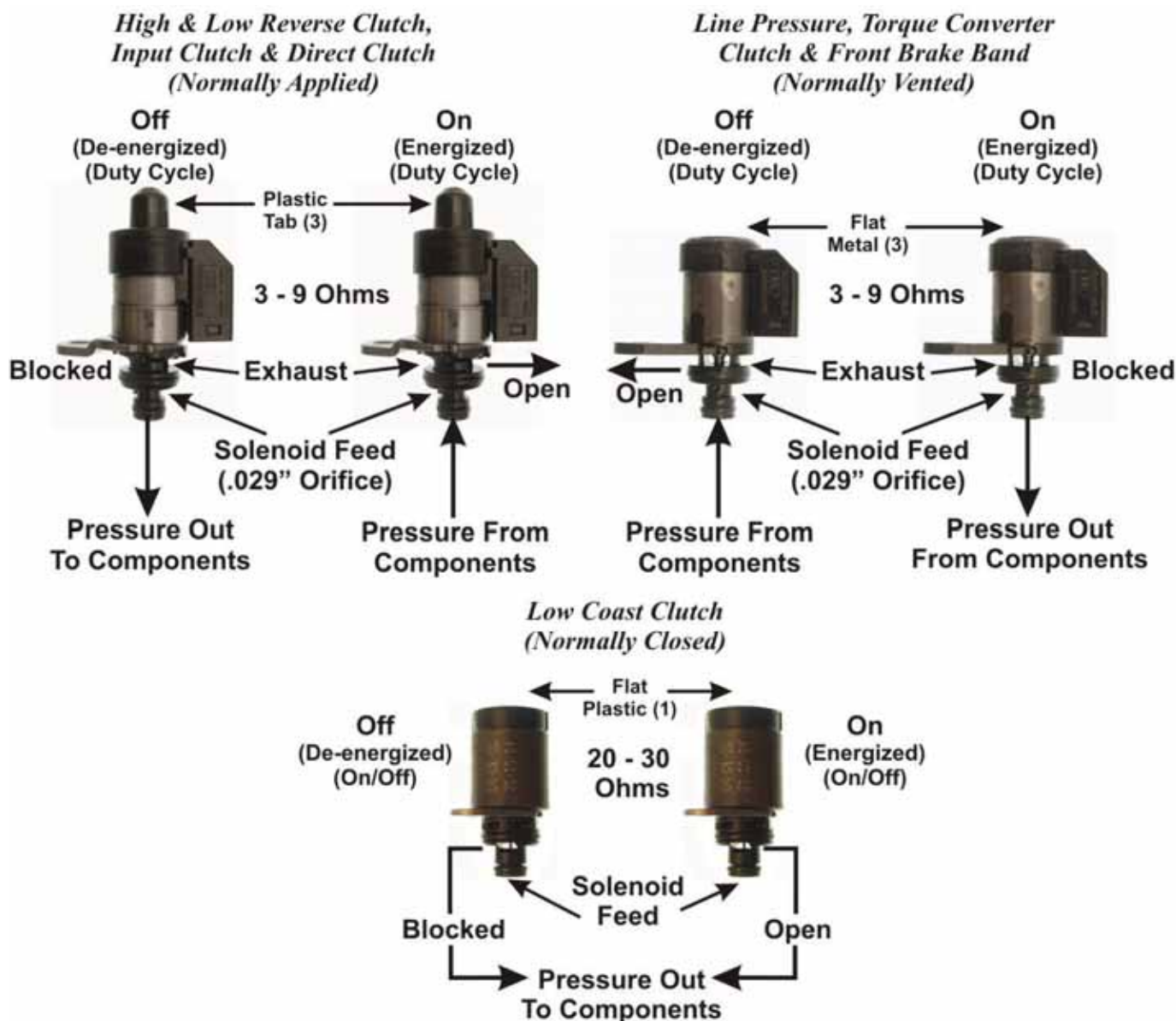
RE5R05A

Solenoid Function (continued)

There are seven solenoids located on the valvebody. Three of these solenoids, High & Low Reverse Clutch, Input Clutch and Direct Clutch, are “Normally Applied” duty cycle type solenoids.

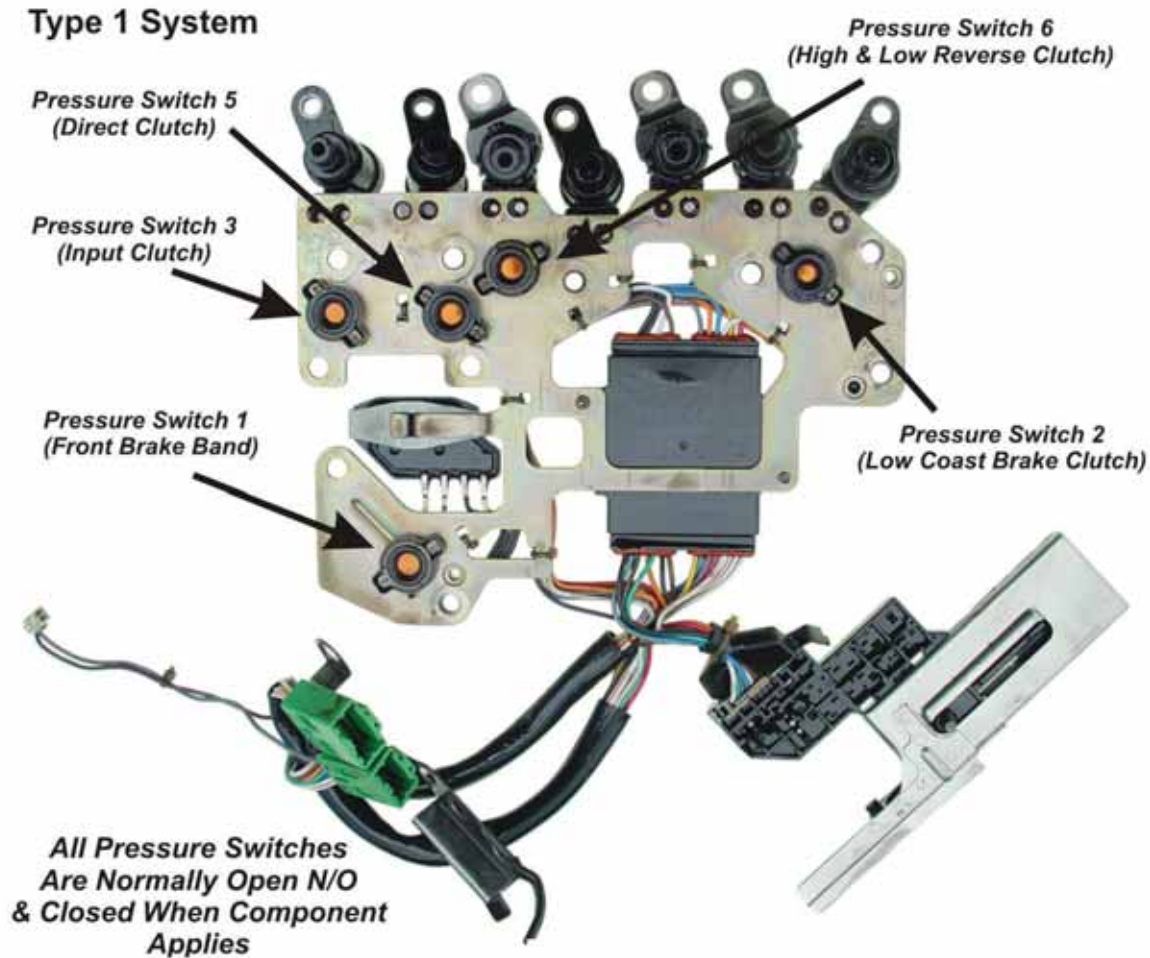
Three other solenoids, Line Pressure, Torque Converter Clutch and Front Brake Band, are “Normally Vented” duty cycle type solenoids.

The Low Coast Brake solenoid is a “Normally Open” On/Off type solenoid.



RE5R05A

Pressure Switch ID and Function Type I



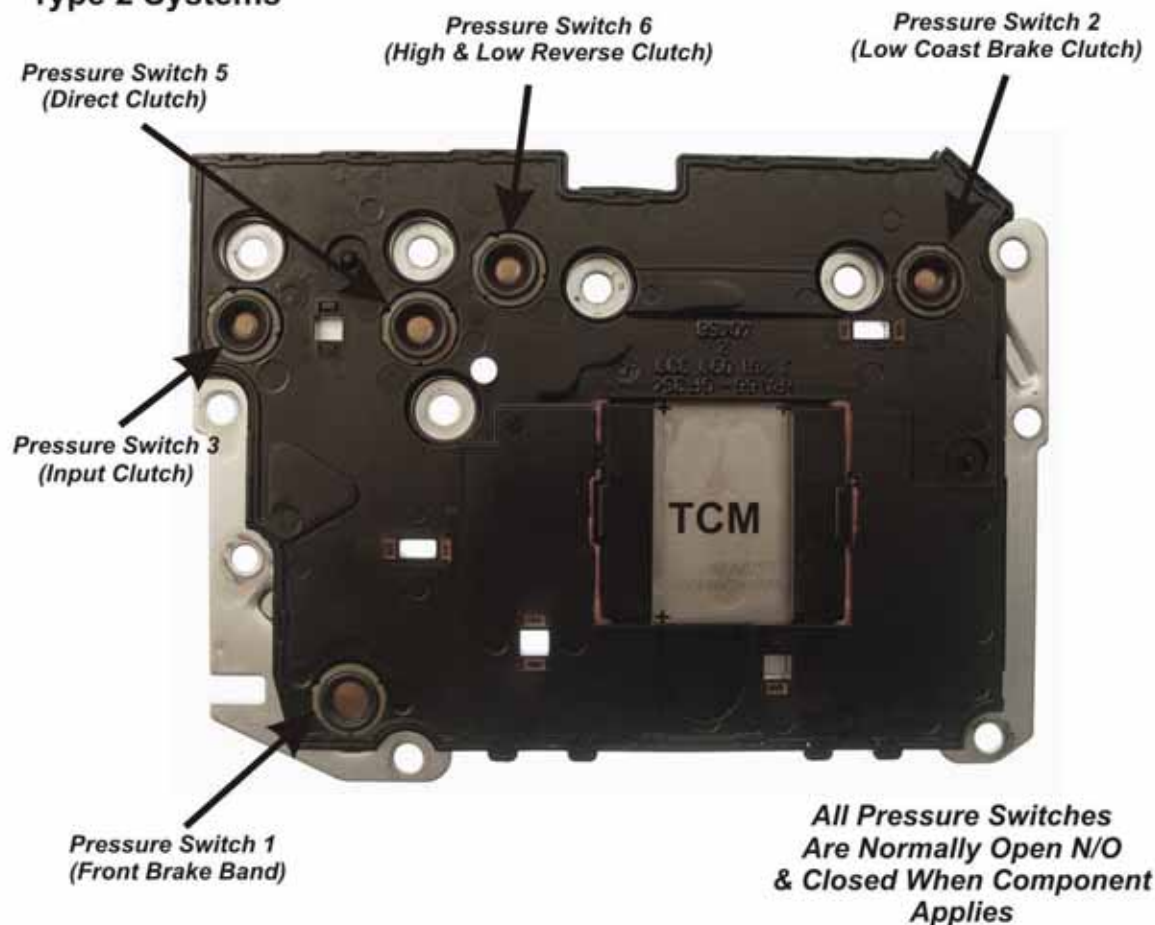
FUNCTION OF PRESSURE SWITCH

Name	Function
Pressure switch 1 (FR/B)	Detects any malfunction in the front brake hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 2 (LC/B)	Detects any malfunction in the low coast brake hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 3 (I/C)	Detects any malfunction in the input clutch hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 5 (D/C)	Detects any malfunction in the direct clutch hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 6 (HLR/C)	Detects any malfunction in the high and low reverse clutch hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.

RE5R05A

Pressure Switch ID and Function Type 2

Type 2 Systems



FUNCTION OF PRESSURE SWITCH

Name	Function
Pressure switch 1 (FR/B)	Detects any malfunction in the front brake hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 2 (LC/B)	Detects any malfunction in the low coast brake hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 3 (I/C)	Detects any malfunction in the input clutch hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 5 (D/C)	Detects any malfunction in the direct clutch hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.
Pressure switch 6 (HLR/C)	Detects any malfunction in the high and low reverse clutch hydraulic pressure. When it detects any malfunction, it puts the system into fail-safe mode.

RE5R05A

Pressure Switch Apply Charts

Floor Shift

	GEAR	PS #1	PS #2	PS #3	PS #5	PS #6
P						
R		A				A
N						
D	1st					A
	2nd				A	
	3rd	A			A	A
	4th			A	A	A
	5th	A		A		A
4	1st					A
	2nd				A	
	3rd	A			A	A
	4th			A	A	A
3	1st					A
	2nd				A	
	3rd	A			A	A
2	1st					A
	2nd	A	A		A	
1	1st	A	A			A

A = Applied

PS #1 Front Brake Band

PS #2 Low Coast Brake Clutch

PS #3 Input Clutch

PS #5 Direct Clutch

PS #6 High & Low Reverse Clutch

RE5R05A

Pressure Switch Apply Charts

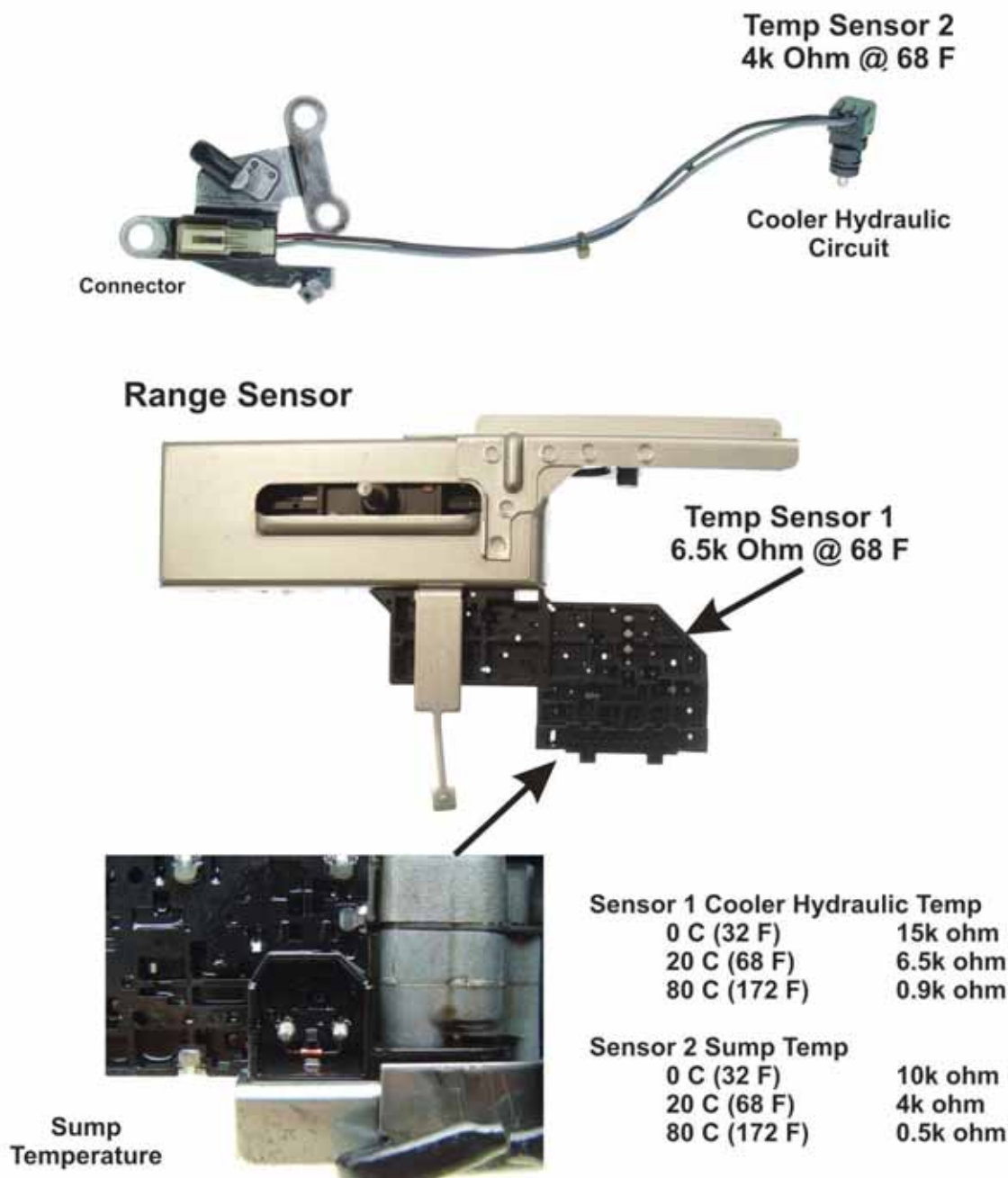
Column Shift

	GEAR	PS #1	PS #2	PS #3	PS #5	PS #6
P						
R		A				A
N						
D	1st					A
	2nd				A	
	3rd	A			A	A
	4th			A	A	A
	5th	A		A		A
M5	1st					
	2nd				A	
	3rd	A			A	A
	4th			A	A	A
	5th	A		A		A
M4	1st					
	2nd				A	
	3rd	A			A	A
	4th			A	A	A
M3	1st					
	2nd				A	
	3rd	A			A	A
M2	1st					A
	2nd	A	A		A	
M1	1st	A	A			A

RE5R05A

Temperature Sensors 1 and 2

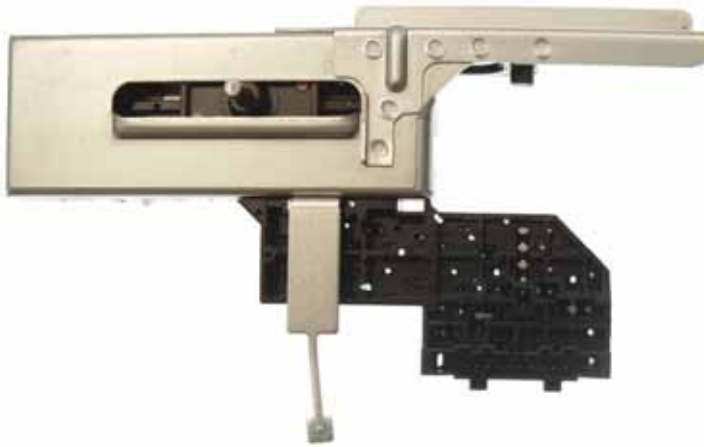
Temperature Sensor 1 (sump temperature) is integral to the Range Sensor (park/neutral position PNP) 6.5k ohm @ 68°F. Transmission Temperature Sensor 2 (cooler hydraulic circuit) is separate from the TCM with 4k ohm resistance @ 68°F. Only Type 1 systems with external TCM can be checked without a scan tool.



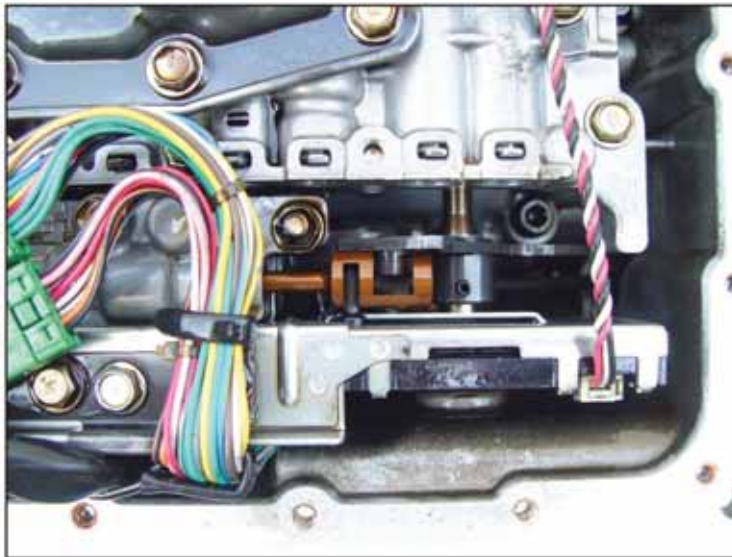
RE5R05A

Park/Neutral Position Sensor (PNP)

Park Neutral Position sensor PNP (range sensor) is located on the valvebody and must align correctly with the manual valve.



Manual Valve Alignment



RE5R05A

Turbine Revolution Sensors 1 and 2

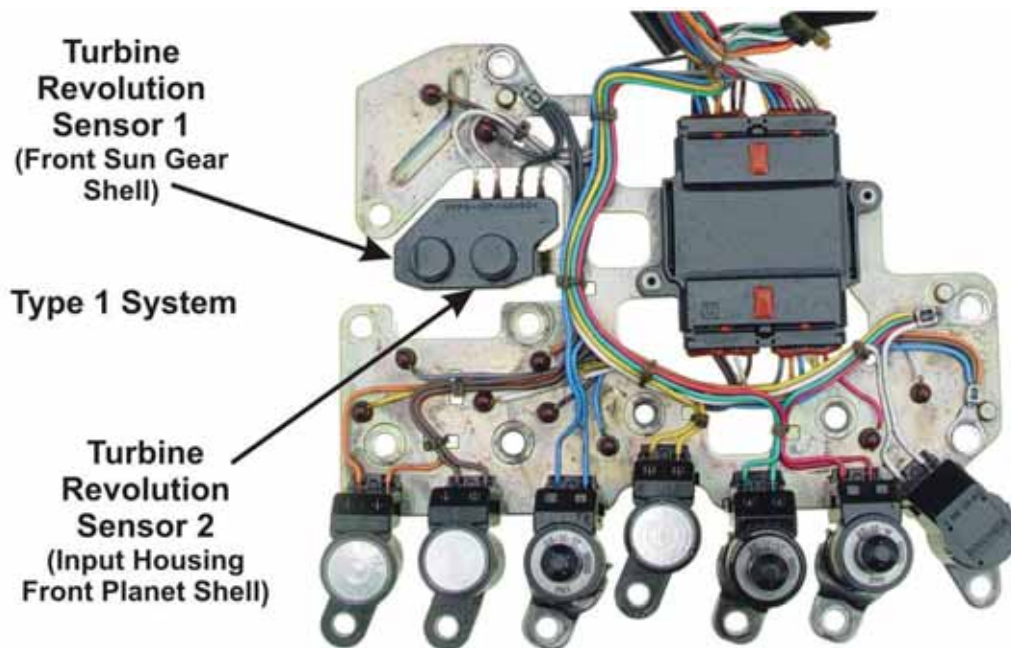
The Turbine Revolution Sensors on the Type 1 system can be checked externally, the Type 2 systems require the use of a capable scan tool or software.

TRS #1

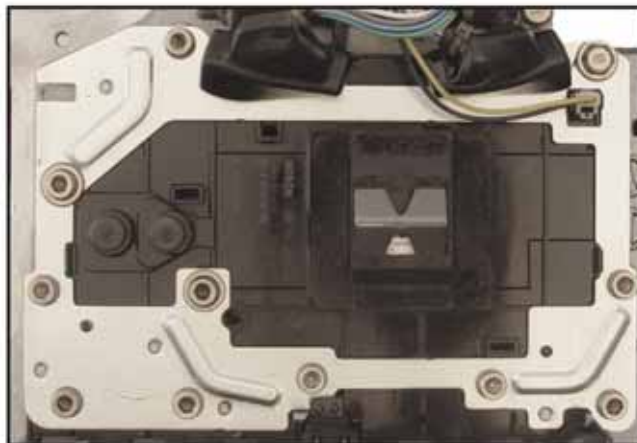
When running at 31 MPH (50 km/h) in 4th speed with the closed throttle position switch "OFF".

TRS #2

When moving at 12 MPH (20 km/h) in 1st speed with the closed throttle position switch "OFF". On a scan tool data Turbine RPM will closely match engine RPM.



Type 2 Systems



RE5R05A

Output Shaft Speed Sensor (OSS)

The Output Shaft Sensor (OSS) connects directly to the Range Sensor (Park/Neutral Position). When diagnosing a failed sensor; lower the pan disconnect the green connector, jump 12 volts to pin 1, ground pin 3 and with a DVOM check for a DC hertz signal on pin 2 while turning the output shaft (extension housing removed).

Nissan Part # 31935-90X02



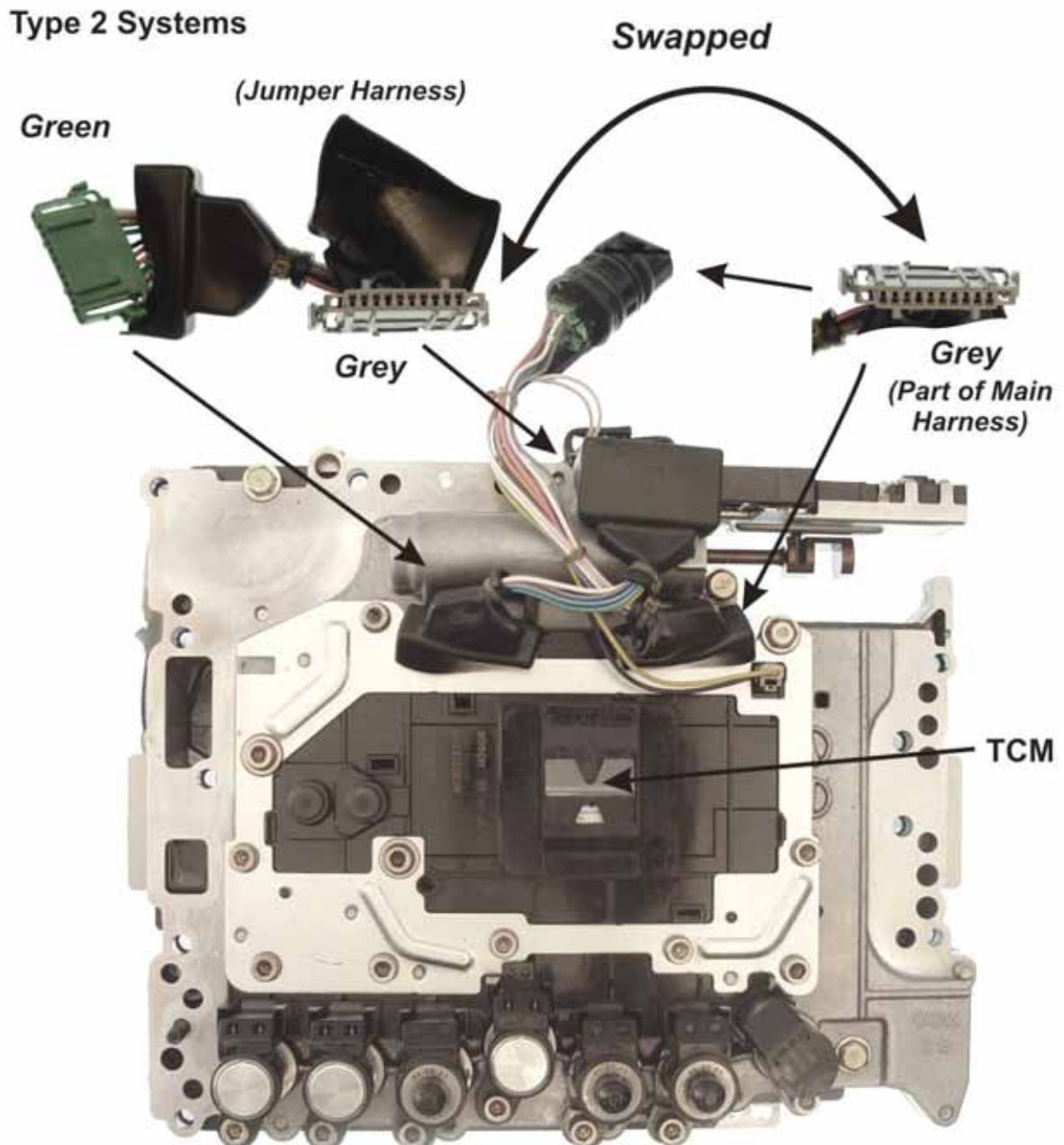
1: 12 Volts
2: Signal
3: Ground



RE5R05A

Connector Mismatch / Blown Fuse

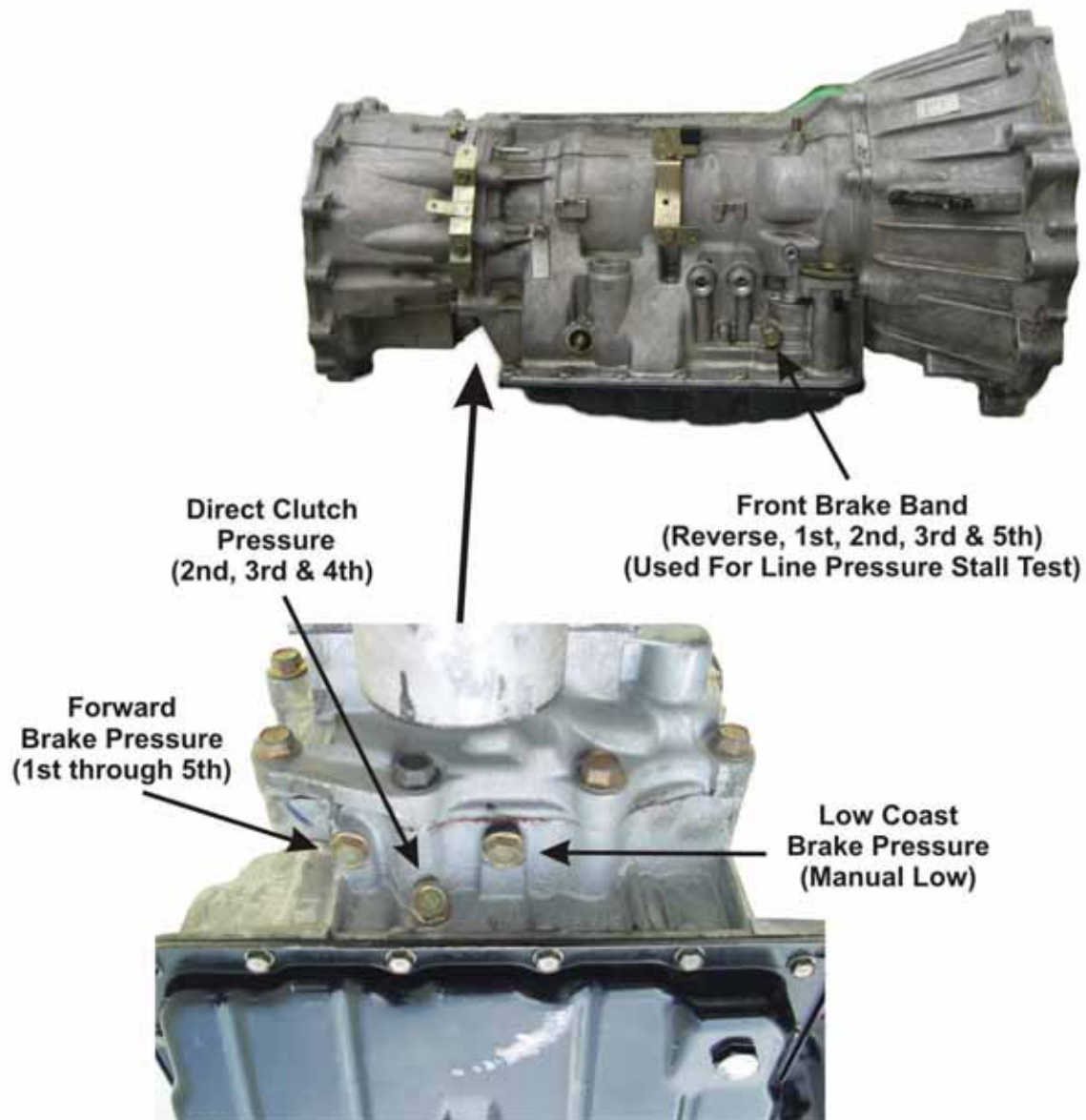
Several tech calls have been received on connector mismatch on Type 2 Systems causing a blown fuse to the TCM. The problem occurs when the grey connector from the main harness is swapped with the grey connector for the park/neutral position sensor.



RE5R05A

Pressure Tests

Line Pressure Specifications		
Engine Speed	Reverse Position	Drive Position
AT Idle Speed	62 - 67 psi	55 - 62psi
At Stall Speed	233 - 283 psi	190 - 218 psi



RE5R05A

Turbine Shaft Interchange

There are two different turbine shaft lengths. One measures 8.250" found in Armada and Titan vehicles with a V8 engine. The other shaft length measures 7.375" in all other vehicle models.

8.250" Armada & Titan V8
7.375" On All Others



RE5R05A

Stator Support Interchange

There are two different stator shaft lengths. One measures 3.500" found in Armada and Titan vehicles with a V8 engine. The other shaft length measures 3.125" in all other vehicle models.



**3.500" Armada and Titan V8
3.125" On All Others**



Stepped Stator Support



RE5R05A

Front Planetary Interchange

These units are built differently for all models, make sure you do a thorough job identifying the parts. As a rule, most of the steel hard parts are for truck applications.

Both Shaft Lengths



**Input Clutch Front
Ring Gear 102T-106T**

**4 Pinion Aluminum
5 Pinion Steel
Front Planet**



**Front Planet Sun Gear
50T, 53T & 54T**

RE5R05A

Center and Rear Planetary Interchange

4 & 5 Pinion
Center Planet



Center Ring Gear
77T & 78T



4 & 5 Pinion
Rear Planet



Rear Sun Gear
61T & 62T



Center Sun Gear
42T (5 Pinion Center Planet)
43T (4 Pinion Center Planet)



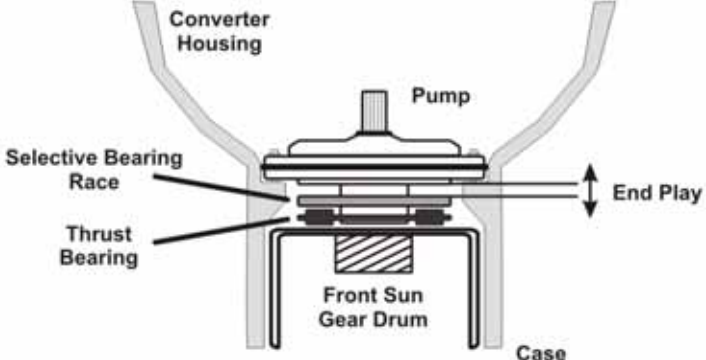
Rear Ring Gear
98T, 99T & 110T

RE5R05A

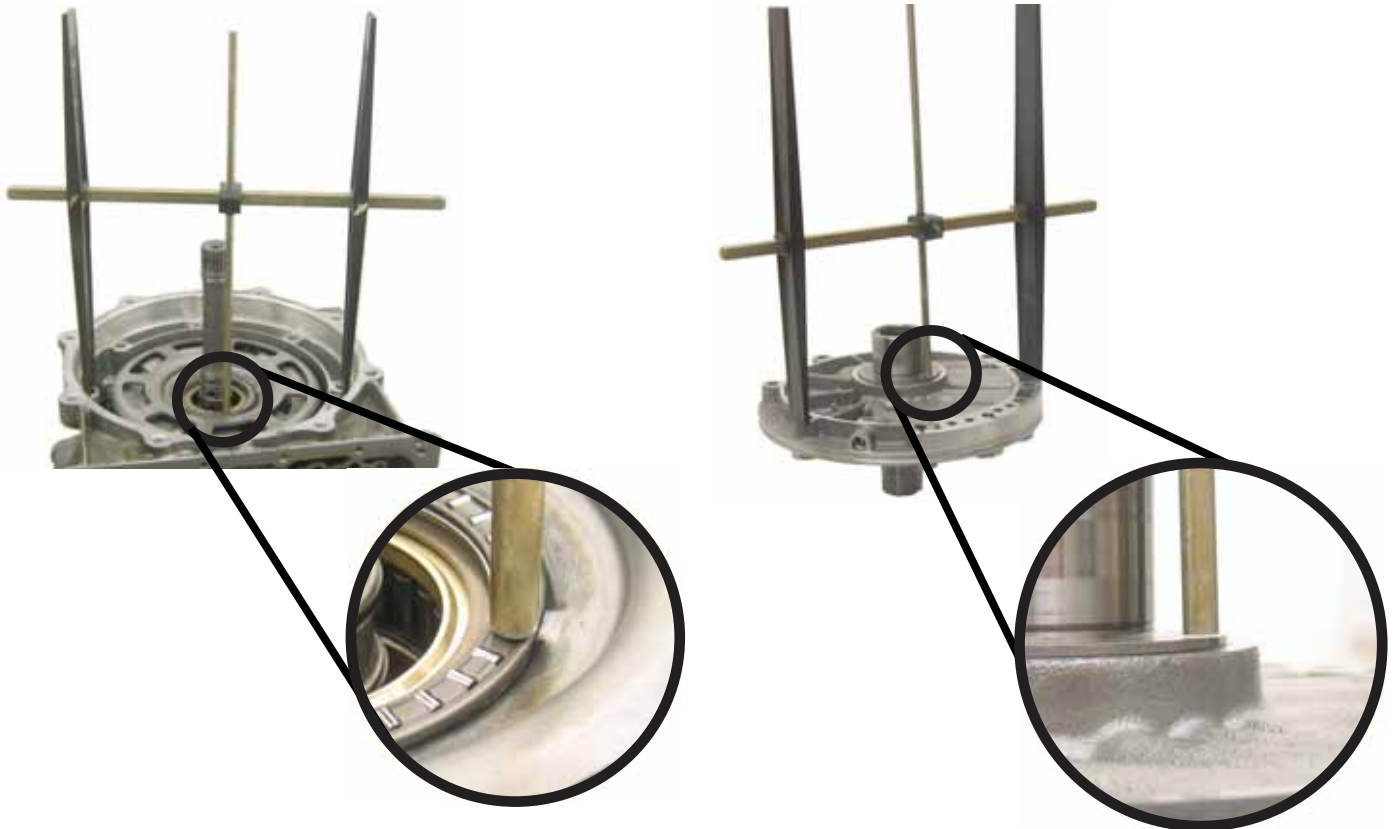
Total Unit End Play Specifications

Measure the total end play from the pump surface to the front sun gear drum selective race, your measurement should be from 0.25 - 0.55mm (.010" - .022").

Selective Race	
Thickness	Part Number
0.8mm (.031")	31 43 5 95X00
1.0mm (.039")	31 43 5 95X01
1.2mm (.047")	31 43 5 95X02
1.4mm (.055")	31 43 5 95X03
1.6mm (.063")	31 43 5 95X04
1.8mm (.071")	31 43 5 95X05



Check transmission end clearance using an H gauge. Set the H gauge on the transmission case and run the bar down to the face of the sun shell roller bearing. Tighten the thumb screw on the H gauge. Flip the H gauge over and place the H gauge over the selective washer on the pump. The clearance at the washer should be 0.25 - 0.55mm (.010" - .022")



RE5R05A

Clutch End Play Specifications

Input Clutch:

0.7 - 1.1mm (.028" - .045") There are no selective components available for the Input Clutch. If clearance is not correct, there is a mis-assembly.

High & Low/Reverse Clutch:

1.0 - 1.5mm (.040" - .060") There are no selective components available for the Input Clutch. If clearance is not correct, there is a mis-assembly.

Direct Clutch:

1.1 - 1.6mm (.045" - .065") There are no selective components available for the Input Clutch. If clearance is not correct, there is a mis-assembly.

Reverse Brake Clutch:

1.1 - 1.6mm (.045" - .065") There are selective Backing Plates available.

Low Coast Brake Clutch:

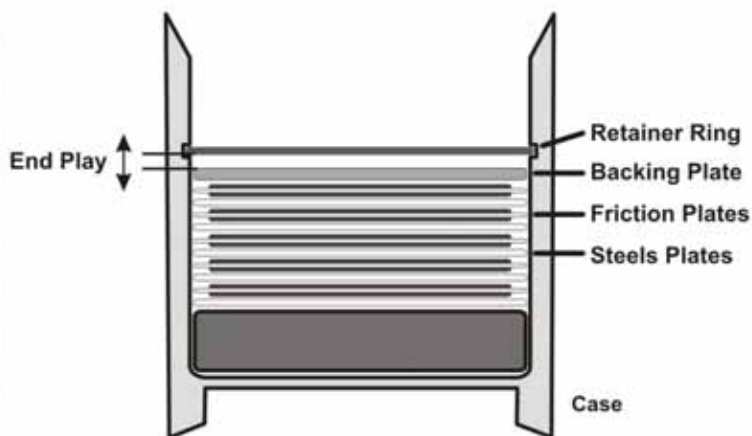
0.5 - 1.0 mm (.020" - .040") no selective components available.

Forward Brake Clutch:

1.0 - 1.3 mm (.040" - .055") no selective components available.

Selective Reverse Backing Plates

Thickness	Part Number
4.2mm (.165")	31 667 90X14
4.4mm (.173")	31 667 90X15
4.6mm (.181")	31 667 90X16
4.8mm (.189")	31 667 90X17
5.0mm (.197")	31 667 90X18
5.2mm (.205")	31 667 90X19



RE5R05A

Torque Specifications

Component	Nm	Ft-lb	In-lb
Band Anchor Adjustment Locking Nut	46	34	
Converter Housing to Case	61	45	
Cooler Line Banjo Fitting Bolts	49	36	
Dipstick Tube Adapter to Case	8		70
Drum Support to Case	23	17	
External Manual Shift Lever Nut	22		97
Inside Detent Spring to Case	8		70
Oil Pan Drain Plug	34	25	
Oil Pan to Case	8		70
Oil Pressure Test Plugs	7.3		65
Oil Pump Assembly to Case	48	35	
Oil Pump Cover to Pump Body	9		80
Output Revolution Sensor to Case	5.8		51
Transmission to Engine Bolts	113	83	
Valve Body & Solenoid Bolts	8		70
4WD Adapter Housing/Extension Housing to Case	61	45	

RE5R05A

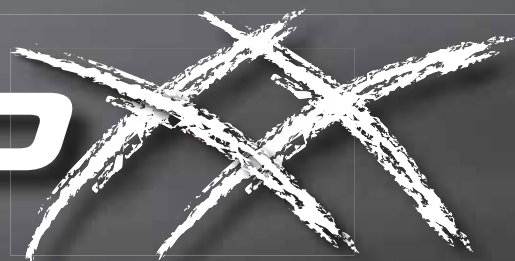
Torque Converter Identification

There are four different converters each with a different overall height. Three have four bolt pads and one has six. Make sure you contact your suppliers with to correct year and model to ensure the proper converter replacment





GP



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Honda/Acura

No Lockup After Rebuild P0740

The most common cause of a no lockup condition after rebuild, would be installing the wrong converter hub O-ring. The aftermarket green O-ring is much thicker and will help prevent any leaks between the converter hub and pump gear mating surface. The original O-ring worked well when pump gear wear was at a minimum, but over time with higher mileage this wear can become excessive, setting torque converter performance code P0740 on some models before and after rebuild.



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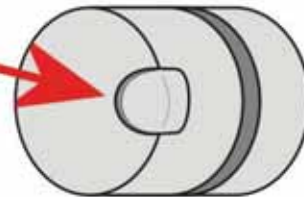
No Lockup After Rebuild P0740 (continued)

This same symptom can be caused by loose valve bore plugs. Over time these valve bore plugs can become loose causing a leak that may set code P0740. There are after market replacement valve bore plugs with O-rings to prevent leaks in these areas.

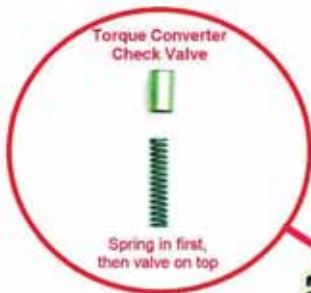
Special care should be taken with the type of lockup shift valve with a sleeve in the valve train. The problem can be caused by installing the valve cap incorrectly into the valve bore or replacing the valve cap with an after market one without the notch.

Example used: MAXA, BAXA, B7XA, B7ZA, M6HA

**Notch
Cut Out**



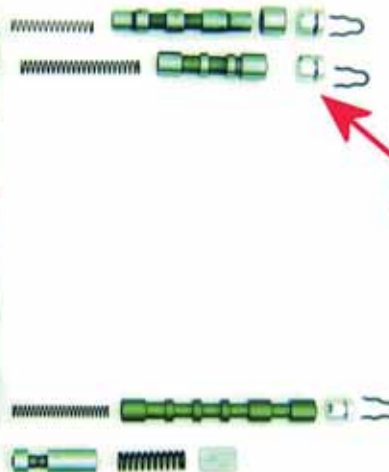
Notch always faces in



Spring in first,
then valve on top



Lockup Shift Valve

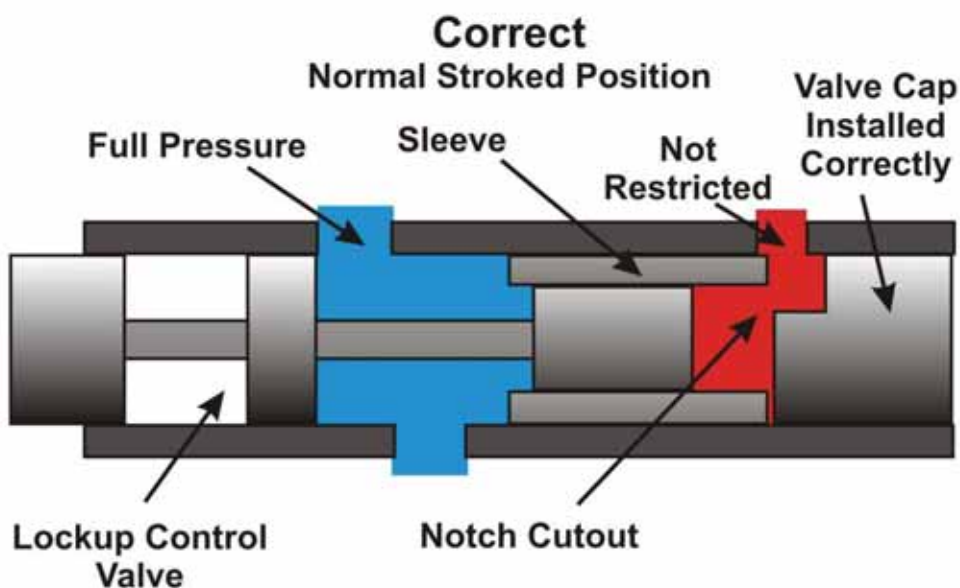
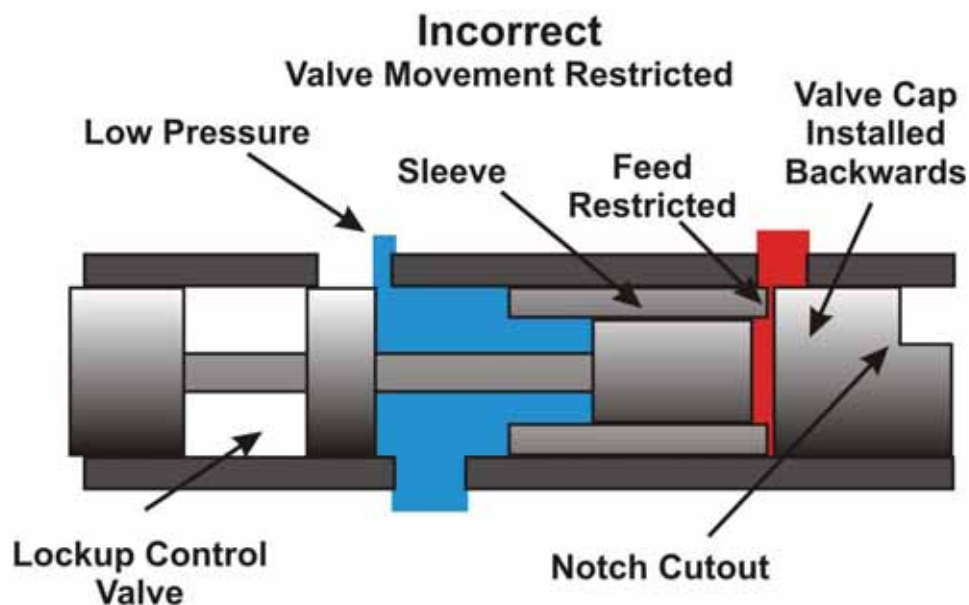


NOTE:
If either of these
end plugs are worn,
loose, or leaking:
Install O-Rings

Honda/Acura

No Lockup After Rebuild P0740 (continued)

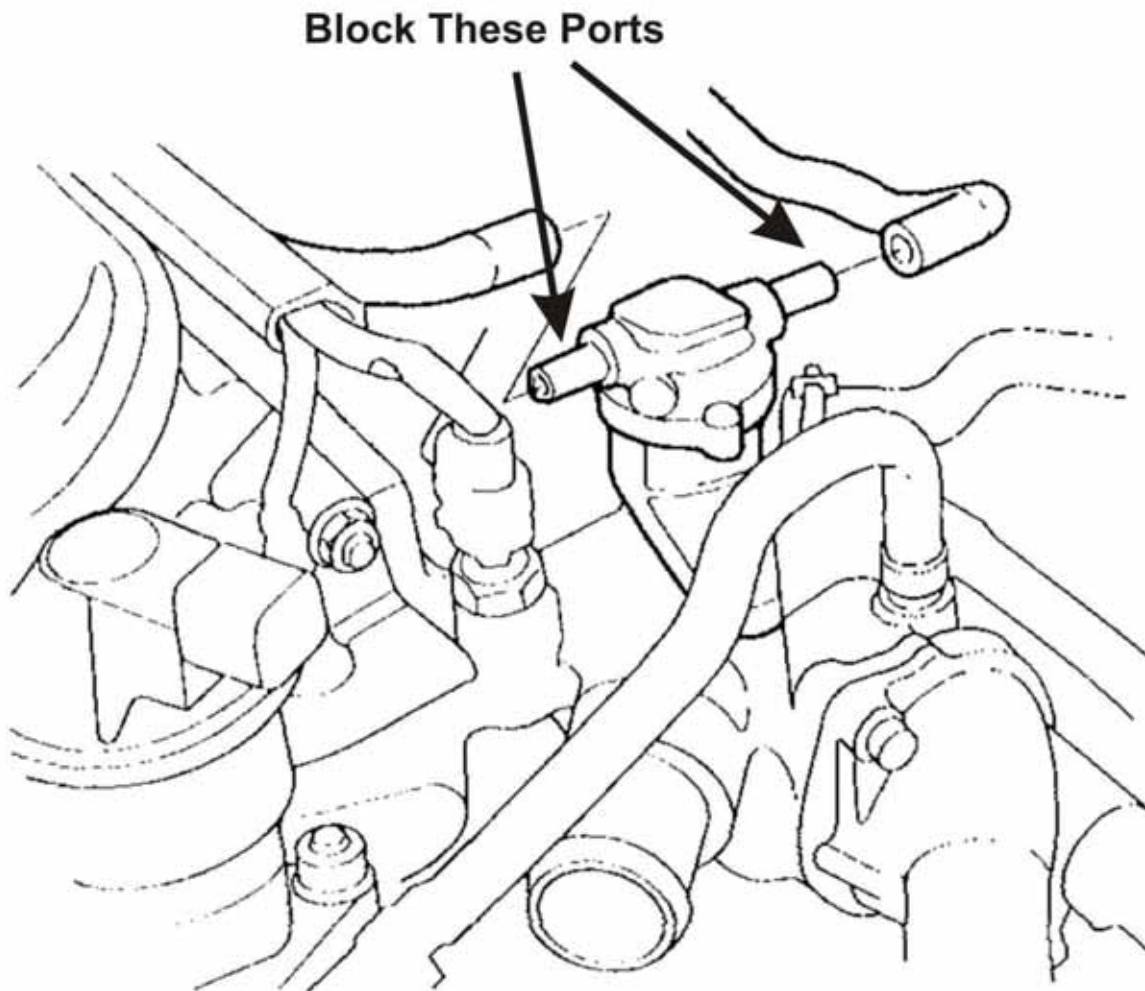
The notch cut out allows oil to enter the sleeve to stroke the lockup control valve. When installed backwards; will restrict the flow of oil through the valve sleeve to stroke the lockup control valve.



Honda/Acura

2002 Odyssey Mistaken TCC Shudder

A TCC shudder symptom on a 2002 Honda Odyssey with a BYBA may be mistaken for a bad Exhaust Gas Recirculation (EGR) Valve. A quick diagnostic test would be to block the EGR ports, if the shudder symptom goes away repair or replace the EGR valve assembly.





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Company Profile

Whatever It Takes (WIT) was founded in 1999 by Kenny Hester, a 35-year veteran in the Transmission parts supply business. WIT is the complete source for all its customer's transmission parts needs, whether it is new, used, or remanufactured. Parts are currently distributed by 23 branch locations throughout the U.S. With the main remanufacturing and distribution located within 10 minutes of U.P.S.' major Air Hub, Whatever It Takes is able to quickly ship parts worldwide. The majority of the sales staff have been in the business for over 20 years. WIT is an employee owned, customer driven company, there are no stockholders or investors to report to. As owners, the WIT employees' only job is to provide the customer with the things they need to be the most successful shop possible.



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Whatever It Takes carries top-quality products from manufacturers such as Raybestos, Toledo Trans-Kits, Allomatic, ATEC-Transtool, ATSG, Autocraft Manufacturing, Borg Warner, CVC Torque Converters, DT Components, Exedy, Hayden Coolers, Life Automotive, Lubegard, Powertrain Systems, Precision International, Rostra, Sachs Clutch Kits, Sonnax, SPX Filtran, Stellar Group, Superior, Teckpak-Fitzall, Transgo, Tri- Components, TTXE, Valeo Clutch Kits, Zoom Technology, OE manufacturers and many others. In addition to new O.E. parts, W.I.T. also carries a full line of remanufactured and used parts for both Automatic & Standard transmission. W.I.T. remanufactures Standard transmissions & transfer cases that include a 12 month/unlimited mile warranty against parts and workmanship.*



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Customer Service is the cornerstone that W.I.T. was founded on, and has helped it become a major competitor in the transmission parts business. Whatever It Takes prides itself on its excellent customer service and having the parts you need by maintaining a minimum fill rate of 98.8%. W.I.T. prides itself on taking care of its customers. Service, Experience, Quality, Product Availability, Timely Credits, a dedicated Customer Service line are just a few of the reasons why Whatever It Takes has become a major competitor in the transmission parts business. WIT is able to ship its parts overnight to most of the North and South Eastern U.S. With its strategically placed stores, it is possible for WIT to service about 80 % of the country within 2 days. In addition to using UPS & Fed-Ex to ship its packages Whatever It Takes also offers free Night-Box delivery to many areas. By making this commitment, WIT helps to increase its customer's profit margin. With Night-Box delivery, Builders no longer have to wait around for UPS or FedEx to arrive; their package is delivered overnight so the parts are waiting on them the next morning.



Research & Development

The Research & Development team stays current with the latest transmissions & take photos of every part in these transmissions in order to provide most complete transmission catalog in the industry. They gather information on common wear issues with each new transmission, and develop text descriptions for all the Catalogs and WIT's website (www.wittrans.com). The R & D team was responsible for creating W.I.T.'s Catalog CD with point and click technology, The Award winning & most up-to-date Vehicle to Automatic Transmission Guide in the Industry, & now the only Vehicle to Manual Transmission Guide in the industry!



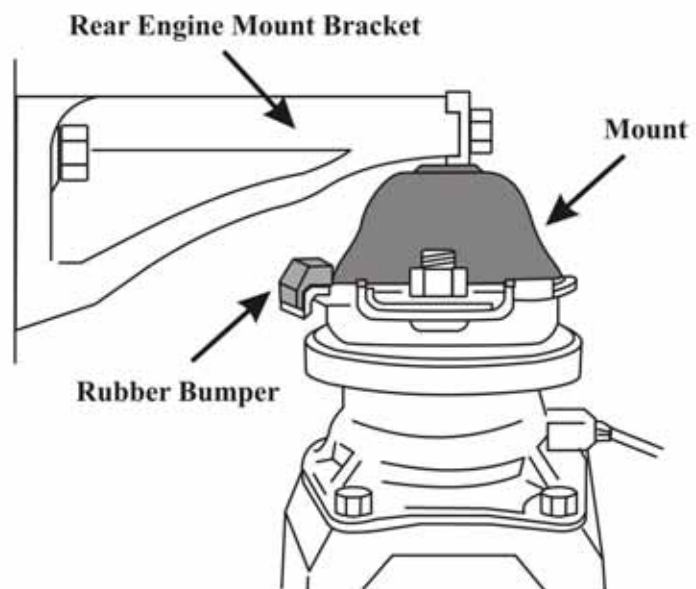
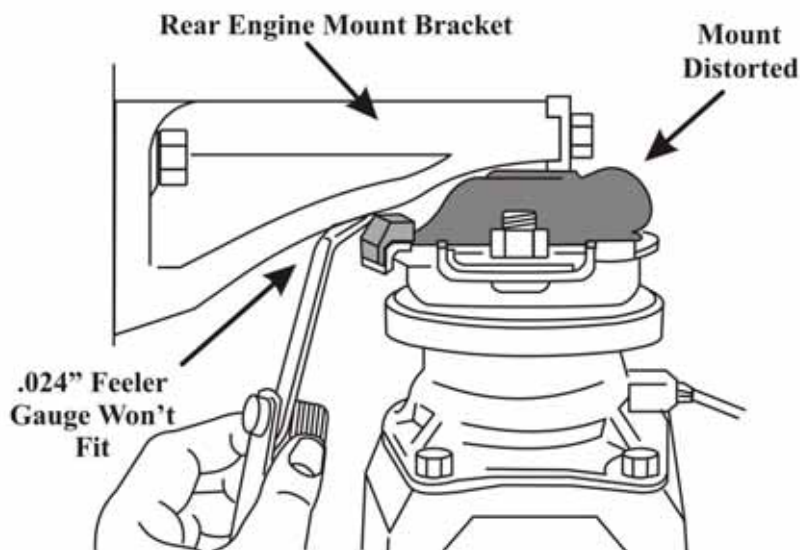
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Honda/Acura

2005-06 Odyssey Mistaken TCC Shudder (continued)

An engine vibration during lockup apply may be mistaken for a TCC apply shudder on some 2005-06 Honda Odyssey BGRA/PGRA models with Active Control Engine Mounts (electronic). Check to verify that the rear engine mount has not failed. There must be a minimum clearance of 0.024" (0.610mm) between the rear engine mount's rubber bumper and the mount bracket. There should be no visible distortion (bulges) seen on the rubber mount.





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AW55-50SN

P0740 After Rebuild

P0740 after rebuild may be caused if the Forward/Direct (Input) housing was changed during the overhaul with the wrong size input shaft. There are two different input shaft diameters one measuring 0.844" for 2wd vehicles and one measuring 0.870" for 2wd turbo or all wheel drive vehicles. The smaller shaft installed in place of the larger one will cause the loss of converter clutch apply oil.



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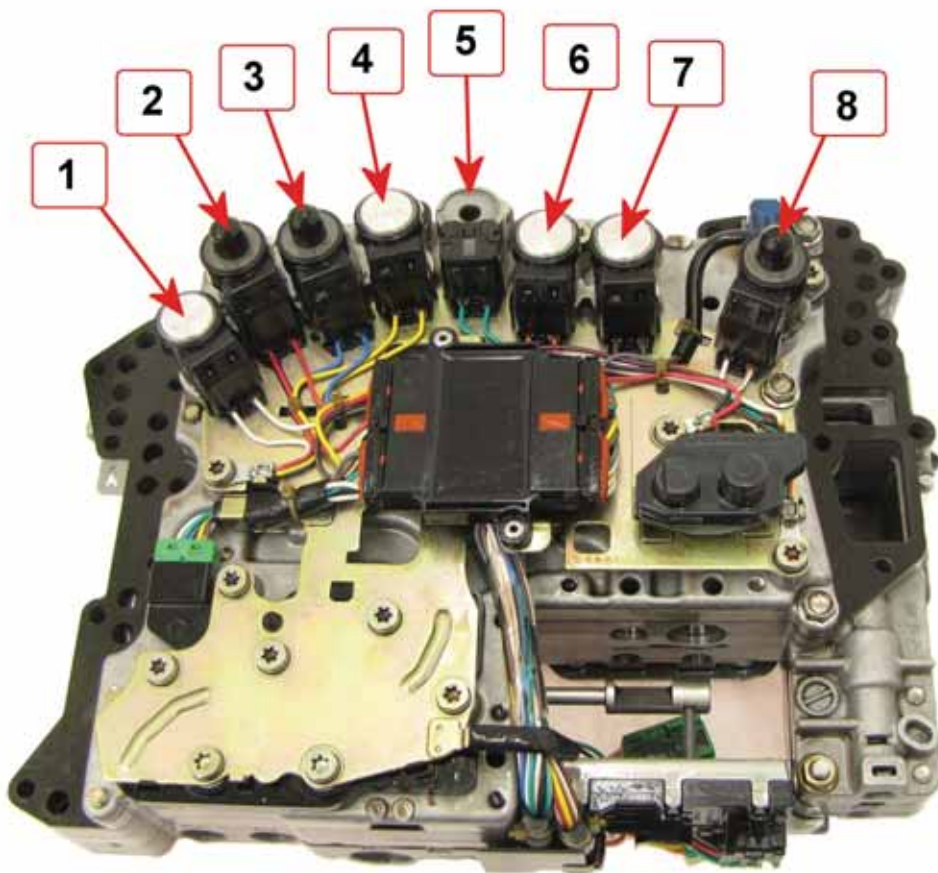
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Solenoid Identification

While working on a 2005 Subaru with the new 5AT eight solenoid transmission, you may find it difficult to find valvebody and solenoid information. Here is a copy of the solenoid locations and identification for the new eight solenoid transmission. Valvebody break down is not yet available from the manufacturer.



- | | |
|---|-----------|
| 1. Front Brake Solenoid | 3-9 ohms |
| 2. Direct Clutch Solenoid | 3-9 ohms |
| 3. Input Clutch Solenoid | 3-9 ohms |
| 4. Transfer Solenoid | 3-9 ohms |
| 5. Low Coast Brake Solenoid | 5-17 ohms |
| 6. Lock-Up Solenoid | 3-9 ohms |
| 7. Line Pressure Solenoid | 3-9 ohms |
| 8. High and Low Reverse Clutch Solenoid | 3-9 ohms |



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ALL Chrysler

TCC Cycling In and Out

1. Loose or dirty battery terminal connections or cables, most often cable ground on engine. (Both) (clean or repair as needed, check battery condition)
2. Noise (EMI) interference from Alternator to PCM. (Both) (install Noise Filter in APPS signal wire or replace Alternator if needed)
3. Noise (EMI) interference from APPS signal to PCM. (24 Valve Diesel Only)(PCM reflash Factory Bulletin #18-02-99 some models or install Noise Filter)
4. Faulty TPS or circuit problems. (Both) (replace or repair as needed)
5. TPS Cam, Bushings or Plastic Throttle Rod Ball Joints worn. (12 Valve Diesel Only) (replace as needed/updated Throttle Rod has Metal Ball Joints p/n 5011959AB)
6. APPS sensor relearn, may have code P1693 Code In Companion Module. (24 Valve Diesel Only) (relearn APPS; Key On Engine Off slowly depress accelerator to floor & back then turn key off)
7. Faulty Spark Plugs or Wires, may have misfire codes> (Gas Only) (replace as needed)
8. Faulty or Loose Brake Switch. (Both) (replace or repair as needed)
9. While Generic Scan Tool is in use. (Both) (remove scan tool and retest)
10. Erratic or faulty Vehicle Speed Sensor (VSS) signal or circuit. (Both) (repair or replace as needed or faulty ABS Module model dependant)
11. Faulty Park/Neutral Switch. (Both) (repair or replace as needed/check for broken or damaged internal rooster comb)
12. Restricted Fuel or Air Filter. (Both) (replace as needed)
13. Faulty Crankshaft Position Sensor or circuit may not set code. (Gas Only) (repair or replace as needed)
14. Engine running cold (Thermostat) or faulty Engine Coolant Temp Sensor (ECT) or circuit. (Both) Repair or replace as needed)
15. Faulty Torque Converter Clutch solenoid (TCC) or circuit, may set code P0743. (Both)(repair or replace as needed)
16. Faulty Transmission Temp Sensor or circuit. (Both) (repair or replace as needed)
17. Faulty ECM, loose or bad connector. (Diesel Only) (replace as needed)
18. Faulty or loose Brake Switch or circuit, may not be seen on scan data or movie snap shot. (Both) (repair or replace as needed)
19. Low Coolant or Coolant Reservoir level, may not illuminate Low Coolant Lamp if equipped. (Both) (repair leaks or repair circuit, replace sensor as needed)
20. Water in Fuel, Warning Lamp should be illuminated. (Diesel Only) (replace Fuel Filter)
21. Lift Pump interference. (Diesel Only) (There are aftermarket kits to relocate the Lift Pump)
22. Retarded Valve Timing, loose Timing Chain. (Both) (replace Timing Chain)

This list is compiled from many years of technical hotline calls on causes and fixes for this complaint which include both gas and diesel engines. Some are specific to gas and/or diesel engines in the order of most common.

ALL Chrysler

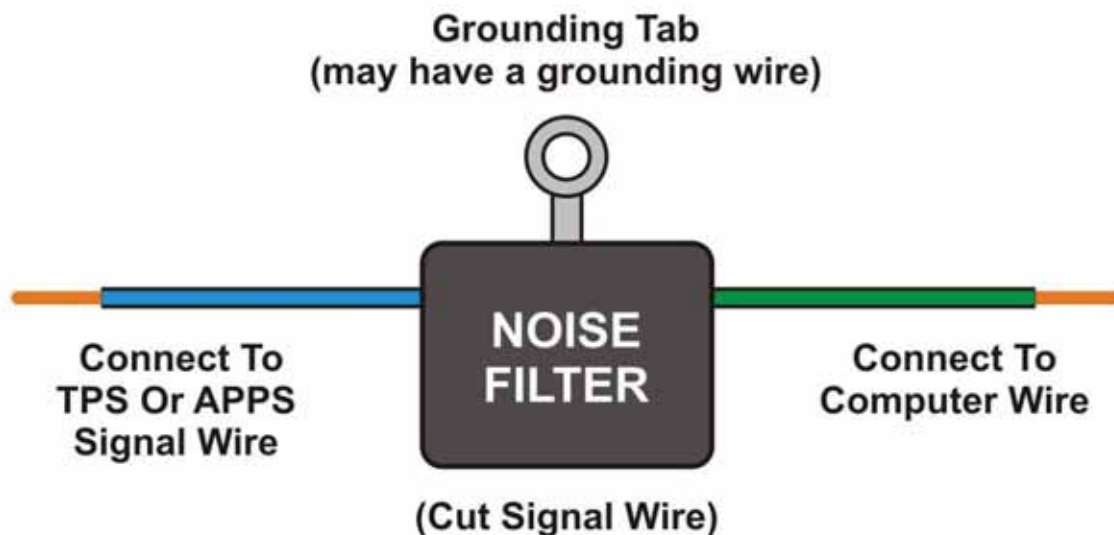
TCC Cycling In and Out (continued)

Dodge and Jeep vehicles with an RE type transmission and a complaint of TCC cycling in and out between 40-50 mph may be caused by Electro Magnetic Interference (EMI).

Use your scan tool to verify the command being sent by the PCM. If the PCM is commanding the TCC to cycle the problem may be caused by EMI from the alternator. To test this unbolt the wire from the battery positive at the alternator (not necessary to unplug the field wire). This test can only be performed for a short time while the problem is present.

The first step would be to clean both battery terminal connections (both batteries on diesel vehicles) no matter how clean they may appear (replace battery cables if needed). Remove the ground cable connection on the engine block and clean the contact surface area (most common fault). This procedure should be done before replacing the alternator along with testing for a faulty diode.

There's a common fix for an EMI problem by installing a noise filter on the Throttle Position (TPS) or Accelerator Pedal Position Sensor (APPS) circuit to the Powertrain Control Module (PCM).

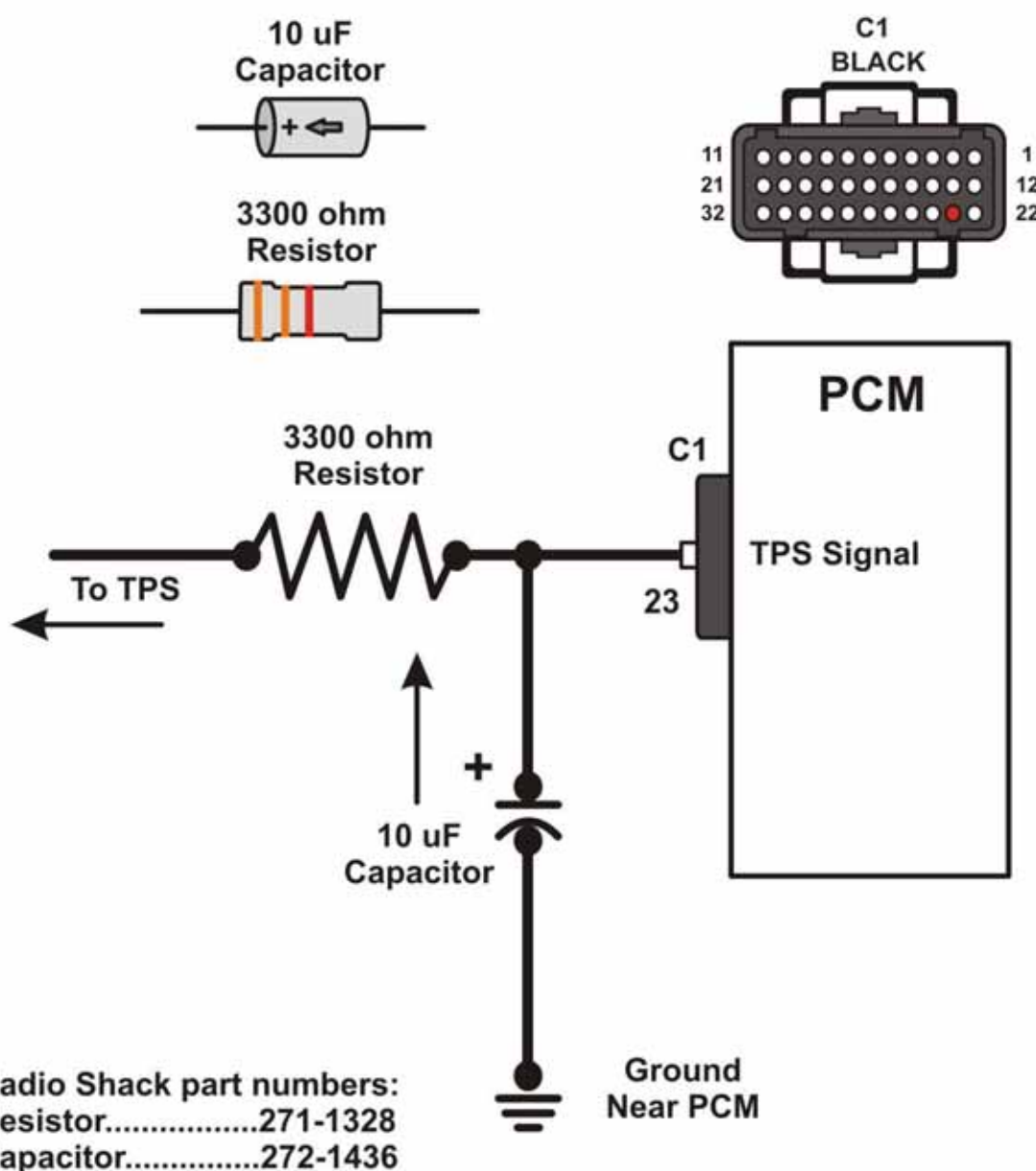


ALL Chrysler

TCC Cycling In & Out (continued)

A noise filter can be purchased through aftermarket suppliers or substituted by making your own filter.

Cut the TPS signal wire near the PCM at the Black C1 Connector Pin 23 and install a 3300 ohm Resistor and 10uF capacitor. Refer to a model specific wire diagram for proper vehicle PCM pin identification. The capacitor is polarized and the positive terminal mark on the body of the capacitor must be spliced towards the TPS signal wire then grounded near the PCM.





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41TE

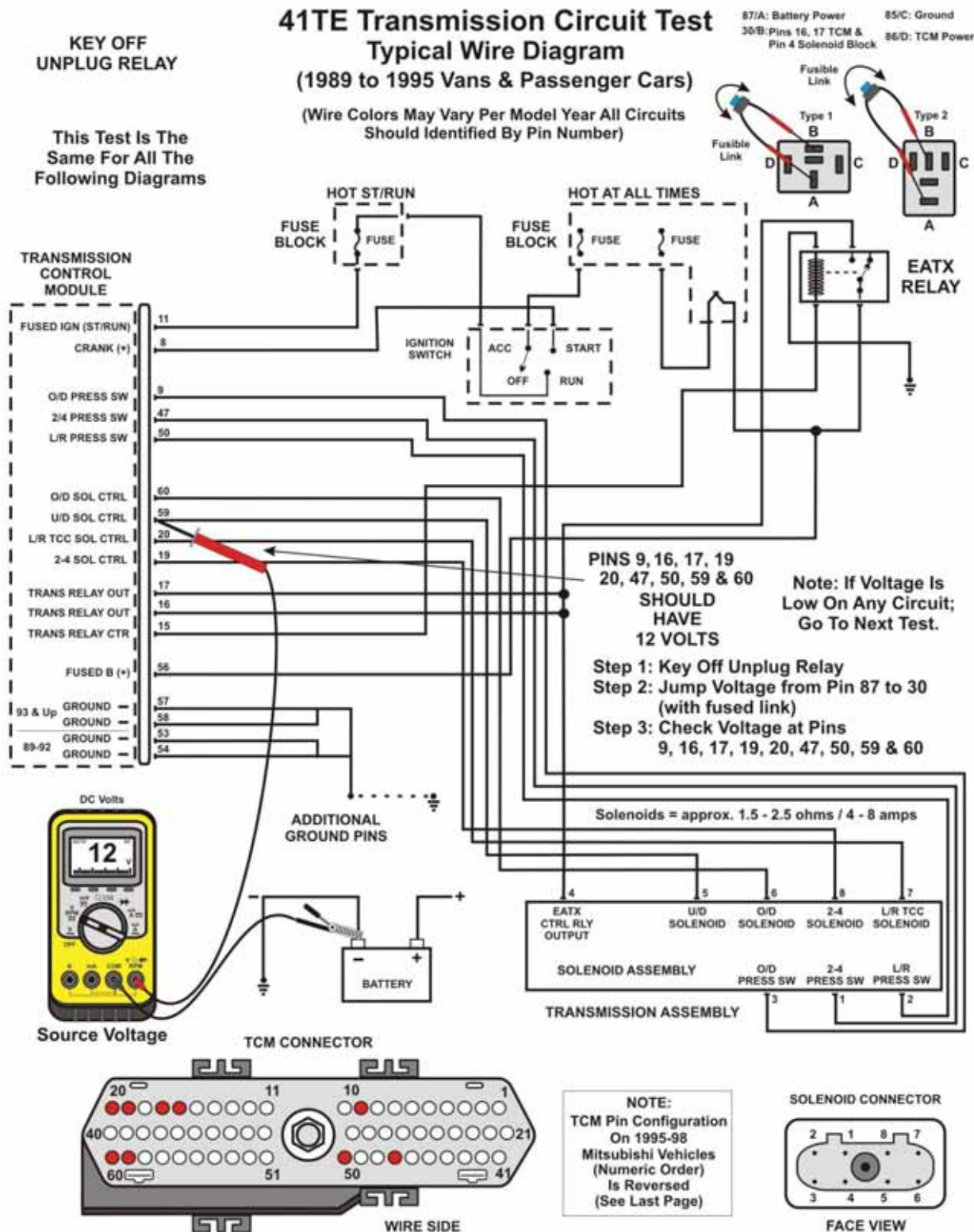
1989-1995 Solenoid and Switch Circuit Test with the "Relay Removed" and the TCM "Connected"

KEY OFF
UNPLUG RELAY

This Test Is The
Same For All The
Following Diagrams

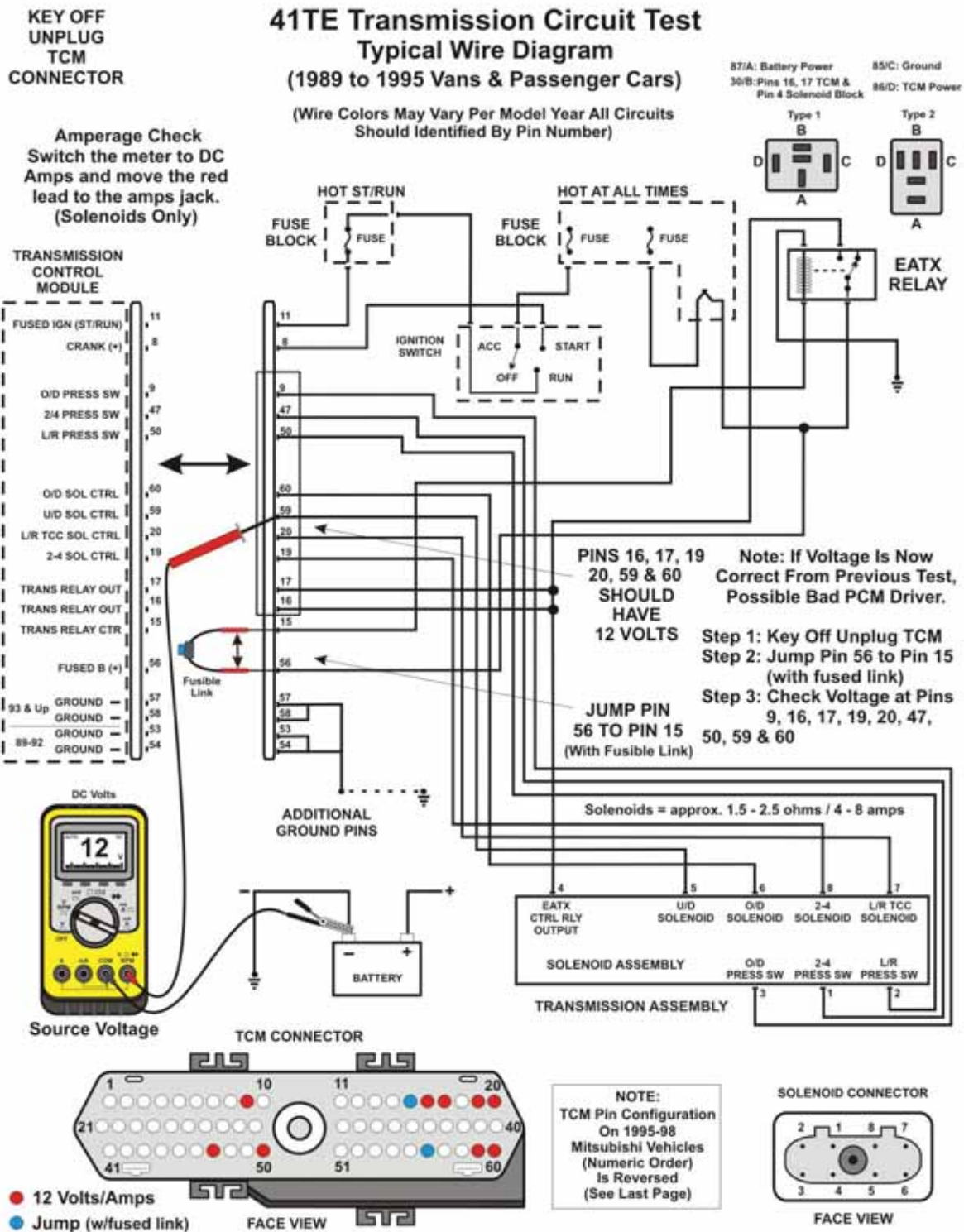
41TE Transmission Circuit Test Typical Wire Diagram (1989 to 1995 Vans & Passenger Cars)

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)



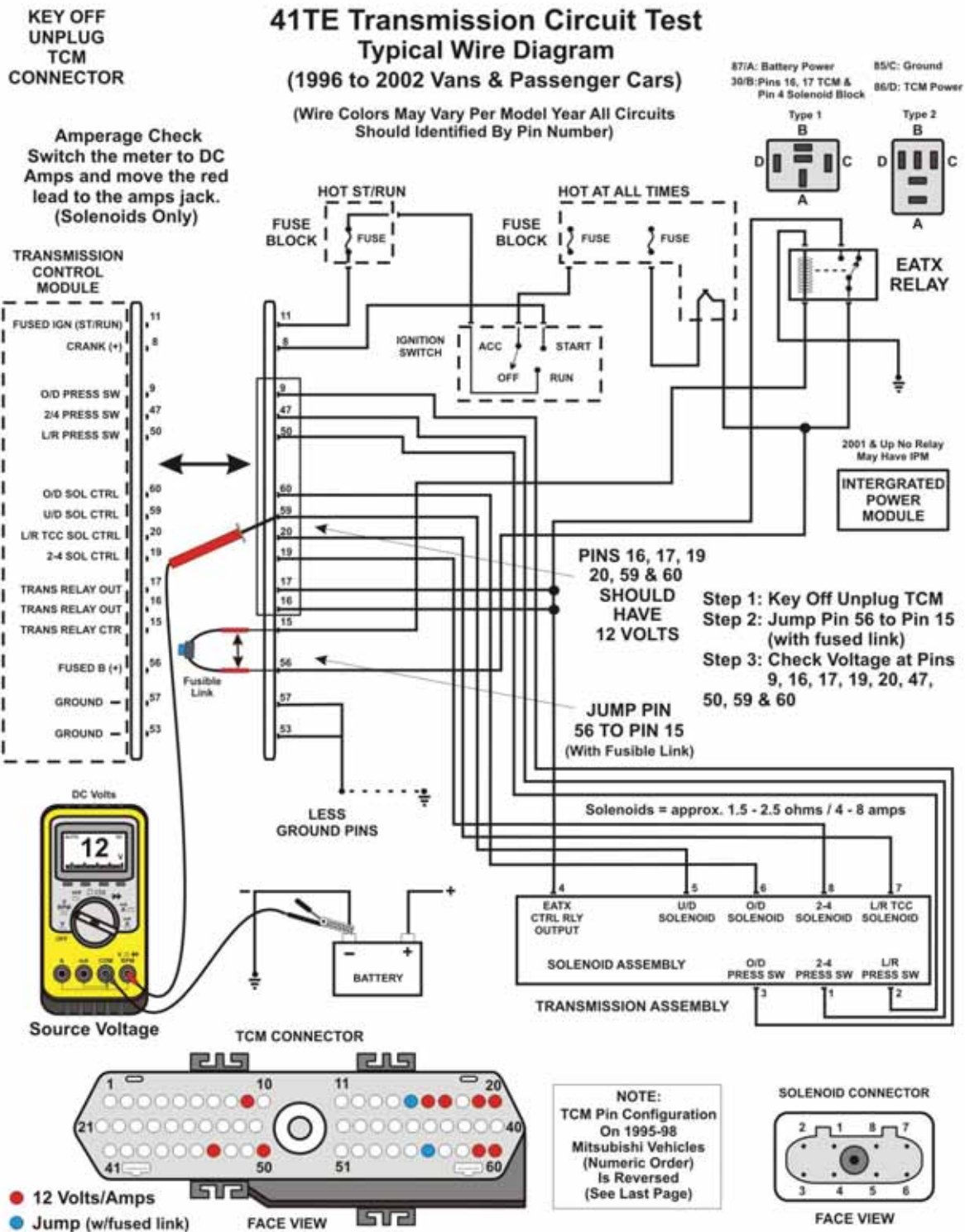
41TE

1989-1995 Solenoid and Switch Circuit Test with the "Relay Installed" and the TCM "Disconnected"



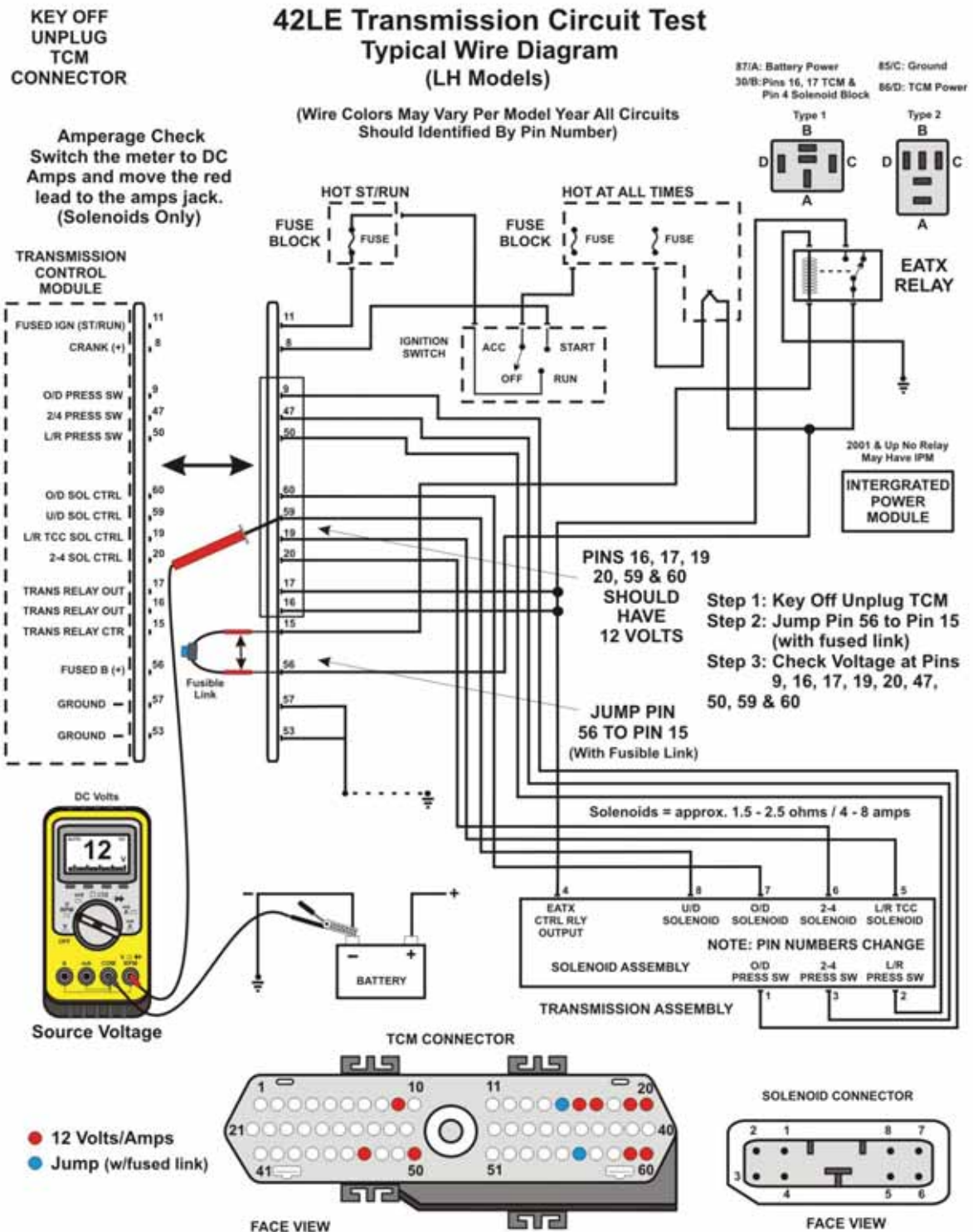
41TE

1996-2002 Solenoid and Switch Circuit Test with the "Relay Installed" and the TCM "Disconnected"



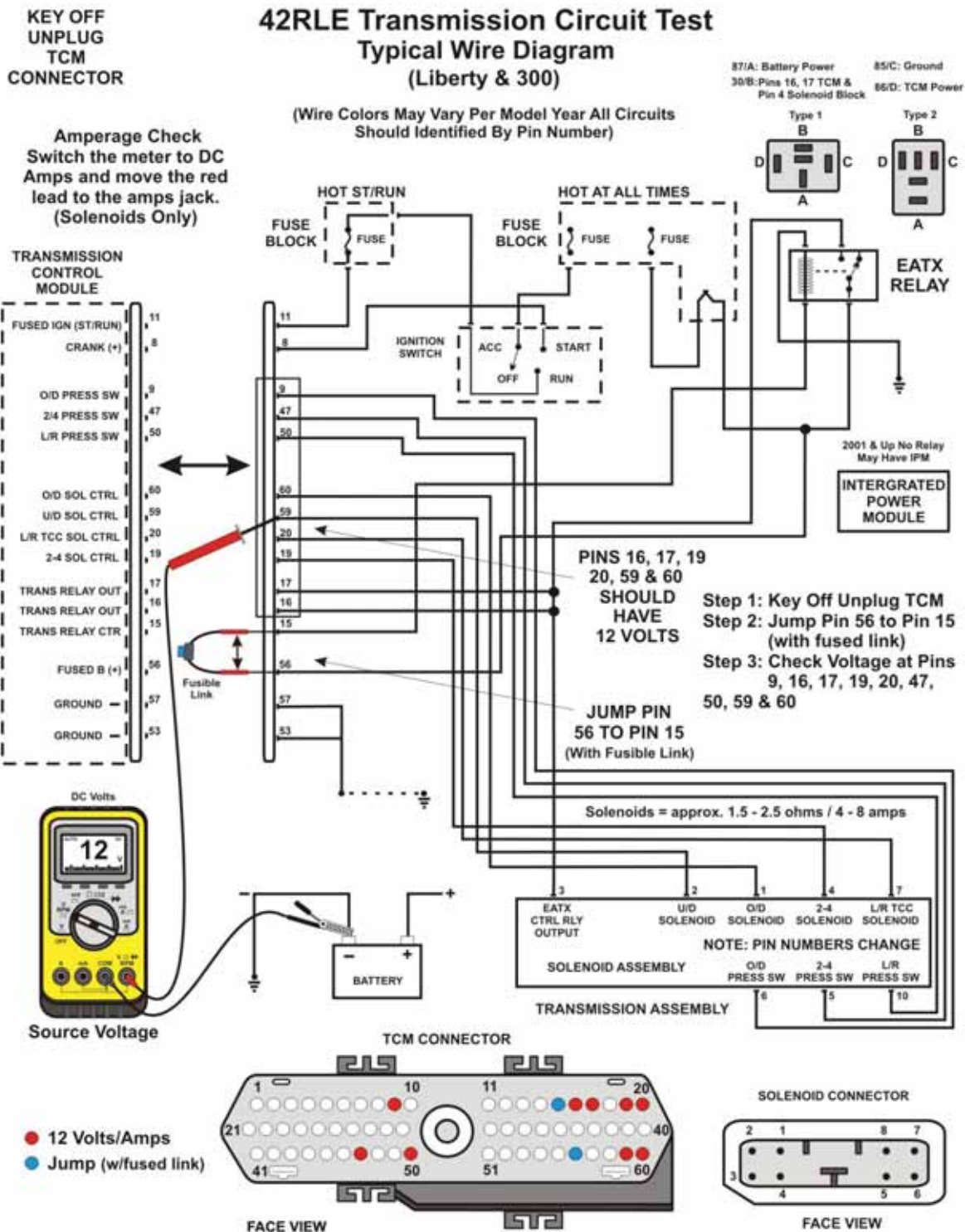
42LE

“LH” Model Solenoid and Switch Circuit Test with the “Relay Installed” and the TCM “Disconnected”



42RLE

“Liberty and 300” Solenoid and Switch Circuit Test with the “Relay Installed” and the TCM “Disconnected”



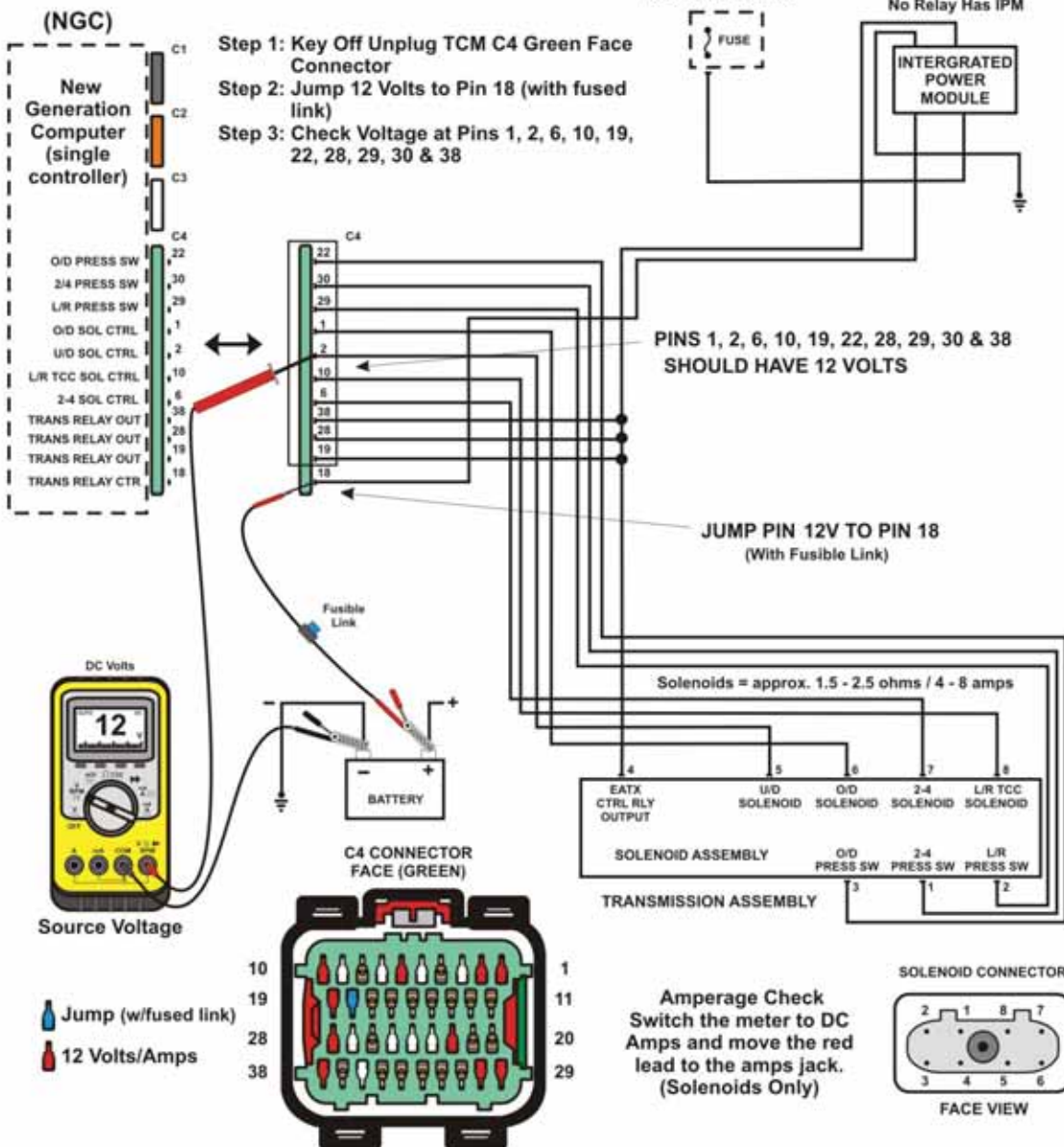
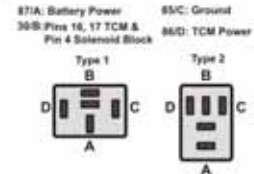
41TE/42LE

2003 - Up Solenoid and Switch Circuit Test with the "Relay Installed" and the NGC "Disconnected"

KEY OFF
UNPLUG
NGC
CONNECTOR
(GREEN FACE)

41TE/42LE Transmission Circuit Test Typical Wire Diagram (2003 & Up)

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)



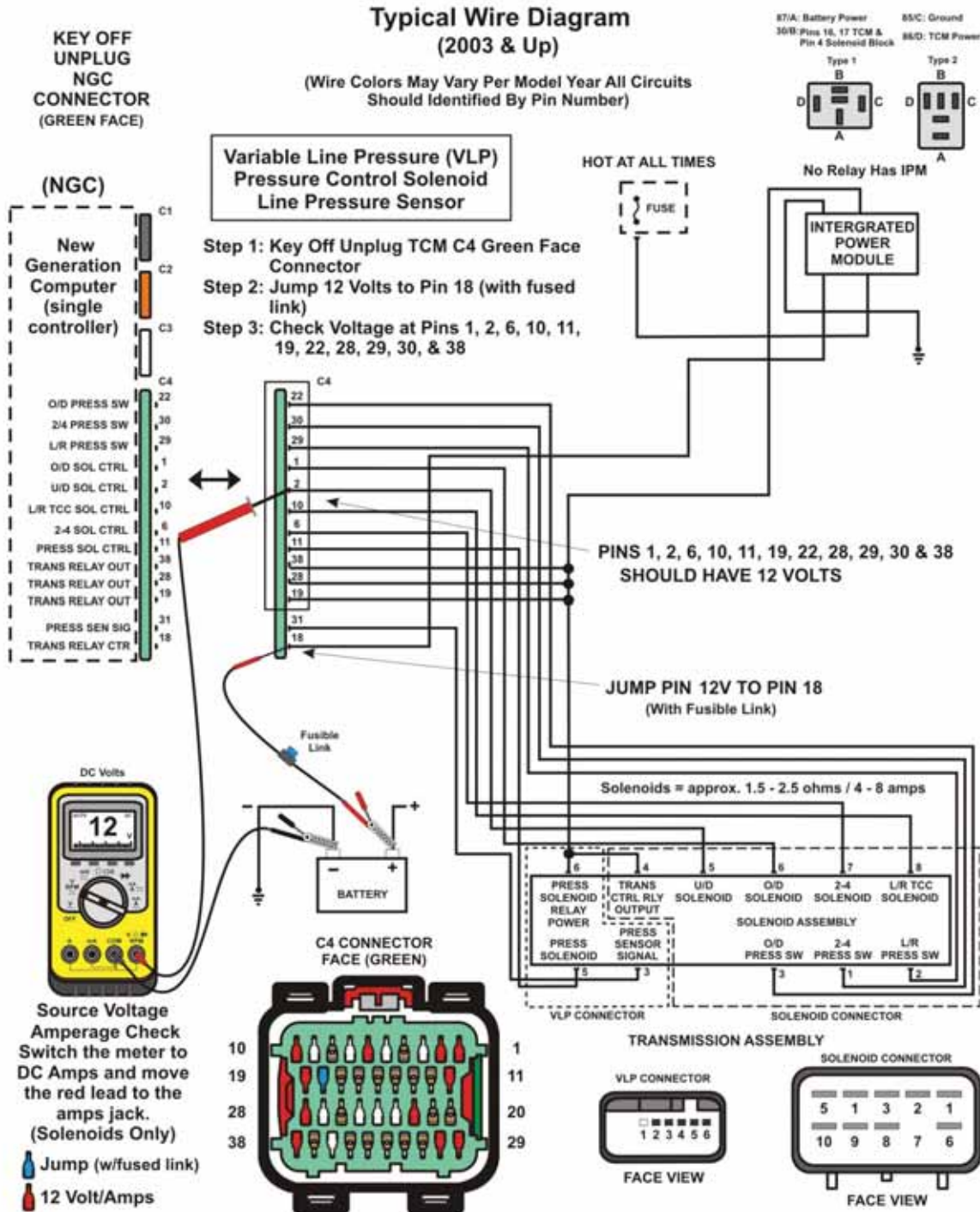
41TES/42RLE

2003 - Up Solenoid, Switch and VLP Circuit Test with the "Relay Installed" and the NGC "Disconnected"

41TES/42RLE 42RLE VLP Transmission Circuit Test

Typical Wire Diagram (2003 & Up)

(Wire Colors May Vary Per Model Year All Circuits Should Identified By Pin Number)



41TES/42RLE

2003 - Up VLP Circuit Test with the NGC "Connected"

41TES/42RLE 42RLE VLP Transmission Circuit Test

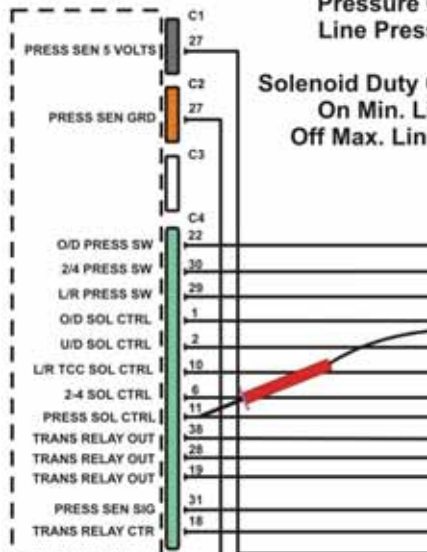
Typical Wire Diagram

(2007 & Up)

(Wire Colors May Vary Per Model Year All Circuits Should Identified By Pin Number)

Engine Running

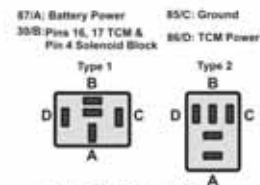
New Generation Computer (single controller) (NGC)



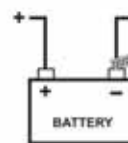
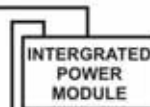
Variable Line Pressure (VLP) Pressure Control Solenoid Line Pressure Sensor Test

Solenoid Duty Cycle Pin 11 Conn C4:
On Min. Line: 62% = 60 psi.
Off Max. Line: 5% = 120-135 psi.

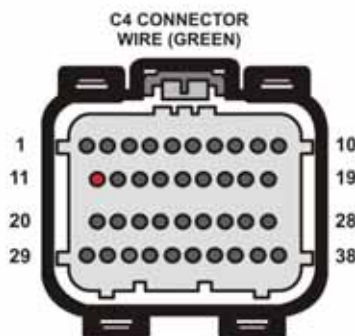
HOT AT ALL TIMES



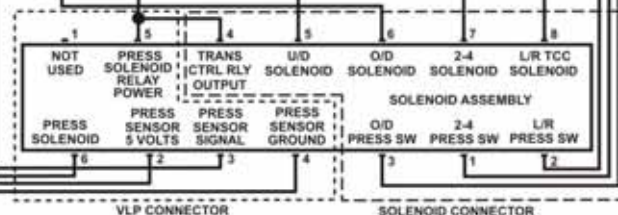
No Relay Has IPM



Solenoids = approx. 1.5 - 2.5 ohms / 4 - 8 amps



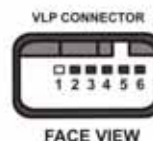
C4 CONNECTOR WIRE (GREEN)



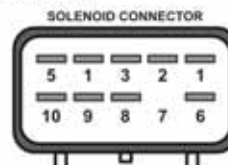
VLP CONNECTOR

TRANSMISSION ASSEMBLY

SOLENOID CONNECTOR



FACE VIEW



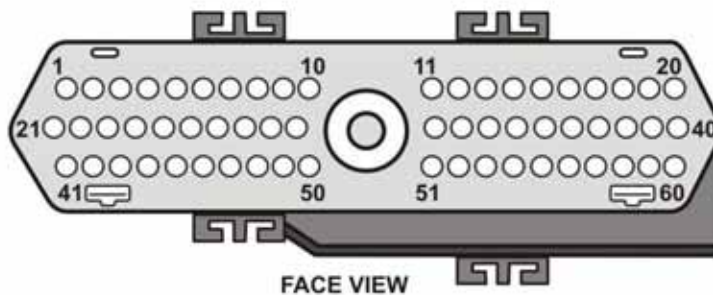
Chrysler and Mitsubishi

TCM Connector Views

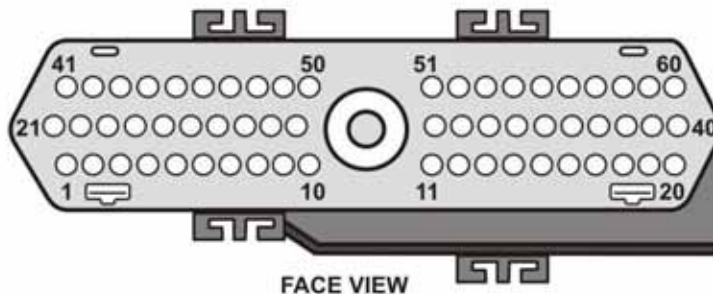
Chrysler & Mitsubishi TCM Connector Views

41TE (604)

**CHRYSLER 60 WAY
TCM CONNECTOR**



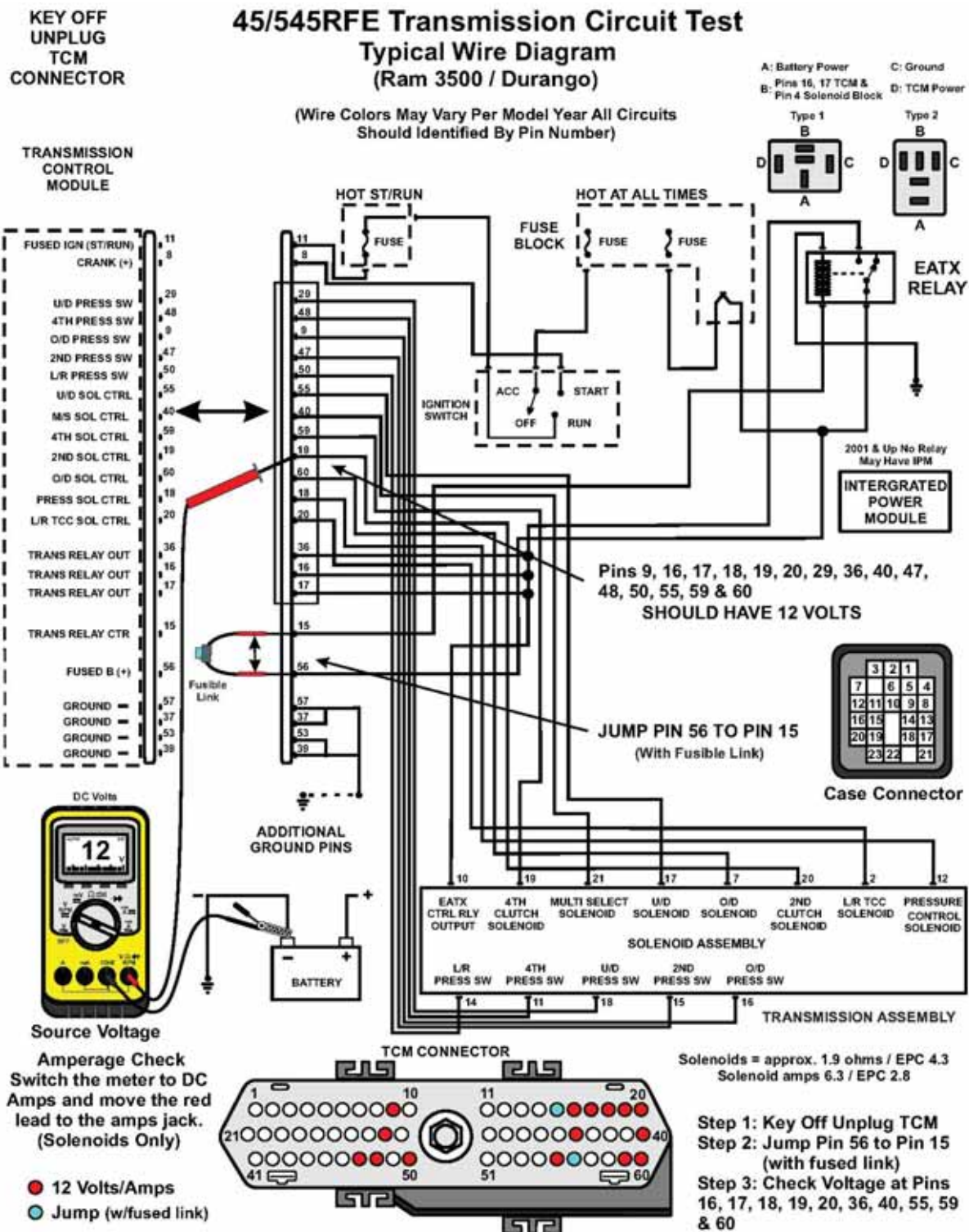
**MITSUBISHI B-85
TCM CONNECTOR**



Note the pin configuration on both connectors is the same just the pin numbers are mirrored.

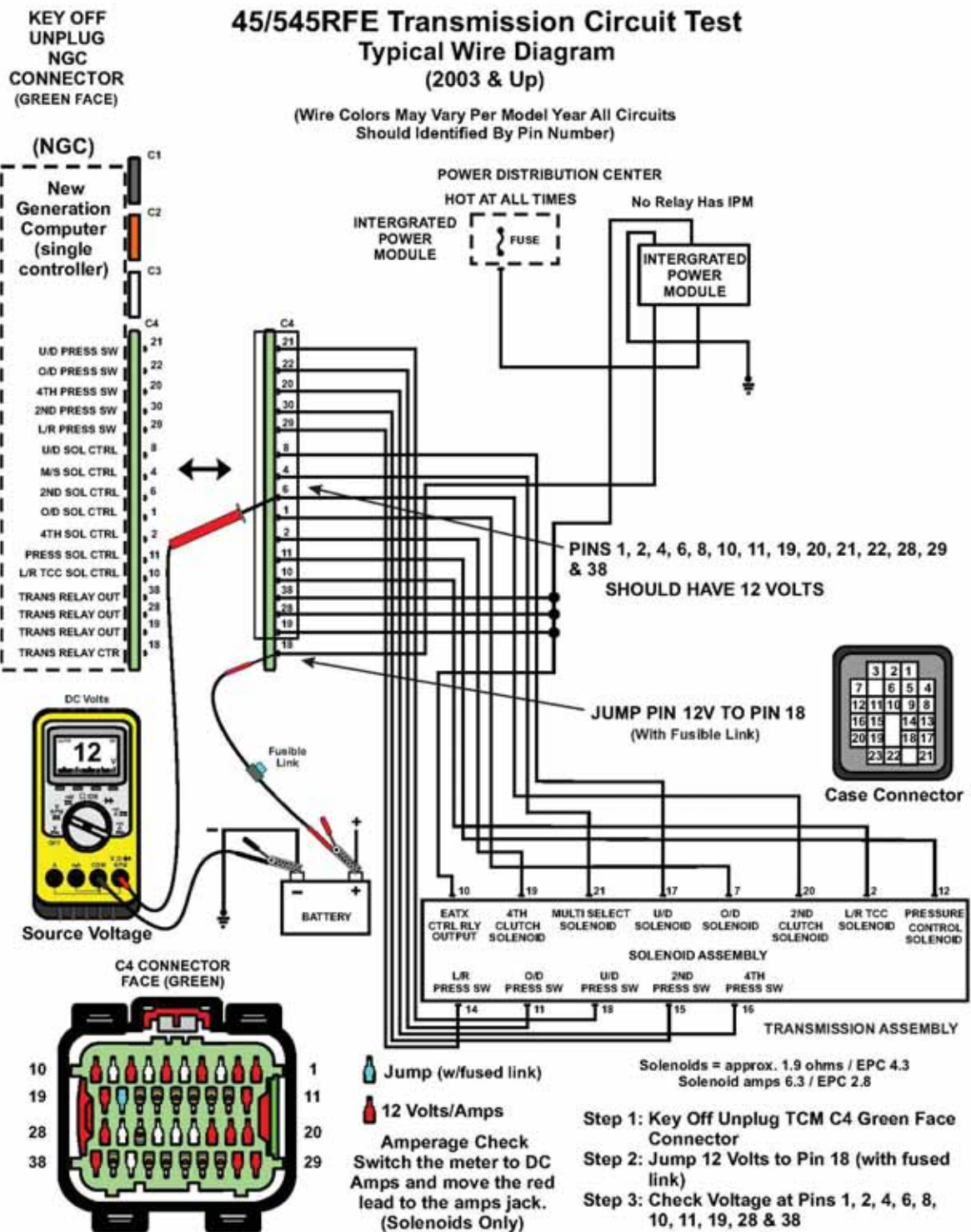
45/545RFE

“Ram 3500/Durango” Solenoid and Switch Circuit Test with the “Relay Installed” and the TCM “Disconnected”



45/545RFE

2003 - Up Solenoid and Switch Circuit Test with the NGC "Disconnected"



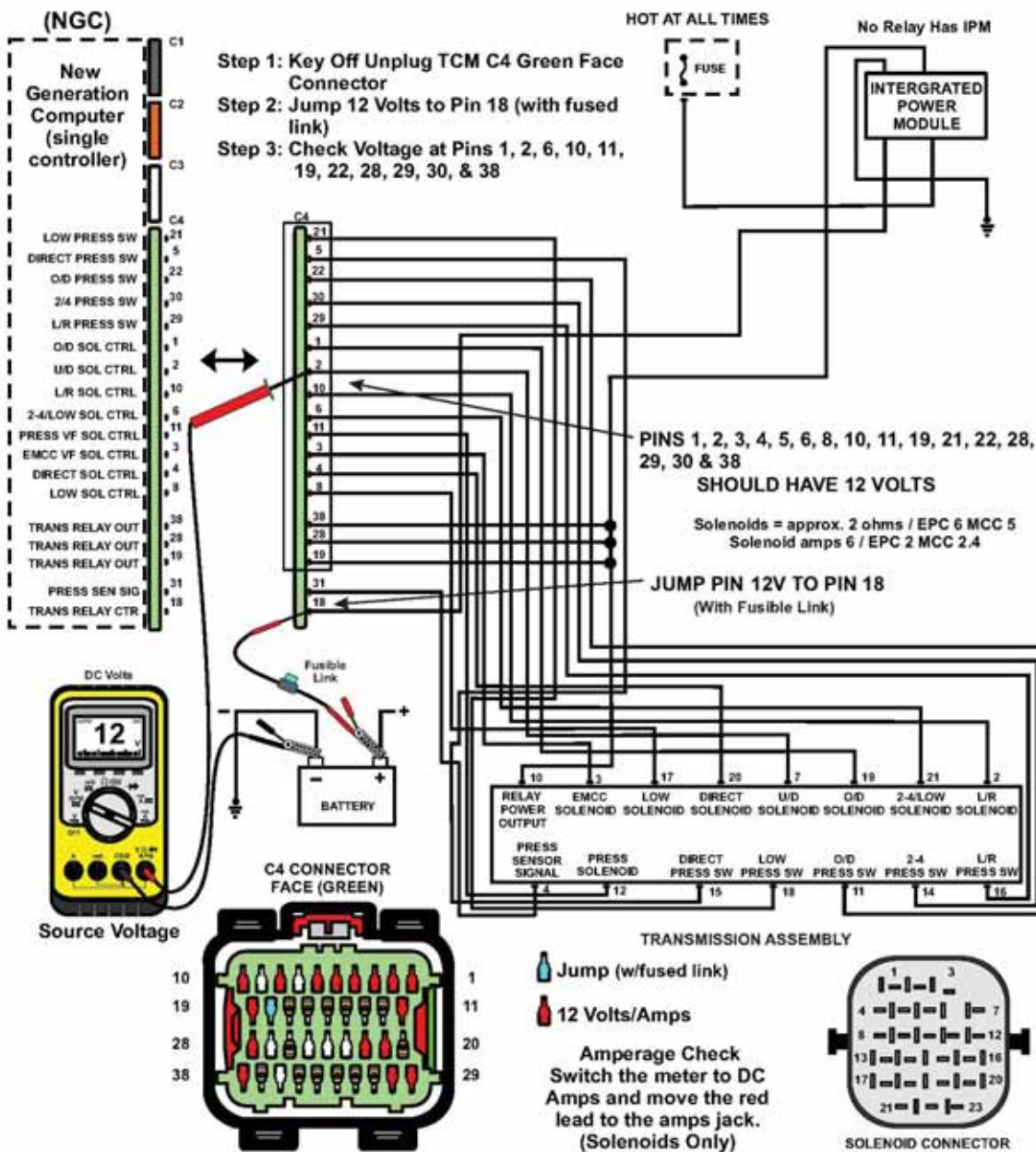
62TE

2007 - Up Solenoid and Switch Circuit Test with the NGC "Disconnected"

KEY OFF
UNPLUG
NGC
CONNECTOR
(GREEN FACE)

62TE Transmission Circuit Test Typical Wire Diagram (2007 & Up)

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)



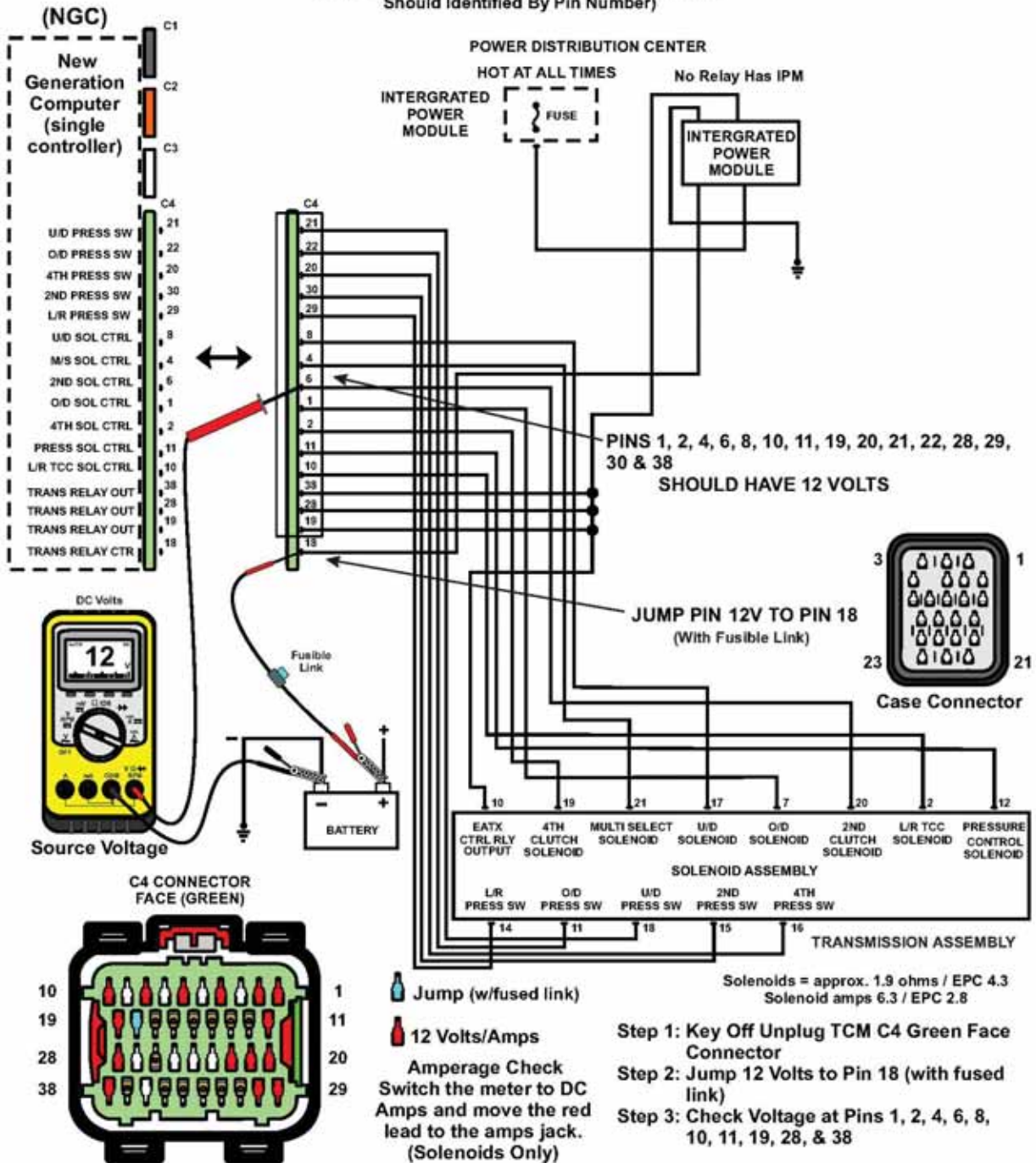
68RFE

2007 - Up Solenoid and Switch Circuit Test with the NGC "Disconnected"

KEY OFF
UNPLUG
NGC
CONNECTOR
(GREEN FACE)

68RFE Transmission Circuit Test Typical Wire Diagram (2007 & Up)

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)



42/44RE

1993 1/2 - 1995 Jeep Solenoid Circuit Test with TCM "Connected"

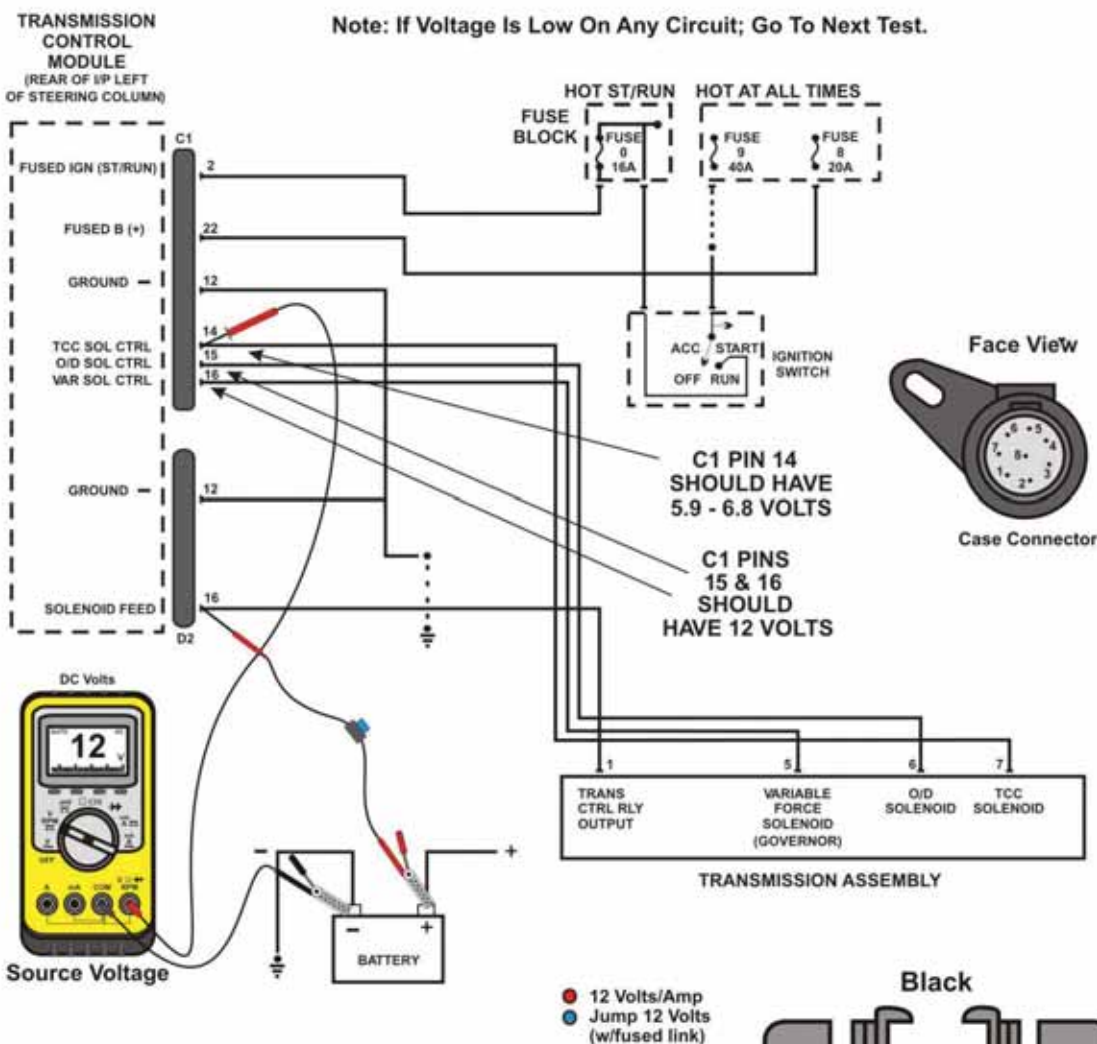
1993 1/2 To 1995 Jeep RE Transmission Circuit Test Typical Wire Diagram

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)

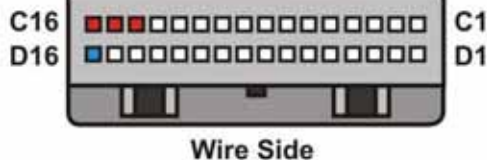
Step 1: Key Off Jump 12 Volts to D2 Connector Pin 16 (with fused link)

Step 2: Check Voltage at Connector C1 Pins 14, 15 & 16
(Pin 14 = 5.9 - 6.8 Volts / Pins 15 & 16 = 12 Volts)

Note: If Voltage Is Low On Any Circuit; Go To Next Test.



The following diagrams are derived from information that has been carefully compiled from industry sources known for their reliability and should be accurate. Always verify the circuits be tested with factory manuals whenever possible.



42/44RE

1993 1/2 - 1995 Jeep Solenoid Circuit Test with TCM “Disconnected”

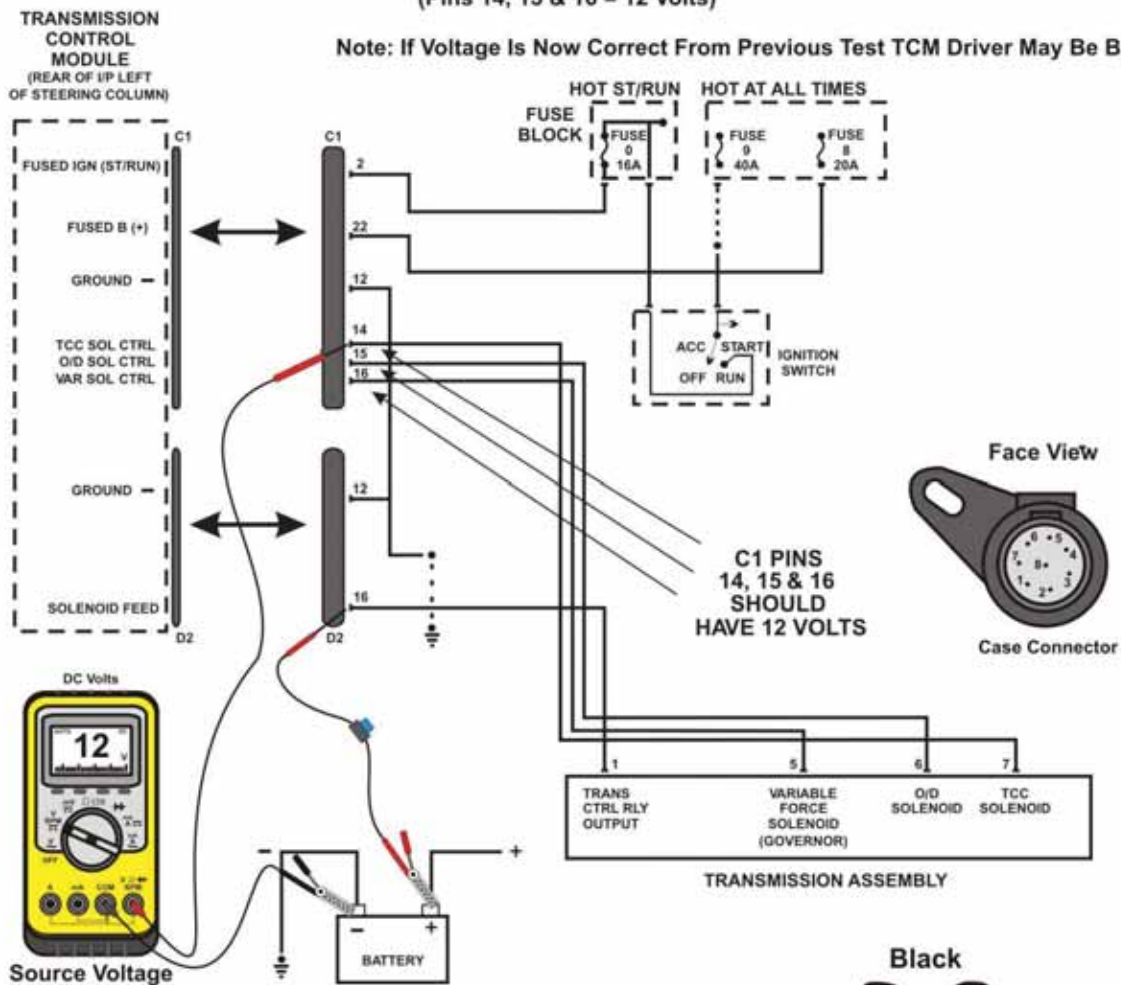
1993 1/2 To 1995 Jeep RE Transmission Circuit Test Typical Wire Diagram

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)

KEY OFF
UNPLUG TCM
CONNECTOR

- Step 1: Key Off Unplug TCM Connector.
Step 2: Jump 12 Volts to D2 Connector Pin 16 (with fused link)
Step 3: Check Voltage at Connector C1 Pins 14, 15 & 16
(Pins 14, 15 & 16 = 12 Volts)

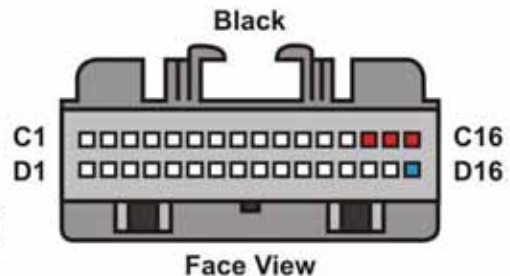
Note: If Voltage Is Now Correct From Previous Test TCM Driver May Be Bad



O/D & TCC Solenoid = 25-40 ohms / 0.48 - 0.30 amps
Governor Solenoid = 3-5 ohms / 4 - 2.4 amps

Amperage Check
Switch the meter to DC Amps and
move the red lead to the amps jack.

- 12 Volts/Amps
- Jump 12 Volts (w/fused link)



Solenoid Circuit Test with Relay “Removed” and PCM “Connected”

Diagram of the back of a 32-pin connector showing the wire side. The connector has two rows of 16 pins each. The top row is labeled 1 to 16, and the bottom row is labeled 17 to 32. The word "WHITE" is at the top, and "Wire Side" is at the bottom.

42-48RE

Solenoid Circuit Test with Relay "Installed" and PCM "Disconnected"

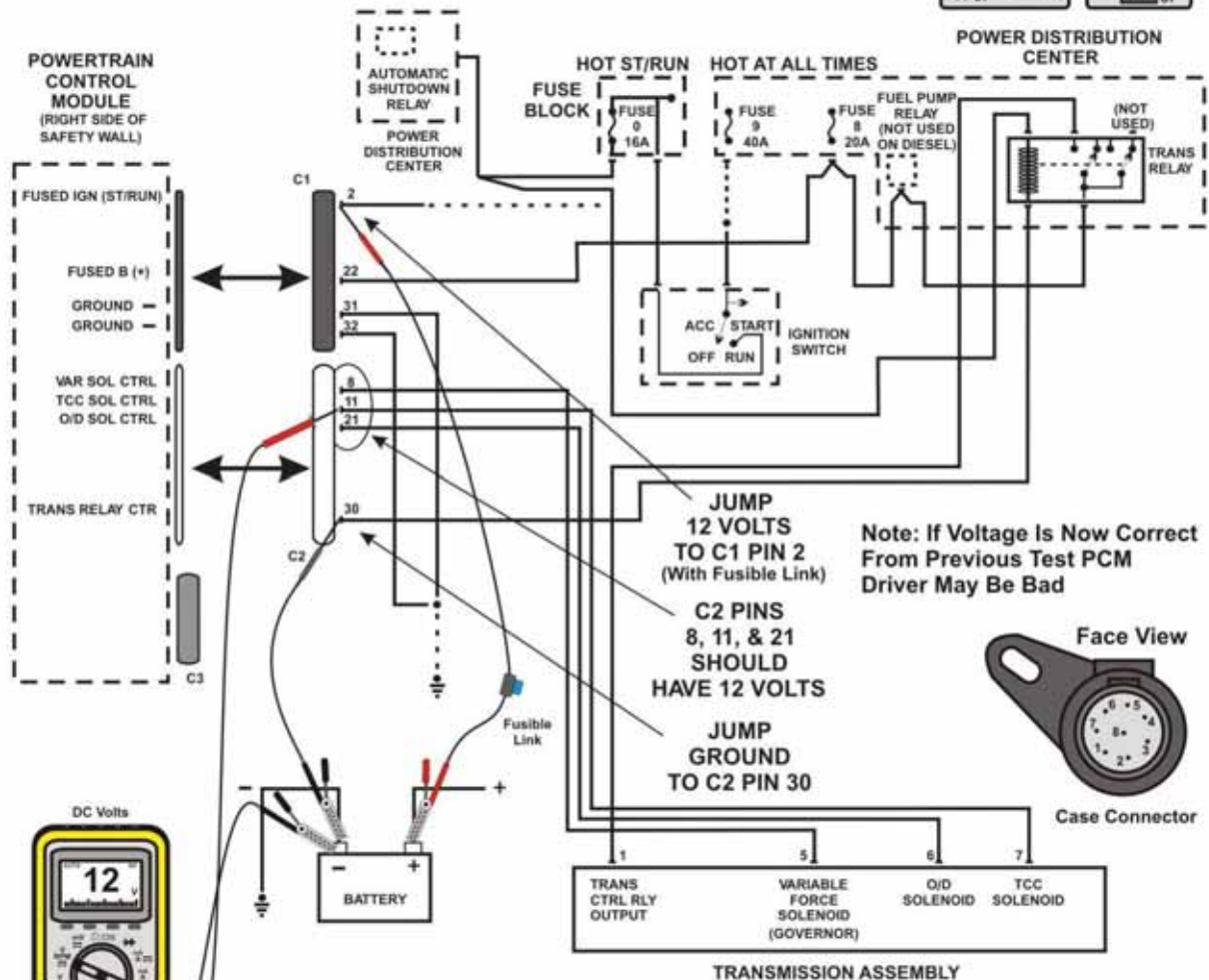
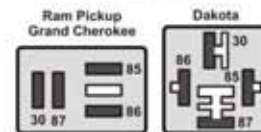
KEY OFF
UNPLUG
PCM
CONNECTOR
C1 & C2

RE Transmission Circuit Test Typical Wire Diagram (Trans Relay Powered by C1 Connector)

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)

30: Battery Power
85: PCM Ground
86: IGN Power
87: Pin 1 Trans

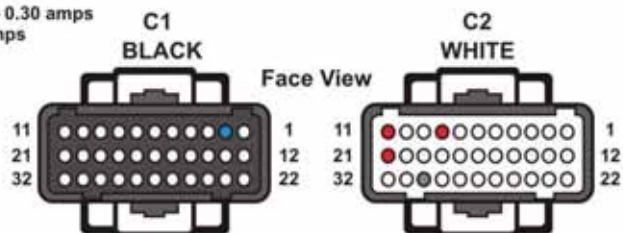
- Step 1: Key Off Unplug PCM Connectors C1 & C2
Step 2: Jump Voltage to Connector C1 Pin 2 (with fused link)
Step 3: Jump Ground to Connector C2 Pin 30
Step 4: Check Voltage at Connector C1 Pins 8, 11 & 21



Source Voltage

Amperage Check
Switch the meter to DC Amps and move the red lead to the amps jack.

- 12 Volts/Amps
- Jump 12 Volts (w/fused link)
- Jump Ground



42-48RE

Solenoid Circuit Test with Relay “Installed” and PCM “Connected”

KEY OFF
UNPLUG
RELAY

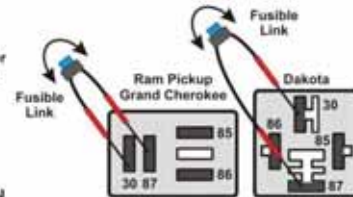
RE Transmission Circuit Test Typical Wire Diagram (Trans Relay Powered by C3 Connector) (Wire Colors May Vary Per Model Year All Circuits Should Identified By Pin Number)

2001 & Up No Relay
May Have IPM

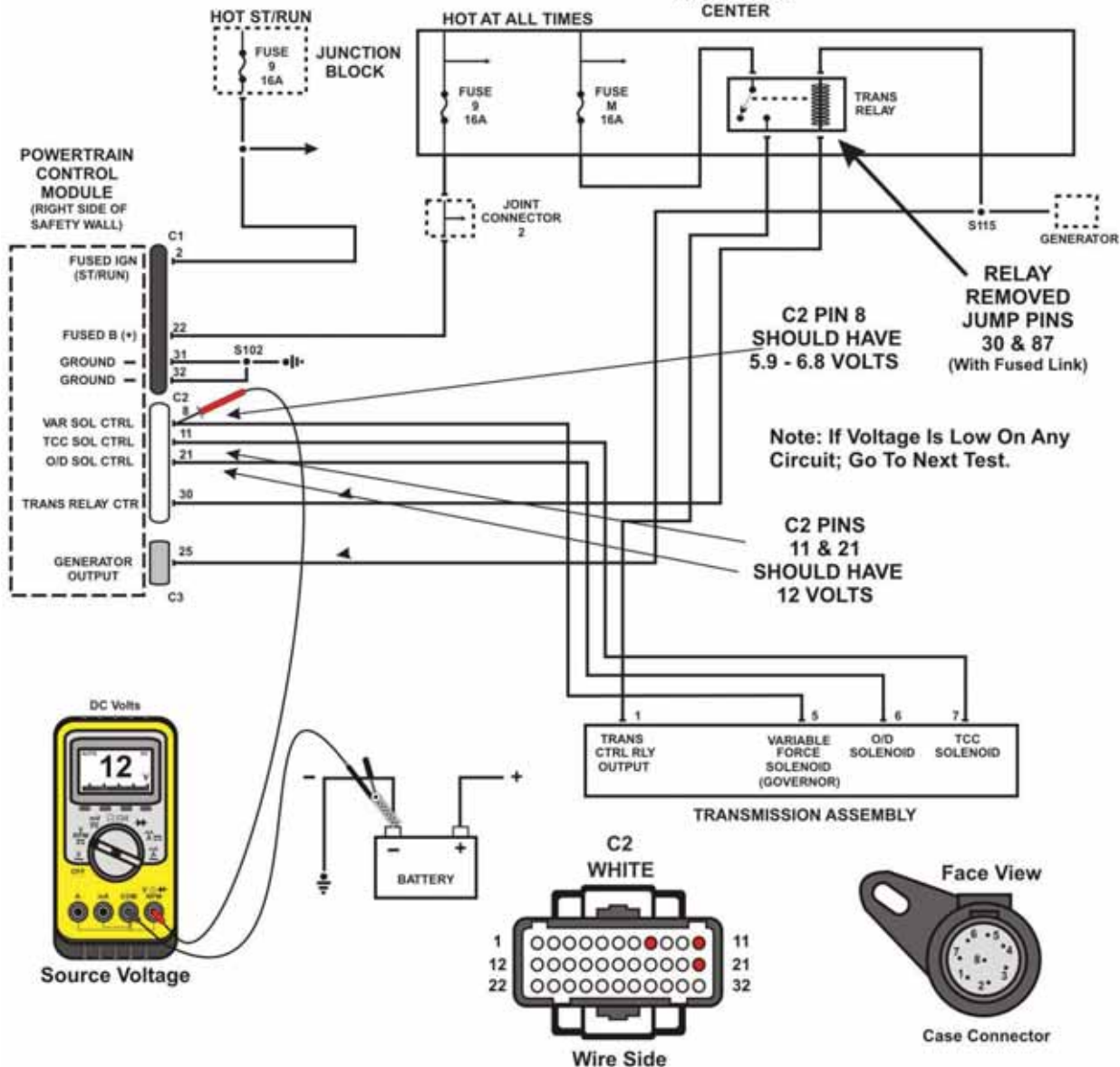
INTERGATED
POWER
MODULE

- Step 1: Key Off Unplug Relay
Step 2: Jump Voltage from Pin 30 to 87 (with fused link)
Step 3: Check Voltage at Connector C2 Pins 8, 11 & 21
(Pin 8 = 5.9 - 6.8 Volts / Pins 11 & 12 = 12 Volts)

30: Battery Power
85: PCM Ground
86: PCM Power
87: Pin 1 Trans



POWER
DISTRIBUTION
CENTER



42-48RE

Solenoid Circuit Test with Relay "Installed" and PCM "Disconnected"

KEY OFF
UNPLUG
PCM
CONNECTOR
C2 & C3

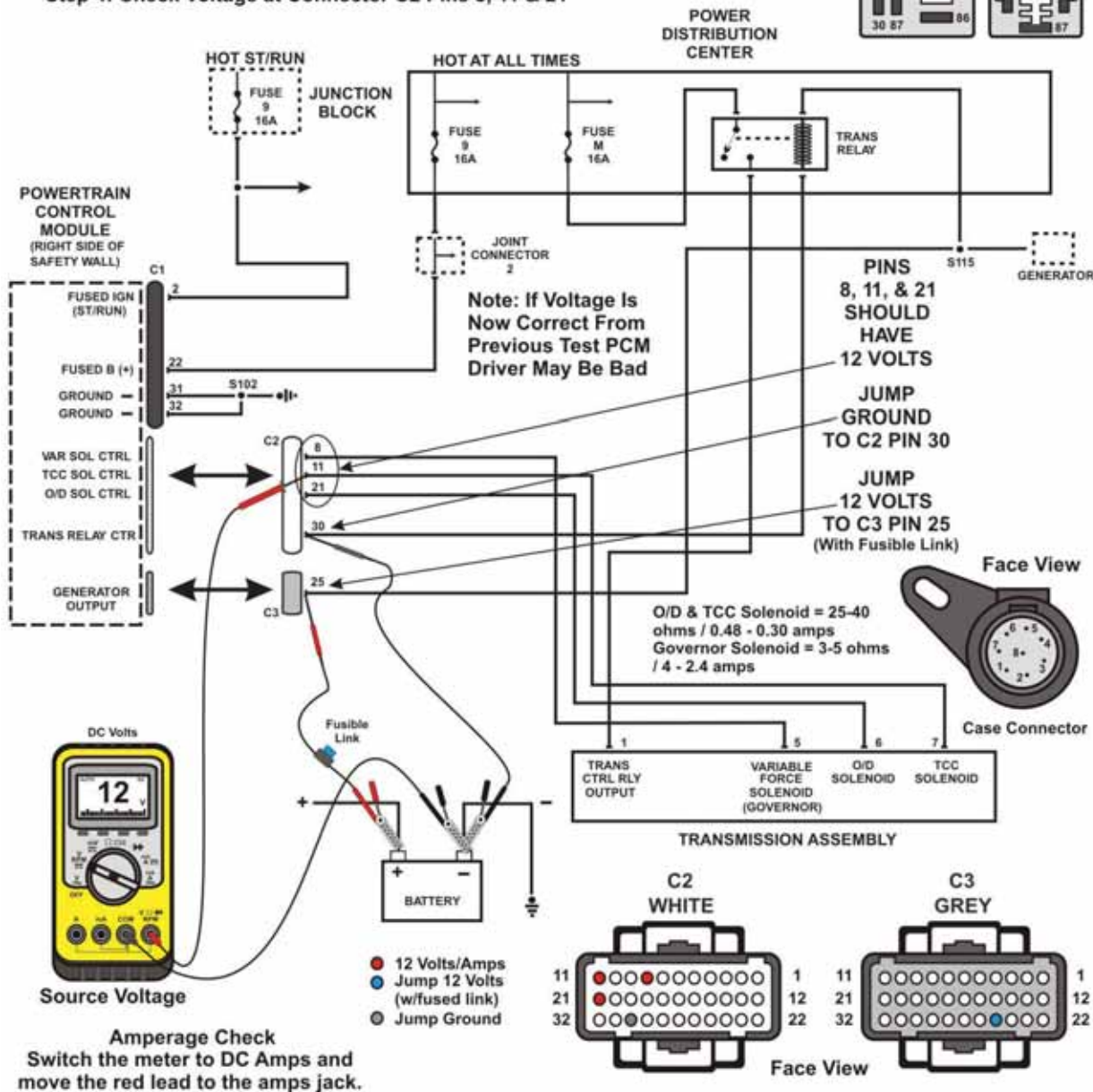
RE Transmission Circuit Test Typical Wire Diagram (Trans Relay Powered by C3 Connector) (Wire Colors May Vary Per Model Year All Circuits Should Identified By Pin Number)

2001 & Up No Relay
May Have IPM

INTERGATED
POWER
MODULE

30: Battery Power
85: PCM Ground
86: PCM Power
87: Pin 1 Trans

- Step 1: Key Off Unplug PCM Connectors C2 & C3
Step 2: Jump Voltage to Connector C3 Pin 25 (with fused link)
Step 3: Jump Ground to Connector C2 Pin 30
Step 4: Check Voltage at Connector C2 Pins 8, 11 & 21



48RE

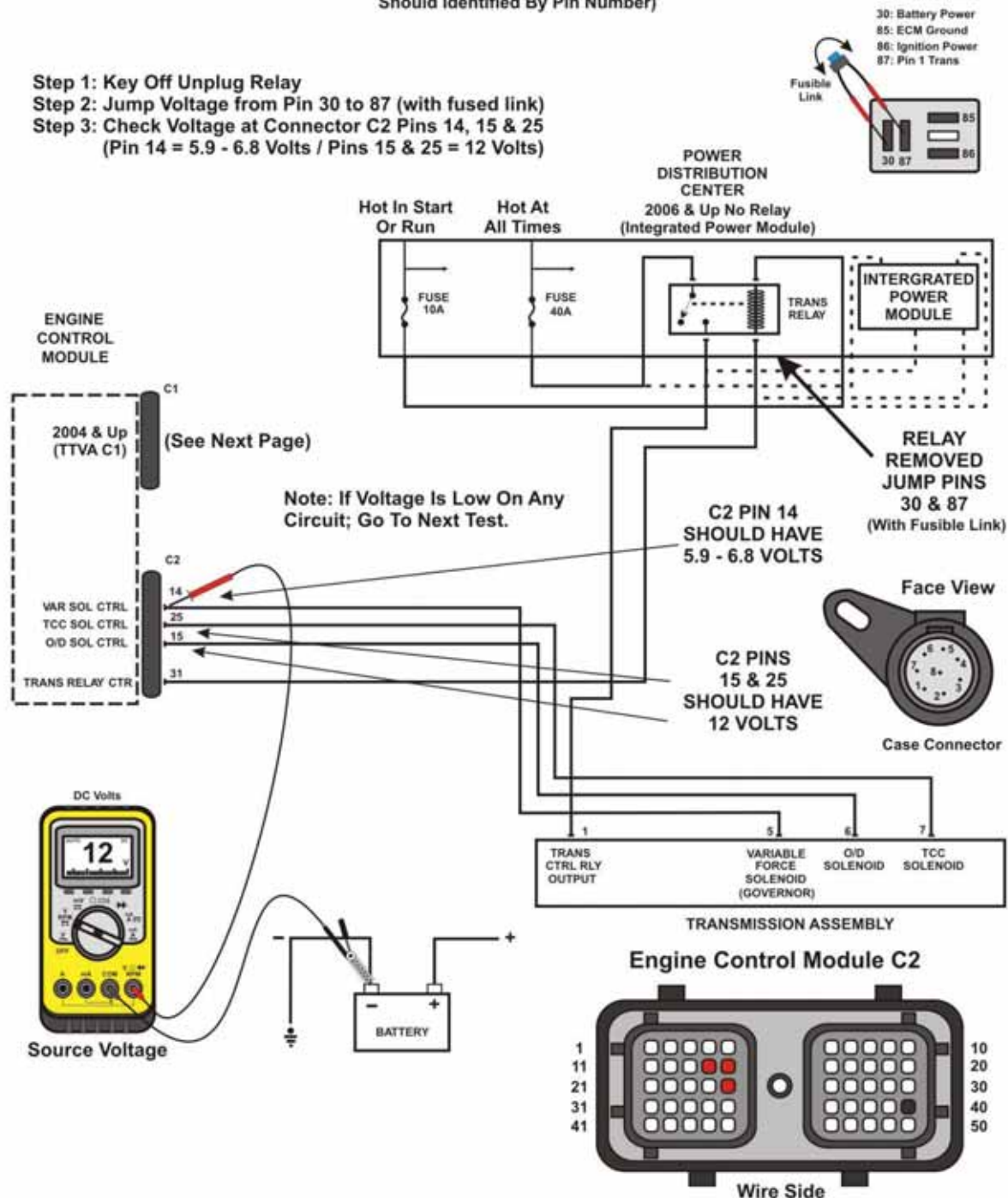
"Diesel Only" Solenoid Circuit Test with Relay "Removed" and ECM "Connected"

KEY OFF
UNPLUG
RELAY

48 RE "Diesel Only" Transmission Circuit Test Typical Wire Diagram 2004 & Up

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)

- Step 1: Key Off Unplug Relay
Step 2: Jump Voltage from Pin 30 to 87 (with fused link)
Step 3: Check Voltage at Connector C2 Pins 14, 15 & 25
(Pin 14 = 5.9 - 6.8 Volts / Pins 15 & 25 = 12 Volts)

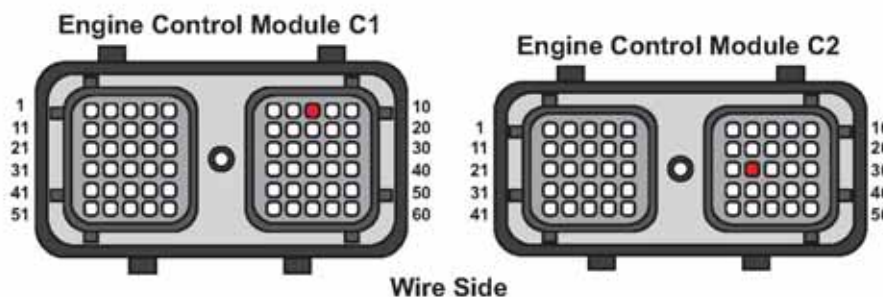
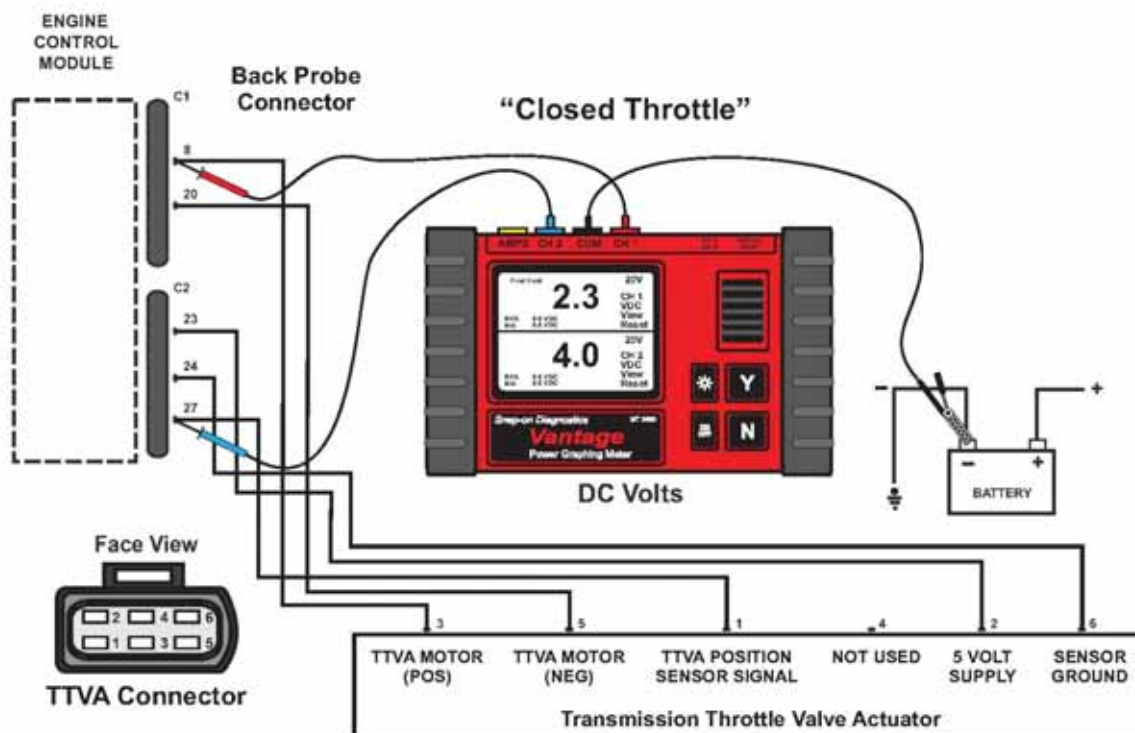


48RE

“Diesel Only” Throttle Valve Actuator Circuit Test ECM “Connected”

After relearn, note TTVA “closed throttle” % on scan data. Closed throttle it needs to be between 2%-22% and increase to above 48% at full throttle. If you do not get this increase, unbolt the TTVA and do the relearn and do the relearn “off the transmission”. Now the percentage at full throttle must go above 51% to assure that the TTVA is good.

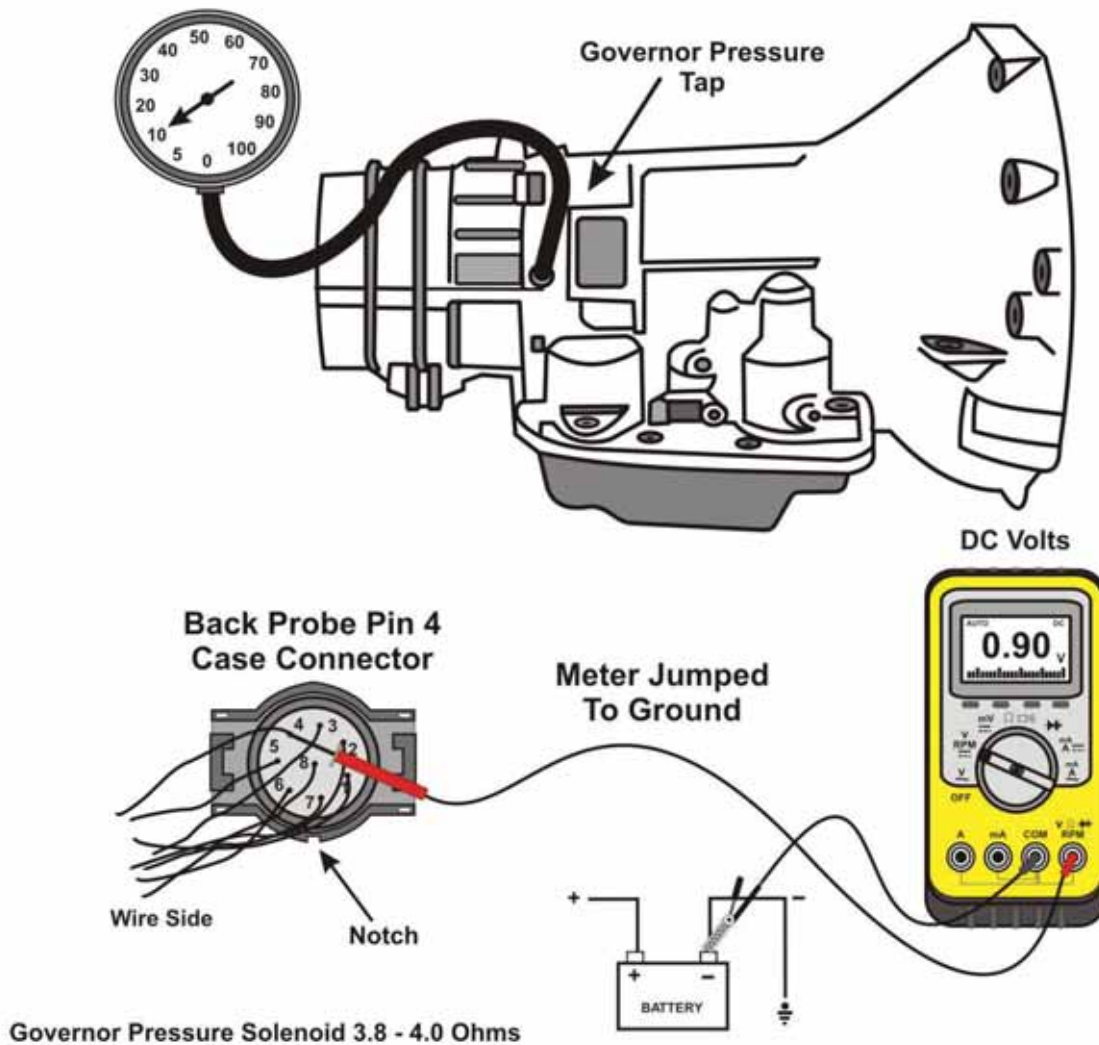
The TTVA Position Sensor Signal is a 5V potentiometer that works similar to a TPS sensor. As the motor sweeps this voltage will change from less than 1 volt to 4.5 volts during the sweep at C2 pin 27. If there is a signal problem here, unplug the TTVA and jump the 5V reference wire “pin 2” to ground wire “pin 6” and with scan data verify that you now get a code for short to ground on 5V circuit. Voltage in ground will affect this signal return voltage.



The ECM Will Re-Calibrate
It's Current "0" Position
When The Ignition Is
Turned On And The
Engine Is Not Running
For 30 Seconds

42-48RE

Governor Pressure Transducer Test



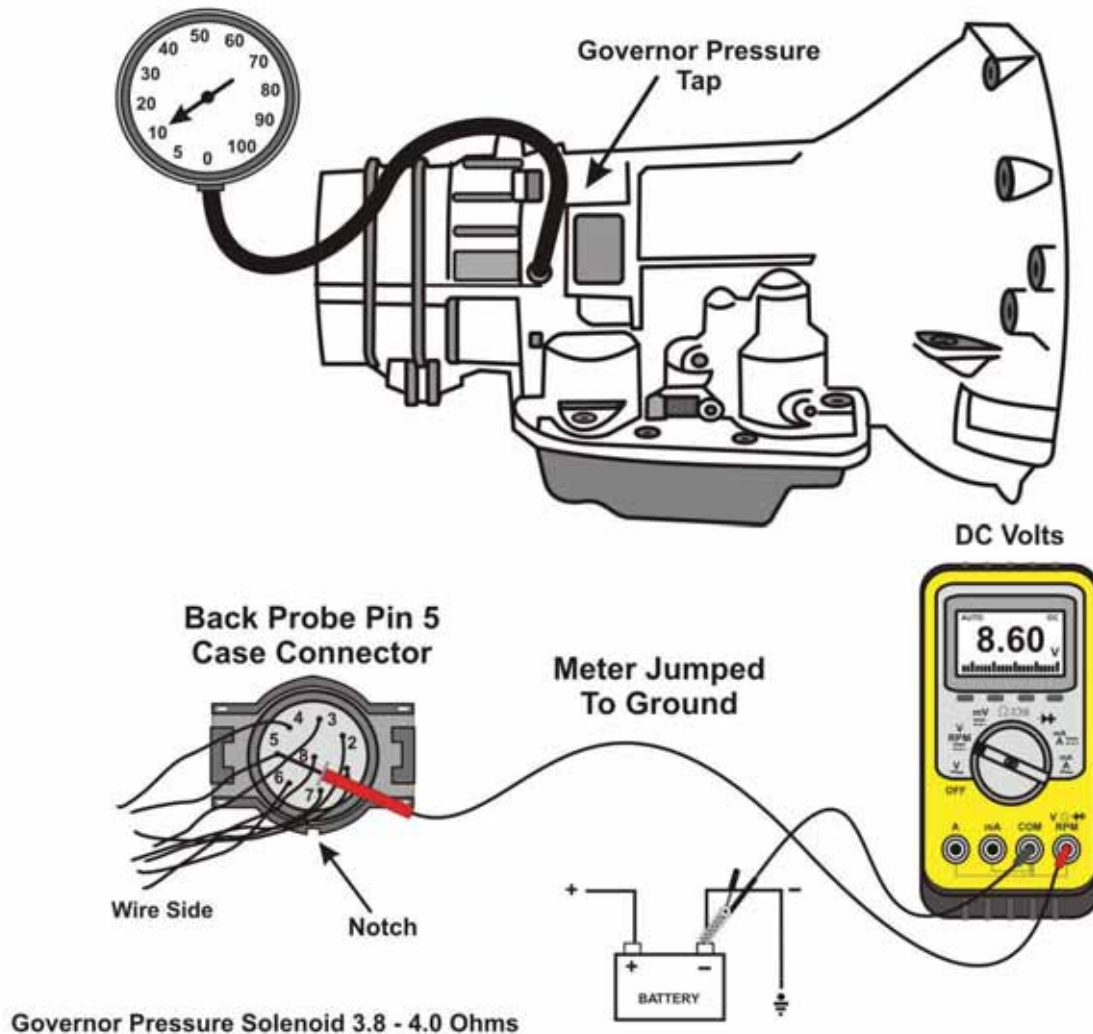
Governor Solenoid	
MPH (SPEEDO)	DC Voltage
0	4.6
15	4.4
20	4.2
25	4.0
30	3.7
35	3.4
40	2.9
45	2.7
50	2.5
55	0

Output Speed Sensor	
Wheels Spinning 1.25v AC - 1.50v AC	
MPH	htz
10	150
20	300
30	450
40	600

Vehicle Speed Sensor	
Wheels Spinning 2.5v	
MPH	DC htz
10	16
20	36
30	46
40	56

42-48RE

Governor Solenoid Voltage Control Test



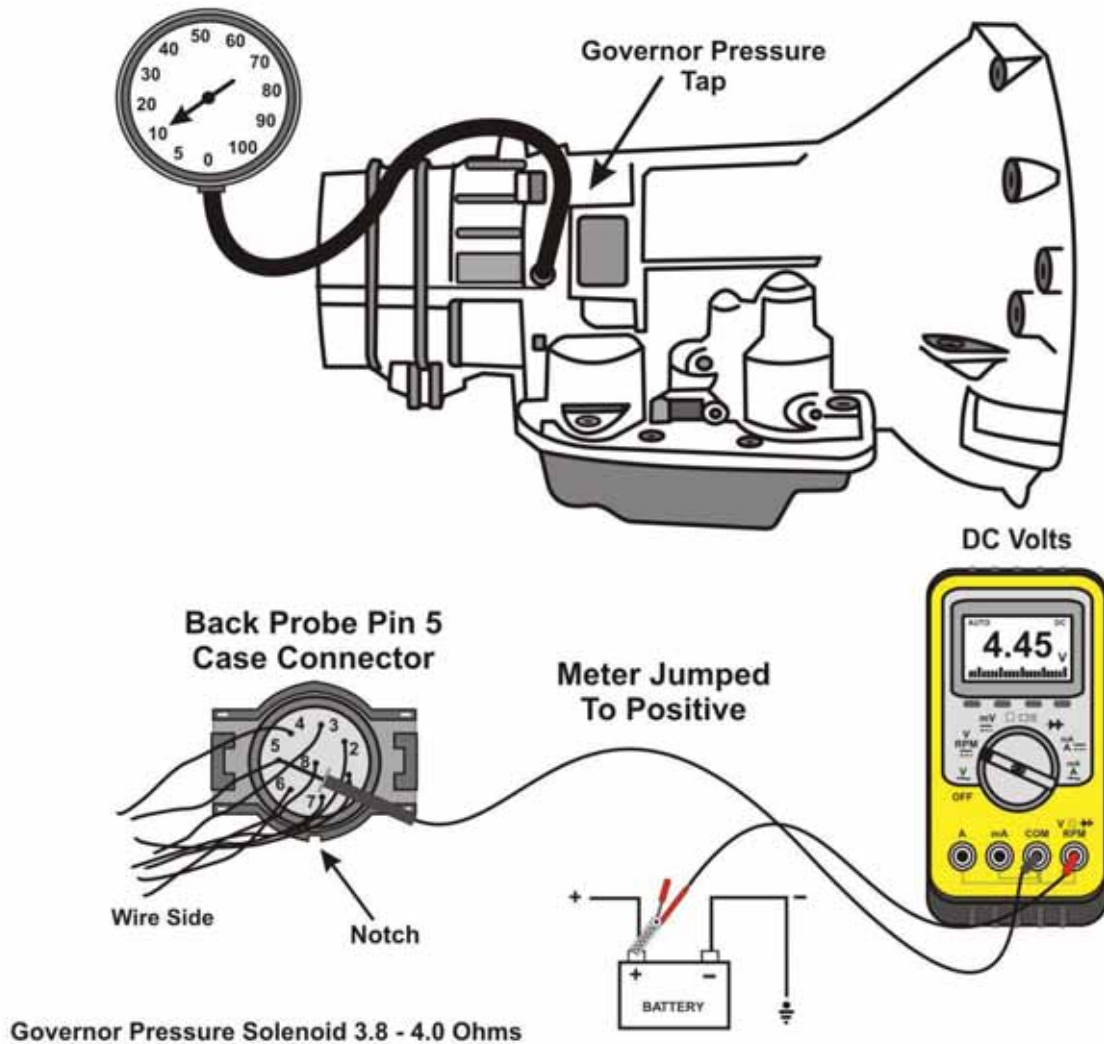
Governor Solenoid	
MPH (SPEEDO)	DC Voltage
0	4.6
15	4.4
20	4.2
25	4.0
30	3.7
35	3.4
40	2.9
45	2.7
50	2.5
55	0

Output Speed Sensor	
Wheels Spinning 1.25v AC - 1.50v AC	
MPH	htz
10	150
20	300
30	450
40	600

Vehicle Speed Sensor	
Wheels Spinning 2.5v	
MPH	DC htz
10	16
20	36
30	46
40	56

42-48RE

Governor Solenoid Load Control Test



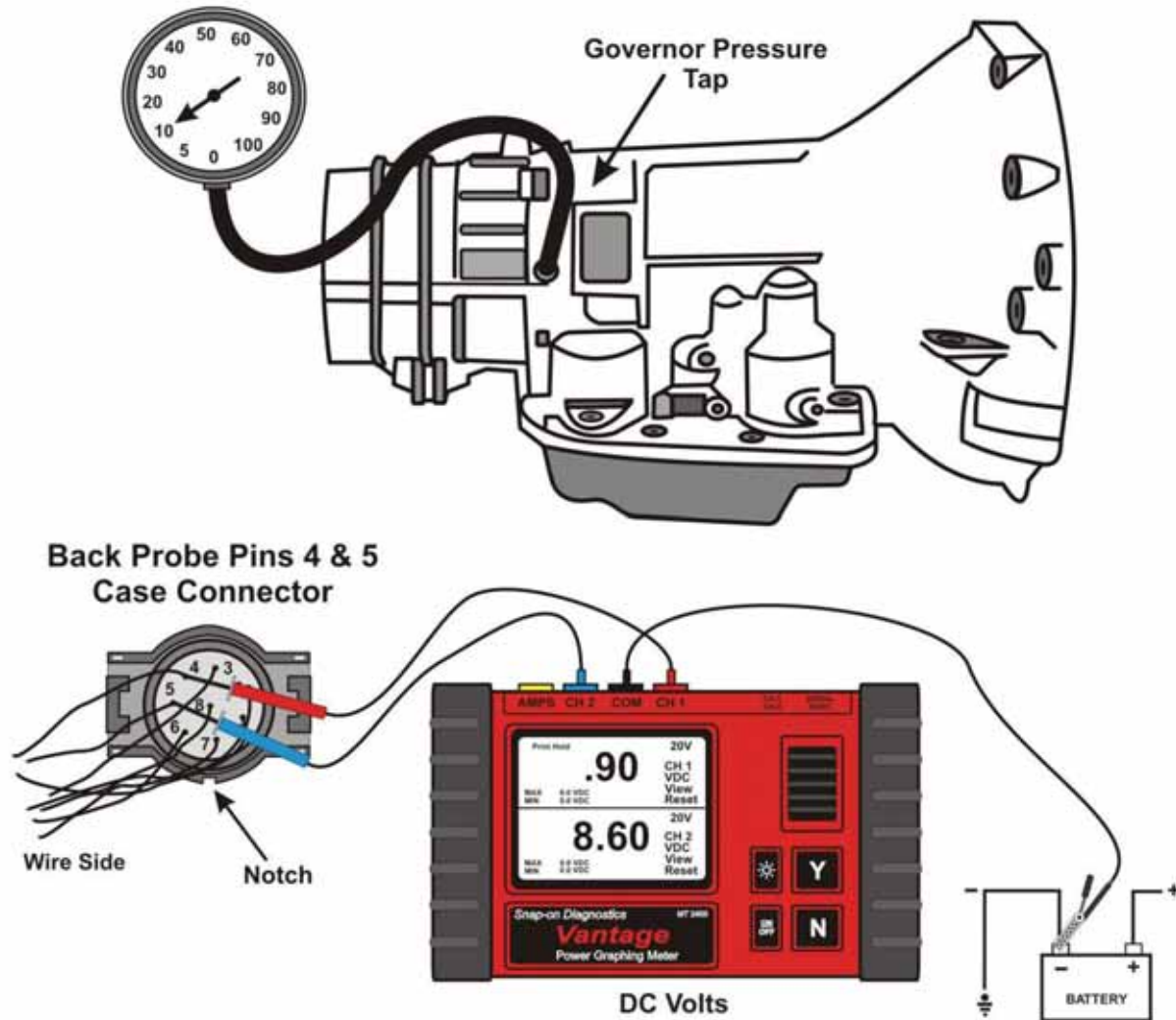
Governor Solenoid	
MPH (SPEEDO)	DC Voltage
0	4.6
15	4.4
20	4.2
25	4.0
30	3.7
35	3.4
40	2.9
45	2.7
50	2.5
55	0

Output Speed Sensor	
Wheels Spinning 1.25v AC - 1.50v AC	
MPH	htz
10	150
20	300
30	450
40	600

Vehicle Speed Sensor	
Wheels Spinning 2.5v	
MPH	DC htz
10	16
20	36
30	46
40	56

42-48RE

Governor Pressure Sensor and Solenoid Tests with Multi-Channel Meter



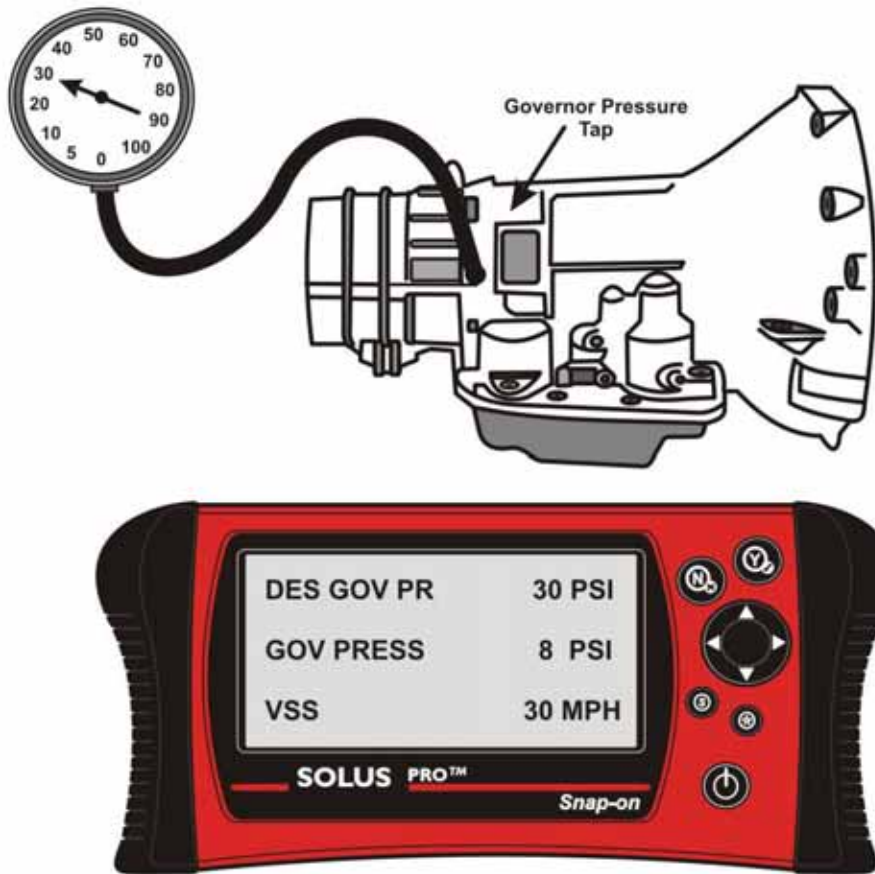
Governor Solenoid	
MPH (SPEEDO)	DC Voltage
0	4.6
15	4.4
20	4.2
25	4.0
30	3.7
35	3.4
40	2.9
45	2.7
50	2.5
55	0

Output Speed Sensor	
Wheels Spinning 1.25v AC - 1.50v AC	
MPH	htz
10	150
20	300
30	450
40	600

Vehicle Speed Sensor	
Wheels Spinning 2.5v	
MPH	DC htz
10	16
20	36
30	46
40	56

42-48RE

Monitoring Governor Pressure Sensor and Solenoid with Scan Tool



Governor Solenoid	
MPH (SPEEDO)	DC Voltage
0	4.6
15	4.4
20	4.2
25	4.0
30	3.7
35	3.4
40	2.9
45	2.7
50	2.5
55	0

Output Speed Sensor	
Wheels Spinning 1.25v AC - 1.50v AC	
MPH	htz
10	150
20	300
30	450
40	600

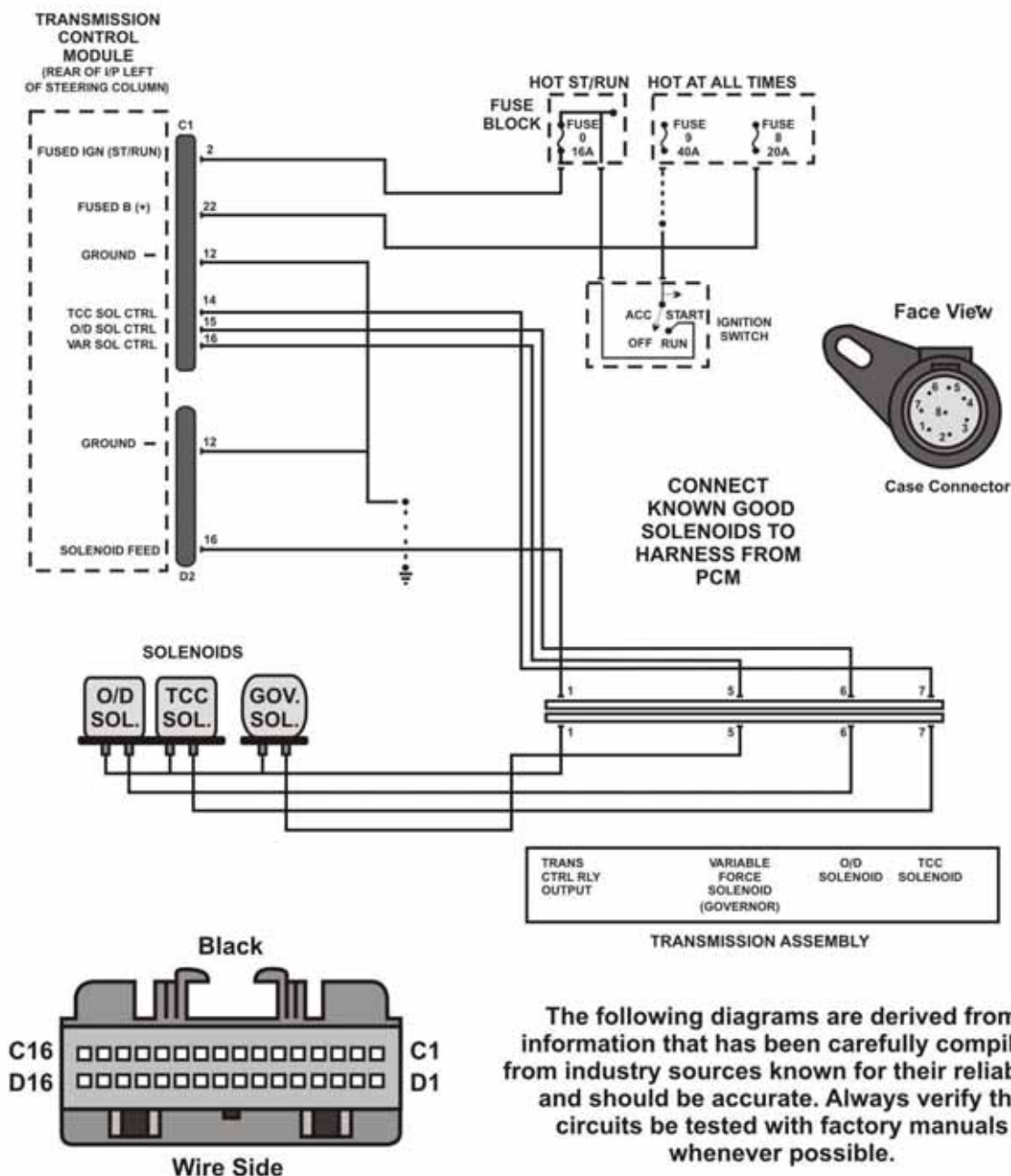
Vehicle Speed Sensor	
Wheels Spinning 2.5v	
MPH	DC htz
10	16
20	36
30	46
40	56

42/44RE

1993 1/2 - 1995 Jeep Wiring Diagram

1993 1/2 To 1995 Jeep RE Transmission Circuit Test Typical Wire Diagram

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)



The following diagrams are derived from information that has been carefully compiled from industry sources known for their reliability and should be accurate. Always verify the circuits be tested with factory manuals whenever possible.

42-48RE

1996 - On With PCM Wiring Diagram

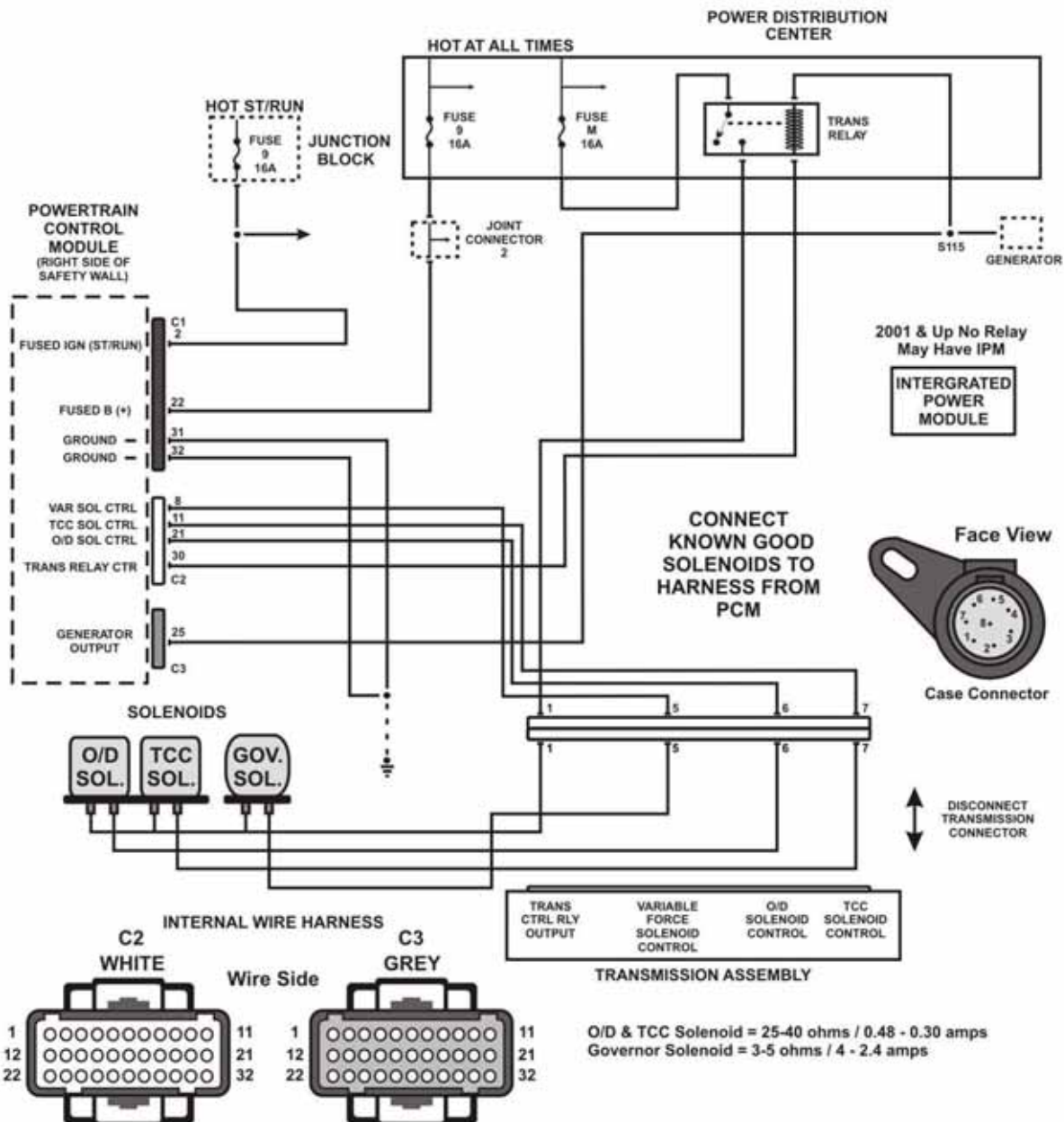
KEY ON ENGINE
OFF/OR RUNNING
(SYSTEM DEPENDANT)

RE Transmission Circuit Test Typical Wire Diagram (Trans Relay Powered by C3 Connector)

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)

QUICK TEST FOR ONE SOLENOID
CODE SET & RELAY CHECKS OK

30: Battery Power
85: PCM Ground
86: PCM Power
87: Pin 1 Trans



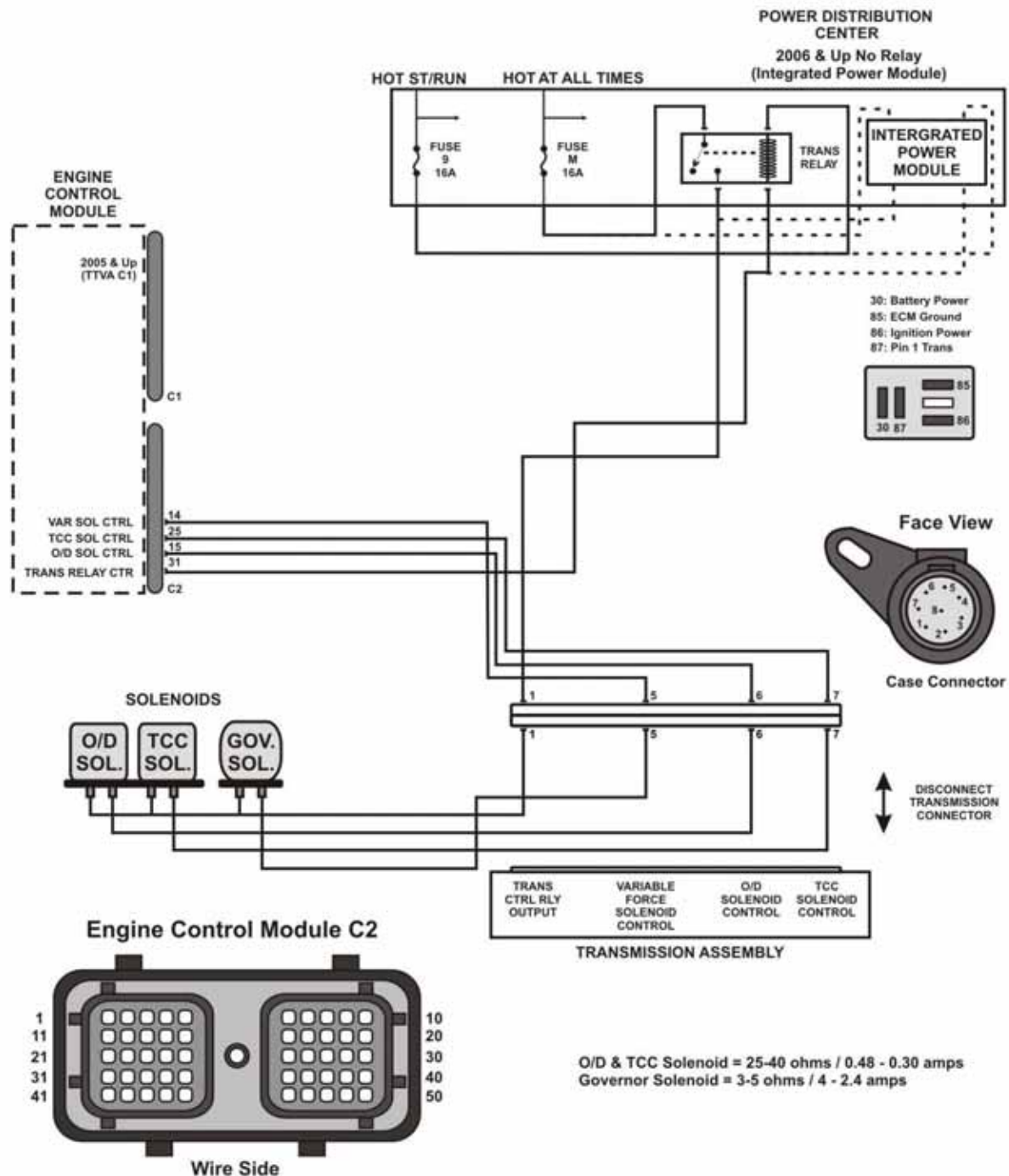
48RE

Diesel Only Wiring Diagram

48 RE "Diesel Only" Transmission Circuit Test Typical Wire Diagram 2004 & Up

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)

KEY ON ENGINE
OFF/OR RUNNING
(SYSTEM DEPENDANT)



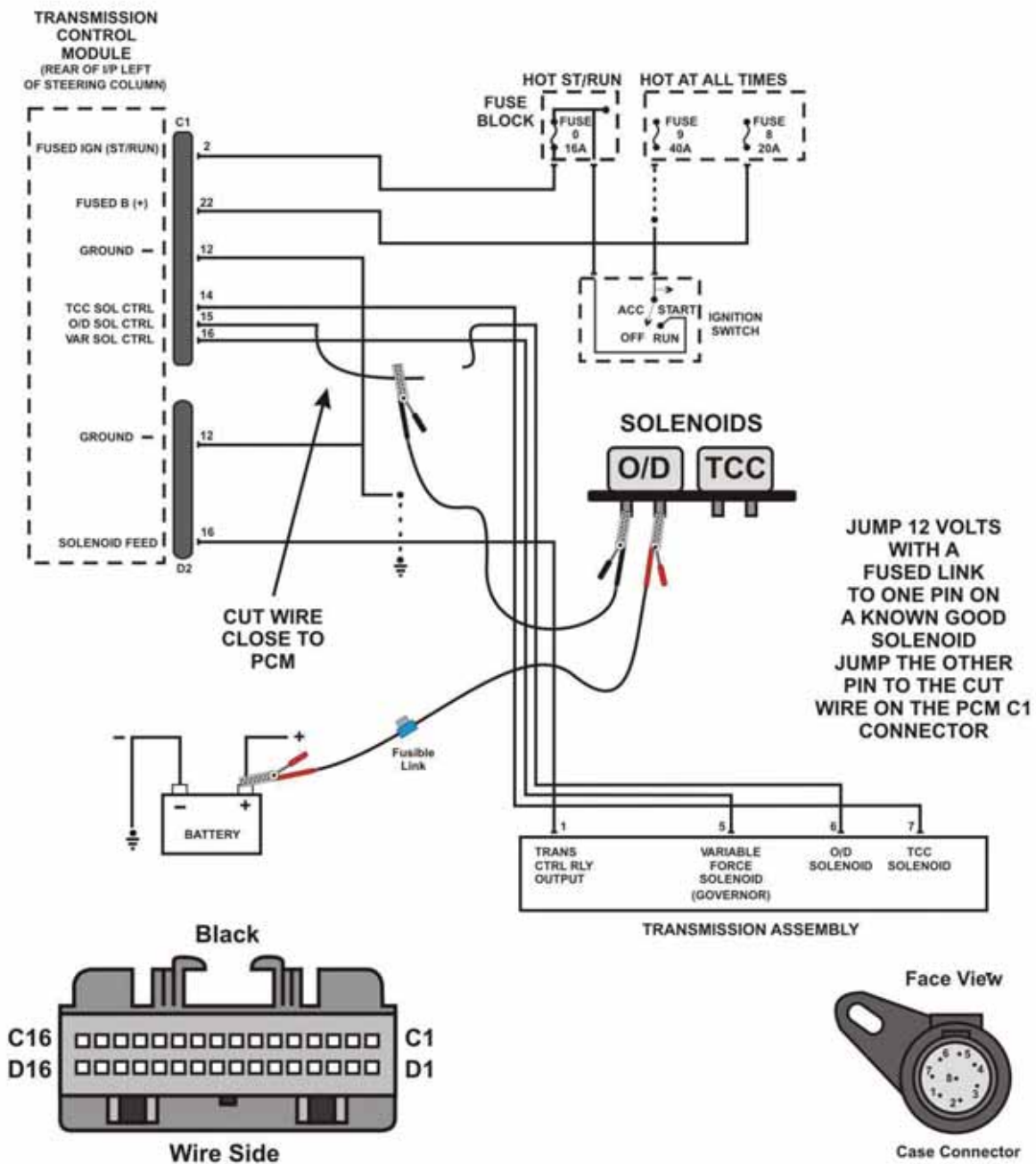
O/D & TCC Solenoid = 25-40 ohms / 0.48 - 0.30 amps
Governor Solenoid = 3-5 ohms / 4 - 2.4 amps

42/44RE

1993 1/2 - 1995 Jeep Quick Tests

1993 1/2 To 1995 Jeep RE Transmission Circuit Test Typical Wire Diagram

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)



42-48RE

1996 - On With PCM Quick Tests with Solenoids (continued)

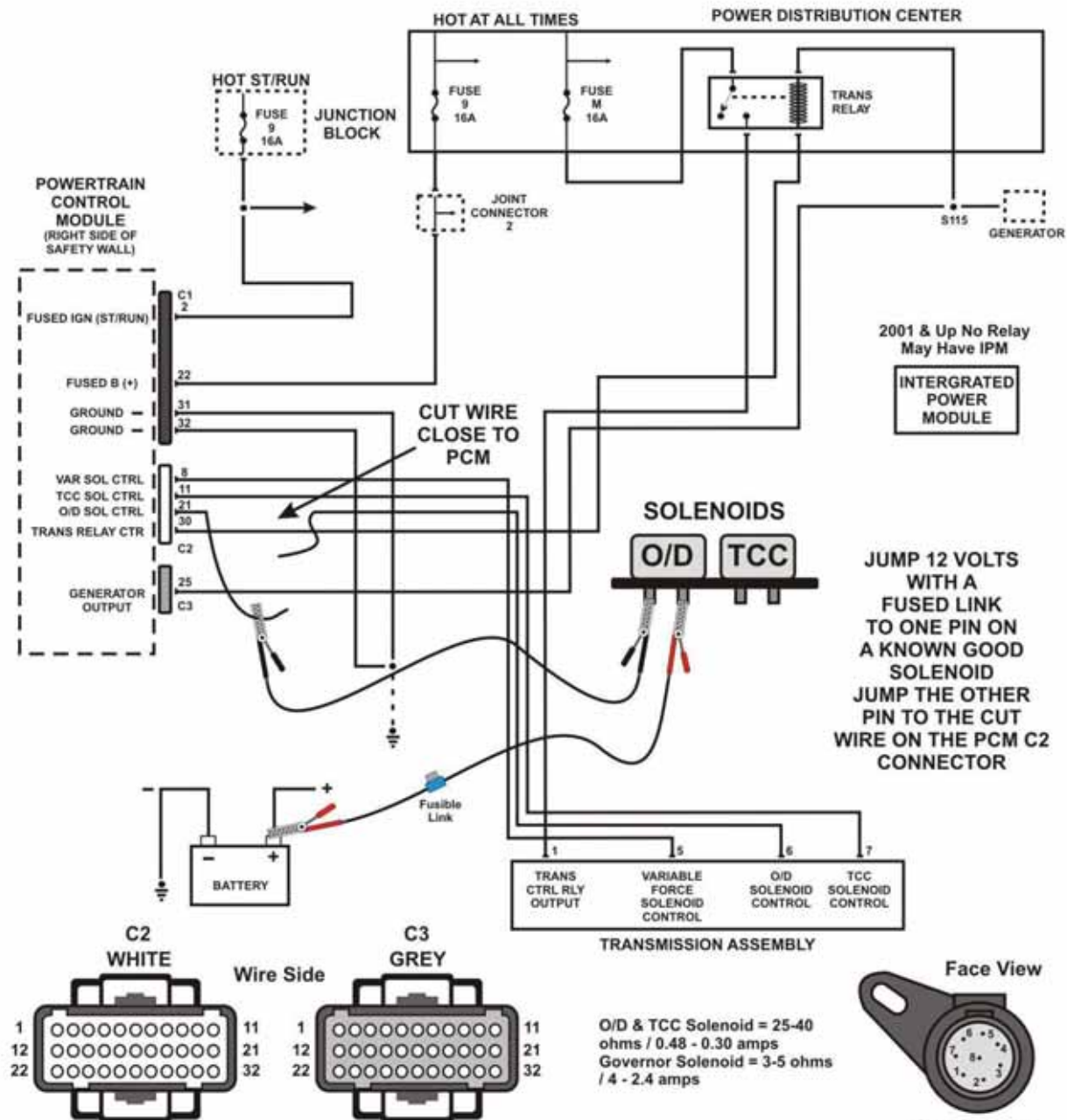
KEY ON ENGINE
OFF/OR RUNNING
(SYSTEM DEPENDANT)

RE Transmission Circuit Test Typical Wire Diagram (Trans Relay Powered by C3 Connector)

(Wire Colors May Vary Per Model Year All Circuits
Should Identified By Pin Number)

QUICK TEST FOR ONE SOLENOID
CODE SET & RELAY CHECKS OK

30: Battery Power
85: PCM Ground
86: PCM Power
87: Pin 1 Trans

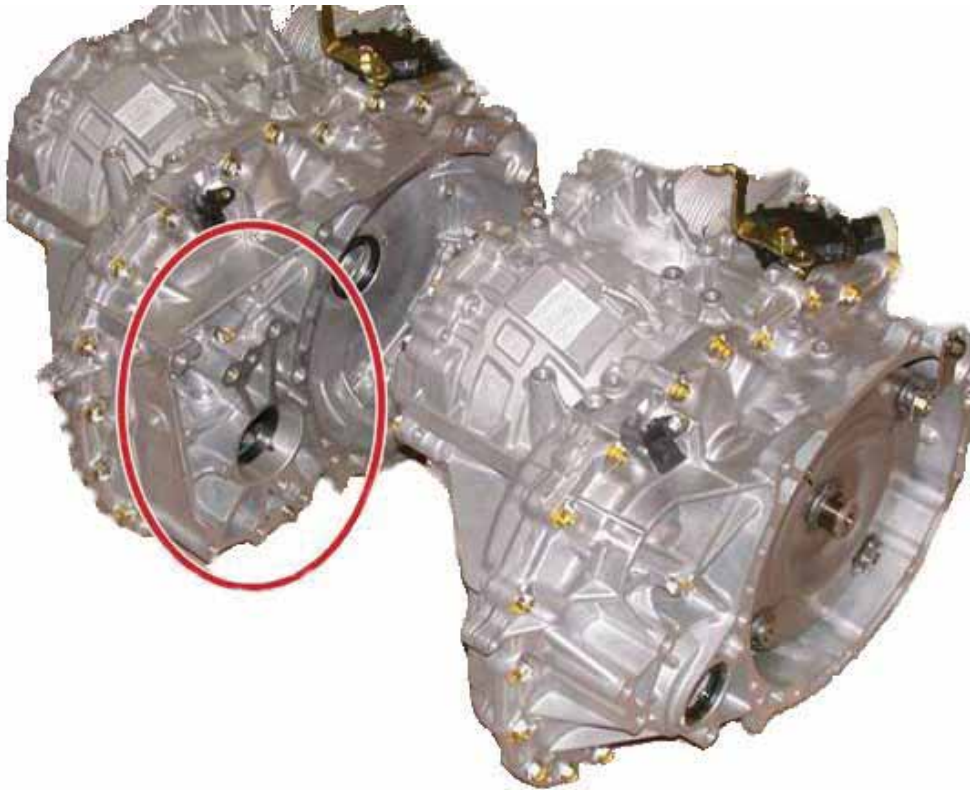


CVT2

Introduction

The Chrysler CVT belt is used to “PUSH” the driven pulley driving the final drive/output. The position of the pulleys is monitored and controlled with the use of a valvebody and solenoids and pressure sensors.

The Chrysler CVT uses a lock up torque converter that during idle and acceleration from a stop, multiplies torque through about 12 mph and then fully locks up driving the input to the pulleys. This design allows optimal driving force in response to the accelerator pedal operation. This torque converter is called a “squished design” as it is pancaked in design.



Transaxle Version	Application
CVT2 (2.0/2.4L FWD)	Dodge Caliber
CVT2 (2.4L FWD)	Jeep Compass, Jeep Patriot
CVT2A (2.4L AWD)	Dodge Caliber, Jeep Compass, Jeep Patriot
CVT2L (2.4L 4x4)	Jeep Patriot

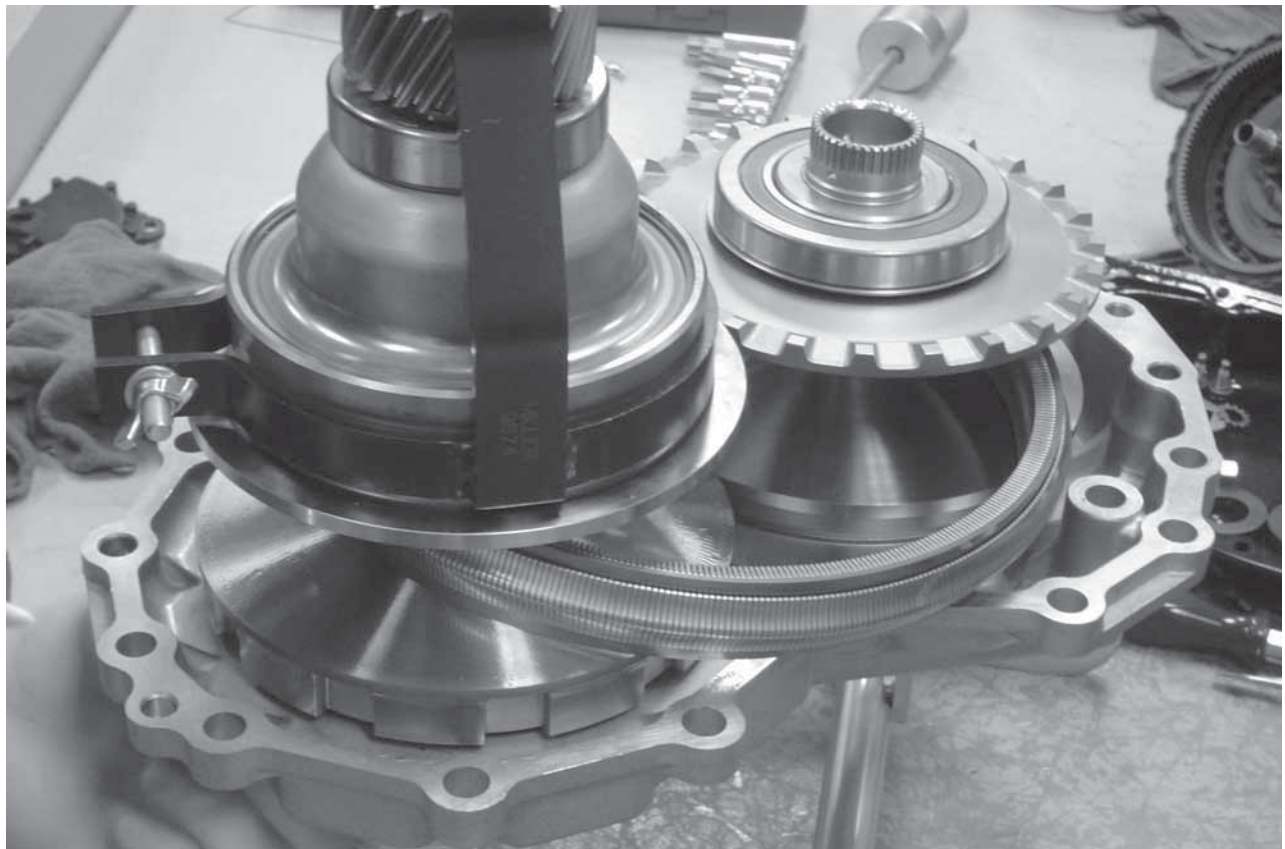
CVT2

Variator System

The heart of the CVT is the variator system (belt and pulley systems). It consists of a pair of pulleys (primary and secondary) with variable operating diameters and a steel “push belt”. The system relies on friction and pressure to transmit torque between the pulleys.

Pulleys

Each pulley set consists of two sheaves, one fixed and one floating. A fluid chamber and piston are part of the floating sheaves. The chamber operates the sheaves on their axis by way of balls and splines when hydraulic pressure is applied



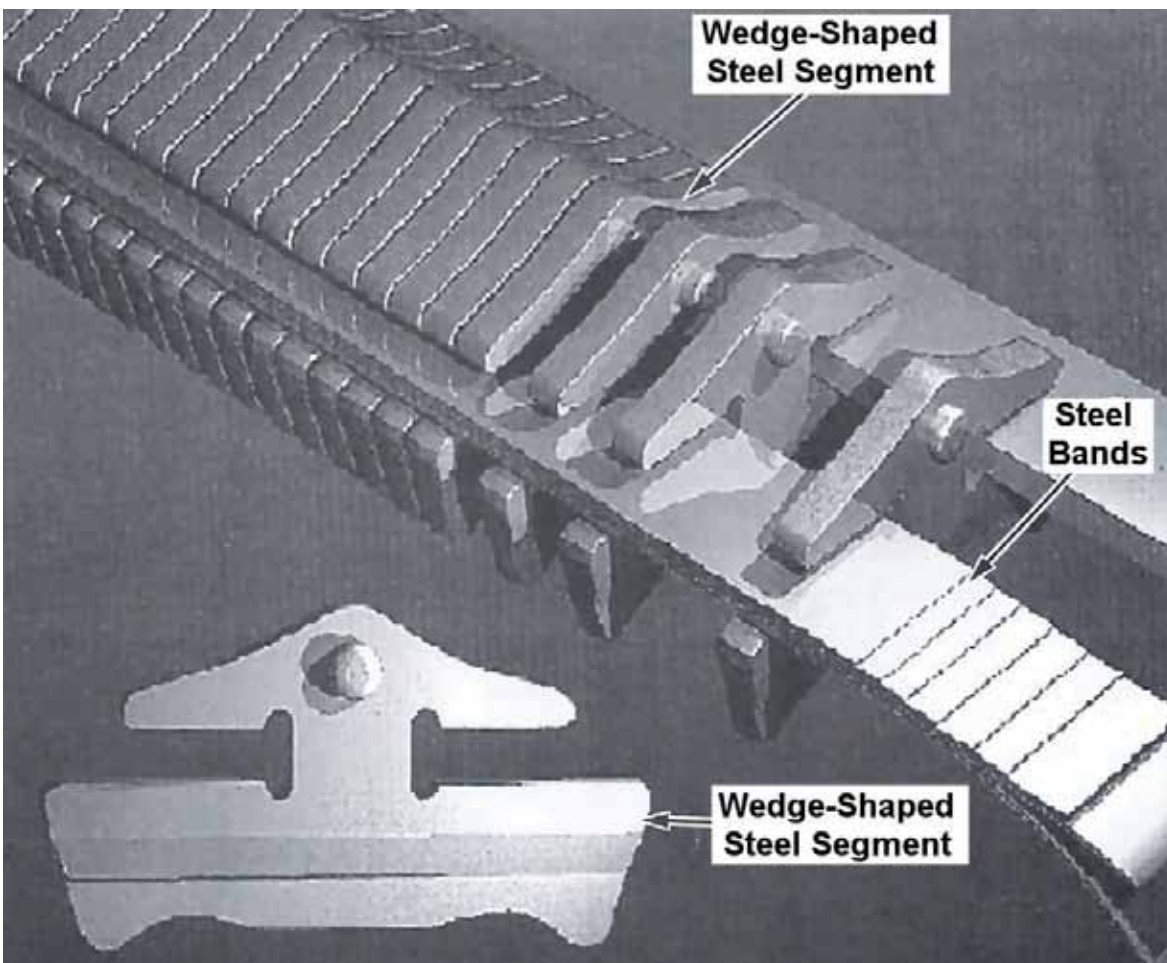
CVT2

Variator System (continued)

The push-belt consists of two sets of metal bands and approximately 400 wedge-shaped steel segments. The belt is considered a “push-belt” because the compressed segments act as a solid column, transferring torque from the primary to the secondary pulley.

Thin steel bands form the main structure of the belt. The bands consist of 12 steel layers, fitted closely together, one set on each side. The bands and segments have an equal role in transferring torque between the pulleys

Edges of the belt are serrated, this aids in torque transfer. Commonly known as “peaks and valleys”.



CVT2

Fluid Specifications

The CVT does use a special blend of fluid. It is IMPORTANT not to mix blends and when topping off.

Fluid:
Mopar CVTF+4 Fluid

Fluid and Filter Change: 7.0L (14.8 pts.)

Overhaul with Converter: 8.1L (17.1 pts.)



CVT2

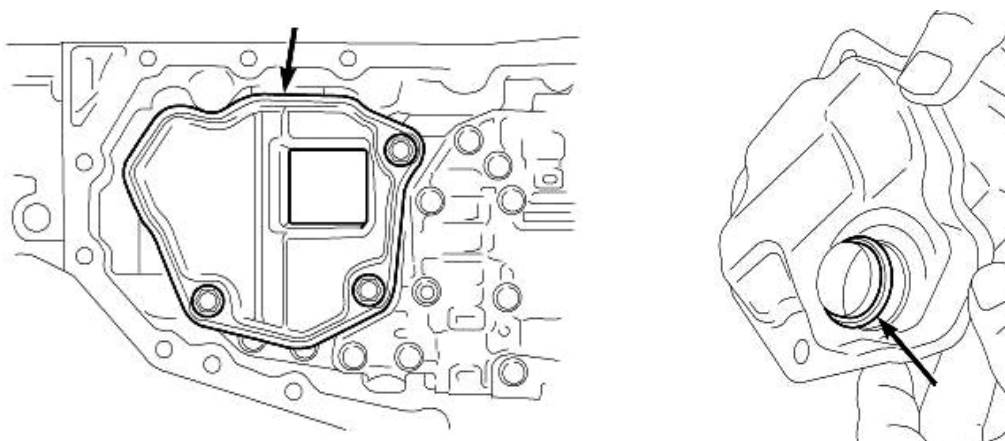
Service Specifications

The CVT does use a special blend of fluid. It is **IMPORTANT** not to mix blends when topping off. If improper fluid is used, belt damage will occur. Follow the check procedure to assure the level is set properly to prevent foaming of the oil. Both under fill and over fill will cause foaming.

Part Numbers:

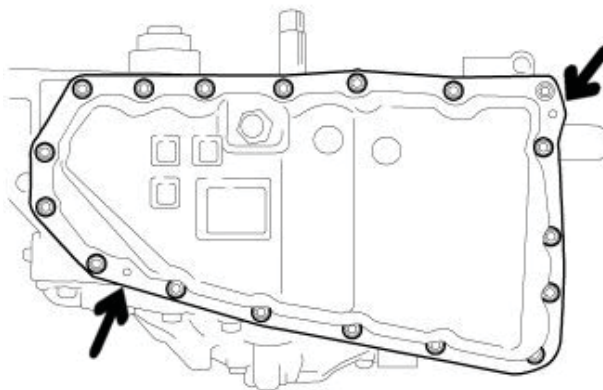
Pan Gasket: 5189838AA

Oil Strainer: 5191890AA



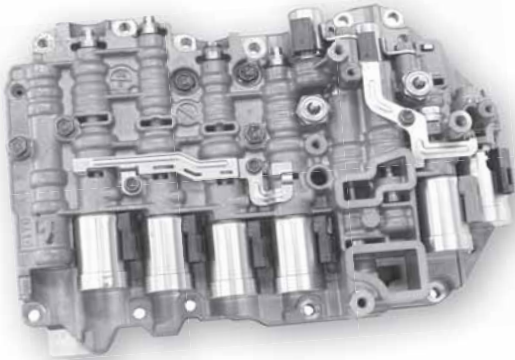
Note: There are two alignment pins in the case to assure pan and gasket line up correctly!

Pan bolts and Filter bolts
torque:
8 Nm (70 in.lbs.)



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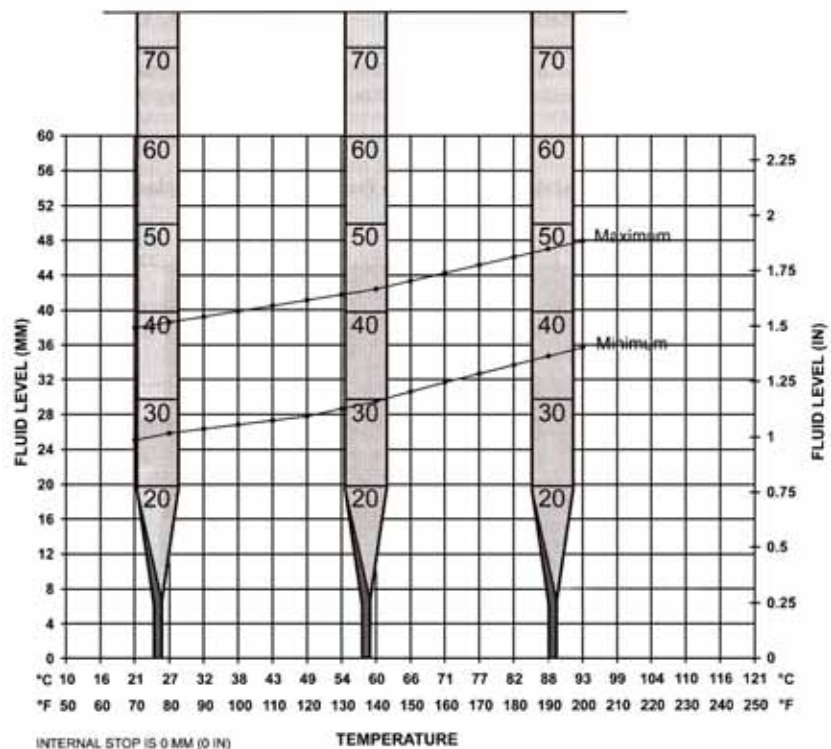
CVT2

Fluid Level Specifications

Checking the oil level requires Miller Tool 9336A. There is no dipstick on this unit. Fluid temperature must be monitored while testing oil level (use of scan tool).

1. Verify that the vehicle is parked on level ground.
2. Remove the dipstick cap.
3. Secure parking brake and let idle with selector in P position.
4. Shift through modes keeping vehicle stationary and engine idling.
5. With transmission warm, wait 2 or more minutes and check the oil level with engine running.

Note: The dipstick has indicator marks every 10mm starting from the tip. The dipstick “WILL” protrude from the fill tube when installed!

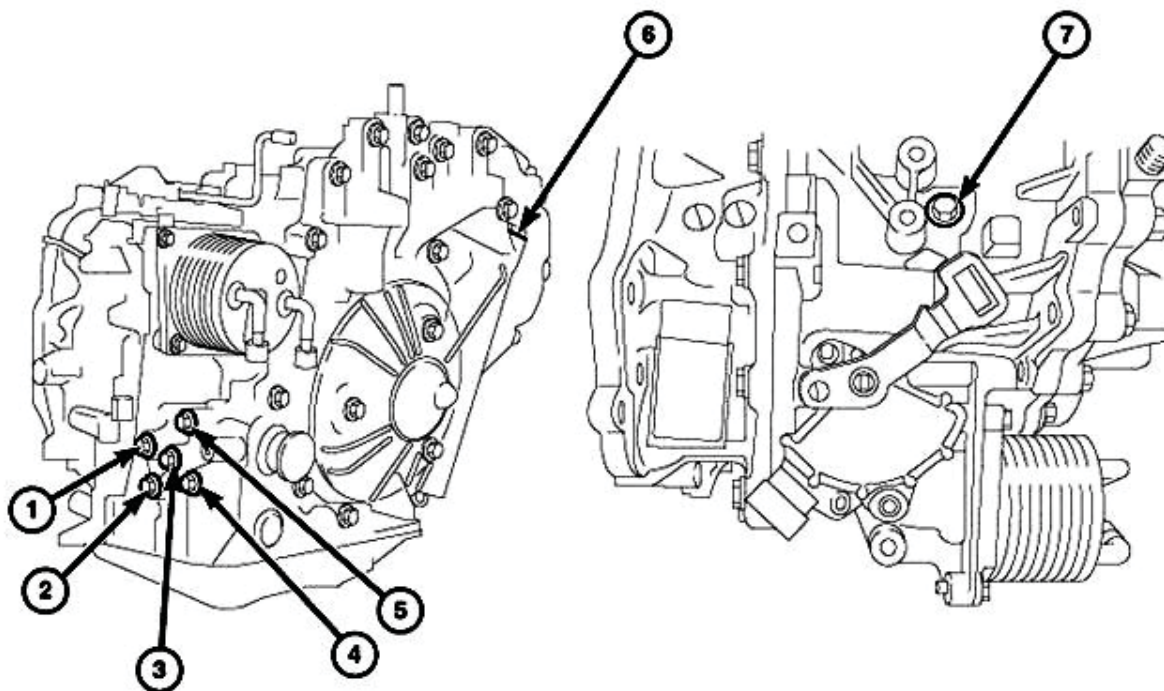


CVT2

Pressure Testing and Specifications

The CVT uses considerably higher pressures than most standard automatic transaxles. A pressure gauge with a MINIMUM 7000 Kpa (1000 psi) capacity is required to take measurements. Lower pressure rated gauges will be damaged when testing!

The pressure taps are located in 3 areas of the transaxle. Certain diagnostic situations may require knowing the pressure at these various locations. ALWAYS USE CARE when doing pressure testing.



1. Secondary Pressure
2. Reverse Brake
3. Torque Converter Release Pressure
4. Torque Converter Apply Pressure
5. Primary Pressure
6. Forward Clutch Pressure
7. Line Pressure

CVT2

Pressure Testing and Specifications

	Fluid Pressure (minimum-maximum)	Fluid Pressure (measurement reference value)		Remarks
	Reference Value- Metric / Standard	Measurement Condition	Reference Value- Metric / Standard	
Line Pressure	0.5 – 6.0 Mpa (5.1 - 61.2 kg/cm ²) 73 – 870 psi	Idling	0.5 – 1.5 Mpa (5.1 - 15.3 kg/cm ²) 73 – 217 psi	
Forward Clutch Pressure	0.5 – 1.5 Mpa (5.1-15.3 kg/cm ²) 73 – 217 psi	Idling (D position)	0.5 – 1.0 Mpa (5.1-10.2 kg/cm ²) 73 – 145 psi	P, R, and N positions: 0 Mpa (0kg/cm ²)
Primary Pressure	0.1 – 6.0 Mpa (1.0 - 61.2 kg/cm ²) 14 – 870 psi	Idling	0.1 – 1.5 Mpa (1.0 – 15.3 kg/cm ²) 14 – 217 psi	
Torque Converter Apply Pressure	0.0 – 1.0 Mpa (0.0 - 10.2 kg/cm ²) 0 – 145 psi	Lock-up ON:	0.0 – 0.2 Mpa (0.0 – 2.0 kg/cm ²) 0 – 29 psi	
Torque Converter Release Pressure	0.0 – 1.0 Mpa (0.0 - 10.2 kg/cm ²) 0 – 145 psi	Lock-up OFF:	0.0 – 0.2 Mpa (0.0 – 2.0 kg/cm ²) 0 – 29 psi	
Secondary Pressure	0.1 – 6.0 Mpa (1.0 - 61.2 kg/cm ²) 14 – 870 psi	Idling	0.1 – 1.5 Mpa (1.0 - 15.3 kg/cm ²) 14 – 217 psi	
Reverse Brake Pressure	0.1 – 1.5 Mpa (1.0 – 15.3 kg/cm ²) 14 – 217 psi	Idling (R position)	0.5 – 1.0 Mpa (5.1 – 10.2 kg/cm ²) 73 – 145 psi	Out of R position: 0 Mpa (0kg/cm ²)



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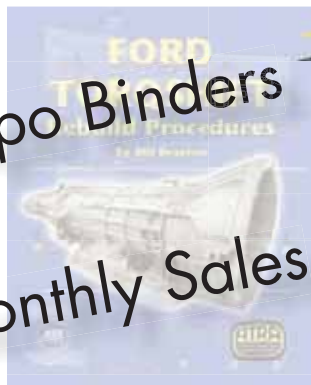
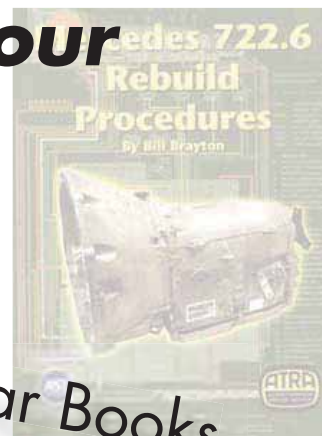
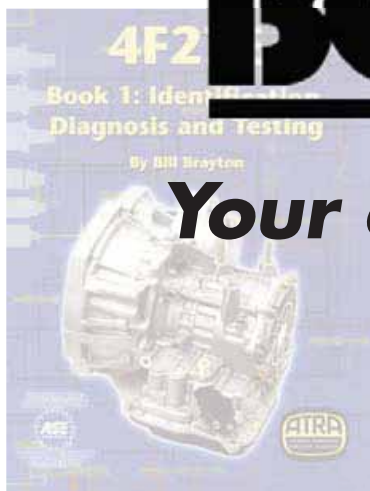
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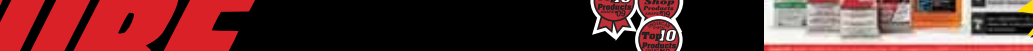


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